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West African TECHNICAL REVIEW

The International Magazine for Industrial & Business Management

May ...

In this issue:

ENERGY

Generator buyer's guide
Alternative energy in Nigeria
US African energy conference

Computers
Nigeria's vehicle market

West African CONSTRUCTION

Gambian hotel project
Architect v. Contractor

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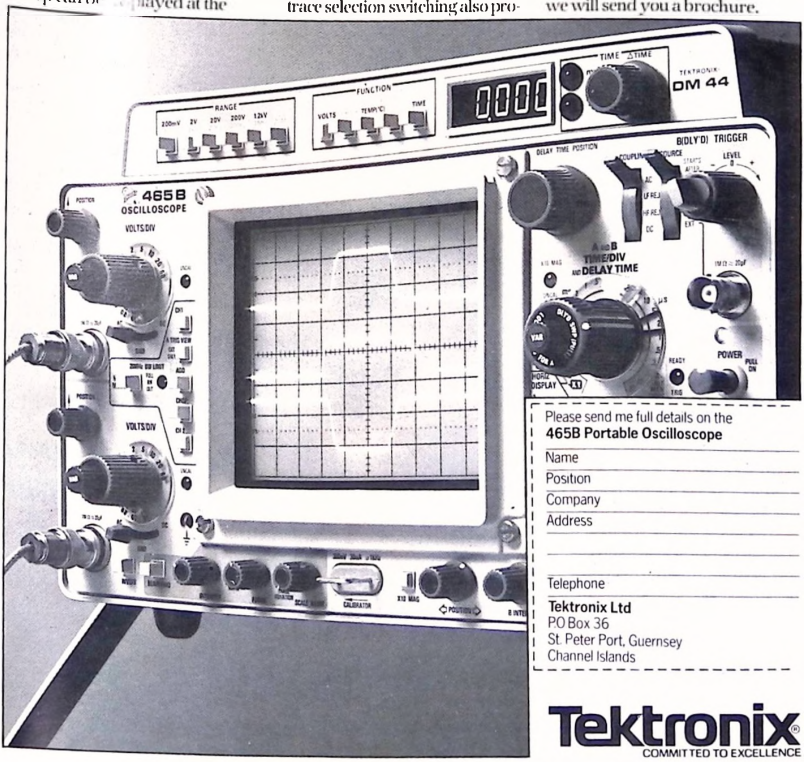

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This months cover: Mounting the chassis of a 911 truck at ANAMMCO, Enugu. Photo by Fiona Ledger.

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Co-Publishers
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Advertising Sales Representatives

NIGERIA
Decade Enterprises Ltd., 11 Bola Adewunmi Street, Obanikoro, Ikorodu Road, P.O. Box 1530 Lagos. Tel: 962127. Commercial Manager: Peter Uwazie.

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Contents

Plus Product and construction digests, Buyers' Guide and supplement on Tractor and Equipment.

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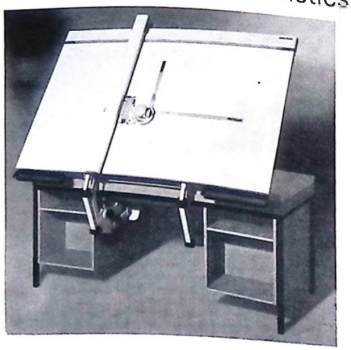

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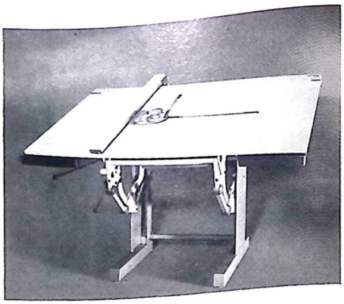

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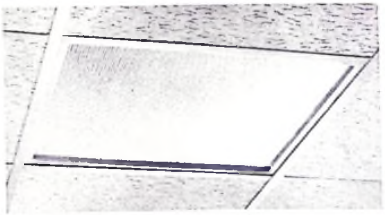

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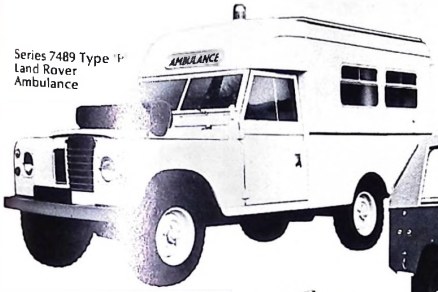

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Circle No. 199 on enquiry card

Reclassification of industries

Some industries in Nigeria have been reclassified, for the purposes of the Indigenisation Act, by the Federal Ministry of Industries. Five industries have been moved from Schedule II, requiring 60 per cent indigenous equity participation, to Schedule III, which requires 40 per cent participation. The five are manufacture of metal containers, fertiliser production, cement manufacture, sugar plantation and processing, and agricultural plantation of cash crops.

The tin smelting and processing industry was transferred in the opposite direction, ie from Schedule III to Schedule II.

Four industries were transferred from Schedule I, which is reserved exclusively for indigenes, to Schedule II. These are: manufacture of jewellery and related articles, including fashion jewellery; watch and clock repair; garment manufacture, and rice milling.

Mallam Adamu Ciroma, Minister of Industry, said that the aim of the reclassification was to attract foreign investment in the industries. The factors taken into account in the reclassification include capital intensiveness, level of technology required, and the level of enthusiasm of indigenous investors to go into the industries. According to the Minister, the growth of the manufacturing sector of the economy has been slower than expected; the new classifications will make it possible for foreign investors to participate more actively in the sub sectors, through providing capital and technical expertise. The Minister stressed that the reclassification will definitely not restrict the rights of any Nigerian to engage in any business enterprise one hundred per cent.

EDF payments speed up

Suppliers and contractors involved in European Development Fund projects should be finding a decrease in delays in payment for work and products.

The EDF makes available aid for projects in the African, Caribbean and Pacific countries. Members of the European Economic Community make contributions to the EDF.

Re-organisation of payment procedure for those involved in EDF projects will mean much less paper work – for example the 15 countersignatures needed on documents of payment will be greatly reduced, and bank guarantees will be made easier, with simplified credit terms

Two polypropylene plants in Africa

Two plants for the production of 68,000 and 35,000 tonnes/ year of polypropylene resins will be built in the next few years at Ras Lanuf in Lybia and at Warri in Nigeria respectively.

They will adopt a high-yield catalyst system and the high stereospecific process developed by Montedison in collaboration with the Japanese company Mitsui Petrochemical Industries.

The two units, the first of which belongs to the Libyan company, Azzawiya Oil Refining Company, and the second to the Nigerian National Petroleum Corporation, will make use of the El Paso Polyolefins Company technology with liquid monomer. The choice of the new Montedison-Mitsui catalysts is due to their flexibility which makes it possible to use them in solvent, liquid monomer and gas-phase processes.

Loan for mines and agriculture

Ghana and Britain have signed a £10m loan agreement for the rehabilitation of sections of the mining industry, and to help boost agricultural production, between 1981 and 1984. Half the loan will be used to provide spare parts and replacement machinery for the mining sector. The remainder will go towards the cost of purchasing agricultural transport equipment. The interest-free loan is repayable over 25 years with a seven year grace period.

₦169,884m for NNPC

The House of Representatives has approved ₦169,884m for the Nigeria National Petroleum Corporation, for expansion work on the country's three refineries. This was one of the recommendations of the House Committee on Petroleum and Energy, headed by Dr T. J. Taribo Sekibo. Warri refinery is to be allocated ₦50,850m to allow an increase in capacity of 20 per cent, thus reducing the country's import demand for finished petroleum products. Kaduna refinery is to receive ₦688,452m for the same reason.

Port Harcourt refinery's allocation was ₦630,585m to be spent on maintenance. Some money is also to be spent building satellite projects, such as the Escravos Warri pipeline phase II project for transmitting crude oil to the refinery.

Gen set survey

Plea for good after-sales service

According to a survey carried out recently by the West African Technical Review, price is not the first thing a customer considers when buying a new generator. It is regarded as an important factor, for sure: but it comes after concern for reliability and good after-sales service, and is not as important as the reputation of the supplier.

The current standard of after-sales service was strongly criticised by some generator users, who indicated how important their generators were as a standby, or even as a constant source of power, but regretted that spare parts were often difficult to obtain. One chief engineer suggested that the purchase of any new generator should be accompanied by an immediate stock of spares. Another called the normal after-sales service and supply of spare parts "atrocious", and felt that this was the biggest problem in Nigeria where generators were concerned. These feelings were echoed by many other generator users.

The organisations covered in the survey ranged from small concerns with less than 50 employees to very large ones with over 3,000. Most users had generators at home, usually small ones of under 25kVA, in addition to the larger models used at their place of work. Most of the generators were on standby, being used five to ten times a week, for a total of anything from five to fifty hours.

About half the users questioned had a preference for one particular manufacturer, although the preferred makes varied widely. Users had differing expectations regarding the durability of their generators – some expected them to last for as long as ten years, others as little as two; but these expectations naturally varied depending upon the size of the generators, and the use to which they were put.

Fuel economy was considered an important factor, almost as important as the initial price; and customers were concerned with quick delivery of a new generator. Automatic start and switch-over did not figure prominently in the list of priorities – the general feeling was that the user didn't mind starting up the generator himself, so long as it functioned reliably once in action! Noise levels entered into most people's consideration when choosing a generator – again, not as a top priority, but certainly of considerable importance.

The fact emerging way ahead of all others in the survey was that customers want to be able to rely completely on their generator; and that however good the brand-new product may be, maintaining it for maximum efficiency is a real headache.

Keep on sending us your complaints, opinions and recommendations concerning generators. We are anxious to have up-to-date knowledge of how the generator customer feels about the products and services available.

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Construction equipment

The International Construction and Utility Equipment Exposition (ICUEE) is due to be held in Missouri on August 11–13 this year. The Exposition will be the seventh in a series of shows held every other year and started in 1966.

Because of demonstration areas covering nearly 80 acres of land, ICUEE is the only show of its kind in which large motorised equipment used in construction and utility industries can be demonstrated under actual working conditions.

Attendance at the 1981 show is expected to include purchasing agents, engineers and construction executives, equipment dealers, distributing and private firms interested in the purchase of heavy duty equipment. A substantial number of foreign visitors is also expected for ICUEE 81.

The exposition is endorsed by three councils: the Manufacturer of Aerial Devices and Derricks Council, the Underground Equipment Council, and the Manufacturers of Telescoping and Articulated Cranes Council. ICUEE 81 promoters include management from major industrial equipment institutes in the United States.

New General Manager at Bintumani Hotel

Caledonian Hotel Management (CHM) announce the appointment of Paal Borresen, 34, as General Manager of their 200-room Hotel Bintumani in Freetown, Sierra Leone.

Paal Borresen, a Norwegian, has been educated entirely in the United Kingdom and has spent more than ten years in the hotel and catering industry. His experience has mainly been gained in and around London where he has held senior management posts at hotels in Windsor, Gatwick and London's West End. For the last two years has been General Manager of the new Stanley Hotel in Nairobi, Kenya, where he was also Chairman of the Regional Hotel-keepers Association and a leading member of three major hotel industry committees.

Announcing his appointment, Wim Mentink, CHM's Managing Director, said: 'Paal Borresen brings to CHM considerable and successful experience in hotel management and we feel his talents particularly suit Sierra Leone where the Bintumani has steadily established an excellent reputation with both the local community and the overseas business travellers and tourists. Visitors to the country have regularly increased year by year and the high standards of service we have set required a general manager of experience to ensure that they are maintained.

EXECUTIVES' CALENDAR

A monthly service listing some of the major events in West Africa and around the world that could be of interest to our readers. Further information on these events can usually be obtained from the Embassy (commercial office) of the country concerned.

June		
2-5	TCS&D – Temperature Controlled Storage and Distribution International Exhibition	BIRMINGHAM (UK)
8-12	RUBBEREX – International Rubber Conference and Exhibition	HARROGATE, UK
9-11	TEMPCON – Temperature Control and Measurement Equipment Exhibition	LONDON
9-11	FIBRE OPTIQUE – Fiber Optics Products Exhibition	PARIS
9-12	Metalworking Machines & Equipment, Tools, Accessories, Press-forging and Casting Machines	PLOVDIV, BULGARIA
11-17	International Mining Exhibition and Congress	DUSSELDORF
11-25	2nd International Exhibition "Building and Roadmaking Machinery & Equipment for Mechanisation of Construction and Erection	MOSCOW
14-23	International Trade Fair	POZNAN, POLAND
15-19	WATER INDUSTRY '81 – International Conference and Exhibition for the Water Industry	BRIGHTON, UK
16-19	Equipment for the Printing and Copying Industry	BUCHAREST, HUNGARY
16-20	CONPEX ASIA '81 – 3rd International Construction Equipment and Public Works Exhibition	SINGAPORE
16-25	3rd International Exhibition of Diamond, Diamond Tools and Equipment for Diamond Machining	KIEV, SOVIET UNION
23-27	IFAT – International Sewage and Refuse Engineering Exhibition	MUNICH
29–3 July	INTRAMA – International Materials Handling and Warehousing Exhibition	BRNO, CZECHOSLOVAKIA

Nigeria Airways buys Airbuses

Nigeria Airways, Africa's largest airline and one of the world's fastest growing carriers, has announced the purchase of four twin-engine 225-seater A310 Airbus jet aircraft jet aircraft for delivery in 1983/4.

The aircraft, costing about £35 million each, will be used on Nigeria Airways domestic and inter-African routes. Nigeria Airways will take delivery of the first two A310's during the fourth quarter of 1983 and will receive another two in 1984. The airline also has an option on a further four A310 jets.

Nigerian Airways hope the new aircraft will also be used on international routes from Lagos to London, Rome and Amsterdam in addition to the airlines fleet of DC10 and Boeing 707 aircraft currently being used.

An important factor in the airline's choice of the A310 is the aircraft's cargo carrying capacity. Like the larger A300 Airbus, the new jet is designed to carry standard LD3 containers two abreast and interline pallets in its bellyhold area.

Nigeria Airways' fleet currently consists of 21 aircraft, including two DC10-30, three Boeing 707-320C, two Boeing 727, two Boeing 737, 8 Fokker F28 and four Fokker F27 aircraft. The airline is also currently leasing Boeing 737 and Boeing 707 equipment to boost its passenger and cargo capacity.

Expanded groupage services

New groupage services from UK to Dakar, Senegal, and Banjul, The Gambia, are being introduced in May by African Container Express (ACE) the container arm of UK/West Africa Lines (UKWAL).

The Dakar service will operate from the London, Liverpool and Coatbridge groupage depots. The first sailing will be from London ('River Kerawa') on May 21 and the second from Liverpool ('River Oil') on May 29.

Initially, the Banjul services will operate from the London and Liverpool depots and there will be sailings from Liverpool ('River Guma') on May 7, from London on May 13, from Liverpool again on May 28 ('Africa Palm') and London on June 6.

The handling charge will be £17 a freight tonne which covers all costs except Ocean freight. It includes UK haulage, UK port charges and West African harbour dues. Containers will be moved to the earliest vessel's loading port at no extra cost to the shipper and consignee in Dakar and Banjul will not incur local handling costs at higher than the current break-bulk charge

Aircraft deal

The Export-Import Bank of the United States (EXIM) has authorised financial assistance in a transaction with Nigeria Airways. The deal allows Nigeria Airways to purchase four Boeing 737-200 aircraft and related spares and parts costing $66 million. Aircraft deliveries are scheduled at one per month in April, June, August and September 1982.

A cash payment of $10 million will be made by Nigeria Airways. Private loans of $43.5 million with Exim's guarantee and $13.4 million without the guarantee make up the financing for the purchase.

Montreal vessel service

North African West African Line (NAWAL) has resumed direct Montreal vessel calls. The service began on April 12th with the Aleki Rokoko V10. The RoRo carrier is now offering the only twice monthly conference service from Montreal to West Africa.

Migration study in West Africa

A joint World Bank-OECD study has been made of migration patterns and trends in West Africa. According to the authors of the study, *Migration in West Africa*, emigration has kept down the rate of population growth and eased pressure on local resources, although countries of emigration remain at the bottom of the economic scale.

The nine-country study covers demographic and economic aspects of trends in the 1970s. Around 1975, there were 2.8 million foreign nationals, constituting 7 per cent of the total population, in the countries studied. Another 4.4 million people were internal migrants. Over the long term, migration appears to have been of greater economic benefit to the countries of immigration, such as Ghana and Ivory Coast, than to the countries of emigration such as Upper Volta. The study is based mainly on the results of censuses and surveys made in the 1970s in The Gambia, Ghana, Ivory Coast, Liberia, Mali, Senegal, Sierra Leone, Togo, and Upper Volta.

About 30 per cent of the 12 million workers in the region were migrants (1.3 million were immigrants, and 2.1 million were internal migrants). External remittances during 1970–74 from the nine countries were $709 million, an annual average of $177 million, representing 7.4 per cent of the average annual export earnings of these countries.

The overall direction of the flow has been from the interior to the coastal areas, and largely to the region or department in which the capital city is located. Between 1965 and 1975, the net migration from rural to urban areas in the region was 1.7 million, which contributed almost half the population growth of cities and further strained urban resources. The study points out that, although migrants include a relatively high proportion of young adults of working age, there is a growing tendency for families to migrate as a group and to settle permanently in their destination.

Extended Minster contract

The Overseas Development Administration, continuing its assistance to the Sierra Leone Produce Marketing Board, has extended its contract with Minster Agriculture Limited for another year. A second phase of operations is to be introduced within the Agricultural Investment Programme, aided by a Minster team of consultants.

Minster will continue its work with the National Produce Company (NAPCO), begun with groundnut purchase and a groundnut seed multiplication programme, by extending to cocoa and coffee purchasing in the next phase.

With the Sierra Leone Agricultural Produce Company (SLAPCO), Minster consultants will carry on with the establishment of a 1,500-acre cocoa and coffee estate. Initial plantings of 230 acres of cocoa and 170 acres of coffee have been augmented by a coffee-pruning programme to boost production and a spraying programme to reduce pests and diseases.

The second phase of the project will entail the completion of the first estate and the preparatory work for the establishment of other estates.

Metallurgical training project

The Nigerian Federal Government and the Federal Republic of Germany have signed an agreement to build, on a joint basis, a ₦40 million metallurgical training institute in Onitsha, Anambra State. The initial training will be undertaken by German experts who will later train Nigerians to replace them.

Nigerian investment

The Nigerian Minister of State for Finance, the Hon Ademola Thomas, led a delegation attending an investment and trade seminar in London at the end of April.

The delegation included the Deputy Secretary, Ministry of Industry (Mrs Okungbowe), the Chief Planning Officer, Ministry of National Planning (Dr J. A. Nwogwugwu), the Deputy Secretary, Ministry of Commerce (Mr N. N. Mwku) and the Deputy Secretary, Ministry of Finance (Mr Ekerendu).

Both seminars were for British businessmen interested in investing in or trading with Nigeria; they were able to hear at first hand, details of the Nigerian Government's Fourth Development Plan, investment legislation and practical experiences of manufacturing and distribution in Nigeria.

The seminars were organised by the English-Speaking Union of Nigeria in co-operation with Standard Chartered Bank Limited and with the support of British Caledonian Airways Limited.

Other speakers included Gordon H. Wilson, Director, UAC International; Michael Madden, Director, Standard Chartered Merchant Bank Limited; John S. Rivett, Treasurer of the Nigerian-British Chamber of Commerce; Martin Dent, Senior Lecturer, Keele University Department of Politics; Sir Mobolaji Bank-Anthony, former Chairman, Lagos Stock Exchange and Prince Michael Ajose, Chairman, Yele Engineers and Constructors Limited.

$394m World Bank loan for Nigeria

Negotiations have been successfully completed between Nigeria and the World Bank for a $394 million loan, intended to finance four new projects in the country. In addition to the individual four projects, $48 million of the loan will be used for technical assistance to further the Federal Goverment's Green Revolution programme.

The Anambra State water supply project will receive $67 million of the loan. The Onitsha water supply programme will utilise a larger part.

Two agricultural projects will benefit under the loan: the Kano project, which will get $[illegible] million, and the Bauchi project, which will receive $132.

Loan for Ondo State

N. M[illegible]schild & Sons, acting on their ow[illegible]lf and for a syndicate of banks, h[illegible]de a £19 million loan to the Ondo S[illegible]vernment of Nigeria. The Export [illegible] Guarantee Department in London [illegible]aranteed the loan.

The [illegible]on will help finance a contract aw[illegible] Incotext Ltd by Nigerian Water R[illegible]s Development Ltd. Under the cont[illegible]cotex will supply materials and equip[illegible] required for the construction of [illegible]orks, service reservoirs, booster stations and pipelines for the Ero River water supply.

Credit for Federal Republic of Nigeria

The Export Credits Guarantee Department has guaranteed the repayment and funding of a US$100 million line of credit which Morgan Grenfell and Co. Ltd, acting on their own behalf and for a syndicate of banks, has made available to the Government of the Federal Republic of Nigeria.

CURRENCY EXCHANGE RATE

The currencies shown below are valued against the US$ and £ sterling at the middle rates between buying and selling rates on the 24th April for $ and 28th April for £. The rates are an indication of the value and are not intended to be used as the basis for transaction. The publishers accept no responsibility for errors.

	$	£
Nigeria – Naira	0.5833	1.267479
Ghana – Cedi	2.75	6.00
Gambia – Dalasi	1.8408	3.989
Sierra Leone – Leone	1.1335	2.40551
C.F.A. Franc*	257.25	559.25

*Applicable in: Benin, Cameroun, Chad, Ivory Coast, Niger, Senegal, Togo, Upper Volta.

Travelling can be tedious. That's why it's so much nicer to travel with friends. Friends like British Caledonian who make you feel totally at home.

We fly to London from more cities in Africa than any other airline. More comfortable reliable services and more of our traditional British hospitality.

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Abidjan, Accra, Algiers, Amsterdam, Atlanta, Banjul, Benghazi, Birmingham, Bogota, Brussels, Buenos Aires, Caracas, Casablanca, Dakar, Dallas/Ft. Worth, Edinburgh, Freetown, Genoa, Glasgow, Guayaquil, Hong Kong, Houston, Jersey, Kano, Lagos, Las Palmas, Lima, Lisbon, Lusaka, Manchester, Monrovia, Newcastle, Oran, Paris, Quito, Recife, Rio de Janeiro, Santiago, Sao Paulo, St. Louis, Tripoli, Tunis

Sulzer turbomachinery guide

Sulzer Turbomachinery have made available their guide to worldwide customer support services. The brochure lists details of works testing, field services, and parts and repair services offered. Technical assistance in the handling of Sulzer machines is discussed under the separate categories of advisory services, reports evaluation, and a variety of training courses for personnel.

Circle No. 23

Irrigation services

A new, full-colour brochure is now available from Dunlop Irrigation Services, detailing its comprehensive range of equipment, systems and services. The company offers a complete irrigation service which ranges from the preparation of feasibility and design reports to help for the customer in finding finance. The brochure gives details of equipment supply, installation and training.

Circle No. 24

Mobile telecommunications

The new Alpha 2000 Series mobile telephone is the feature product described in a brochure from Harris Corporation's RF Communications Division. The publication presents the telephone as part of the firm's VHF and UHF worldwide Short Range Radio Communications product line. Also described are digital paging systems, two-way radios, base stations and hand-held Porta-Phones.

Long-range transportable systems are covered in a separate brochure also available from Harris; presented are several equipment packages including systems for radio-equipped jeeps, ground-to-air and ship-to-shore communications.

Circle No. 25

Water treatment

Clearwater Systems Ltd have published a broadsheet depicting the water cycle. As well as illustrating how the cycle occurs in nature, the publication traces graphically the many uses and treatments to which water is subjected by man in the daily round of domestic and industrial activities.

Various treatment techniques are given in a detailed process chart, which defines the basic methods of softening, demineralisation, clarification, filtration, sterilisation, plus the biological treatment of sewage and organic industrial waste water. Called "The Clearwater Cycle", the broadsheet also lists process applications and typical water qualities achieved.

Circle No. 26

Construction and gesting of pipes

The Pipes Division of TAC Construction Materials has introduced two new brochures on the construction and testing aspects of its established ranges of asbestos-cement Everite pressure and Turnall pipes for water supply, drainage and sewerage applications.

The fully illustrated brochures describe in detail the various inspection, handling, laying, jointing and testing characteristics of the Everite and Turnall ranges, both of which are available in a series of metric sizes ranging from 75mm to 750mm. Special conversion factor tables are also detailed in each brochure.

Circle No. 27

Sewer cleaning accessories iine

A free 16-page accessories catalogue has just been released by Aquatech. The catalogue outlines and illustrates the new, complete line of nozzles, hoses, root cutters, saws, rollers, intake tubes, sludge removal accessories as well as several other ac-

cessories that are available with all Aquatech sewer and waste treatment plant cleaning equipment.

Currently, Aquatech manufactures 11 different sizes and pieces of cleaning equipment for these accessories. They include C-2000 combination true vacuum sewer cleaner and sewer jet cleaning unit, the chassis-mounted sewer jet unit in five sizes, three sizes of sewer jet trailers and two jet vac trailers.

Circle No. 28

Compaction equipment

Raygo, a manufacturer of road construction and road maintenance equipment, has brought out three product directories covering their product lines in each of their marketing groups. The company's Construction Group offers a product directory covering a broad line of vibratory self-propelled compaction equipment for both soil and asphalt applications plus a soil stabilisation unit. The Industrial Group product directory covers a variety of smaller vibratory compaction equipment, plus an asphalt paver, an articulated motor grader, a front-end loader, a sealcoating machine and other complementary equipment. Pavement milling, planing and profiling equipment is described in the third directory, covering the Raygo Pavement Maintenance Group.

Each of the three directories offer comprehensive facts and figures on each unit's estimated production ranges, standard features, options and pertinent dimensions and specifications. The Pavement Maintenance Directory also includes a list of buyer's tips for anyone contemplating entry into the pavement milling industry.

Circle No. 29

Guide to chemical exporting

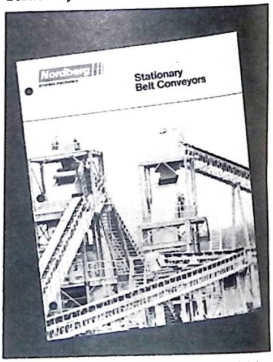
World[illegible] chemical supplies, a new guide to exporting chemicals and allied products to overseas markets, has just been issued by Ellis & Everard (Exports) Ltd.

The company, part of the Ellis & Everard Group, specialises in locating, buying, documentation, handling and transportation of over 40 different types of chemicals. Consignments are shipped to all parts of the world in volumes ranging from full container loads to single packs, depending on the needs of customers.

Circle No. 30

Stationery belt conveyors catalogue

A new, 28-page catalogue on Nordberg Stationary Belt Conveyors is now avail-



able from the Process Machinery Division of Rexnord Inc.

The four-colour brochure illustrates and details the features and optional equipment of both the Model 240 and 250 conveyors. Charts listing operating capacities, horsepower and stockpile capacities are also provided.

Circle No. 31

Concorde for Lagos?

The economics of Concorde have recently been called into question in a recent report compiled by the British House of Commons Industry and Trade Committee. At present British Airways is operating Concorde on the New York/London route and the London/Washington route; the route from London to Bahrain and Singapore was discontinued last year because of heavy losses, and now the London/Washington route seems too uneconomical.

The airline is now looking for new routes to support this fuel hungry piece of technology, and Lagos is one of the destinations which has been suggested. With an upsurge in business activity in Lagos and 1,100 hours flying time, Lagos seems an attractive possibility but it will lie with Nigeria Airways as to whether British Airways can set up this potentially more profitable route.

Nigerian hardwood used for paper

For the first time in Africa, natural hardwoods are to be used in the manufacture of paper. The Nigerian Paper Mills, Jebba, received a $85 million loan to finance the project from a consortium of foreign banks. The loan will cover civil construction works, piping erection work, forestry access roads and other related contracts for the project, due to be completed in 1982.

The Jebbe Paper Mill at present has the capacity to produce 12,000 tons of paper per annum from imported pulp. The expansion project when completed will increase the capacity to 65,000 tons per annum of integrated pulp and paper production.

Disperger plant for Nigerian Paper Mills Ltd.

Escher Wyss Ravensburg/ FRG have received the order for a 150 t/24 h disperger plant from Nigeria Paper Mills of Jebba on the River Niger, Nigeria. The plant will handle mixed waste paper and consist of wire press, screw system and disperger.

It will form part of the stock prep supplying the two new Escher Wyss paper machines for the production of corrugating medium, Kraftliner and Kraft sack papers.

Start-up of the stock prep system including Disperger plant and the two paper machines is set for early 1982.

Export service expanded

Emos Dynamics Company Limited, of 97A Leverson Street, London SW16, which has for some years past been supplying a wide range of consumer goods, machinery and equipment to West Africa has continued to expand its business operations and has recently opened a new Branch Office at 10, Mitcham Lane, London, SW16 6NN. This office will be responsible for bulk buying and supply of all commodities including specialist building and construction materials and equipment.

The consultancy service extends over professional services incorporating an advisory service in the recruitment of professional staff for overseas assignments and is intended to assist in locating highly skilled specialist staff to work in West Africa.

Additionally, through this Branch, it will be possible to arrange export finance for Clients who may require assistance in this field. An industrially orientated section is concerned with the provision of industrial processes for the production of locally manufactured goods.

Among the products it can supply is Townplas Roofing Compound which is based on a vinyl acetate ethylene copolymer emulsion reinforced with fibre. It is water-based, making it safe and easy to handle, in a range of six colours: solar reflective white, green, rustic red, tile red, grey and black.

Guide for contractors

A third volume in the construction series by Derek Miles has recently been published, called *The Small Building Contractor and the Client*. The book is a comprehensive guide for managers and owners of small contracting businesses interested in improving their managerial capacity.

The publication stresses the importance of contractor/ client relationships, instructing the contractor on how best to acquire and then keep his clients. The material has been used as a basis for training courses and is the result of the author's long experience in helping small contractors in developing countries to get themselves established and to run their businesses effectively.

TAC wins £2.5m export order

The Pipes Division of TAC Construction Materials has received a major export order from Nigeria worth £2.5 million for the supply of Everite asbestos-cement pressure pipes. The pipes are being supplied to the Aminci Commercial and Construction Company, of Kontagora, via the London-based Fertitrade Company, and are to be used for the major water development scheme now undergoing construction in Niger State, on behalf of the Niger State Water Board. They comprise 75 per cent of the total contract placed with Aminci, the remaining pipes being supplied by local Nigerian companies.

● Bamburi Portland Cement Company of Mombassa, Kenya have recently purchased a 15-ton Grove RT58B Rough Terrain crane for maintenance and stockyard operations in their cement manufacturing plant.

For more Construction News turn to page 115.

OIL NEWS

Benin's oil on target

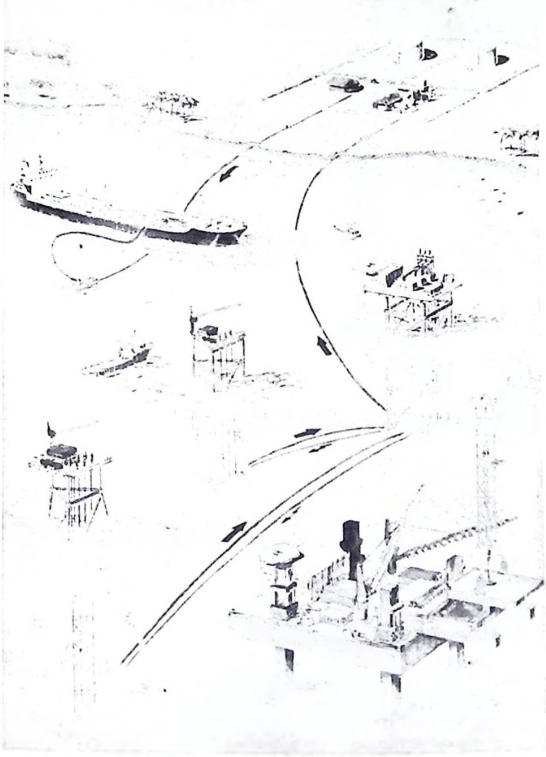
Development of Benin's first oilfield is proceeding on schedule for a late-1982 start-up, according to the operator for the development, Saga Petroleum of Norway. The field – named Sémé, and located some 15– 20km off the coast near the border with Nigeria – is likely to reach its peak output soon after start-up, holding out the prospect of Benin joining the oil exporters as from 1983. Production should be in excess of the Republic's own oil requirements.

Under the first phase of the Sémé development project, the jack-up drilling rig, two wellhead support platforms and one combined well- and field terminal platform will be installed, at a cost of 740 million Norwegian kroner (approximately $142 million). Oil will flow from the offshire production facilities through a 6-inch pipeline to the shore, where a processing and storage facility will be constructed. This will include two tanks, each with a capacity of 40,000cu.m. From the processing and storage plant, the oil will be pumped back to sea through a 20-inch pipeline leading to an offshore tanker-loading facility. The larger size of the second pipeline will allow oil to flow quickly from the storage tanks into the moored tanker, minimising the tanker's turn-round time.

The largest – and most costly – item of equipment needed in the Sémé development is the purpose-built jack-up drilling rig, which will be used for production drilling and also for work-overs on production wells. The contract for the rig went to Stord Verft, of Norway, with tow-out scheduled for spring 1982. Another recent contract is for twp combined anchor-handling and supply boats, which will be built in small Norwegian shipyards for Wilh. Wilhelmsen – the company granted a charter contract by the government of Benin. Delivery of the two boats, of 800dwt each, is scheduled for late this year.

Norwegian companies figure prominently in the Sémé development, as the Norwegian government is guaranteeing the major part of the project's cost in exchange for work for Norwegian industry. Saga Petroleum is operator for the development under a service contract signed with the government of Benin, but has no equity interest in the field (which is owned 100 per cent by the government of Benin). Kvaerner Engineering is the engineering management contractor for the project.

Although the depth of water above Sémé, at between 30 and 50 metres, is not vast by today's standards, the oil is relatively heavy and provision has had to be made for substantial pumping capacities. Gravity of the oil is 22° on the API scale, compared with 37° for Nigeria's much lighter Bonny Light grade.



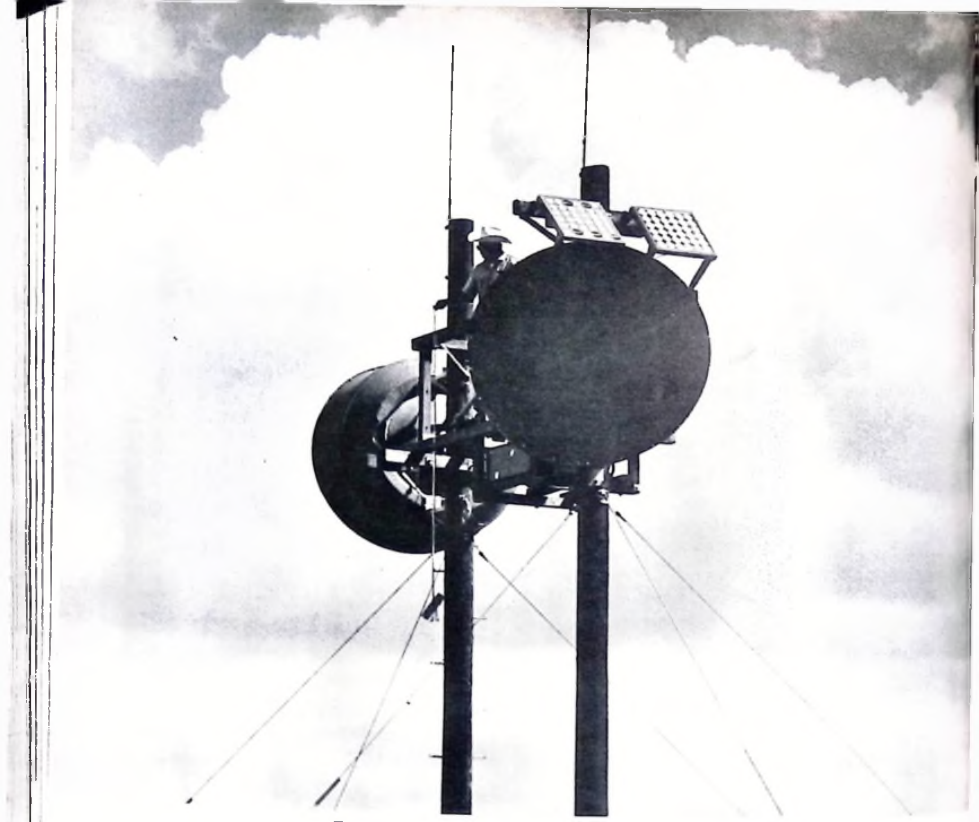
Flow chart of development of Sémé field.

Cameroun

Total and Mobil, 50:50 partners for the H-17 permit area offshore Cameroun, have announced the find of an oil and gas structure. The well was drilled 16km offshore near the town of Kribi, the planned location of Cameroun's gas liquefaction plant, and reached a total depth of 3,294 metres. The companies state that the quantities discovered are small, but the find has nevertheless generated considerable interest as it is the first oil strike in the Kribi zone. If proved commercial, the field will be developed under the two companies' agreement with the state's Société Nationale des Hydrocarbures du Cameroun (SNH).

Elf Serepca and Shell's affiliate Pecten have found a "gas and liquid hydrocarbons structure" in their H-48 permit (Rio del Rey number 2 area). The well was drilled near Cap Idabato, some 90km northwest of Victoria, and reached a total depth of 1,871 metres. It showed evidence of one reservoir containing gas and a second, separate, reservoir holding hydrocarbon liquids. The Elf-Shell find, like that by Total-Mobil, will be developed in association with SNH if subsequent work proves it to be commercial. Both finds improve prospects for the planned gas liquefaction project, on which (as reported last month) final decisions are due to be taken by end-year.

continued on page 33.



Who takes power from the sun for microwave transmission...

GTE, the worldwide communications people.

A solar-powered microwave repeater that costs about 75% less than existing repeaters, and can be installed in just a few hours, has been developed by GTE Communications Transmission Systems—Lenkurt Group, San Carlos, California.

System capacity is 600 FDM or 120 PCM channels, or video. It is extremely reliable: MTBF is 80,000 hours. Thus, it is ideal for remote areas. No access roads, power lines, air conditioning or

and provides an electronic telephone for the Head of Protocol in Brussels?

generators are needed: power is supplied by solar panels, supplemented by batteries.

Currently, the system is making possible the first telephone service for a remote Navajo Indian outpost in the western U.S.

Meanwhile, back in Europe, an innovative telephone system is at work for the Head of Protocol in the Brussels Town Hall. Called The 8000 System, it is a solid-state intercom which provides up to 25 extensions with access to 5 central exchange lines and 5 internal links.

The 8000 System is modular in design, and requires only a small 4-wire cable for connection to the control equipment. It is manufactured by our subsidiary, GTE ATEA, Herentals, Belgium.

From a single microwave repeater to complete telecommunications networks for entire nations, GTE has the experience, the products and the capability to provide for your needs. For any telecommunications requirements, contact the nearest GTE office, or GTE Communications Products, One Stamford Forum, Stamford, Connecticut 06904, USA. Telex 965821.

GTE | **Communications Products**

Circle No. 256 on enquiry card

Hercules makes the impossible possible in a remote wilderness.

Perhaps Hercules can help your country.

Gold and silver are being mined in an area of Canada, hundreds of miles from any road, train or port.

Without Hercules, these precious metals could not be mined. The Lockheed Hercules flies in mining equipment, bulldozers, tractors, fuel oil, food and everything needed to run the mines. Then it flies out the gold and silver that has been mined. In the summer, it lands on gravel. In the winter, it lands on a frozen lake.

This is typical Hercules work. It goes where other planes cannot possibly go, and it also carries loads impossible for other aircraft.

The gold and silver could be copper, tungsten, manganese, or fresh produce. Whatever the cargo, Hercules can get to it – and handle it!

Is there a remote area in your country that awaits development? Think about Hercules. It makes the impossible possible all over the world.

Contact Director of International Sales, Lockheed-Georgia Company, Zone 1, Marietta, GA 30063, U.S.A. Telex 542642 Lockheed Mara.

Lockheed Hercules

Circle No. 239 on enquiry card

Tin agreement in jeopardy

The future of the International Tin Agreement, the world's oldest commodity pact, looks extremely insecure following the breakdown of negotiations between consumers and producers of the metal in April. The agreement operates through the use of a buffer stock which is topped up or reduced as prices move towards the bottom or top of an agreed price range.

The present price support range is 27.28 to 35.47 Malaysian ringgit per kilo, equating to a mid-point of about £6,190 per tonne. This price has been in force since March 1980 and producers are anxious to have it raised to keep up with inflation. The April meeting of the International Tin Council was supposed to formulate a new price support range but following the sharp fall in world tin values over the last few months the world's consumers, led by the US, refused to entertain the idea of upping the guaranteed price for the metal and producers, in consequence, walked out of the talks. It is believed that the producers were seeking a price rise of about 10 per cent – although no figure was actually quoted.

Exporting countries signatory to the International Tin Agreement are Australia, Bolivia, Indonesia, Malaysia, Nigeria, Thailand and Zaire.

The Council will reconvene in July but analysts are pessimistic about the possible outcome. The new Reagan Administration is known to favour a free market for commodities and it is unlikely to offer any significant concessions to producing countries to shore up a market stabilisation arrangement of which it does not really approve.

Without the introduction of higher agreement support prices the outlook for the tin market seems bleak. Since peaking at £8,300 per tonne a year ago prices have fallen rapidly, touching a new 2¼-year low before Christmas. A number of factors have contributed to the weakness of tin. The recession has hit the canning industry at a time when mine production is rising, despite political troubles in Bolivia, and high US interest rates have discouraged industrialists and speculators from buying forward in the metal. But the most important factor has been America's decision to sell off a large proportion of its reserve stockpile of the metal. This has particularly annoyed producers because the US is effectively dumping the metal on a world market already in surfeit.

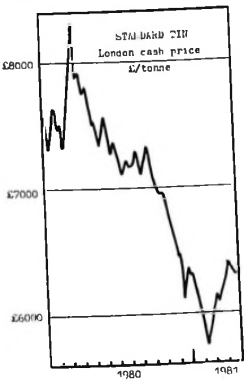
Even the future holds little cheer for producers. Mine production is likely to increase as the Bolivian industry gets back to normal, and unless industry offtake in the West improves, commercial stocks of tin will go on mounting. Furthermore, the market for tin in the tinplate industry (where 40 per cent of the metal is consumed) will be increasingly eroded by new metallurgical processes in the years ahead. There is a growing move away from tin to cheaper and lighter materials such as aluminium, nickel, tin-free-steel and plastics.

Cocoa pact hangs in the balance

It is now six months since the majority of cocoa producing and consuming nations agreed in principle to introduce a new International Cocoa Agreement to buoy up the depressed market, but the future of the proposed agreement remains as uncertain as ever.

March 31, 1981 was the official closing date for signatures to the draft accord. The terms of the agreement stipulate that exporters representing 80 per cent of global exports and importers representing 70 per cent of imports should sign. This target was not reached. Only 72 per cent of exporters signed and just under 60 per cent of importers. The reason for the shortfall was the absence of the Ivory Coast and the US. However, all is not lost for both these key countries will be allowed to join up to the final cut-off date of May 31.

The constant uncertainty surrounding the viability of the cocoa agreement, however, has not been without benefit. Traders realise that if the agreement comes into force it will undoubtedly raise prices because surplus cocoa will be bought from

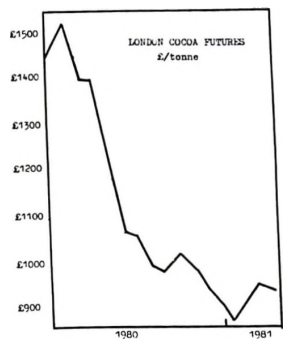


the world market. The threat of such intervention on the market has helped steady prices. Other steadying factors have been Nigeria's refusal to sell 1980–81 cocoa until the price is above the domestic producer price, Ghana's inability to ship large quantities of cocoa because of evacuation problems and the scarcity of Brazilian material, which is going mainly to Eastern Europe.

Palm oil futures

The world's first palm oil futures market opened in Kuala Lumpur, Malaysia, last October, but so far the market has failed to attract enough investment to make it a fully viable hedging medium for producers and consumers of the commodity.

The authorities estimate that the market needs a daily turnover in excess of 350 lots per day to generate the requisite liquidity to make the terminal important to the trade in the way that the London cocoa or coffee terminals are. This turnover would repre-



sent about the same tonnage of palm oil as one year's Malaysian production. Unfortunately, turnover is averaging little over 100 lots a day, and the big plantation owners and refiners who hoped to be able to use the market to "iron out" some of the ups and downs in palm prices are now pulling out.

A further problem is that a lot of speculative funds which might have been invested in palm oil futures are being syphoned off into the Kuala Lumpur stock exchange which is performing dramatically and offers the chance of massive winnings for the local investor.

In the end, however, palm oil traders believe that the market will take off and when that happens all sides of the industry should benefit from the high liquidity and consequent ease of trading.

Kuala Lumpur, as a trading centre, will also benefit. The Malaysian capital is already a major rubber and tin trading centre and some observers see the establishment of the palm oil exchange as an important step along the road to origin-centred trading. At the moment the only other big commodity futures centres outside Europe and the US are Singapore and Sydney, where wool is traded. But Indonesia is looking into the futures business and African and Latin American countries may also be anxious to bring more commodity trading to the Southern Hemisphere.

Commercial Review

continued from page 27

Ivory Coast

Speculation is growing that the Phillips find offshore Ivory Coast is a major oil-field with – according to US sources – reserves of 3 to 8 million barrels. The field, named Espoir, may measure some 20km across, although within this area there might be several distinct producing zones. The discovery well is said to have showed at least 100 metres of "perfect, clean oil sands". The first appraisal well, drilled seaward and to the south to check the east-west trend, encountered some of the same oil zones as tested by the discovery well.

As an indication of the field's significance, Phillips has contracted five additional drilling rigs to work in the area this year. The government is allocating further exploration permits, but the difficulty is that the continental shelf slopes steeply in places and the 1,800 metres depths encountered are beyond the capability of present drilling and production facilities.

Nigeria

Criticisms that the planned gas liquefaction plant will take gas which could otherwise be used in Nigeria were refuted by Bonny LNG, the consortium company set up to own the plant. Bonny LNG states that Nigeria's gas reserves stand at 75,000,000 million cu.ft. The liquefaction project, however, will require only 15,000,000 million cu.ft. over its operating life (up to 2005). Nigeria's own requirement for gas over the same period (to 2005) is estimated by Bonny LNG at 19,000,000 million cu.ft., leaving some 66,000,000 million cu.ft. of gas still to be used after 2005. LNG exports will thus require 15–22 per cent over the 20 years life of the project. The project is expected to give employment to 5,000 Nigerians during the construction stages, with 2,500 Nigerians being employed permanently when the project is on stream.

The Nigerian National Petroleum Corporation plans to start its first onshore oil production from a well in Bendel State next year.

MK Services, a British company based at Milton Keynes, is hiring equipment for use in offshire geophysical and hydrographic surveys to companies operating in Nigeria and Gabon, under contracts agreed over the past six months.

Zaire

ETPM was awarded a $28 million contract by Gulf Zaire covering the engineering, supply and installation of a gas re-injection platform for the Mibale offshore field.

Transferring technology

CED report from USA

The transfer of technology – which "is often fully packaged in the collection of resources and services associated with foreign direct investment" – is the "heart of the economic development process", according to a new report by the Committee for Economic Development (CED) in the United States.

The Report, entitled "Transnational Corporations and Developing Countries: New Policies for a Changing World Economy", was released in Washington, April 9. The CED is an independent research and educational organisation of 200 business executives and educators.

Following are excerpts from the Report:

The Heart of the economic development process is the absorption and application of technology in its broadest sense – that is, knowledge of how to carry on useful activities and make useful things. The acquisition of technology is probably a more important element of the development process than the accumulation of capital. Indeed, the two are closely related since investment in capital equipment is an important vehicle through which new technology is introduced into an economy.

Although some rapidly growing third world countries are beginning to generate their own technology, the developing world remains overwhelmingly dependent on the industrial countries for most of its technology. The transfer of technology is often fully packaged in the collection of resources and services associated with foreign direct investment. Increasingly, however, technology is also being made available by foreign companies in unpackaged forms through licencing agreements in which valuable knowledge and technical skill, whether patented or unpatented, are conveyed for a royalty or fee.

Developing countries express three major concerns about the process of technology transfer as it now takes place through transnational corporations: the appropriateness of the technology to the conditions prevailing in the third world, the cost of the technology and the conditions attached to its transfer, and the extent to which an independent technological capability in the developing countries is encouraged through support for local research and development as well as for training activities.

Appropriateness of technology

The choice of technology can affect the nature and direction of development. Therefore, host countries have legitimate concern for the appropriateness of products and the production processes of local affiliates of transnational corporations.

With respect to products, the concern is that they may be too sophisticated, too highly designed, and too elaborately packaged to meet the needs of most of the people in poor countries. Such products, which reflect the tastes and standards of the home country, are often said to cater largely to the consumption demands of the elite in the host country.

Outside the consumer goods field, however, product modifications tend to be minor. Pharmaceutical companies, for example, assert that they have little flexibility because drugs are the result of expensive research and require high and uniform standards of quality for their effectiveness. In the automotive and heavy-machinery industries, accessories may vary, but the basic product is standardised to facilitate interchangeability of parts and servicing worldwide. In general, market scale and cost are key considerations in determining whether to develop a new product or adapt an existing one.

Policies and attitudes

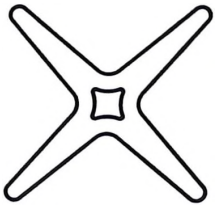
Transnational as well as local firms are guided in what they produce by market demand. To the extent that patterns of local consumption are regarded as socially undesirable, it is up to host governments to discourage such consumption, preferably through taxation rather than through direct controls or prohibitions. But if "luxury"

continued on page 37.

CAUTIONARY NOTICE

Trade Marks
NIGERIA

Notice is hereby given that BRAITHWAITE & CO. ENGINEERS LIMITED an English Company, of 59, Church Road, Great Bookham, Surrey, England are the Registered Proprietors in Nigeria of the Trade Mark CROSSED RIBS Device, a representation of which appears below:



The said Trade Mark is used upon or in relation to pressed steel plates for use in the construction of tanks, silos, hoppers, pontoons, docks and the like structures.

BRAITHWAITE & CO. ENGINEERS LIMITED claim all rights and title in and to the said Trade Mark and warning is hereby given that any imitation or unauthorised use of the said Trade Mark will be dealt with according to law.

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Patent Design & Trade Mark Agents,
Barristers & Solicitors,
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Lagos, Nigeria.

The role of management accounts

IN OUR series to date we have discussed many of the things that accountants in Nigerian Industry do and also what they can do, particularly in relation to costing and budgetary control. We now conclude this series by discussing the role of management accounts.

Limitations

These are:–

(a) The annual profit and loss account and Balance Sheet are inadequate for management to make use of them effectively on a day to day basis.

(b) More information is required on the past and the future and will certainly be required more frequently than the annual accounts can provide.

(c) More classification and analysis of the nature cost elements than is shown in the Profit and Loss Account is required by management for planning, controlling and co-ordinating the business activites.

These limitations effectively preclude the annual financial accounts from being used for management purposes. It is therefore necessary to consider what precise data management must have available and the purpose that it is needed for.

It has been pointed out previously in this series that financial and cost accounts are both concerned with the same basic transactions. However, differences of approach and purpose may mean that two sets of accounts have been prepared with a difference in the way that data has been analysed and tabulated.

The role of management accounts is to bring the two sets of data together so that the Directors can see what the entire financial picture of the company is; and they are then in the position to make decisions.

This form of reconciliation can frequently be a task requiring considerable expenditure of time and effort. However much of this can be avoided if the company's books are suitably designed and the concept of separate Profit and Loss Accounts for financial and costing purposes discarded in favour of a unified set of management accounts which will serve both needs.

Management accounts arising from the integration of cost and financial records. The accountant and the Directors of the company will have to decide on the level at which to integrate the management accounts. Some companies may feel that they want to integrate their records to the stage of factory cost (see our cost definitions earlier in this series). On the other hand some companies may want to integrate the whole of the records. The stage will depend on the relative complexity of the business.

How do we do it?

Dependent upon the degree of integration decided upon, the normal classifications of expenditure into categories (the way we discussed) does not need to be dropped in favour of control accounts; a separate control account being opened for each classification of cost. Typical control accounts would be:

1. Materials Control Account
2. Direct Labour Control Account
3. Factory Overheads Control Account
4. Administration Overheads Control Account
5. Selling and Distribution Overheads Control Account

Nos. 3, 4 and 5 should preferably be sub-divided between fixed and variable costs, a separate sub-control account being opened for each category.

Provisions, accruals, prepayments and movements in inventory should be dealt with by transfers to suitably named suspense accounts so that the balances remaining upon each control account represent the charges for the period. Full details of items posted to the control accounts would be kept separately tabulated with the following objectives in mind:

(a) To provide very detailed costing information

(b) To form the basis of journal entries so that control accounts can be cleared to suitable revenue accounts.

The amount of detail that the accountant will keep in the ledger depends on varying circumstances for instance a company selling timber may have a different number of entries from a company building a bridge, but should preferably be kept to a minimum, detailed information being kept in the tabulations or summaries.

The use of recovery accounts. Although the preparation of management accounts is a matter of great importance, the need for conventional accounts for the use of shareholders, banks and the Inspector of Taxes must not be forgotten. The best idea is to have a system which permits both types of account to be prepared from the nominal ledger. This can be achieved by following the steps laid out below.

1. The nominal ledger is written up in conventional form, accounts being opened for purchases, wages and overheads classified by type of expense.

2. An account is opened for work-in-progress or production and debited with the tabulated (summarised) costing information. This account operates as a control account for the costing records and shows in summary form the cost of all operations carried on.

3. All entries debited to the production account are credited to one or more accounts termed 'Recovery accounts' and not to the actual revenue accounts recording the costs. The identity of the various items which make up the costs and overheads of the business is therefore not lost and a conventional Trading and Profit and Loss Account can be prepared; the entries on the Production and Recovery accounts equal each other and are ignored.

The limits of integration of management accounts. However complete the integration of cost and financial accounting may be, there will normally be certain items which are out with the system. Examples of this are Directors fees and appropriation of profit. Such items should be posted to appropriately named accounts and not to a cost control account, these items being kept in a private ledger. If this method is adopted the nominal ledger will be confined to the following:

1. Account for purchases of material, labour and the various types of overhead.
2. Sundry provisions and prepayments accounts.
3. Stock accounts
4. A production account
5. Recovery accounts
6. A cost of sales account
7. Sales Account
8. Profit and Loss Account
9. Private Ledger Account

You see, like any system, even management accounts have this limitation. Their

continued

The author of this article, Edward McNairn, works for Spicer and Pegler Management Consultants, the consulting arm of Chartered Accountants Spicer and Pegler. They have long standing connections in Nigeria through their close connection with Egunjobi, Sulaimon Consultants Limited who are based in Kano.

efficiency and use in the company depends almost entirely on the care and ability exercised by the accountant. He is the person who must prepare and frequently interpret the figures. The very success of the business is often due to him.

Conclusion

I hope you have found this series helpful and that the points that have been discussed will enable you to see the real benefits that can be made to Nigerian business by using to the full the abilities of your accountant.

Transfer Technology
continued from page 33.

consumption is to be discouraged, it would be appropriate to penalise it regardless of the source of the luxuries (i.e. whether imported or produced domestically by local or foreign firms).

Processes. Even more important than the appropriateness of products is the question of whether the technology embodied in production processes is compatible with the stage of development, market size, and resources of the host country. For example, the technology could intensify the unemployment problem, aggravate inequalities of income, and worsen the balance of payments by inducing excessive importation of capital equipment.

In any particular industry, capital intensity may be affected by host country policies and attitudes. Host governments frequently adopt policies that encourage the substitution of capital for labour (e.g. concessionary loans for machinery and equipment, investment tax credits, overvalued exchange rates that reduce the cost of imported capital equipment below its true market value, and restrictions on the reduction of the labour force when market demand slackens). Moreover, developing countries often resist the use of "obsolete" technologies, insisting that anything but the "latest and the best" is patronising and offensive. Developing countries would be well advised to be highly cautious in adopting policies that directly or indirectly promote a higher degree of capital intensity in the choice of industries or processes than is warranted by the relative costs of their resources. Going beyond this limit on promoting capital-intensive industrialisation, can in effect, slow rather than enhance the improvement in per capita standard of living in a developing country.

Both transnationals and host countries can take measures that could contribute to the adoption of more appropriate technologies. We would encourage companies to establish regular procedures for considering process adaptations before technology is actually transferred. Technological exchanges among developing countries themselves are also desirable. Such arrangements would encourage the cross-fertilisation of ideas from different third world affiliates and countries and generally raise the level of consciousness on this issue. They could facilitate not only the development of appropriate new technologies but also the consideration of older techniques and secon-hand machinery that may be more compatible with the needs and resource endowments of particular third world countries at their current stage of development.

