HEEMAF-POST

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N. V. HENGELOSCHE ELECTRISCHE EN MECHANISCHE APPARATEN-FABRIEK

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Telephones: 54, 78, 82, 119, 313, 357

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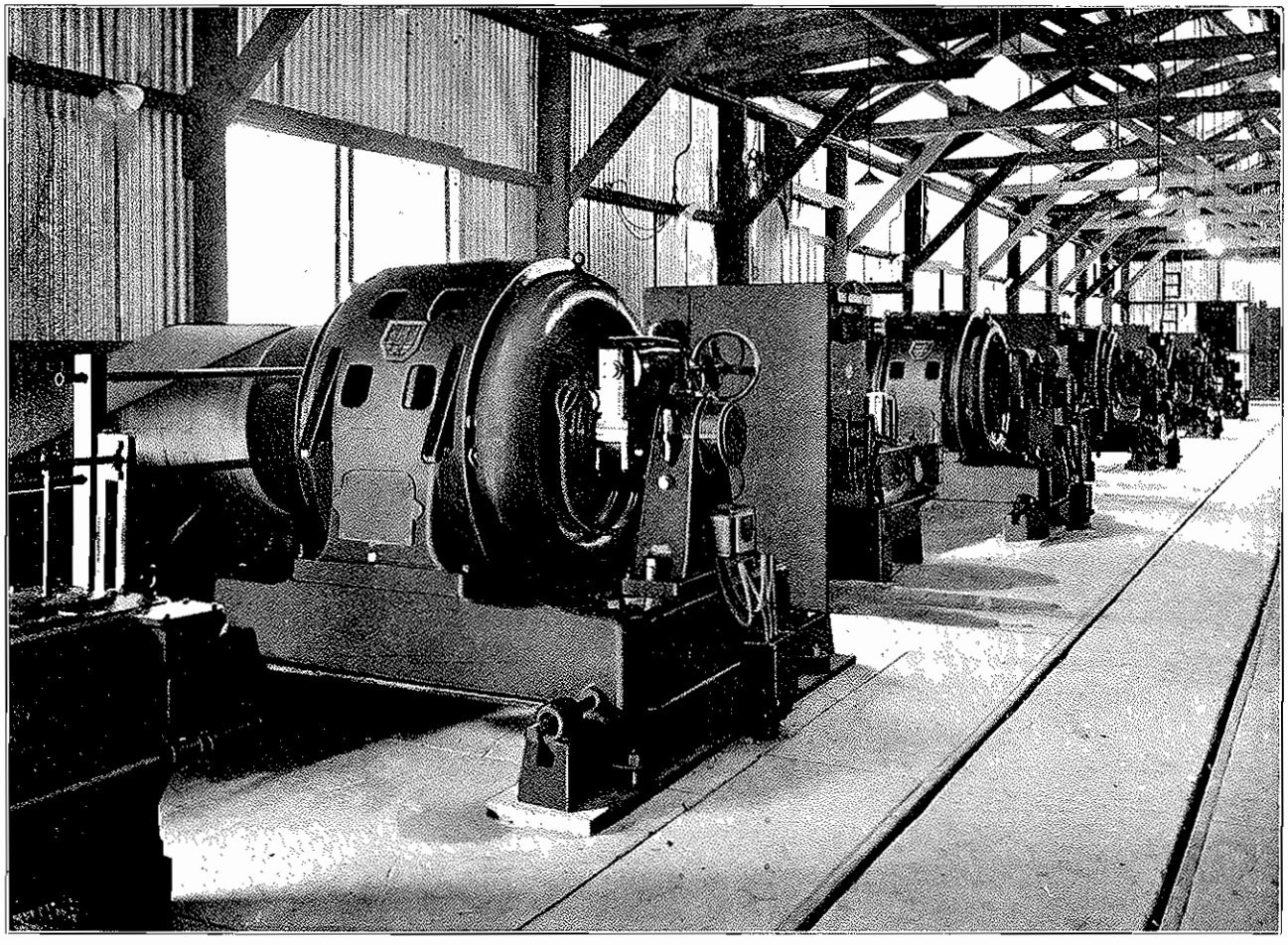
„NUMBER E 4"

„X-MAS 1923"



Five of an order on twelve threephase A.C. slipring motors 250 B.H.P. 2000 Volts, 500 r.p.m. for tube mill drive.

