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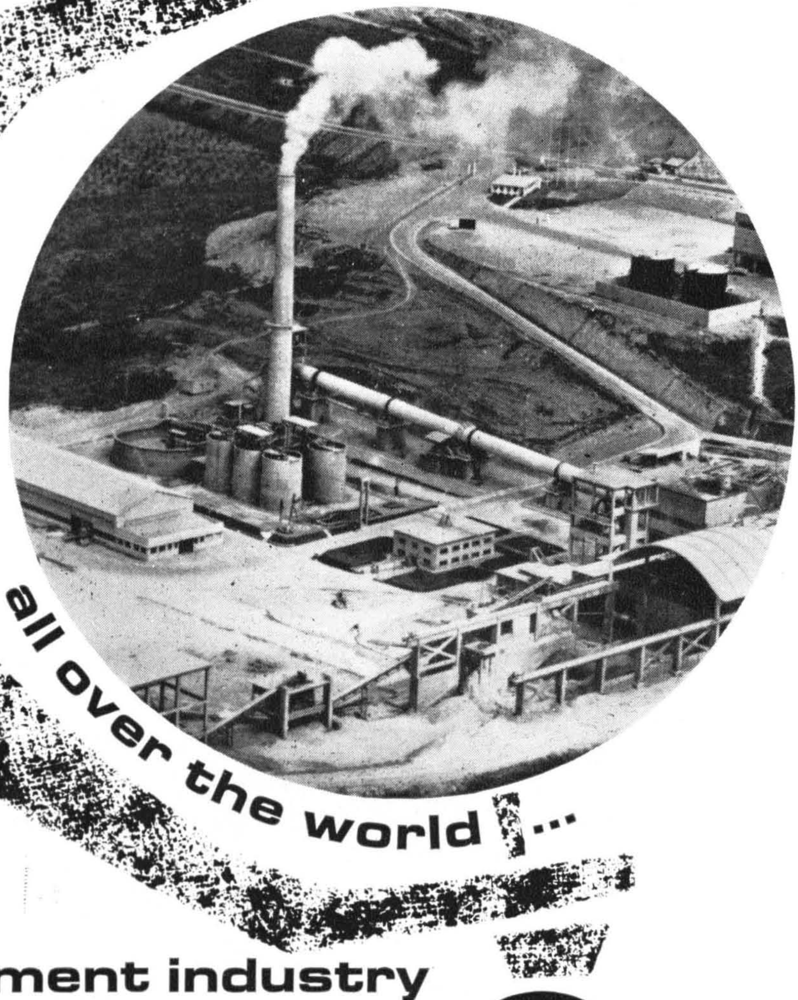

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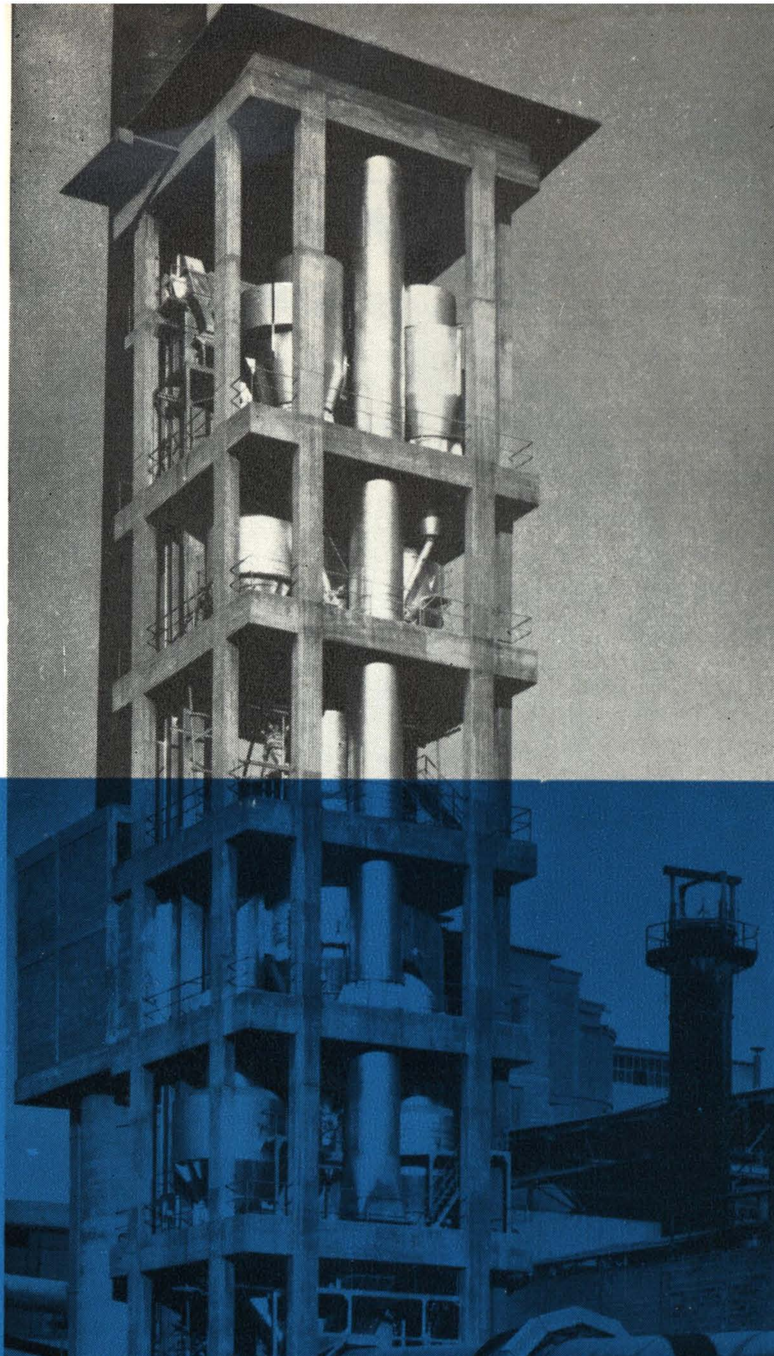

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Electric Power for Cement Works.

In early works manufacturing Portland cement, man-power was used almost entirely for winning raw material and handling it throughout the process. For driving the washmills, crushers, and grinding mills, small steam engines were used. Reid, in a book published in 1868, mentions a mill, washing 5 tons per hour, requiring "the power of eight horses to work it," and a line of stone-breakers, edge-runners and horizontal stones, requiring respectively 3, 5 and 8 horsepower for an output of 2 tons of cement per hour.

With technical development, many phases were passed through: increasing size of units, the advent of the rotary kiln, mechanical handling, and electric power.

Some of the earlier installations of rotary kilns were very beautiful examples of millwrightwork, in which the whole works was driven by a central slow-speed steam, mill-engine by ropes and belts, with a direct current generator for supplying minor electrically-driven auxiliaries. Works driven in this manner survived until about 30 years ago.