Terms of technology transfer

The pricing of technology is one of the most controversial aspects of the relations between transnational firms and developing countries. The basis of the conflict is a fundamental difference in perception. An extreme third world view is that technology is part of the common heritage of mankind and that therefore, like any other form of knowledge that lies in the public domain, it should not command a price. A less extreme view is that the costs of private research and development should be largely recovered in the industrial countries and that the developing countries' more limited capacity to pay entitles them to a lower price than that charged to other purchasers. There is also a tendency to regard technology as being overpriced because it is transferred under monopolistic and oligopolistic conditions and because the expenses incurred by the transnational in developing it have already been sunk.

From the perspective of a private firm, whether transnational or domestic, the foregoing views rest on erroneous premises. Like any other investment, expenditures on research and development must yield an economic return. The return must be sufficient not only to pay for the sunk costs and risk incurred in developing the existing stock of technology but also to finance a continuing flow of new technology in the future. Because the costs of research and development are typically built into the price of the goods and services they help to produce, there is often a wide gap between the direct manufacturing cost of high-technology products and their market price – hence the perception that such products are overpriced.

Transnational firms recover their research and development cost in a variety of ways. One method is to charge royalties and fees for the sale of technology to local entities through licencing arrangements without any equity participation by the foreign company. This method is preferred by some developing countries as a way of minimising oreign control over domestic economic activity. At the other extreme, a fully-owned subsidiary may not pay separately for technology because the parent company can realise its return in the form of profits rather than payments made explicitly for the technology. When host governments set arbitrary limits on royalties or profits of foreign-owned subsidiaries, an inducement is created for a parent company to attempt to recover the cost of research and development through altering the prices on intracompany transactions – for example, charging more for components sold by the parent to its subsidiary.

Research and development

Because developing countries often regard foreign technology as inappropriate, high priced, and subject to restrictive conditions, they seek to reduce their technological dependence on foreign companies. The quest of the developing countries for greater technological independence has two aspects: the desire for a research and development capability and the insistence that foreign technology in its broadest sense be adequately mastered.

In most cases, company self-interest and host-country policies of indigenisation coincide in the fields of employment and training. With few exceptions, transnationals prefer to employ and train host-country nationals not only for unskilled and skilled manual jobs but for all levels, including technical, financial, and managerial positions.

The trend toward the employment of host-country nationals as managers and technical personnel reflects an increased awareness on the part of transnational companies of the financial and other costs of employing non-local personnel. Not only is it costly to transport and maintain home-country nationals for these positions, but such assignments may not be particularly welcome to executives, who may regard them as outside the mainstream of career development. When non-local personnel are used, it is frequently because qualified nationals are not available and need to be trained. We believe that arbitrary host-country limits on the use of home-country personnel are generally unnecessary and ill advised.

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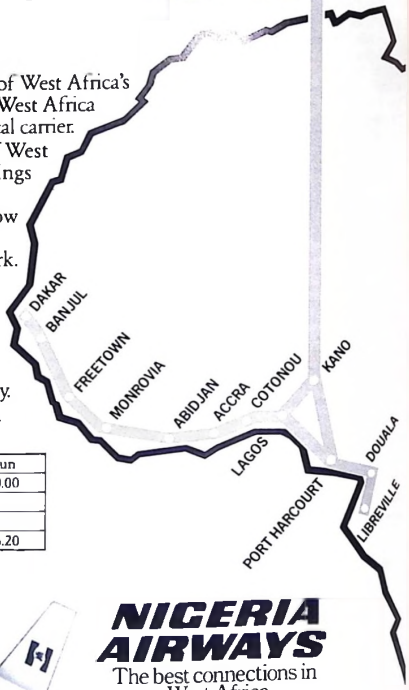

		Daily	Wed	Sat	Sun
London (Heathrow)	Depart	22.00	21.30	11.00	10.00
Kano	Arrive	03.35	03.05		
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Circle No. 228 on enquiry card

The art of communicating

IT IS rightly said that much unhappiness and even conflict is caused by a failure to communicate, to converse or talk to our fellow human beings. By the spoken word we convey meanings and intentions to fellow managers, other employees, customers, and external agencies such as those of government. Communication is always a two-way process, even though the recipient may not take up his option to reply. This could be because of misunderstanding, a lack of intention, or more often because he is not skilled enough in using words. Yet with knowledge as the basic industry of our time, with the outpouring of ideas and information on almost every subject, all citizens will need to understand what is going on if they are to apply their knowledge and skills, whether to make a contribution to society or for their own betterment. We will all need to be articulate in speaking and in listening, whether individually or in groups; if we cannot respond ourselves we may have to ask someone else to speak for us, even to consult and bargain for us.

In families, we have a common language and motive: to understand one another and to act singly or together to preserve a common interest. Survival of the family, a growth in standards of living, and the preservation of a quality of life we can share and enjoy are common aims. However, in the work situation, though we almost always work in groups, relationships are by no means as strong, except perhaps among the family members in a family-owned business. In most countries the biggest source of skilled wealth lies in small family businesses. They are very individual in character. I must add however that some of the worst arguments and disagreements have taken place in family businesses, leading to a splintering of effort, and quite often the starting up of rival businesses in the same trade. But why not? I am reminded of the saying that "the world would be a wonderful place but for the fact that people insist on behaving like human beings".

The workers!

I shall introduce the subject of communications as they affect the relationship of managers and their fellow employees – I prefer fellow employees to the word "workers" because all of us are workers. Whether in the boardroom, as managers and supervisors, as office staff or as specialists such as engineers, sales or accounts – all are workers. In Britain and other countries a gap between office and workshop staff has grown up producing two kinds of workers at the shop level; those in offices and those in workshops. This difference embraces a hopelessly outmoded system.

Nowadays, in the so-called advanced industrial countries, there is as much mechanisation, automation and even robotry in offices as there is in workshops. The elimination of drudgery and the reduction of labour costs are as important in offices as in workshops, and in the period between 1981–91 very great changes are forecast in all overheads. This change will be largely due to the management of information, currently a problem in most companies, whether small or large.

A manager has an urgent need to be informed and to keep up to date on a wide range of subjects, experiences and ideas. When young, most managers are specialists, such as engineers, chemists, accountants, salespeople, etc. They study and pass examinations in specialist fields, and thereafter have to fight off obsolescence. Many changes take place in all specialist areas of skill, changes that often occur with dramatic suddenness. It is our individual responsibility to remain on the frontiers of change and to understand, apply and adapt new developments to our own work situation. Senior managers and the chief executive have to cover a wide span of activity. Their

continued

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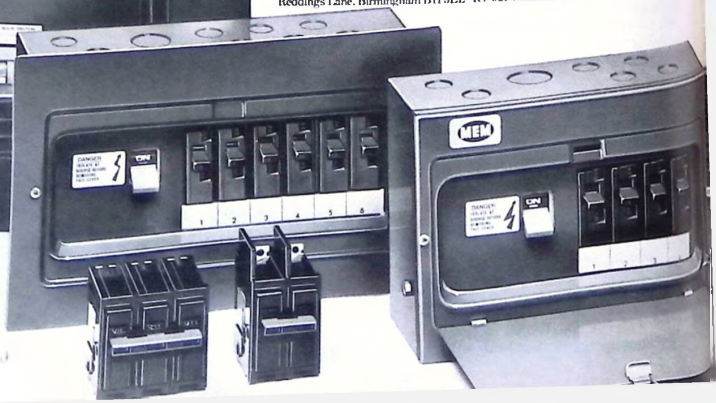

Circle No. 234 on enquiry card

own speciality may still be valuable, but they must also co-ordinate, direct and control the other functions of managerial responsibility. These functions may include finance, marketing, purchasing, production, research and development. The top men will need to have enough knowledge of these special areas to be able to ask the right questions as well as interpret and coalesce the answers. In addition, they will need to have sufficient knowledge of the external factors surrounding the enterprise, not only national and local government requirements, but sometimes international trends, too.

The top man in a company or department will, and should always, know more of the broad situation than his subordinates. His first level of communication should be as full as possible, and at all times consistent with that of his immediate subordinates. The subordinates then have a task of first importance to maintain contact with and understand their *equals*. Most senior managers usually spend more time talking to their equals in meetings, individual talks, on the telephone or in writing to each other, than with workers on other levels. Nevertheless, this second-level manager must still communicate with his subordinates, carrying forward the process of horizontal and vertical communication until the information reaches those on the office or factory floor. Inversely, the lower communicating levels need to ascertain the reactions of their subordinates and pass cumulative information upwards, until the top man is aware of what his employees are thinking at each level.

If all this seems complicated it need not be, once the drill of communicating is established and has become a good working habit. In some organisations special short periods of time are set aside, when employees gather round to learn and discuss matters of interest to them, usually plans or decisions which directly affect their place of work or habits.

It will clearly be seen that employees at the management and specialist levels need to know a good deal more about the business than those engaged in more narrow or routine jobs. Much depends on the educational level of the people concerned. The more employees are involved in continuous learning processes, the more they will understand the needs of their working group and probably the rest of the business as well.

"Nothing is done better in a state of ignorance" said a very successful industrialist recently. In this age of rapid communication, radio, television and all forms of the written word, there is a danger of "intellectual constipation, or mental overkill". Each manager has to make communication a priority in his life.

I would like to end with a few cautionary words of advice:

> Analyse what you know, and then decide what you need to communicate.
>
> Avoid jargon, keep the message simple, and colloquial where possible.
>
> Ask for responses and ensure that you get to know what people *really* think, not necessarily what someone has decided you would like to know.
>
> Make communication a top priority in your job. Information is the life blood of an organisation.
>
> Ask yourself this question: what do I need to know in order to do my job effectively?

"... all citizens need to know what is going on if they are to apply their knowledge and skills, whether to make a contribution to society, or for their own betterment."

There is an old saying . . . "a lie can get half way round the world before truth can get its boots on". The process of communication means reconciling differences, and establishing common agreement for successful activity as a team.

The author, John Marsh, CBE, D.Sc., CBIM, FIMC, is chairman of Executive Resources International and is widely known in many countries for his work in propogating the practice of management. He has been since 1947, Director of the Institute of Personnel Management, Director of the Industrial Society 1950-61, and Director-General of the British Institute of Management from 1961-76. He has visited Nigeria on three occasions.

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Circle No. 292 on enquiry card

Computers:

– the next move for developing countries

HISTORICALLY the computer has been a much pampered beast requiring uninterrupted electrical power and an artificially controlled environment to regulate temperature, humidity and dust. Its servants have been qualified technocrats attending to such areas as operational control, systems design, maintenance etc.

Within this cocoon the computer has responded by giving more input/output power, more processing power, more storage, at in real terms, and a steadily reducing capital outlay. The technically advanced countries needed the computer but in turn the computer could only function properly with the physical and human environment that such countries provided.

Beasties!

In the developing countries of West Africa where voltage and frequency fluctuations in electrical power are common, where total power failure without any warning is equally common, where heat, humidity and dust are common, where little, and not so little, beasties make their homes in computer cabinets and chew the wires, where native technocrats are few, it is little wonder that the computer has never got past first base.

Intelligent terminals

The big monolithic computer is no longer pre-eminent, first it spawned intelligent terminals as being one up on slave input/output devices, in turn these intelligent terminals have grown up into low cost computers that can operate with the large main frame computer or as stand alone units. Thus all the input/output and processing required no longer has to go through the main frame bottleneck, it can be distributed through these "low cost computers". That means that if one or more units break down the system may still be able to function albeit at a degraded operating level as all the eggs need no longer be in one basket.

All this has been made possible through advances in micro-electronics. These same advances have allowed engineers to steadily reduce the number of mechanical components in computers and hence inherent reliability has made considerable advances. It has also made computers more compact, with less internal wiring which must be bad news for the little beasties! At the same time the computer has become more tolerant of heat and humidity changes. It is still a bit unhappy with dust, but compactness and the fact that new computers generate less heat is allowing advances in sealing vital parts

Computer Association of Nigeria Second annual conference

Data General is an American company represented by Joint Komputer Kompany Ltd. in Ibadan. Data General's Commercial Systems CS/40 series is specially designed for small growing businesses. Using ANSI '74 COBOL, a popular business language, the CS/40 systems provide all the benefits to users with no previous small computer experience. The system includes DASHER displays for every department in a company and has 20 million bytes of disc storage.

EARLIER ON this year the Computer Association of Nigeria (CAN) held its second annual conference at the University of Ibadan. The conference which was held in collaboration with UNESCO (under the aegis of the Committee on Informatics for Development) consisted of 16 papers concentrating on applications of mini and micro computers, and was accompanied by an exhibition. The four-day event was opened by the Minister for National Planning, Mrs Ebun Oyagbola. The uses of computers in Nigeria were, she said, numerous, and included airline systems, oil drilling and processing and national economic forecasting.

According to the Minister, there are, at present, 200 computers operating in Nigeria. She expressed the hope that the relatively slow and cautious attitude to computers would give way to fairly rapid demand in all sectors.

The mini-computer has a variety of uses in the industrial and engineering sectors. Dr O. A. Olatunbosun, of the Department of Mechanical Engineering, University of Lagos, drew attention in his paper to the use of computers in vehicle system vibrational analysis. The amount of paperwork and the repetitive nature of this area of research makes it a good candidate for computerisation.

Steel industry

O. O. Adeluyi of the Metallurgical Research and Tests Division, Jos, set out in his paper to show the applications of the mini computer in Nigeria's burgeoning iron and steel industry. Raw materials such as iron ore, clay, limestone, dolomite, coal and manganese ore can be analysed for purity and content by using a computerised multichannel X-ray fluorescence (XRF). In Nigeria the XRF is controlled by a central processing unit with a 16k core memory at the Jos laboratory. A typical sample analysis involving 12 elements which would take days and sometimes weeks using manual methods, can now take place in 50 seconds.

T. A. Akeju looks at applications of computers in civil engineering both on the design and accounting side. The computer is becoming more popular with contractors and civil engineers. Costaine West Africa Ltd, for example, have had an ICL computer for three

continued

against the incursion of dust.

Power fluctuation

Even the electrical power problems are proving less intractable. Compact modern computers consume much less electricity than their big ancestors and so you can now find equipment with battery back-up that will either keep the machine in suspended animation with no data loss until the power returns, or in some cases allow you to use the computer long enough to complete the job in hand. The latter system is preferable.

This immediately allows the computer to unhitch itself from a series of generators and a room full of cadmium cell batteries to keep things going whilst power is switched from main to generator. You reduce your requirement for technical staff to the computer area, as you no longer have to worry about the generators and the sophisticated power switching equipment.

Non-volatile memory

But, more important than battery back-up in the "low cost computer" is the progressive phasing out of volatile memory with non-volatile memory which means that if the electricity is switched off then the memory of the computer still retains the information. With volatile memory, unless you have battery back-up, a power-down results in the memory being wiped clean, but beware, many computers still have a combination of volatile and non-volatile memory. In such units the operating system is usually protected (non-volatile) but the user area has a volatile memory.

So far we have talked about improvements that are taking place on the physical side of the computer, or hardware as the technocrats have designated it. The antithesis of this is software, namely the integration of the computer operating and user system to produce, hopefully, the results on the computer as specified by the client or end user.

Software is becoming a steadily increasing percentage of the total cost of computer systems, for by nature it is labour intensive. Thus whilst the physical costs of hardware per unit of money invested becomes cheaper by the day, getting the best out of these physical advances requires more sophisticated software, which in turn requires more man hours for development, and in turn more technocrats.

On the surface this puts the developing countries of West Africa in a cleft stick. On the one hand the computer, physically, has largely adapted to the "exigency" of environment and thus eased the technical problems of maintenance, yet on the other hand the software development has put increasing demand on technocrats, which are in short supply.

This is the challenge that has yet to be resolved before computerisation can really progress in the developing countries.

The computer manufacturers themselves and independent software houses are helping in this respect by developing pro-

continued

CAN conference continued from page 43

years now, which, so far, has handled the accounts, but which will in the near future be used for project planning.

Exhibitors

All the well-known names took exhibition space at Ibadan, and some new ones too. **Cado Systems** is one such newcomer on the Nigeria scene. The company, which has been established one year now, and is based in America, is particularly anxious to promote its Cado System 20 series. This is a multi-task system which can handle accounts, receive international telexes as well as fulfil the basic function of a word processor. The company claims to offer the world's first teach-yourself tutorial packages which guides the customer's staff through the basic functions of the system. The system 20 series comprises five systems ranging from the system 20/20 to the 20/28 with 52 million characters of storage. A spokesman for the company says that the medium range are most popular in Nigeria.

Texas Instruments is another American company specialising in business computer systems. The company has been active in Nigeria for almost a year now and has evolved over the past 30 years a family of compatible DS990 Business Computers. The company has had a particular success with the small models in the DS990 business computer series. The company claims that DS990 models 1 and 2 provide four times the data storage capacity of most systems in their class. As the customer's company grows the models 1 and 2 can serve as compatible work stations to larger Texas Instruments is represented by Comsoft Data Systems Ltd in Nigeria.

Storage media

BASF is a German company manufacturing a wide range of products. In Nigeria it has become known in association with dyestuffs, cassettes (and other sorts of plastics) and fertiliser. Its activities as a supplier of computer storage media is relatively recent. The range of storage media offered by BASF includes: a FlexyDisk series suited to most current Diskette drives with permanent self-cleaning. BASF computer tape with recording densities up to 6,250bpi; a Disk-Cartridge series and two types of Compusette with exact tape control and high storage capacity.

Another company specialising in computer storage media is **3M**. The first commercial computer tape was developed by 3M in the early 1950s. The company manufactures a wide range of disk packs and data modules, disk cartridges and diskettes, each designed to accommodate a different type of drive, including Siemens, IBM, ICL and Shugart drives.

Wang is a company which boasts that the secret to its success lies in its service to first-time users. Typesetting and word processing hardware are particular specialities of Wang.

As far as actual computer systems are concerned the Wang 2200 series has been specially designed for the small business. It ranges from the desktop 2200 PCS-III to the 2200 MVP which can handle several processing jobs at once. The system supports 12 work stations with large optional disc storage capacity and expandable memory.

ICL has been active in Nigeria for 16 years now and has, since that time, set up a [illegible] venture company, ICL Nigeria.

New [illegible]el

ICL [illegible] is introducing on to the Nigeria[illegible]t for the first time, the ME29 [illegible] There are two basic processors [illegible]ME29 range: the model 35 and [illegible]45. The model 35 has a power [illegible]st to the ICL 2904/50 and me[illegible] almost twice as powerful. The [illegible]m user store is 256Kb and thi[illegible]e increased to a maximum of [illegible]n economic modules. A basic ME[illegible]s 35Mbs of fixed disc backing [illegible]whilst the largest system can have u[illegible]6,000Mbs of fixing and exchangeable backing store. The ME29 works well with international computer languages: RPG2, COBOL and FORTRAN.

Leventis Technical Ltd specialises in selling and servicing the **Olivetti** DE700 Intelligent Data Entry System and the Olivetti TC800. The former specialises in clean data processing from clean input.

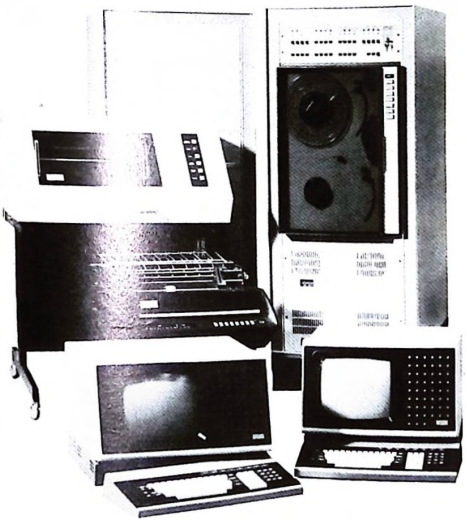
There are four versions available in the DE700 system, each taking a floppy disc unit and each capable of storing up to one million bytes.

The TC800 system is particularly designed for banking. It can use the entire range of magnetic media from cassettes, to discs and tapes, and has a capacity of 40 million bytes. It is particularly useful for counter and back office transactions, as well as for handling decentralised data processing at branches and head offices.

NCR Nigeria is particularly anxious to promote its VRM system which provides accurate information in all management areas, either on video screen or in printed form.

The system can process orders, ensuring total control over incoming orders, printing daily business summaries and producing invoices; it can plan, control and manage inventory, maintaining inventory levels that ensure maximum return on investment and reduction of holding cost; it handles debtor accounting and carries out sales analysis. The system comes completely programmed and ready to run.

4 COMPUTER SYSTEMS FOR THOSE WHO WANT THE BEST



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grammes, or software packages, that have wide applicational appeal. Thus the user increasingly has proven and tested systems available in most areas of financial control and many areas of scientific development at hand without having to design and develop them from scratch.

However, applicational packages can only be modified within certain parameters to suit the specific users input/output requirements.

Thus many users are faced with the choice of either developing costly software suitable for themselves or adapting their systems to fit within the parameters of existing applicational packages.

The former approach is not very practical in developing countries as it requires technocrats that are not readily available. The latter approach, however, is worth serious consideration.

Experience gap

Adaptation to existing applicational software is often more difficult in developing countries because developing countries are largely moving straight from the hand-written ledger to the computer without going through the intermediate stages of development experienced elsewhere. This experience gap is difficult to explain to clerical staff and so they approach change in a very conservative manner. However, a firm accountant should be able to bridge the gap. Accountants are also in short supply but less so than computer orientated and trained technocrats, so it is progress of a sort.

Being more positive, the work that a computer system is required to process in developing countries is usually less sophisticated and less in volume throughput terms than that processed by comparable systems in the developed countries. Thus once you have adapted your procedures to fit the computer the actual take-over should not be too difficult.

If you now feel inclined to progress computerisation in the developing world then bear the following in mind:

Important points

1. If you can use several units rather than one unit, at comparable cost, to process your work then do so. It spreads the risk, reducing the probability of total system shut-down.
2. Favour computer systems that do not need to be pampered with careful temperature and humidity controls.
3. Try to purchase a system with non-volatile memory. If this is not possible be careful to ensure that recovery techniques for the volatile areas of memory are feasible.
4. Battery system will run off batteries when electricity supply fails, then this is preferable to any other alternative.
5. You can use existing, proven, applicational packages then do so. Why keep reinventing the wheel.
6. Consider looking at the availability of back-up for the computer software support is as important as hardware support.
7. Finally, remember the computer system is only as good as the people who design and apply it. The computer in itself is not a panacea, it only does what people tell it to do.

Good luck!

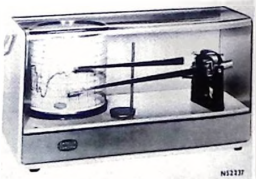
Temperature and humidity recorder

FOR ALL those needing to keep continuous records of ambient temperature and relative humidity, **Casella London Ltd** have introduced a new "de-luxe" thermohydrograph. Such records may be required to ensure correct heating and ventilation conditions for the operation of computers, as well as the manufacture and storage of goods, the growing of plants and the preservation of books and pictures.

The new model aims to combine a particularly attractive appearance with the sensitivity, accuracy and reliability of the company's existing, purely functional instruments (which will continue in production). Ventilation-slots ensure free airflow over the elements but prevent hypersensitive response to momentary opening of doors or windows. Temperature is measured from the curvature of a bimetallic helix; humidity from the length of a human-hair element.

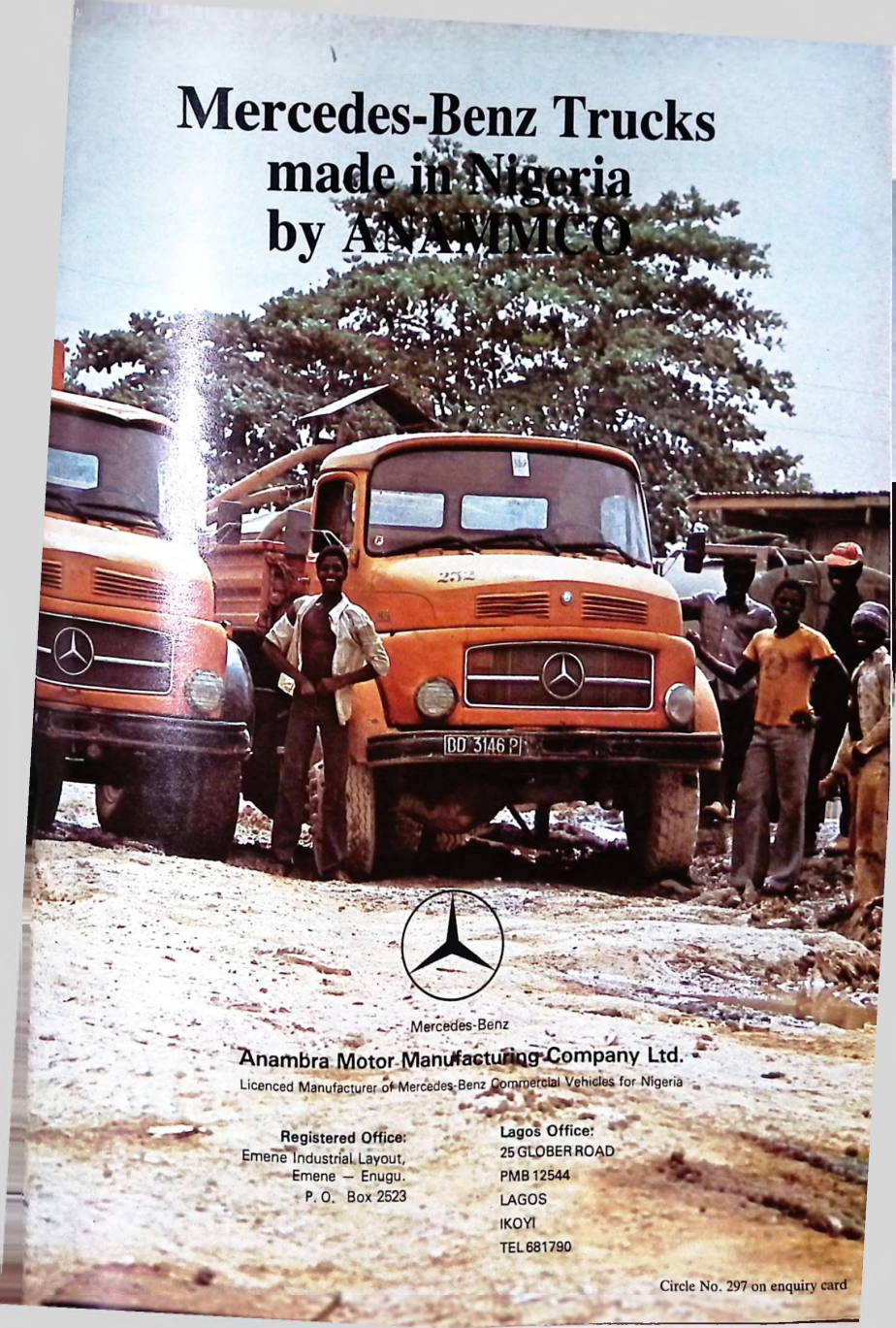
The instrument records humidity and temperature graphically in different colours on a single chart wrapped round a slowly rotating drum. "Daily", "weekly" and "monthly" clock-drives are available, the first two being rapidly interconvertible by means of change-wheels.

Standard charts cover relative humidities from 0 to 100 per cent and temperatures from 0 to 50°C or 30 to 130°F. However, the instrument's full temperature range is from −25 to



+80°C (−10 to +180°F), and a screw adjustment allows various 50°C or 100°F spans within this range to be selected. The encapsulated fibre-tipped pens last many months even with a "daily" clock and require no topping-up with ink.

Mercedes-Benz Trucks made in Nigeria by ANAMMCO



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Lagos Office:
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Nigerian Vehicle market firming up

Special report on commercial and passenger vehicles

Nigeria's vehicle market is flourishing and the demand for both commercial and passenger vehicles is high. In this report West African Technical Review's Editor looks at the position of manufacturers, dealers and suppliers, reviewing problems and prospects.

Leyland is repeating the Leyland Landtrain promotional exercise this year.

NIGERIA'S BURGEONING car industry is unique in West Africa. Although Renault assembles approximately 10,000 ckd vehicles p.a. in the Ivory Coast and until recently CFAO had a Ford Assembly plant in Senegal, Nigeria is the only West African country which has drawn up a programme for commercial and passenger vehicle manufacture, as distinct from assembly, which aims to be self-sufficient in components by 1990.

When in 1969 the Government invited tenders for the establishment of commercial vehicle plants the competition to get a slice of the Nigeria market from the inside was intense; 24 vehicle manufacturers submitted tenders. In the end only four were accepted: British Leyland, the German Daimler Benz, the Italian Fiat and, somewhat later on in the proceedings, the Austrian Steyr-Daimler-Puch.

Regional market

The location of the four respective plants reflected regional market demand. Daimler-Benz's medium-sized Mercedes Benz trucks have always been popular in the east; while the large Fiat trucks, making long distance hauls have always done well in the north. Oyo and Lagos States have provided good markets for small trucks and pick-ups (Leylands' smallest truck is a two tonne WF).

Manufacturers believe that now market boundaries are in the process of fading and they are all trying to improve their distribution and after sales service by stepping up national coverage.

After reaching an alltime low in 1979 when Nigerian market potential for the year sank to 12,000 (a decline of almost 50 per cent on the previous year), the Nigerian vehicle market has improved considerably, with figures for 1980 standing at 13,500–14,000 and for 1981 at 20,000. The market will, therefore, for this year fall short by 14,000 of the 1977 assessment of 34,000, when the market was at its zenith.

Registration figures of Lagos State alone for the year 1980 stand at 59,397 for vehicles, an increase by 22 per cent on the previous year's figures. The bulk of vehicles registered in 1980 were private (37,500) with 7,591 buses registered and 5,600 commercial vehicles registered.

When Leyland opened its plant in Ibadan the market could not have been more depressed, but at present the plant is working to an annual output of 6,000 trucks and 4,000 Land-Rovers and Range Rovers (compare with the *total* Nigerian

continued

Vehicles in operation in West Africa

Year ending 1979

	Cars	Trucks and Buses	Total
Benin	14,000	9,000	23,000
Cameroun	55,000	42,000	97,000
Ghana	64,000	46,000	110,000
Ivory Coast	100,000	60,000	160,000
Liberia	12,182	16,176	28,358
Niger	20,000	5,000	25,000
Nigeria	400,000	300,000	700,000
Senegal	65,000	10,000	75,000
Sierra Leone	70,000	33,000	103,000
Togo	20,000	12,000	32,000
Upper Volta	11,000	12,000	23,000

The following figures, compiled by the British Society for Motor Manufacturers and Traders (SMMT), represent the latest statistics for West African countries. They are based on information supplied by exporting manufacturers in Europe, America and the Far East, but do not take into account assembly/manufacture in Nigeria, Ivory Coast and Senegal. On the whole, with the exception of Togo and Benin, figures for 1979 show a definite increase on 1978 figures, reflecting the fact that West Africa is a growing market. In the case of Nigeria this means an increase from 637,089 in 1978 to 700,000 in 1979.

market potential of 1979, of 12,000). It was the first manufacturer to come on stream and so far has followed the policy of progressive manufacture most closely – it is the only manufacturer to practice engine assembly at the moment and it has already installed hydraulic presses for production of body work. At the moment the plant is one of the best self-contained manufacturing centres equipped with a sewage farm, laundry, and sophisticated sick bay; on the production side this is reflected in the 14 engine test beds and fuel injection pump test room, along with five separate assembly lines.

The company holds 30[illegible]0 line items in stock, worth a total of N[illegible] it is therefore not surprising that a Syst[illegible] computer terminal is being introduced to keep track of all those components on order, in stock or in transit. Daily production in February of this year was as follows:

Land Rovers	20
WF (5 ton and 7 ton)	5
Chieftain (8 ton)	3
Clydesdale (10 ton)	1
Reiver (14 ton)	3
Landtrain	1

Production of Range Rovers was halted at the time because of a saturated market, but the production target is a daily output of three.

Of all the manufacturers Leyland produces the widest range of vehicles, this in itself poses some problems; people do not always immediately associate the name of Leyland with a Land-Rover or a WF for example, although the Landtrain has become, thanks to an intensive and spectacular promotional tour last year, fairly well recognised. This year Leyland is taking advantage of the resurgence in business activity to carry out a heavy marketing programme. The company hopes eventually to produce consistently 30 Landtrains per month. At the moment a campaign to promote Land-Rovers is underway and in September the company is to reveal marketing plans of an exciting and innovative nature – could this be an export drive to another West African country which Nigerian industry is always promising?

New distributors

Accompanying these promotional exercises is a concerted effort to increase the scope of distribution and after sales service. To this end Leyland has appointed CVDS (Commercial Vehicle Distribution Services) which will operate from Kaduna and cover the north of Nigeria, a challenge to the traditional territory of the heavyweight Fiat truck; and also BAP (Bewac Automated Products) to cover the eastern region. At present the company has 46 distributing branches under the aegis of SCOA, BEWAC, CFAO, as well as CVDS and BAP.

ANAMMCO

Daimler Benz was the most recent of the four vehicle manufacturers to come into operation, although the joint venture company, Anambra Motor Manufacturing Company (ANAMMCO) was formed around the same time Leyland Nigeria was formed. Daimler Benz have had twenty years of experience in exporting to Nigeria, but while ANAMMCO gets off the ground Leventis Technical still plays a very supportive marketing role importing fully built

Renault's Saviem range has considerable success in Francophone West Africa. In Nigeria, Mercedes-Benz is an important name in the bus market.

the well known Daimler Benz City and Intercity buses from Brazil, some passenger vehicles and the 4 × 4 Daimler Benz Cross Country, a competitor to Range Rover, Nissan's Patrol and Toyota's Landcruiser, all under licence. At the same time Leventis Technical is gradually phasing out assembly of trucks in Lagos to make way for ANAMMCO's present annual production target of 7,000 trucks. At present the original range of 911s is in the process of being broadened to include the 1113, 1513 and heavier 24 tonne 1924. The factory at Enugu is being added to as the production programme proceeds; and by the end of this year the factory will have a fully equipped test centre, a central training centre and a staff canteen. At the moment the 911 and 1113 are the most popular models.

Leventis Technical is no longer Daimler Benz's sole distributor; partly in an attempt to expand the scope of its distribution and aftersales service centres and partly in response to the Government's move to discourage exclusive dealership, there are now five agents, besides Leventis Technical, selling Daimler Benz vehicles: Ilodibe in Onitsha, Dantata in Kano, Ferdinand Enterprises (the east generally) and in Lagos, John Allen and Rutam. Except for John Allen (a division of John Holt) and Rutam, these are names less well-known on a national level but have the advantages of a good local reputation and local contacts.

Leventis Technical has representation in nearly every state. At the moment Leventis Technical feels the market is good. The company is getting a lot of feedback from the Imo rural electrification project begun at the end of last year, with big demand for flatbed trucks from contractors such as

continued

Glass for cars and trucks

Triplex is a new company which will be making a major contribution to progressive manufacture in the vehicle sector by the end of this year. It will be manufacturing windscreens, sidelights and backlights. Pilkington Glass, a company with extensive experience in Nigeria, is the expatriate element in Triplex Safety Glass Nigeria Ltd, the Nigerian shareholding in the company consisting of private Nigerian investors.

The company aims at first to supply Leyland, Steyr, ANAMMCO and NTM, but it hopes to move on to supply Peugeot and Volkswagen. The bulk of work done at Triplex will consist of trimming, shaping and laminating.

The company has no competitors manufacturing in Nigeria so far. Despite this, Triplex's managing director, Mr Gatti, struck a far from complacent note when he told *West African Technical Review* that the big challenge for him was to turn out a good-quality product, working at a planned rate of production. Production output will tie up with that of the vehicle manufacturers and will eventually expand to include the aftermarket as well.

Vehicle Survey

James Scott and Deutz Engines. Although Abuja contractors are tending to buy offshore at the moment this trend could change as more projects get under way.

Trucks and tractors

The other two heavy vehicle assemblers, Steyr Nigeria and National Trucks Manufacturers, situated in Bauchi and Kano respectively, have both chosen a dual production programme of trucks and tractors. In the case of Steyr Nigeria, which opened in July 1979 tractor production has got off the ground ahead of truck production with the first trucks being produced (the 13 ton 1291 and the 25 ton 1491 in May 1980). The company claims that at present everything used in manufacture except the traditional Steyr parts is bought locally and that over ₦3,000,000 has been spent on buying local components, including some investment purchases.

Steyr Nigeria has a truck manufacturing capacity of 8,000 trucks a year; from the beginning it was assumed that the company would have to enter into some sort of licensing agreement for manufacture of another company's trucks since Steyr-Daimler-Puch in Austria itself does not have the surplus capacity to supply basic components needed to produce that many trucks. It came, therefore, as no surprise when the Chairman of Ford of Britain announced that an agreement had been signed for the assembly of approximately 2,000 D-Series trucks a year, delivered in ckd form. Since that time nothing has been officially announced. Ford is not prepared to say whether production of the D-Series has started or not.

The situation has become confused by the fact that Ford announced to the British press in March that it was launching a new truck range, the Cargo range of trucks which will eventually replace the 16 year old D-Series. The Cargo series will, according to a report in the British Financial Times, be marketed in the Third World as well as in Europe. It seems that tripartite negotiations are still taking place between Ford, Steyr and the Nigerian Government; possibly D-Series kits will continue to be assembled until supplies in the UK run out and then the Cargo Series in ckd form will be introduced. A spokesman for Ford told West African Technical Review that any comment on the situation would jeopardise negotiations.

The National Truck Manufacturers are geared up to produce 6,000 Fiat trucks

continued

Once-a-year oil changes

Super oils that will last a year in a truck's diesel engine are now available. In commercial-vehicle terms that is a bold advance. Once a year often means well over 50,000 miles. Lower yearly mileages still mean a tough life for engine oil—variable temperature, variable loading, variable speed; acid and soot formation.

Two parallel lines of development have resulted in these remarkable oils. One has been to extend the traditional additive-lacing techniques. The other approach has been to start afresh and see what happens if you create a new base oil synthetically.

In the long term the synthetic route is the more enterprising. It has the deeper significance that there will always be an oil to lubricate machinery even if supplies of natural oil run short. The chemists can extract hydrocarbons from vegetation or coal and fuse them together to create an oil; test-tube oil.

This way there is more control over the base formulation. Contaminants such as wax can be avoided, so the mobility of the oil is retained in freezing conditions where ordinary oils behave more like tar. Lighter fractions can be eliminated right from the start; that gives an inherent ability to resist the burning that forms carbon and oxidation inside an engine.

Synthetics therefore achieve at the outset the sort of qualities ordinarily obtained by sophisticated additive treatment. Their snag is that they are expensive—between three and four times the price of orthodox oils.

For that reason most lubricating-oil specialists are preferring to keep improving the natural stuff. At their best they are achieving comparable results, except maybe at the rare extremes of cold or heat. Synthetic are too far ahead of their time, runs the argument.

Whatever the respective merits the rivalry has been good for those who run transport fleets. In the last year has come the chance of buying very high quality oils that stay fluid in a wide range of temperatures, reduce oil consumption, improve fuel consumption by at least two per cent, extend engine life and themselves last about six times as long before needing to be changed.

On top of all that, these new super-specification oils (look for the spec-codes SE, CD, and Mack-T5) are so versatile that they can be used in petrol engines as well as big turbo-charged diesels; servicing is simplified as well as being needed less frequently.

A big step forward for the future of Nigeria

National Trucks Manufacturers Ltd. are proud to announce the opening of their advanced new Commercial Vehicle and Agricultural Tractor plant in Kano by the President of the Federal Republic of Nigeria, His Excellency

Alhaji Shehu Shagari
on 15th April 1981

This new achievement opens a new chapter in the 30-year-long history of the Fiat Group's participation in the industrial development of Nigeria.

In fact, following the construction of the Kainji hydroelectric complex, the Bakolori and Goronyo dams, the third Ni Bridge of Lagos, more than 10,000 Kms of new roads, big bridges and viaducts, and huge projects in the field of land reclamation and agricultural development the Fiat Group, through its Commercial Vehicles Division – Iveco – is also proud keep on collaborating in the continuous progress of Nigeria.

The Company wish to thank the Federal Government, the Kano and Sok State Governments, Iveco, the Commercial Banks, the Contractors and Suppliers, Companies and Institutions and all individuals who have contributed to the creation of this impressive industrial comp

National Trucks Manufacturers

In Nigeria, for Nigeria

Circle No. 223 on enquiry card

starting with the light-weight 682, as well as tractors. The company aims to reach a high degree of integrated manufacture, emphasising its engine production programme. This programme is based on one high-powered model (230bhp) and a high range of modular 3, 4 and 6-cylinder engines which can be used on trucks, buses and tractors as well as in industrial context. The company feels that the modular design of the engines is advantageous in that it facilitates integration of locally produced components. NTM has four distributors: Incar Nigeria, UTC Nigeria, Nigertruck and Bewac with 23 dealer branches for its trucks.

After a delay of nearly a year NTM will go on stream producing tractors as well as trucks (the reasons for the delay have not been made public). Finland Nigeria now have a competitor.

VW Nigeria factory off the Badagry Highay. Lagos.
Aerial photograph by Photair.

Passenger car manufacturers

It should not be forgotten in assessing the progress made by the truck manufacturers that their way was paved for them some years in advance by the manufacturers of passenger vehicles. Peugeot Nigeria was the first company to go into production. Peugeot vehicles represent 70 per cent of all French vehicles exported to Africa and it is interesting that an anglophone market, Nigeria, not a franco phone market is its biggest market. In 1979 Peugeot exported 52,406 vehicles to Nigeria; the next biggest market in Africa trails far behind, that is the Ivory Coast with total car imports of 3,933. Indigenous manufacture will undoubtedly depress exports to Nigeria; last year Peugeot Nigeria exceeded its production target of 45,000 by 5,000 vehicles, that is a 38.6 per cent increase on 1979 output. In February of this year the company was manufacturing approximately 240 vehicles a day the bulk of which was devoted to 504 L models with air conditioner.

The 504 pick up has proved sufficiently popular to merit production of 50 vehicles daily. The company plan to increase output this year to 55,000. Included in the range being produced will be the 504 GL and GR models as well as the recently introduced 505 SR of which 2,800 units were imported in 1980 under licence. Three thousand 305 models have been introduced this year and recently the model has been approved for assembly.

Despite production increases the company finds it hard to keep abreast with demand and according to the Business Times people are waiting up to nine months for certain models. It is for this reason as well as to take full opportunity of the present boom that Peugeot has decided to decentralise its distributing network, each district being responsible for distribution and marketing. Having had its use of UTA air freighting facilities severely curtailed, Peugeot has resourcefully resorted to using the railways and is the only vehicle manu-

continued

Articulated bus – the first in its generation

Flexibus on show

Lex Vehicle Engineering Ltd, the British manufacturers of specialist vehicle bodywork, is co-operating with two leading continental companies in articulated bus design.

Based on the Mercedes Benz "Model 0305 G" articulated bus chassis, powered by a rear-mounted 240bhp diesel engine, the bodywork of the new "Flexibus" is built by Lex in close co-operation with Heuliez of Cerizay, foremost in this particular technology.

Apart from side frames, the front and rear GRP assemblies and some standard components, the entire bodywork has been manufactured at the Hampshire works of Lex Vehicle Engineering in the UK.

Solid construction

Typical of the solid construction which is a major feature of the "Flexibus" is the design of the entire framework in rectangular hollow section and/or pressed steel sections, integrally welded into a homogeneous assembly with the rectangular hollow section framework of the chassis.

All underframe members are impregnated with polyurethane and the superstructure is treated with an anti-corrosive preparation during assembly.

Power is transmitted from the naturally aspirated diesel engine through a Mercedes Benz "W3D 080/R" fully-automatic three-speed gearbox with torque converter and built-in retarder, operated by the foot brake.

Braking arrangements include dual-circuit compressed air service brakes, parking brake on central and drive axles, retarder/exhaust auxiliary brake and bus stop brake operating on the central axle.

Other features include full air suspension, power steering, automatic chassis and turntable lubrication and comprehensive electricals. The turntable incorporates the Mercedes anti-jackknifing device.

Lex Vehicles Engineering has been supplying the Nigerian market for some time now. Here it specialises in purpose-built vehicles such as ambulances, rescue units, mobile workshops and refrigerated vehicles. The company believes that there is potential for the Flexibus in Nigeria, particularly for use in airports and on urban transport routes. Provided a rigorous maintenance programme was pursued this ingenious vehicle could be a great asset to the Lagos city transport sector.

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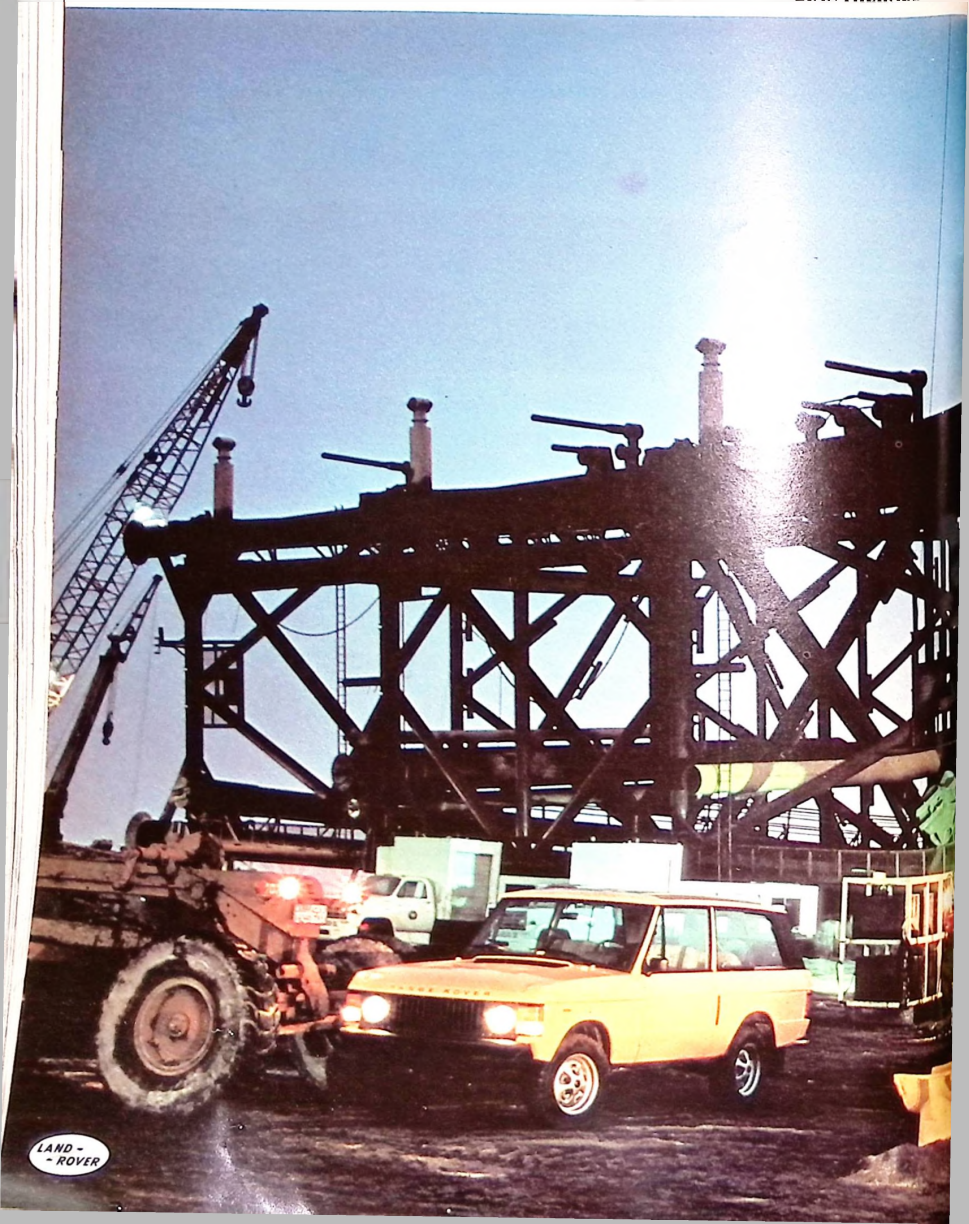
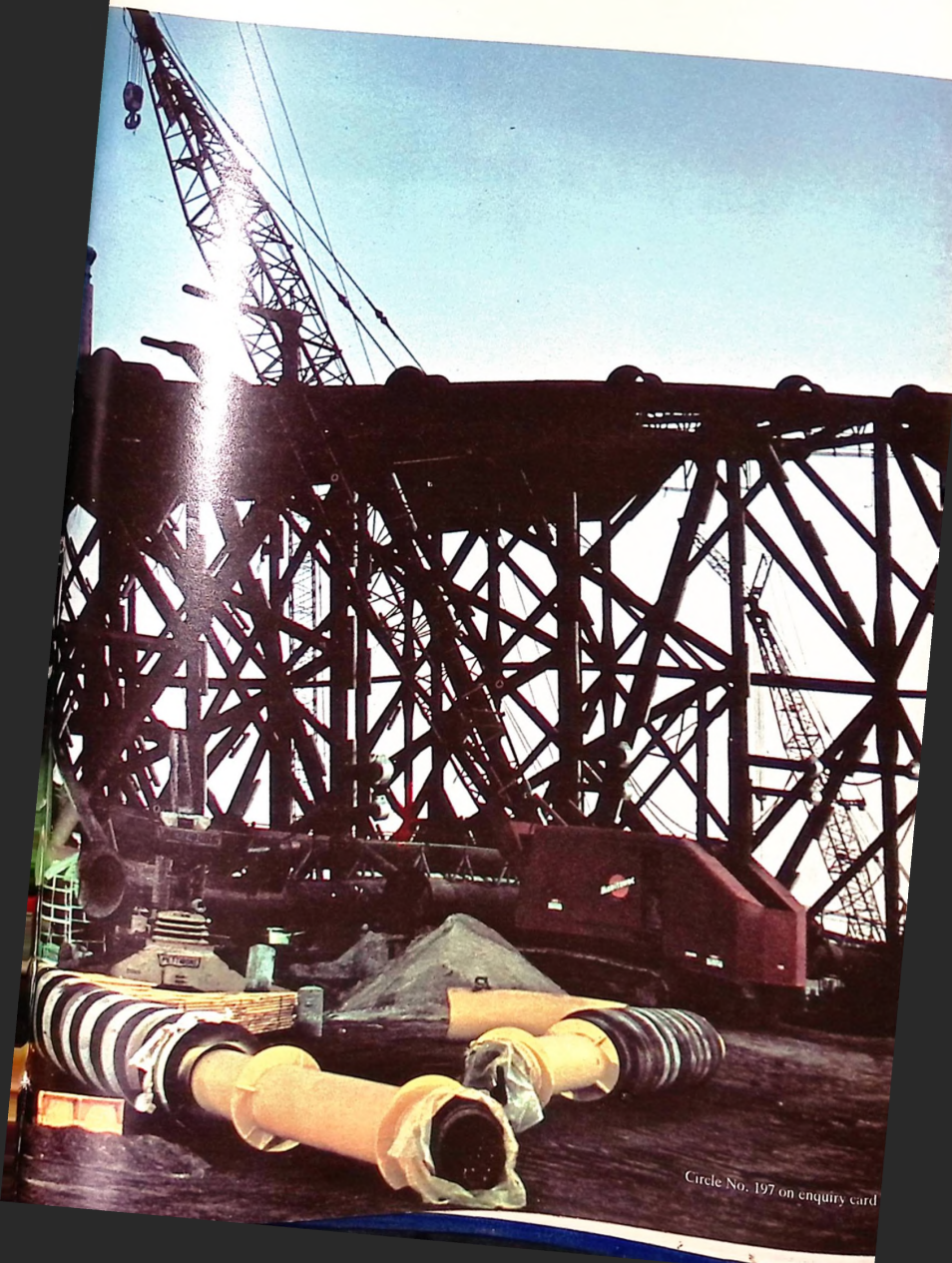


ONE CAN ONLY BUILD ON SUCCESS.



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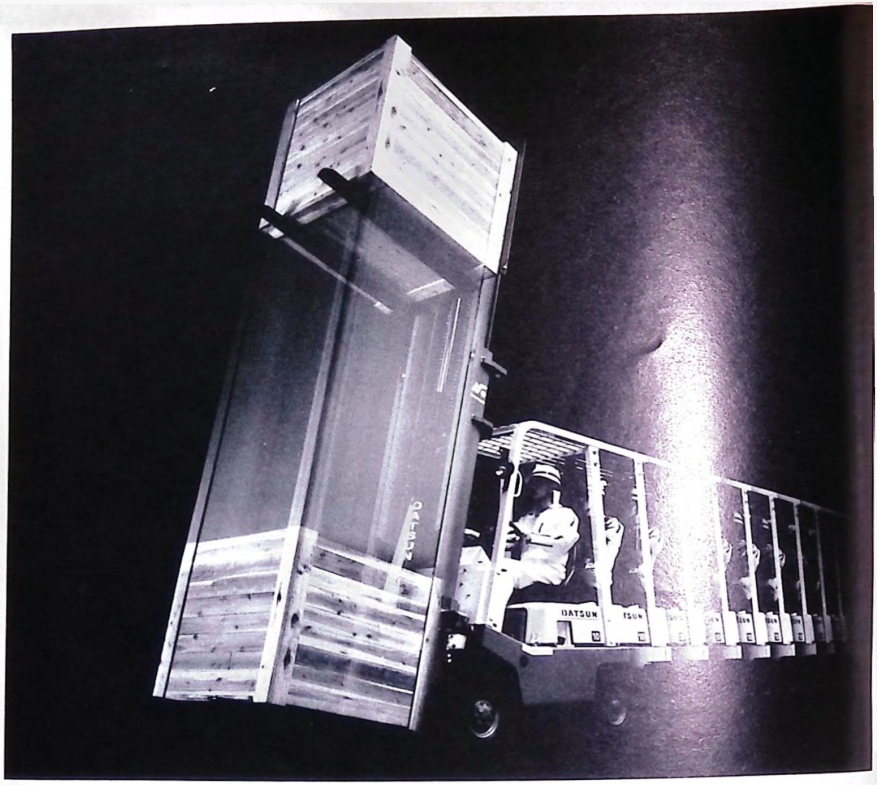

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DATSUN FORKLIFT

NISSAN

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facturer to take advantage of the recently reorganised NRC, with 1,200 containers of components being shifted from Port Harcourt to Kaduna earlier on this year.

The first Beetle was exported to Nigeria in 1953. Volkswagen Nigeria began production in March 1975 with a single shift producing roughly 60 cars per day, mainly Beetles. With the expansion of production facilities daily output was increased to 140 cars and additional models such as the Passat and Audi 100 GLS were produced. The total output of cars at the end of December 1980 was 37,056, comprising 80,805 Beetles, 9,92[illegible]gala, 11,492 Passat and 2,831 100 GL[illegible]W Nigeria has been like other manufa[illegible]rs exposed to the vicissitudes of a ch[illegible]ng market, perhaps more so than truck[illegible]ufacturers since the passenger car ma[illegible]is more sensitive to economic clima[illegible]han commercial vehicles. Sales r[illegible]d a peak in the 1978/79 period a[illegible]hen fell off, largely due to a restructu[illegible]of the car loan policy by the Federal M[illegible]y Government. The company now sa[illegible]hat it has since mid 1980 experien[illegible] continuous improvement and [illegible] company is particularly anxious t[illegible]romote the Passat TS, a modified version [illegible]he Passat range.

Problem of definition

All six vehicle manufacturers face the same problems in trying to follow the Government's guidelines on progressive manufacture. According to these all of the manufacturers are supposed to integrate progressively into their production programmes locally manufactured components until the Nigerian motor industry is as self-sufficient (that is for the most part independent of imports) as its counterpart in developed countries. The date for this target is 1990. The policy is a sensible one for a country embarking on an industrialisation and development programme aimed at cutting back imports and generating manufacturing sector. But it is difficult to put into practice. Firstly because it implies that local manufacturers must grow to keep apace with the vehicle manufacturers this is hard to co-ordinate; it depends on a high level of trained manpower and a regular supply of raw materials.

Secondly, the policy itself begs definition, because in a sense all manufacturers practise a kind of assembly. All manufacturers are dependent on suppliers overseas as well as at home, in some cases for large, structural components. For Nigeria its vehicle industry can only become truly self-sufficient once the steel mills come on stream, thus providing supplying industries with raw materials.

There is one final aspect to the manufacturing policy that is important: that is market incentive. The marketing of vehicles manufactured according to an integrated programme can only work if cheap and competitive imports are discouraged and cheap assembly is halted. This has not yet happened. There is no indication so far as to when FMI is going to discontinue assembly of the successful and popular Bedford trucks, the components of which arrive in Nigeria in pkd form. These are being produced at a rate of 5,000 a year. Meanwhile CFAO, SCOA and BEWAC assembly plants are all being phased out according to sell-defined schedules.

As far as imports are concerned the importation of Land-Rovers under light commercial vehicle licences instead of under 4×4 licences (the latter are more difficult to obtain) is undercutting Leyland's marketing programme, and cheap counterparts to the Range-Rover and Land-Rover are becoming increasingly common such as the Russian Lada and Toyota's Landcruiser.