HEEMAF - HENGELO - Holland

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N.V. HENGELOSCHE ELECTRISCHE EN MECHANISCHE APPARATEN-FABRIEK

„NUMBER E 4"

„X-MAS 1923"

PREFACE.

„The best is not good enough."

The present number of the Heemaf-Post has been issued for the purpose of giving our customers in different parts of the world a general review of some lines of our manufactures.

Notwithstanding the unfavourable conditions during the last years we have been able to introduce our products in many foreign markets and the results attained by our representatives abroad, are without doubt due to the quality of our manufactures, which are the outcome of many years' experience.

We specialize in A.C. and D.C. machines, apparatus and instruments, for H.T. as well as for L.T. and have aimed at making them suitable for the particular market to which they are being exported. Due to the fact that we have gained considerable experience in taking care of the special requirements for new fields, and since export requires articles of the very best quality, our products are well adapted to this trade.

We hope that this number will keep our customers posted on the new developments in our works and familiarise those of our readers, not already acquainted with the Heemaf Co. with our various products.

Any additional information regarding our manufactures, descriptive leaflets and prices will be gladly furnished on request.

The Heemaf Type „S. K. A." Induction Motor.

Patents: Ned. Octrooi No. 10036. Brevet Belge No. 299705. British patent No. 179890. Argentine patent No. 19865. Other patents pending.

General description.

Normal squirrelcage motors, when connected directly to the supply voltage, usually have a maximum starting torque equal to about 1.8 to 2 times full load torque (F.L.T.) and require a starting current of 6 to 8 times full load current (F.L.C.)

The following table contains data regarding starting current and starting torque for normal squirrel cage motors with normal voltage applied to the stator terminals.

B.H.P.	Starting torque.	Starting current.
up to 5 BHP.	1.5—2 × F.L.T.	6—7 × F.L.C.
20 BHP.	1.25—1.8 „	6.5—7 × F.L.C.
150 BHP.	1—1.5 „	7—8 × F.L.C.

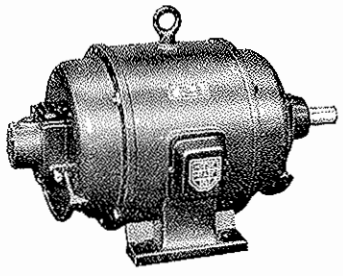


Fig. 1.
20 B.H.P. type S.K.A.-motor.

It is obvious when considering the above figures, that it will be hardly possible to connect a motor with the above characteristics directly to the supply voltage at starting. Therefore, in most cases, the Electricity Supply Co's. allow this method of starting for the smaller motors only, say upto 3 BHP. Above this size they are usually started with star-delta switches, autotransformer starters etc. in order to cut down the starting current and thus avoiding undue interference with other machines, lighting installations etc. which are connected to the same circuit. The application of a lower voltage than normal to the terminals, however, also affects the starting torque, which is proportional to the square of the voltage applied.

When starting with a star-delta switch, the starting torque will therefore be reduced to $^1/_3$rd of the values indicated above, i.e. to about .5 to .3 F.L.T. This is the reason why squirrelcage motors can be used only when starting under noload or with very low loads.

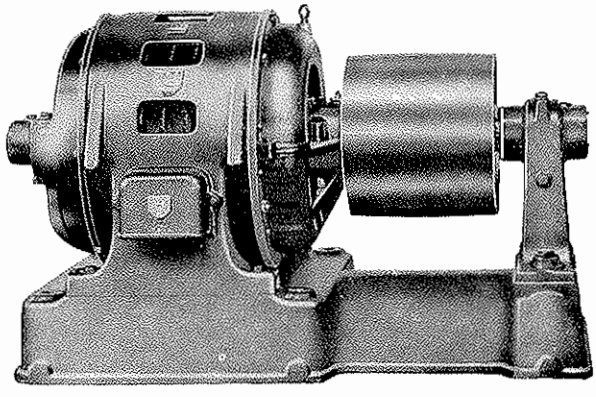


Fig. 2. 150 B.H.P. type S.K.A.-motor 2000/3460 Volts, 50 cycles, synchr. speed 600 r.p.m.