With the growth of the use of electricity in industry, direct mechanical drives from engines were replaced by electric motors. Many cement works were located in areas remote from a public electricity supply and installed their own generating plant, using either steam or gas engines. Outlying clay plants and washmills retained their own prime-movers, gas engines being widely used in place of steam.

These generating plants can usually no longer compete in cost with supplies from the national grid, which are available in the remotest districts in the U.K.

The load factor of a cement works can be kept high, at between 75 and 85 per cent., and the overall works power-factor can frequently be corrected to approach unity. It is normal practice to regulate the hours during which grinding is done, so that the demand is reduced during periods of peak load in the supply system, particularly in the winter months. This makes it possible to negotiate advantageous terms for the supply.

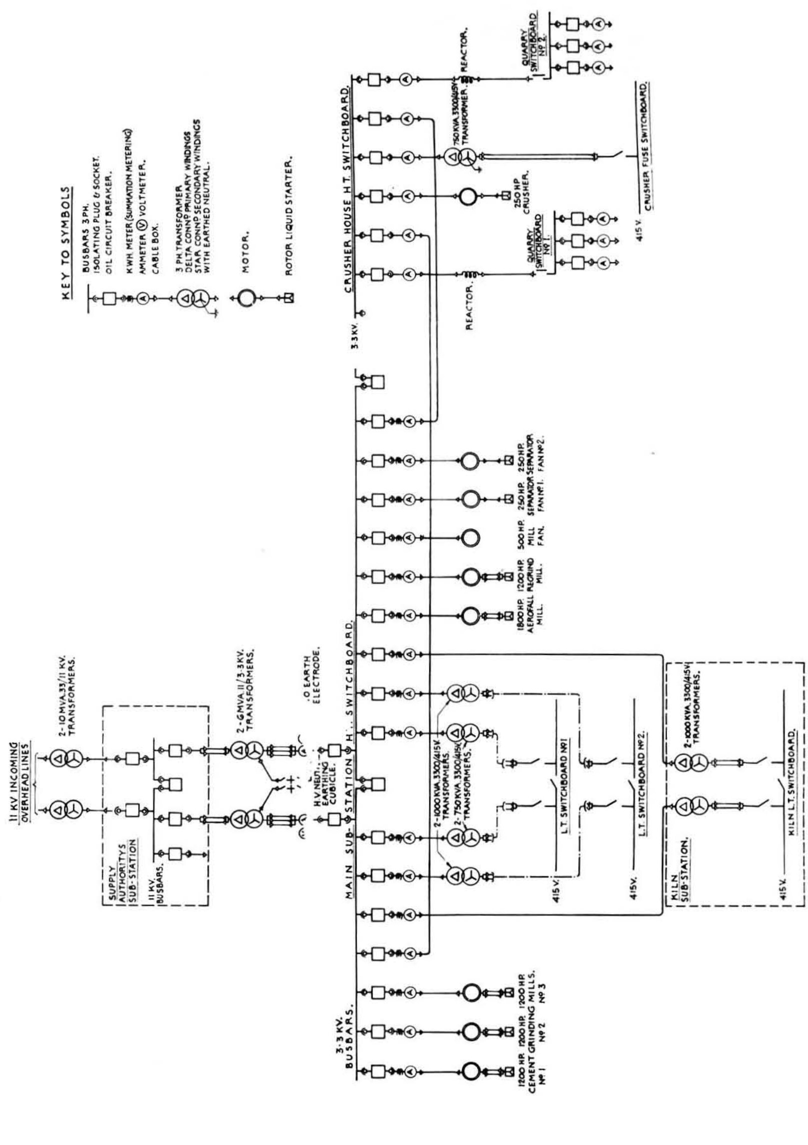


Fig. 1.—Typical Distribution System.

The power consumption per ton of cement produced may lie in the range of 80 to 130 kWH, depending very largely on the hardness of the raw material, which at 80 per cent. load-factor would set up a demand approximately in the range of 12 to 20 kW. per 1,000 tons of cement produced per year.

The installed capacities will of course be greater than this, that provided for a 300,000-tons per year wet-process plant and a 400,000-tons per year semi-dry plant, both installed recently, being 28 and 25 kVA per 1,000 tons per year respectively.

In dealing with the technical aspects of the application of electrical power the following features are peculiar or of particular interest to the industry.

The drives on cement works call for both large and small motor units, generally at a constant speed and torque and installed sometimes over a considerable area, so that 3-phase 50-cycle alternating current, as standardised in the grid system in the United Kingdom, is suitable for almost all applications.

Where power to be dealt with is 1,500 kW. and upwards, 3·3 kV. is an economical pressure for main transmission and direct use on motors down to 125 h.p., whilst for smaller ratings transforming down to a secondary pressure of 415 V. 3-phase 50-cycles is convenient. The " neutral " point of both the 3·3 kV., and 415 V. systems will be earthed. The lighting for the main works and office buildings can be carried out using the 240 V. four-wire system but, in order to keep the lighting system apart from the power it is preferable to install, at different points on the works, individual transformers of say 25 kVA. stepping down from 415 to 240 V. For portable tools and hand lamps it is essential, for safety, to use 110 V. with the central point of the winding earthed; this voltage can be obtained from a separate winding, of say 5 kVA. capacity, arranged on the transformer.

Power Distribution

A cement works must have continuity of supply and this necessitates arrangements being made with the Supply Authority concerned for duplicate incoming feeders, each of which has the capacity to meet the full works demand.

Although this may involve additional cost, it would be small in relation to the loss of production in the event of a failure of the supply.

Fig. 1 is a line diagram of a typical 3·3-kV. and 415-V. distribution system. It will be seen that the high-tension supply is distributed from the main works substation to several section substations. In all of them adequate enclosure for the exclusion of dust, which is always present in some degree even in the most well-run works, is of paramount importance.

HIGH-TENSION DISTRIBUTION. — There are many types of switchgear now available for 3·3-kV. distribution. Metal-clad gear is preferred, either air insulated or oil or compound filled, incorporating vertical isolation and single or double cross-jet oil circuit breakers designed to meet the higher fault conditions brought about by the increase in power of the supply authorities networks. Such increases have, in many older works, necessitated the replacement, at great expense, of