There is another advantage to curbing imports besides giving home industry room to breathe; the Nigerian vehicle scene is in desperate need of rationalisation. There are just too many dealers competing for the same customer who is getting bad after-sales service because most dealers cannot

continued

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afford to run a very extensive stockpile of spare parts and do not have the trained manpower to carry out proper maintenance and repair procedures.

Suppliers

The number of suppliers in Nigeria to the vehicle manufacturers is small but growing, and having, like the vehicle manufacturers themselves, to survive among cheap and competitive imports. At present, it seems that component suppliers are being relied on more for after-market needs than for the manufacturing process; all the manufacturers are using products of Berger Paints Nigeria, however. Nationalist buying trends are evident with other products. Thus Leyland Nigeria will be incorporating Turner & Newall brake linings into all after-sales service, and at present installing British air-conditioners from Mark IV; once the ABM and Triplex Nigeria factories have gone into operation in Ibadan the company will also be buying chloride batteries from the former and Pilkington Glass windscreens from the latter. NTM is relying on another Italian company and one within the Fiat Group for pneumatic components, Magneti Marelli, which has built a factory in Zaria. (NTM has plans, incidentally, to produce its own fibre glass cabs.)

As far as tyres are concerned Leyland does buy British with Dunlop, but like some other manufacturers buys them more as a back stop, finding Michelin tyres more durable, and Leyland should know – it has its own tyre-testing unit. Volkswagen Nigeria buys lubricants from Agip (Nigeria) Ltd and Nigerian National Oil Company. It buys tyres and tubes from Dunlop Nigeria and paints from Chemical and Allied Products Ltd as well as from Berger.

Counterfeits

At present a certain mood of distrust has set in among buyers and suppliers. The reason: counterfeit or spurious parts. The rise in the number of imitation components in the past few years has been dramatic and has particularly hit the vehicle industry. Nigeria has not been the only victim – developed countries have been hit too, but Nigeria's brisk trade provides a comfortable camouflage for imitation goods from Taiwan and Korea.

It is difficult to formulate a campaign against counterfeit or spurious parts – manufacturers are extremely wary of having their names identified or associated with products being imitated; they fear that their share of a market already flooded by the counterfeits will be reduced to zero as people avoid buying the product altogether in case they buy only an imitation. Of the indigenous manufacturers, Turner & Newall Nigeria in Ibadan have, in the past, had their market undermined by clever and lethal imitations of disc brake pads.

Leventis Technical report that it has come across a spate of counterfeit oil filters. The original product comes from Germany and is manufactured by KNECHT; the imitation filter is of inferior quality and is labelled, to give the buyer a sporting chance, KENECHT. Speaking at the launch of Peugeot's new 305, Mr Titus A. Animoror, West District Manager, warned customers to be vigilant and guard against imitation parts. It should perhaps be pointed out, however, that not all imitation components are spurious in the sense of being defective, some are cheap and good – but not many people are going to take the risk!

So what are the next few years going to be like for dealers and manufacturers? There is generally a mood of optimism despite such difficulties as the increase in import duties in April 1980 from five per cent to 18 per cent in Ibadan, 15 per cent in Enugu, ten per cent in Kano for approved user status goods (Steyr still only pays five per cent in Bauchi). Leyland, for example, says it expects a ₦1.27 million turnover for 1982. Leyland, VW Nigeria and Peugeot are demonstrating their faith in the buoyancy of the market by bringing out new models.

Another interesting development in the vehicle manufacturing sector which is just beginning to emerge is the prospect of exporting vehicles manufactured in Nigeria to other West African countries. VW Nigeria seems to be leading the way with proposals to export to Sierra Leone and Ghana.

Ultimately the profitability of the Nigeria vehicle manufacturing sector depends on the restriction of imports. With the recent ratification of the 1981 Finance Act car duties have been reduced and cars will be cheaper (import duties are now based on the value of the car instead of engine capacity as was the case previously). Although the import quota for 1981 has not yet been fixed this seems to indicate that more import licences will be issued this year than last year. This means the going could be tough for Peugeot and Volkswagen Nigeria, while the dealers in passenger cars such as Leventis Technical will be doing good business. The same Finance Act stipulates an increase in the duty on assembled lorries, trucks, pick-ups and delivery vans from 20 per cent to 35 per cent. This will, to some degree, protect manufacturers of commercial vehicles who will also benefit from the upsurge in activity in the civil engineering and construction sectors. ●

Aerial shot of Federated Motor Industries (FMI) factory in Apapa. FMI, which is part of UAC Nigeria, is still assembling Bedford trucks. A dead-line for closure of the plant has not yet been set. Aerial photo by Photair.

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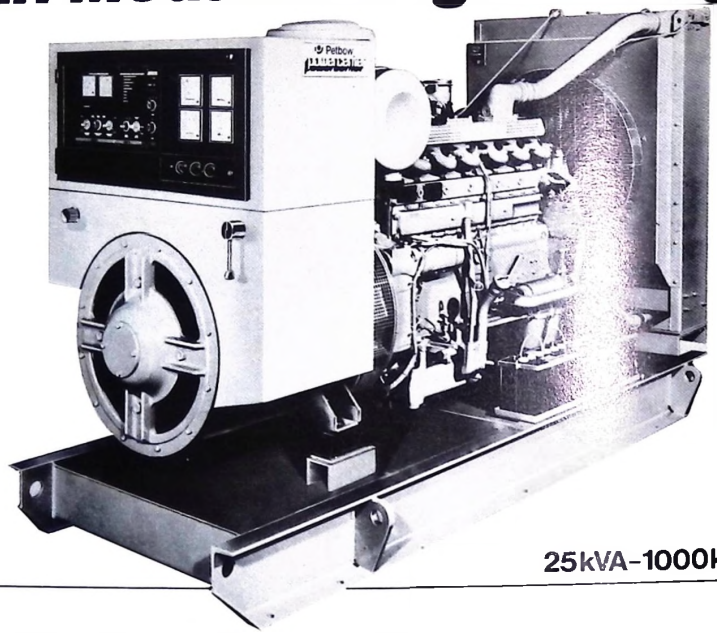

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A perspective on African energy

Special report on Houston conference

by Martin Quinlan

UNDER THE theme of "The Global Energy Challenge: African Perspectives and Business Opportunities", politicians and planners from African countries met with US and European businessmen in Houston, Texas, in mid-March. Unfortunately, the conference – organised by the African Development Group – fell short of presenting a clear "African perspective" on energy issues, and some of the businessmen present commented that they had hoped for better business opportunities than the meeting actually gave rise to.

Neither of these faults were wholly or directly attributable to the African Development Group, but were the result of the non-attendance of many African political and business figures who had indicated they would be there.

". . . it is the size of the African continent's resource base for energy which strikes home – and the fact that so little of this potential has been tapped so far . . ."

Business highlights

As a merchant banking, consulting and trading company operating in sub-Saharan Africa, the African Development Group is well aware of the potential for the development of Africa's energy sector, and it was the potential that the conference sought to highlight. Sessions covered the mechanics of doing business in Africa, legal matters, financing and insurance. This may have been of interest to businessmen from companies new to the African market, but it seemed that many of those present already had experience of doing business in Africa.

On the energy scene, some significant impressions were made. Overall, it is the size of the African continent's resource base for energy which strikes home – and the fact that so little of this potential has been tapped so far. According to US Department of Energy figures, proven recoverable reserves in the African continent amount to 57,700 million barrels of oil, 210,000,000 million cubic feet of gas (of which Algeria has 132,000,000 million and Nigeria 41,000,000 million) and 21,600 million US tons of coal (mainly in southern Africa but with significant deposits in Nigeria). Additionally, the continent has 16–20 per cent of the world's hydro-electricity potential, of which most is in Zaire, together with vast solar energy resources.

Urban growth

But, although energy investment in Africa is said to be increasing faster than anywhere else in the world, Africa's own energy needs are still met to the extent of 75 per cent by fuelwood. As people move from rural areas to cities, however, the demand for higher-grade energy forms, such as kerosene and liquid petroleum gas (LPG), increases – and in most African countries this demand is met by imports.

Thus urbanisation – a trend which is meant to reflect growing prosperity – can actually lead to *reduced* prosperity on a national level, as cheap indigenous fuels are replaced by costly imported energy products. The bonus, however, is that the spreading de-forestation which accompanies reliance on fuelwood in many parts of Africa is checked. Even in oil-rich Nigeria, de-forestation of northern areas as a result of the over-harvesting of wood for burning is a cause for concern; poorer countries have less scope for changing their fuel-demand patterns.

What can be done? The need, it seems, is for joint-venture projects between European and American companies on one hand and African companies on the other; the former have the technology, while the latter know the market. The need for equity participation – in place of commission arrangements – was stressed by the African speakers at Houston; we are no longer "colonial trading partners", one Nigerian businessman said. The problem is that, due to poorly developed infrastructure and shortage of experienced staff, European and US businessmen might find their partly-owned African subsidiaries functioning at lower levels of efficiency than they would tolerate at their home base. But the rewards in fast-growing African markets could make the problems worth surmounting.

The question of bribery was also raised, one speaker observing that American companies resorted to bribery whereas British and French companies were more likely to be able to function without it since they knew how to operate in their former colonies. But others said there was no need for bribing, provided government requirements had been rigorously complied with.

On a practical level, the need seems to be for small-scale projects for hydro-electricity generation, coal-mining, and the growing of "biomass" – fast-maturing vegetable material used as fuelwood or for fermentation to give fuel alcohols. Although capital costs might be high, the money can usually be found from international sources if a project is well planned and aimed specifically at local needs – requirements which serve to reduce the commercial risks involved.

But for large scale high-technology projects, such as oil exploration, production and refining, and particularly for the production and processing of shale-oils and heavy crudes, the international oil companies are best placed to supply both technology and capital. Crude oil prices of up to $40/barrel will now justify some shale-oil projects, the conference was told, but companies are becoming reluctant to invest because of the political risks involved.

". . . reserves in the African continent amount to 57,700 million barrels of oil, 210,000,000 million cubic feet of gas, and 21,600 million tons of coal. Additionally, the continent has 16-20 per cent of the world's hydro-electricity potential, together with vast solar energy resources . . ."

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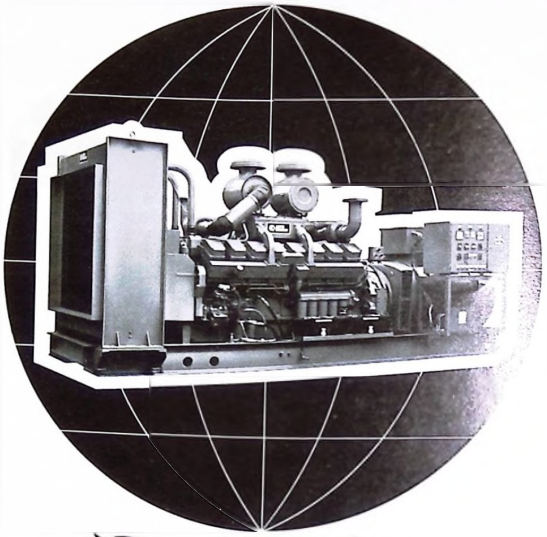

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African energy Continued

Arbitrary increases in royalty and taxation, for example, serve to delay the break-even date for a project and can even – in view of escalating interest rates – prevent a project from reaching this point at all.

As a result, while there are around 3,000 drilling rigs working in the US, there are only 51 in Africa – although the latter includes a number of expensive off-shore rigs. Progress has been slow, but is now speeding up considerably: there are a dozen countries without present oil production, or with only a small volume of production, which are now actively exploring with a good chance of making substantial finds. Cameroun, Chad, Ghana, Ivory Coast, Equatorial Guinea, Guinea Bissau, Liberia, Madagascar, Niger, Senegal, Sierra Leone and Sudan all come in this category, with Ivory Coast deserving a special mention in view of the rumoured size of its recent oil finds.

"... while there are around 3,000 drilling rigs working in the US, there are only 51 in Africa ... Progress has been slow, but is now speeding up considerably: there are a dozen countries without present oil production, or with only a small volume of production, which are now actively exploring with a good chance of making substantial finds."

Financial risks

Although many countries will set their sights on crude oil, it could be that projects for the development of non-oil energy forms offer a greater certainty of success for many countries, in view of the high financial risks involved in drilling for crude. Particularly in the tropical parts of Africa, where high temperatures coupled with high rainfall allow vegetation to reach maturity much faster than elsewhere, wood-harvesting projects would appear to have considerable scope for development.

"... the scope for local production increases as technological complexity decreases. Energy planning is thus a vital first stage – and even Nigeria has only the basics of an energy plan at present. Speakers categorised African countries according to their energy resources and general level of development." Nigeria is in the fortunate "high energy/high development" category.

Wood processing

One company represented at Houston, Morbark Industries of Michigan, US, produces equipment to reduce trees of up to 27 inches in diameter into wood-chips for fuel use, and can offer mobile machines capable of processing whole trees, or several smaller trees, without pre-treatment. The tree is reduced to wood-chips at the site of felling, minimising handling difficulties. Morbark comments that wood is 30 per cent cheaper than gas, coal or oil on a heat-content basis – although this comparison will vary from country to country. But wood, unlike crude oil, is renewable – and, from the viewpoint of an African country, wood-processing has the advantage of employing more labour and using less complex technology than does oil exploration and production. Wood-chips could be made available in cities more readily than fuelwood, and could be burned in place of costly imported kerosene for cooking and heating purposes.

Moving to larger energy projects, small hydro-electricity installations received some attention, mainly in the context of the US Department of Energy's involvement in small hydro development, for which it is backing pilot projects and funding studies by other organisations. One US consultancy, Tudor Engineering, reports that it is involved with 46 such projects, of which some are completed and others are in various stages of design or construction. Altogether, these projects will provide 200 megawatts of generating capacity and will give an average annual generation total of some 1,000 million kilowatt-hours of electricity. The average plant size of about 4,800kW, and the average capacity factor is 57 per cent. The company comments that it would take 1.5 million barrels of oil annually to generate that amount of electricity in an oil-fired plant.

What of the costs? In the US, capital costs of such plants are given by Tudor Engineering as varying from $685 to $1,400 per kilowatt of installed capacity, at 1978 prices. The resulting electricity cost is between 1.4 and 2.8 cents per kilowatt-hour generated, allowing for operation at an average of 57 per cent capacity and amortising over 10 years. (Maintenance and financing costs will of course increase these figures.) The company cautions that the average can be misleading as almost every low-head hydro project is unique in its constructional – and thus economic – aspects; in an African context costs might be higher if it is necessary to import much of the plant required.

Planning

The same consideration applies, of course, to solar, biomass, and wind energy projects, although the scope for local production increases as technological complexity decreases. Energy planning is thus a vital first stage – and even Nigeria has only the basics of an energy plan at present. Speakers categorised African countries according to their energy resources and general level of development, with "low energy/low development" countries such as those of the Sahel urged to concentrate their resources on fuelwood production and solar energy projects. "High development/low energy" countries such as Kenya might opt for ethanol projects (as Kenya has done) as a substitute for crude oil imports; Kenya is also leading the way in the use of geothermal energy in Africa. "Low development/ high energy" countries such as Gabon, Angola, Congo and Zaire have scope for high oil exports because of their low domestic consumption, and could therefore invest their oil revenues in projects such as coal mining and hydro-electricity. This leaves the fortunate countries in the "high energy/ high development" category – typically Nigeria, as well as Algeria and Libya – which might have both the finance and the infrastructure resources to justify involvement in LNG projects, large-scale electrification and in the more sophisticated alternative energy projects.

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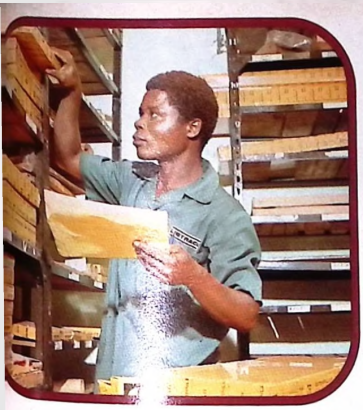

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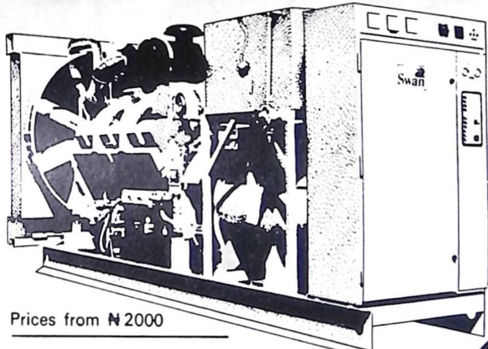

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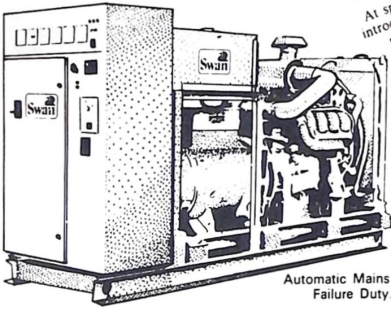

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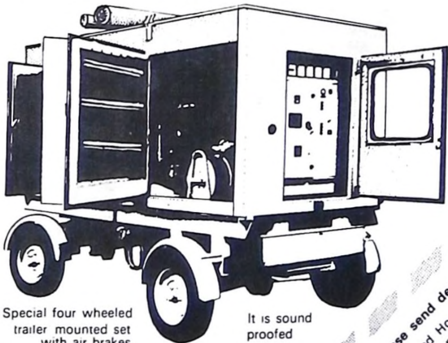

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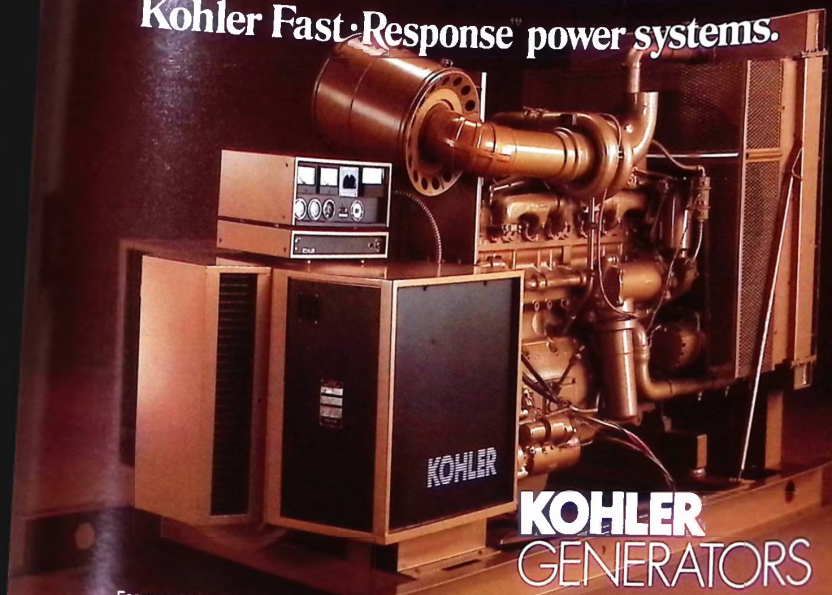

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Practical power generation

Garbage in Energy out

HIGH TECHNOLOGY and a capital-intensive approach have given rise to the electricity industry adopting a certain standoffishness in countries where technology has not yet become an integrated part of society. This situation is not improving and is often reinforced by monopolistic state policies prohibiting commercial production of electricity by private sector interests.

By providing electricity at a subsidy to a fast-growing consumer sector through a state oligopoly, dependence on external techno-resources is strengthened and extended. Some negative aspects of state monopoly in the electricity industry are inefficiency and excessive capitalisation. The latter has resulted in high electricity

Irrigation pump powered by diesel engine in a small town

In attempting to solve Nigeria's energy problems, there are many options open, although not all of them commercially viable. H.K.E. Iteke examines some of the weaknesses and strengths of possible energy policies for Nigeria.

rates which most people think are outside the average consumer's income bracket. Unreliable and unstable power supply is the major product of the former.

In an earlier article, the notions of "scale reduction", harnessing of environmental factors, private utility companies, etc., were developed around the perennial problem of urban and rural production and distribution of water in Nigeria.

This article extends these notions to the generation and distribution of electricity. The socio-economic and political backdrop remains the same and presents the same obstacles; but with electric power, there is much greater urgency for a realistic development model which will relate the burden of development to a much broader spectrum of available resources.

To gain an insight on the magnitude of resources demanded by huge centralised power generation schemes, note may be taken of the cost of installation for "firm" power, estimated at ₦2.50 billion in the "off-and-on" Lokoja Hydro-electricity scheme in Nigeria. This does not include the cost of distribution. There is tremendous growth in the demand for electricity in Nigeria. The pressure on government capital resources represented by this demand must have to be relieved in one way or another. It is difficult to establish that provision of subsidised electric power to the public is of significant economic value to the country. But the pressure must be relieved all the same.

Energy resources

To reduce internal consumption of petroleum resources and consequently, increase foreign exchange intake from petroleum, hydro-electricity schemes come easily to mind as an alternative to petroleum-energised electric power plants. However, the hydro-dam system is not usually amenable to fragmentation into a large number of similar, economical and independent sub-systems. There are other alternative energy sources in Nigeria besides petroleum and hydro-dams.

Among these are to be found, many low energy materials deriving mainly from domestic garbage and agricultural wastes, which presently cannot be burnt directly in the manner of firewood for domestic use. Most of these energy sources are renewable. There is already need to develop a strategy for the efficient disposal of these materials because they constitute a social and health menace in their lowest form: domestic garbage.

The ideal strategy for the removal of this menace is to create a positive demand which ascribes to garbage a certain economic "value". But this requires the creation of other unique sub-systems which are able to impart this "value" by themselves.

Garbage is only one of several renewable low-energy sources, but it also poses the greatest menace and is quite expensive to dispose of. Therefore, a development model which generates a positive demand for garbage will reduce the difficulty of disposal, and improve sanitation. *In situ*, the model will provide for the consumption of straw, leaves, firewood as well as lignites, coals and any other solid fuels available in Nigeria.

In order to dispose of garbage, attempts have been made in the past to use it for land reclamation, or to burn inside incinerators. In each situation, the garbage menace persisted at least partly because the system failed to create a visible demand for garbage. The onus of garbage collection did not rest with the people who generate it. The collection was therefore expensive and often, people were not in the least interested in transfering garbage to a collection point just around the corner. Garbage containers were often ignored, leading to a pile-up almost everywhere.

Selling garbage

The ideal tactic of an energy system based on garbage, leaves out the garbage collection function. The garbage collection centres are transformed tactically into purchasing depots where anyone bringing in garbage will receive payment for it. After

continued

all, a 50-kilo sack of low energy garbage yielding 4,000Btu/lb, is equivalent to about three gallons of heating oil. If the garbage is mostly dry organic matter, the value of a 50kg sack of garbage would almost always exceed six gallons of heating oil. These value comparisons could provide one basis for evaluating the prices across the counter at garbage purchasing depots.

The next component of the model is a miniature power system capable of producing electricity from a given "catchment area". At once we run into the question of continuity or reliability of garbage sources within the catchment area, and even of the sufficiency of garbage rates.

Problems of this kind need not hinder further development of the model. However, if the unreliable aspect of garbage supply is a ready argument in favour of the *status quo* (large-scale centralised power generation), it is only necessary to stress that the alternative micro-units of power generation will burn all types of solid fuels.

This opens up a tremendous market for Nigerian lignite and coal resources, as well as industrial and agricultural wastes, all of which may be purchased on the same basis as garbage. However, miniature thermo-electric schemes as a concept, must ride the crest of opposition from "economies-of-scale" arguments.

The problem with this principle is not its validity but the fact that it is difficult to put into practice. In Nigeria, simplicity, labour intensiveness, low maintenance expenses are important priorities.

Combustion technology

Recently, garbage incinerators have entered the market sporting smallness of scale as well as the efficient combustion[2] of a motley range of solid fuels having calorific values as low as a 1,000Btu/lb,[1] roughly one-eighth of the heating value of wood. Some of this equipment is being offered, together with heat recovery options, enabling the combustion heat to be recovered and stored in the form of hot water or hot brine solutions. The harnessing of hot brine at 100°C and atmospheric pressure for electricity production has been made possible by another technology which is also available in the international marketplace. This brings us to the next component: Organic-working-fluid-Rankine engines. The steam engine, more than two centuries old, is a *Rankine Engine*. But steam power systems require high-pressure installations, high temperatures and elaborate insulation, water treatment facilities. These increase their complexity and cost.

The organic-fluid-rankine engine differs from steam in that it draws heat from relatively low temperature sources, operates at lower pressures, and does not require treatment of working fluid or extensive insulation. This has made it possible to build compact self-contained energy converters that can generate electricity once in contact with any heat source at temperatures as low as 90°C. Power output for such systems range from less than one kilowatt through more than 0.4MW, so far.

The coupling of an energy conversion system[3] based on an organic fluid cycle with a miniature garbage incinerator is conceptually and practically simple. The result is a power plant capable of varying degrees of miniaturisation. For a rough quantitative discussion of this hybrid power system, we pick an incinerator rated at 32kg/hr (fuel-burning capacity) and handling a 4,000Btu/lb garbage provided from within a catchment radius of 100 yards. A nominal charge on the garbage is ₦0.5 for every 50kg, at the generating plant. This is a reasonable charge considering that the garbage is "caught" within a 100 yards radius of the power plant. If the overall conversion efficiency is 30 per cent, a coupled power plant based on this incinerator would produce 25kW. The cost of the incinerator is quoted at ₦7,000 in Nigeria. The energy conversion system is valued at about ₦5,000 in that power range.

continued

[1] *NTG Engineering Limited of Darlington, UK, are marketing such systems.*
[2] *The Central Technical Research Lab. of Chuba Electric Power Co. Inc. Japan, have developed an incinerator that decreases the quantity of soot production significantly. The incinerator features great durability, minimal maintenance costs, and can be installed in a small space.*
[3] *The OEC's (Ormat Energy Converters) of Ormat Turbines in Yvanne Israel, have been developed on this principle.*

Energy consumption

According to a Central Bank report* the demand for primary commercial energy, at 8,058,778 tonnes of coal equivalent (tce), recorded increases of 14.8 per cent and 12.7 per cent compared with the figures for the first and second halves of 1979, respectively. Apart from coal consumption which declined by 21,378 tce or 25.9 per cent, consumption of each of the other energy components increased. Hydropower, natural gas and petroleum products increased by 39.8, 25.9 and 7 per cent compared with their respective levels in the second half of 1979. Compared with the first half of 1979, aggregate primary energy consumed increased by 12.7 per cent. Consumption of hydropower and petroleum products rose by 184,772 tce or 17.4 per cent and 928,973 tce or 19.1 per cent, respectively, while that of coal and natural gas, fell by 2,560 tce or 4 per cent and 71,994 tce or 6.9 per cent, respectively.

The Kaduna refinery, built at a cost of about ₦500 million and with a capacity of 100,000 barrels per day, was completed during the review period, and was expected to start production in October. The refinery has two distinct units: one for processing imported crude from Kuwait and Venezuela into lubricating oils, asphalt and bitumen, etc. and the other for processing local crude oil (Escravos) into liquid petroleum gases for domestic cooking, automotive gas oil, kerosine, fuel oil, etc.

Installed electricity generating capacity increased by 5.4 per cent to 1,822.7 megawatts. The major power stations at Kainji (Hydro, 760mW), Delta (GT 312mW), Afam (GT 252mW), Sapele (ST 240mW), Ijora I (GT 96.7mW) and Ijora II (ST 85mW), accounted for 95.8 per cent of the total generating capacity.

Total electricity consumed rose by 710,606 thousand kilowatt hours, or 39.8 per cent compared with 369,543 thousand kilowatt hours or 17.4 per cent in the corresponding period of 1979. The industrial, commercial and residential sectors recorded increases of 2.1, 32.5 and 77.1 per cent, respectively.

**Developments in the Nigerian Economy during the first half of 1980.*

Electricity consumption ('000kWH)

Type	Jan. – June 1979 (1)	June – Dec. 1979 (2)	Jan. – June§ 1980 (3)	Difference between (1) & (3) Absolute	Percentage	(2) & (3) Absolute	Percentage
Industrial	665,862	724,314	739,684	+73,822	+11.1	+15,370	+2.1
Commercial	408,396	273,247	362,066	–46,330	–11.3	+88,819	+32.5
Residential	1,050,420	786,054	1,392,471	342,051	+32.6	+606,417	+77.1
Total	2,124,678	1,783,615	2,494,221	+369,543	+17.4	+710,606	+39.8

Source: National Electric Power Authority (N.E.P.A.)
§Provisional.

Based on a ten-year amortisation period and a maintenance overhead charge of ₦10 per day, the cost of electricity is calculated to be 2.50 kobo per kilowatt/hour. Comparison with current rates charged for electricity underlines the potential value of this type of power generation on a small scale. An alternative is the use of small diesel-electric plants. Equivalent calculations for diesel power in this range indicate a cost of 6.6 kobo per kilowatt-hour.[4] This figure is similar to the current NEPA rates, and leads to the conclusion that diesel-electric plants in small sizes are not more economical to the consumer.

When economic power generation on a small scale is feasible, the power distribution cost is negligible. Low tension transmission is used throughout and the risk of accidents is therefore much less.

A small incinerator consuming only 0.7kg of garbage per hour, will provide 0.5kW[5] of electric power through an energy converter system, enough to light four fluorescent lamps of 40W each, operate a small refrigerator and run a fan.

The fuel cost for operating in this range is negligible (17kg of garbage per day). The operating and overhead expenses virtually disappear. The only significant power cost arises from the charge on capital investment in equipment. Electric power from this limited miniature generator, at 0.5kW rating, is estimated at 5.0 kobo per kilowatt-hour. To arrive at this estimate, the amortisation charge was based on a capital investment of ₦2,250, out of which about ₦1,000 was allocated to a small incinerator and ₦1,250 to the energy conversion unit.

Undercutting NEPA

The figure of 5.0 kobo per kilowatt-hour is below the current NEPA rate for domestic consumers of electricity. This small-scale model would therefore appear to offer superior economics in comparison with NEPA grid-power, in sizes down to small units in the 0.5kW range.

It is difficult to establish that provision of subsidised electric power to the public is of significant economic value to the country

The capacity of the model to utilise extremely cheap sources of energy and standard technologies should facilitate miniaturisation and decentralisation of electricity generation and use.

In the foregoing discussion, we have examined some of the implications of micro-power generators from an economic and environmental consideration.

The small-scale model indicates that micro-power generation can be very economical for individual homes. At the same time, exotic developments in solar energy point to the emergence of small, independent power generating facilities and based on photovoltaic solar cells. In fact, it is predicted that "thin-film" solar cells operating at about ten per cent efficiency will provide power at a capital cost of $0.5[6] per watt by 1990. This is the equivalent of paying $13,000 for a 25kW power plant needing no fuel, enough for central air-conditioning, refrigeration, cooking etc.

The emergence of such energy conversion systems is, it should be remembered, incompatible with centralised generation and distribution of electric power, because it relies on a globally diffused resource. ●

[4] *Based on a specific fuel consumption of 241g/kW/hr, ₦10/day overheads and maintenance cost, ten year Amortisation, 70 kobo/gal. of diesel.*

[5] *Ormat Turbines, Yvanne Israel have introduced a 0.5kW ECU (Energy Conversion Unit) deriving heat by burning alcohol externally.*

[6] *Industrial Research and Development, November 1980. Page 41.*

On and off or on and on!

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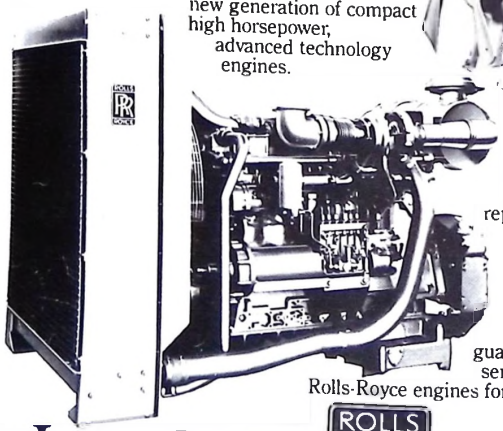

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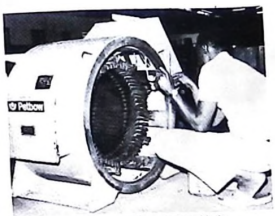
Maintain that generator and ensure *Power all the year round*

Reliable standy power generation is a key to successful manufacturing in Nigeria. For example, a factory manufacturing galvanised sheets could lose days of production if all power failed; electrical furnaces would grow cold and the metal inside them solidify. Regular service is essential to reliable power generation. The following article gives maintenance hints and tips for minimising breakdowns.

MOST OWNERS of standby generating sets throughout West Africa already ensure that they are completely and regularly maintained. There are, however, other operators who ignore maintenance. And when there is a power failure, the set inevitably does not start.

In many of these cases, faulty starting and control systems can be blamed. But over the years, the real villain is neglect of regular preventative maintenance. This neglect can be expensive – in both repairs and lost production – and even endanger life.



Alternator being overhauled at Holt Engineering's workshop in Ikeja.

Preventive maintenance is the easiest and most inexpensive form of maintenance since it permits staff to carry out the work at convenient times. It starts with a well-prepared schedule. This should be established according to the duties expected of the generating set, since while most sets are only used for short periods, there are others used for load shedding, which have higher working periods.

Generally, a standby set should be checked weekly and run for a short period, preferably on load, to exercise both the engine-alternator and its control panel. All information and readings should be logged.

The suggested schedule check sheet may be used as a guide to establish a maintenance programme to fit any specific operation. It is assumed that the set has been commissioned and that the initial running-in instructions have been carried out.

All of the operations should be carried out by a properly trained maintenance

continued

Standby sets

Suggested maintenance schedule check sheet

Check point	Action	10 hours weekly	100 hours or monthly	200 hours or yearly
	Engine:			
1	Check lubricating oil level	•		•
2	Change lubricating oil and filters			•
3	Check fuel tank level	•		
4	Check water coolant level	•		
5	Check anti-freeze content in cooling system			•
6	Check vee-belt tension			•
7	Clean air filter or if oil bath type check level			
8	Check all fuel, exhaust, air piping for leaks		•	
9	Drain sediment from fuel tank		•	
10	Check fuel tank breather			
	Engine electrics:			
11	Check electrolyte level in battery	•		
12	Check state of charge with hydrometer		•	
13	Clean cable terminations on battery and regrease		•	
14	Check auxiliary terminal box connections	•		
	Generator:			
15	Clean apertures and internally with a dry air supply		•	
16	Grease bearings (if required)	•		
	Switchgear:			
18	Check functioning of all relays			•
19	Check functioning of all switches (including engine)			•
20	Check contacts of circuit breakers and contactors are clean			•
21	Check condition and rating of fuses			•
	General:			
22	Check and tighten all nuts and bolts (as required)			•
23	Check condition of anti-vibration mountings			•
	Complete set:			
24	Run set for one hour minimum, preferably on 50 per cent	•		
	Note:			
	1. Approximate starting time			
	2. That all engine instruments are functioning			
	3. That all switchgear meters are functioning			
	4. All lamps are operating correctly			
	5. All switches are functioning			•
25	Clean complete set and exterior of panel			
	Remove dust and rust			
	Repair as necessary			•
26	Have generating set inspected by manufacturer			

The author of this article, Charles Porter, is Overseas Service Engineer at Petbow Ltd. Holt Eng, the Petbow distributor for Nigeria, offers a fully comprehensive service contract for generating sets. This itemises no less than 60 checks and running tests. Recommendations and component conditions are also fully logged following each service visit.

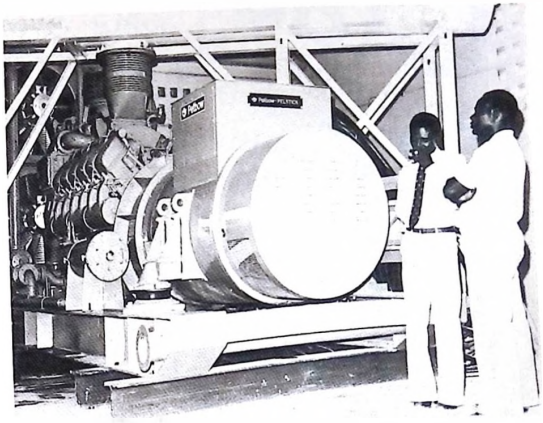
department, who should supplement these with any other particular operation that may be listed in the generating sets engine manual. The time between checks could vary depending upon site conditions, for example, high dust-laden atmosphere, which the maintenance schedule should take into account. Whilst many companies employ trained operators, few have either engineers or workshop facilities to comply with, for example, engine overhauls *as recommended by manufacturers' schedules.*

Contract

It is therefore advisable to enter into a regular maintenance contract with the supplier or local distributor. Several set manufacturers offer this facility. It generally takes the form of a simple signed agreement between the owners of the set and the manufacturer's representative.

Whilst preventative and regularly planned maintenance is not a total guarantee for malfunctioning, it will go a long way to avoid the non-starting of the set when it is most needed.

Remember – prevention is better than cure.



1,250kVA standby generating set, used at the works of Nigeria's largest daily paper, the Daily Times.

Sizing generator sets

Every day more construction power users equip themselves with on-site diesel standby or prime power. Why? Of all the problems that can occur on your construction project, few are more certain than power interruptions. They might be generating, transmission or transformer failures, accidents that down a utility pole, lightning, snow or wind toppling trees into power lines, birds on circuit-breakers, or other uncontrollable power outages. R. M. Jarman, of Caterpillar Tractor Co. Engine Division, explains how to choose the right generator set for your project.

THE COST OF power failures on a construction project is substantial. The message for contractors is clear: an on-site diesel generator set offers protection from power outage or reduction.

If you are considering a job in an isolated area, you will probably have to provide your own power. If not, agreement must be reached with the utility to provide extra power and to build the necessary transmission lines. But regardless of location, determining prime or standby power needs is of major importance. If you take time to determine all the electrical equipment to be powered, a lot of confusion and potential delay will be prevented.

When you decide to equip your construction project with diesel prime or standby power, two basic questions must be addressed: How do you calculate the total power needs of your equipment? How do you decide what size generator to power that equipment? The first question will be answered by some sort of an inventory. We have a sample later in this discussion. The second question is best answered by careful attention to the loads that will be carried by the generator set.

Determining the load

The first step in choosing a generator set is to determine the actual load in kilowatts (kW) that will be powered by the generator set. This figure is found by adding **static loads** and **motor loads. Static loads** consist of heaters, lamps, communication equipment – items which do not involve rotating machinery. Static loads are expressed in kW. **Motor loads** are those electric motors in your operation which power such things as hoists, refrigeration units, air compressors, and conveyors. These motor loads are also expressed in kW, but they also place an additional demand on the electric supply. That demand is called starting kVA (skVA).

Electric motors, when they represent a significant percent of a unit's capacity, can present severe loads to the generator set during the starting and acceleration period. During this period, current demand (amperes) can range from five to ten times the normal full load current; and kW demand can be two to three times the normal full load demand. The electric motor load then becomes a key factor in selecting your generator set.

Table 1
Identification of code letters on typical US design B phase induction motors

NEMA code letter	skVA per horsepower (multiplier)
Motors with these code letters are usually three-phase	
A	3.1
B	3.5
C	4.0
D	4.5
E	5.0
F	5.5
G	6.2
H	7.0
J	8.0
Motors with these code letters are usually single-phase	
K	9.0
L	10.0
M	11.0
N	12.5
P	14.0
R	16.0
S	18.0
T	20.0
U	22.0
V	25.0

Wound rotor motor has no code letter.

Method

So to determine your total load:

(a) Add up the static loads in kW to establish total static load.

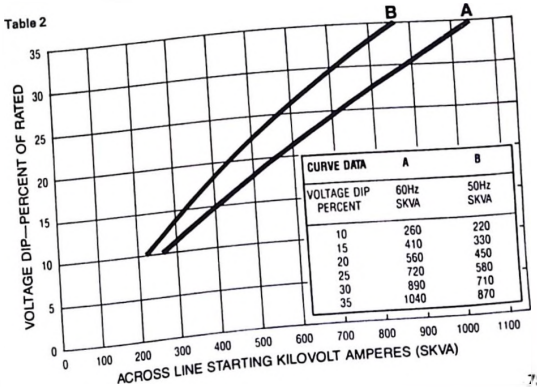
(b) Identify the individual motor loads and compute their total kW value. Then individually calculate the starting kVA of each motor.

American Design Motors: the motor horsepower (hp) and the NEMA (National Electrical Manufacturer's Association) code letter will be shown. These two items allow you to determine quickly the motor power requirement in kW and the starting requirement in kVA (called skVA). For kW – multiply the nameplate horsepower by 0.85. (*0.85 is derived from the conversion of 0.746kW/hp divided by a typical motor efficiency of 0.88.) The result closely approximates the motor kW demand of full load. For skVA – refer the NEMA code letter to Table 1. Multiply the related skVA/hp figure by the motor nameplate horsepower. Example: 100hp Code F motor. skVA = 100 × 5.5 = 550skVA.

European Design Motors: essential data is on the nameplate of European design motors. However, the method of using this information may be different. The motor capacity (output) may be expressed in

continued

Table 2



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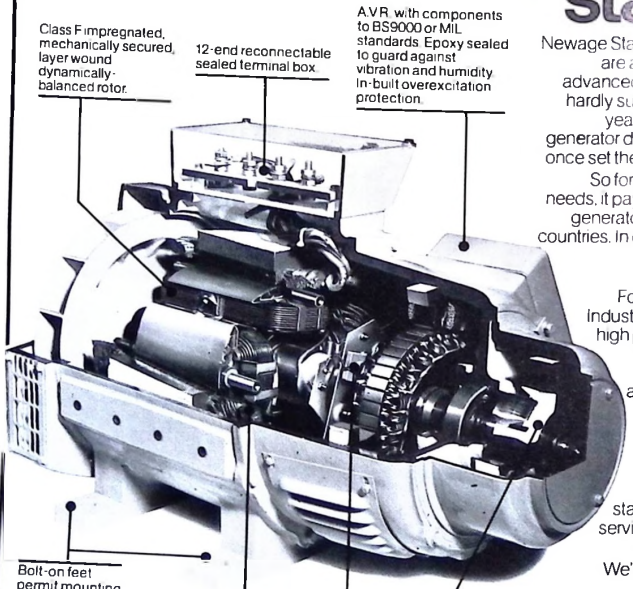

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horsepower, or in kW; and there will not be a code letter. If the nameplate includes horsepower, multiply this figure by 0.85 to determine the kW requirement. (Same process as with American design motors.) If the nameplate lists motor capacity in kW, multiply this mechanical kW figure by 1.15* to determine the electrical kW requirement from a generator set. (*1.15 is derived from the reciprocal of a typical electric motor efficiency (88% or 0.88) 1/0.88 = 1.15.) The nameplate may list the starting kVA (skVA) or may list a figure, LRA, which means Locked Rotor Amperes. To arrive at the skVA, the following formula should be applied:

$$skVA = \frac{LRA \times Rated\ Voltage \times 1.732}{1,000}$$

Example: A 33kW, 380-volt, 50Hz three-phase motor has an LRA of 352 amp.

$$skVA = \frac{352 = 380 = 1.732}{1,000} = 231 skVA$$

(c) Establish total kW demand. The static load kW should be added to the motor load kW. When this exercise is completed for all static and motor loads, the total figure is the **minimum** generator set capacity expressed in kW. Determine the motor starting capacity of the selected generator set.

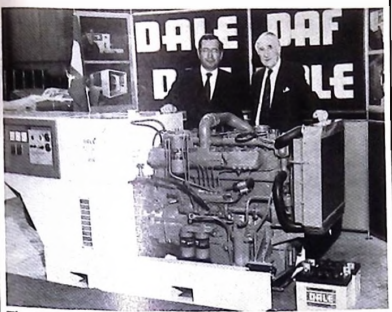
The next step is to establish if the generator set with the required kW capacity will be adequate to cope with your motor skVA needs. Some manufacturers provide tables listing voltage dip versus skVA. Others provide charts. Table 2 is an example of a specific generator capability which shows the approximate voltage dip occurring at motor start.

Each motor is checked against the generator set skVA capacity for the probable voltage dip. That figure is compared with the acceptable voltage dip. If the expected dip exceeds the acceptable dip, the generatpr size will have to be increased or the starting requirement of the motor will have to be reduced. On most constriction sites, the limiting factor is the ability to make the motor start and accelerate to operating speed.

To use a chart like Table 2:
A 60Hz, 480-volt, 100hp US-designed motor has a code letter "G" (multiplier of 6.2). The skVA is 620. After locating 620 on the horizontal axis, extend upward to the 60Hz curve. Reading to the left to the voltage dip at start results in a 21% dip. This percentage indicates the lowest voltage expected at the time of this motor start-up. Thus, a 21% dip from a 480-volt generator means the motor being started (and all other on-line equipment) will momentarily experience a voltage drop from 480 to 379. Most construction site motor applications can withstand starting voltage dips of 30–35%. Fans and centrifugal or turbine pumps can be exceptions. More voltage dip can be tolerated, but control system relays and starters may chatter during the point of minimum voltage. This type of problem can often be avoided if the largest motor is put on line first.

Next month Mr. Jarman continues this article on sizing a generator. Among some of the aspects he will examine are load analysis, motor starting requirements and gen set terminology.

New Gen Set range



The British manufacturer, Dale, has launched an economical range of DAF powered generating sets, the Diamond Range. Power outputs will range from 57kVA to 255kVA and Dale have designed the set to meet the challenge of cost-conscious markets.

The whole system is mounted on one baseplate – fuel tank and control panel are integral. The set can be converted from electric or manual start to automatic mains failure simply by adding a 'plug on' mains failure panel. The Diamond Range was launched by the two Chairmen of Dale and DAF.

The picture shows (left) Mr. P. J. G. Van Doorne, Chairman of DAF and Mr Leonard H. Dale, Chairman of Dale.

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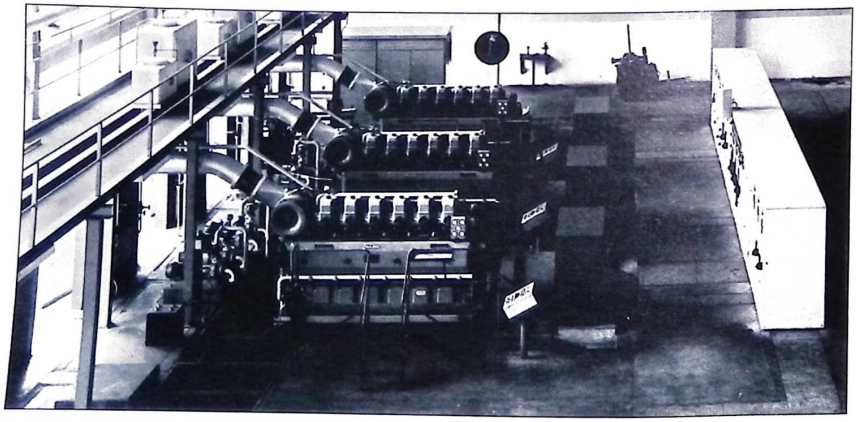

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Diesel engines

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In the search for a solution to the much forecasted worldwide petroleum shortage, fuel derivatives from peanuts, sunflowers, corn oil, soya beans and even eucalyptus trees have variously been considered, but the technology is not yet commercially viable. Researchers at the British company, Perkins Engines, believe that the good old diesel engine is still one of the most practicable ways of tackling fuel shortages.

THE LIST of vegetable derived fuels may, at first sight, seem attractive for many developing countries since many of the crops are ideally suited to their growing conditions. However, there is no one fuel source that can provide a universal answer to the world's fuel problems, and vegetable-derived fuels would compete with food production for land resources.

In common with many developing areas of the world, West Africa has many national and regional variations in fuel resources and fuel needs. Even though some, such as Nigeria, may be rich in crude petroleum, and therefore not so endangered in the short term by world energy shortages, most developing nations must consider changes to their energy policies according to their resources – whether "home-grown" or bought in.

Contaminants

Fuel policies in the past have always been fairly universal, with only comparatively minor local changes in fuel quality. Certain types of propulsion for mobile plant are seriously affected by contaminants or other lowering of quality ratings. The diesel engine, however, is far more tolerant of changes in fuel quality than, for example, gasoline-fuelled engines. Not only are diesels more tolerant of poor fuel, they are also more robust in other ways. This accounts for the many items of diesel-powered equipment which may be found giving useful service in remote locations and under arduous conditions 30 years or more after they have left the factory.

In view of the general energy and economic situations it should also be pointed out that, despite wide variations in fuel quality, the diesel engine can show appreciable gains in fuel economy over the gasoline engine. The operational economy of the diesel engine is complemented by the lower energy requirements to produce diesel oil in the petroleum refining process as compared with gasoline, or even low-octane gasoline.

Although strict diesel oil specification produces benefits for the user in lower maintenance requirements and longer engine life, the diesel engine has never been pampered by the petroleum industry to the extent of the comparatively delicate gasoline engine. The first effect of changes in world energy policy for mobile plant is forecast to be a general degradation in diesel fuel (lowering of the cetane number) over the next few years. This is often happening to preserve the gasoline specification during the refining process.

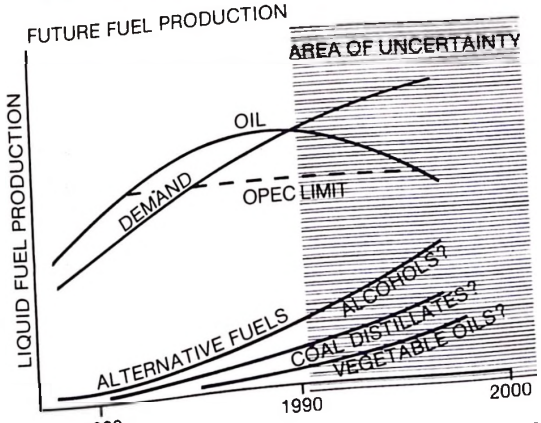
In this atmosphere of uncertainty and individual solutions, Perkins Engines Group, as the world's biggest independent specialist manufacturer of diesel engines, has been studying the main available alternative fuel sources throughout the past decade to determine which of them are viable, and what sort of engine can use them in the best way.

Diesel flexibility

Perkins Engines, although capable of producing gasoline-fuelled engines and derivatives of them using alternative fuels, has based their research and development programme mainly on the diesel engine, and its further flexibility through assisted ignition. It believes that the diesel engine offers the best basis for future development with its inherent flexibility towards different fuel types and qualities, the overall economy including refinery energy, and its reliability under arduous conditions.

In addition to its aims for the use of alternative fuels Perkins is internationally committed to making the maximum effort to ensure that its engines are environmentally and socially acceptable so that an extension of their use, in terms of other fuels, would not jeopardise the achievement of appropriate ecological standards.

continued



With obvious logic, the company recommends that existing petroleum-based fuels, as a valuable commodity, should be confined for mobile needs where they are of most use, and that all stationery equipment should be powered by energy forms such as electricity, coal, and natural gas. The company also recommends that the use of compression ignition engines, such as the diesel and its derivatives, be officially encouraged and extended for use with petroleum-based fuels and all possible alternative fluid fuels such as those derived from vegetable oils, coal, and alcohol sources.

Brazil

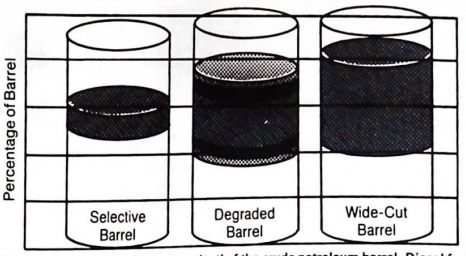
Land-rich countries with fast developing economies, and facing some shortages of traditional fuels, are at the forefront of the application of alternative fuels. In one case, Brazil, there is an advanced use of pure alcohol for car gasoline type engines. While Perkins recognises the convenience value in this case, as Brazil is rich in sugar-cane, the company's engineers still place their confidence in a power unit for overall use that will be derived from the diesel engine we know today. The main advantage of the diesel is that basically the same engine could be used for differing fuels. This enables the same basic power unit to be retained in an item of plant which is transferred from one area to another using a different fluid fuel. It also gives a continuity of power supply within those more delicate economies which may be subjected to a change in fuel base at relatively short notice. As it is already in a high state of development, the diesel engine provides a smooth, and useful route for the development of a unit capable of using the more advanced alternative fuels.

Present production diesel engines, although tolerant of existing variations in diesel fuel quality, are not designed for the possible range of alternative fuels which may be available. The first engines in the Perkins development programme for future fuel needs will be able to use a 'wide cut' of the crude petroleum column. This means that they will be able to accept, without loss of efficiency, a wider section of the constituents of crude petroleum. This makes considerable savings in refinery energy requirements in the 'cracking' process as well as being more adaptable to national variations in fuel quality. Further development of the diesel engine will take the form of spark-assisted ignition and microprocessor-controlled ignition systems for varying types and qualities of fuel.

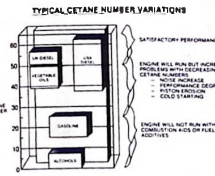
The Perkins team has analysed the benefits and drawbacks of different possible future fuels, to be used when petroleum-based fuels are no longer available, or are too expensive. The summarised findings are:

Vegetable oils: There is a vast range of potentially interesting vegetable oils, and while it is impossible to generalise, it does seem that none are suited to spark-ignition engines. Some have acceptable cetane levels for diesel use and perform acceptably in diesels when initially tested. Although they are all virtually sulphur-free, most have at least one problem such as excessive viscosity, and a tendency to cake the injectors. These have long-term detri-

Gas Oil Refining Option



Petrol demands a very selective narrow 'cut' of the crude petroleum barrel. Diesel fuels of more variable quality, or a 'degraded barrel' are widely forecast by major oil companies for the immediate future.



Comparative cetane number chart for some fuels.

mental effects and must be avoided by further development. Vegetable oils seem likely to form a high proportion of the fuels for future diesel engines.

Coal-based fuels: Limited coal resources in West Africa, and large oil reserves in Nigeria and some other countries, do not seem conducive to the development of any coal liquefaction programmes in the area. However, the relative cost of coal mined from large deposits elsewhere together with improvements in mining, handling and transportation techniques may mean that coal-based fuels could have a significance for West Africa in the future. They would be of particular interest if all land resources were needed for food production.

Coal-based fuels may take the form of a wide-cut (low quality) type of diesel fuel, or methanol. South Africa and Brazil have followed this route but their coals have a high ash content. Perkins researchers believe that any coal-based fuel deserves serious consideration. More work needs to be done but indications are that such syncrude fuels will have similar characteristics to those in use today. Similarly, Perkins believe that these new fuels should be biased towards diesel usage.

Gazogene: This is a gas mixture obtained by burning carbon in restricted air. It was used extensively in the Second World War but is relatively inefficient. The major problems are sufficient supply of charcoal or wood chippings, and their cost. This route, of course, would make greater pressure on West African land usage, and on the timber already used extensively for domestic fuel. If, however, the process could be made viable, and the engine life acceptable with improved gas filtration, then gazogene production costs would be low and time for exploitation short.

Alcohol fuels: Ethanol may be derived from sugar cane and methanol from wood and coal. With poor cetane ratings and high octane ratings they are poor fuels for the diesel engine. The drawbacks are an unpleasant exhaust, although less toxic than a gasoline engine exhaust, and the inability of an alcohol containing any water to mix with diesel fuel. As 'dry' alcohol is hard to achieve, some way of using alcohol containing water would have to be found for diesel engines. Despite the problems, Perkins researchers believe that this is one of the more promising lines for future research.

Diesel and alcohol fuels may be introduced to the engine separately or as an emulsion. The emulsion route requires mechanical mixing on board or the supply of a chemically stabilised emulsion at the distribution point. Separate fuels can be introduced by fuel injectors or carburettor. Unless a chemically stabilised emulsion were to be available all the methods would require two tanks on board and two feed systems to the engine.

The carburettor duel-fuel system seems to offer the possibility of a cheap and simple method of proportional alcohol use which could be retrofitted to existing engines with new modifications. There may, however, be problems with controlling the inputs and with cold starting. The main benefits are that it would extend the life of the many diesels now in use in those areas where alcohol would be a prominent fuel, such as in some parts of West Africa, and would also enable the operator to switch back to the use of pure diesel if need be.

Perkins researchers, therefore, base their faith in the diesel engine and its derivatives on the following points:

- The diesel engine is the most efficient way of using the remaining hydrocarbon fuels.
- The diesel can be adapted for use with methanol, alcohol coal-derived wide-cut fuels, and vegetable oils.
- Diesels are durable, long-lasting power units and those in use around the world still have a long useful life if they

continued

can be adapted to alternative fuels. This would avoid excessive capital expenditure for those developing countries which can ill afford it.

- A diesel engine will always burn any fluid fuel more efficiently than an equivalent power spark-ignition gasoline-type engine.

- Diesel derived units can run on a wide spectrum of fuels whereas a spark-ignition gasoline type engine will be confined to alcohol or a similar high-octane fuel.

Forklift truck in Abidjan operated by diesel engine.