The great advantage of this type of motor is, however, the simple and robust construction; it is furthermore suitable for practically every condition of service and this is the reason why the Heemaf Co. tried and succeeded in designing a squirrel cage motor with *high* starting torque and *low* starting current.

The Heemaf type S.K.A.-motor, which has an ordinary wound stator, is built on the following principle. The rotor contains two independent squirrel cage windings, each consisting of a number of copper bars, embedded directly in the rotor iron and welded to copper end rings. The outer winding has a high resistance and low inductance, whilst the inner cage has a low resistance and a high inductance. The cooperation of the two windings results in a high starting torque and low starting current. It will be seen that the construction is similar to the Boucherot and Dolivo-Dobrowolski special squirrel cage motor, with this difference, that owing to important patented modifications, the named features have been attained without sacrificing either efficiency, slip or power factor.

Values of efficiency and power factor, determined in tests, carried out at the Technical University Delft, Holland, on a 4-pole 5 BHP. motor 220/380 volts are given below:

Load	$^1/_4$	$^1/_2$	$^3/_4$	$^4/_4$	$^5/_4$	$^6/_4$
Eff. %	74.5	85.5	87.5	88	87.5	85.5
P.F.	0.4	0.69	0.805	0.85	0.855	0.85

For a 4 pole 20 BHP.-motor the efficiency was

found to be 88.5 %, P.F. 0.865 and for a 6 pole 40 BHP.-motor the following results were obtained:

Load	1/4	2/4	3/4	4/4	5/4
Eff. %	82.5	88	90	90	89.5
P.F.	0.57	0.775	0.84	0.865	0.87

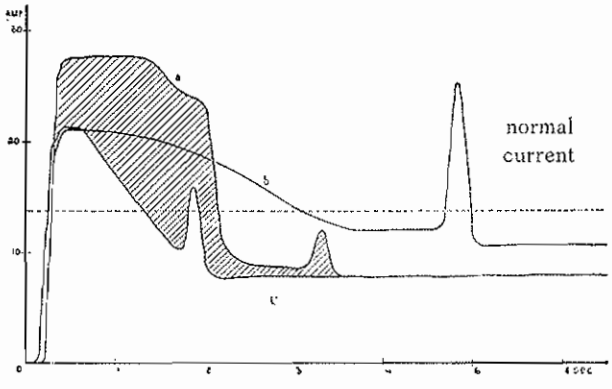


Fig. 3. Comparison of current consumption of normal squirrel cage motor (a) and type S.K.A.-motor (c) of same size at 1/3 load. b current of S.K.A.-motor at 71 % load.

The following table contains some data, determined by tests regarding starting torque and starting current, expressed in % F.L.T. and F.L.C. resp., for Heemaf type S.K.A. motors, when started with star-delta switch.

Frame No.	BHP.	rpm.	Starting current in % F.L.C.	Starting torque in % F.L.T.	Specific torque.
42—4	5	1500	150	100	0.67
52—4	10	1500	145	95	0.655
53—4	12	1500	175	110	0.63
61—4	15	1500	155	105	0.67
62—4	20	1500	170	110	0.65
73—8	25	750	130	70	0.54
81—6	40	1000	150	80	0.535

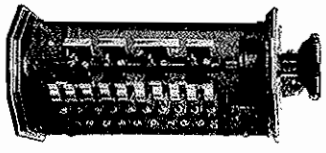


Fig. 4. Air break star-delta switch Type S.D.