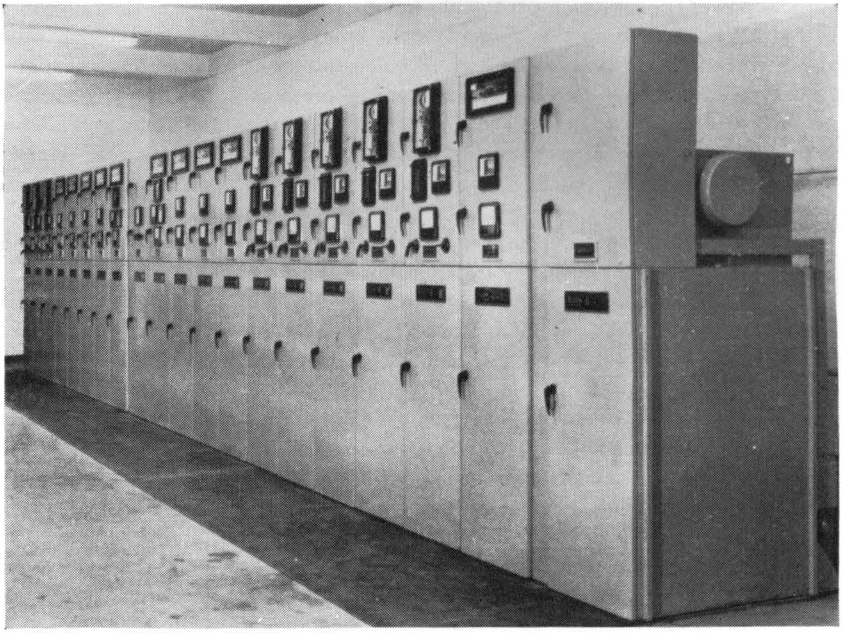


Fig. 2.—Typical High-tension Gear.

switchgear that was otherwise adequate for the works requirements.

In designing the power distribution system, it is of utmost importance to provide suitable protective relays which can be graded so that, in the event of a fault occurring, only the faulty breaker will trip, leaving the remainder of the circuits in a healthy condition.

Indiscriminate tripping of circuits must be avoided in all circumstances. Typical high-tension gear is shown in *Fig. 2*.

TRANSFORMERS.—The selection of the rating of the 3·3-kV. and auxiliary 415-V. transformers depends to a large extent on the magnitude of the loads in the various sections of the manufacturing process. The present practice is to duplicate the transformer capacity on those sections of the plant where continuity of operation is vital, so that in the event of a failure of one transformer unit that the section is kept in operation at least at 90-per cent. capacity.

LOW-TENSION DISTRIBUTION.—For switchgear to control the 415-V., 3-phase 50-cycle distribution, it is generally accepted that, for currents in excess of 1,000 amperes, the air circuit breaker be used together with switch-fuse gear for currents from 800 to 300 amperes. For the smaller loads of 200 amperes and below it is general practice to use fuse-gear alone.

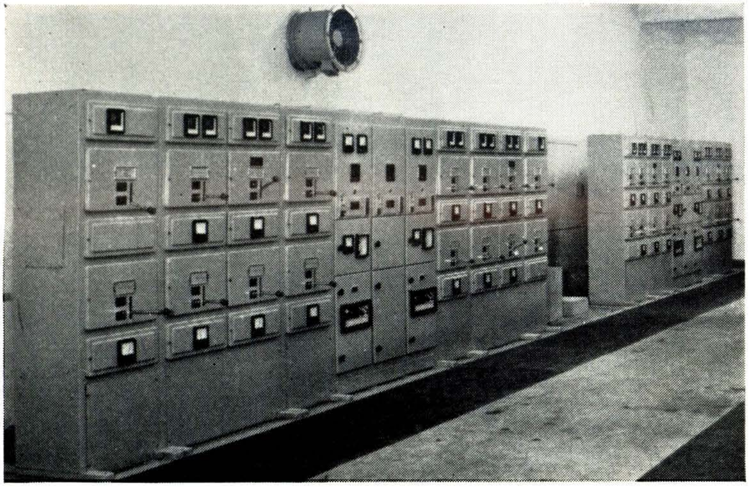


Fig. 3.—Typical Low-tension Gear.

The air circuit breakers are usually manually operated, although solenoid operation can be included if so desired.

For protection of the air circuit breakers, over-current and earth-leakage relay operating through a shunt trip-coil system are incorporated.

The air circuit breakers and the associated switch-fuse gear selected, should carry an A.S.T.A. Certificate that each unit is capable of withstanding short-circuit conditions within a range of 25 mVA. to 35 mVA., equivalent to 23,000 to 30,000 amperes, according to the design requirements of the network. *Fig.* 3 shows typical low-tension gear.

CABLES.—The use of copper conductors in cables is generally preferred although the use of aluminium conductors is increasing and does show a saving in cost for the higher voltage and current ratings for high-voltage supplies from the substations of the supply authorities to the works substations.

In general for the 3·3-kV. works distribution, paper-insulated lead-covered single wire-armoured cables to B.S. 480 are used, whilst the feeders to the quarry are double wire-armoured to B.S. 760 to comply with the Mines and Quarries Regulations.

The trailing cables used to supply the excavators and mobile equipment are of the tough rubber sheathed type to B.S. 1116, being specifically designed to comply with the Mines and Quarries Regulations.

For the 415-V. distribution, paper-insulated single-core cables are used to a minimum of 0·06 sq. in.; PVC. insulated cables are now frequently used for the smaller sizes of power cables. For control and auxiliary wiring, the use of cables down to a minimum of 0·0045 sq. in. is considered adequate.

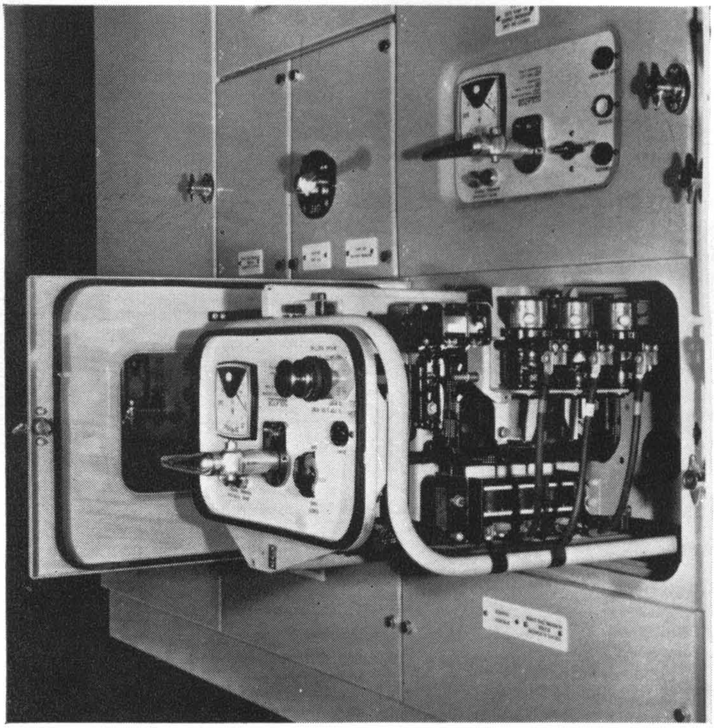


Fig. 4.—Multi-starter Control Cubicle (See Fig. 5).

In hot locations near the kiln, the use of mineral insulated conductors may be advantageous.