For the efficient operation of both agriculture and industry, suitable fluid fuels will be required for mobile plant well into the foreseeable future. The problem is to find a method of operating the plant in variable circumstances. While alcohol-fuelled gasoline-type engines are suited to lighter applications in certain circumstances, no type of engine has the all-round performance and is so advanced in its development as the diesel engine. With these advantages, and the likelihood of retrofit systems for existing units, the diesel engine seems to be the most economical route for West Africa to tackle future fuel problems for mobile plant.

New engine runs on natural gas

R. A. Lister & Co. Ltd has introduced a new three cylinder spark ignition engine designed to run on any type of natural gas. The new gas engine has the advantage of not requiring special fuel supplies as it can simply use natural gas from the field. Besides powering well-head compressors and pumping jacks, the gas engines are ideally suited for generating sets and irrigation pumps – in virtually any climate.

The new air cooled engine, the HR3G, retains most of the features of the Lister diesel and major changes relate only to the combustion system. A special light alloy cylinder head houses the heavy-duty spark plug and coil assembly and new pistons with dished crowns are used with a compression ratio of 10:1. A power output from 12.7bkW (17bhp) at 1,000rev/min to 25.4bkW (34bhp) at 1,800rev-min continuous rating is obtained with gas having a calorific value of not less than 10.73kWhr/m³ (1,037Btu/ft³).

Stellite valves and valve seats are used to ensure a long life. An improved airflow system has been incorporated, which together with a flywheel fan provides excellent cooling at ambient temperatures up to 52°C (125°F).

Fuel efficiency in diesel engine design

Sven Nylin is Technical Information Officer, Scania Division of Saab-Scania, Södertälje, Sweden.

When designing diesel engines for total operating economy, fuel efficiency is only one of several equally desirable features. Sometimes these features conflict with each other and the designer is then faced with striking a balance which gives the best overall performance.

In this article, Sven Nylin discusses some of the ways in which the designers of Scania diesels approach the task of producing efficient and economic engines for various duties.

WITH THE steadily rising cost of fuel oil, diesel engine manufacturers throughout the world are placing greater emphasis in their research and development work on obtaining better fuel efficiency.

While the diesel cycle is the most efficient form of internal combustion, and engines based on it have been under continuous development for more than 80 years, Scania of Sweden believe that the specific fuel consumption of production engines can still be improved.

At the same time, Scania, who have manufactured diesels since 1936, consider that fuel efficiency is only part of the total operating economy of their products. Taken over an engine's working life, operating economy includes such factors as first cost, reliability, maintenance costs, servicing intervals and suitability for specifi duties.

Development

The most significant improvement in fuel efficiency came with the change from precombustion chambers to the direct injection of fuel into the cylinders. Scania made this change in 1949 and, as Diagram 1 shows, it bought a substantial reduction in specific fuel consumption. Direct injection, in turn, made possible the introduction of turbo-charging, with the first turbo-charged Scania engine leaving the production line in 1951.

The cumulative effect of these innovations is shown in Diagram 1, which is based on broadly similar Scania diesels of between 7.25l and 10.26l capacity. Today, however, there is little further scope for such dramatic improvements in fuel efficiency. Instead, progressive improvements in both fuel efficiency and operating economy are being achieved through concentration on detail design.

A typical example of this detail design work is the latest generation of Scania 14-litre V-8 engines. The new unit provides higher power output and higher torque with lower peak engine speed and specific fuel consumption. For example, at its intermittent [illegible] the new DS14 engine develops [illegible] (295kW) at 2,200rev/min, compared with the 350hp (257kW) at 2,300rev/min of the earlier version. Torque is about 20 per cent higher, while specific fuel consumption has been reduced by 3 per cent.

The higher power and lower specific fuel consumption are mainly the result of improved combustion. Redesign of the inlet air passages in the cylinder heads has improved the volumetric efficiency and gives the optimum degree of "swirl" in the combustion chamber. The "swirl" improves the mixing of the fuel with the charge air which improves combustion efficiency. Detailed design changes associated with the improved combustion include new fuel injection equipment, a new turbocharger, new pistons and new valve seats and valves, with redesigned rocker mechanism and a new camshaft.

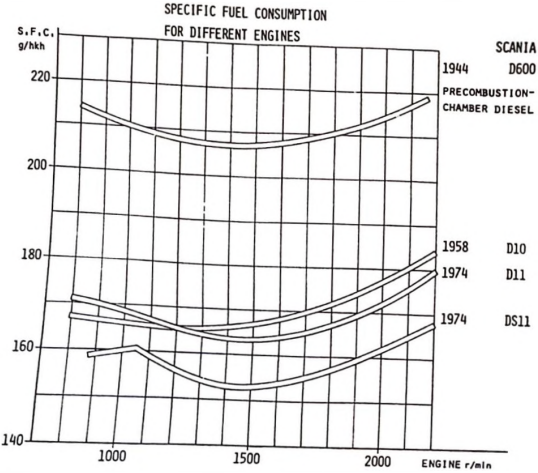


Fig. 1.

Users

Four groups of diesel engine users have particular interests in fuel efficiency. These are: (a) bus and truck operators; (b) boat owners; (c) users of earthmovers, forestry and other off-highway equipment; and (d) operators of stationary engines used to drive generators, pumps and air compressors. Each group has its specific requirements from an engine.

Automotive users will rarely run an engine continuously at full power at full speed, therefore an engine with good fuel efficiency over a fairly wide band of engine speeds and loads is required. For vehicles covering high annual mileages the fuel savings can be considerable and, at the same time, this type of operation requires long engine life and minimum down-time for servicing.

In contrast, the marine engine will generally operate at constant speed and high loadings for long periods. However, in such applications the engine auxiliaries, such as the oil system and cooling group, can be

continued

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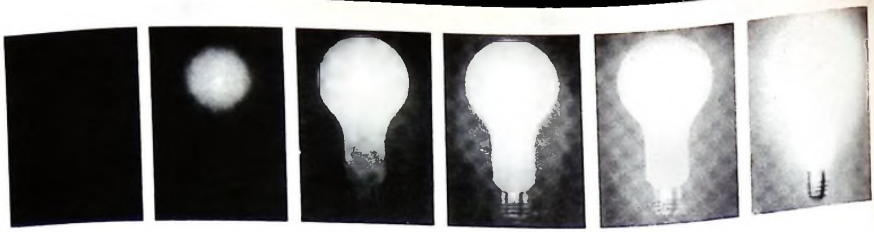

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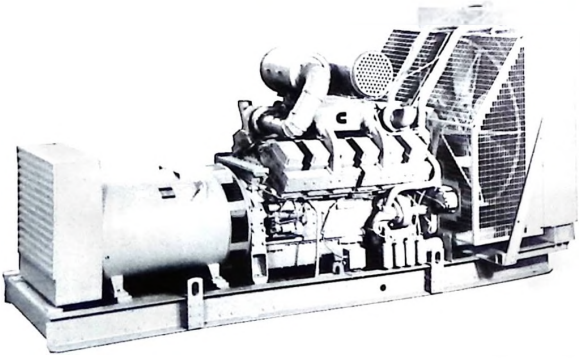

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ily modified to match the application. th the transmission and propeller desig- l to match the boat's cruising speed to engine's most fuel-efficient operating eed, low fuel consumption is possible. is not only means lower operating costs; also offers the options of longer range om existing tankage or increased carry- g capacity through reduced fuel capacity r the same range.

The third user, typically in construction r forestry work, imposes an entirely ifferent duty cycle, with high intermittent oadings at near maximum utilisation over ne or more shifts per day. Once again, eliability and maximum periods between ervicing are particularly important.

Finally, diesel engines in power packs will run for prolonged periods at constant speed. The benefits of low fuel consumption are similar to those for truck and bus and marine applications. Once again, there are unique requirements. For example, the engine in a diesel generator set used for standby duties must be able to start up from cold and be giving full power in seconds.

To obtain the large-scale production needed to give an economic first cost, Scania policy is to produce a small number of basic engine designs optimised for economy, which can then be matched to many different applications by varying the external equipment. Thus, at the moment, the company's total production of some 30,000 engines a year is split between just three basic designs – an 8-litre straight-six, an 11-litre straight-six and a 14-litre V-8; but since these are available with and without turbo-chargers and intercoolers, they span the whole power range between 130 and 400hp (100kW and 300kW).

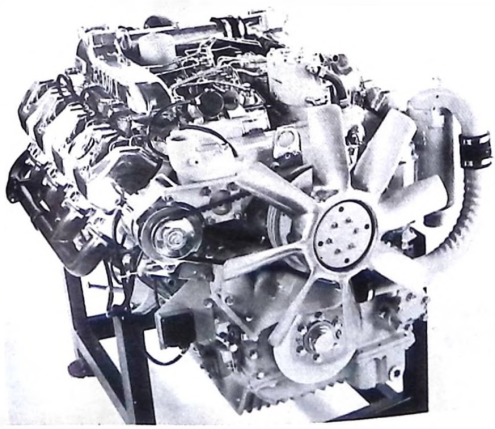
Fundamental to Scania's design approach is the low-revs philosophy, which they introduced in 1976. A diagram of specific fuel consumption versus mean effective pressure versus engine speed for a Scania diesel shows the lowest fuel consumption between 1,200rev/min and1,700rev/min. More significantly, this applies between 60 per cent and 100 per cent of full rated power.

The "low engine speed" philosophy exploits this by using the gearing in the drive train – whether to wheels or to a ship's screw – to maximise that portion of the duty cycle which is spent in the 1,200–1,700rev/min speed band.

The "low revs" philosophy does not produce its benefits automatically. The end user, such as the truck driver, must be educIn trying to optimise an engine for economy, the designer has to strike a balance between desirable features which may sometimes conflict.

A Kockums 412T medium dumper, powered by a Scania DS engine, working underground.

A Scania 14-litre V-8 engine.



Design

In trying to optimise an engine for economy, the designer has to strike a balance between desirable features which may sometimes conflict.

One example is the use of trapezoid or "keystone" piston rings. These are fitted to Scania diesel engines supplied to an American company for installation in tractors and earthmoving equipment; also to certain standby power units. The rings are used with a design of piston which increases the clearance between the piston crown and cylinder wall, from the 0.7mm of conventional three-ring pistons to about 2mm. This combination reduces lubricating oil consumption by 65 per cent in exchange for a small increase (maximum 1 per cent) in fuel consumption.

Another compromise must be reached on combustion pressure. High combustion pressures are one way of reducing fuel consumption, but such pressures need a stronger, and therefore heavier, engine to contain them. High combustion pressures are also associated with an increase in engine noise at a time when quieter engines are being required by law in several countries. Scania meet these conflicting requirements in an engine by attention to the design of several related components.

The choice of a high-pressure fuel pump and injector nozzle to give a high fuel-injection speed enables combustion to be located as near piston top-dead-centre as possible. This in turn allows a relatively high combustion pressure to be used without excessive noise levels or reduced engine life.

Many other factors contribute to efficient combustion. The design of the intake passages has already been mentioned. Also of importance are the design of the injector, the pattern in which the fuel is injected and the distribution of the spray of fuel drop-

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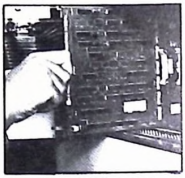

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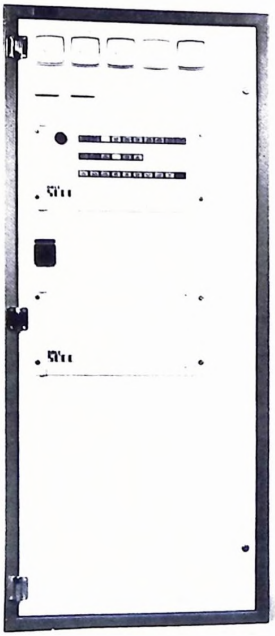

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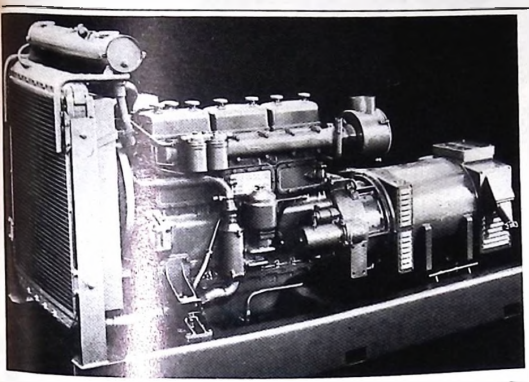

Left: diesel generator set engine.

lets in the combustion chamber, while large valves minimise pumping losses.

Turbo-charger design is another important area in designing for fuel efficiency. Clearly, the turbo-charger must be designed as a single unit so that the turbine and compressor sections are as efficient as possible. An efficient turbine section reduces back pressure in the exhaust, so reducing losses, while the compressor section is designed to provide maximum mass flow with the lowest temperature rise in the charge air.

Another development which introduces conflict can be seen in the same area. In many applications water-cooled manifolds are desirable and increasingly specified by users; but by reducing the energy in the exhaust gases, such manifolds will increase the specific fuel consumption of a turbo-charged engine. On the other hand, the fitting of a charge-air cooler between the turbo-charger and the cylinders will increase the mass of charge-air admitted. This in turn will give higher power ratings and improved fuel efficiency at additional cost and a slight increase in weight.

The benefits of charge-air cooling can be exploited in two ways. Scania choose to use it to increase the power output by about 20 per cent without any increase in mechanical or thermal stresses. Fuel consumption is also unaffected. Alternatively, charge-air cooling could be used to reduce specific fuel consumption by 5–6 per cent while leaving the power output unchanged.

Economy

While this article has concentrated on design for fuel efficiency, low fuel consumption is only one aspect of an engine's operating costs. Long life and reliability are equally important. Scania truck engines average 700,000 to 800,000km before replacement, but if the "low-revs" philosophy is followed by the driver, a longer service life is possible. There are many examples of over 1 million km run by original engines. "Low revs" also affects running costs. An analysis of the servicing requirements of Scania diesels shows that over the period since 1967, down-time for servicing has been halved.

GENERATORS SUPPLIERS GUIDE

A guide to manufacturers of generators, prime movers and alternators and their representatives in West Africa

This list has been compiled from information supplied by companies at the time of going to press, and may not be exhaustive.

Key: N – Nigeria; G – Ghana; L – Liberia; SL – Sierra Leone; Gam – Gambia; IC – Ivory Coast; S – Senegal.

A

Afrotec Technical Services,
Nigena Limited,
PMB 1061,
Oshodi Lagos State,
Plot 3,
Block M, near to Mandilas,
Isolo Industrial Estate.
Tel: 845656/844706.
Range: 3kVA to 1,000kVA.

Allis Craig Electrical Div.
Stephenson Way,
Thetford, Norfolk UK.
Tel: 0842 2710.
Telex: 81171.
Range: 1.5kVA to 250kVA.

Alco Power Inc,
100 Orchard Street.
Auburn NY 13021,
USA.
Tel: (315) 253-3241.
Telex: 937300.
Range: 600kVA to 2800kVA.SEE ADVERTISEMENT.

Allam Generators Limited,
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Essex SS4 1ND,
UK.
Tel: 0702-549564.
Telex: 995127 (ALLGEN G).
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At present looking for representatives.
Range: Portable Generators from 1-10kVA.

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Illinois 60426,
USA.
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G:
Ghana Tractor Africa Limited,
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Accra.
L:
Liberia Machinery Supply,
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Rocks Hill,
S. Carolina 29730.
Tel: (0803) 3664171.
Telex: 8106722559.
Range: 6kW to 12kW.

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Tel: 0234 67400.
Telex: 82486 APEBED E.
VYB (Nigeria) Limited,
13-15 Wharf Road,
PO Box 155, Apapa.
Tel: 845811.

G:
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Accra.
Tel: 64658/9.
Range: 270kW – 2,700kW.

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(Sodik asea).
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Services Limited,
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Tel: 22 261/22 1037/22 1224
Telex: 4284 nestra li.
Telgr. nestra monrovia, liberia.
SL & Gam & S:
Range: 40kVA to 3,000kVA.

Astra,
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Via Caorsana, 79,
29 100 Piacenza,
Italy.
Tel: 0523-62010.
Telex: 530148.
Range: 100kVA to 3,000kVA.

Ateliers de Constructions Electriques de CHARLEROI SA,
Division Exportation.
Tel: 071 44 21 11.
Range: 1,500kVA to 30,000kVA.

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Surrey, UK.
Tel: Chertsey 62655.
Representatives:
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Ibadan.
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PO Box 480,
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UK.
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Telex: 263835 Genset G.
Representatives:
N:
VYB (Nigeria) Limited,
13-15 Wharf Road,
PO Box 155,
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Branches at Kano, Kaduna,
Port Harcourt, Enugu, Benin,
Warri, Calabar, Jos, Onitsha
and Owerri Ibadan.
Range: 20kVA to 1,500kVA.

B

David Barton Limited,
Walsh Lane,
Meriden,
West Midlands,
UK.
Tel: 0676 22254.
Telex: 311033 CHAMCOM.
At present looking for representatives in Africa.
Range: 1.5kW to 90kW.

Benno H. Tiadan (GmbH & Co.),
PO Box 32 31 51,
D 2000 Hamburg 13.
Tel: (040) 410 40 71.
Telex: 02 14935 TIADND
Range: 2.8kVA to 2800kVA.
Brand: Atlanta.

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241 Avenue Berthelot,
69 008 Lyon,
France.
Telex: 340 816.
Tel: (7) 875 76 64.
Range: 15 to 800kVA.
N:
Berliet Nigeria Ltd,
PO Box 6655,
Isolo Express Way,
Lagos.
IC:
Codimatel,
8 Bis Rue des Brasseurs,
Abidjan.
Tel: 35 60 03
S:
Senematel
BP 336,
9 Allee Delmas
Dakar.
Tel: 21 13 90.
Range: 15kVA to 500kVA.

AB Bofors-Nohab,
(Diesel Division),
S-461 01 Tollhatten,
Sweden.
Tel: Sweden 520/18000.

Robert Bosch GmbH,
Eisemann Division,
Rosenbergstr. 61,
7000 Stuttgart,
West Germany.
Tel: (0711) 6005-1.
Representatives:
N:
Union Trading co. Ltd,
Motor Department,
PO Box 1005,
Apapa.
Tel: 45331.
G:
R. T. Briscoe (Ghana) Ltd,
PO Box 1635,
Accra.
Tel: 28511/28517.
L:
Jos. Hansen & Söhne (Liberia) Ltd,
PO Box 28,
Monrovia.
Tel: 22317/22091.
SL:
Brewo Motors Ltd,
PO Box 77, Freetown.
Gam:
Breckwoldt & Co. (Gambia) Ltd.,
PO Box 281/282,
Banjul.
Tel: 8310.
Range: 0.65kVA to 93kVA.

British International Industries Limited,
Princes House,
Bagshot,
Surrey,
UK.
Tel: 0276 71033.
Telex: 858598. BIIG
Range: 3kW to 7,500kW, diesel, gas or steam.

Broadcrown Limited,
Mill Street,
Stone,
Staffs,
ST15 8BA,
UK.
Tel: (0785) 817513.
Telex: 36401 Bunico G.
Range: 4kVA to 1,500kVA Crown Range.
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Broadcrown Generators Technical Division

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The Blackstone 'Economy Range' of standard packaged generating sets achieves the optimum in cost per kW by combining the reliability of medium speed running with carefully streamlined manufacturing and operating costs. In other words, long term dependability with maximum economy.

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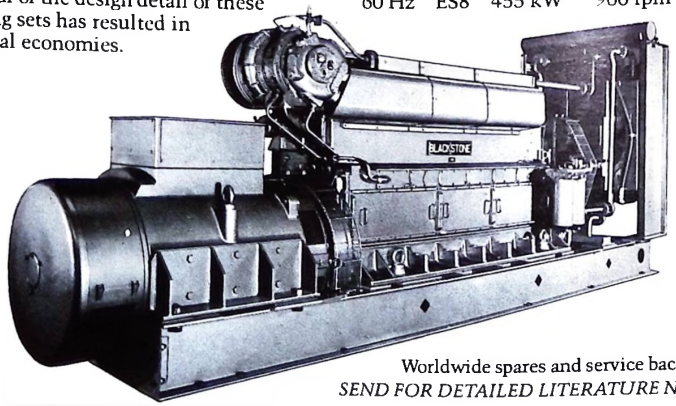
50 Hz	ES8	506 kW	[illegible]00 rpm
60 Hz	ES6	342 kW	900 rpm
60 Hz	ES8	455 kW	900 rpm



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roda Road,
a, Lagos.
: Ilupeju 963457.

sl & Stephenson Limited,
wer Building,
Water Street,
verpool,
3 1BW,
K.
el. 051 236 7766.
elex. 627075.
epresentatives:
:
C. Zard & Co. Limited,
25/127 Ikpoba Slope
Amadasun House
PMB 1621
Benin City
Range: 1.5kVA to 1,000kVA.
G:
Bisi & Stephenson Ghana Ltd.
PO Box 1913
Accra.
Tel 76632

C

Caterpillar Overseas SA,
118, rue de Rhône,
PO Box 171,
Geneva 3,
Switzerland.
Representatives:
N:
Tractor & Equipment,
Division of UAC of Nigeria
Limited,
PMB 1015,
Ebute-Metta,
Lagos.
Tel 43310.
G:
Tractor & Equipment,
Division of UAC of Ghana
Limited,
PO Box 5207,
Accra – North.
Tel 21900.
L:
Liberia Tractor & Equipment
Co.,
PO Box 299,
United Nations Drive,
Monrovia.
Tel 22279 22057.
SL:
Tractor & Equipment,
Division of UAC of Sierra
Leone Limited,
Blackhall Road,
PO Box 127,
Freetown.
Tel: 50852 or 50777.

Clark Group,
Lower Clapton Road,
Hackney,
London,
E5 0QR, UK.
Tel: 01-986 8231.
Telex: 897784
Ranges: 0.5kVA to 1,000kVA.

Compact,
See Auto Diesels Braby Ltd,

Coronet Generators EM Ltd,
Long Furrow,
East Goscote Industrial Estate,
Leicester,
LE7 8XJ, UK.
Tel: 0533 606321.
Telex 341974 COROEMG.
Representatives:
N:
Afrotec Technical Services
Nigeria Ltd,
Block M,
Plot 3,
Isolo Industrial Estate,
PMB 1061,
Oshodi,
Lagos State.
Tel: 845656.
Range: 3.5kVA to 825kVA.

Countryman Power Plant Ltd,
Fleming Way,
Crawley,
West Sussex RH10 2JY, UK.
Tel: (0293) 23451 and 513412.
Telex: 87229 Couman G.
Range: 22.5kVA to 2,000 kVA.

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See APE.

Cummins Engine Company, Inc.,
PO Box 3005,
Columbus,
Indiana 47201, USA.
Tel: 812-372 7211.
Telex: 217411 Columbus.
Range: 75kVA to 1,000kVA.
Representatives:
N:
Scoatrac,
Isolo Industrial Estate,
PMB 21108 Ikeja,
Lagos.
Tel: 848144/845249
IC:
Cummins Corporation,
10 BP 1888,
Abidjan 01
Ivory Coast
Tel: 32 27 80
Telex Comvoir 2333
Togomat SA,
Boulevard Circulaire 302,
PO Box 1641,
Lome,
Togo.
L:
Electromantime,
PO Box 1275,
Monrovia.

Custom Power
See Ailsa Craig.

D

Dale Electric of GB Limited,
Electricity Buildings,
Filey,
Yorkshire,
YO14 9PJ.
UK.
Tel: 0723 514141.
Telex: 52163.
Representatives:
N:
Stokvis (Nigeria) Limited,
PO Box 136,
Ebute-Metta,
Nigeria.
Tel: 844609, 843391
SL:
African Commercial &
Agricultural Enterprises
Limited,
PO Box 1058,
Freetown.
Range: 1.75kVA to 5,160kVA

Dawson Keith Limited,
DeeKay House,
Brockhampton Lane,
PO Box 14,
Havant, Hants PO9 1QH.
Tel: (0705) 474122.
Telex: 86491 Deekay G.
SEE ADVERTISEMENT.
Representatives:
N:
Afrotec Technical Services
Nigeria Ltd,
Block M,
Plot 3,
Isolo Industrial Estate,
PMB 1061,
Oshodi,
Lagos State,
Range: 110 – 3,000kVA.

Denyo Co. Limited,
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Kamitakada,
Nakano-ku,
Tokyo, 164,
Japan.
Tel: 03 389 3111.
Telex: 232 2936 DENYO J.
Cable: DENWELTYO
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Seeking reliable
importers/dealers in West
Africa.
Range: 1kVA to 400kVA.
(Standard).

Detroit Diesel Allison
Division of General Motors
Overseas Distribution
Corporation
25200 Telegraph Road
Southfield MI 48034
USA.
Tel: (313) 424 4836.
Representatives:
N:
Diesel Sales & Service,
Division of Blackwood Hodge
(Nigeria) Ltd,
PO Box 109,
11 Burma Road,
Plot 1136,
Apapa.
Tel: 47107/47049/42223.
G:
Diesel Sales & Service,
Division of Blackwood Hodge
(Ghana) Ltd,
PO Box 126,
Ring Road,
West Accra,
Accra.
Tel: 21255, Accra.
L:
Diesel Sales & Service,
Division of Blackwood Hodge
(Liberia) Inc.,
PO Box 105,
Industrial Park,
Somalia Dr.,
Gardnersville,
Monrovia.
Tel: 21039.
SL:
Diesel Sales & Service,
Division of Blackwood Hodge
(Sierra Leone) Ltd,
PO Box 1456,
Freetown.
Tel: 50993/50645.
Gam:
See Sierra Leone.
Range: 31kVA – 1,375kVA.
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See British International
Industries Ltd

Diesel Electric Systems,
See Allis-Chalmers Corp.

Diesel Energie,
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92230 Gennevilliers,
France
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Telex 620 225 VALCK
GENVL
Range: 5kVA to 2,500kVA.
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Representatives:
N:
Scoatrac,
Kiri Kiri,
Industrial Area,
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Apapa,
Lagos.

E

Elco Power Plant Ltd,
Spencer Road,
Bradford 7,
UK
Tel: 573554.
Telex: 517556.
Cable: ELPOWER
BRADFORD
Range: 1 to 1,000kVA.
SEE ADVERTISEMENT

Elequip Limited,
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Wigston,
Leicester,
LE8 2YN, UK.
Tel: 0533 772711.
Telex: 341263.
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Machinery & Electrical
Equipment,
Division of UAC of Nigeria
Limited,
PMB 1015,
Ebute-Metta,
Lagos.
Tel: 843310, 843311, 853507.
G:
GCMT Division of UAC
of Ghana Limited,
PO Box 3400,
Accra.
Range: 3kVA to 1,500kVA.

V/O Energomachexport,
Ul. Deguninskaya,
1 korp 4,
Moscow 127486,
USSR.
Representatives:
N:
Wasteco Limited,
219 Apapa Road,
Iganmu,
PO Box 3237,
Lagos.
Tel: 41883/4 & 43037.
Range: up to 1,000kVA.

Ergen SpA,
Via R. Cozzi 8,
20125 Milano,
Italy.
Tel: 6424043.
Telex: 310225IML MI I
Range: 15kVA to 3,700kVA.
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Representatives:
N:
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Ijora.
PO Box 2181 Ijora.
Tel: 843664, 843652, 843667.
Telex: 21382 INGLA NG.
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Kaduna – PO Box 428,
Kano – PO Box 774,
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Erskine Systems Limited,
Lee De Forest House,
Eastfield,
Scarborough,
North Yorkshire,
YO11 3DU, UK.
Tel: (0723) 583511.
Range: up to 15kVA.

F

Forest City Electric Co.,
Cawdor Street,
Walkden,
Manchester,
M28 5HF, UK.
Tel: 061 790 8241.
Telex: 669034 Forest G.
Range: 1kV to 750kVA.
SEE ADVERTISEMENT

Fuji Heavy Industries Limited,
Subaru Building,
Sh In Juku,
Tokyo, Japan.
Tel: 845811.
Telex: 0 232 2268.
Representatives:
N:
VYB (Nigeria) Limited,
13-15 Wharf Road,
PO Box 155,
Apapa.
Tel: 845811.
Range: 1.5kVA to 10kVA.

G

Gardiner Marshall Engineering Limited,
Hollywood Road,
Bristol,
BS4 4LF,
UK.
Tel: (0272) 772488.
Telex: 449752 CHACOM M
GAMA
Representatives:
N:
C. Zard & Co.,
184 Adeniji Road,
PO Box 808,
Lagos.
Tel: 20089.
G:
Bisi & Stephenson (Ghana)
Limited,
Cantonment Road,
PO Box 1913, Accra.
Tel: 76632.
Range: 1.5kVA to 8.75kVA.

GEC Machines Limited,
Mill Road,
Rugby,
Warwickshire,
UK.
Tel: Rugby (0788) 2121.
Telex: 848537 Gencom G.
Range: 2kVA to 6,000kVA.

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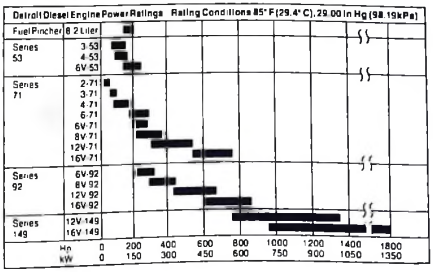
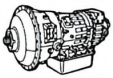
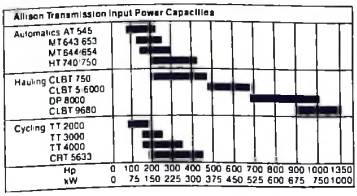
Our world-renowned heavy-duty diesels are available in four engine Series—53, 71, 92 and 149. The Series designation indicates the cubic inch displacement of each cylinder within the series. Engines with different numbers of cylinders are available in each Series to meet a variety of power requirements. Each Series is similar in concept and design, with standardization of components and maximum parts interchangeability for ease of service and minimum service training. The Detroit Diesel design offers high power-to-weight ratios, and immediate throttle response. A new addition to our line is the medium-duty 8.2 liter Fuel Pincher Diesel, available from 119 to 152 KW



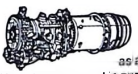
Allison Transmissions



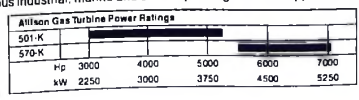
Over the years, we have pioneered a wide range of Automatic and Powershift transmissions for nearly every kind of trucking and heavy equipment operation. Allison transmissions offer quick, full-power shifts in all speed ranges to give excellent operation and performance. Driver efficiency can be greatly increased because less driver training is required and the driver has better vehicle control. Allison transmissions also help reduce engine damage by eliminating mis-shifts and overspeeding. And they help reduce both engine and transmission shock to give long life to driveline components

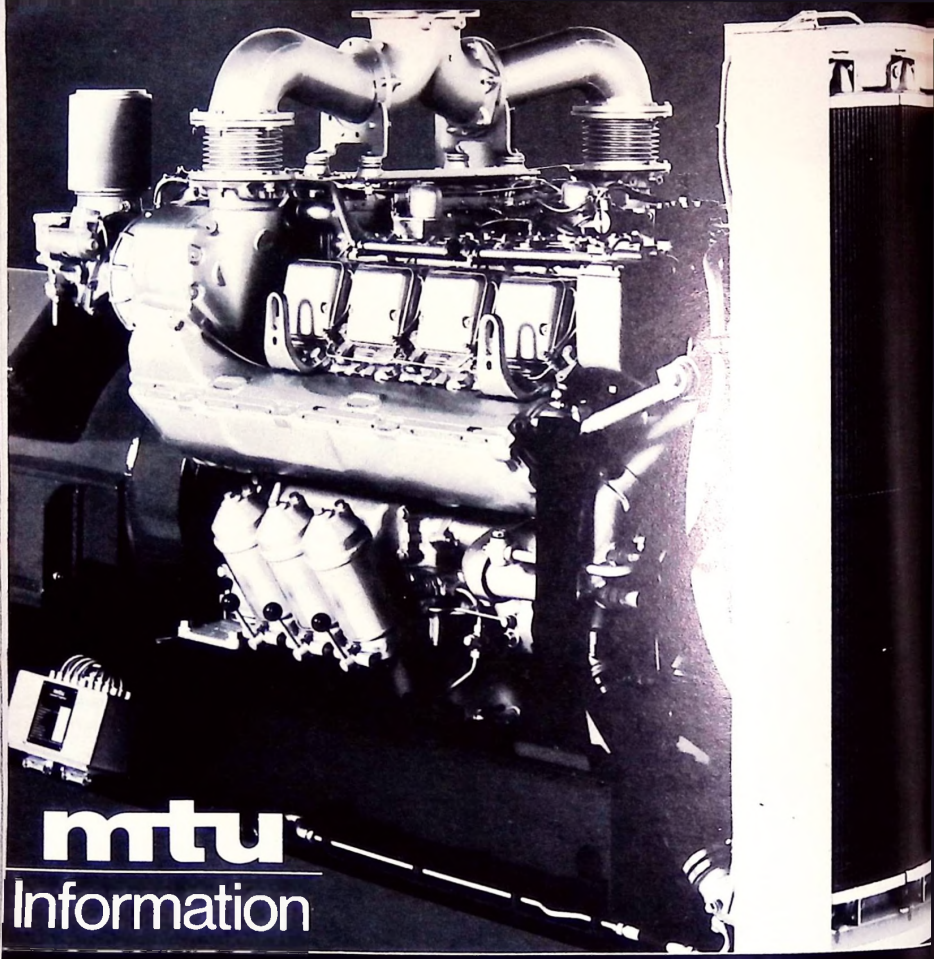


Allison Gas Turbines



Throughout the world, Detroit Diesel Allison is known and respected as a leader in the development and manufacture of gas turbine engines. Our 501-K and 570-K turbines are used in numerous industrial, marine and electric power generation applications where up to 5300 kilowatts are required. (Higher power requirements can be met by coupling units together.) They have some of the best fuel economy ratings of any gas turbines in their power class, and they can operate efficiently on a wide range of liquid fuels or natural gas.





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Lagos-Nigeria
Telephone 41310/9
Representative for Nigeria

Circle No. 232 on enquiry card

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G & M Power Plant Company Limited,
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IP1 5LX,
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Tel: 0473 41795.
Telex: 98216.
Representatives:
N:
Samphill (Nigeria),
PO Box 169,
17 Harcourt Street,
Calabar.
Range: 0.3kW to 640kVA
Engineering and Merchan[illegible]
enterprises,
68 Abba Road,
PO Box 393,
Port Harcourt.
Range: 0.3kW to 640kV[illegible]

H

Hampson Automation Limited,
Eastern Avenue,
Lichfield,
Staffordshire,
UK.
Tel: Lichfield (05432) 5[illegible]4
Telex: 336533 Hampgr G
Representatives:
N:
Prunepower Ltd.
Railway Avenue,
PO Box 326
Kaduna South
Tel: 242505
Telex: 71316 Songhai NG.

Hawker Siddeley Power Plant Ltd,
Thrupp,
Stroud,
Glos. GL5 2BW.
Tel: Brimscombe
(045 388) 5166
Telex: 43559
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Burbage Hinckley,
Leics.
LE10 2DB,
UK.
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Telex: 342305.
Range: 1.5kVA to 950kVA.

Hitachi Limited,
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1-chome,
Chiyoda-ku,
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Japan.
Tel: Tokyo (212) 1111.
Telex: J22395, J22432, J24491, J26375.
Cable: Hitachy Tokyo.

Homelite, Division of Textron Inc.,
PO Box 7047,
Charlotte, NC 28217,
USA.
Tel: (704) 588 3200.
Telex: 810 6210 584.
Representatives:
N:
Wiedemann & Walters,
24 Warehouse Road,
PO Box 379,
Apapa.
Sonnar Limited,
13 Savage Lane,
PO Box 3878,
Lagos.
G:
Blackwood Hodge,
Ring Road West,
PO Box 12,
Accra.
L:
Blackwood Hodge,
PO Box 105,
Monrovia.
SL:
Blackwood Hodge,
PO Box 1456,
Freetown.
IC:
CACOMIAF,
PO Box 1317,
Abidjan.
Range: 1kVA to 7.5kVA.

Honda Motor Co. Ltd.,
No. 27–8,
6-chrome, Jingumae
Shibuya-ku, Tokyo,
Japan.
Tel: 03-499 0111.
Representatives:
N:
Leventis Technical Ltd.,
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Lagos.
G:
Ghana National Trading Corp.,
(Technical Dept.),
PO Box 1524,
Accra.
L:
OAC,
PO Box 281,
Monrovia.
SL:
Michaels' Stores,
1 Tikonko Road,
PO Box 33,
Bo.
Tel: Bo 213,
John Michael Motors Ltd.,
PO Box 803,
Freetown,
Gam:
Breckwoldt & Co. Ltd.,
PO Box 281, 23,
Buckle Street,
Banjul.
S:
Societe de Promotion Commercial Africaine
SPCA Thubet & Cie
BP 157, 2 et 4
Rue de Dr. Theze
Dakar
Tel: 270–40
Telex: 623 Athubet SG
IC:
Societe Ivoirienne Farhat Freres
Av. Crosson Duplessis
BP 235
Abidjan.
Tel: 35 70-54
Telex: 3110 Siftec CI.
Range: 0.25kVA to 3.5kVA.

J

"Jet'Stream",
See Matzen & Timm.

Jonlaw Engineering Co. Ltd,
37 West Road,
Oakham,
Leicestershire,
UK.
Tel: Oakham 2201/56831.
Representatives:
N:
Stag Eng. Co. (Nigeria) Ltd,
18 Hamed Jimoh Close,
PO Box 353,
Surulere,
Lagos.

K

Kaycee (Nigeria) Ltd.,
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and 3 Balogun Street,
Lagos.
Tel: 842120, 636033
Range: 1.3kVA to 2kVA.
Kelvin Diesels Limited,
254 Dobbie's Loan,
Glasgow G4 0JL.
Tel: 041 332 1266.
Telex: 777917.
Representatives:
Gam:
Gambia Agricultural Mechanisation Limited,
Kaniling Industrial Estate,
PO Box 223,
Banjul,
The Gambia.
Tel: Serrekunda 2568.
Telex: 2210 CWG V
G:
State Fishing Corporation,
PO Box 211,
Tema,
Ghana.
Tel: 2706.
Cable: Longrange.
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Telex: 8812-0.
Representatives:
N:
Nigerian Technical Company Limited,
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PO Box 356,
Apapa.
Tel: 45131, 45542, 48074.
G:
Messers. Rowedder, Delmenhorst,
c/o Reiss & Co.,
D 757-4 Clement Papatio Avenue,
PO Box 3074,
Accra.
Tel: 655105-8.
L:
United Liberian Rubber Corp.,
Randall Street,
PO Box 51,
Monrovia.
Tel: 21506 & 21708.
SL & Gam & S:
Sofica,
BP 1783 KM 4,
Route de Rufisque,
Dakar.
Tel: 50537.
IC:
Dacivo,
BP 363,
Rue de l'Industrie,
Abidjan.
Tel: 332 700.
Range: 15kVA to 2,500kVA.

Knight Taylor Limited,
305–307 Chase Road,
Southgate,
London N14,
UK.
Tel: 01 886 1422.
Range: 1.5kVA to 7kVA.

Knytor,
See Knight Taylor Ltd.

Kolfer Power Limited,
Kings Cross Road Works,
Dundee,
Scotland,
UK.
Tel: (0382) 817040.
Telex: 76297.
Range: 2kVA to 1,500kVA.

Kosan Ses a/s,
Vojensvej 8–20,
DK 2610 Denmark.
Tel: (01) 41 23 33.
Telex: 15646 Sesco dk.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos.
Tel: 87 18 97.
Range: 32.5kVA to 320kVA.

L

Lindenberg Aggregate GmbH,
PO Box 1128,
5064 Roesrath,
West Germany.
Tel: 2205 1085.
Telex: 088 7111.
Representatives:
N:
Wiedemann & Walters (Nigeria) Limited,
24 Warehouse Road,
PO Box 379,
Apapa.
Tel: 45401.
Range: 15kVA to 5,000kVA.
SEE ADVERTISEMENT.

Lister Generating Sets,
Hawker Siddeley Power Plant Ltd,
Thrupp,
Stroud,
Glos. GL5 2BW.
Tel: 0453 885166.
Telex: 43559.

BENIN
J. Walkden et Cie,
Dept MATFORCE,
BP 24,
Cotonou,
Cables: WALKDEN,
Tel: 30-38.
Telex: 5214

CAMEROONS
Matforce,
Div de la Ste SOCOMI,
BP 609,
Douala,
Cameroons,
Tel: 42-35-40.
Telex: 5272.

GABON
H. & C. Technique,
BP 4052
Liberville,
Gabon,
Cables: ANGOLA.
Tel: 228-80.
Telex: 5224.

Ghana
The Union Trading Co of Ghana Ltd,
PO Box 3180,
Accra,
Ghana.
Cables: UNIONTRADE.
Tel: 63015/64503

Union Trading Co,
PO Box 3180,
Accra.

IC
Dept, MATFORCE,

IVORY COAST
Dept, MATFORCE,
BP 1844,
Abidjan,
Ivory Coast,
Cables:
Telephone: 225-93.
Telex: 367.

Liberia
West Brand Corporation,
PO Box 87,
Monrovia,
Liberia.
Cables: WESTTRADE.

Nigeria
Union Trading Co. of Nigeria Ltd,
PMB 1010,

Apapa.

Union Trading Co. of Nigeria Ltd,
Technical Division,
Mason Street,
Isolo,
Mushin.

Union Trading Co,
PO Box 3180,
Accra.

SENEGAL
Nosoco – Senegal, Dept
Matforce,
PO Box 791,
Dakar.
Cables: NOSOCO.
Tel: 23-350.
Telex: 503.

SL
Commercial Enterprises Ltd,
PO Box 669,
Freetown,
Cables: ENTERPRISES
Tel: 23503-23683.
Telex: 3284 ENTERP SL.

TOTO
United Africa Co. Ltd,
(Matforce),
BP 345,
Lime,
Cables: UNAFRICO.
Tel: 28-00.
Telex: 5219

UPPER VOLTA
Dims-Haute Volta,
BP 25,
Ouagadougou,
Cables: COFRANCO.
Tel: 33-26.
Telex: 5207.

ZAIRE
Matforce Diesel,
BP 13 599 KIN 1,
Kinshasa,
Republique du Zaire,
Cables: SEDAUTO.
Tel: 23972.
Telex: 21254 Sedec/Kinshasa.

ZAMBIA
AFE Ltd,
PO Box 1505,
Lusaka.
Cables: AFEQUIP.
Tel: 73700.
Telex: ZA42450

ETS Ali Mazey & Cie,
BP 1033,
Conarky,
Rep of Guinea.
Telex: 647 MAZEH.

M

Machinery & Electrical Equipment,
1 Taylor Road,
Ebute-Metta, Iddo,
Lagos.
Tel: 43310.
Range: 5kVA to 4,375kVA.

MAK Maschinenbau GmbH,
PO Box 9009,
Falckensteiner Str. 2–4,
23 Kiel 17,
W. Germany.
Tel: 0431/30111.
Telex: 0299877.
Representatives:
N:
Afrotec Services Ltd,
Oke-Afa/Isolo Road,
Mushin,
Lagos State.
Range: to 1,250kVA.

Markon Engineering,
Pillings Road, Oakham,
Rutland LE15 6LW, UK.
Tel: Oakham (0572) 3811.
Range: 0.5kVA to 1,875kVA.

Matzen & Timm,
Gr. Bahnstr. 11-25,
2000 Hamburg 54,
West Germany.
Tel: 040 85 50 01.
Telex: 215 450/215 624.
Representatives:
N:
Matzen & Timm (Nigeria) Limited,
PO Box 333,
50, Burma Road,
Apapa.
Tel: 41150/42591.
Matzen & Timm (Nigeria) Limited.
PO Box 5806,
Trans Amadia Ind. Layout,
Plot 71,
Port Harcourt,
Matanmi Agencies,
PO Box 359,
56 New Market Road,
Onitsha.
Tel: 447.
G:
Matzen & Timm (Ghana) Limited,
PO Box 2108,
M & K Engineering Bldg.,
Ring Road North Industrial Area,
Accra.
Tel: 21245.
SL:
Matzen & Timm (S.L.) Limited,
PO Box 428,
21 East Street,
Freetown.
Tel: 23360.
Range: 3·5kVA to 1,000kVA.

Mawdsley's Limited,
PO Box 3,
Zone Works,
Dursley,
Gloucestershire,
GL11 5AE, UK.
Tel: Dursley (0453) 4131.
Telex: 43128.
Representatives:
N:
Mofat Engineering Co. Limited,
PO Box 6369,
8 Agege Motor Road,
Sogunle,
Lagos.
Tel: 35744.
Universal Automobiles & Parts Limited,
No. 1 Kaduna North Station Road,
PO Box 877,
Kaduna.
Range: 5kVA to 750kVA.

Mirrlees Blackstone (Stockport) Limited,
Bramhall Moor Lane,
Hazel Grove,
Stockport,
SK7 5AH,
UK.
Tel: 061 483 1000.
Telex: 667314.
Range: 1,500kVA to 10,340kVA.
Representatives:
N:
UTC (Nigeria) Limited,
PO Box 1129,
Lagos.
Tel: 660220
Telex: 21232 UNITRA NG.
G:
Union Trading Co. of Ghana Limited,
PO Box 3180,
Accra.
Tel: 64503.
SL:
Commercial Enterprises Limited,
PO Box 669,
Freetown.
Tel: 23503, 23683
Telex: 3284 ENTERP SL
Gam:
Technical Services & Supplies Limited,
11 Russel Street,
Banjul.
Tel: 281.
Telex: 2209 MADI GV

Mitsubishi Electric Corporation,
Mitsubishi Denki Bldg.,
2–3 Marunouchi,
2-chome,
Chiyoda-ku,
Tokyo 100,
Japan.
Telex: Melco J24532.
Cable: Melco Tokyo.

Mofat Engineering Co. Limited,
8 Agege Motor Road,
Sogunle,
PO Box 6369,
Lagos.
Tel: 935 744.

Motorenfabrik Hatz Gmbh & Co. KG
PO Box 20,
D-8399 Ruhstorf/Rott,
West Germany.
Tel: 08531/3022.
Telex: 05 7260
Representatives:
N:
Machinery & Electrical Equipment,
1 Taylor Road,
Ebute-Metta,
Iddo,
Lagos.
SEE ADVERTISEMENT

Motoren-und Turbinen-Union Friedrichshafen GmbH.,
(Dept., VVA),
Postfach 2040,
7990 Friedrichshafen 1,
West Germany.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos,
Tel: 41310/9.
Range: 300kVA to 5,000kVA.

Motoren-Werke Mannheim AG,
D-6800 Mannheim 1,
Carl-Benz-Strasse,
PO Box 1563,
West Germany.
Tel: 0621 3841.
Representatives:
N:
Nigerlink Intern. Ass.,
7th Floor,
Western House,
8/10 Broad Street,
Lagos.
Tel: 21662/3.
Telex: 21107 NG.
Range: 5kVA to 7,000kVA.

Frank W. Murphy Limited,
178 High Street,
Teddington,
Middlesex TW11 8HU,
UK.
Tel: (01) 977 0193.
Telex: 928063.
Brand: Murphymatic.
SEE ADVERTISEMENT.
N:
Newage Engineering Limited,
PO Box 17,
Barnack Road,
Stamford,
Lincolnshire PE9 2NB,
UK.
Tel: (0780) 2552.
Telex: 32268
Range: 1kVA to 1,500kVA.
SEE ADVERTISEMENT.
Representatives:
C:
Hamelle-Afrique,
BP 4041,
Doula,
Cameroon.

NMI Limited,
26 Wharf Road,
PMB 1032 Apapa,
Lagos, Nigeria.
Tel: 876518/876629.
SEE ADVERTISEMENT.

O

Omega Powerplants Limited,
Apex Road,
Brownhills,
W. Midlands,
UK.
Tel: Brownhills 77295.
Telex: 339 346 POWER G.
Range: 4kVA to 1,500kVA.
Representatives:
N:
Clausen Engineering Co. Limited,
Plot 83, Airport Road,
PO Box 5037,
Kano.

Onan Europe BV,
Backershagen 79,
Buitenveldert,
Amsterdam 1011,
The Netherlands.
Tel: 42-32-27.
Telex: 15650 Onams.
Representatives:
N:
Witt & Busch Ltd,
Plot 1A – Ijora Causeway,
PO Box 17,
Ijora, Lagos.
Tel: 42288/42298.
Witt & Busch Ltd,
4 Yakubu Gowon Drive,
PO Box 740,
Port Harcourt.
Tel: 21656.
Branch in Kaduna.
G:
Grant Engineering Co. Ltd,
PO Box 379.
Accra.
Telex: 21000.
Range: 1.2kVA to 781.3kVA
50hz.

Oxford Diesels Ltd,
Cuckoo Works,
Cuckoo Lane,
Iffley, Sandford,
Abingdon,
Oxon, UK.
Tel: Oxford (0865) 730011.
Telex: 837604 JF Gens Abydn.
Range: 1.5kVA to 1,000kVA.

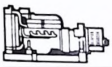
[illegible] Diesels Limited,
[illegible] 8,
[illegible]ster,
[illegible]HW,
[illegible]06 3133.
[illegible]1851 GEC PDC G.
[illegible]ntatives:
[illegible]ry & Electrical,
[illegible]n of UAC (Nigeria)
[illegible]ds,
[illegible]015,
[illegible] Metta,
[illegible] 43310.
[illegible]
[illegible] Ghana Consolidated Machinery & Trading Co. Limited,
PO Box 3400,
Swanmill,
Accra.
Tel: 63921/2.
Telex: 2008 ACCRA UNAMERCH.
Range: 250kVA to 3,125kVA.

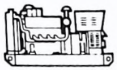
Penven,
281 Chaussée Jules César,
95250 Beauchamp,
France.
Tel: 413 54 32.
Telex: 695119 F.
Representatives:
N:
NMI,
PO Box 1032,
Wharf Road,
Apapa, Nigeria.
IC:
Tecmat 01 BP 1461,
Abidjan 01,
Ivory coast.
Agence Centrale,
PB 675,
Niamey,
Niger.
Agence Centrale,
BP 1246,
Lome,
Togo.
Range: 15kVA to 3375kVA.
SEE ADVERTISEMENT.

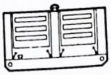
Petbow Limited,
Ramsgate Road,
Sandwich,
Kent,
CT14 9BU,
UK.
Tel: (0304) 613311.
Telex: 96329 PETBOW G.
SEE ADVERTISEMENT.
Representatives:
N:
Holt Engineering,
PMB 21413,
Plot 3 & 4,
Adewunmi Industrial Estate,
Oregun Village,

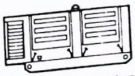
ALL THE POWER OF THE GENSET

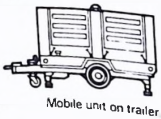
A complete range of generator sets from 15 to 800 kVA.


For permanent indoor installation


For installation under temporary cover


For outdoor use


Sound Proofed generating set


Mobile unit on trailer

TYPE		LBA 1	LBA 2	LCA 3	LDA 5	LDT 8	LGA 9	LDA 10	LGT 11	LGT 13	LPT 16	LPT 18	LPR 20	LPR 22	LVR 25	LVR 27	LVR 30	LSR 35	LXT 43	LXR 51	LYT 58	LYR 63	LYR 72
P· kVA *at 50Hz	Continuous use	15	21	38	55	80	90	–	115	130	160	180	200	225	250	275	300	350	430	510	580	630	720
	Emergency use	16,5	23	42	60	88	100	100	130	150	180	200	225	250	275	300	330	390	470	570	640	700	800

Fill in this coupon and send to the following address. *

Full names _____ Position _____

Name of Company _____ Field of activities _____

Address _____ Telephone no _____

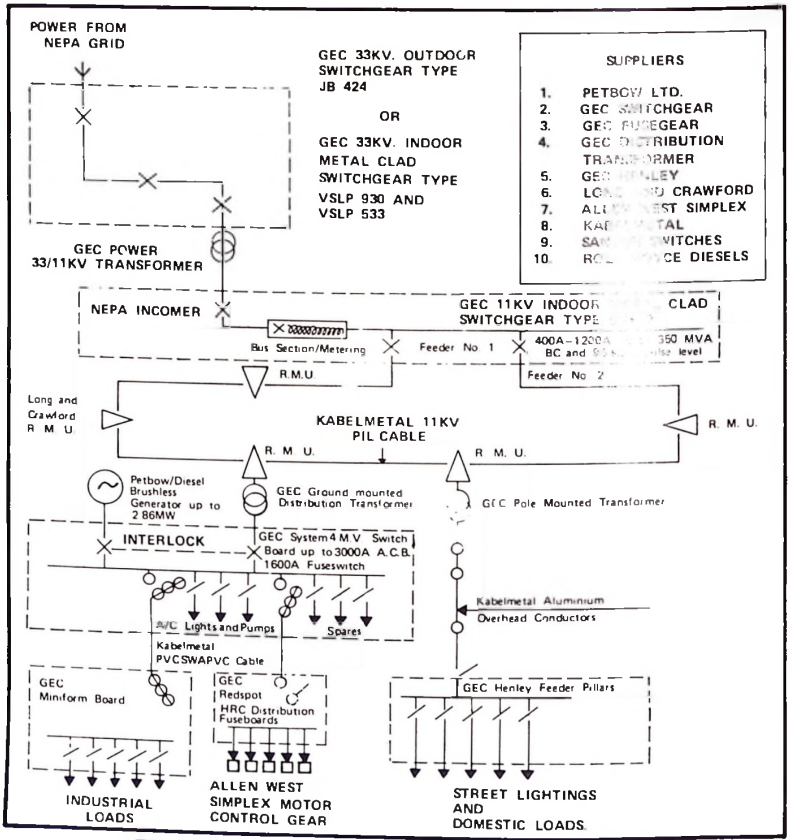
RENAULT
Groupes Electrogènes

Lyon: 241, avenue Berthelot - 69008 Lyon
Tel. (7) 800.55.24 - Telex: 340816
*For Nigeria: Berliet Nigeria LTD: Head Office & Lagos Branch
Isolo Express Way, Ilasamaja industrial sheme
p.o. box 6655 - Lagos - Tel. 84.28.92
cables: autoberlie Lagos.

Circle No. 197 on enquiry card

HOLT ENGINEERING

Complete Industrial Electrical Equipment



The Schematic shows our scope

HOLTENG

HOLT ENGINEERING
A Division of J Allen & Co Ltd

Oregun road P.M.B. 21413 Ikeja–Lagos.
Branches at: Oregun Warri Akure Maiduguri Kaduna Kano Enugu Port Harcourt

G&C Petbow ROLLS-ROYCE DIESEL ENGINE

Circle No. 253 on enquiry card

Ikeja,
Lagos.
Range: 25 – 6,000kVA.
L:
Monrovia Tractor Corporation,
PO Box 2861,
Monrovia,
Tel: 21231.
SL:
Air Cold Engineering Ltd,
PO Box 1416,
Howe Street,
Freetown.

Powermaker International Limited,
Shenstone Drive,
Aldridge,
Walsall,
WS9 8TP,
UK.
Tel: Aldridge 54711.
Telex: 338355 WEB G.
Representatives:
N:
Powermaker Generators,
Technical Division of
Tarpaulin Industries (WA)
Limited,
8 Burma Road,
Apapa,
PO Box 2227,
Lagos.
Tel: 41730, 47814.
Cables: Tarpind.
Range: 12.5kVA to 872kVA.

Puma Power Plant Limited,
2 Serjeants' Inn,
London EC4Y 1LL.
Tel: (01) 353 3112.
Telex: 261093 OBPUMA G.
Range: 20kW to 8 Megawatts.

Grahame Puttick Limited,
See Puma Power Plant Limited.

R

Raynar Power Limited,
Fiveacres Centre,
Merston, Chichester,
West Sussex PO20 6EG.
Tel: Chichester (0243) 786049.
Telex: 86705.
Range: 2kVA to 6,000kVA.
Representatives:
G:
African Automobile Ltd,
PO Box 1346,
Accra,
seeking agents in other countries.

Renault Vehicules Industriels,
241 Avenue Berthelot,
69008 Lyon,
France.
Tel: (7) 800 5524.
Telex: 340816.
Range: 15kVA to 800kVA.
Representatives:
N:
Berliet Nigeria Limited,
PO Box 6655,
Isolo Express Way,
Lagos.
Telex: 21891.
IC:
Codimatel,
8 Bis rue des Brasseurs,
Abidjan.
Tel: 35 60 03.
S:
Senenatel,
BP 336,
9 Alle Delmas,
Dakar.
Tel: 211390.
Range: 15kVA to 500kVA.
Brand: RVI–Berliet.
SEE ADVERTISEMENT.

S

Scandinavian Engineering Limited,
Vojensvej 8-20,
DK – 2610 Copenhagen,
Denmark.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos.
Tel: 41310/9.

IC:
CARIC
Bd. Marseilles,
BP 20884,
Abidjan,
Tel: 226257/58.
S:
SEAS,
Route de Rufisque,
BP 254,
Dakar.
Tel: 360 60.
Range: 13kVA to 1,000kVA.