When connected directly on the line with stator phases in delta, the above values for starting current and starting torque would be appr. three times larger. From the above data it will be readily seen that the S.K.A.-motor in the star position developes a starting torque equal to about 70—110 % F.L.T. with a starting current of about 130—175 % F.L.C. With the ordinary squirrel cage motors these figures are 40 % F.L.T. and 230 % F.L.C. respectively.

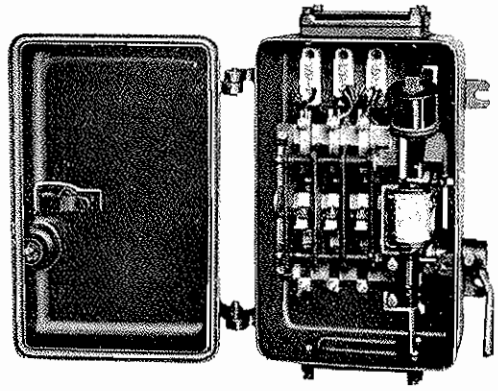


Fig. 5. Ironclad automatic circuit breaker type S.K.V.

Since the starting torque of normal squirrel cage motors is comparatively small, it will be necessary in many cases to select a larger size or a slip ring motor on account of starting conditions, than is actually required at normal speed and for such cases again, our S.K.A.-motor, due to the high starting torque and low starting current, could be satisfactorily applied. The last column in the above table indicates the ratio:

$$\frac{\text{Starting torque in \% F.L.T.}}{\text{Starting current in \% F.L.C.}}$$

This value, sometimes called the „specific tor-

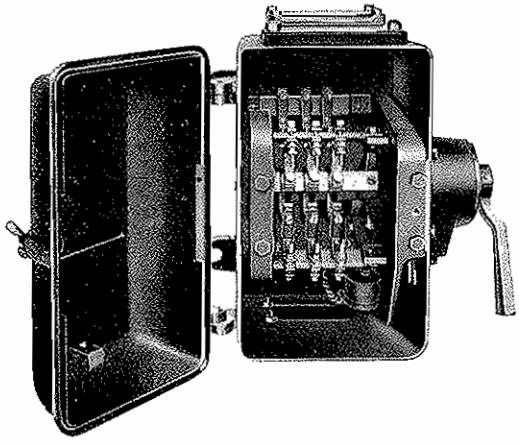


Fig 6. Ironclad air break star-delta switch type S.D.K.

the construction of the first named type, being a squirrel cage motor, is much simpler. Further, in most cases slip ring motors are fitted with short circuiting- and brush lifting gear, so that this type of motor must be placed within easy reach of the operator, whilst with the S. K.A.-motor we have a much greater freedom in mounting as the above mentioned devices are not required. Starting of a slip ring motor usually requires three operations viz:

1. closing the main switch.
2. starting the motor with the rotor starter.
3. short circuiting and lifting of the brushes.

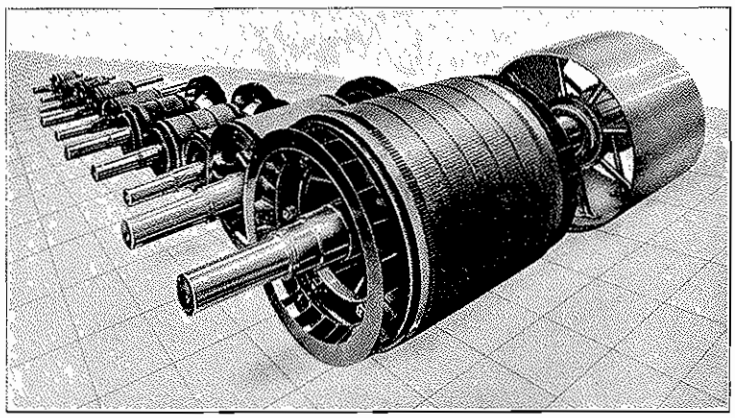


Fig. 12. Rotors of type S.K.A.-motors (3 to 200 B.H.P.)