Motors

CONTROL GEAR.—On a modern cement works up to some 75 per cent. of the motors must of necessity be remotely controlled. The practice of locating each control unit alongside its particular motor is now the exception rather than the rule and has been superseded by the " Multi-starter control cubicle " containing a group of air break contactors, the number of which will depend upon the number of drives to be controlled in that particular section of the plant.

For protection of these motors, suitable over-current and under-voltage protection is incorporated on each circuit with the addition of " group earth leakage relays " which will trip all the motors included in the particular control cubicle in the event of any one motor developing an earth fault. The groups of multi-starter control cubicles are usually housed in a suitable enclosure, which is kept under a slight air pressure to avoid the ingress of dust. An example is shown in *Fig.* 4, and a rear view of the retractable unit in *Fig.* 5.

MOTORS.—In a cement works the power of motors normally employed ranges

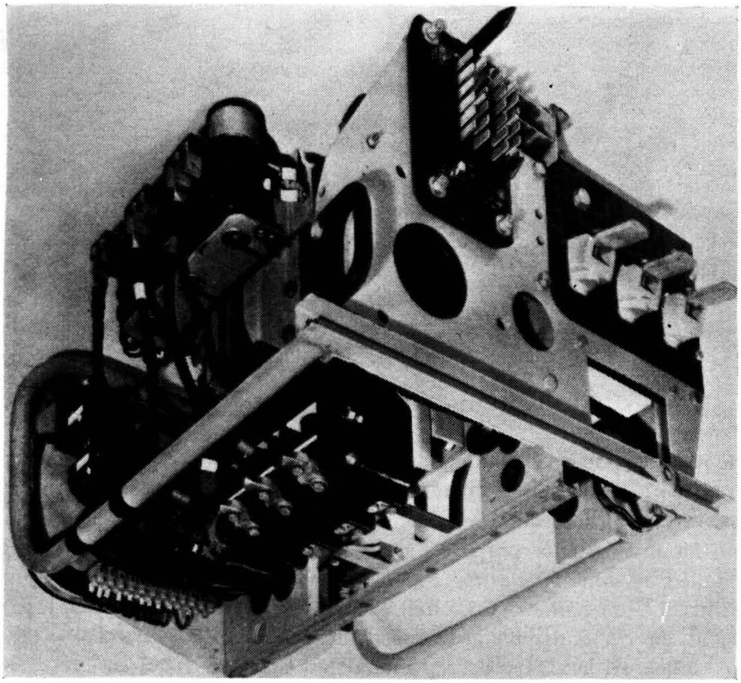


Fig. 5.—Rear View of Retractable Unit (See Fig. 4).

from a fraction to 3,000 h.p. It is usual to arrange for motors of 180 to 200 h.p. and above to be supplied at 3·3 kV. However, with the ever increasing size of grinding mills it is probable that the power may rise to 5,000 or 6,000 h.p., for which special consideration would have to be given to the choice of voltage and starting equipment.

The motors for cement mills are usually of the drip-proof synchronous induction-type with an efficiency of up to 97 per cent. at full load running with a starting torque of 1½ times full load. These machines are designed for a leading power factor of 0·95 and are used to correct the works overall power-factor which can be maintained between 0·99 and unity. It is then not necessary to install any condenser equipment.

For protection of these larger motors suitable thermal over-current and earth-leakage relays are incorporated, together with thermal elements embedded in the motor end windings which can be made to operate a trip or alarm circuit in the event of overheating in the windings, thus avoiding the possibility of burning out, which would necessitate completely re-winding the motor, with its inevitable loss of production.

For driving compound-mills, the usual British practice is to use a motor

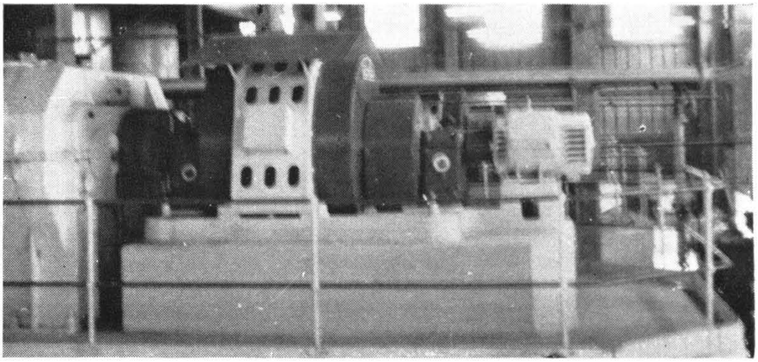


Fig. 6.—1,200-h.p. Motor.

running at 750 r.p.m. Adequate steps have to be taken to ensure the exclusion of dust from both motors and control-gear. It is desirable to house them in a room separated from that housing the mills. To ease the stresses involved when inching the mill for maintenance purposes, small auxiliary motors and " barring gear " are installed by some operators. *Fig.* 6 shows an example of a 1,200-h.p. motor which runs at 750 r.p.m. driving a mill. The motor in *Fig.* 7 is an 1,800-h.p. motor running at 200 r.p.m. driving an autogenous grinding mill.

For almost all auxiliary drives a final low speed is required. A variety of means is available to reduce the speed from the motor, such as Vee-ropes, spur-and-worm-gear box or a combination of these, according to the circumstances.

There is also available a large selection of motors with gears built in.

For the more arduous starting duties slip-ring motors are used but, for drives of

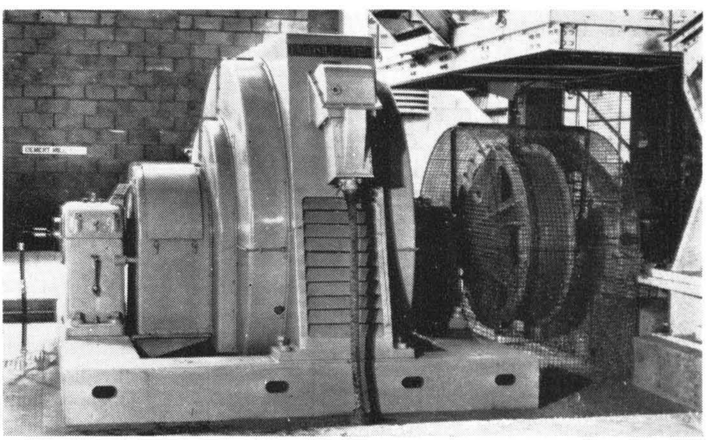


Fig. 7.—1,800-h.p. Slow-speed Motor.

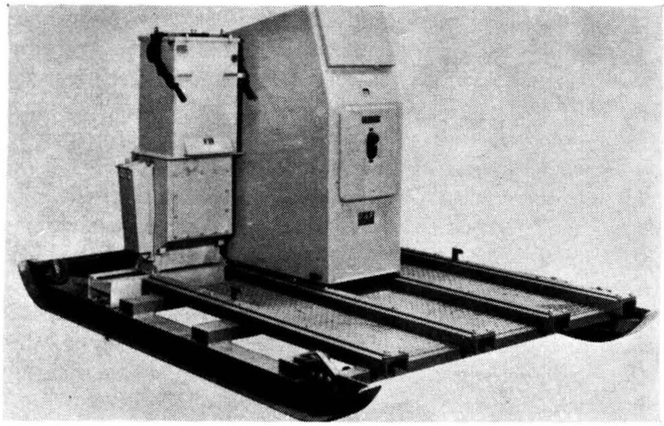


Fig. 8.—Skid-mounted High-tension Gear.