SEG UK Ltd,
666 High Road,
Tottenham,
London, N17 0AB.
Tel: 01-808 3375.
Representatives:
Leynchain Nigeria Ltd,
Unit 1,
Block 6,
Industrial Estate,
Lagos.
Range: 50kVA to 3,500kVA.

William S. Selwood Limited,
Chandlers Ford,
Eastleight,
Hants,
SO5 3ZL, UK.
Representatives:
N:
Adeoye Adejobi Trading Stores Ltd,
SW8/129A Lagos By-Pass,
Oke-Ado,
PO Box 763,
Ibadan.
Tel: 032 24037.
Telex: 31157 NG.
Range: From 1.5kVA to 250kVA.

Shannon Power Services Limited,
Leigh Street,
Walshaw,
Bury,
Manchester,
UK.
Tel: 061 761 1434.
Telex: 66 88 50.
Range: 4kVA to 1,000kVA.

Simplon Lighting and Hemcol Limited,
Debdale Lane,
Mansfield,
Woodhouse,
UK.
Representatives:
N:
Afrotec Technical Services
Nigeria Limited,
Plot 3, Block M,
Isolo Industrial Estate,
PMB 1061,
Oshodi,
Lagos State.
Tel: 845656.
Range: Mobile Lighting Sets, 4 to 7.5kVA.

Standfast Engineering Co. Limited,
Kilbarrack,
Dublin 5, Ireland.
Tel: Dublin 322221.
Representatives:
N:
Peppmar Technical Supplies & Services Limited,
PMB 1155,
225 Apapa Road,
Igannmu,
Lagos.

Stokvis (Nigeria) Limited,
1 Dawodu Lane,
PO Box 136,
Ebute-Metta,
Nigeria.
Tel: 844609, 843391.
Range: 10kVA to 1,000kVA.

Strüver KG
2000 Hamburg 61,
Niendorfer Weg 11,
Postfach 610 420,
West Germany.
Representative:
N:
NITECO,
11/13 Warehouse Road,
PO Box 356,
Apapa.

Lagos.

RTD Swan Limited,
Swan Close Road,
Banbury,
Oxon OX16 8AH.
Tel: Banbury (0295) 3494.
Telex: 83426 Swan G.
N:
Lanre Bhadmus Industries Ltd,
26 Calcutta Crescent,
PO Box 516,
Apapa,
Lagos.
Tel: 846647/932973.
Range: 1kVA to 1,220kVA
SEE ADVERTISEMENT.

Sulzer Brothers Limited,
CH-8401 Winterthur,
Switzerland.
Tel: 052 81 11 22.
Telex: 76 165.
N:
Mandilas Enterprises Limited,
Mandilas House,
96/102 Broad Street,
PO Box 35,
Lagos.
Tel: 65 25 20/29 and 65 25 30/39.
Telex: 21383 mandla ng att.
Mr. Godel.
G:
Devag Ltd,
PO Box M 262,
Accra,
Tel: 6 49 78, 6 49 79 and 7 63 07.
Telex: 2146 Accra.
IC:
Selfci
Societe des Ets. Louis Feltrin de Cote d'Ivoire,
01 BP 1083,
Abidjan 01.
Tel: 35 43 41 and 35 63 52.
Telex: 2292 feltrin abidjan.

T

Tilley Diesel Industry Ltd,
Stonewall Industrial Estate,
Newcastle,
Staffs.,
UK.
Tel: 0782 612331.
Telex: 36484.

Tokyo Shibaura Electric Co. Ltd,
1-6 Uchisaiwai-cho,
1-chome,
Chiyoda-ku,
Tokyo 100,
Japan.
Tel: (03) 501 5411,
(03) 501-5480.
Cable: Toshiba Tokyo.
Telex: J22587, 24344, 24576, Toshiba.
Range: 25kVA to 18,000kVA.

Tradelines Development Limited,
1 London Road,
Hindhead,
Surrey,
GU26 6AB.
Tel: 042 873 6020.
Telex: 858 802 WAYWIS G.
Range: 4kVA to 1,000kVA.

Transilite,
See Transunits Ltd,

Transunits Limited,
Telford Way,
Thetford,
Norfolk,
IP24 1HU,
UK.
Tel: 0842-4817.
Telex: 81626.
Representatives:
N:
Diesel Sales & Service,
Div. Blackwood Hodge,
(Nigeria) Limited,
11 Burma Road,
Apapa.
PO Box 109.
Tel: 847107, 847049, 842223.
G:
Blackwood Hodge (Ghana) Ltd,
PO Box 126,
Accra.
L:
Blackwood Hodge (Liberia) Inc,
PO Box 105,
Monrovia.
SL:
Blackwood Hodge (Sierra Leone) Ltd,
PO Box 1456,
Freetown.
Blackwood Hodge (Côte d'Ivoire) SARL,
BP 140066,
Marcory,
Abidjan.
Tel: 35 60 01.
Brand: Translite.
Range: 2kVA to 1,312kVA.

U

Uberol Equipment Limited,
Ascot House,
29a High Street,
Ascot, Berkshire SL5 7HG.
Tel: 0990 21468.
Brand: UBECO
Range: 1kVA to 500kVA.
Seeking agents and distributors.

W

[illegible] W. Ward Limited,
[illegible]inery (Wardpower)
[illegible]on,
[illegible]n Works,
[illegible]s Street,
[illegible]ld, UK.
Tel: Sheffield 26311.
[illegible] 54119.
[illegible]entatives:

[illegible]eyancer (Nig) Ltd,
[illegible]3, Iganmu,
[illegible]rial Estate,
[illegible]1189 Apapa,

[illegible]37025.
[illegible]21310.

[illegible]wpower,
[illegible], Uxbridge Road,
[illegible],
London W5 5TL.
Tel: (01) 567 9482.
Telex: 934455.
Range: 4kVA to 1,200kVA.
F. G. Wilson (Engineering) Ltd,
Units 24,
Central Trading Estate,
Staines,
Middlesex,
UK.
Tel: 01-751 3145.
Range: 3kVA to 2,750kVA.

Wiedemann & Walters (Nig) Ltd,
24 Warehouse Road,
PO Box 379.
Tel: 870671.
Telex: 21369 WIWA NG.
Branch Offices:
Headquarters Apapa,

Branch Offices:
Trans Amadi Junction,
PO Box 493.
Tel: 21979.
Telex: 61131.
Port Harcourt.

Sir Kashim Ibrahim Road,
PO Box 260,
Maiduguri.

5, Hadejia Road,
PO Box 2107,
Tel: 4460.
Telex: 77130.
Kano.

NC 390 Mando Road,
PO Box 1666.
Tel: 062/215362.
Kaduna.

Sapele Road,
PO Box 493,
Tel: 209.
Warri.
SEE ADVERTISEMENT.

Winsor Bond Developments Ltd,

-199 Bradford Street,
mingham B12 OJD.
:021 772 2227.
lex: 338773 SPS BHMG.
nge: 1.5kVA to 750kVA.

rkman, Reed & Co.,
mited,
acon Works,
rish,
eston-Super-Mare,
on BS23 6SW.
el. 0934 833316.
lex: 936281.
nge: 4kVA to 750kVA.
EE ADVERTISEMENT.

Rysepower Limited,
Drove Road,
Everton,
Nr Gamlingay,
Bedfordshire,
UK.
Tel. 0767 50011.
Representatives
N:
CFAO (Nigeria) Limited,
Structor Technique,
PO Box 391,
Apapa Road,
Iganmu,
Lagos.
Tel: 44027.
Telex: 21438.
And at:
PO Box 18,
10-11 Murtala Muhammad
Road,
Kano.
PO Box 5130,
8 Liberation Drive,
Port Harcourt,
Range: 2kVA to 745kVA.

Y

Yamaha Motor Co. Ltd,
2500 Shingai,
Iwata City,
Shizuoka-Ken,
Japan.
Representatives:
N:
J Allen & Co. Ltd,
Yamaco Division,
Adquenmi Estate,
Oregun Industrial Estate,
Ikeja,
PO Box 542,
Lagos.
Tel: 47881/5, 47423/4.
Range: 1.5kW Portable
Generator 220V, 50Hz.

Yanmar Diesel Engine Co. Limited,
1-1, Yaesu 2-chrome,
Chuo-ku,
Tokyo, 104 Japan.
Telex: 0222-2310, 0222-4733.
Representatives:
N:
Holt Engineering,
Plot 3 & 4 Adewunmi Estate,
Oregun Industrial Estate,
PMB 1413,
Ikeja,
Lagos.
L:Oost Afrikannsche
Compagnie,
PO Box 281,
Monrovia.
IC:
Baraderie Freres Abidjan,
Autoroute de l'aeroport,
Km 2, 7
BP 276,
Abidjan.
SL:
John Michael Motors
PO Box 803,
Freetown.
Range: 4hp to 18hp.

ALTERNATORS

A

AVK,
PO Box 101 128,
6072 Dreieich,
W. Germany.
Tel: 6102 248-1.
Representatives:
N:
H. Friedrich Schroeder,
23 Abebe Village Road,
PO Box 1209,
Iganmu,
Lagos.
Tel: 4189/45216.
Telex: 21454.
L:
Electro Maritime Inc.,
PO Box 1275,
Monrovia.
Tel: 21691/26641.
Range: 1 to 10,000kVA.

Allam Generators Limited,
13 Purdeys Way,
Rochford, Essex SS4 IND,
UK.
Tel: 0704-549564.
Telex: 995127 (ALLGEN G).
Representatives:
At present looking for
representatives.

B

Brush Electrical Machines Limited, A Division of Hawker Siddeley Electric Export Limited,
Export Department,
PO Box 18,
Loughborough,
Leics,
LE 11 1HJ, UK.
Tel: 0509 63131.
Representatives:
N:
The Union Trading Co. of
Nigeria Limited,
PMB 1010,
26 Wharf Road,
Apapa.
G:
Holt Engineering,
John Holt Batholomew
Limited,
PO Box 468,
Accra.
Range: 1.5kVA to
100,000kVA.

Caterpillar Overseas SA,
118, rue du Rhone,
PO Box 171,
Geneva 3,
Switzerland.
N:
Tractor & Equipment,
Division of UAC of Nigeria
Limited,
PMB 1015,
Ebute-Metta,
Lagos.
Tel: 843310.
G:
Tractor & Equipment,
Division of Uac of Ghana
Limited,
PO Box 5207,
Accra-North,
Tel: 21900.
L:
Liberia Tractor & Equipment
Co.,
PO Box 299,
United Nations Drive,
Monrovia.
Tel: 2279,22057.
SL:
Tractor & Equipment,
Division of UAC of Sierra
Leone Limited,
PO Box 127,
Freetown.
Tel: 5082 or 50777.

Conyers Limited,
Faraday House,
Eastfield, Scarborough,
North Yorkshire,
YO11 3UT,
UK.
Tel: 0723 584661/2.
Telex: 527241.
Representatives:
N:
Stokvis (Nigeria) Limited,
PO Box 136,
Ebute-Metta,
Lagos.
Tel:844609/843391.

Cooper Energy Services
Superior Engines,
46-47 Pall Mall,
London SW1 Y5JG,
UK.
Tel: 01-839 5161.

Representatives:
N:
Camco,
PO Box 5009,
Lagos.
Telex: 21510 (ERNST).

J

Jonlaw Engineering Co. Ltd,
37 West Road,
Oakham,
Leicester,
UK.
Tel: Oakham 2201/56831.
Range: up to 25kVA.

M

Motoren-and Turbinen-Union Friedrichshafen GmbH/MTU,
(Dept., VVA),
Postfach 2040,
7990 Friedrichshafen 1,
West Germany.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos.
Tel: 41310/9.
Range: 300kVA to 5,000kVA.

P

Petbow Limited,
Ramsgate Road,
Sandwich,
Kent,
CT13 9NE,
UK.
Tel: Sandwich 613311.
Telex: No. 96329 PETBOW G
SEE ADVERTISEMENT
Representatives:
N:

Holt Engineering,
PMB 21413,
Plot 3 & 4 Adewumni
Industrial Estate,
Oregun Village,
Ikeja,
Nr. Lagos.
Tel: 45801, 45802.
L:
Monrovia Tractor Corporation,
PO Box 2861,
Monrovia.
Tel: 21231.
SL:
Air Cold Engineering Limited,
PO Box 1461,
Howe Street, Freetown.
Tel: 5644.

T

Tokyo Shibaura Electric Co. Ltd,
1-6 Uchisaiwai-cho,
1-chome,
Chiyoda-ku,
Tokyo 1000,
Japan.
Tel: (03) 501-5411.
Telex: J225897, 24344, 24576,
Toshiba.

PRIME MOVERS

A

Allis-Chalmers Corporation,
(PO Box 563) 151st &
Halsted,
Harvey,
Illinois 60426,
USA.
Tel: (312) 339-3300.
Telex: TWX 910 257 2135
answerback HVYILEP.
Range: 60 HP to 450 HP.

B

A. B. Bofors-Nohab/Nohab-Polar,
(Diesel Division),
S-461 Tollhatten,
Sweden.
Tel: Sweden 520/18000.
Range: 500kW to 2,500kW.

C

Caterpillar Overseas SA,
118, rue du Rhone,
PO Box 171,
Geneva 3,
Switzerland.
Representatives:
N:
Tractor & Equipment,
Division of UAC of Nigeria
Limited,
PMB 1015,
Ebute-Metta,
Lagos.
Tel: 843310.
G:
Tractor & Equipment,
Division of UAC of Ghana
Limited,
PO Box 5207,
Accra-North.
Tel: 21900.
L:
Liberia Tractor & Equipment
Co.,
PO Box 299,
United Nations Drive,
Monrovia.
Tel: 2279, 22057.
SL:
Tractor & Equipment,
Division of UAC of Sierra
Leone Limited,
PO Box 127,
Freetown.
Tel: 50852 or 50777.

Cooper Energy Services International Inc.,
Superior Engines,
46-47 Pall Mall,
London SW1 Y5JG,
UK.
Tel: 01-839 5161.

D

Dorman Diesels Limited,
Tixall Road,
Stafford,
ST16 3UB,
UK.
Tel: 0785 3141.
Telex: 36156.
Representatives:
N:
Machinery & Electrical
Equipment (Division of UAC
of Nigeria Limited),
PMB 1015 Ebute-Metta,
Lagos.
Tel: 43310, 43311, 53507.
G:
G.C.M.T. Division of UAC of
Ghana Limited,
PO Box 3400,
Accra.
Range: 24kVA to 930kVA.

H

Honda Motor Co. Ltd,
No 27-8,
6-chome,
Jingumae,
Shibuya-ku,
Tokyo,
Japan.
Tel: 03-499 0111.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos.
G:
Ghana National Trading
Corporation,
Technical Department,
PO Box 1524,
Accra.
L:
Oost Afrikaansche Compagnie,
PO Box 281,
Monrovia.
SL:
Michaels' Stores,
1 Tikonko Road,
PO Box 33,
Bo.
Tel: Bo 213.
John Michael Motors Ltd,
PO Box 803,
Freetown.
Gam:
Breckwoldt & Co. Ltd,

PO Box 281,
23 Buckle Street,
Banjul.

L

Lombardini,
PO Box 5,
Reggio E,
Italy.
Range: 5 to 70 HP.

M

Mirrlees Blackstone (Stamford) Ltd,
Ryhall Road,
Stamford,
Lincolnshire,
PE91 UH,
UK.
Tel: 0780 4641.
Telex: 32234.
Range: 150kVA to 2,440kVA.
SEE ADVERTISEMENT

Motoren-und Turbinen-Union Friedrichshafen GmbH,
(Dept., VVA),
Postfach 2040,
7990 Friedrichshafen 1.
West Germany.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos.
Tel: 41310/9.

Motoren-Werke Mannheim AG,
D-6800 Mannheim 1,
Carl-Benz Strasse,
West Germany.
Representatives:
N:
Nigerlink Inter. Ass,
7th Floor,
Western House,
8-10 Broad Street.
Lagos.
Tel: 21 662/3.
Telex: 21107 NG.
IC:
Somotec,
BP 90388,
Zone Industrielle de Vridi,
Abidjan.
Tel: 354090.
Range: 5 HP to 8,000 HP.

P

Perkins Engines Limited,
Peterborough PE1 5NA.
Tel: 0733 67474.
Representatives:
N:
Stokvis (Nigeria) Limited,
Perkins Dept,
PO Box 136,
1 Dawodu Lane,
Ebute-Metta,
Lagos.
Tel: 834609/83339.
Cable: Toolco.
Telex: 11117 net TDS.

R

Rolls Royce Motors Limited,
Diesel Division,
Whitchurch Road,
Shrewsbury,
Salop,
UK.
Tel: Shrewsbury 52262.
Telex: 35171/2.
Representatives:
N:
Holt Engineering,
Plots 3 & 4,
Adewunmi Industrial Estate,
Oregun Village,
PMB 1413,
Ikeja,
Lagos.
G:
Mechanical Lloyd Limited,
Ring Road West Industrial Area,
PO Box 2086,
Accra.
SL:
Aircold Engineering Limited,
Howe Street,
PO Box 1416,
Freetown.
SEE ADVERTISEMENT.
Ruston Diesels Limited,
Vulcan Works,
Newton-le-Willows,
Merseyside,
WA12 8RU, UK.
Tel: 09252 5151.
Representatives:
N:
Machinery & Electrical Equipment,
(Division of UAC of Nigeria Ltd),
1 Taylor Road,
PMB 1015,
Iddo, Ebute-Metta,
Lagos.
G:
Machinery Services div. of GCMT,
PO Box 3400,
Accra.
Range: 500–5,000 HP.
HX 627131.

S

Société Alsacienne de Constructions Mécaniques de Mulhouse,
1 rue de la Fonderie/BP 1210,
68054 Mulhouse, Cedex,
France.
Tel: (89) 46 01 08.
Telex: SACMM 881699F.
Range: 720 HP to 8,400 HP.

Sulzer Bros. Limited,
8401 Winterthur,
Switzerland.
Tel: 052 811122.
Representatives:
N:
Mr. Jean-Claude Godel,
Sulzer Delegate,
c/o Mandilas Limited,
PO Box 35,
Lagos.

Y

Yanmar Diesel Engine Co. Limited,
1-1, Yaesu 2-chrome,
Chuo-ku,
Tokyo, 104
Japan.
Telex: 0222 2310 & 0222 4733.
Representatives:
N:
Holt Engineering,
Plot 3 & 4 Adewunmi Estate,
PMB 1413,
[illegible]
[illegible]
[illegible]
[illegible] Afrikaansche
[illegible]pagnie,
[illegible] Box 281,
[illegible]rovia.

[illegible]erie Freres Abidjan,
[illegible]route de l'aeroport,
[illegible] 2, 7,
[illegible]76,
[illegible]am.

[illegible] Michael Motors Limited,
[illegible] Box 803,
[illegible]own.
[illegible] 4 HP to 18 HP.

Circle No. 268 on enquiry card

UNIDO looks for alternatives

Some 85 per cent of the energy available in oil, gas and coal fields is still lost on the way from extraction through upgrading, conversion, transport, distribution, storage and end-use. This was stated by K. Brendow, Deputy Director (Economic Commission for Europe), at a recent meeting in Venice where the United Nations Industrial Development Organisation (UNIDO) assists developing countries in their energy programmes. The energy systems of the developed countries, he said, at present operate at an efficiency of only 15 per cent.

Food, energy imports and debt servicing, the Economic Commission for Africa estimates, will swallow up as much as 60 per cent of the export earnings of oil-importing African States, and the fact that they can no longer rely on cheap oil for their long term needs makes the future of their industrial development look grim unless alternative sources of energy are tapped.

Africa's current share of industrial output is less than one per cent, and it was largely with the object of doubling it by the end of this century to raise living standards that the Industrial Development Decade for Africa (1981–1990) was proclaimed last December.

Commercial energy consumption in the region, which accounts for half of Africa's needs, is roughly 10 per cent of the Third World's total consumption of some $58 billion in 1980. The other half comes from firewood, animal dung, charcoal and crop residues. To get firewood for cooking their food, people in rural areas spend the best part of a day searching for it.

An all-out effort is being made to cut back on energy consumption and reduce waste. Conservation measures include energy-saving modifications to buildings and equipment. At the same time, the search for oil and alternative fuels is being stepped up. There are good prospects, according to the World Bank for some 17 African countries to start or to increase oil production. Six of these do not now produce oil. Some nations have plans to exploit the huge quantities of oil trapped in tar-sands and shales, while others are involved in the development of coal, natural gas, hydro and geothermal power. Kenya, for instance, has embarked on a major project which will make it the first African country to harness geothermal energy on a large scale.

Hydro-electric energy, which took a back seat in the past, is now being given priority in a number of countries. Africa has a vast hydro potential but only two per cent of it is presently being exploited. While interest in nuclear power is growing, ambivalent national attitudes over costs, safety standards, disposal of spent fuel and the dangers of nuclear proliferation have made the nuclear option attractive to only a few African countries.

With abundant sunshine and greater solar radiation than in industrialised countries, Third World nations are seriously involved in developing what is after all free and inexhaustible, and virtually free of transport, distribution and pollution problems. Almost every African country has at least one or two projects powered by solar energy. These range from desalination plants in Sudan to railway stations in Togo linked through photovoltaic-powered radios.

In weighting the relative merits of other alternatives, most of the apparently attractive energy systems drop out of the reckoning against such criteria as cost and capital investment. Two potential sources gaining interest are biogas and biomass. Biogas technology is embodied in a biogas plant using human or animal waste mixed with water as an input. They are popular mainly in India and China and, following an international meeting organised by UNIDO and China in Peking last July, several developing countries in Asia and Africa have expressed interest in setting up biogas plants.

Used for cooking and small-scale power generation, the plants have two main parts: a digester – which is generally dug into the ground, lined with masonry – into which input material is introduced, and an iron drum which is placed on the slurry to cut off air and permit the fermentation process to take place. Biogas plants can be made in various sizes ranging from 2 cubic metres (family size) to 140 cubic metres (community size).

UNIDO's role involves assistance in the evaluation of the potential prospects and viability of ethanol production as a gasoline additive, as well as giving advice on the technology and financing of such programmes. To assist African and other countries, UNIDO has asked the CTP, the Brazilian technology centre, to develop a cost model of fermentation ethanol production for developing countries.

'Prime power' engines

Perkins Engines has launched a new scheme whereby its national distributors around the world can use their own workshop facilities to tailor basic Perkins units on the spot and therefore meet the specific demands of both new and existing customers.

Under the scheme – designated 'Prime Power' – Perkins will supply these distributors with base diesels in the 40–101hp range and suitable for a variety of agricultural and industrial applications. The distributors will also be supplied with a variety of option packages of additional components, each designed, and made up to meet, the individual requirements of different market areas.

The three base engine units involved are: the three cylinder direct injection D3.152 engine, the four cylinder 4.236 and the six cylinder 6.3544. Each base engine will be supplied at 2,250rpm, but will be capable of being adjusted by the distributor within the 2,000–2,400rpm speed range.

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Electricity Congress

The Union of Producers, Conveyors and Distributors of Electricity in Africa (UPDEA) is to hold its triennial congress in Libreville, Gabon, from June 1 to June 5 this year. The theme is to be "African Electricity Companies and the Energy Challenge". Membership of the Union is open to companies, organisations or enterprises whose principal activities provide a public service in the field of generation, transmission and distribution of electrical power.

PO Box 281,
23 Buckle Street,
Banjul.

L

Lombardini,
PO Box 5,
Reggio E,
Italy.
Range: 5 to 70 HP.

M

Mirrlees Blackstone (Stamford) Ltd,
Ryhall Road,
Stamford,
Lincolnshire,
PE91 UH,
UK.
Tel: 0780 4641.
Telex: 32234.
Range: 150kVA to 2,440kVA.
SEE ADVERTISEMENT

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(Dept., VVA),
Postfach 2040,
7990 Friedrichshafen 1.
West Germany.
Representatives:
N:
Leventis Technical Limited,
Iddo House,
PO Box 159,
Lagos.
Tel: 41310/9.

Motoren-Werke Mannheim AG,
D-6800 Mannheim 1,
Carl-Benz Strasse,
West Germany.
Representatives:
N:
Nigerlink Inter. Ass,
7th Floor,
Western House,
8-10 Broad Street.
Lagos.
Tel: 21 662/3.
Telex: 21107 NG.
IC:
Somotec,
BP 90388,
Zone Industrielle de Vridi,
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P

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Stokvis (Nigeria) Limited,
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Ebute-Metta,
Lagos.
Tel: 834609/83339.
Cable: Toolco.
Telex: 11117 net TDS.

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Salop,
UK.
Tel: Shrewsbury 52262.
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Representatives:
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Oregun Village,
PMB 1413,
Ikeja,
Lagos.
G:
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Accra.
SL:
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PO Box 1416,
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Vulcan Works,
Newton-le-Willows,
Merseyside,
WA12 8RU, UK.
Tel: 09252 5151.
Representatives:
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(Division of UAC of Nigeria Ltd),
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PMB 1015,
Iddo, Ebute-Metta,
Lagos.
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Machinery Services div. of GCMT,
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Accra.
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HX 627131.

S

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68054 Mulhouse, Cedex,
France.
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Telex: SACMM 881699F.
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Switzerland.
Tel: 052 811122.
Representatives:
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Mr. Jean-Claude Godel,
Sulzer Delegate,
c/o Mandilas Limited,
PO Box 35,
Lagos.

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Chuo-ku,
Tokyo, 104
Japan.
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Representatives:
N:
Holt Engineering,
Plot 3 & 4 Adewunmi Estate,
PMB 1413,
[illegible],
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[illegible]
[illegible] Afrikaansche
[illegible]pagnie,
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[illegible]rovia.
[illegible]derie Freres Abidjan,
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Making common accidents uncommon

*An automatic collision prevention system which should reduce the risk of accidents when industrial cranes are used has been developed by a British company. *Philip Rowley describes this technology.*

COLLISIONS INVOLVING overhead travelling cranes are, unhappily, not uncommon. At different times they have been caused by inexperienced or inattentive drivers; by incorrect or misunderstood hand signalling; by obstructions blocking the driver's line of sight; and, unhappily again, by the failure under industrial conditions of a variety of automatic limiting devices and proximity-detection systems designed specifically to prevent such accidents.

What, then, are the main requirements of an automatic collision-prevention system?

1. It should accurately detect the approach of a moving crane to within several predetermined distances from a hazard. Such a hazard may be another crane operating in the same bay, or it may be a fixed obstruction such as an end-wall or large machine. The set distances should be easy to alter for different applications, depending on the masses and speeds of the cranes involved, the weight of the loads they may be carrying and the braking arrangements available.
2. The equipment must provide a progressive response that brings the crane and its load safely to rest before it reaches the hazard. (Note that the effect of *sudden* braking on a heavy hanging load can be just as dangerous as a collision.)
3. It must operate reliably and with minimum attention in industrial environments. Such environments may be dirty, hot and corrosive; may be "noisy" in almost any part of the frequency spectrum because of nearby machinery or processes; and may change from moment to moment because the crane itself moves.
4. If any part of the system should fail, the user must be warned immediately and automatically, both in the interests of safety and so that the equipment may be serviced. The faulty component should be self-identifying so that operation can be restored quickly and easily (e.g. by replacement of a printed circuit board or an antenna without the need for fault-diagnosis by experts.

Environmental problems

Many different systems have been devised which operate satisfactorily enough in the development laboratory, but which tend to fall down when exposed to the 'real-life' industrial conditions of Criterion No. 3 above.

'Wired' systems, for example, employing some sort of balancing network, are highly vulnerable to dirt on [illegible] contacts and to ambient temperature changes, and have been found to require unacceptably frequent adjustment to maintain reasonable standards of performance. Their installation costs are high, and the cost of the copper conductors, which must run the whole length of the crane bay, also makes them very expensive in first cost.

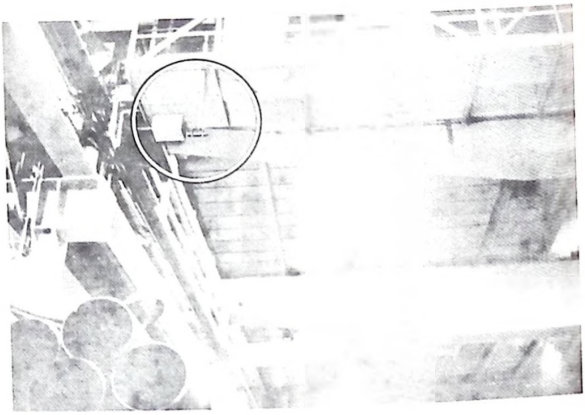


Fig. 1.

Other systems, which use photoelectric, infrared or ultrasonic detectors, have proved vulnerable to dirty atmospheres, ambient lighting changes and interference from nearby heat-sources or machinery as well as being unsuitable for detecting more than one distance. Again, radar-based systems are costly, and require critical setting of the reflector-plate, which can easily be disturbed; they and VHF and UHF radio systems can also suffer from spurious signals reflected from other objects in the crane's changing environment.

Because of these deficiencies, the majority of crane users today still rely primarily on the experience of trained crane operators – possibly backed up by some sort of mechanical buffer to mitigate the results of their mistakes!

However, this is not a satisfactory arrangement. The problems of manipulating a heavy, often dangerous load through a workshop filled with people, plant and machinery deserve the operator's full attention. Even in a single-crane shop, end-walls and fixed structures present hazards enough, and if one considers the position of the driver controlling the middle crane of three – having to keep track of two other moving hazards, one on each side, as well as his load – the need for a reliable automatic proximity-detection system is obvious.

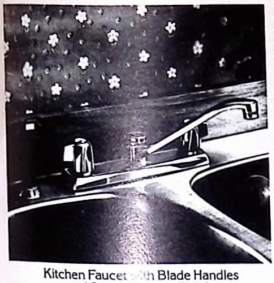
Low-frequency radio

Three years ago, a completely new system was launched in North America, and the field experience of it now runs to about 4,000 system-years. The 'Telelimit' system makes use of low-frequency radio waves and of a phenomenon known as the 'Near-Field Induction Effect'. At propagation distances below about one-tenth of a wavelength (wavelength being around 1245–1485m for the frequencies employed, which lie between 202 and 241kHz), the amplitude of the signal radiated from the transmitter changes approximately as the inverse cube of distance. This steep relationship means that measurement of signal strength at a receiving position can be made to give a very accurate assessment of the distance-away of the transmitter.

Three other factors are vital. First, these low-frequency waves are neither reflected nor screened by metal objects (they pass through them virtually unaltered), so such objects cannot affect the estimation of distances. Second, no signals able to con-

continued

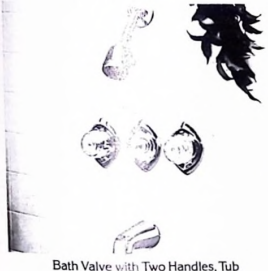
*W. Philip Rowley, MBE, CEng, FIERE is director of Telemotive UK Ltd., Walton-on-Thames, England.



Kitchen Faucet with Blade Handles and Spray. Chrome Finish.

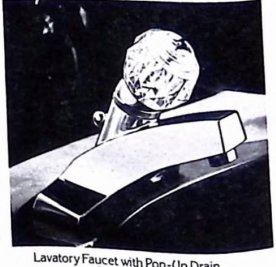
Widespread Lavatory Faucet with Pop-Up Drain. Antique Brass Finish.

Bath Valve with Lever Handle, Diverter Spout and Shower Assembly. Chrome Finish.

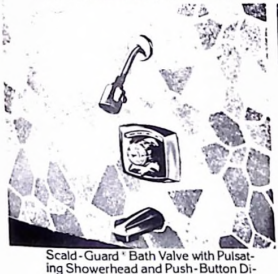


Bath Valve with Two Handles, Tub Spout, Pulsating Showerhead, Push-Button Diverter, Chrome Finish.

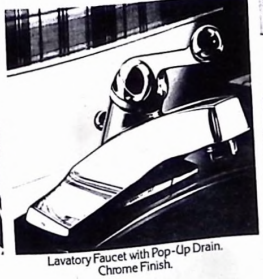
Widespread Waterfall™ Lavatory Faucet Rotary Pop-Up Drain. Chrome Finish.



Lavatory Faucet with Pop-Up Drain. Gold Finish.



Scald-Guard® Bath Valve with Pulsating Showerhead and Push-Button Diverter. Antique Brass Finish.



Lavatory Faucet with Pop-Up Drain. Chrome Finish.

Kitchen Faucet with Spray and Dispenser. Chrome Finish.

DELTA® FAUCET. AMERICA'S FAVORITE WASHERLESS FAUCETS.

In 1953, Delta revolutionized the industry by introducing the first single-handle faucets with the washerless design.

In 1971, Delta followed with two-handle washerless faucets.

Since then Delta has added hundreds of designs and styles, making it one of the world's most complete lines of washerless faucets.

The Delta Award Collection offers "Glamour for the Eighties" with a line of beautifully designed faucets in rich decorative finishes of Antique Brass, Bright Gold, Satin Gold, and Modern Chrome.

Delta chrome faucets combine versatility and modern design in a full range of styles for every need and every taste.

No wonder people in America specify Delta more often than any other faucet for their kitchens and bathrooms.

Delta Faucets. American quality with international appeal.

For more information contact Miran P. Sarkissian
MASCO CORPORATION
Masco International, 21001 Van Born Road, Taylor, Michigan 48180, U.S.A.
Telephone (313) 274-7400—TWX 810-221-5120

Circle No. 236 on enquiry card

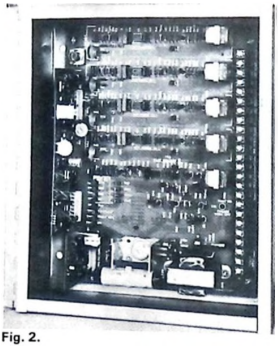


Fig. 2.

fuse the receiver are generated by industrial processes. And third, there are enough different frequencies available to equip many cranes operating in one factory.

The Telelimit system (Fig. 1) makes use of a small radio transmitter in a protective box mounted on each hazard, and a matched receiver on the crane. Each of the radio units has a small ferrite-rod antenna. The receiver (Fig. 2) is wired directly into the crane-control system, the type of controller (cab, pendant or radio) being immaterial. The equipment can be installed quickly and inexpensively and requires no routine maintenance thereafter.

Fig. 3 shows a simple application with a single crane and two transmitters attached to the end-walls. As the crane approaches either transmitter, three successive stages of warning or control action are triggered in the corresponding receiver. The distances-away at which the contact-closures occur, and the corrective action taken at each are independently selectable for each application. Typically, at the first set-point (which can be set anywhere between 15 and 30m), an audible warning is given. If the crane reaches the second set-point (settable between 12 and 21m), it is automatically decelerated electrically. At the third point (3–12m), the power supply to the crane long-travel motion is cut, the main brake is applied, and the crane is brought to a controlled stop.

In some applications it is preferable to initiate deceleration at the first set-point as well as sounding a warning, in order to ensure a more progressive slowing-down that prevents excessive swinging of the load. Each point can be set with an accuracy of about ± ten per cent.

Moving hazards

To prevent crane-to-crane collisions, combined transceiver units are fitted to each adjacent pair of cranes (Fig. 4); and as the vehicles approach one another, corrective actions are applied to both. End-wall protection can be provided as well, if desired. A system of this kind is installed at the electrical transformer repair shop of **Allis-Chalmers** in Wisconsin, USA (Fig. 5). Two 150-ton capacity cranes and one

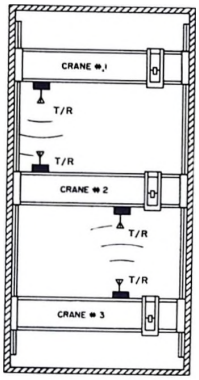


Fig. 4.

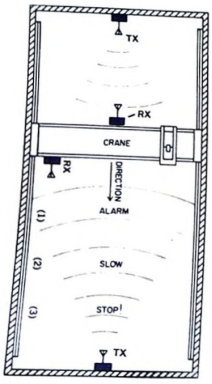


Fig. 3.

smaller crane share the same rails, and operate at speeds up to 1m/s in a very long bay. Crane-to-crane and crane-to-wall protection are provided, with three successive stages of deceleration triggered at distances of 21m, 14m and 7.5m. Once the crane has stopped, a timed bypass allows it to be driven slowly into the danger zone, which is necessary for certain duties.

Another type of application (Fig. 6) is where cranes operate at two different heights within a bay. Danger arises only when the upper crane is carrying a load. At other times the cranes may pass freely. Here, therefore, the transceiver on the upper crane is turned on automatically, by a limit-switch, only when the hoist is in a lowered position. A similar arrangement has been used to protect tracked vehicles on the ground from loads carried by an overhead crane.

Safety after failure

An important consideration with any safety system is what happens when it fails (as all systems occasionally do). The Telelimit system incorporates self-checking circuits which, if they detect any fault, give an immediate, distinctive audible warning to

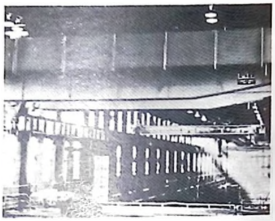


Fig. 5.

the crane operator to indicate that the responsibility is back with him. This is safer than an equipment which, for example, stops all motion which could be a very dangerous nuisance at certain moments in the crane working cycle. As an additional safeguard, the third, most critical, set-point is followed up by a fourth, normally reduced set perhaps 1m closer and producing automatically the same corrective actions.

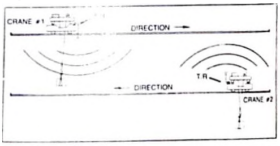


Fig. 6.

Of the more than 2,000 Telelimit systems now operating in North America, the great majority are fitted to overhead travelling cranes. However, several West Coast ports including Tacoma (Fig. 7) have applied the system to dockside gantry-cranes; and other applications include driverless materials-handling vehicles such as locomotives and ingot buggies. In a tractor factory, Telelimit has recently been fitted to the front and rear of large air-cushion-supported pallets on which tractors are carried about.

Circle No. 13 on enquiry card

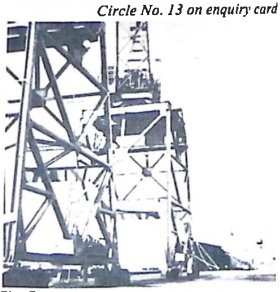


Fig. 7.

West African
CONSTRUCTION

L400C crawler loade[r] Terex.

Drop in cemen[t] prices

A noticeable drop [in] the price of bulk cement has been recorded in Lagos, from between ₦5.50 and ₦7 per bag of 20kg to ₦4.50 and ₦4 per bag, in cement depots around the capital. According to the Nigerian Business Times, cement imports have fallen off, while as a result of the mass housing schemes being undertaken all over the country, most cement companies have stepped up production. State governments, in a bid to save foreign exchange, have tended to build with locally manufactured cement to avoid importation.

Records show a total of 1,897,000 tonnes of cement consumed in the country in 1979/80. Out of this amount, imported cement accounted for 587,448 tonnes, leaving 1.3 million tonnes from local production. Available statistics estimate the amount of cement now produced locally to be just over 4 million tonnes annually, with the West African Portland Cement Company (WAPCO) producing the greatest share of about 1.5 million tonnes.

Although WAPCO appear to have hit their capacity production, many smaller plants are now functioning in the country, with more being commissioned by various state governments. A trend is beginning to emerge which leans toward local cement companies for most of the cement needed for building projects.

Equipment fleet to West Africa

Nineteen identical sets of International Pay loaders, crawler dozers and hydraulic excavators are included in a $23 million International Harvestor equipment package enroute to Cameroun for use in road-building projects.

The shipment, loaded at the Port of Montreal, is composed of 19 sets of a 530 Pay Loader, TD-15C crawler dozer and 630W hydraulic excavator. Graders, compactors, lowboy trailers to transport the machinery from project to project, and International trucks are also included. The look-alike fleets are destined for 19 administrative districts in Cameroun.

A complete training school will be established to increase the technological self-sufficiency of Cameroun technicians in various phases of construction equipment maintenance and operation.

Harbour contract in Togo

Further developments are planned in Togo for the commercial and industrial harbour at Lomé. Tenders have been invited for a contract to construct a second £20 million pier in the commercial harbour. The new pier will more than double the harbour's official handling capacity of 400,000 tonnes, although it is currently handling 600,000 tonnes a year, 50 per cent over its planned handling capacity.

An International 530 Pay Loader being loaded at the port of Montreal. This is part of a $23 million exporting package.

New crawler dozer line

Terex Corporation, the largest of the IBH group of earthmoving equipment manufacturers, has expanded its operations to include a line of crawler dozers. The new line consists of the Terex L400C, 87 flywheel (65kW) horsepower crawler loader and the Terex L600C, 144 flywheel horsepower (107kW) crawler loader. The L400C is equipped with a 1.5cu.yd standard bucket and the L600C is equipped with a 2.5cu.yd standard bucket.

Both the L400C and the L600C are powered by four-cycle, six-cylinder, direct injection diesel engines. The units also have full powershifting transmissions with three speeds forward and three speeds reverse.

Road construction contract

Previously awarded to Songhai Construction Company, the contract for the Benue State Ayangba-Iyale-Abejukolo road project has been reassigned to the Road Construction Company. In a government change of plan, the new road will reach more towns and villages than originally specified, bringing the cost of the contract up to nearly ₦20,500,000.

To be completed within 12 months, the road will be 84km long. Benue State Government has also budgeted ₦48 million for the construction of rural roads throughout the state in the current fiscal year.

Prefabrication for insulation

Special purpose buildings have become increasingly important among commercial and technologically oriented businesses. For example, certain aluminium aircraft parts, epoxy resins, solvents and other liquid chemicals all require a temperature-controlled area to guarantee proper consistency and flexibility during production. In the processes of munitions manufacturing, cement mixture testing or in seed germination research, working conditions need to be precisely temperature-regulated.

Bally Inc. have developed a range of prefabricated buildings for these industries, engineered and constructed to provide precision control of temperature, humidity or sound. Their systems allow for maximum insulating efficiency, ease of dissembly and reassembly where relocation is expected, and the option of enlargement in case of future needs.

The buildings are assembled of metal-clad 4in thick foamed-in-place urethane panels with exposed tongue and groove edges. The outer and inner metal skins are formed with double breaks on vertical edges to enhance the bond between the foam and metal. The metal skins seal the urethane and prevent moisture absorption so that insulation efficiency is maintained. The resulting structural strength eliminates the need for wood structural members and 100 per cent of the panel is insulated.

Panels are joined by a fastening device in two parts – a locking pin and a locking arm – actuated by a hex wrench. The joining system consists of male devices on one side and end of a panel, connected by metal straps to matching female devices on the other side and end.

A wide variety of doors, ceilings and windows are available within the Bally system, including floor panels capable of supporting 600lbs per sq. ft. Special purpose buildings can be supplied in sizes from very small (2,000sq. ft. or less) up to the 10,000 – 30,000sq. ft. range. *Circle No. 11*

Tower/gantry cranes operate above ground congestion

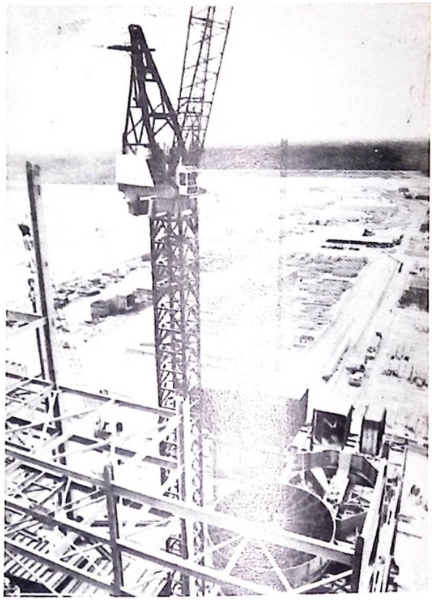
Link-Belt tower / gantry cranes, manufactured by **FMC Corporation**, are designed to operate above on-the-ground congestion for a clear 360° swing area, mounted on either a tower, bogie or gantry. The cranes are ideally suited for use in heavy construction, offering contractors the advantage of handling most loads on a single part line for fast hook speeds. In addition, they offer long reach, increased lifting capacity capabilities at both minimum and extended radii, high hoist line pull and infinitely variable three-speed load raising/ lowering for greater crane production. The machines incorporate smooth and responsive pneumatic controls to activate major crane functions.

The operator's cab features a specially engineered control console for increased operator efficiency. Short throw levers control the main, anxiliary and boom hoists, while foot pedals control the swing. Easy-to-read instrumentation and gauges monitor vital machine and engine systems including a load moment device that warns operator against crane overload.

Circle No. 12

New backfill tamper

Stanley Hydraulic Tools has introduced its model RA55 Tamper for backfill tamping of trenches and patching of asphalt pavement. The TA55



weighs 23lb and offers maximum compaction with 2,300 blows per minute and a 1in stroke on a 6in-diameter shoe. Available in 1ft and 2ft handles and equipped with a "dead-man" safety valve, the TA55 only contains two moving parts, for maximum tool performance and minimum maintenance.

Circle No. 14

Heavier excavator

A 230,000lb hydraulic excavator, the newest addition to the 100 Series line, was introduced recently by **Bucyrus-Erie**. The 500-H brings all Bucyrus-Erie 100 Series features to a heavier machine. These features include demand/ control hydraulics for maximum digging production using full engine horsepower, and automatic response to dig cycle requirements, providing optimum force and speed during each phase of the dig cycle.

Checks of battery, hydraulic filters, hydraulic level and pressure, and engine oil pressure plus lube of hoist and dig cylinders can all be made easily from the central service access area. Tri-armor housings are used for machinery house and operator's cab, insulating against noise and temperature extremes.

Circle No. 15

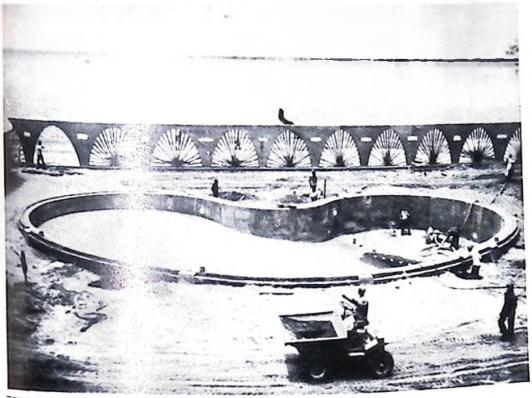
Portable hydraulic clamping

Enerpac have devised a method of efficiently welding the mixing fins of concrete mixing drums requiring less labour. Their new product is a lightweight, 5-ton-capacity RC-57 cylinder that has been welded to a C-clamp. This unit, powered by a PA-133 air-hydraulic power pump, is used to hold the mixing fins in position for the welding operation.

The use of this hydraulic system resulted in 60 per cent labour savings. Previously, men were required to do this operation manually. Now, one man can use the foot-actuated pump to power the clamping cylinder and work with both hands.

Circle No. 16

Seaside success



The swimming pool under construction.

THE INTERNATIONAL construction and engineering group, Balfour Beatty, is particularly strong in the design, engineering, project management, construction and installation of major developments worldwide. Its work is undertaken by four Operating Companies, each of which is largely autonomous but capable of combining, under a single project manager, to undertake multi-discipline contracts of whatever size and complexity. Some of the recent contracts undertaken in West Africa by these four Operating Companies include: the Kainji Hydro-Electric Development, Nigeria (Balfour Beatty Engineering – Principals: Niger Dam Authority); the Central Bank of The Gambia, Banjul (Balfour Beatty Construction – Architects: Victor Heal & Partners); buildings for rural development in The Gambia (Balfour Beatty Construction – Principals: the Gambian Ministry of Agriculture), and a 33kV pole-mounted substation, part of the Eastern Sector of the Countrywide Electrification Project, Nigeria (Balfour Beatty Power Construction – Engineers: Motor Columbus).

Shortly before Christmas last year – December 11, 1980, to be precise – the President of The Gambia, His Excellency Sir Dawda Kairaba Jawara, officially opened the New Atlantic Hotel. The hotel, with its 240 air-conditioned bedrooms, is situated on the outskirts of the capital, Banjul, and is the first hotel in the country built to international standards.

Speedy

The construction of the hotel was completed very speedily indeed. The contract was awarded in August 1979 and work began on September 1. The whole was completed in 15 months, in time for the start of the tourist season.

The majority of the work on the hotel was done by Gambians; about 500 were employed on the project. As had been the case in previous construction projects in The Gambia, regular training sessions took place in which site workers soon became qualified as carpenters, fitters, draughtsmen, accountants and foremen; some developed management skills and have gone on to become supervisors, office managers and site agents.

The overall period covering organisation of finance, design, construction, furnishing, equipping and commission lasted no longer than 18 months. This speed of operation was possible thanks to the initial establishment of an effective construction group which consisted of financial, architectural and project management teams, the hotel managers and UK support services. From the outset a close relationship developed between the hotel owners, the Nigerian Investment Board of The Gambia, and Balfour Beatty. Back in the UK shortly after the completion of the project, senior members of Balfour Beatty were keen to emphasise how helpful Gambian government officials had been throughout the period of construction.

Time was not the only strictly limited factor in the construction of the hotel. The feasibility study set tight parameters as far as the total cost of the project was concerned: the hotel had to be built to a budget of approximately £20,000 per bedroom.

Project breakdown

Client
The Government of The Gambia
Turnkey Contractors
Balfour Beatty Construction Ltd
Architect
J. van Melick
Electric and Mechanical Engineering Services
Balfour Kilpatrick Ltd
Structural Design
Balfour Beatty Engineering Ltd
Bankers
Standard & Chartered Ltd

This required an extremely high level of control over the cost plan, the use of indigenous materials wherever possible, and an intensive purchasing operation in the UK and elsewhere to ensure that the most cost effective imports were obtained.

Economy

Economy and speed were indeed achieved with the use of local building

continued on page 118.

A wing of the hotel under construction. Balcony decorations were cast on site.

materials – but as Mr J. van Melick, the hotel's architect, points out, this commonsense policy was less straightforward than it sounds, because The Gambia is an alluvial basin with no outcrops of hard stone and no deposits of gravel, and therefore even concrete aggregates of high quality are usually imported. However, by experimentation and the experience already gained in construction work in The Gambia, Balfour Beatty were able to produce a design which allowed the local lateritic aggregate to be used; the technique of making alluvial material into a form of load-bearing material was perfected. The need for imported materials for roofing was eliminated by the extensive use of thin shell barrel vaulting. Because the local rather weak aggregate had to be used in these structures, full-scale testing of the barrel vaults was carried out before construction commenced.

Due to the lack of local resources, many of the services which would normally be provided by specialist subcontract had to be carried out under the direction of the Project Manager. This even included the landscaping, and one of the first tasks that he performed when he set himself up at the site was to create a nursery for all the trees and shrubs which would eventually be used in the landscaping of the hotel.

Another feature of construction was the use of finishing trades such as plastering and joiner work, for which there was no previous experience in The Gambia other than amongst the labour force who had worked on the construction of the Central Bank of [illegible]bia. The hotel had to be built to a [illegible]ighter programme, and was a large[illegible]ct, so even the labour resources [illegible]d from the Central Bank project had [illegible] supplemented. ●

General view of construction under way at the site, with [illegible]om wing, swimming pool in the foreground, and thatched bar between.


TRACTOR &
EQUIPMENT
A DIVISION OF UAC OF NIGERIA LIMITED
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SPREADING A CLIMATE OF PROGRESS
UAC
TRACTOR & EQUIPMENT
INDUSTRIAL FACILITY
INAUGURATION
25TH NOVEMBER 1980
CONSTRUCTIVELY

CHAIRMAN'S STATEMENT

Mr E. K. O. Shonekan,
Chairman, UAC of Nigeria Limited

UAC of Nigeria Limited through its Tractor and Equipment Division has been the accredited Caterpillar dealer in Nigeria for over 32 years. During these years, tremendous changes have taken place in the economic, environmental and socio-cultural spheres of our country – Nigeria.

UACN has grown and progressed with the country, having been engaged in diversified business interests covering various aspects of industrial, technical, manufacturing and commercial endeavours which have contributed in no small way to Nigeria's economic development. We are proud to have been associated with Nigeria's economic growth and share its aspirations for the future.

Since 1948 when UAC acquired the dealership of Caterpillar products, it has through T&E engaged in activities in such vital areas of the nation's development as road construction, communications network, housing, rural development, agriculture and forestry, ports and harbour and general infrastructural development. These activities are carried out through the sales and service of Caterpillar and allied products of Rome, Fleco and Albaret. Every piece of equipment sold is backed up by an efficient product support system, unsurpassed by competition.

From its Lagos base in the late 1940s, Tractor and Equipment has spread over the country with 12 depots offering services to customers on equipment selection and application, wide parts availability and various other related services.

As at today Tractor and Equipment Division of UACN have approximately 2,000 Nigerian employees out of a total UACN staff strength of 20,000. The Division has 200 management staff of which over 90% are Nigerian.

UACN will continue through Tractor and Equipment and its other Divisions to offer services which foster the rapid economic progress of our great country – Nigeria.

PRODUCT LINE

Tractor and Equipment offer the most complete product line in the industry . . . Caterpillar machines and engines for landclearing and forestry, for petroleum industries, marine applications, mining, construction, materials handling and earthmoving.

They dig, push, rip, lift, haul, level, grade, compact, load, carry and provide power – to mention a few of the uses. Caterpillar products are at work throughout Nigeria.

CATERPILLAR D10
Today's most technologically advanced Track Type Tractor – the world's largest most productive bulldozer . . . 700 horsepower . . . weight 86,320kg.

LAND CLEARING AND DEVELOPMENT EQUIPMENT

Tractor and Equipment supply a wide variety of attachments custom built to utilise all the productive power your Caterpillar built tractor has to offer. Typical of these are the Land Clearing and Development attachments manufactured by two of the world's leading specialists – Fleco Corporation; Rome Industries.

D7G Tractor with Fleco Root Plow as demonstrated at T & E seminar 'Operation Land Development'

Application
The root plow is designed for killing brush and growth by undercutting vegetation at the crown or bud ring. Large roots are forced to the surface. Root plows also shatter hard surface crusts resulting in better water retention as well as preparing a good seed bed.

D8K Tractor with Fleco TP8 Tree Pusher, land clearing for Palm Oil Estate Development

Application
Because it removes the entire tree, the Tree Pusher is a highly effective tool when the land clearing project requires that no stumps be left in the ground.

D8K Tractor with Rome TYH16-36 Hinge Type Offset Disk Harrow on demonstration at Bagauda Lake, Kano.

Application
The TYH is designed for the most severe land clearing jobs requiring equipment of maximum strength. It is built for clearing land, breaking newly cleared land or whenever both penetration and maximum strength of equipment is necessary.

A complete line of Land Clearing, Development and Land Forming equipment in a wide variety of configurations is used successfully throughout Nigeria. Your T & E Agricultural Sales Engineer will help you to select the correct equipment for the job to give you the greatest return on your investment.

FORESTRY EQUIPMENT

In the forests . . . the yards . . . the saw mills

When you buy equipment to use in the forests or the millyard you are making a decision that will affect your profits for years to come. Machines that require little maintenance, are easy to service, do the jobs you need done, and produce according to your expectation, make a big difference.

Caterpillar equipment for Forest Products – with all these advantages and more – is noted for long service life and dependability, staying on the job day after day with minimum down time.

At Tractor and Equipment we offer you the widest selection of equipment in the industry. Your choice of eight track-type tractors, two skidders, eight wheel loaders, six track type loaders, six motor graders, three hydraulic excavators, two wheel dozers – not to mention all the different models of scrapers, off-highway trucks, lift trucks and engines.

T & E stock the extensive range of Caterpillar machines and also a wide range of accessories for building and maintaining roads, felling, bunching and skidding logs, clearing, piling, replanting, loading logs, pushing chips, stacking lumber – all the demanding and varied jobs in the forests, the yards and around the mill.

No matter what you need, Tractors, Skidders, Loaders, Graders, Excavators, etc we can supply it. Qualified Agricultural Engineers will help you select the right equipment to get the maximum benefit from your equipment investment.

Few machines receives more abuse than the skidder. It routinely drags logs over rocks and stumps often on steep grades and bad underfoot conditions. Caterpillar skidders are designed from the ground up for highest performances with matched components throughout.

Versatile Caterpillar wheel loaders can be equipped to do about any job you have. There are eight models to choose from. The range of attachments include log and lumber forks, woodchip buckets and winches.

CONSTRUCTION EQUIPMENT

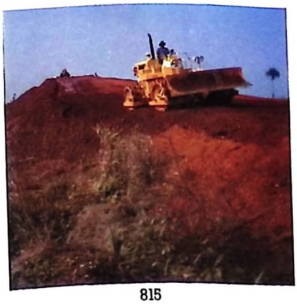
Tractor and Equipment is your direct access to Caterpillar machines actively engaged around Nigeria on projects designed to improve man's economic lot and his environment; on irrigation schemes, Airport construction, Port complex, Highways and Bridges, Housing sites, Industrial estates, Schools and Hospitals.

Over 120 models of earthmoving and construction equipment and more than 140 configurations of diesel and natural gas engines – provide an unmatched selection to meet almost any job requirement.

To complement the range Tractor and Equipment also offer
The DJB Range of articulated haulers.
The Albaret Range of Pneumatic Tyred Compactors, Vibrating Compactors, and Dead Weight Rollers for every compaction need.