With reference to the above described methods for starting an S.K.A.-motor, it is obvious that, whilst in the succession of manipulations of the slip ring motor an error is easily made, this is absolutely impossible with the S.K.A.-motor.

As already mentioned above, the S.K.A.-motor consists of a normal wound stator and a rotor with two squirrel cage windings of which the bars are embedded in the rotor slots, without insulation, and welded to copper end rings. Rotors for sizes from 3 BHP. to 200 BHP. motors are shown in fig. 12 and we may say that with the experience, which we have gained and our improved manufacturing methods this type of rotor, which forms one solid mass of material, is indestructible.

Heemaf S.K.A.-motors have been standardized for sizes up to 1500 BHP. and for L.T. as well as for H.T.

All motors of 5 BHP. and larger are normally provided with closed end brackets, having an opening at the bottom side. The windings are therefore completely protected and the motor although called „open" is really of the enclosed ventilated drip proof type.

The largest special squirrel cage motors built by the Heemaf Co. are those supplied to the Dutch State Mines, two of which have now been in operation for several months and for which two repeat orders each for two similar machines have been received. The first two machines were built for direct coupling to centrifugal pumps.

For this particular case a very high starting torque was not required, 40 % F.L.T. being spe-

Fig. 13. 150 B.H.P. S.K.A.-motor with direct connected centrifugal pump.

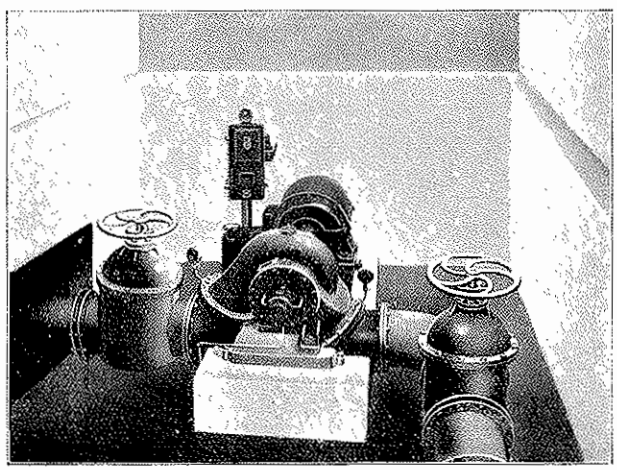
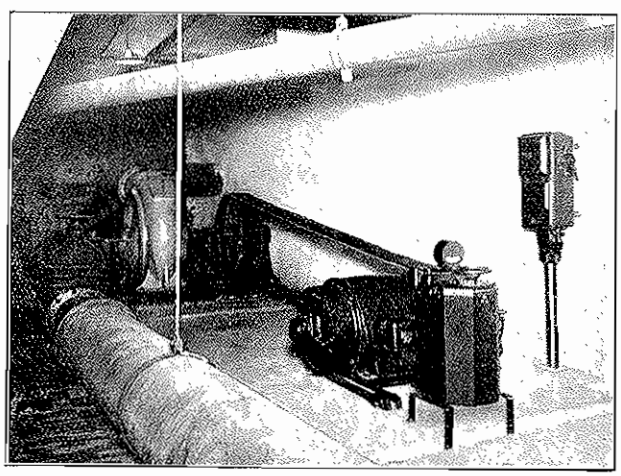


Fig. 14. 80 B.H.P. S.K.A.-motor driving centrifugal pump.



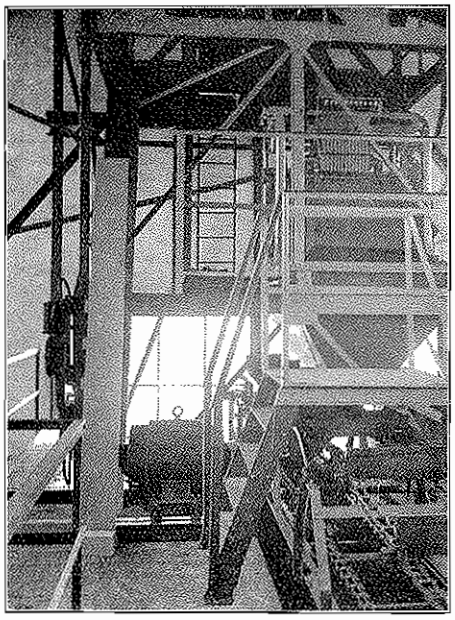


Fig. 15. 20 B.H.P. S.K.A.-motor driving coal conveyor.

cified with 170 % F.L. current. Tests carried out by the Mine Officials gave the following results.