75 h.p. and below, squirrel-cage totally-enclosed motors complying with B.S.2613 are used.

In order to avoid having to carry a multiplicity of spares, it is desirable to keep to a minimum the types and sizes of motors employed, as well as the speed reducers associated with them. It is found that most requirements can economically be met up to 20 h.p. by 1,450-r.p.m. motors of 1, 5, 10 and 15 h.p.

Special Applications.—There is a number of drives in a cement works for which variable speed is required.

Each drive will call for special investigation on an A.C. system, but the following generally applies to cement works duty. For powers up to about 100 h.p. not

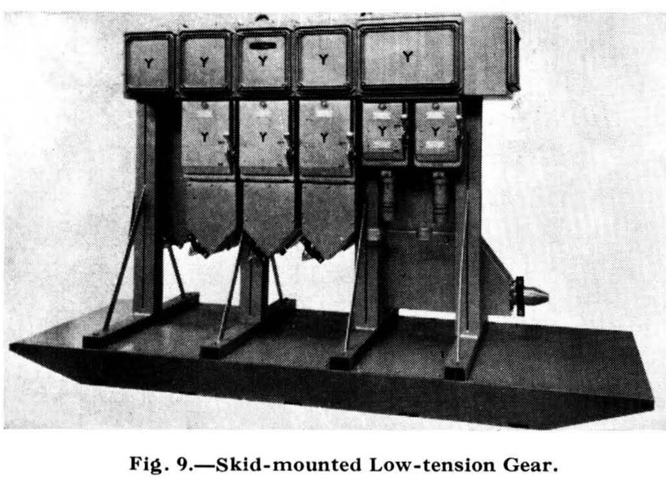


Fig. 9.—Skid-mounted Low-tension Gear.

requiring a range of speed variation of more than 2:1 or constant torque through the range, the slip-ring motor with rotor resistance will be satisfactory though at some loss of efficiency, which may not be of importance when the duty is intermittent. But for any power where continuous operation and constant torque at any point in the range are required, the A.C. commutator motor is found efficient and satisfactory though higher in first cost.

The commutator motor is almost invariably used for driving rotary kilns. It has also been used for induced draught fans in preference to rotor resistance or hydraulic couplings, although a fixed-speed fan with damper control is now often installed.

For smaller drives, such as grates, coolers, and feeders, it gives better speed regulation than rotor resistance, but squirrel-cage motors with one of the many mechanical variable speed gears, are found to be very reliable with lower maintenance requirements.

In the quarry, mobile equipment has to be supplied with electricity. Large excavators may be run on 3·3-kV. supply, using 3,300-V. motors, the operational control being either electrical, by means of a modified Ward-Leonard system, or mechanical from a single motor. The supply is brought to the machines by gate-end switches and trailing cables.

Low tension supplies for smaller machines and for lighting are obtained through transformers and switchgear which can be skid-mounted and thus be kept reasonably close to the machines, with a minimum movement of heavy cable. *Figs.* 8 and 9 show skid-mounted high-tension and low-tension gear respectively.

Acknowledgements

The equipment illustrated in *Figs.* 2 and 3 is Ellison switchgear, and that illustrated in *Figs.* 4 and 5 was supplied by Messrs. Baldwin & Francis Ltd. The motor illustrated in *Fig.* 6 is supplied by Messrs. Crompton Parkinson Ltd., and that in *Fig.* 7 by the English Electric Co., Ltd. The skid-mounted switchgears illustrated in *Figs.* 8 and 9 were supplied by the Yorkshire Switchgear Co.

Recommendations for Testing Cement

THE Draft Recommendations for "The Testing of Cement" prepared by the International Organisation for Standardisation were published recently by Cembureau. The publication, which is divided into three main sections—definitions and terminology, strength testing, and chemical analysis—is obtainable, in English and French, from Cembureau, The European Cement Association, 2 Rue St. Charles, Paris 15e, France. Some of the recommendations are given in the following.

Strength Tests

The Rilem-Cembureau method of testing the bending and crushing strengths of cement is recommended and is as follows.

PREPARATION OF SPECIMENS.—A mortar is prepared from a standard sand, the proportions by weight being 1 part of cement, 3 parts of perfectly dry standard sand and ½ part of drinking water (water-cement ratio=0·50). The mixing apparatus and procedure is described in detail in the publication.

The test specimens are prisms 40 mm. by 40 mm. by 160 mm., which are to be cast in hard steel moulds comprising three compartments to enable three specimens to be prepared at the same time. The mould is to be securely clamped on a machined steel base-plate, and is to be surmounted by a metal hopper, the dimensions of which are specified. The mould is to be lightly oiled inside and the external joints sealed.

The mould, with the hopper, is fixed to a jolting table full details of which are described, and the first layer of mortar of about 320 g. introduced directly from the mixer into each of the mould compartments. This layer is to be spread by means of a steel plate levelling tool, which is drawn twice forward and backward along the mould while pressing its flanges against the top of the hopper. Sixty jolts are to be given to the first layer in 60 sec. A second and identical layer of mortar is then introduced, levelled and compacted as previously. The mould is then lifted off the table and the hopper removed. Excess mortar is struck off with a metal straight-edge, the surface being subsequently lightly smoothed, using the straight-edge held almost flat. Marks identifying the specimens are then made on the moulds. The filled moulds are covered by a steel or rubber sheet and placed in a curing room or cabinet which shall be at a temperature of 20±1 deg.C. and a relative humidity of not less than 90 per cent.

In the case of tests at twenty-four hours, demoulding is to be carried out 15 to 20 mins. before the test is due. For tests at other ages, demoulding is to be carried out between 20 and 24 hours after moulding. If the mortar has not acquired sufficient strength after twenty-four hours to be handled without danger of damage, demoulding may be delayed a further twenty-four hours. Demoulding shall be done with care, preferably with a device illustrated in the publication. Each demoulded test specimen is then weighed as a check on the procedure.

After demoulding, the specimens are to be cured at 20±1 deg.C. in ordinary tap-water (not running) until the time for testing. The specimens are to be taken from the water less than 15 mins. before testing and are then wiped with a clean cloth.

TESTING.—The testing machine for bending strength is to be capable of applying loads of less than 1,000 kg. with a precision of 1 per cent. for the upper 80 per cent. of its range. The bending device is to comprise two supporting rollers of 10-mm. diameter spaced 100 mm. or 106·7 mm. apart and a loading roller of the same diameter placed centrally between the other two.