657

D8K



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ALBARET

DJB.

Consider these possibilities

As the amount of choice land available around Nigeria decreases, more land previously considered unproductive must be developed. Swamps and marshy land, low-lying areas of all kinds will present a new challenge to land developers.

The need: economic earthmoving equipment with good floatation characteristics and no-compromise performance capabilities.

The solution: Cat LGP track-type tractors . . . special machines for soft underfoot conditions. These tractors are designed to furnish the performance and reliability demanded by work in mud and soft ground.

and

Day after day . . . every day . . . the refuse keeps coming. Sanitary landfilling is an engineering method of disposing of solid wastes on land by spreading in thin layers, compacting to the smallest volume and covering them with soil each working day to turn waste land into valuable development land.

MINING & QUARRYING EQUIPMENT

Nigeria possesses a wealth of mineral opportunity, tin, iron ore, coal, uranium, granite, limestone to name but a few. Caterpillar machines sold and serviced by Tractor and Equipment are actively engaged on mineral extraction throughout Nigeria on projects designed to improve man's economic lot.

Your Tractor and Equipment Sales Engineer is available to assist in economic machine selection of the Caterpillar products illustrated and Track Type Loaders, Wheel Dozers for bulk material handling, Motor Graders for haul road construction and maintenance, and off-highway Dump Trucks, 35, 50 and 85 ton capacity.

The Caterpillar D10, D9, D8K and D8K are built as tough as the work they do.

For years the D9 has been the backbone of the tractor industry, the standard track type tractor that all other tractors were measured against, and it has proved itself in production and reliability. The Caterpillar D10, D9, D8K and D8K are designed for tomorrow's demands . . . in ripping . . . in reclamation . . . in push loading . . . stripping over burden

Caterpillar Hydraulic Excavators with backhoe, or front shovel configuration handle your really tough loading jobs . . . in tough to dig materials . . . in tight cramped spaces . . . on high working faces . . . under poor ground conditions.

Caterpillar Hydraulic Excavators are known as the responsive machines. Every machine in the line responds with all the speed, power precision and versatility you need to meet today's demanding schedules. They are built to keep on producing with a minimum of maintenance . . . hour after hour, day after day, and year after year.

The Caterpillar 980C, 988B and 992C Wheel Loaders are designed to give you sustained, top production. And they are built to take the tough punishing work you do.

They deliver full buckets and fast cycles. The ease of operation will keep your Operator comfortable so he can give you top production even at the end of a long shift. The 980C, 988B and 992C are designed for simple maintenance so it gets done.

ENGINE POWER

CAT PLUS

Caterpillar power capability extends through an unsurpassed engine range for one source of supply in Nigeria.

A multitude of applications are Caterpillar powered. These include rural electrification; standby – or prime power for Banks, Hospitals, Schools, Airports, Breweries and Industry; power for vital irrigation schemes; Marine power for fishing fleets, pleasure craft, tugs and barges; power for the construction, mining and agricultural industries – for trucks, harvesters, compressors, drills, compactors, crushers, cranes, pump shovels, etc. Power for drilling platforms, oil exploration and pumping stations.

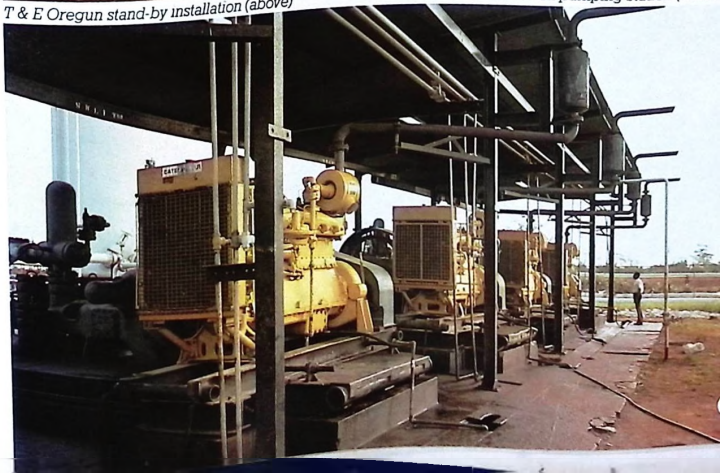
More than 1200 manufacturers offer Caterpillar engines for their equipment.

From Tractor and Equipment alone you have one source of supply; one source of product support.

Make your own enquiries – then let T & E Engineers assist you – with your power selection: T & E offer expert advice on correct economic selection of diesel Generator Sets and all your engine power needs:
Industrial Engines from 100 to 1300 BHP
Generator Sets from 50 to 930 kW
Marine Propulsion Engines from 85 to 1125 continuous BHP.

T & E Oregun stand-by installation (above)

Crude-oil pumping station (below



LIFT TRUCK RANGE

From their famous earthmoving ancestry, the Caterpillar range of Lift Trucks has inherited a ruggedness uncommon in the field of material handling equipment and today's Caterpillar extensive Lift Truck range enables you to match machine handling capabilities to your operating needs both indoors and out.

Additionally, to ensure maximum handling efficiency, there is a wide variety of mast, power, fork and tyre options – plus clamps, rotators, arms, hooks and many other attachments and accessories to give you maximum utilisation and flexibility thus ensuring greater return on your Lift Truck investment.

Today Caterpillar Lift Trucks are sold and serviced by T & A Motors exclusively in Nigeria. They are evident in an enormous diversity of material handling applications. These include Wharf operations with hundreds of Caterpillar trucks in action, Airport cargo handling, at Sugar refineries, Oil terminals, in food and distribution trades, cold stores, breweries, textiles to name but a few.

Your Tractor and Equipment Sales Representative is fully trained to assist you in correct material handling selection.

The Caterpillar Lift Truck range includes:

	Capacity
M-Series Electric Cushion Tyres – 10 models	1000 KG – 5000 KG 2000 LB – 11000LB
V-Series Diesel Pneumatic Tyres – 16 models	1500 KG – 14000KG 3000 LB – 30800LB
T-Series Diesel Cushion Tyres – 16 models	1500 KG – 13300KG 3000 LB – 30000LB
AM/AH-Series Diesel Pneumatic Tyres – 6 models	16400KG – 27200KG 36000LB – 60000LB

PRODUCT SUPPORT

CAT PLUS

Cat Plus identifies the T & E commitment to protect your investment. Tractor and Equipment have been the Caterpillar Dealer in Nigeria for over thirty years.

You can enjoy 'A world of difference' from T & E; a world which encompasses proven superior product and support services – superior in experience; in investment and in benefit available to you.

A commitment which is continuously appraised. Cat Plus is our pledge to help you gain the greatest possible return on your investment in Caterpillar equipment.

Our desire is to serve you well – these are a few concrete examples of our investment and commitment.

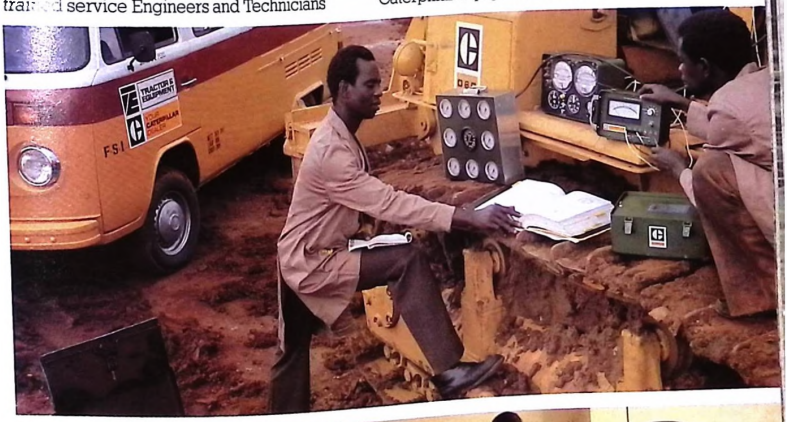
The Services

TRACTOR & EQUIPMENT Service Departments are manned by Caterpillar-trained service Engineers and Technicians having the latest knowledge of Caterpillar-built machines and service technology.

This enables us to provide you with TOTAL VALUE SERVICE which matches both your investment in Caterpillar machines and the exceptional quality of these products.

Our service departments operate large fleets of specially equipped field service vans that facilitate the provision of preventive maintenance and repair services to keep your equipment downtime to the barest minimum.

TRACTOR & EQUIPMENT has seven conveniently located Workshops fully equipped with diagnostic and specialised tooling and equipment that provide emergency and contract services to keep your Caterpillar equipment in good working condition. Service training facilities for your Operators and Mechanics can be made available at these Workshops to assist them with training that helps you keep your Caterpillar equipment running.



PRODUCT SUPPORT

CAT PLUS

Our Service Workshops incorporate general repair shops where repairs and overhauls of Caterpillar equipment component parts are carried out and tested against original specifications.

Complete engine rebuilding services are provided in our Workshops and each rebuilt engine is guaranteed for three months. All engines are run under load simulating operating conditions on our 2,500 Hp Dynanometers. Transmission and hydraulic components are repaired and rebuilt in the Specialisation Section of our Service Workshops to the original manufacturer's specifications. These are fully tested under simulated load on our specialised hydraulic test bench to ensure satisfaction and performance.

TRACTOR & EQUIPMENT offers other specialised facilities which include Technical Advisory Services, Lift Truck Repair and Maintenance services and Specialist services for Caterpillar marine engines and transmissions. We provide Custom Track Services that reduce undercarriage costs. Automatic submerged arc-welding equipment is used to ensure that worn components are remanufactured to Caterpillar specifications for the longest possible operational life.

Our service commitment and reliability starts in our large New Machine Assembly Workshops and [illegible]ies to support you throughout mach[illegible]e.

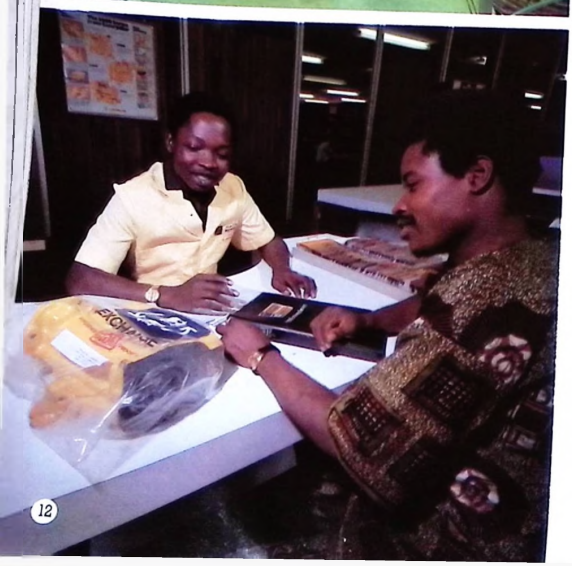
Our Branch S[illegible]e Managers will be pleased to demo[illegible] these product support services to you.

New Machine Assembly Workshop T & E Oregun

PARTS OPERATION

Tractor & Equipment is committed to providing the best possible parts service to Caterpillar users.

Ten branches throughout Nigeria carry comprehensive stocks of parts for all models. Total parts stock amounts to approximately 56,000 different items valued at ₦42 million.



Tractor & Equipment operates a Parts Exchange Service designed to save the user considerable expense and inconvenience in repairing failed units.

Our P.E.S. inventory comprises over 700 units which have been repaired to the highest standard, tested on the most modern equipment and fully guaranteed.

Serving the customer is a management and staff team of nearly 400 people all of whom have the aim of providing the right part at the right time.

Stock control is computerised and modern storage and handling equipment is employed in our parts warehouses. An inter-branch transport system enables parts to be transferred to wherever they are needed in the shortest time. Urgent parts not available in the country are ordered by telex from the Caterpillar Parts Centre in Grimbergen, Belgium from where they are air-freighted by either scheduled or charter aircraft.

Grimbergen has the facility to immediately contact every Caterpillar Parts Centre in the world in search of the most obscure parts. Line items stocked by Grimbergen is 160,000 plus.

Tractor & Equipment is rapidly expanding its Custom Track Service to cover all areas of the country.

Fully trained Inspectors will visit machines on site to measure undercarriage wear with the aim of obtaining maximum component life.

PARTS OPERATION

CAT PLUS

During each inspection a report is compiled showing the extent of wear of each undercarriage component and advising the customer what, if any, maintenance should be carried out. If necessary a fully detailed estimate of repair charges is also presented to the customer.

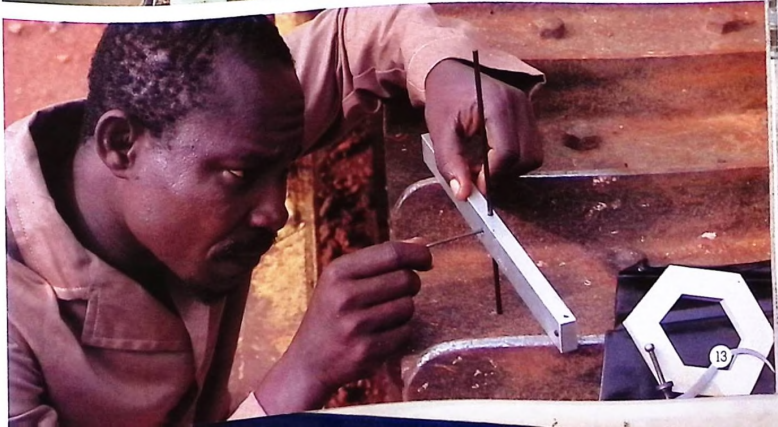
Facilities for repairing all undercarriage components exist at our Lagos, Port Harcourt, Kano and Kaduna branches. The inspection and estimate service is free and available to all users of Caterpillar track-type machines.

T... items of normal parts stock, Batteries and H...draulic Hose are used by an ever...creasing number of customers in a vari... of non-Caterpillar applications.

Caterpillar Batteries are used on Buses, Trucks, Private Cars, Stationary Engines etc and large stocks are always available. Caterpillar Hose is used in the oil and mining industries and again large stocks are always available. Both products are world renowned for performance and durability.

Coming into the Tractor & Equipment team in the very near future will be Product Support Representatives. They will be keeping in close touch with customers in all parts of Nigeria and their sole aim will be customer satisfaction.

Branch Parts Management would be pleased to show you round our well stocked Warehouses and discuss the Caterpillar Parts Support available only from Tractor & Equipment.



PERSONNEL, TRAINING AND WELFARE SERVICES

To support T & E development in the rapidly expanding Nigerian economy, every care is taken to ensure that an adequate skilled and effective workforce is available. Commensurate with the growth of the business, the personnel levels have grown substantially in recent years.

Indeed in the past five years they have quadrupled to the existing strength of almost 2000 of which approximately 10% are Management Staff.

Recruitment

Skilled manpower is obtained through a process of careful selection, positive recruitment procedures and progressive training. Continual contacts are established with Technical and Educational Institutions and other sources.

Training

Tractor & Equipment is committed to and excels in the training and development of staff at all levels both within and outside Nigeria.

Tractor & Equipment run a modern training complex for theoretical and practical training at the new Oregun Facility. Additionally, T[illegible] operate a residential Training School in Kano where instruction in well equipped workshops is carried out by experienced instructors.

The technicians subsequently return to their respective branches with new skills, abilities and an increased awareness of their individual and increasing contribution to T&E services.

To further emphasise Tractor & Equipment determination to develop its own expert staff, overseas training is arranged for selected personnel from all departments. This training covers all aspects of development requirements ranging from participation in International Seminars to service training in factory training schools.

Welfare

The improvement of personal skills and techniques goes hand-in-hand with the provision of medical and welfare facilities. In common with their colleagues of other Divisions of UAC of Nigeria all employees of Tractor & Equipment receive free medical advice, treatment and drugs. The new facility at Oregun has a modern Clinic with a resident Senior Staff Nurse and other medical personnel including a visiting Doctor.

Other welfare arrangements at Oregun include the provision of excellent Canteen services, individual Lockers and Washroom/ Shower facilities.

Tractor and Equipment, endeavour to create worthwhile careers for all their staff. This is demonstrated in the opportunities given to individuals to acquire skills, exercise responsibility, experience achievement, obtain recognition and gain personal ambitions.

THE FUTURE

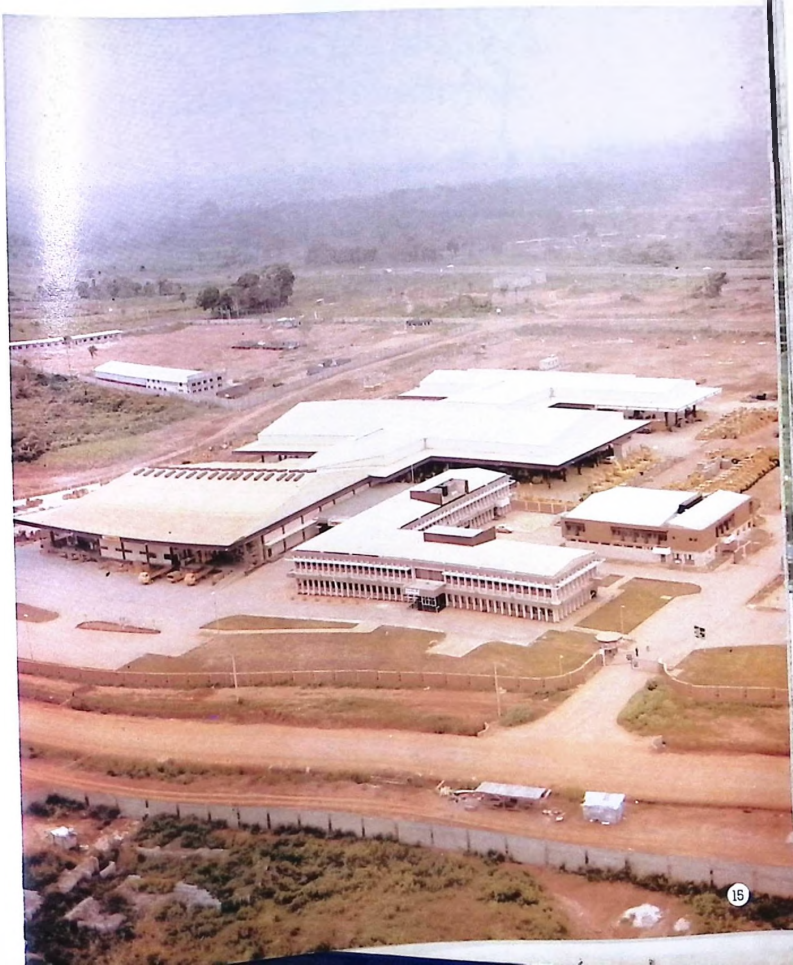
In a great nation like Nigeria with its massive potential for progress, T & E faces the future with optimism. But optimism alone is insufficient. The real need for grasping the exciting opportunities in Nigeria today is twofold.

The first is an ongoing movement in technical development; the second is centred on training the men to handle the escalating demands that progress imposes.

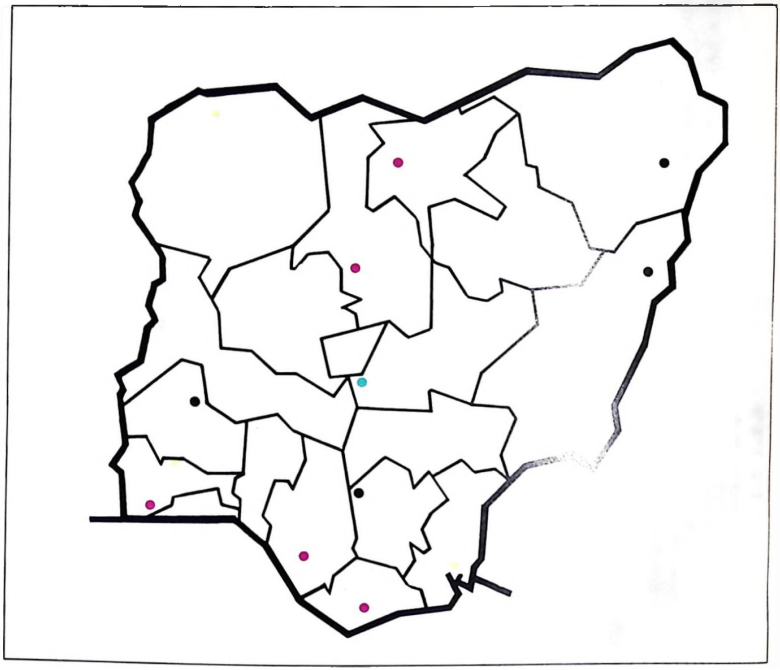
T & E is acutely conscious of these circumstances which confront an organisation with progressive national commitments.

In practical terms, the Division has invested heavily in new facility development throughout the country. It can also boast a solid core of well-trained staff and an enlightened Management team whose carefully thought out training plans are focused on advanced technology.

It is with this knowledge that T & E confidently faces the future committed to the task of making the Division a competent and professional CATERPILLAR dealership able to contribute significantly to the technical stature that tomorrow's Nigeria must achieve.



TRACTOR & EQUIPMENT IN NIGERIA



KEY

- Main Depots
- Sales Coverage
- Branches
- Proposed Branch

HEAD OFFICE
Billingsway
(Off Oregun Road)
Oregun Industrial Estate
P.M.B. 21480, Ikeja.

APAPA
Lift Truck Operation
6/8, Sea Plane Road
P.O. Box 663, Tel: 873932
Apapa.

ENUGU
5, Okpara Avenue
P.O. Box 100
Tel: 253440, Enugu.

ILORIN
P.O. Box 833
Ibadan/Lagos Road, Ilorin.

IBADAN
New Court Road
Niger Motors Building
Ile-Itesiwaju
P.O. Box 20, Ibadan.

PORT HARCOURT
P.O. Box 6,
Tel: 222627, Port Harcourt.

WARRI
P.O. Box 543
Tel: 287, Warri.

MAIDUGURI
P.O. Box 12
Tel: 2738, Maiduguri.

KADUNA
P.O. Box 7
Tel: 243121, Kaduna.

YOLA
P.O. Box 505
Tel: 24103, Yola.

KANO
P.O. Box 2049
Tel: 5191, Kano.

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TRACTOR & EQUIPMENT

making a world of difference in Nigeria

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Architect versus Contractor

Co-operation or confrontation?

From the earliest times in history, whether people have lived in tribes or societies, they have built. Sometimes their buildings have been primitive shelters, sometimes massive constructions, but always they have built. Architecture is one of the greatest arts of civilisation. Construction is the science of interpreting architectural design into reality.

Lever House, New York. Fine example of modern glass curtain wall construction.

THE MASTER mason, who was both architect and building contractor in ancient times, reached the pinnacle of his profession in medieval times with the building of the massive cathedrals, churches and castles of Europe. The master mason continued in his dual role until comparatively recent times when it became obvious that the skills required were beginning to diverge with the introduction of a more scientific approach to design and the development of new building techniques to match them.

The architect specialised in building design, replacing older, empirical methods with scientific method which calculates stresses, strains and weights and designs structures from known factors rather than the old principle that if it looked right, it was right. The building contractor became and still remains, a master craftsman with a practical "feel" for his materials and methods. The architect is purely the designer who allies engineering skill with artistic flair to produce designs which satisfy the client's need and produce a building which is both functional and aesthetically pleasing.

Architecture is very difficult to define because the design of a particular building is really in two parts. Technically speaking, if the strength and functional requirements are adequately met, it can be claimed to be good architecture. But if it looks awful by being badly proportioned or uses materials which create discord in colour, shape or texture, or has a disjointed appearance because insufficient attention has been paid to line and sweep, it is bad architecture. Or is it? And here is the major controversy, because different people have different ideas of what is pleasing and what isn't. Some modern buildings, resembling nothing more than huge glass boxes, may be functional and strong enough to withstand an earthquake, but they look pretty horrible. Or do they? The answer is very much a personal thing.

Architect's role

All architecture is a form of building but all buildings are not architecture. The dictionary defines architecture as "the art of building." Not just building, please note, but the *art* of building. Unfortunately, the term "art" is also very difficult to define because it involves so much of what is personal pleasure or personal preference. Most people will agree that art has something to do with beauty, and that there are certain rules to be followed regarding skill and intelligence to create a work of art. The architect has the unenviable task of being bound by definite rules dictated by engineering necessity and at the same time needing to satisfy the personal whims and fancies of his client. Difficult to say the least, especially when the contractor, who will have to build to his designs, is often critical of the methods or materials specified.

The architect's contract with his client will almost always include the supervision of the actual construction work, or it should do, to ensure that the design is followed and the materials and methods correctly employed. Such is human nature that cutting corners in an effort to save on building costs has become a common although highly reprehensible practice. One reads far too often of buildings failing in service because the specifications were not complied with during construction. Just another example of the problems facing the architect.

Theory and practice

The first and, more often than not, by no means the least of an architect's problems is his client. This is the person or organisation commissioning the design and they will have a great many ideas they think should be incorporated in the finished product. After all, they will be paying the bil and feel that they consequently have a righ to dictate what shall be done.

In the early stages of a new design th architect has two main practical objective

continue

Mosque in West Africa.

Rome 18C Scrapers with laser

Rome 16C Agricultural Scrapers

Rome/Gurries GL-16 Bottomless Scraper

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475 hp

and matched **Equipment** up to

42' wide

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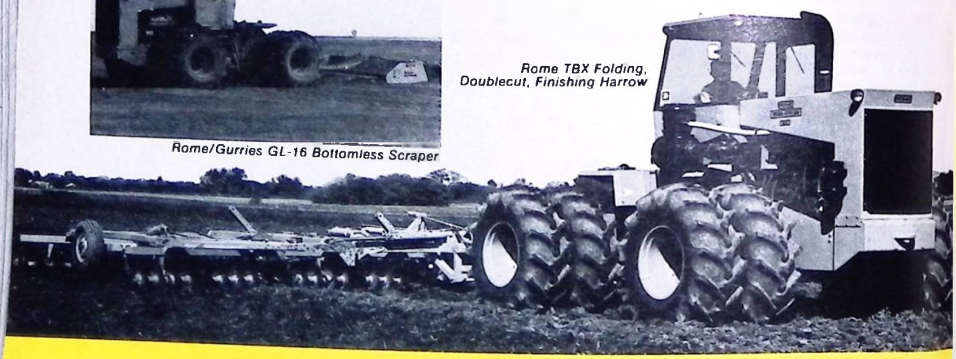
Rome has introduced a new flywheel hp tractor with matched equipment systems for everything from plowing to land forming. Rome offers the only 475 flywheel hp tractor with power shift, no clutch, and four wheel drive with enough input torque capacity to take any weight transfer you can give it!



Rome TBX Folding, Doublecut, Finishing Harrow

Rome 18C Agricultural Scrapers

See your Rome Group AG System Dealer for the best recommendations on the right power and equipment for your specific acreage, type of soil, type of job, and your time schedule.

ROME

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in mind, apart from aesthetic considerations. The first objective is utility, and answers the question of "what" the building will be. The second objective is construction, and answers the question of "how". "What", is very firmly in the architect's province only, because the purpose for which the building is required will dictate the format. The problems associated with design in the sphere of what the building is for will require co-operation with the client but do not create an interface with the constructor. How it will be built brings a different set of factors into play and needs a knowledge of materials and methods which are the province of the building contractor. This constitutes an area where initial co-operation isn't always possible because almost always there is a "cart before the horse" situation because tenders will not be called for before the designs are complete and accepted. Consequently, the contract will not have been let and the poor architect does not know who is going to construct his building.

Many of the large construction companies will have their own architectural division and their designs through discussions with their colleagues in the building division, will therefore be based on practical, first-hand knowledge of methods and materials. The purely architectural companies will have a certain amount of practical experience on their payrolls but may well have to buy in more from consulting engineers specialising in building construction. This theoretical/practical interface is a point of controversy often raised by architects and contractors alike.

Decorative effects

The aesthetic considerations of building design create even more problems for the architect. Apart from the personal preference aspect mentioned earlier, there is the question of cost to be taken into account. Simple straight lines, balanced proportions and undecorated surfaces have a distinct appeal but can look somewhat bleak and functional, especially if the building is erected in an area already containing traditional or more adventurous designs. It can look out of place and not only itself look awkward but also detract from the appearance of the whole. Some of the glass monstrosities built in European cities amidst some of the finest examples of traditional architecture, look positively hideous.

Aesthetic appeal can be made in two main ways, by the use of geometric shape, or by surface decoration. Both of these can be described as functionally unnecessary and very expensive. There is the contractor's viewpoint to consider here too, and one well-known company's spokesman said recently that decoration is "the architect's twiddly-bits which cost more per square metre than working floor space."

Some form of decoration is essential to all architecture but never to the detriment of the structure. Decoration is essentially an embellishment, and is included purely to enhance appearance and create a pleasurable effect. Many interesting and satisfying decorative effects can be obtained from the careful choice and use of the actual building materials. Surface textures can be varied by the intermittent use of say, bricks and concrete. Cladding panels can be coloured during the manufacturing process and *in-situ* concrete cast in formwork whose surface carries a pattern of shapes or variations of texture. These decorative forms are less costly than the subsequent application of, for instance, glazed tiles or relief work.

In this modern age, the architect may well employ a specialist decorative designer to add "eye appeal" to both the inside and outside of his buildings. Sculptural form, often in cast concrete, is used for both exterior and interior features to create effect and to relieve the severity of necessarily intrusive beams and columns. But what does the building contractor think of all this?

Building contractor's role

The light-hearted reply from a contractor who was asked what his first reaction was to the initial sight of an architect's plans was, "a jolly good laugh". But seriously, there is often a difficult gap between the theoretical and the practical and it is the contractor who has the task of translating the architect's thoughts and calculations into the finished building. Almost all contractors will agree that there is room for a great deal more co-operation between architects and builders in the planning stages of a new design. But, as has been mentioned before, the contractor is usually selected too late for him to take an active part or make any contribution which will affect the subsequent materials to be used or methods to be employed – at least not without a great deal of argument and specification changes.

The contractor is faced with a set of drawings and perhaps an artist's "impression" of what the finished project should look like, and must bring all his practical skills to bear on the problems of building it. With the larger projects much of the preliminary work will have been done by the architect, especially the taking off of quantities, but if not, this essential first step is done during the tendering stage to allow accurate costs to be made. Even though the architect's contract will almost certainly include supervision of the actual building work, the contractor must be given a free hand to decide how the work will be done. For instance, mass concreting may well prove to be less costly if it is pumped rather than carried and dumped. System scaffolding and formwork can often be effectively used, with – again – a cost saving over purpose-built shuttering. Applied decoration may be easier if surface preparation is carried out during the construction stages of the walls rather than after they have been built.

Even with the most skillful and thorough planning during the design stage, it is

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Above: Paris Opera House – Structural requirements of the grand stair-case turned into decorative features.

Below: Murtala Mohammed airport, incorporating clean lines and functionality.

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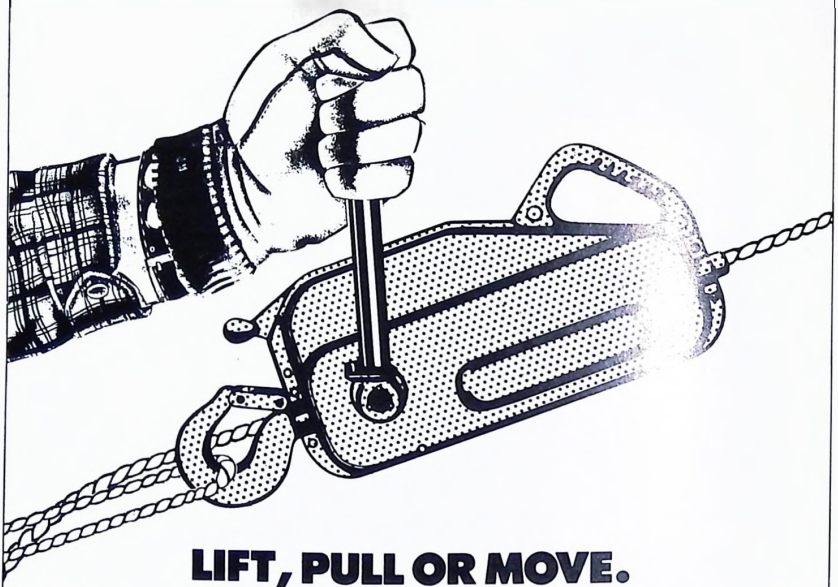

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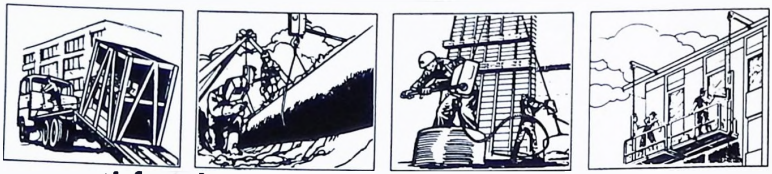

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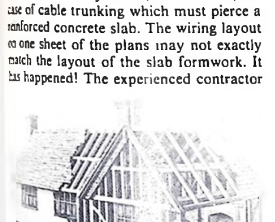
almost inevitable that problems will occur during the actual building. It is not until the structure becomes a composite whole, as distinct from pictures on a sheet of paper, that many inaccuracies appear. The contractor, the *good* contractor, will anticipate many of these problems and resolve them before costly and time-wasting rectification is necessary. Take, for instance, the case of cable trunking which must pierce a reinforced concrete slab. The wiring layout on one sheet of the plans may not exactly match the layout of the slab formwork. It has happened! The experienced contractor



Wooden framed s enth century European house.

will identify this as a blem before the pour begins. A quick cussion with the architect's representat and the problem is solved: before the ctification costs reach alarming propor ns and there is a fight between architect and contractor as to who will pay for it.

Transferring dimensions from paper to a piece of bare ground is an exacting task and calls for a high degree of skill. Although made much easier in recent years by the advent of laser levelling, setting out is a practical skill, and unless it is done absolutely right the whole project will fail. This is an example of the old master mason's skills being carried over to the present day. Only the instruments have changed.

Correct skills

The employment of the correct skills is very much the province of the contractor. Bricklayers, concreters, plumbers, electricians – in fact all the skilled people needed to erect a building have to be assessed for their individual worth and ability in the light of the architect's requirements. Only experience and professional know-how can perform this task correctly: one aspect of a professional contractor's skill that is often overlooked by the layman. The ability to recognise the requisite levels of skill distinguish the professional building contractor from say, the jobbing builder. The average handyman may be competent enough to stick a few tiles on a bathroom wall but you wouldn't employ him to overlay 300m² of concrete wall with expensive ceramic mosaic. Where do you find a tiler capable of undertaking such work? A contractor would know; that's why he is a contractor.

Architect v. contractor

This sub-heading reads like an advertisement for a prize fight and only too often that's exactly what it becomes. Although many of the comments each makes about the other are jocular, there is all too often an underlying feeling of real antipathy. For instance, an architect told me that the average contractor was incapable of reading his drawings. A contractor's reply was that the architect should learn to draw. The real situation was that the drawings, which were very comprehensive, tended to be works of art in themselves, a feature the contractor didn't appreciate or understand. In all seriousness, there was little need to include in these particular drawings – intended to be used for checking elevation measurements – decorative sketches of trees and women pushing prams, but (and this was the architect's intention) they did give an immediate impression of scale. The ill feeling was therefore quite unnecessary.

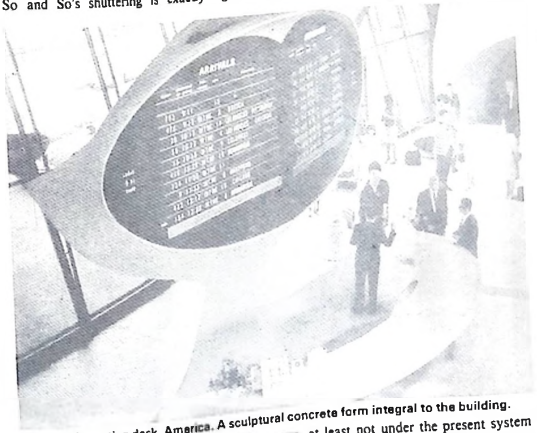
Another contractor was very vociferous in his condemnation of an architect's choice of dimensions for some *in-situ* concrete beams. "If", he said, "the architect had made them only 2cm deeper, I could have used system formwork to cast them. So and So's shuttering is exactly right otherwise." The architect's reply to this criticism was illuminating. He said, "There are over eighteen different so-called standards of system formwork and we don't have details of them all. Even if we did, there's no guarantee that we can dimension or design to the one a particular contractor happens to be using."

There is a case to be made against the makers of machines and equipment for the building industry. All too often their sales promotions are directed towards the end user, the building contractor. This means that unless the architect makes a special effort to keep abreast of current developments, he may well become very much out of date with what is available and the best, quickest and cheapest way of accomplishing a particular task. Much of this lack of knowledge could be rectified if earlier co-operation were possible in the design stages of a new project, but the difficulties of this have been already explained.

The old master mason had the best of both worlds since he had total control over the project from design and planning right up to the finished structure. The modern architect has limits placed on his abilities because he is dependent on other people for

'The architect is purely the designer who allies engineering skill with artistic flair to produce designs which satisfy the client's needs . . .'

the execution of his designs. The contractor is inhibited too, by often being told to work in a way which he knows, from experience, to be not necessarily the best. But, since he must work to specification, he undertakes the contract often on a compromise basis. The loser, as always, is the client, who must eventually pay the bills of both parties. He may not get exactly what he expected and it may well cost more than it need have done. The answer? There isn't one, at least not under the present system of design – tender – build. Only a return to the old master mason system would completely answer all of the problems and although many of the larger companies are, in effect, doing this by incorporating both architectural and contracting divisions under one management, there is still a preponderance of companies operating as separate entities who only come together when it is too late for full and effective co-operation.



Airport information desk, America. A sculptural concrete form integral to the building.

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The basics of construction machinery hydraulics.

Part 3.

Part two of this series explained that there are only two energy 'elements' present in a hydraulic system: pressure and flow. The pressure exerts the force, and the flow provides the motion. In part three, Eric Meadows investigates these factors and explains how they are created and what their effect is.

PRESSURE CANNOT be created in a liquid unless the confinement is total or the flow rate into the confining system is greater than the rate of escape. In other words, if a liquid is squeezed by some form of load and there is nowhere for it to go, or it can't get out as fast as it is being put in, then a pressure is created. There are two ways of applying a load to a liquid, either some form of mechanical pump, and a hydraulic ram becomes a pump in this context, or by the weight of the liquid itself. In point of fact and contrary to popular belief, a pump cannot create pressure. Pressure in a circuit supplied by a pump occurs because the pump is trying to push oil into a space that is already full. The pump outlet is said to be "restricted" and a pressure rise occurs in whatever container is connected to the pump. Obviously if nothing moves or steps are not taken to relieve the pressure build up, something will burst. This is why hydraulic circuits must always be fitted with pressure relief valves.

Thinking in terms of an actuator, the pressure is self regulating, building up only high enough to start something moving and then remaining constant whilst the movement is taking place. But more about this later. The arithmetic involved in pressure calculation is extremely simple, and is worthwhile learning; it answers many problems associated with selling and servicing hydraulic equipment because it can be used to explain what is happening, or to find out what is wrong if it doesn't happen.

Pressure, as we have seen, is a load expressed as a weight applied to an area. Pressure – area calculations are as follows:

$$\text{pressure} = \frac{\text{load}}{\text{area}} \quad (P = L \div A)$$

$$\text{load} = \text{pressure} \times \text{area} \quad (L = P \times A)$$

$$\text{area} = \frac{\text{load}}{\text{pressure}} \quad (A = \text{load} \div \text{pressure})$$

Fig. 3 explains these terms as applied to a hydraulic ram.

Pressure is exerted equally in every direction, so putting values to the illustration in fig. 3 shows the relativity of the different elements involved in pressure calculations.

Assume: piston area (A)=78.5cm²
(10cm dia piston)
pressure=140kgf/cm²
load=P×A=140×78.5=10,990kgf

In other words, a 10cm piston subjected to a pressure of 140kgf/cm² would produce a thrust of 10,990kgf, nearly 11 tonnes. Looking at the question the other way round, it is often necessary to know how much pressure is required to move a given load, so:

Assume a load of 7,000kg.

$$\text{pressure} = \frac{\text{load}}{\text{area}} = 7{,}000 \div 78.5 = 89.2\text{kgf/cm}^2$$

Another question could be, what is the piston area if a pressure of 93kgf/cm² is supporting a load of 8.5 tonnes?

$$\text{area} = \frac{\text{load}}{\text{pressure}} = 8{,}500 \div 93 = 91.4\text{cm}^2$$

It must always be remembered that pressure cannot be generated unless there is a resistance. Conversely, pressure will only rise sufficiently to overcome the applied resistance and the resultant thrust, pressure x area, will never exceed the load opposing it. The terms load and thrust therefore are equal but explain either the "weight" opposing the actuator or the "weight" the actuator must exert to overcome the opposition. This simple concept of the effect of pressure is the "secret" of how hydraulics work. The effects of a static head in creating pressure were discussed in part one and shown to be 0.4286lbf/in² for every foot rise of water.

Pascal's Law

It has been said earlier that the pressure in a confined liquid acts equally in every direction and this is one of the basic laws of hydraulics expounded by Blaise Pascal (1623–62) who was a French scientist of varied gifts but remembered in the engineering world for establishing some of the first principals of hydraulic study. Pascal's law states:

The pressure acting on an enclosed fluid is transmitted undiminished throughout the fluid and acts equally in every direction.

This is illustrated clearly in fig. 4 which shows how pressure in an enclosed system is made to support two different weights in a state of equilibrium.

This reads as: The small piston, A, has an area of 1cm² and weighs 10kg. It will therefore be producing a pressure in the system of 10÷1=10 kgf/cm². This pressure is transmitted undiminished throughout the system and acts on the base of piston B which has an area of 10cm². The weight of piston B therefore, if no movement is to take place, must be also capable of producing a pressure of 10 kgf/cm² and, since the area of A, it must weigh 10×10=100kg.

This fundamental law is the basis of many of the functions designed into a hydraulic system.

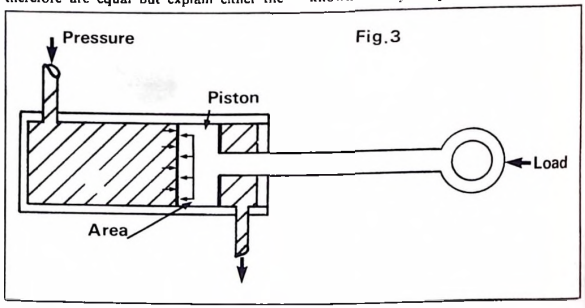
Flow

So far only oil in a static condition has been considered and the study of this condition is known as hydrostatics, which in essence, only deals with the effect of pressure changes in a fixed volume of oil. Flow is rather easier to understand as something can be seen to move and this is known as hydrodynamics. Flow is the movement of a liquid caused by a difference of pressure between two points. The rate of flow in a hydraulic system determines the speed at which it will work. The velocity of flow is the result of volume and time relative to the size of the conducting pipework. This is illustrated in fig. 5.

Each of the chambers in the illustration has a volume of one gallon and, although the dimensions are different, each will require the same rate of flow to fill them in one minute, a rate of 1UKg/m. However,

continued

Fig.3



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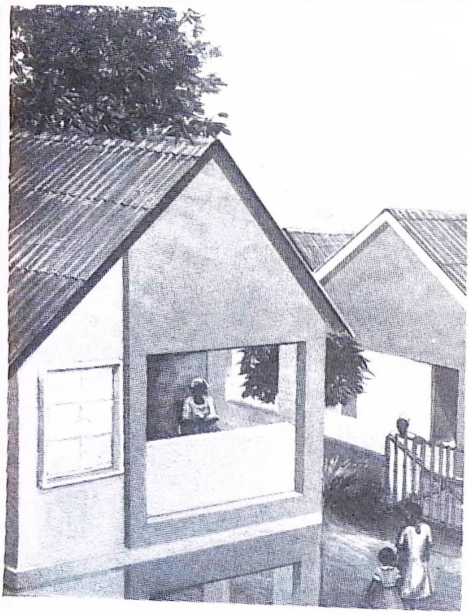

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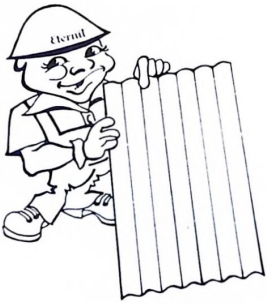

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on want.

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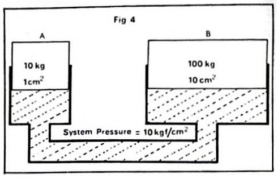
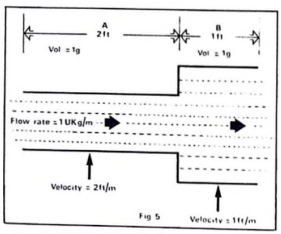


chamber A is twice as long as chamber B, 2ft against 1ft, therefore the velocity of the oil moving through them will be different. If fig. 5 represents a section of pipe, it is obvious that a constant rate of flow will result in a lower velocity when the diameter of the pipe increases. The velocity of flow through a pipe is in inverse proportion to the cross section area, or to the diameter squared. For example, the velocity of flow through a 2-inch pipe will only be one quarter as fast as through a 1-inch pipe. These figures do not take into account the losses due to turbulence and friction.

Flow rate and speed

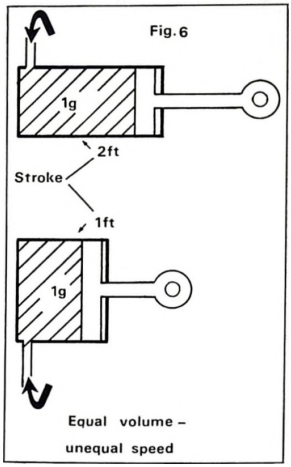
In a simple hydraulic ram it is the flow rate imparted to the oil by the pumps which determines the speed at which it will work. In fig. 6 two hydraulic rams are illustrated,



both with the same volume. 1 gallon. If they are each supplied with oil at a flow rate of 1UKg/m, it will be seen that, although each will fill in one minute, ram A will travel twice as fast at 2ft/m whilst ram B will only move at 1ft/m.

Suppose the rate of flow to the two rams is doubled, to 2UKg/m. The rams would now fill in half the time; the speed would have doubled. This illustrates how designers of hydraulic components have two ways of controlling the speed of a ram. 1, by decreasing the size of the bore, or 2, increasing the rate of flow. It can be stated therefore that *the speed of a ram is proportional to the rate of flow and inversely proportional to the piston area.* It is particularly important to remember that it is the piston area which is the important dimension since, in double-acting rams where oil can be supplied at both ends, one side will have a smaller area and volume by the amount of space taken up by the piston rod. This is illustrated in fig. 7.

In this type of ram the piston area is reduced on one side by the area of the piston rod onto which it is fastened (fig. 7a) and the volume on the same side is reduced by the volume of the rod. Consequently, a double-acting ram supplied with oil at the same rate on both sides of the piston, will move more slowly on the full bore side (fig.



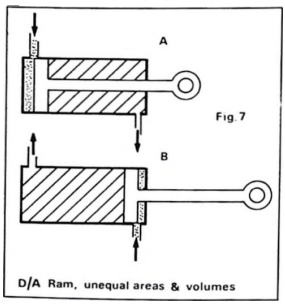
7b) than the other which is called the annular side.

Flow and pressure

Flow and pressure can be summarised as follows:

Pressure controls the force in the system.
Flow controls the speed at which it will operate.

A basic rule of hydraulics is that

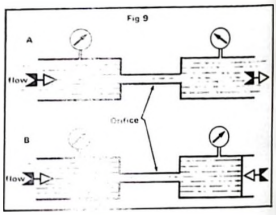


wherever there is a flow there must be a pressure difference. Conversely, whenever there is a difference in pressure there must either be flow, or a difference in level.

When a liquid is not subjected to pressure either from pumps or a difference in level, it will automatically find its own level. This is illustrated in fig. 8.

In each of the open-topped containers shown at "A", which are connected at the bottom, the liquid is subjected to atmospheric pressures only and the level is the same regardless of shape or size. In "B", the pressure is being applied to the system and the liquid from one to fill the other containers to an equal level. If the pressure is raised higher, a continuous flow will be set up until the liquid spills from the top.

There is always a pressure difference when a liquid is flowing and it is lower at the downstream end. This difference is referred to as a pressure drop and may be deliberately engineered to provide special conditions to assist in the operation of some components. An orifice is an "engineered hole" used to create a deliberate pressure drop. The restriction is deliberately placed in the system of oil so that the resultant pressure drop can be made to do useful work as shown in fig. 9.

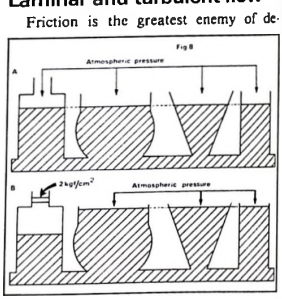


This drop in pressure will only take place as long as the oil is flowing. If the flow is blocked, a hydrostatic state exists and, by Pascal's law, the pressures will be equal.

A pressure drop will also occur when oil is passed through a control valve or restricted pipe. The energy lost by this pressure drop is converted to heat and wasted.

Laminar and turbulent flow

Friction is the greatest enemy of designers of hydraulic pipework. The effect of friction reduces the pressure at the downstream end of the system and on complex installations can be quite significant. The situation is aggravated by abrupt changes of direction through elbows, sharp bends or rough pipes. Then, instead of moving in smooth, parallel lines, the oil develops cross currents, turbulence is set up resulting in a very significant increase in friction and a consequent pressure drop. For maximum efficiency, the aim is to keep the oil flowing smoothly. This is called laminar flow.



Systems building

Our systems building series continues with a description of complete packages available, consisting of units which are suitable for tropical conditions due to proper design and treatment of materials.

ONE COMPANY which specialises in timber frame building and which has a record of success in Nigeria is Guildway. Packages have been provided for use as residential buildings, offices, dormitories, schools and guest houses.

The buildings Guildway manufacture for this market are specially designed to suit the climatic and environmental conditions experienced in West Africa. Among the various features included in the designs are such items as sliding aluminium windows with flyscreens, cross ventilation to habitable rooms, trimmed openings in external walls for air-conditioning units with adjacent power supply and well-insulated external walls and ceilings, all of which contribute to more comfortable living in hot and humid conditions.

The packages are supplied through a local distributor in Nigeria who is also a building and civil engineering contractor. The combined association of distributorship and contracting has proved very successful and has enabled the distributor to quote a turnkey service to prospective clients.

Experience has shown the company that in order to sell premanufactured buildings to developing countries, it is no use offering clients Guildway packages on their own when they seek complete buildings they can occupy and enjoy.

Completion

Guildway has found that it is essential to provide an erection and completion service. The distributor, with his own construction company has not only been able to provide this service but on one occasion has supplied land and constructed a complete private estate of over 50 dwellings, together with roads, sewers and services, servants' quarters and garages, tennis courts, swimming pool, estate shop and clubhouse.

This was the Abake Estate, cut out of the virgin jungle on the outskirts of Ibadan. The estate serves as a permanent practical display centre for the company's prospective clients. It has been leased to Leyland Nigeria Limited.

The tropicalised Guildway packages are more comprehensive than those supplied to the UK and European markets and include roof and external wall cladding, complete plumbing kits, sanitaryware, electrical harnesses and fittings, vinyl asbestos floor tiles and ceramic wall tiles.

Extensive precautions are taken to prevent termite infestation. All structural timber is treated by the Vac-Vac process. Specially designed aluminium termite shields are provided and fitted under the soleplates to provide an impassable barrier and the specification recommends the poisoning of the oversite fill before casting the slab and the provision of a 600mm-wide poisoned trench around the perimeter of the foundations.

These enlarged Guildway packages can be erected and completed on site with a minimum of skilled labour and are accompanied by full sets of drawings which include details for such items as the plumbing and electrical installations.

In addition, the company provides technical back-up so that quick and efficient completion of the buildings is achieved on site and it also trains local operatives to use the packaged homes to the best advantage.

Comprehensive

The company's approach to this export market is first to design buildings to meet all the requirements of the territory, to supply comprehensive packages to cut down on the amount of labour and skill required for completion and to offer distributors and customers technical assistance so as to ensure the provision of completed buildings rather than building packages.

The assistance on site is backed up by marketing sales and technical assistance to distributors in the field.

GRS International offers the Status Mobile Accommodation Unit to the West African market. The company manufactures high quality, individual specification accommodation for many purposes including offices or office extensions, school classrooms, construction site offices, laboratories, bungalow accommodation for up to six people and other forms of accommodation requirement.

Status Mobile accommodation can be erected speedily without the use of cranes and with the minimum of site preparation being necessary. All the components are supplied in one or more containers and, if required, supervision of erection will be arranged. The high-quality internal and external finish is according to individual customer requirements and the design is personalised for each client.

A panelled instant accommodation unit was introduced last year by Wyseplan, one of the UK's largest portable building manufacturers. This new system was specially designed for the overseas market and is said to drastically reduce transport and installation costs.

The Unitpack range is ideally suited for either single installation, as a jack leg unit, or a linked accommodation to form large complexes for construction camps and small townships. Unitpack components are manufactured in the UK and shipped out to site by pallet or container – seven modules can be carried on one container flat.

Economy and ease

The system is ready for easy assembly either on site or at the local depot. As well

continued

Interior of Wyseplan ...tant accommodation.

as offering large sav... in transport costs, Unitpack has also e... nated the need for heavy plant to assist ... h the building erection procedure. Both ... k leg and skid base models use the same ... undard components and can easily be ...ected by unskilled labour. Minimal site ...oundations are required.

For linked accommodation complexes clear spans of 7.3m and 9.8m can be provided. Intermediate supports enable greater spans to be achieved. Floor, walls and roof are well insulated and exterior finishes are designed to withstand extreme climatic conditions.

The floor units are of sandwich panel construction consisting of 9mm plywood decking overlaid with 2mm solid vinyl finish on a 50mm styrofoam core with a 6mm termite-resistant plywood base. The units are tongued together using special hardened steel drilling screws.

The sub-structure steel skid unit is constructed out of components of 150mm by 75mm RHS channel running longitudinally with joists of 100mm by 50mm RHS set at 1,200mm centres. The steelwork is treated against corrosive atmospheres.

Leg units

Heavy duty mild steel jack leg units can be supplied to enable loading and unloading from flat bed transport by only one man. The building can also stand on these legs which in turn facilitate two-storey stacking.

The roof units are of sandwich panel construction tongued together at the joints with a decking of 9mm exterior grade plywood on a 46mm styrofoam core with 4mm vinyl-faced plywood ceiling lining. The roof is finished with a tropical grade hyperlon roofing system designed to resist solar radiation.

Wall units are in panel construction 9mm termite treated exterior grade plywood, scarf jointed to form a one-piece outer skin fixed to 44mm by 34mm timber frame set at 400mm centres. The timber having been treated against termite attack, the cavity formed is filled with 65mm fibre-glass insulation material with the internal lining being 4mm decorative finished plywood. The wall units are joined together by the use of a concealed Cam-Loc panel jointing system. The exterior finish is spray applied texture finish giving prolonged weather protection as a standard. Alternative finishes can be supplied and partition units of panel construction can be supplied as required.

Roof fascia board, corner cappings and plinth capping are all formed from aluminium satin anodised to 25AA and finished into position using stainless steel fixings. The doors and windows are similarly aluminium satin anodised. Each window has a top ventilator section complete with flyscreen. The skirting is formed using black-painted timber. Corner cappings and window apertures are finished in black heat-resistant PVC. Ceiling architraves are white.

Insulation performance of walls, floors and roof achieves less than 0.6W/m^2°C and all electrics are fitted internally, enabling depots to easily meet specific customer requirements.

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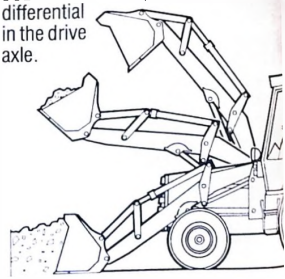

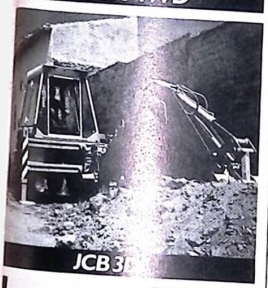

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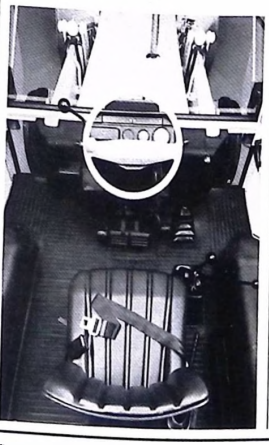

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LOADER BREAKOUT FORCE	kgf lbf	5410 11928	5410 11928	5410 11928
LOADOVER HEIGHT	m ft in	3.14 10 3½	3.14 10 3½	3.14 10 3½
EXCAVATOR DIG DEPTH	m ft in	4.28 14 1	4.74 15 7	— —
EXCAVATOR REACH AT GROUND LEVEL	m ft in	5.41 17 9	5.86 19 3	— —
EXCAVATOR DIPPER TEAROUT FORCE	kgf lbf	2681 5910	2681 5910	— —
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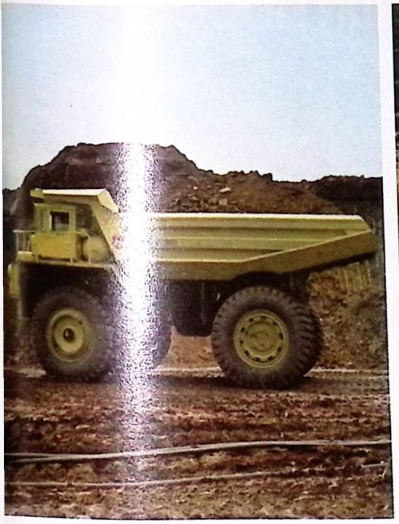

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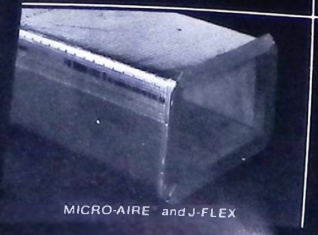

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Improving housing for developing countries

A small shanty-town in Colombo, Sri Lanka, is being cheaply rehabilitated using low-cost materials and on-site production techniques. The materials include fibre-reinforced cement roofing sheets, already produced experimentally in Africa, the Caribbean, South America and the South Pacific. The materials and the production process could have wide application in the Third World.