Capacity of pumps	1320 gallons p. min.
Manometric head	1960 feet.
BHP. of motor	1300
Voltage	2000 volts, three-phase A.C. 50 per. p.s.
Synchr. speed	1500 r.p.m.
Efficiency	95.7 %
P.F.	0.9
Slip	1.2 %

Fig. 19. illustrates the two motors on the testbed at the Mines and clearly shows the rigid construction. The motors are enclosed ventilated, dripproof and provi-

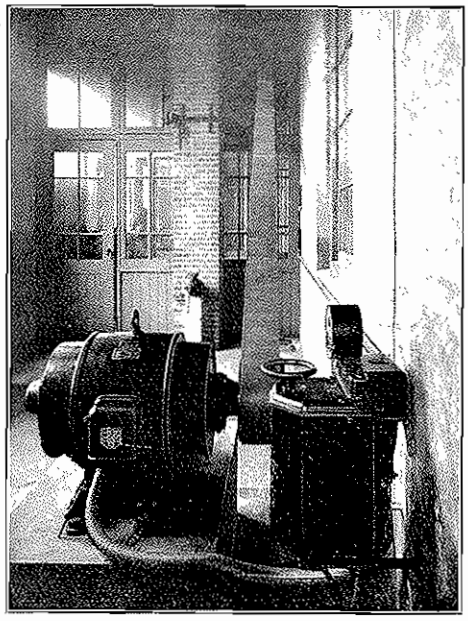


Fig. 16. 25 B.H.P. S.K.A.-motor driving line shaft.

ded with two pedestal bearings on common C.I. bedplate. For starting a H.T. type O.S.D. oil immersed starting controller was supplied.

On the first notch the starting current is 300 amps., on the 2nd notch 530 amp. decreasing to 200 amps.; on the 3rd notch 450 amps. decreasing to 150 amps. and on the 4th notch 300 amps. The current rush, as will be seen, never exceeds the full load current of 325 amps. Starting is effected without noise, vibration or mechanical shocks and on the 2nd notch nearly full load speed is attained in appr. 8 seconds. The design of the controller is such as to avoid the possibility of excess voltages when passing from one notch to the next.

Tests carried out in Holland and abroad with motors of various sizes and voltages have confirmed the favourable features, which we claim for this motor and the results we have obtained with these machines for various applications have *proved* that the S.K.A.-motor can be used in many cases where formerly only the slip ring motor could be applied.

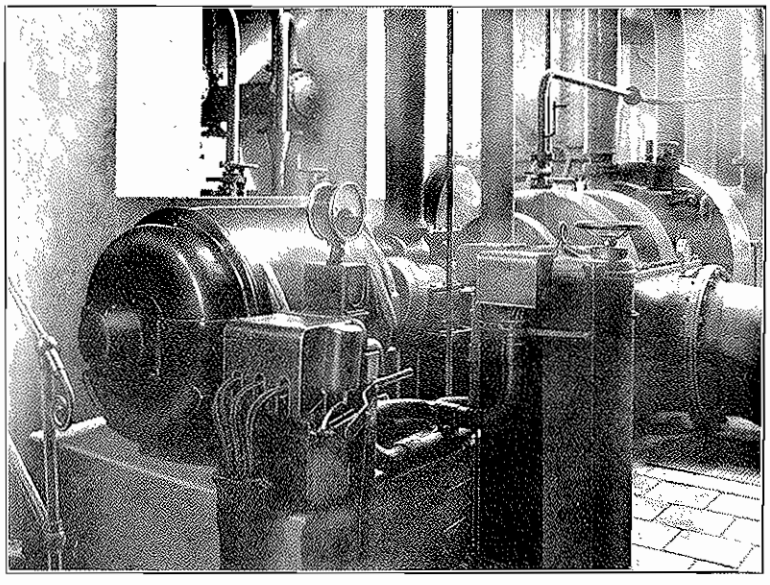


Fig. 17. 300 B.H.P. S.K.A.-motor driving condensor pump of 12000 K.V.A. turbo generator set.