The specimen is placed in the bending device and the load P is applied vertically by the loading roller, and is to be increased progressively at the rate of 5 ± 1 kg. per second. The modulus of rupture (in kg. per sq. cm.) is given by the expression 0·234 P for 10-cm. spacing and 0·250 P for 10·67-cm. spacing.

After testing in bending, the half-prisms are to be damp stored until the crushing test. Each half-prism is to be tested in compression on the lateral moulded faces on a section of 40 mm. square between two plates of hard metal.

The compression testing machine is to have a precision of at least 1·5 per cent. for the smallest loads used in the tests, and is to be provided with at least two ranges of loading, one up to 4 or 5 tonnes, the other up to 15 to 25 tonnes. The upper plate is to bear a spherical seating, the centre of which is situated in the plane of the lower plate. Sundry other particulars of this machine are described and illustrated.

The bending and compressive strengths are to be determined on at least three prisms for each age. The test report shall give all the results but the arithmetical means of the results of three bending-strength tests and of six compressive strength tests at each age are to be taken as the bending and compressive strengths of the mortar.

Chemical Analysis: Main Constituents in Portland Cement

The following procedures are recommended.

LOSS ON IGNITION.

Heat 1 g. of the sample in a weighed covered platinum crucible with a volume of 20 to 25 ml. The crucible and its content are heated to constant weight in a muffle furnace at a temperature of 925 ± 25 deg. C. The initial heating takes 15 min.; subsequent periods take 5 min.

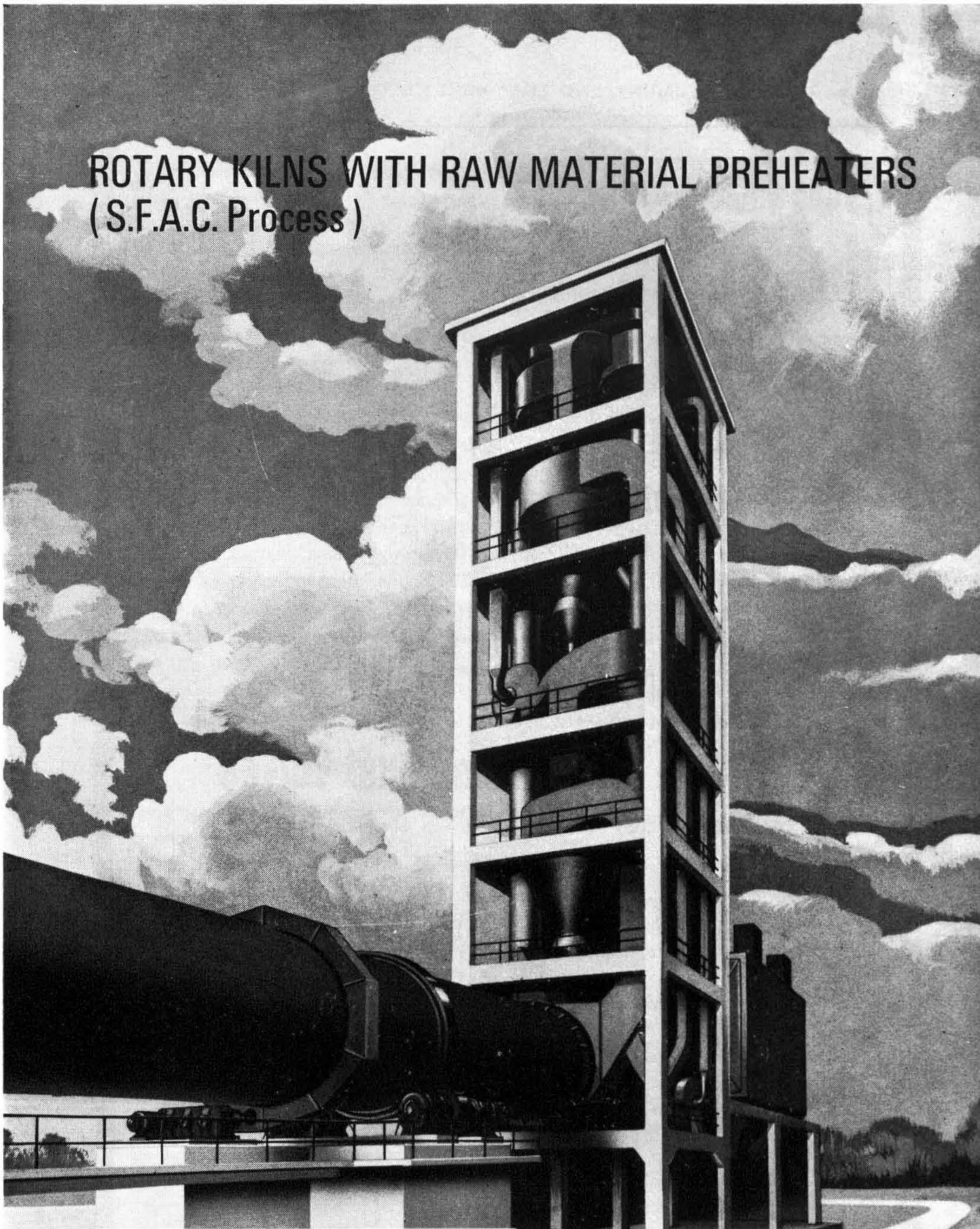
The percentage loss on ignition is calculated to the nearest 0·1 per cent.

INSOLUBLE RESIDUE.

To 1 g. of sample add 10 ml. of cold water and whilst vigorously stirring the mixture add 5 ml. HCl ($d = 1{\cdot}19$).

Dilute the solution to 50 ml. and digest for 15 min. at a temperature just below boiling. Filter the residue with a medium filter, wash six times with hot water. Transfer the filter-paper and its contents back to the reaction beaker. Add 100 ml. of NaOH (10 g. per l.) and maintain the solution at a temperature just below boiling point for 15 min. In the presence of methyl red as indicator acidify the solution with HCl, and add an excess amount equivalent to 4 or 5 drops of HCl. Filter with a medium filter and wash the residue 12 to 15 times with a hot solution of NH_4NO_3 (20 g. per l.).

Ignite the residue to constant weight, in a weighed crucible at 900 to 1,000 deg. C. Calculate the percentage of insoluble residue to the nearest 0·01 by multiplying the increase in weighing by 100.


ROTARY KILNS WITH RAW MATERIAL PREHEATERS
(S.F.A.C. Process)

TOTAL SILICA (SiO_2).—The principle of the Maczkowske method. Some causes of error and some general comments are given. The procedure is as follows.

Weigh 1 g. of sample and 1 g. of ammonium chloride (NH_4Cl.). Mix the whole carefully in a 250 ml. beaker and spread the material evenly over the bottom of the beaker. Cover this with a clock glass and add slowly, using a graduated pipette, 10 ml of concentrated hydrochloric acid ($d = 1{\cdot}19$) down the side of the beaker. When the reaction has subsided, stir the mixture with a glass rod to break down any lumps which may have formed. The beaker together with its cover is placed on a water bath for 30 min. The temperature should not exceed 100 deg. C. During this time, the contents of the beaker are stirred frequently with the glass rod to prevent the formation of lumps.