A COUPLE of years ago, in a derelict shanty area of Colombo, Sri Lanka, a ramshackle hut collapsed on top of the old woman who lived in it. But instead of being a disaster, it was a blessing in disguise. The old woman was provided with a brand new house of bricks and fibre-reinforced cement, completely free of charge. Her new dwelling was the demonstration house for an imaginative slum upgrading experiment.

Upgrading

Bulldozing slums and uprooting the inhabitants in order to manicure a city never works, as many urban authorities have found out. The dispossessed trickle back to the area, or create a new slum elsewhere. Recent thinking has turned more and more towards upgrading slums, so that the inhabitants can continue to live and work in a familiar environment where they have built up social ties and sources of income.

Even an upgrading programme can be an expensive business if materials have to be imported or industrially manufactured. The most feasible way to provide better housing for the poor is to use locally produced, low-cost materials and simple, labour-intensive technology. Ideally, the inhabitants should be able to remain in the slum while their homes are being improved.

'Recent thinking has turned more and more towards upgrading slums, so that the inhabitants can continue to live and work in a familiar environment where they have built up social ties and sources of income.'

This is the approach of an experimental project to upgrade a small shanty-town at Kirillapone, in Combo, Sri Lanka. The project is being undertaken by the US Save the Children Federation and the London-based Intermediate Technology Development Group (ITDG), founded by Dr Ernst Schumacher.

Kirillapone consists of about 300 huts made of a variety of materials including mud, plaited coconut fronds, pasteboard and rusty galvanised iron sheets. The aim of the upgrading scheme is to provide low-cost permanent housing with a solid foundation, brick walls and a strong, durable roof.

Rectangular foundations are built first, then wooden supporting pillars and the roof. Gradually the brick walls are built, and lastly the cement floor is added. During the whole process the occupants can continue to cook, eat and sleep inside the newly-constructed frame – with some discomforts no doubt, but they they have nowhere else to go.

Local materials are cheaper and familiar to the builder.

The ITDG consultants for the project chose low-cost, readily-available materials which are expected to give each house a life of at least 15 years. Particular attention was concentrated on the roof sheets, which will protect the materials below and prevent their deterioration. The roofs will have to withstand the monsoon rains, and keep out the worst of the sun's heat.

The consultants decided to use a fairly well-known materials, fibre-reinforced cement. ITDG has experimented with this materials in a number of countries, using whatever type of fibre was locally available. In Sri Lanka, this was coconut fibre.

Equipment

The ITDG consultants introduced simple, inexpensive equipment which could be made locally and operated by the shanty dwellers. Within three weeks of the start of the project, a sheet-making table and a brick press had been run up by local craftsmen and were ready to go into operation.

The procedure for making roof sheets involves using a wooden-framed table with a top which can be tilted. Each worktable produces up to 20 sheets a day. A piece of asbestos roof sheeting is laid on the table to serve as a mould. Over this is laid a flat piece of board, fixed to the table frame, and over the board a layer of polythene sheeting, which is attached at one end to the asbestos.

Cement, sand and chopped-up coconut fibre are mixed into a plaster and spread in

continued

a thin, even coat over the polythene. The table top is then tilted, and the asbestos is drawn out, away from the fixed board, so that the polythene sheet with its coating of plaster drops into the corrugations of the mould. The wet sheet and its mould are then stacked for 24 hours to dry.

After that, the newly made sheet is separated from the asbestos mould by pulling at the intervening polythene, and the mould can be re-circulated to make more new sheets. The new sheets are cured by being kept moist for 28 days before being used. Tests carried out on the sheets showed that after 14 days they could take the weight of 300 bricks piled in the centre.

Cost

Each roofing sheet measures 4ft by 2ft 8in (120 by 80cm) and cost 32 rupees (just under US$2). At this price the sheets are considerably more expensive than the "cadjan" thatch, woven from coconut branches, which is traditionally used in Sri Lanka. But, ITDG point out, cadjan thatch has to be replaced every year or two, which greatly increases the expense. Its other drawbacks are that it may harbour disease-carrying animals and, in the process of decay, it accelerates the decay of adjacent parts of the structure.

Other roofing materials used in Sri Lanka include galvanised corrugated iron and clay tiles. Corrugated iron is fairly cheap, but is only durable if painted at regular intervals – another recurrent expense. It also transmits the sun's heat into the building. Tiles create a cooler interior, but a complex and costly roof structure is needed to support them.

Asbestos cement sheets only need a light roof structure, and radiate much less heat than corrugated iron, but health authorities are worried that dust from these sheets may cause lung disease. Asbestos sheets are also extremely expensive to buy or to produce. An asbestos sheet costs 132 rupees (about $8) in Sri Lanka, and ITDG reckons that to set up a medium-sized production plant would cost at least $4 million. The on-site equipment used to produce the coconut fibre/cement sheets costs only $400.

'Asbestos cement sheets radiate much less hear than corrugated iron, but health authorities are worried about lung disease.

Brick

The Kirillapone project is also producing its own sun-dried bricks from the local laterite clay. ITDG has introduced a simple on-site brick-making press with a single mould. The operator has to shape the clay roughly by hand, slap it down into the mould, smooth off the top and press a foot pedal to eject the shaped brick.

This device produces about 225 bricks a day at a minimal cost. Left to dry for 24 hours, they can then be stacked up to make a 9ft (3m) wall. Diluted PVA adhesive is used instead of cement, but a coating of the same fibre-reinforced cement used for the roof sheets is applied to the finished wall for extra protection.

Costs have been kept low mainly by training local people to make their own building components on site, thus avoiding the costs of transport and specialised labour. The first few completed houses cost only 13,000 rupees ($750) each, and this is expected to drop to 9,000 rupees as the work teams improve their skill and efficiency. This is about a third of the cost of the cheapest house that can be built in Sri Lanka by conventional methods.

ITDG has been involved in producing fibre-cement roof sheets in Dominica, Honduras, Guatemala, Fiji, Egypt, Gambia, Botswana and Zimbabwe, and has experimented with a range of different fibres including coir, copra and henequen. Coconut fibre is found throughout the Third World – it is particularly good reinforcing agent. Clearly, the materials and techniques used in the Kirillapone project have enormous potential for application in other developing countries.

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Nigeria's road industry – appropriate technology the answer?

O. J. Eze-Uzomaka, Professor and Dean, Faculty of Engineering, University of Nigeria, examines exactly what is meant by 'appropriate technology' – and considers how it can help the development of the road industry.

Nigeria spends a significant fraction of her budget on road development. Most of this expenditure is in scarce foreign exchange because the industry is dominated by foreign companies. Furthermore, the poor durability of Nigerian roads raises a question on the appropriateness of the designs. Therefore, considering its importance her healthy advancement, ways of applying appropriate technology to develop Nigeria's road industry to accommodate her socio-economic and environmental constraints are considered.

Appropriate technology implies a satisfactory engineering solution which accords with the capabilities and life style of a society. Its underlying philosophy and motivation is the development of the ability of a people to solve their own problems in a way that fits their own culture and resources. That the solution must suit the socio-economic status of the society demands that it has to be solved by those who experience the dynamics of that society. Thus there is the implicit requirement of self-reliance and self-sufficiency. However, this self-reliance and self-sufficiency are not mutually exclusive with international cooperation. The development of this capability will be facilitated by aided self-reappraisal, an aid which is best offered by those who have themselves gone through the mill.

This article first appeared in the form of a paper delivered at a conference on Appropriate Technology in Civil Engineering, held in April 1980 at the Institute of Civil Engineering in the UK.

It should be emphasized that appropriate technology does not specify particular levels of technology for different levels of society. Rather it dictates that a technological problem should be critically analysed and a solution which takes full cognisance of the peculiarities of the situation should be evolved. This process demands strict objectivity.

Objectivity

It is for this avoidance of compartmentalization engineering solutions according to socio-economic status that appropriate technology proves more widely applicable, efficient and durable than its fore-runner, intermediate technology. The latter is often adopted a priori, especially in the developing countries, to be a mere means for creating new market opportunities. It is therefore crucial for a successful application of appropriate technology that its intrinsic attributes of objectivity, relevance, self-reliance and self-sufficiency should be carefully guarded.

continued

...nvironment

Except the northernmost parts of the ...country such as Sokoto, which enjoys ...about eleven months of construction ...eriod, most other parts have between six ...d eight months in the year for road con...truction due to heavy rain. Even the dry ...eason poses its own problems. Rugged ...errain is often encountered along road ...lignments, and the earth material varies from soft and loose soils to hard rocks. Thus difficult and extensive earthwork is sometimes involved, necessitating the use of heavy plant. Except in a few cases where black-cotton soil pervades the state, the sub-grade material is not much of a problem. However, suitable base materials are unevenly distributed, thus involving extensive haulage operation. Most of southern Nigeria is endowed with the right combination of rainfall and soil types amenable to severe erosion. These environmental constraints have obvious cost and performances implications.

Human resources

The acute shortage of all cadre of engineering personnel in the country is well known, in spite of the absence of reliable statistics. For example, of twenty two established posts in a State's Ministry of Works, only six had been filled by August 1979. Feedback from consulting firms reveals large turnover of staff who continue moving in response to better offers. This leads to several ill effects. The few available personnel are over-worked, leading to prolonged delays, inefficiency and poor performance. Several State Ministries of Works often pay off consultants without any assessment of their work, only to discover later, at contract stage, numerous errors and omissions which lead to costly variations and delays. In several instances also, establishments have been constrained to entrust people with responsibilities which outstrip their technical experience, the result being disorderlines and shoddy output.

Equipment

The usual heavy road construction equipment is considered indispensable for construction of strong road bases which can carry the high traffic intensity of usually heavy axle loads that ply the few motorable roads in Nigeria. A recent survey by the author returned a 100 per cent "No" answer to the question: "Do you think any of these machines can be done away with, without affecting the rate or quality of construction?" The respondents included Ministries of Works, Consultants and Contractors. All necessary items of equipment, ranging from such simple and ordinary things as field density equipment to heavy items such as bulldozers, are imported.

Even if one resigns oneself to having to

continued

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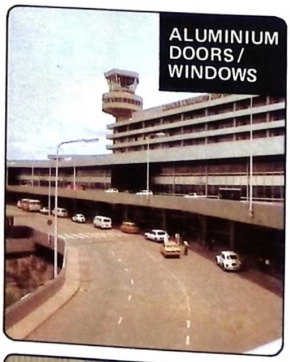

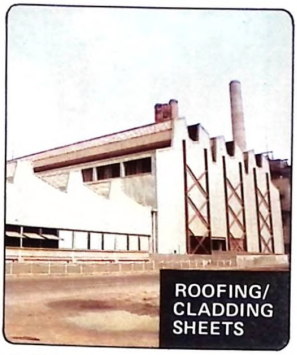

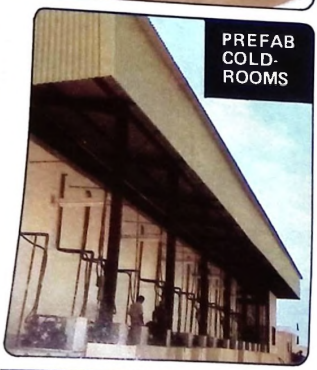

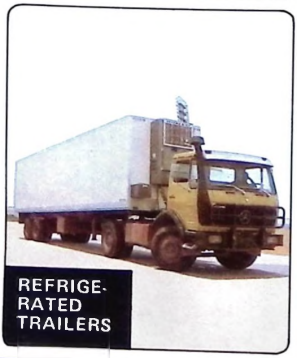

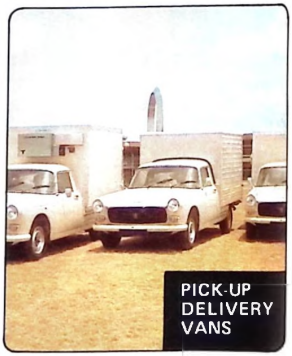

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import equipment, the lack of capability for servicing and repairing the equipment is most disconcerting. The author's survey further shows unanimity on the inadequacy of maintenance facilities in the country and its resultant short service life of construction plant. The experience of a majority of the organisations is that the working life span of conventional equipment such as scrapers, graders, rollers, bulldozers, traxcavators, etc., ranges from two to five years. The obvious root causes of this deficiency are lack of skilled technicians and shortage of spare parts. Thus construction equipment depreciates very rapidly and has no scrap value. Furthermore, road projects are often delayed due to delayed arrival of plants and their spare parts. All this escalates the cost of road construction in the country.

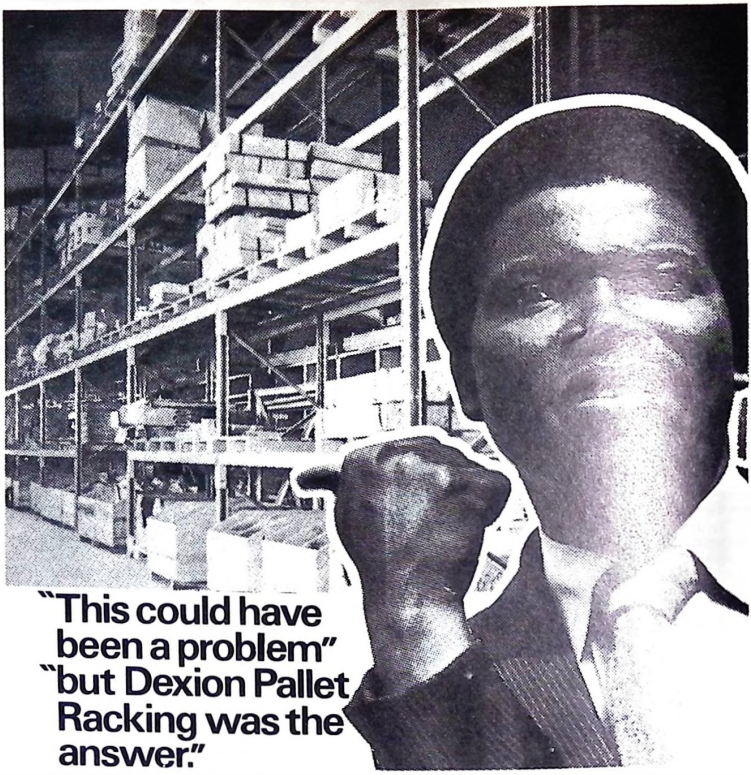
Planning and management

Policy and financial. Government decision to construct a road is often a political one rather than a dispassionate apprisal of its cost-benefit value. This is perhaps inevitable in order to foster unity of a diversity of people. Nevertheless, the implication is that scarce resources are spread too thinly over many projects that the construction of durable roads cannot be adequately funded.

Design considerations. The basis of pavement design for Nigerian roads requires a critical review, considering the poor durability of the roads. The most popular current view attributes this poor durability to the indeterminate increase in axle loads due to excess payload, but this may well be just one of the several factors, thus demanding concerted research and development work. Also the problem may, in part, be that consulting firms do not carry out through investigations to enable them to relate their designs to the locality. The negligence stems primarily from a desire to maximize profits.

For expatriate firms, a further factor may be the tendency to under-rate local technical expertise. For example, during an overseas tour in 1977, the author got to learn by chance that an expatriate testing house had been retained by another expatriate consulting firm to carry out tests and advise on materials for a road project not far from a University with sufficient facilities to undertake that assignment. There are also numerous other instances when technical expertise has been imported by expatriate consultants in spite of the existence of adequate capability within the country. Some of these specialist consultants tend to put more emphasis on embellishing reports with glossy covers and coloured maps and photographs in place of technical content, in the belief that this would make better impression on the Nigerian client, who, on the other hand, may be disappointed in not finding the substance he has paid for.

In the next issue O. J. Eze-Uzomaka will discuss maintenance and the role of the construction company in Nigeria.



"This could have been a problem" "but Dexion Pallet Racking was the answer."

When the warehousing management at T & E considered the storage problems to be encountered at their parts warehouses throughout Nigeria, they were considering various solutions which were available to them.

Technical advice was given by GCK – Dexion suggesting a design for constructing a storage system using Dexion Speedlock Pallet Racking.

"Not only did the whole system promise to meet the job specifications, but Dexion Speedlock Pallet Racking was the world's only such system to have been awarded the AGREEMENT Certificate".

After negotiation, work on installing the Dexion Speedlock Pallet Racking started and was soon completed. In addition, an open shelf storage system was designed and installed for storage of smaller items. T & E now have a warehouse equipped with storage systems that will continue to work for years to come.

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Hero range of drills

The unit construction principle has been used in a new range of hydraulic rotary drills by **Hands-England Drilling Ltd.** The first of the new drills – the Hero 30C – is a crawler-mounted angle hole drill. It has a hoisting capacity of 3,000kg and a feed capacity of 2,000kg.

The main feature of the Hero 30C is the power pack, which is built on the unit construction principle. The complete pack – including the diesel and oil tanks – can be removed via a single lifting point as one unit for major servicing.

The unit construction principle has also been applied to the 30C's hydraulic control panel. In addition to being easily removed during maintenance, the panel has been designed with a low profile to enable the operator to have an unobstructed view during drilling. Another feature of the control panel design is the easy access to all the hydraulic fittings.

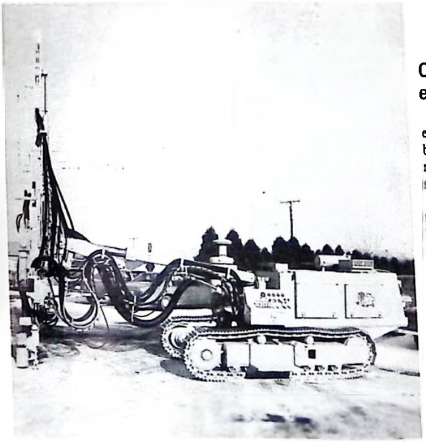
The heavy duty levelling jacks fitted at the front and rear of the rig all have a 600mm stroke. This is an increase of 100mm on the company's Drill-master models. *Circle No. 17*

Crawler drilling rig

The LeRoi II crawler drilling rig is fully hydraulic and self contained. Designed for the quarry construction and mineral exploration markets, its rock drill rotation motor operates between 0 and 190rpm. The air-cooled V-8 engine powers the hydraulic pumps which in turn power the rest of the rig. All three pumps are run at the same speed as the engine: two pumps are used for the drill, tram and positioning circuits, and the third pump powers the on-board compressor for blow air.

The hydraulic drilling controls are grouped in position for the operator at the side of the drill feed. The controls are for drill rotation, blow air, drill impact and drill feed. A manual engine shutdown switch is located with the drilling controls for easy operator activation, if necessary. Automatic shutdown devices include switches for low engine oil pressure, high engine and hydraulic oil temperature and high compressor oil temperature.

The rotary screw compressor for blow air is hydraulically driven with its own circuit and pump. All components for the compression system are located on one side of the rig's housing to allow easy access for routine service. *Circle No. 18*



Flying carpets

"Flying Carpets" are being manufactured by **R. A. Lister** as an alternative to scaffolding. The 8000 series of high-level work platforms are available in two versions – a slab type for use only on paved surfaces and a rough terrain type suitable for construction sites. Both models are now offered with a Lister ST2 or ST3 diesel respectively as an alternative to the standard battery or propane gas engine.

Flying Carpets have been found to provide an excellent alternative to scaffolding, which had led to security problems and was also a danger to children tempted to climb the structure. All movements are controlled from the work platform where a console can be easily removed at the end of a day's work to completely immobilise the unit against unauthorised use and vandalism.

The slab type, carrying a 1,100kg (2,420lb) safe working load, elevates men and equipment up to a height of 7.5m (24ft 6in) or 10.9m (35ft 9in) with a 900kg (2,000lb) load. The rough terrain Flying Carpet will exceed these height and weight performances taking a 450kg (1,000lb) load up to a height of 14.3m (47ft). When in use, complete stability is ensured by powered outriggers operated from the platform. *Circle No. 19*

Champion's 100T earthmoving system

The 100T – one of the largest earthmovers in the world – has been designed for large earth-moving projects, open-pit and strip mining.

Weighing more than 100 tonnes, the 100T is 15.2m (50ft) long and 5.5m (18ft) high, with a power plant developing 500hp. Its articulating frame and front wheel steer provide a 14.3m (47ft) turning radius.

The 100T dramatically reduced haulage cycle times; it spreads material faster than bulldozers, creates superior haul surfaces, and eliminates ruts and pumping in pickup and lay-down areas. *Circle No. 20*

Mobile work platform

The B10 Factory Trailer, available from the Hy-Ryder Division of **Wyseplant Ltd**, is a mobile, aerial work platform designed for maintenance operations. Used in numerous situations where it would be impossible to erect scaffolding, the B10 unit is supplied in many combinations to meet a variety of site maintenance or repair requirements.

The unit can be used to clean and replace lamps on perimeter road lighting; regular preventive maintenance, such as greasing, on 12 gantry cranes; *in-situ* roof ventilation motor repair and filter renewal, general roofing maintenance and many other areas such as greasing roller shutter-door mechanisms and cleaning blocked pipework. Self-propelled, the B10 operates to a safe working height of over 31ft. Controls are duplicated in the cage or at ground level for either single or two-man operation.

Small portable compressors

The **Joy Manufacturing Company's** line of small portable compressors has expanded to include a 275 CFM model Quiet power compressor.

All Joy rotary screw portables now offer energy efficient diesel power, "engineered" sound attenuation and a long list of standard chassis, engine and compressor features, including the Simplair capacity control system. A new speculation sheet is available on this new 94hp portable compressor. *Circle No. 22*

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Telephone: 664440, 664490, 661142, 664493.

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C3P81

Circle No. 259 on enquiry card

The smallest infra-red distancer in the world

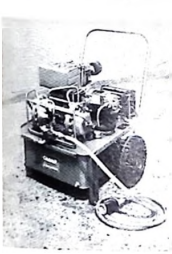
Micro-electronics continue their successful conquest of surveying, too. An impressive proof: the Wild Distomat DI 4 Infra-red Distancer, whose development has just been successfully concluded by Wild Heerbrugg, Switzerland.

Using an invisible infra-red beam, the instrument measures automatically up to a distance of 2.5km. For this, the Wild DI 4 automatically regulates, by means of filters, the reflected infra-red beam, and determines the precise distance within seconds from 1920 individual measurements. According to the switch position selected by the operator, it automatically takes into account air temperature, atmospheric pressure, height above sea level and projection distortion. Fitted to the telescope of a Wild theodolite, only a single pointing measures distance and angles, even with steep lines of sight from –75 to the zenith. After entering the angles on a separate keyboard, the instrument computes horizontal distance, height difference and co-ordinate differences. For setting-out there is a tracking program which displays the slope distance at four-second intervals. The accuracy of the measurements (standard deviation 5mm +5mm/km) can be read off the Wild DI 4 in clear figures in milli-metres, also its functional status by means of a test program. The state of the battery, too, sufficient for 1,500 measurements, is automatically monitored.

Agents for Wild Heerbrugg in West Africa are: F. Steiner and Co. Ltd., Survey Division, 150 Broad Street, P.O. Box 602 Lagos, Nigeria.

Drain jetting equipment

Seeking agents in West Africa are **G. C. Ogle & Sons**, who manufacture high pressure wash pumps and drain jetting equipment. One wash pump in particular, called the Champ, has been specifically designed to deal with the maintenance of sewerage systems in rural areas. The drain jetting equipment clears blockages in small-diameter drains where access



with normal rods is impossible due to bends in the pipeline. The Champ's small size and relatively light weight allows it to be mounted easily and taken to the scene of any sewer blockage with the minimum of disturbance to land and crops.

Champ pressure washing equipment is also of interest to industrial users because it provides the power for a range of accessories designed to clean walls, floors, drains, chutes, vehicles and equipment used throughout the manufacturing industry. Available accessories include garbage chute cleaners for high rise flats, lances for cleaning vehicles and equipment, and a floor cleaner for factory floors. *Circle No. 1*

Safer milling machines

A complete redesign of the Viceroy range of milling machines has enabled **Denford Machine Tools Ltd** to incorporate automatic and mechanical safety features as standard equipment. Improved specifications on all three machines in the range – the V1P vertical mill, T1P turret mill and the U1P universal horizontal model with vertical head – include heavy-duty cast bases for total rigidity in operation. All models now include Halogen low-voltage illumination for safer working conditions, with electric coolant pump and fittings.

Primarily intended for use in technical training, Viceroy milling machines are also suitable and economical for basic production work. The V1P model can be equipped with variable speed feed controlled by an electronic thyristor and giving infinitely variable rates up to 250mm/min. *Circle No. 2*

Heat machine

A new series of heat reclaim machines that save energy, improve thermal efficiency and reduce operating costs has been introduced by **Carrier International Corporation**. Called "Heat Machines", the new line takes low grade heat and raises it to temperature levels that can be used. Hot water temperatures of 40 to 70°C are possible from incoming heat of 15 to 30°C.

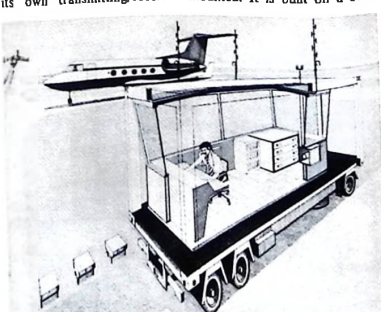
Sources for the low temperature heat include water-cooled air-conditioning systems, process water, solar panels, lakes, wells, waste water and any other warm fluid. The resulting hot water can be used for reheat for humidity control, preheat applications, domestic hot water and process hot water.

Heating costs are reduced because Heat Machines deliver up to five or more units of heat for each unit they use in operation. Coefficients of performance range from 2.3 to 6, depending on the water temperatures involved. With heating capacities from 50kW to 1,050kW, Heat Machines are available in 17 sizes. All models are completely packaged with insulated coolers and condensers, heavy-duty compressors, controls and internal piping and wiring. *Circle No. 3*

Air traffic control

Aluminium Alloy Fabrications Ltd are now introducing TATCOF, a temporary air traffic control system for airport authorities and airfield operations. The TATCOF is an autonomous unit complete with its own transmitting/receiving and ancillary equipment, power supply and fittings so that it can maintain the operational requirements of an airport in the event of the permanent air traffic control facility being temporarily out of action. In addition, the TATCOF can be positioned to upgrade an existing airfield or permit an airport under construction to become operational prior to the permanent facility's completion.

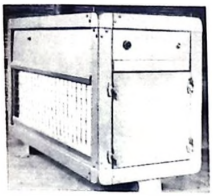
The TATCOF is fabricated using modular components and is built to the ISO dimensions of a 20ft container. If required, the TATCOF can be wheel-mounted. It is built on a steel platform with a wooden floor and steel members providing vertical and lateral structural support. The recently introduced Alifabs Sonarview glass is fitted as standard. This glass is an acoustic and solar control glass specifically designed for Visual Control Rooms. *Circle No. 4*



Vequip revamps auto filter

Vequip have introduced design changes in their Automatic Roll Filters to ensure less attention during service. The air filters are constructed by Vequip's Fastbuild system of assembly, and new filter media is being used.

The equipment incorporates a continuous filter roll carried



on two motorised spools. As the pressure differential across the filter rises, due to collection of dust on the filter, the reels move the used area of filter media to expose an unused area of media for further filtering. When the complete length of the filter reel has been used, an electric signal is initiated to energise an audible and, or, visual alarm. In this way media replacement is only necessary very infrequently, and is simply accomplished.

The Fastbuild construction system ensures that the Automatic Roll Filter is contained in a sealed modular unit which is sized to match the Vequip Air Handling Units, but is also suitable for operation separately. The standard filter media used has a dust holding capacity of 748gm/m² (BS 2831).

Circle No. 5

Truck body turns into low-loader

Gowrings Engineering have converted the rear section of a truck body into a 6-tonne capacity lift. Designed to transport heavy plant and machinery, the Loadlift can be fitted to most makes of two-axle 16 tonne gross vehicle weight chassis. Total loading area (forward and rear platform) is about 7.35m long by 2m wide, sufficient to accommodate a small excavator and a forklift truck or two forklift trucks.

To pull non-self-propelled loads onto the rear platform, a two-way control winch with 45m of steel cable is fitted as standard behind the driver's cab. One operator, who can be the truck driver, can control the entire loading/unloading sequence in about 90 seconds; using a hand-held control unit on a wander lead, he can operate the hydraulic rams and two legs which support the body's middle section during the loading/unloading operation. Rams and support legs are powered by a hydraulic unit mounted behind the cab, providing a maximum working pressure of 20MPa.

Circle No. 6

Asbestos-free insulation

Hasco have produced "energy saving" plates made of a new material for injection moulds and pressure diecasting dies. The insulating plates, used to reduce heat losses and keep a uniform temperature in mould heating, are now made of synthetic resin and glass fibre. As well as improving insulating properties, the new plates are asbestos-free, eliminating the risk of lung damage from toxic dust during machining.

Circle No. 7

Largest ambulance

The largest rescue vehicle regularly manufactured anywhere in the world is now available through **Elgin Leach Corporation.** The new Star-Line SuperMod ambulance is nearly 26ft long by 8ft wide and 8ft high, allowing for two or more adult patients and several infant incubators to be transported at the same time.

Stability is a feature of the vehicle, which uses a dual-axle suspension system to keep all wheels on the ground despite obstructions and depressions. The suspension system also allows for a greater payload capacity.

Roof-mounted air-conditioning controlled from a separate on-board generator make the patient compartment immediately comfortable without operating the vehicle engine. The generator furnishes both 110 and 220-volt power.

Circle No. 8

Shears from Edwards

A new series of mechanical shears with capacities of 2.5 to 3.5mm material thickness and up to 3,750mm material width are announced by **F. J. Edwards.** The "Truecut" standard machines are supplied complete with all equipment for most applications. The shears are suitable for sheet shearing requirements in a variety of industries: mild/stainless steel, non-ferrous metals, rubber, fibreboards and plastics.

Rapid blade setting is a feature of the "Truecut", with five seconds needed to change blade gap from maximum to minimum or any intermediate position. The shears can perform up to 45 cuts per minute on single cycle and 50 cuts per minute on continuous cycle. When operating on single cycle, power is consumed only when the foot control is depressed – there are no continuously running motors or flywheels.

Circle No. 9

Cone penetrometer test system

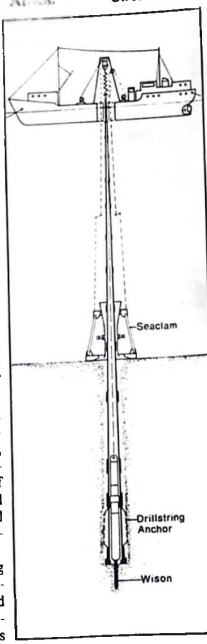
Geotechnical consultants **Fugro Limited** (UK) have introduced a new independent cone penetrometer test system for marine and onshore projects. The lightweight equipment, trailer mounted, is designed to be used when the terrain is unsuitable for the usual 20-tonne trucks. It is linked to the Fugro electric measurement system and can be readily mounted on a barge or jack-up craft for work in marine conditions.

Problems involving soft soils or limited access to areas to be tested are two of the obstacles the system is geared to overcome. The equipment is towed to site by winching or Land-Rover and a reaction force of up to 17 tonnes is obtained by using screw anchors placed at the four corners of the rig.

Offshore drilling and testing systems are also available from Fugro, including tools for push-sampling, cone penetration testing and pressuremeter testing. The basic feature of the offshore equipment is that tests are performed from the bottom of a vertically stabilised drillstring, offering increased protection against buckling of tools or drillstring and making it possible to control and monitor vertical displacements accurately.

The reaction for pushing test probes or sampling-tubes into the soil is obtained from the weight of the embedded drillstring. If this is sufficient, two Fugro [illegible]ns provide extra reac[illegible]he "Seaclam" or the [illegible]string-Anchor". Both [illegible]ystems can deliver the [illegible]nal reaction required, [illegible]ly 5 to 10 tons maxi[illegible] One or both can be [illegible] depending on soil [illegible]tions, survey vessel [illegible]nd the scope of the [illegible] Fugro are actively [illegible]ng agents in West [illegible].

Circle No. 10



ıotogrammetric otting

Direct graphic plotting re- ains the principal task of ıotogrammetric offices. With e Avioplot RAP automation ccessory and the Aviotab TA)igital Plotting Table, this rocess is automated and mproved. The time gain is con- iderable, particularly in roducing large-scale plans of lensely built-up areas. In ıddition, the graphic plot can, n many cases, be used as the inished product, since little or o subsequent enhancement is required. Plotting buildings and other man-made objects, plotting curves by polar digitising, plotting curves and parallel lines, automatically marking and figuring spot levels with fixed or flexible positioning, annotations of any size and at any angle, plotting almost any symbol and type of line. These are amongst the operations effected by this automation.

These operations are functions of the system and can be easily executed by means of a clearly arranged keyboard and a double footswitch, largely without needing to look at the keyboard. For determining auxiliary parameters (e.g. size of letters or figures) an alpha-numeric terminal is available, for the dialogue between operator and computer by means of menus.

The system can be operated with a minimum of training and requires no knowledge of computers or programming. The date for (absolute) orientation can be computed and set on the instrument. Control points and coordinate grids can be plotted first. National grid coordinates (including heights) are shown continuously on the screen. Faulty manipulations are blocked and signalled acoustically to the operator. The RAP automation accessory results in greatly increased efficiency and better performance in direct mapping.

Vault

Chubb & Son's Lock and Safe Co Ltd, UK introduce the demountable extendable vault

(DEV). It has been developed after a considerable period of research into the problems of producing a vault that while providing the highest security requirements, can be assembled and dismantled on the site where it is required for use.

It is made from a new Chubb armour, F110, which while light enough to provide side and roof panels of manageable weights, is strong enough to meet the highest specifications in terms of resistance to all types of assault. These range from thermal lancing to explosion.

The DEV, available in a wide variety of sizes and layouts, consists of roof, floor and side panels which interlock, to provide full protection to internal fastenings. The risks from corner joints are eliminated by the use of one piece corner panels. The vault door, which can be placed in a wide variety of positions to suit customer requirements, is supplied with two Chubb eight lever keylocks and four way moving boltwork.

Visual indicator

The new 18-833 visual indicator from **IMI Norgren Ltd.** of UK can continuously monitor pressure-drop or differential pressure anywhere in compressed-air systems. One major application will be to monitor the pressure-drop across air-line filters to indicate when the element is clogged and needs replacing. With the addition of selector-valves, one indicator can check the condition of a number of filters.

The indicator is completely mechanical and consumes no air itself. It consists of a light-weight aluminium housing, containing a diaphragm on which a spring-loaded plunger bears. The two pressures to be compared are led to opposite sides of the diaphragm. The greater (upstream) pressure acts below the diaphragm and the lesser (downstream) pressure above it. When the pressure difference exceeds 0.4 bar (6 psi), the diaphragm begins to move upwards against spring pressure. By means of a crank, this movement causes a parti-coloured ball (visible through a wide-angle domed lens) to rotate. The colour changes progressively from all-green at 0.4 bar (6 psi) differential pressure to all-red at 1 bar (15 psi). Intermediate pressure differences can be nudged with reasonable accuracy. Maximum absolute pressure is 16 bar (250 psi).

Racking system

Sentors new Post Pallet Racking provides a simple demountable racking system.

Manufactured from tubular steel for maximum strength and stability, the design has removable main posts that can be supplied to suit particular unit load heights. Designed to accept a loaded standard pallet – other sizes can readily be supplied.

Liquid urethane waterproofing

UWM-28 is a seamless, liquid applied urethane rubber waterproofing membrane for waterproofing concrete construction either between slab or below grade.

UWM-28 provides a seamless barrier which eliminates joints in the flat and provides a sound compatible sheet material for troublesome expansion joints and parapet terminations where structural movement is anticipated. It does not depend on variable atmospheric moisture for cure. UWM-28 remains flexible at temperatures as low as −90°F and will not creep, sag or flow at elevated temperatures. It is compatible with hot applied asphalt wear course. It is a two part material that cures at an ambient temperature. It is not intended for exterior exposure. It is also available in a heavier consistency for vertical applications (UWM-29T).

buyers' guide

A guide to services and supplies for buyers in West Africa

Organisations involved in supplying or servicing industry, government or commerce may be listed in this guide for a period of 12 months at: Naira 100, Cedes 150, Leone 125, $140, or equivalent per listing.

CLASSIFIED INDEX

Full addresses listed alphabetically on following pages.

Abrasives
Bissolu Enterprises Ltd, Apapa
Landmark Industrial Supplies Limited
Reiss & Co. (Nig.) Ltd, Ebute-Metta

Accounting Machines & Systems
GBO BEAM (a Divison of UAC of Nigeria Ltd), Lagos
Leventis Technical Ltd, Lagos

Adhesives
Bostik Ltd, Leicester, UK

Aerial Photography
Kenting Africa Resource Service Ltd, Lagos

Agricultural Chemicals
Yakon Enterprises (Nig.) Ltd, Benin

Agricultural Consultancy
Yakon Enterprises (Nig.) Ltd, Benin

Agricultural Equipment
Afrocommerce (W.A.) Ltd, Lagos
Afrotec Technical Services (Nigeria) Ltd, Isolo
J. Allen & Co. Ltd, Apapa
Bewac Limited Apapa
Blackwood Hodge (Nigeria) Ltd, Apapa
R. T. Briscoe (Nigeria) Ltd Agricultural Equipment Group, Kano
Camplant, Apapa, Nigeria
Dizengoff, W.A. (Nigeria) Ltd, Apapa
Elof Hansson Ltd, UK
Hallam Graders, Leicester, UK
Incar (Nigeria) Ltd, Lagos
KAH Engineering Services Ltd Members of Hamzagroup, Apapa
Leventis Motors Ltd, Apapa
Morpol Industrial Corp. Ltd, Apapa
NITECO, Apapa
Nigerian Motors, Apapa
Phoenix Motors Ltd, Lagos
Henry Stephens Engineering Co. Ltd, Ilupeju
Scoatrac (Nig) Ltd, Isolo
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos
UTC Technical, Isolo-Mushin
UTC Hardware Division, Apapa
Waateco Ltd, Technical Division, Lagos
Yakon Enterprises (Nig.) Ltd, Benin

Agricultural Services
Cidpag Nigeria Ltd, Calabar

Agrochemical Fertilisers
A/S Cheminova, Denmark

Air Cargo Services
IMNL International Messengers (Nigeria) Ltd, Lagos, Kano, Ikoyi, Kaduna, Port Harcourt, Zaria
Nigeria International Air Services Ltd, Apapa
Triana Ltd, Apapa

Air Compressors & Pneumatic Plant
Blackwood Hodge (Nigeria) Ltd, Apapa
R. T. Briscoe (Nigeria) Ltd, Technical Department, Matori – Oshodi
R. T. Briscoe (Nigeria) Ltd, Lagos
Brossette (Nigeria) Ltd, Apapa
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C. Zard & Co. Ltd, Lagos

Air Conditioning & Refrigeration
Dizengoff, W.A. (Nig.) Ltd, Apapa
Drake & Scull (Nig.) Ltd, Lagos
Equip Home (a Division of SCOA Nigeria Ltd), Lagos
Equip Iard, Scoa (Nig.) Ltd, Ogba
Hademec Ltd, Lagos
Haven Nigerian Computer Co, Lagos
Holt Engineering Ltd, Apapa
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James Kilpatrick (Nigeria) Ltd, Ilasamaja
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Nigeria Engineering Works Ltd, Port Harcourt
Norman Industries Ltd, Ikeja
Morpol Industrial Corp. Ltd, Apapa
Patterson Zochnis & Co. Ltd, Lagos
R. & A. Services (Division of UAC Ltd), Lagos
VYB (Nigeria) Ltd, Apapa
Waateco Ltd, Technical Division, Lagos

Air Courier Services
IMNL – International Messengers (Nigeria) Ltd, Lagos, Kano, Ikoyi, Kaduna, Port Harcourt, Zaria
Redcoat Express Ltd, Surrey, UK
Triana Ltd, Apapa

Aircraft Test/Aid Equipment and Accessories
Intermaco (Ghana) Ltd, Accra

Air Tools
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Aluminium Doors & Windows
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Brossette (Nigeria) Ltd, Apapa
Cego (Engineering) Ltd, Essex, UK
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Flag Aluminium Products
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Asbestos Cement Building Materials
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Mandilas Enterprises Ltd, Lagos
Turners Building Products (Emene) Ltd
Scoatrac, Ikeja, Lagos

Asbestos Manufacturers
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Asphalt Plants
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Morpol Industrial Corp. Ltd, Apapa
Nigerian Motors Industries Ltd, Apapa
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Scoatrac (Nig.) Ltd, Isolo
Tarpaulin Industries (WA) Ltd, Apapa

Audio Visual Equipment
Beam (Division of UAC Nig. Ltd), Lagos
Controls and Automation, Apapa
Grette Communications (Nig.) Ltd, Lagos
Ihekoke International Concern (Nig.) Ltd, Jos

Automotive Parts
J. Allen & Co. Ltd, Apapa
Leventis Motors Ltd, Apapa
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NITECO, Apapa
Phoenix Motors Ltd

Bearings – Ball, Roller & Needle
R. T. Briscoe (Nig.) Ltd, Apapa

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Bitumen Boilers & Distributors
Blackwood Hodge (Nigeria) Ltd, Apapa
M. & E. (a Division of UAC of Nigeria) Ltd
Morpol Industrial Corp. Ltd, Apapa
NITECO, Apapa
Scoatrac, Ikeja, Lagos

Block Making Machinery
Adamog (Nigeria) Ltd, Ibadan
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Borehole Drilling
West African Water Drilling and Allied Services Co. Ltd, Lagos

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Burglary Alarms Equipment
Jos Hansen & Sochne Ltd, Lagos

Business Consultants
Cidpag Nig. Ltd, Calabar

Business Services
Danlon Associates, Lagos

Business Establishment Services
Danlon Associates, Lagosg11Business

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Air Marketing International Group of Companies, Crawley, UK
All Counties Business Agency, UK

Capacitors – AC Motor Starting & Electrolytic
Daly (Condensers) Ltd, Dorset, UK

Carbon Brush Manufacture
H. F. Schroeder (WA) Ltd, Iganmu (under licence from Morganite UK)

Cargo Airlines
Redcoat Cargo Airlines, UK

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Electrolux Mandilas Ltd, Ikeja
Equip Home (a Division of SCOA Nigeria Ltd), Lagos
Leventis Technical Ltd, Lagos
Nirexim GmbH, Vienna
F. Steiner & Co. Ltd, Lagos
VYB (Nigeria) Ltd, Apapa

Cement Manufacturers
Calabar Cement Co. Ltd, Calabar
Nigerlink Industries Ltd, Lagos

Chemical Engineering
Heplac Nigeria Ltd, Lagos
Shogbola Techniteonics Inc., Lagos

Charter Operations

Agbedeta Shipping Agencies Ltd, Lagos

Civil Engineering Contractors

Beton (Nig.) Ltd, Ikeja

Civil Services

Cidpag Nigeria Ltd, Calabar

Civil, Electrical & Mechanical Engineers & Constructors

Hademec Ltd, Lagos
James Kilpatrick (Nig.) Ltd, Lagos
Lemco Nig. Ltd, Calabar

Cold Stores

Alumaco, Apapa
Thomas Refrigeration (UK) Ltd

Commercial Painting & Maintenance

Fadi Lekan Ent., Lagos

Compactors

Afrotec Technical Services (Nigeria) Ltd, Isolo
Blackwood Hodge (Nigeria) Ltd, Apapa
Holman Brothers (Nigeria) Ltd, Apapa
Holt Engineering (a Division of J. Allen & Co. Ltd, Oregun Village)
Leventis Motors Ltd, Apapa
Metro Technical, Ikeja and Agbara
Morpol Industrial Corp. Ltd, Apapa
Nigerian Motor Industries Ltd, Apapa
NITECO, Apapa
Henry Stephens Engineering Co. Ltd, Ilupeju
Scoatrac, Ikeja
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos
UTC Technical, Isolo-Mushin

Computers & Related Services

GBO BEAM (a Division of UAC of Nigeria Ltd), Lagos
Haven Nigerian Computer Co., Lagos
Modata Ltd, Lagos
International Computers (Nigeria) Ltd, Lagos, Nigeria
Leventis Technical Ltd, Lagos
Remac Computer Services, Surulere
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Concrete Machinery

Adamog (Nigeria) Ltd, Ibadan
Afrotec Technical Services (Nigeria) Ltd, Isolo
Holman Brothers (Nigeria) Ltd, Apapa
M. & E. (a Division of UAC of Nigeria) Ltd
Morpol Industrial Corp. Ltd, Apapa
Henry Stephens Engineering Co. Ltd, Ilupeju Industrial Estate
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Structor Technique
UTC Technical, Isolo-Mushin

Concrete Reinforcement

Nigerian Wire Industries Ltd

Construction Equipment

Blackwood Hodge Nigeria Ltd, Apapa
Camplant, Apapa, Nigeria
Joy Manufacturing Co., USA
Izzat (Nigeria) Ltd, Lagos
Landmark Industrial Supplies Ltd, Lagos
Metro-Technical, Ikeja and Agbara
Scoatrac (Nig.) Ltd, Ikeja
Henry Stephens Engineering Co. Ltd, Ilupeju
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Consultancy Services

Cidpag Nigeria Ltd, Calabar

Containers & Tanks

Fibreglass Reinforced Plastics Co. Ltd, Abeokuta

Copy/Duplicating Machines & Products

GBO BEAM (a Division of UAC of Nigeria) Ltd, Lagos
Leventis Technical Ltd, Lagos

Corrugated Boxes

Nigerian Carton & Packaging MFG. Co. Ltd, Ikeja
Polythene Enterprises (Nigeria) Ltd, Ikeja

Couplings

R. T. Briscoe (Nig.) Ltd, Apapa

Cranes, Ropes & Hydraulic Excavators

Afrotec Technical Services (Nigeria) Ltd, Isolo
Blackwood Hodge (Nigeria) Ltd, Apapa
Camplant, Apapa, Nigeria
Conveyancer (Nigeria) Ltd, Apapa
Holman Brothers (Nigeria) Ltd, Apapa
Holt Engineering Ltd, Apapa (a Division of J. Allen Oregun Village & Co. Ltd)
Jones Cranes Ltd, UK
Leventis Motors Ltd, Apapa
Metro Technical, Ikeja & Agbara
Morpol Industrial Corp. Ltd, Apapa
Nigerian Motors Industries Ltd, Apapa
H. F. Schroeder (W.A.) Ltd
Henry Stephens Engineering Co. Ltd, Ilupeju
Stronghold (Nigeria) Ltd, Engineering Services Division, Ikeja
Scoatrac (Nig.) Ltd, Isolo
Tractor & Equipment, Ebute-Metta
Waateco Ltd, Technical Division, Lagos

Crown Wheel & Pinions (for commercial vehicles)

Gajra Gears, Malaysia

Cutting & Bending

Afrotec Technical Services (Nigeria) Ltd, Isolo
UTC – Hardware Division, Apapa

Decoration & General Joinery

Northern Sawmill & Furniture Manufacturing Co. Ltd, Kano

Dewatering Wellpoint Equipment and Services

Morpol Industrial Corp. Ltd, Apapa
Mandilas Enterprises Ltd, Lagos

Diesel Generating Plant

Afrotec Technical Services (Nigeria) Ltd, Isolo
Blackwood Hodge (Nigeria) Ltd, Diesel Sales and Service Division, Apapa
R. T. Briscoe (Nigeria) Ltd, Technical Department, Matori-Oshodi
Camplant, Apapa, Nigeria
Clausen Eng., Co, Kano
E. D. G. (Nigeria) Ltd, Kano
Holman Brothers (Nigeria) Ltd, Apapa
Holt Engineering (a Division of J. Allen & Co. Ltd, Oregun Village)
ITT Nigeria Ltd, Yaba
Leventis Technical Ltd, Lagos
M. & E. (a Division of UAC of Nigeria) Ltd
Nigerian Motors Industries Ltd, Apapa
Nigerlink Industries Ltd, Lagos
NITECO, Apapa
Phoenix Motors Ltd, Oregun, Lagos
Powermaker Generators (Technical Division Tarpaulin Inc. (WA) Ltd), Apapa
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Scoatrac, Ikeja
Stokvis Nigeria Limited, Ebute Metta
Stronghold (Nigeria) Ltd, Engineering Services Division, Ikeja
Structor Technique, VYB (Nigeria) Ltd, Apapa
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos
UTC Technical, Isolo-Mushin
Waateco Ltd, Technical Division, Lagos
Wartsila Nigeria Ltd, Apapa
C. Zard & Co. Ltd, Lagos

Diesels – Industrial and Marine

Blackwood Hodge (Nigeria) Ltd, Apapa
R. T. Briscoe (Nigeria) Ltd, Technical Department, Apapa
Equip Home (a Division of SCOA Nigeria Ltd), Lagos
Holt Engineering Ltd (a Division of J. Allen & Co. Ltd, Oregun Village)
Leventis Technical Ltd, Lagos
M. & E. (a Division of UAC of Nigeria) Ltd
Morpol Industrial Corp. Ltd, Apapa
Nigerian Motors Industries Ltd, Apapa
Nigerlink Industries Ltd, Lagos
Scoatrac (Nig.) Ltd, Ikeja
Henry Stephens Engineering Co. Ltd Ilupeju Industrial Estate
Stokvis Nigeria Limited, Ebute-Metta
Tarpaulin Industries (WA) Ltd, Apapa
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos
Tractor & Equipment, Ebute-Metta
UTC Technical Division, Isolo-Mushin
Wartsila Nigeria Ltd, Apapa

Dispensing and Bulk Pumps

Reiss & Co. (Nig.) Ltd, Ebute-Metta
Wayne (West Africa) Ltd, Apapa

Doors & Windows

Aluminium Manufacturing Company of (Alumaco), Nigeria Limited, Apapa
Bisiclu Enterprises Ltd, Apapa
Cintall-Hope Nigeria Limited, Ikeja
General Metal Products, Apapa
Steel Works Ltd, Ibadan, Nigeria

Dredging & Reclamation Contractors

Ham Dredging (Nig.) Ltd, Ikeja
Nigerian Dredging & General Works Ltd, Apapa
Westminster Dredging (Nig.) Ltd, Lagos

Dumpers

Afrotec Technical Services (Nigeria) Ltd, Isolo
Camplant, Apapa, Nigeria
Conveyancer (Nig.) Ltd, Apapa
Holman Brothers (Nigeria) Ltd, Apapa
Leventis Motors Ltd, Apapa
M. & E. (a Division of UAC of Nigeria) Ltd, Lagos
Morpol Industrial Corp. Ltd, Apapa
Nigerian Motors Industries Ltd, Lagos
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Scoatrac, Ikeja
Henry Stephens Engineering Co. Ltd, Ilupeju
Structor Technique
UIC Technical, Isolo-Mushin
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Earthmoving Equipment

Afrotec Technical Services (Nigeria) Ltd, Isolo
Bewac Ltd, Apapa
Blackwood Hodge (Nigeria) Ltd, Apapa
R. T. Briscoe (Nigeria) Ltd, Lagos
Camplant, Apapa, Nigeria
Greenham Plant Hire (a Division of UAC of Nigeria Ltd), Ikeja
Holman Brothers (Nigeria) Ltd, Apapa
Holt Engineering (a Division of J Allen & Co. Ltd, Oregun Village)
Conveyancer (Nigeria) Ltd, Apapa
Hallam Graders, Leicester, UK
Holman Brothers (Nigeria) Ltd, Apapa
Joy Manufacturing Co, USA
Leventis Motors Ltd, Lagos
Metro Technical, Ikeja & Agbara
Nigerian Motors Industries Co. Ltd, Apapa
Scoatrac, Isolo
Stronghold (Nigeria) Ltd, Engineering Services Division, Ikeja
Tractor & Equipment (a Division of UAC of Nigeria Ltd), Lagos

Electrical Contracting Materials

Clausen Engineering, Co. Ltd, Kano
Cutler-Hammer Nigeria Ltd, Yaba
Holt Engineering Ltd (a Division of J. Allen & Co. Ltd, Oregun Village)
Pan Electric, Apapa
Remco Nigeria Ltd, Calabar
West African Engineering Co. (Nig.) Ltd, Apapa

Electrical/Electronic Equipment

R. T. Briscoe (Nigeria) Ltd, Technical Department, Matori – Oshodi
Cutler-Hammer Nigeria Ltd, Yaba
EMS (a Division of UAC of Nigeria Ltd), Apapa
Fado Engineering Co. Ltd, Ebute-Metta
Grette Communications (Nig.) Ltd, Lagos
Haven Nigerian Computer Co., Lagos
Holt Engineering Ltd (a Division of J. Allen & Co. Ltd, Oregun Village)
Leventis Technical Ltd, Lagos
Mofat Engineering Co. Ltd, Lagos
Nigerian Computer Co., Lagos
NITECO, Apapa
G.N. Okosia Electric Company
VYB (Nigeria) Ltd, Apapa
West African Engineering Co. (Nig.) Ltd, Apapa

Electrical Engineering Contractors

Aluminium Wire & Cable Co. Ltd
Artec Engineering Ltd, Yaba
Clausen Engineering Co. Ltd, Kano
Electric Cable & Overhead Conductor
Bennet Babs Electrical Co., Ikeja
Drake & Scull (Nig.) Ltd, Lagos
E.D.G. (Nigeria) Ltd, Kano
A.D. Green & Co. Ltd, Ibadan
Hademec Ltd, Lagos
Heplac Nigeria Ltd, Lagos
James Kilpatrick (Nigeria) Ltd, Ilasamaja
Lilleker Brothers (Nig.) Ltd, Zaria
Marryat Daniel (Nigeria) Ltd, Lagos
Mofat Engineering Co. Ltd, Lagos
Technical Constructions (Nigeria) Ltd, Lagos

Electric Fans

Nigeria Engineering Works Ltd, Port Harcourt
Reiss & Co. (Nig.) Ltd, Ebute-Metta

Electric Generating Sets

Lanre Bhadmus Ind. Ltd, Lagos
Phoenix Motors Ltd, Lagos
Scoatrac, Ikeja, Lagos
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Electrical/Mechanical Contractors

Lilleker Brothers (Nig.) Ltd. Zaria

Electrical Services

Afrotec Technical Services (Nigeria) Ltd, Isolo
Bennet Babs Electrical Co., Ikeja
Cidpag Nigeria Ltd, Calabar
Reiss & Co. (Nig.) Ltd, Ebute-Metta
H. F. Schroeder (WA) Ltd, Iganmu

Electric Pumps

Morpol Industrial Corp. Ltd, Apapa
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Tractor &Equipment (Division of UAC Nigeria Ltd), Lagos

Electrolytic Capacitors

Daly (Condensers) Ltd, Dorset, UK

Electronic Communication Equipment

GTE Nigeria Ltd, Lagos
Grette Communications (Nig.) Ltd, Lagos
Jos Hansen & Soehne Ltd, Lagos

Electronic Kits ("do it yourself")

Steen Bolbroe A/S Denmark

Engineering Services

Cutler-Hammer Nigeria Ltd, Ikeja

Drake & Scull (Nigeria) Ltd, Lagos
James Kilpatrick (Nigeria) Ltd, Ilasamaja

Engineering Laboratory Services

Artec Engineering Ltd, Yaba
Foundation Engineering (Nigeria) Ltd, Lagos

Excavators (Hydraulic)

Camplant, Apapa, Nigeria
Metro Technical, Ikeja & Agbara
Scoatrac, Ikeja, Lagos
Henry Stephens Engineering Co. Ltd, Ilupeju
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Feed, Mill & Grain Storage Systems

Lolita Nigeria Ltd, Enugu

Fencing

Nigerian Wire Industries Limited

Fibreglass Stockists

Pilkington Glass (Nigeria) Ltd, Apapa

Filters

Morpol Industrial Corp. Ltd

Fire-fighting Equipment & Vehicles

Guthrie (Nigeria) Ltd, Lagos
Leventis Motors Ltd, Lagos
Omot Fire Protection Eng. Ltd, Ikeja
Preussag Drilling Engineers Ltd, Maiduguri
SIDES
Stronghold (Nigeria) Ltd, Security & Safety Services Division, Ikeja

Fire Protection Equipment & Systems

Omot Fire Protection Eng. Ltd, Ikeja
Intermaco (Ghana) Ltd, Accra
Reiss & Co. (Nigeria) Ltd, Lagos

Flow

Brossette (Nigeria) Ltd, Apapa

Flow Meters

Wayne (West Africa) Ltd, Apapa
West African Engineering Co. (Nig.) Ltd, Apapa

Food Processing Equipment

Henry Stephens Engineering Co. Ltd, Apapa
UTC Technical, Isolo-Mushin

Fork Lift Trucks

Adamog (Nigeria) Ltd, Ibadan
Afrocommerce (W.A.) Ltd, Lagos
Afrotec Technical Services (Nigeria) Ltd, Isolo
Bewac Limited, Apapa
K. T. Briscoe (Nigeria) Ltd, Technical Department, Apapa
Conveyancer (Nig.) Ltd, Apapa
Engineering Services Division, Ikeja
Leventis Motors Ltd, Lagos
Lyntraco Sweden (Nig.) Ltd, Ikeja
Nigerian Motors Industries Ltd, Apapa
NITECO, Apapa
Henry Stephens Engineering Co. Ltd, Ilupeju
Tarpaulin Industries (WA) Ltd, Apapa
Tractor & Equipment (a Division of UAC of Nigeria Ltd), Lagos
Waateco Ltd, Iganmu

Foundation Works

Foundation Construction Ltd, Iganmu
Raymond Constructors (Nigeria) Ltd, Lagos
Trevi Foundations Nig. Ltd, Oshodi

French Windows and Doors

Crittall-Hope Nigeria Ltd
Steel Works Ltd, Ibadan
General Metal Products, Apapa

Full and Split Charter Operations

Air Marketing International Group of Companies, Crawley, UK
Triana Ltd, Apapa

Furniture

Beam (Division of UAC Nig. Ltd), Lagos
Nigerian Office Stationery Supply Stores Ltd, Apapa

Garage Equipment

Landmark Industrial Supplies Ltd, Lagos
Pump Services Nigeria Ltd, Lagos
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Stokvis Nigeria Limited
VYB (Nigeria) Ltd, Apapa
Wayne (West Africa) Ltd, Apapa
C. Zard & Co. Ltd, Lagos

Gas and Arc Welding Equipment

Nigerian Gas Industries Ltd, Lagos

General Building Contractors

Fuad-Lekan Ent., Lagos

Generating Sets

Holman Brothers (Nigeria) Ltd, Apapa
Incar (Nigeria) Ltd, Apapa
Lilleker Brothers (Nig.) Ltd, Zaria
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Tarpaulin Industries (W.A.) Ltd, Apapa

Glasshouses

Makin Ltd, Ilupeju
General Metal Products, Apapa

Glass/Mirrors Processors

Pilkington Glass (Nigeria) Ltd, Apapa

Graders

Blackwood Hodge (Nigeria) Ltd, Apapa
Camplant, Apapa, Lagos
Holt Engineering Ltd (a Division of J. Allen & Co. Ltd, Oregun Village)
Metro Technical, Ikeja and Agbara
Morpol Industrial Corp. Ltd, Apapa
Nigerian Motors Industries Ltd, Apapa
Scoatrac, Ikeja, Lagos
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Graphic Arts Requisites

A.M. Faltas (West Africa) Ltd, Lagos

Hand & Power Tools

Landmark Industrial Supplies Limited
Reiss & Co. (Nig.) Ltd, Ebute-Metta
UTC – Hardware Division, Apapa

Hemodialysis Systems

Intermaco (Ghana) Ltd, Accra

Hoses

Akan Ltd, Kano
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos
Equip Home (a Division of SCOA Nigeria Ltd), Lagos
A.M. Faltas (West Africa) Ltd, Lagos
Fawaz Steelwood & Chemicals (Kano) Ltd, Kano
Nirexim GmbH, Vienna
Ihekoke Int. Concern Ltd, Jos
Scoatrac, Ikeja, Lagos
F. Steiner & Co. Ltd, Lagos
UTC Technical, Isolo-Mushin

House Furniture

North Sawmill & Furniture Manufacturing Co. Ltd, Kano

Ice Plants

Phoenix Refrigeration (UK) Ltd, Lagos

Identity Cards

Veritas & Co. (Nig.) Ltd, Lagos

Importers/Exporters

G.N.A. Hamzer & Co. (Nig.) Ltd

Industrial Electrical Installations

H. F. Schroeder (W.A.)Ltd

Industrial Engines & Accessories

Landmark Industrial Supplies Ltd, Lagos
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Scoatrac, Ikeja, Lagos
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Industrial Chemicals

Stauffer Chemical Europe S.A., Switzerland

Industrial Gases

Gas & Welding (Nigeria) Ltd, Ikeja
Industrial Gases Ltd, Apapa

Industrialisation Services

Danlon Associates, Lagos

Innoculation Apparatus

Intermaco (Ghana) Ltd, Accra

Instrumentation

Brossette (Nig.) Ltd, Apapa

Insecticides

A/S Cheminova, Denmark

Insurance Brokers & Consultants

Interbroker & Co.