The following figures in this article illustrate some of the many applications for which the S.K.A.-motor has proved its suitability, whilst the table below clearly shows the possibilities for the applications of the S.K.A.-motors.

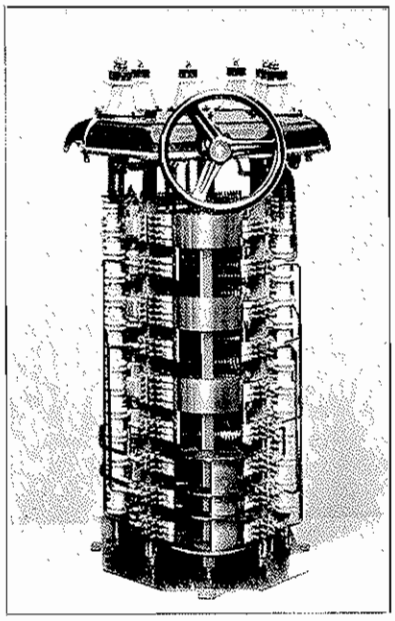


Fig. 18. High tension oil immersed starting controller type O.S.D. 1300 B.H.P. 2000 Volts.

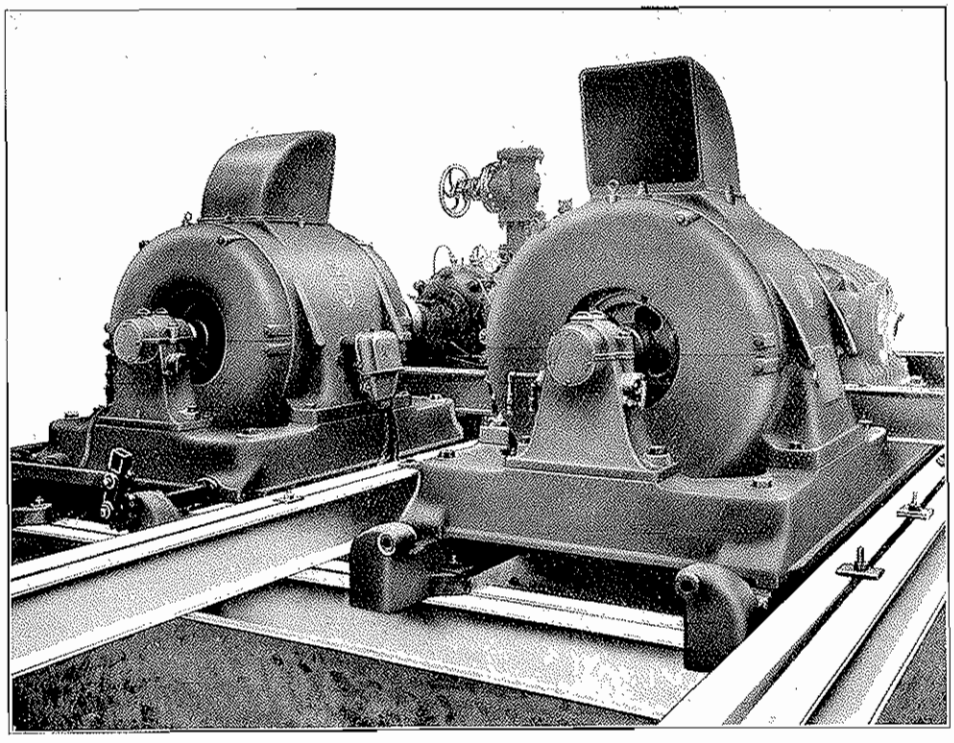
Goods lift	5 BHP.	380 volts.	1000 rpm.	
Coal conveyor	20 „	380 „	1000 „	
Fans in boiler plant	20 „	380 „	1000 „	
Transmission	25 „	220 „	1000 „	
Centrifugal pump belt driven	80 „	220 „	1000 „	
Centrifugal pump, direct coupled	150 „	220 „	1000 „	
Condensor pumping set for 12000 KVA. steam turbine	300 „	500 „	1000 „	
Tube mill drive	150 „	2000 „	600 „	for direct switching on the line.
Centrifugal pumps direct coupled	350 „	2000 „	1500 „	series parallel starting.
Centrifugal pumps	175 „	2200 „ 2 ph.	1000 „	
Centrifugal pumps	175 „	500 „	1500 „	star-delta starting.
Pumps	175 „	3150 „	1500 „	for direct switching on the line
Pumps	100 „	3150 „	1500 „	