Dilute with about 50 ml. of hot distilled water the syrupy residue at the bottom of the beaker, and pour on to a rapid filter-paper of 11-cm. diameter. Thoroughly wash the precipitate twice with hot 5 per cent. hydrochloric acid and then with hot distilled water until the washings are free from chloride (tested by means of silver nitrate). The precipitate with its filter-paper is placed in a weighed platinum crucible, which is covered with its lid and heated gently to smoke off the filter-paper without it flaming, so that entrainment of silica does not take place. Finally, ignite at 1,150 deg. C. in an electric furnace for 45 min. Cool in a desiccator to room temperature (about 15 min.) and weigh. This gives the total silica contaminated with impurities, mainly the sesquioxides.

The purification of the silica is carried out as follows.

The contents of the crucible are moistened with a few drops of water and on to this is poured 5 ml. of pure concentrated hydrofluoric acid and three or four drops of concentrated sulphuric acid. Evaporate the contents of the crucible on a sand bath or any other convenient evaporator, ignite for 5 min. at a temperature of 1,150 deg. C. to 1,200 deg. C; cool in a desiccator and weigh. This gives the traces of sesquioxides entrained by the silica; this weight is subtracted from the original weight to give the pure silica; the result is multiplied by 100 and calculated to the nearest 0·1 per cent.

TOTAL OXIDES (R_2O_3).—These tests relate to aluminium, iron, titanium, vanadium and chromium oxides, and to phosphoric anhydride. The general principle and some particular points to observe are described. The procedure is then as follows.

Add about 5 ml. of bromine water to the filtrate from the silica separation (double this volume in the presence of high concentrations of manganese); 3 per cent. hydrogen peroxide solution can also be used as a means of oxidation instead of bromine water. Evaporate to a volume of 150 ml. until all free bromine has been driven off. Then add two or three drops of methyl red solution and 1 g. of ammonium nitrate and precipitate the hydroxides by the addition drop by drop of ammonia diluted to 10 per cent. and free of carbonic acid until the solution is coloured yellow. Stir vigorously during the precipitation. Then cover the beaker with a clock glass and allow the precipitate to settle for a few minutes. Decant the solution onto a medium filter of 11-cm. diameter, which has been thoroughly rinsed with a dilute solution of ammonium nitrate; add to the precipitate a hot solution of ammonium nitrate, pour the whole onto the filter and wash the precipitate with the same solution.

Then proceed with a second precipitation. For this carefully take the filter with its precipitate from the funnel, place in the beaker used for the precipitation and redissolve in hot 1/1 hydrochloric acid; mix to disintegrate the filter-paper and carry out a second precipitation using ammonia diluted to 10 per cent. in the presence of methyl red. Filter on a medium filter and wash the hydroxides with a dilute solution of ammonium nitrate. The filter-paper with its precipitate is placed in the platinum crucible containing the residue from the evaporation of the fluosilicic acid. After having smoked off the paper, ignite the precipitate at a minimum of 1 100 deg. C. for 30 min., allow to cool in a desiccator and weigh; this gives the total oxides. Verify that the weight remains constant. The result obtained is multiplied by 100 and calculated to the nearest 0·1 per cent.

To be conclvded.

Safety in Cement Works

THE following is abstracted from a report for the year 1966 by the Accident Advisory Committee of the Cement Makers' Federation.

"It had been hoped that in the Committee's Report for 1966 a reduction in the number of lost-time accidents compared with 1965 would be recorded, but the results show an increase of three accidents. This is a reminder that if accidents are to be reduced each year there is still much to be done and it will become progressively harder each year.

Here are the comparisons:

	1965	1966
Number of competing works	44	45
Total number of lost-time accidents.. ..	264	267
Frequency rate..	0·95	0·96
Works with no lost-time accidents	6	11
Works with frequency rate below 1·0 (including accident-free works)	25	27

In 1966 there was a great improvement in the number of works with no lost-time accidents, this being achieved by eleven works which is only one short of the 1962 record. The net result shows that the accident position within the industry is about the same as in 1965. However, during the year, at two particular works which introduced planned organised safety and subsequently achieved significant improvement over the previous year, the number of accidents was reduced by eighteen to five at one works and by nine to thirty at the other.

Of the 257 accidents, ninety occurred in the Blue Circle Group's twenty-nine works* with a frequency rate of 0·50 compared with 106 accidents and a frequency rate of 0·60 in 1965. The remaining sixteen works contributed 177 accidents with a frequency rate of 1·81 against 158 accidents with a frequency rate of 1·56 in 1965.

Special mention is made of the Aberthaw Works which with eight accidents halved their 1965 figure, and at West Thurrock, the industry's largest works, accidents were reduced by nine."

*Full details of the continued improvement in the accident rate in Blue Circle Group works are given in "Accident Prevention: Report for 1966." Copies are obtainable from the offices of the Group.

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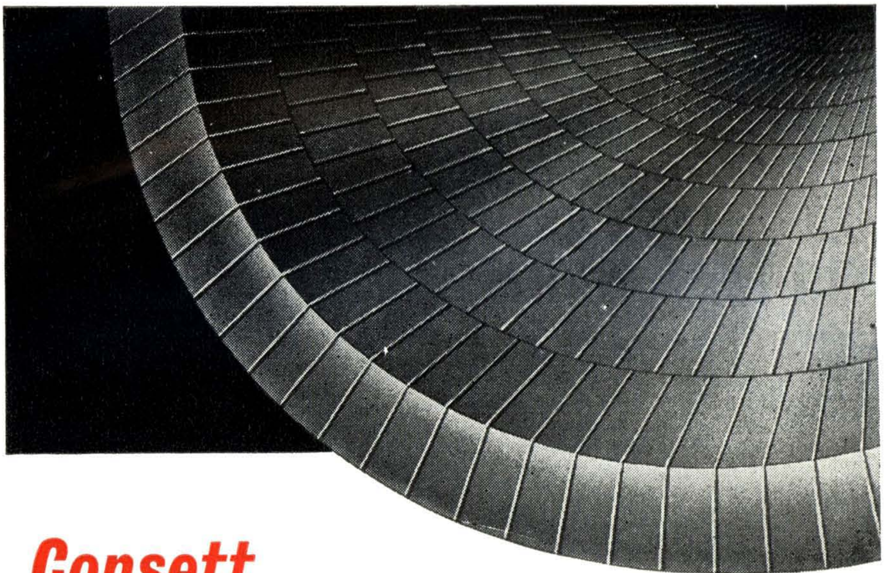


The Associated Portland Cement Manufacturers Ltd.

The following are abstracts from the Chairman's Statement at the Annual General Meeting of The Associated Portland Cement Manufacturers Ltd., which was held in June last.