Interior Decorating

Fuad/Lekan Ent., Lagos

Intruder Detection & Alarm Systems

Reiss & Co. (Nigeria) Ltd, Lagos

Ironmongery & Locks

UTC – Hardware Division, Apapa

Irrigation Equipment

Afrotec Technical Services (Nigeria) Ltd, Isolo
Brossette (Nig.) Ltd, Apapa
Guthrie (Nigeria) Ltd, Lagos
Jos. Hansen & Sochne (Nig.) Ltd, Lagos
I.I.D.C., New York
Landmark Industrial Supplies Ltd, Lagos
Leventis Technical Ltd, Lagos
Scoatrac, Ikeja, Lagos
Stokvis Nigeria Limited, Ebute-Metta
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos
U.T.C. Engineering Division, Lagos

Kitchen Cabinets

Steel Works Ltd, Ibadan, Nigeria

Laboratory Chemicals/Reagents

Ihekole International Concern (Nig.) Ltd, Jos
The Twilights Nigeria Ltd
Intermaco (Ghana) Ltd, Accra

Laboratory Furniture

Fawaz Steelwood & Chemicals (Kano) Ltd, Kano
Ihekole International Concern (Nig.) Ltd, Jos
Intermaco (Ghana) Ltd, Accra
Nirexim GmbH, Vienna

Laundry Equipment

Electrolux Mandilas Ltd, Ikeja
Equip Home (a Division of SCOA Nigeria Ltd), Lagos
F. Steiner & Co. Ltd, Lagos
VYB (Nigeria) Ltd, Apapa

Library Equipment

Ihekole International Concern (Nig.) Ltd, Jos
Nigeria Engineering Works Ltd, Port Harcourt

Lift/escalator installations/maintenance

Nigerian Motors Industries Ltd, Otis Division
H. F. Schroeder (WA) Ltd, Iganmu

Light Fittings

Context (Nig.) Ltd, Lagos

Liquid Storage Tanks

Braithwaite Dept. Gottshalcks Building Materials, Apapa
Reiss & Co. (Nigeria) Ltd, Lagos

Lighterage

Niger Benue Transport Co. Ltd, Warri

Livestock Feed Mills

UTC Technical, Isolo-Mushin

Machine Tools & Woodworking Machinery

Holt Engineering Ltd (a Division of J. Allen & Co. Ltd, Oregun Village
Landmark Industrial Supplies Ltd, Lagos
Leventis Technical Ltd, Lagos
Lyntraco Sweden (Nig.) Ltd, Ikeja
M. & E. (a Division of UAC of Nigeria Ltd), Lagos
Nigerian Motors Industries Ltd, Apapa
Stokvis Nigeria Limited, Ebute-Metta
Stokvis Nigerian Tool & Die Co. Ltd, Ebute-Metta
UTC Technical, Isolo-Mushin
UTC – Hardware Division, Apapa
C. Zard & Co. Ltd, Lagos

Manhole Covers & Gully Gratings

Ajoola Enterprises Ltd, Apapa
Nigerian Foundries Ltd, Lagos

Mapping

Surveys Africa Resource Service Ltd, Lagos

Marine Engines & Accessories

Allens Marine, Port Harcourt
Blackwood Hodge (Nigeria) Ltd, Diesel Sales and Service Division, Apapa
K. T. Briscoe (Nigeria) Ltd, Lagos
Holman Brothers (Nigeria) Ltd, Apapa
Nigerian Motors Industries Ltd, Apapa
Henry Stephens Engineering Co. Ltd, Apapa
UTC Technical, Isolo-Mushin
Scoatrac, Ikeja, Lagos
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Materials Handling Equipment

Gottshalks Building Materials (a Division of UAC Nig. Ltd), Apapa
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Mechanical Services

Cidpag Nigeria Ltd, Calabar

Mechanical & Electrical Engineering Contractors

Artec Engineering Ltd, Yaba
Equip Home (Division of Scoa Nigeria Ltd), Ogba
Fado Engineering Co. Ltd, Ebute-Metta
Hademec Ltd, Lagos
Heplac Nigeria Ltd, Lagos
Landmark Industrial Supplies Ltd, Lagos
Marryat & Daniel (Nig.) Ltd, Lagos
Remco (Nigeria) Ltd, Calabar

Medical Gases & Medical Equipment

Ihekole International Concern (Nig.) Ltd, Jos
Industrial Gases Ltd, Apapa

Metal Cutting Machinery

Afrocommerce (W.A.) Ltd, Lagos

Mining Equipment & Quarrying

Holman Brothers (Nigeria) Ltd, Apapa
Joy Manufacturing Co. Ltd, USA
Morpol Industrial Corp. Ltd, Apapa
Scoatrac, Ikeja, Lagos

& Equipment (Division of C Nigeria Ltd), Lagos

ile Broadcasting cles

Communications (Nig.) Ltd, Lagos

tor Transport (Trucks)

s & Co. Ltd, Apapa
Briscoe (Nigeria) Ltd, Motor vision, Iganmu
(Nigeria) Ltd, Lagos
ss Motors Ltd, Apapa
ICO, Apapa
n Motors Ltd, Lagos
Stephens Engineering Co. Ltd, papa
rico Ltd, Iganmu

otor Spare Parts and ccessories

n Gears, NS SDN BHD, Malaysia
Ghadmus Ind. Ltd, Lagos
Industrial Corp. Ltd
Bros Brothers, Yaba & Lagos
Life General Motors (Nigeria) Co. Ltd

lunicipal and Specialist ehicles

Life General Motors (Nigeria) Co. Ltd

ffice Equipment

Steelwood & Chemicals (Kano) Ltd
EO BEAM (a Division of UAC of Nigeria Ltd), Lagos
Technical Ltd, Lagos
Engineering Works Ltd, Port Harcourt
Office Stationery Supply Stores Ltd, Apapa
Steiner & Co. Ltd, Lagos
General Metal Products Ltd, Apapa
Works Ltd, Ibadan

Oil – Seals

T. Briscoe (Nig.) Ltd, Apapa

Oil Tank Calibrators

Caleb Brett & Sons (Nig.) Ltd, Apapa

Ovens

Kilns & Co. (Nig.) Ltd, Ebute-Metta

Oxygen, Acetylene & Special Gases

Gas & Welding (Nigeria) Ltd, Mushin
Industrial Gases Ltd, Apapa

Packaging Materials

Akan Ltd, Kano
Nigerian Carton & Packaging MFG Co. Ltd
Polythene Enterprises (Nigeria) Ltd, Ikeja

Paging & Public Address Systems

Grette Communications (Nig.) Ltd, Lagos
Jos Hansen & Soehne Ltd, Lagos

Paints & Varnishes

Apex Paints Ltd, Ikeja
Berger Paints (Nigeria) Ltd, Ikeja
Elsiolu Enterprises Ltd, Apapa
Dulux, ICI Paints (Nigeria) Ltd, Ikeja
Plenilux Paints, International Paints (West Africa) Ltd, Ikeja
Reiss & Co. (Nig.) Ltd, Ebute-Metta

Paper Converting Machinery

Elof Hansson Ltd, UK

Partitioning

Contest (Nig.) Ltd, Lagos

Petrol and Diesel Pumps

Avery Nigeria Ltd, Ikeja

Petroleum Hoses

Wayne (West Africa) Ltd, Apapa

Piling

Foundation Construction Ltd, Iganmu
Raymond Constructors (Nigeria) Ltd, Lagos
Trevi Foundations (Nig.) Ltd, Oshodi

Pipes, Building & Pressure

Akan Ltd, Kano
Bisiolu Enterprises Ltd, Apapa
Brossette (Nigeria) Ltd, Apapa
Dunlop Nigerian Industries Ltd, Ikeja
Interplast Ltd, Accra
Leventis Stores, Lagos
Mandilas Enterprises Ltd, Lagos
Nigerian Foundries Ltd, Lagos
Turners Building Products (Emene) Ltd, Enugu

Plant Hire

Camplant, Apapa, Nigeria
Costain (West Africa) Ltd, Lagos
Greenham Plant Hire (a Division of UAC of Nigeria Ltd), Ikeja
Holman Brothers (Nigeria) Ltd, Apapa
James Kilpatrick (Nigeria) Ltd, Ilasamaja

Plant Protection Chemicals

A/S Cheminova, Denmark

Plastic Processing Equipment

Nigerian Office Stationery Supply Stores Ltd, Apapa
Reiss & Co. (Nig.) Ltd, Ebute-Metta

Plumbing Contractors

Akan Ltd, Kano
Artec Engineering Ltd, Yaba
Hademec Ltd, Lagos
Equip Iard – SCOA Nigeria Ltd
James Kilpatrick (Nigeria) Ltd, Ilasamaja
Marryat Daniel (Nig.) Ltd, Lagos

Pothole Repair Materials

Roadcare (Nigeria) Ltd, Ibadan

Poultry Feed Distribution Equipment

Afrotec Technical Services (Nigeria) Ltd, Isolo

Printing Machinery

Elof Hansson Ltd, UK

Printing Materials

Makeri Smelting Co. Ltd, Jos
Nigerian Office Stationery Supply Stores Ltd, Apapa
Reiss & Co. (Nig.) Ltd, Ebute-Metta

Projected Windows

Steel Works Ltd, Ibadan

Protective Coatings

Bostik Ltd, Leicester, UK
General Metal Products Ltd, Apapa

Protective Clothing

Akan Ltd, Kano
Landmark Industrial Supplies Ltd, Lagos

Protective Plant

Roadcare (Nigeria) Ltd, Ibadan

Pumps

Afrotec Technical Services (Nigeria) Ltd, Isolo
R. T. Briscoe (Nigeria) Ltd, Technical Department, Apapa
Brossette Nigeria Ltd, Kano
Jos. Hansen & Soehne Nigeria Ltd, Lagos
Holman Brothers (Nigeria) Ltd, Apapa
I.I.D.C., New York
Landmark Industrial Supplies Ltd, Lagos
Leventis Technical Ltd, Lagos
M. & E. (a Division of UAC of Nigeria Ltd), Lagos
Mandilas Enterprises Ltd, Lagos
Morpol Industrial Corp. Ltd
Nigerian Motors Industries Ltd, Apapa
NITECO, Apapa
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Henry Stephens Engineering Co. Ltd, Ilupeju
Stokvis Nigeria Limited, Ebute-Metta
Sulzer Nigeria Ltd, Lagos
UTC – Engineering Division, Apapa
UTC – Technical, Isolo-Mushin
VYB (Nigeria) Ltd, Apapa
Wasteco Ltd, Technical Division, Lagos

Quarry Plant

Afrotec Technical Services (Nigeria) Ltd, Oshodi
Blackwood Hodge (Nigeria) Ltd, Apapa
John Finlay (Engineering) Ltd, N. Ireland
Holman Brothers (Nigeria) Ltd, Apapa
M. & E. (a Division of UAC of Nigeria Ltd), Lagos
Morpol Industrial Corp. Ltd
Reiss & Co. (Nig.) Ltd, Ebute-Metta
Scoatrack Ikeja, Lagos
Henry Stephens Engineering Co. Ltd, Ilupeju

Radio Communication Equipment

J. Allen & Company Ltd, Apapa
Comsac Communications Associates of Nigeria Ltd, Ikeja
R. T. Briscoe (Nigeria) Ltd, Telecommunications Department, Apapa
Dzregeff, W.A. (Nig.) Ltd, Apapa
GTE Nigeria Ltd, Lagos
Grette Communications (Nig.) Ltd, Lagos
ITT Nigeria Ltd, Yaba
Mofat Engineering Co. Ltd, Lagos
Philips (Nigeria) Ltd, Lagos
Plessey (Nigeria) Ltd, Lagos

Radio Distributors

Leventis Technical Ltd, Lagos
Pan-Electric (a Division of UAC of Nigeria Ltd), Ebute-Metta

Radio Telephones

Comsac: Communications Associates of Nigeria Ltd, Ikeja
Grette Communications (Nig.) Ltd, Lagos
Mandilas Enterprises Ltd, Lagos

Radio & Television Broadcast Equipment

Grette Communications (Nig.) Ltd, Lagos

Refrigeration

ITT Nigeria Ltd, Yaba
Phoenix Refrigeration (UK) Ltd

Refrigeration Gases

Industrial Gases Ltd, Apapa

Repair/Rewinding of Electric Motor/Generators

H. F. Schroeder (WA) Ltd, Iganmu

Reprographic Materials

Veritas & Co. (Nig.) Ltd, Lagos

River Transport

Niger Benue Transport Co. Ltd, Warri

Road Making Equipment

Blackwood Hodge (Nigeria) Ltd, Apapa
Holman Brothers (Nigeria) Ltd, Apapa
Joy Manufacturing Co., USA
Leventis Motors Ltd, Apapa
M. & E. (a Division of UAC of Nigeria Ltd), Lagos
Metro-Technical, Ikeja and Agbara
Morpol Industrial Corp. Ltd, Apapa
NITECO, Apapa
Phoenix Motors Ltd, Oregun, Lagos
Henry Stephens Engineering Co. Ltd, Apapa
Scoatrac, Ikeja, Lagos
Tractor & Equipment (Division of UAC Nigeria Ltd), Lagos

Road Services

Cidpag Nigeria Ltd, Calabar

Road Repair Products (Instant)

Roadcare (Nigeria) Ltd, Ibadan

Roller Shutter Doors

Crittall-Hope Nigeria Ltd, Ikeja
Steel Works Ltd, Ibadan

Roofing & Cladding Materials

Alumaco (Aluminium Manufacturing Co. of Nigeria Ltd), Apapa
Eternit Ltd, Sapele
Fibreglass Reinforced Plastics Co. Ltd, Abeokuta
Tower Aluminium (Nigeria) Ltd, Ikeja

Ropes

Nigerian Ropes Ltd, Apapa
UTC – Hardwood Division, Apapa

Safety Equipment

World Life General Motors (Nigeria) Co. Ltd

Sales/Installation/Service Electrical Hoisting Equipment

H. F. Schroeder (WA) Ltd, Ioanmu

Sanitary Ware Manufacturers

Armitage Shanks Ltd, Glasgow

Sanitary Ware & Fittings

Bisiolu Enterprises Ltd, Apapa
Brossette (Nig.), Apapa
Gottschalcks Building Materials, Lagos
Leventis Stores, Lagos
Nigerian Foundries Ltd, Lagos
F. Steiner & Co. Ltd, Lagos
Henry Stephens Engineering Co. Ltd, Apapa
Henry Stephens Engineering Co. Ltd, Apapa
Structor, Apapa
UTC – Hardware Division, Apapa
C. Zard & Co. Ltd
Projects Department, Apapa

School Furniture

Ihekole International Concern (Nig.) Ltd, Jos
Fawaz Steelwood & Chemicals (Kano) Ltd, Kano
Steel Works Ltd, Ibadan, Nigeria

Science & Laboratory Instruments

A. M. Faltas (West Africa) Ltd, Lagos
Ihekole Int. Concern Ltd, Jos
F. Steiner & Co. Ltd, Lagos

Screening Equipment

John Finlay (Engineering) Ltd, N. Ireland
Scoatrac (Nig.) Ltd, Isolo

Sealants

Bostik Ltd, Leicester, UK

Sewage Treatment Plant

Bewac Ltd, Apapa
R. T. Briscoe (Nigeria) Ltd
UTC – Engineering Division, Apapa

Sewing Machines

Cinsere Sewing Machines Ind. Co. Ltd, Lagos
Pfaff Industrial Sewing Machines

Sewing Threads & Cords

West African Thread Co. Ltd, Apapa

Shelving Systems

Brossette (Nig.) Ltd, Apapa
The Twilights Nigeria Ltd
General Metal Products Ltd, Apapa
Gottschalks Building Materials (a Division of UAC Nigeria Ltd), Apapa
Steel Works Ltd, Ibadan, Nigeria

Shipping & Forwarding Agents

Air Marketing International Group of Companies, Crawley, UK
Sevenseas Shipping Co. Ltd (Hamzer), Apapa
Triana Ltd, Apapa
Veritas & Co. (Nig.) Ltd, Lagos

Soil Investigation

Foundation Engineering (Nigeria) Ltd, Lagos

Nigerian Dredging & General Works Ltd, Lagos
Raymond Constructors (Nigeria) Ltd, Lagos
Trevi Foundations Nig. Ltd, Oshodi

Solders
Makeri Smelting Co. Ltd, Jos
Reiss & Co. (Nig.) Ltd, Ebute-Metta

Stationery
Nigerian Office Stationery Supply Stores Ltd, Apapa

Steel Structures
Nigerian Engineering Works Ltd, Port Harcourt
Steel Works Ltd, Ibadan

Storage & Equipment
Brossette (Nig.) Ltd, Apapa
Dexion Department
Gottschalcks Building Materials, Apapa
Leventis Stores Ltd, Lagos
Nigeria Engineering Works Ltd, Port Harcourt
Stronghold (Nigeria) Ltd, Handy Angle Division, Ikeja
General Metal Products Ltd, Apapa

Structural Steelwork – Fabrication & Erection (Roof Trusses)
Grid Index Nigeria Ltd, Suru-Lere
Intermaco (Ghana) Ltd, Accra

Survey Equipment
Atlas (Nig.) Ltd, Lagos
Kenting Africa Resources Survey Ltd, Lagos
Ihejoke Int. Concern Ltd, Jos
Plessey (Nigeria) Ltd, Lagos
F. Steiner & Co. Ltd, Lagos

Suspended Ceilings
Context (Nig.) Ltd, Lagos
Gottschalcks Building Materials, Lagos

Swimming Pool Construction & Maintenance
Ojo-Famo Nig. Co., Ikeja
C. Zard & Co. Ltd, Lagos

Technical Management Consultants
Shogbola Technitronics Inc., Lagos

Technology Transfer
Shogbola Technitronics Inc., Lagos

Telephone Equipment
J. Allen & Company Ltd, Apapa
Comsac: Communications Associates of Nigeria Ltd, Ikeja
Grette Communications (Nig.) Ltd, Lagos
GTE Nigeria Ltd, Lagos
Jos. Hansen & Soehne Ltd, Lagos
ITT Nigeria Ltd, Yaba
Philips (Nigeria) Ltd, Lagos
Plessey (Nigeria) Ltd, Lagos
Sentrycom Alarms (Nigeria) Ltd, Lagos
Ultra-Modern Electronics Ltd, Surulere

Testing Machines
Avery Nigeria Ltd, Ikeja

Time Card Clocks & Systems
Bisiolu Enterprises Ltd, Apapa
Jos. Hansen & Soehne Ltd, Lagos
Leventis Technical Ltd, Lagos
F. Steiner & Co. Ltd, Lagos

Towage
Niger Benue Transport Co. Ltd, Warri

Trailer Axles and Components
Shannon Ltd, UK

Tugs & Barge Hire
Nigerdelta Shipping Agencies Ltd, Lagos

Turnkey Laundry & Drycleaning Systems and Equipment
Laundry Systems (Nigeria) Ltd, Yaba

Under Water Services
Nigerian Divising Services, Lagos

Water Drilling, Water Sources Prospecting & Water Wells
Atlas Copco, Stockholm, Sweden
Scoatrac, Ikeja, Lagos

Water & Waste Water Treatment Plants
Ihekole Conwn (Nig.) Ltd, Jos

Weighing Machines
Avery Nigeria Ltd, Ikeja

Welding Equipment
Reiss & Co. (Nig.) Ltd, Ebute-Metta

ALPHABETICAL LISTINGS

Adamog (Nigeria) Ltd,
N5B/66 Idi-Ape, Iwo Road, POB 910, Agodi Gate, Ibadan. Tel: 61696

Afrocommerce (W.A.) Ltd,
168 Awolowo Road, Ikoyi, Lagos, Nigeria.

Afrotec Technical Services (Nigeria) Ltd,
PMB 1061, Oshodi, Lagos.
Tel: 45656/44706

Akan Ltd,
3 Beirut Road, PO Box 2038, Kano, Nigeria.

Alakija & Alakija Contracting Services Ltd,
6 Ondo Street, West Ebute-Metta, Lagos, Nigeria. Tel: 48286.

Armitage Shanks Ltd, Glasgow,
Tubal Works, Barrhead, Glasgow G78 1NG, UK.

Air Marketing International Group of Co's,
9 Church Road, Lowfield Heath, Crawley, Sussex, UK.
Tel: Crawley 515651. Telex: 877180.

Alhaji M. R. Shittu & Sons Ltd,
41 Oguntola Street, Shomoly, Lagos.
Tel: 44191.

All Countries Business Agency,
West House, Slough Lane, Saunderton, Nr. High Wycombe, Bucks, UK.
Tel: 024024 3701. Telex: 837560.

J. Allen & Company Ltd,
PO Box 542, 25 Creek Road, Apapa.
Tel: 47881.

Allens Marine, J. Allen & Co. Ltd,
9/10 Yakubu Gowon Drive, PO Box 282, Port Harcourt, Rivers State, Nigeria.

Aluminium Manufacturing Company of Nigeria Limited (Alumaco),
32 Creek Road, PO Box 60, Apapa.
Tel: 844664/5, 844686.
Cable: PANALPINA.

Aluminium Wire & Cable Co. Ltd,
Port Tennant, Swansea, Glamorgan, UK.

Artec Engineering Ltd,
1 Popo St., Yaba, PO Box 3763, Lagos.
Tel: 42593. Cable: AGRIGBABU, Lagos.

Atlas Copco,
Water Well Drilling Dept/KNS-105 23, Stockholm, Sweden. Tel: 08/7438000.
Telex: 14090 COPCO S EXDA +

Atlas (Nigeria) Ltd,
Oshodi Scheme, Isolo Industrial Estate, Oshodi Expressway, PO Box 2120, Lagos, Nigeria. Tel: 848868

Avery Nigeria Ltd,
Obasa Road, PO Box 2, Ikeja, Lagos, Nigeria.
Tel. 933657/933627. Cable: Avery Ikeja.

Beam (Division of UAC Nig. Ltd),
H.O. 58 Marina, PO Box 1081, Lagos, Nigeria. Tel: 663241, 662179, 662197.

Bennett Babs Electrical Co.,
PO Box 444, Ikeja, Lagos.

Berger Paints Nigeria Ltd,
Oba Akran Avenue, PMB 1052, Ikeja.

Bewac Limited,
1 Commercial Road, PMB 1016, Apapa.
Tel: 450955, 41193.

Bisiolu Enterprises Ltd,
1 Warehouse Road, Apapa.
PO Box 3214, Lagos.
Tel: 47288. Telex: BEKBEK 21543N.

Blackwood Hodge (Nigeria) Ltd,
15 Burma Road, PO Box 109, Apapa.
Tel: 47107/47049.

Bostik Ltd,
Ulverscroft Road, Leicester LEH 6BW.
Tel: Leicester 50015. Telex: 34625.

R. T. Briscoe (Nigeria) Ltd,
Agricultural Equipment Group,
1 Independence Road,
PO Box 3, Kano, Nigeria.
Technical Dept., Matori & Oshodi & Apapa.
Motor Division: Iganmu.
Telecommunications Dept., Apapa.
Projects Dept., Apapa. Tel: 46471.

British Caledonian Airways,
c/o Central Hotel, PO Box 794, Kano.
Tel: 2040, 4834/5.

British Caledonian Airways,
18/19 Ahmadu Bello Way, PO Box 238, Kaduna. Tel: 22029, 22032.

British Caledonian Airways,
10 Beach Road, PMB 2248, Jos.
Tel: 2638/5. Telex: 81365 BCALJ.

Brossette (Nigeria) Ltd,
311 Apapa Road, PMB 1135, Apapa.

Brossette Nigeria Ltd,
Bompai Road, PO Box 2013, Kano.

Calabar Cement Co. Ltd,
PO Box 219, Calabar. Tel: 306.

Caleb Brett & Sons (Nig.) Ltd,
29/34 NPA Commercial Block "A", Wharf Road, PO Box 52, Apapa.
Tel: 45456, 47015.

Camplant Engineering Sales & Services Ltd,
225 Apapa Road, PMB 1155, Nigeria.
Tel: 846336, 846504/6.
Cable: Camplantlagos.
Telex: 21324 Lagos.

Cego (Engineering) Ltd,
Silver Eng. Witham, Essex, UK.
Tel: 0376 83241. Telex: 987425.

Chellaram's Building Materials Department,
19 Wharf Road, Apapa. Tel: 46177.

Cheminova A/S,
PO Box 9, DK-7620, Lemvig, Denmark.
Tel: (07) 83 4100. Telex: 66514.

Cidpag Nigeria Ltd,
58 Fossberry Road, PO Box 1096, Calabar, Nigeria.

Cinsere Sewing Machines Ind. Co. Ltd,
5 Badejo Kalesanwo Street, Maturi Ind. Estate, Oshodi-Mushin, Nigeria.

Clausen Engineering Co. Ltd,
Plot 83 Airport Road Ext.
Box 5037, Kano.
Tel: 7674. Telex: 77206NG.

Context (Nigeria) Ltd,
21 Danmole Street, Victoria Island, PO Box 1742, Lagos.

Controls and Automation,
270 Herbert Macaulay Street, PO Box 448, Apapa. Tel: 41958.

Conveyancer (Nigeria) Ltd,
Plot 12, Igamu Industrial Estate, Iganmu, PMB 1189, Apapa. Tel: 47025.

Comsac Communications Associates of Nigeria Limited,
Block E Industrial Crescent, Ilupeju Industrial Estate, PMB 22129, Ikeja.
Tel: 900304 900305.
Cable: COMDEC, Lagos.

Costain (West Africa) Ltd,
174 Western Avenue, PO Box 88, Lagos.
Tel: 434774/5/6.

Crittall-Hope Nigeria Limited,
Agege Motor Road, PO Box 28, Ikeja, Lagos. Tel: 831508, 845790.
PO Box 231, Kaduna. Tel: 42329.
PO Box 1336, Ibadan. Tel: 61475.
PO Box 398, Port Harcourt. Tel: 21165.

Cutler-Hammer Nigeria Ltd,
5 Elcruwa Street, Ikeja Industrial Estate, PO Box 490, Ikeja.

Daly (Condensers) Ltd,
Granley Works, Granby Ind. Estate, Weymouth, Dorset DT4 9TE, UK.
Tel: 030-2871. Telex: 41476.

Danlon Associates,
25 Illupeju Road, off Cappa Avenue, Palm Grove, Lagos, Nigeria.
Tel: 863189. Cable: Dan Consult Lagos.

Dexion Dept., Gottschalcks Building Materials,
PO Box 321, Burma Road, Apapa.
Tel: 47298 9.

Dizengoff, W.A. (Nigeria) Ltd,
23 Creek Road, PO Box 340, Apapa.
Tel: 42080, 42089.

Drake & Scull (Nigeria) Ltd,
PO Box 2389, 90 Lewis Street, Lagos.
Tel: 631252 and 636549. Telex: 21298.

Dulux, ICI Paints (Nigeria) Ltd,
Adeniyi Jones Avenue, Industrial Estate, Ikeja.

Dunlop Nigerian Industries Ltd,
Oba Akran Avenue, PMB 1079, Ikeja.
Tel: 3165.

E.D.G. (Nigeria) Ltd,
11 Zaria Road, PO Box 243, Kano.
Tel: 5532. Telex: 77129.

EMS,
40 Warehouse Road, Apapa.

Electrolux Mandilas Ltd,
Isolo Industrial Estate, PO Box 4065, Ikeja, Nigeria.
Tel: 840058. Telex: 21383 NG.

Elof Hansson Ltd,
32/36 Great Portland Street, London W1N 5AD, UK.
Tel: (01) 636 1881. Telex: 23133.

Etco (Nigeria) Ltd, Engineering & Technical Co,
14 Creek Road, PO Box 337, Apapa.
Tel: 46666 and 42127.

Equip Home (a Division of SCOA Nigeria Ltd),
152/156 Broad Street, POB 452, Lagos, Nigeria.

Equip/Iard (a Division of SCOA (Nigeria) Limited),
Surulere Industrial Road, Ogba.
Ogba Scheme, Ikeja, PMB 21518 Ikeja, Nigeria.
Tel: 962052, 962054.

Eternit Ltd,
PO Box 483, Sapele,
Bendel State, Nigeria. Tel: (054) 41311.

Fado Engineering Co. Ltd,
Phoenix Motors Building,
52/54 Murtala Mohammed Way,
PO Box 35, Ebute/Metta. Tel: 44006.

A.M. Faltas (West Africa) Ltd,
PO Box 1915, 62/64 Campbell Street, Lagos. Tel: Lagos 26774, 23639.

Fawaz Steelwood & Chemicals (Kano) Ltd,
UmaRU Babura Rd., Bompai Industrial Area, PO Box 980, Kano.

Fibreglass Reinforced Plastics Co. Ltd,
PO Box 206, Ibara, Abeokuta, Ogun State.
Tel: 0362 2246. Cable: Glassplast Abeokuta.

John Finlay (Engineering) Ltd, N. Ireland,
Export Dept., Drumquin Road, Omagh, Co. Tyrone, N. Ireland, UK.
Tel: Omagh (0662) 45127. Telex: 747929.

Flag Aluminium Products,
Wesley House, 21/22 Marina, Lagos, Nigeria. Branches: Port Harcourt, Kaduna.

Foundation Construction Ltd,
174 Western Ave., Iganmu, POB2100, Lagos.
Tel: 845090/835393. Telex: 21100 or 21227.
Cable: Foundations Lagos.

Foundation Engineering (Nigeria) Ltd,
174 Western Avenue, Iganmu,
PO Box [illegible], Tel: 845090/83593
Telex: [illegible] or 21227. Cable: Foundations Lagos.

[illegible] Ltd,
PO Box [illegible] Falomo-Lagos, Nigeria,
12 [illegible] Street, Ilasamajor, Mushin.

G[illegible] (a Division of UAC of Nigeria Ltd),
[illegible] 51 Marina, Lagos.
Tel: [illegible]234/23976. Branches: Sales and [illegible] throughout Nigeria.

G[illegible] Ltd,
PO Box [illegible], 2 Tinubu Square, Lagos.
Tel: [illegible]8025. Telex: 21518

G[illegible] SDN BHD,
PO Box [illegible], Seremban NS, Malaysia.
Tel: [illegible]. Telex: MA 63875 Bajrang.

G[illegible] (Nigeria) Ltd,
PMB [illegible], Ikeja, Nigeria.

G[illegible] Metal Products Ltd,
A[illegible], Iganmu, PO Box 442, Apapa.
Tel: [illegible]. Cable: Gemsprol.

Gottschalcks Building Materials (a Division of UAC Nig. Ltd),
Dexion Dept., 2 Sapele Road,
PO Box 321, Apapa, Nigeria.

A.D. Green & Co. Ltd,
Electrical Contractors,
346A Dugbe Market Street, Adekunle Fajuyi Road, PO Box 1329, Ibadan. Tel: 23726.

Greenham Plant Hire (a Division of UAC of Nigeria Ltd),
Ilupeju Road, Mushin Industrial Estate, PO Box 8, Ikeja. Tel: 47428.

Grette Communications (Nig) Ltd,
15 Abeokuta Street, Anifowoshe, Ikeja.
Tel: 931776/932959.
POB 1043 Surulere, Lagos, Nigeria.

Grid Index Nigeria Ltd,
PO Box 3743, Suru-Lere, Lagos State, Nigeria.

Guthrie (Nigeria) Limited,
Plots 37-39, Iganmu Industrial Estate, PO Box 7585, Lagos. Tel: 43471/2.

Hallam Graders,
Leicester LE8 0LT, UK.
Local M.F. Distributor.

Hademec Ltd,
Industrial Avenue, Ilupeju, Lagos,
PO Box 205, Yaba. Tel: 962168.
Cable: Coolth, Lagos.

GNA Hamzer & Co. (Nigeria) Ltd,
34/36 Burma Road, PMB 1047, Apapa, Lagos. Tel: 847873. Cable: Sevnshue.
Telex: 21396 NG.
19 Kofo Avayomi Avenue, PO Box 117, Apapa. Tel: 845858 and 842854.
Telex: 21396. Cable: Galhamzaro.

Jos. Hansen & Sochne Nigeria Ltd,
31/33 Martins Street, POB 141, Lagos.
Tel: 633864, 633721. Telex: 21413.

Haven Nigeria Computer Co. Ltd,
Hamburg House, 31/33 Martins Street, PO Box 4034, Lagos.
Tel: 636651. Telex: FANHOL 21457.

Heplac Nigeria Ltd,
Head Office, Plot 21, Mile 7½, Ikorodu Road, PO Box 5498, Marina, Lagos.

Holman Brothers (Nigeria) Ltd,
26 Burma Road, PO Box 81, Apapa.
Tel: 45007/8. Overseas cables: Airdrill, Lagos. Inland telegrams: Airdrill Apapa.
Telex: 21502. Branches: POB 293, Harbour Road, Port Harcourt. POB 427, Textile Road, Kaduna South.

Holt Engineering,
Div. of J. Allen & Co. Ltd,
Plot 3 & 4 Adewunmi Industrial Estate, PMB 2143, Oregun Village, Ikeja, Lagos.

Ihekole International Concern (Nig) Ltd,
33 Murtala Mohammed Way, PMB 2201, Jos, Nigeria. Tel: 55341.
Telex: 81344 IHEKOLE NG.

: Ibekole Jos.
(Nigeria) Ltd,
Causeway, Ijora, PO Box 2581, Lagos.
843652/843664/843667.
: 21382 Incar, Lagos.
strial Gases Ltd,
Apapa Road, PO Box 53, Apapa.
42041/4.
Industrial Estate,
Highway, Isolo. Tel: 32497.
Dermott Road, PO Box 23, Warri.
178.
Ijebu By-pass, Oke-Ado Road,
5321, Ibadan. Tel: 23201.
Road, PO Box 144, Kaduna.
43353.
Sakpoba Road, Benin City.
Ltd,
Box 6687, Lagos.
& Co,
Adebola Street, Surulere.
: Terbrok, Lagos.
(Ghana) Ltd,
Box M352, Accra.
national Computer (Nigeria) Ltd,
Awolowo Road, Ikoyi, Lagos, Nigeria.
684957, 684763.
national Messengers (Nigeria) Ltd
(INL),
House, 17 Laide Tomori Street,
Medical Road, Ikeja,
Box 2780, Lagos. Tel: 9639
national Messengers (Nigeria) Ltd
(INL),
House, 360 Sarkin-Yaki Road, Kano.
Box 1785.
7726. Telex: 77150 (Ano
national Messengers (Nigeria) Ltd
(MNL),
House, 451 Zaria Road, opposite
Broadcasting Co., Jos.
national Messengers (Nigeria) Ltd
(MNL),
House, 22 Almadu Bello
Tel: 213697. Telex:
national Messengers (Nigeria) Ltd
(MNL),
Agbo Oba Street, off Taiwo Road, Surulere,
national Messengers (Nigeria) Ltd
(MNL),
1st Floor, Block B, Unit 11, Lagos State.
national Messengers (Nigeria) Ltd
(MNL),
c/o KLM, Forestry Commission, Maiduguri.
national Messengers (Nigeria) Ltd
(MNL),
Ozuoremodu Village Road, via Aba
Road Nr Presidential Hotel, Port Harcourt.
International Messengers (Nigeria) Ltd
(IMNL),
Commercial Area, Samaru,
PO Box 589, Zaria. Tel: 3744
Inter-Beton (Nig.) Ltd,
POB 826, Ikeja, Nigeria.
Interplast Ltd,
PO Box 1069, Accra. Tel: 21771.
Telex: 2088. Cable: Interplast.
Irrigation and Industrial Dev. Co. (IIDC),
250 Madison Avenue, New York, NY
10016, USA.
Tel (212) 832 7070. Cable: Irredelco.
Telex: RCA 234182 IDC NY, ITT 420856
IDC NY.
ITT Nigeria Ltd,
Ikorodu Road, Yaba.
Tel 47611/2. Telex: 21439.
Jule Builders Co. Ltd (in association with
Kramer Ltd, Zurich), 13 Shonda Street,
Ebute Metta, PO Box 3578, Lagos.
Tel 46290 and 46295.
James Kilpatrick (Nig.) Ltd,
Plot 10, Block B, Isolo Expressway, Itire
Junction, Ilasamaja, Nigeria. Tel: 847513.
Jones Cranes Ltd,
c/o Publicity Dept, 600 Group Engineering
Division, PO Box 13, Letchworth,
Herts SG6 1LU.
Joy Manufacturing Co,
HW Oliver Bldg., Pittsburgh, PA 15222,
USA. Tel: 412-562-4593. Telex: 86-6558.
Kaiser Africa Resource Service Ltd,
33 Lawson Street, Lagos. Tel: 636555.
Kienzl Systems Int. (Nig.) Ltd,
42 Kayode Street, Ogba-Ikeja, Lagos,
PO Box 3765, Lagos, Nigeria.
Kohler Co.,
Generator Div., Wisconsin 53044, USA.
Tel 414 565 3381.
Landmark Industrial Supplies Limited,
39 & 40 Ibadan Street (West), Ebute Metta,
POB 1552, Lagos.
Laure Bhadmus Ind. Ltd,
26 Calcutta Crescent, PO Box 516,
Apapa, Lagos.
Tel 875216 and 870639.
Cable: CarCareLagos.
Laundry Systems (Nigeria) Ltd,
1A Birrel Avenue, PO Box 395, YABA, Lagos.
Leventis Motors Ltd,
Apapa Road, PO Box 390, Apapa, Lagos.
Tel 45231/6.
Leventis Stores Ltd,
Marina, Lagos.
Leventis Technical Ltd,
PO Box 159, Iddo House, Iddo Island,
Lilleker Brothers (Nig) Ltd,

69Z Queen Elisabeth Road, PO Box 347,
Zaria State, Nigeria, Lagos.
Tel: 41311.
Lyntraco Sweden (Nig.) Ltd,
PO Box 3310, Ikeja, Lagos, Nigeria.
Tel: 681959. Cable: LYNTRACO, Lagos.
Machinery & Electrical Equipment
(Division of UAC Ltd),
1 Taylor Road, Iddo, PMB 1015,
Ebute-Metta, Lagos. Tel: Lagos 43310.
Makeri Smelting Co. Ltd,
PO Box 653, Jos.
Tel: 2841. Telex: 81114 Ng.
Mandilas Limited, Air Conditioning
Division,
7 Creek Road, Apapa. Tel: 46071-4, 45042.
Mandilas Enterprises Ltd,
96/102 Broad Street, Lagos.
Marryat Daniel (Nigeria) Ltd,
8/10 Broad Street, PO Box 453, Lagos.
Tel: 653845. Telex: 21115 DANCO.
PO Box 453, Lagos.
Metraprod Industries Ltd,
12 Oba Akran Avenue, Ikeja,
PO Box 3656, Agege, Lagos State.
Metalum Ltd,
Block H Plot, 2 Industrial Estate, Isolo,
PMB 21471, Ikeja.
Metro-Technical,
PO Box 2919, Ikeja, 11 Olatunde Ayoola
Avenue.
Obanikoro, Ikorodu Road, Lagos.
Tel: 963146.
Metro-Technical,
PO Box 2919, Ikeja, 11 Olatunde Ayoda
Avenue, Obanikoro, Off Ikorodu Road.
Tel: 963146.
Mofat Engineering Co. Ltd,
8 Agege Motor Road, Sogunle,
PO Box 6369, Lagos. Cable: Mofat Eng.
Morpol Industrial Corp. Ltd,
4 Warehouse Road, PO Box 187, Apapa.
Tel: 43802, 41254. Telex: 21517.
Cables: Morcor Lagos.
Branch Office: 12 Kodesoh Street, Ikeja.
Mufbat Brothers,
304 Murtala Muhammed Way, Yaba,
170 Nnamdi Azikwe Street, Idumota, Lagos,
Nigeria. Tel: 863640.
Nigalex-Nigerian Aluminium Extrusions Ltd,
Plot No. 5 Block (H),
Ikeja-Apapa Express Way,
Oshodi Industrial Scheme, Nigeria.
Niger Benue Transport Co. (NBTC) Ltd,
35 Market Road, PO Box 323,
Warri Bendel State, Nigeria.
Tel: 053-234012.
Telex: 43283 FLOSUD NG.
Nigerdelta Shipping Agencies Ltd,
41 Yoruba Road, Sapele-Bendel, 21 Wharf
Road, 6th Floor, Apapa, Lagos, Nigerian
Port Authority Premises, Warri.
Tel: Lagos (01) 847 844, Sapele (054) 42258,
41710. Telex: 42266 NIDELT.
Nigerian Carton & Packaging MFG Co Ltd,
Sapara Street, PO Box 296, Ikeja and
23 Industrial Avenue, Ilupeju, Lagos.
Tel: 960209. Cable: Nicapaco Lagos.
Nigeria Diving Services,
Savannah Bank Chambers, 138/146 Broad
Street, 6th Floor, PO Box 2151,
Lagos, Nigeria.
Tel. 636577, 664759. Cable: DODCO.
Nigerian Dredging – General Works Ltd,
6 Bauchi Road, PMB 1029, Apapa.
Tel: 45045, 45046.
Nigerian Engineering Works Ltd,
Plot 49, Trans Amadi Industrial Layout,
PO Box 519, Port Harcourt.
Tel: 21482, 21876. Cable: "Nigeng".
PO Box 3682, Lagos. Tel: 54468, 23641.
PO Box 2081, Kano. Tel: 5285.
Nigerian Foundries Ltd,
(Manufacturers of cast iron water fittings),
PO Box 3574, Lagos.
Tel: 963266, 963267, 963402.
Nigerian Gas Industries Ltd,
41 Jebba Street (East), PO Box 72, Ebute
Metta, Lagos, Nigeria.
Tel: 860393. Cables: Oxygases.
Nigeria General Motors Ltd,
65 Marina, PO Box 4694, Lagos, Nigeria.
Factory. Old Ojo Road, off KM11,
Badagry Expressway, Lagos.
Tel: 662079, 660377, 662009, 660298.
Nigerian Office Stationery Supply Stores
Ltd,
Noss, 25 Warehouse Road, Apapa.
Tel: 846304, 845869.
Cable: Staltonics, Apapa, Lagos.
Nigerian Motors Industries Limited,
26 Wharf Road, PMB 1032, Apapa.
Tel: 46848. Branch Office: PO Box 833,
Ous Division Plot 1090,
PO Box 8591, Adeola Odeku Street,
Victoria Island. Tel: 610068.
Kano, PMB 5383, Port Harcourt.
Nigerian Ropes Ltd,
66/68 Eric Moore Road,
Iganmu Industrial Estate, PO Box 115,
Apapa. Tel: 45693.
Nigerian Wire Industries Limited,
PO Box 50, Ikeja.
Tel. 33015. Cables: Niwind, Lagos.
Nigerlink Industries Ltd,
MWM-Division, Western House, 8/10 Broad
Street, PO Box 1977, Lagos.

Nigerian Paints, International Paints
(West Africa) Ltd,
PO Box 67, Oba Akran Avenue,
Ikeja Industrial Estate, Ikeja. Tel: 33895/6.
Niresim Handelsgesellschaft GmbH & Co. KG,
Dorotheergasse, 6/11, a-1010 Vienna,
Austria. Tel: (222) 520737.
Telex: 11918. Cables: Niresim.
NITECO,
11/13 Warehouse Road, PO Box 356,
Apapa, Lagos, Nigeria.
Norman Industries Ltd,
PO Box 334, Ikeja. Tel: 40058.
Northern Sawmill & Furniture
Manufacturing Co. Ltd,
Kundala Road, PO Box 147, Kano.
Tel: 4320 & 4739. Telex: 77141 East Ng.
Cables: SAFUMECO.
Oje-Fame,
PO Box 1839, Ikeja,
Plot 318, Akanro Street, Ilasamaja, Mushin,
Lagos State, Nigeria.
G.N. Okozala Electrical Company,
48 Aminu Road, S/Gari, Zaria.
Omot Fire Protection Eng. Ltd,
8 Agege Motor Road, Sogunle, PO Box
1551, Ikeja, Lagos State, Nigeria.
Tel: 961348, Cable: MOTFIRP LAGOS.
Pan Electric,
Seaplane Road, PO Box 345, Apapa.
Tel: 42485.
Patterson Zochonis & Co. Ltd,
Technical Department,
160/162 Broad Street, Lagos.
Tel: 26621. Ext: 219, 223, 239.
D.J. Payne (Nigeria) Ltd,
41 Commercial Avenue, PO Box 151,
Yaba. Tel: 43471.
Phoenix Motors Ltd,
Ikosi Road, Oregun, PMB 12011, Lagos.
Telex: 21238 Holts, Lagos.
Phoenix Refrigeration (UK) Ltd,
Phoenix House, Coniston Avenue, Grimsby,
England. Tel: 0472 82 5074. Telex: 52 7226.
Pilkington Glass (Nigeria) Ltd,
11 Creek Road, PO Box 270, Apapa.
Tel: 42843/4/5.
Plessey (Nigeria) Ltd,
21/22 Marina, PO Box 3481, Lagos.
Tel: 24848. Telex: 21269.
Polythene Enterprises (Nigeria) Ltd,
4 Obasa Road, Ikeja Industrial Estate, Ikeja.
Tel: 33009, 31221.
Preussag Drilling Engineers Ltd,
13 Monguno Road, Maiduguri, Nigeria.
Telex: 82123 (Maiduguri).
Pump Services Nigeria Ltd,
(Distributors for Gilbarco Ltd),
46 Balogun Street, PO Box 321, Lagos, Nigeria.
Tel: 635330.
R. & A. Service Division of UAC
(Technical) Ltd,
1 Taylor Road, Iddo, PMB 1015, Ebute-
Metta, Lagos. Tel: Lagos 43310.
Raymond Constructors (Nig.) Ltd, Lagos,
Investment House, Suite 213, 21/25 Broad
Street, Lagos, Nigeria.
Tel: 662956. Telex: 21818.
Redcoat Cargo Airlines,
Balcombe Road, Horley, Surrey, England.
Tel: Horley 74141. Telex: 87337.
Isolo Office: Plot 4, House 32515, Isolo
Expressway.
Branches: Aba, Benin City, Calabar,
Kaduna, Kano, Onitsha, Warri.
Reiss & Co. (Nig.) Ltd,
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Tel: 834215. Cable: Roco. Telex: 21161.
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KM7, Ibadan-Ijebu-Ode Road, PO Box
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H. F. Schroeder (W.A.) Ltd,
Plot 3, Block D, LSDPC, Amuwo, Odofin,
Apapa Oshodi Expressway. GPO Box
1209, Lagos, Nigeria. PMB 5307, Port
Harcourt.
Scoatrac (Division of SCOA Nigeria Ltd),
Dual Carriageway, Isolo Industrial Estate,
Isolo, PMB2 1108, Ikeja.
Tel: 848144 and 845249. Telex: 21969.
Sentrycom Alarms (Nigeria) Limited,
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PO Box 94, Lagos. Tel: 46794, 45451.
Shannon Ltd,
Lancaster House, 80 Princess Street,
Manchester, UK.
Shogbola Technitronics Inc.,
PO Box 178, E B Lagos, Nigeria.
Stauffer Chemical Europe S.A.,
25 Rue des Caroubiers, CH-1227 Carouge,
Geneva, Switzerland.
Steel Works Ltd,
Oluyole Ind. Est., off Ring Road, Ibadan.
Tel. 461430 or 412140. Telex: 31147.
Steen Bolbroe A/S,
Postbox 170, Walterholm 11,
2750 Ballerup, Denmark.
Tel: 02651133. Telex: 35367 Josty DK.
F. Steiner & Co. Ltd,
150 Broad Street, PO Box 602, Lagos.
Tel: 21565 and 53095. Cable: Steiner.
Henry Stephens Builders' Merchants Ltd,
PO Box 331, Apapa, Lagos.
Telex: 21566 HENSHIP.
Cables: HENSBUILD, Apapa.

Ikeja. Tel: 961055. Telex: 21566
and 21286. Cable: HENSENCO.
Stokvis Nigeria Limited,
1 Dawodu Lane, PO Box 136, Ebute-Metta,
Lagos, Nigeria.
Tel: 834609, 833391. Cable: TOOLCO.
Stronghold (Nigeria) Ltd, Engineering
Services Division,
Plot 17, Oba Akran Avenue, PMB 1060,
Industrial Estate, Ikeja.
Tel: 32980, 31719, 32476.
Stronghold (Nigeria) Ltd, Security and
Safety Services Division,
Plot 17, Oba Akran Avenue,
PMB 1060, Industrial Estate, Ikeja.
Tel: 32980, 31719, 32476.
Structor,
PO Box 391, Apapa, PO Box 18, Kano,
PMB 5130, Port Harcourt.
Structor Technique,
Apapa Road, Igo. Tel: 44027.
10/11 Hadeja Road, Kano,
8 Liberation Drive, Port Harcourt.
Sulzer Nigeria Ltd,
35 Simpson Street, Lagos, Nigeria.
Tarpaulin Industries (WA) Ltd,
8 Burma Road, Apapa, PO Box 2227,
Lagos. Cables: "TARPIND", Lagos.
Tel: 841730, 847814.
Taylor Woodrow of Nigeria Limited,
10 Abebe Village Road, Iganmu,
PO Box 138, Lagos. Tel: 837366, 837407,
837468. Telex: 21544.
Tower Aluminium (Nigeria) Ltd,
PO Box 9, Ikeja. Tel: 932801/932802.
Cable: Tower Lagos.
Tractor & Equipment
(Division UAC Nigeria Ltd),
Tractor & Equipment, Billingsway,
off Oregun Village Road, PMB 21480, Ikeja.
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20 Commercial Road, PMB 1064, Apapa.
Tel: 47858, 45983, 45373. Telex: 21122.
Trevi Foundations Nig. Ltd,
Km23 Badagry Express Road, Lagos.
PMB 1189, Oshodi, Nigeria.
Turners Building Products (Emene) Ltd,
Enugu, PO Box 646. Tel: 253553.
Telex: 51146NG.
The Twilights Nigeria Limited,
83 Zik Avenue, PO Box 627, Enugu.
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Street, Isolo-Mushin.
UTC – Engineering Division,
Ladipo Street, Isolo,
PMB 1129, Apapa. Telex: 21232.
UTC – Hardware Division,
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VYB (Nigeria) Ltd,
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Tel: 45811.
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Wanteco Ltd,
219 Apapa Road, Iganmu, Lagos.
Tel: 41883/41884/43037.
Wartsila Nigeria Ltd,
PO Box 1096, Apapa, Lagos, Nigeria.
Tel: 848494. Telex: 21671 PYN NG.
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(Subsidiary of Dresser Industries Inc.),
35/40 Burma Road, PO Box 108, Apapa.
Tel: 47354 and 45950. Telex: 21576.
Cable: Waynoil, Lagos.
Welde & Company (Nig.) Ltd,
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PO Box 2319, Lagos.
West African Water Drilling and Allied
Services Co. Ltd,
116 Agbani Road, PO Box 750, Enugu,
Nigeria.
29 Ikorodu Road (Jibowu bus stop), Yaba,
Lagos, Nigeria.
Westminster Dredging (Nigeria) Ltd,
24 Creek Road, Apapa, PO Box 1519,
Lagos. Tel: 45647, 47395.
George Wimpey & Co. (Nigeria) Ltd
(Building, Civil, Mechanical, Electrical
Engineering Contractors),
5 Sumbo Jibowu Street, SW Ikoyi,
PO Box 2049, Lagos.
West African Engineering Co. (Nig.) Ltd,
30 Wharf Road, POB 388, Apapa, Nigeria.
West African Thread Co. Ltd,
16/17 Burma Road, PO Box 105, Apapa,
Nigeria.
Tel: 847876, 845127.
Cable: STITCHING APAPA.
World Life General Motors (Nigeria) Co. Ltd,
6 Pepple Street, PO Box 989, Ikeja, Lagos.
Tel: 932018.
London office: World General Motors
(Export), 49 Osborne Road, Forest Gate,
London E7 0PJ, UK.
Tel: 01-534 4016 or 01-555 0823.
Telex: 897 356.
Yakon Enterprises (Nig.) Ltd,
No. 11, Ikpoba Slope, Benin City, Nigeria.
Tel: 24178, 243900. Telex: 41359 YAKON NG.
C. Zard & Co. Ltd,
184 Adeniji Adele Road, PO Box 818,
Lagos. Tel: 20089/20582/24112.
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