As expected, the demand for cement remained practically stationary in 1966 and, with 1,000,000 tons of new capacity coming into action during the second half of the year, for the first time since the War there was significant over-production. Steps have been taken to meet this situation by closing, it is hoped only temporarily, some old plant. The closures have been mainly in the Thames Area because the new kilns have been placed near the centres of high consumption and have to a great extent taken the place of supplies which up till now had to be brought from the Thames.

Over-production is not a new problem in certain countries, particularly in the U.S.A., but it does mean that the price of cement has to include the cost of the standing charges on unused plant. Such over-production cannot therefore be in the best interests of the consumer.

Thanks largely to good weather, the deliveries for the first four months of 1967 are 8 per cent. above last year. An increase of about 4 per cent. on last year is a reasonable expectation. Industrial building and housing in the private sector have not yet recovered normal levels but the cement industry is largely dependent on expenditure in the public sector. The Government is now responsible for over 60 per cent. of all construction and for 90 per cent. of the work carried out by civil engineering contractors.

Expansion overseas is either in hand or has recently been completed in all countries in which A.P.C.M. operate, with the exception of Rhodesia. The overseas companies established a new sales record of 5,478,283 tons, an increase of almost 20 per cent. on last year, which was itself a record. Although this result reflects the acquisition of three works in Spain at the end of last year, it was realized in some instances against the background of uncertain trading conditions and unsettled political trends.

The Mexican subsidiaries achieved record production and sales. The new 300,000-ton expansion at the Atotonilco works came into production in June. Plans to build a new 450,000-ton works to serve the State of Jalisco in Western Mexico are in an advanced stage.

In Australia, sales by Associated Portland Cement Manufacturers (Australia) Ltd., were maintained at the record level of the previous year, notwithstanding a decline in overall cement consumption in the Company's areas of operation. The 300,000-tons expansion at Maldon works in New South Wales is nearing completion.

In New Zealand, sales of The Golden Bay Cement Co., Ltd., were marginally lower, following a deterioration in the country's economy towards the end of the year. The new plant at the Tarakohe works in the South Island is now in operation.

The competitive conditions that have been a feature in Malaysia for the last few years continued unabated during 1966. Malayan Cement Ltd. maintained sales at near capacity levels. Future prospects have improved as a result of a recent merger between Malayan Cement Ltd., and one of its competitors, Pan Malaysia Cement Works Ltd., which has works situated in Northern Malaya and Singapore. This move has had the effect of bringing two more works under the Group's management.

The works of White's South African Portland Cement Co. Ltd., produced to capacity throughout the year and record sales were achieved. At the Lichtenburg works, the installation of a new 300,000-tons per annum dry-process kiln is under way. Deflationary measures taken by the South African Government have brought a marked reduction in the volume of planned building, which in turn is likely to result in a falling off in the demand for cement this year.

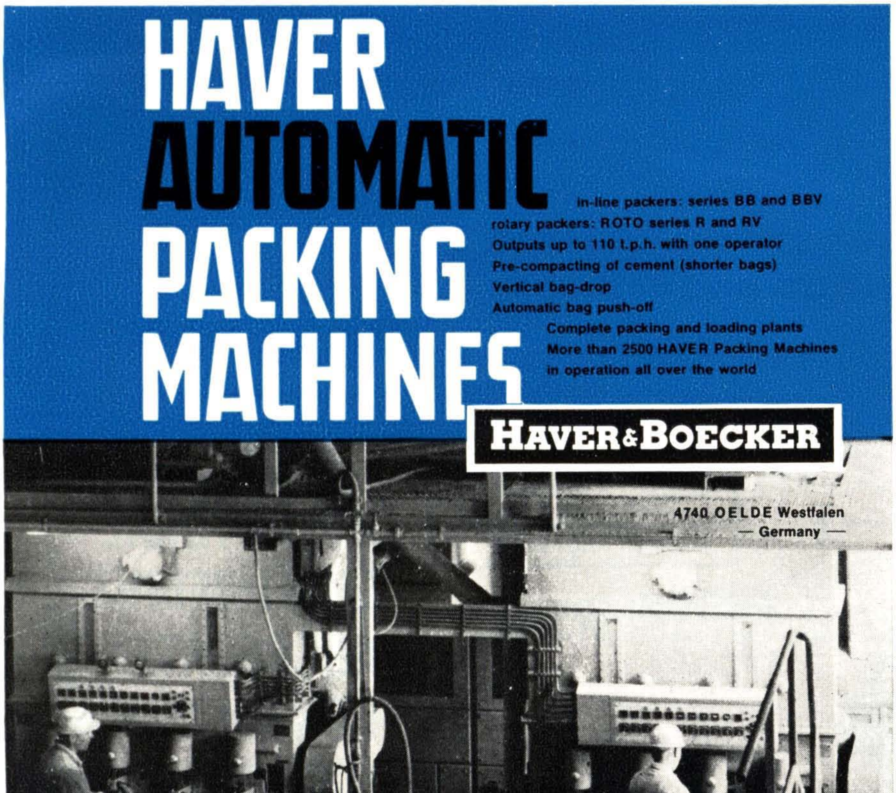
In Rhodesia, The Salisbury Portland Cement Co., Ltd., had its most profitable year. The measures introduced at the beginning of 1966 to rationalise cement marketing have largely contributed to the increased profit. The outlook necessarily remains uncertain and the Company's operating problems will tend to increase in line with external pressures.

Despite recurring political crises, The West African Portland Cement Co., Ltd., had a successful year, surpassing previous levels of sales and profits. The expansion of this Company's works to 500,000 tons capacity is in hand and further expansion is under active consideration.

In East Africa, the Company's interests are in Bamburi Portland Cement Co., Ltd., the The East African Portland Cement Co., Ltd., both in Kenya, and the Tanganyika Portland Cement Co., Ltd., in Tanzania. Settled conditions in Kenya have resulted in an increased local demand which has reflected favourably on the two Kenya companies. Bamburi Portland Cement Co., Ltd., at Mombasa continues to export the major proportion of its output and is presently engaged in increasing its capacity by 300,000 tons to 700,000 tons per annum. The Tanzanian plant near Dar-es-Salaam has come into operation and is producing to capacity.

Cement sales of Ocean Cement & Supplies Ltd., the associate in British Columbia, increased by a third last year. The new 300,000-tons plant being installed at Bamberton works on Vancouver Island will shortly be available to meet any further increase in demand. During the year the trade investment in Canada Cement Co., Ltd., was disposed of.

Asland Asociada, S.A., the associated company in Spain, continued its policy of development and further expansion, and now represents one of the major overseas investments. The new 400,000-tons semi-dry process kiln at Cordoba has made a significant contribution and has thus raised the capacity of the Company to over 1,000,000 tons per annum. Additional expansion is presently in hand at Moncada, near Barcelona, and further major expansion in that area is at an advanced stage of planning.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