It is of importance to mention the fact that the excellent results obtained with the S.K.A.-motor, have led us to develop our type V.D.-motor. This is a squirrel cage motor built for 2 or more speeds, the alteration in speed being obtained either by two separate stator windings wound for a different number of poles or by changing the grouping of the stator windings so that a different number of poles is formed, or by a combination of these two methods.

They are specially adapted for fan driving in boiler houses and similar cases where maximum duty is required under peak loads whilst at other times the output may be much smaller.

For these motors the S.K.A.-rotor is applied,

Fig. 19. Two special squirrel cage motors 1300 B.H.P. 2000 Volts 1500 r.p.m.



thus giving the same excellent results as regards starting torque and starting current as the S.K.A.-motor.

Conclusion.

The many advantages of the S.K.A.-motor can be summarized as follows:

1. High starting torque.
2. Low starting current.
3. Greater factor of safety than the slip ringmotor, owing to the small number of parts, and elimination of slip rings, brush-lifting- and short circuiting gear.
4. Cheaper than the slip ring motor.
5. Small weight and shipping dimensions.
6. No possibility of error, as only one starting operation is necessary.
7. Greater freedom in method of mounting.
8. Possibility of application of smaller motor, due to high starting torque.
9. Saving of energy during starting.
10. Quick starting.
11. Saving in first costs, erection costs and maintenance.
12. Owing to the very simple construction, this motor can be used for many applications, viz:

    a. For places were unskilled labour is employed.
    b. For places exposed to risk of explosions.
    c. For boiler rooms and other dusty places.

Automatic Motor Starters.

Automatic starters have been developed principally to avoid the necessity of leaving the

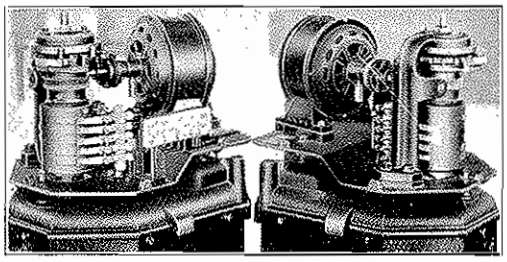


Fig. 20. Control mechanism and auxiliary motor mounted on top of type A.C. automatic oil immersed starting controller.

operation of valuable machinery in the hands of unskilled operators, with consequent danger of damage which always results in heavy expenses for repairs and delays.

Besides overcoming these difficulties, automatic control gear has to a great extent simplified the electric drive in those cases where the motors are required to start or to stop frequently, according to the pressure of air, water, etc. or by the travel of hydraulic accumulators, cranes, lifts, etc.

Generally speaking this type of starter is applied to start a motor under the following conditions:

1. For starting and stopping a motor from a distance. This can be done by means of a switch or push buttons.
2. For motor driven pumps feeding a tank. In this case the starter is controlled by a float switch of which the opening and closing is effected by a float and floatgear.
3. For electrically driven compressors. The starter is controlled by a switch, which is operated by the pressure of air.

The Heemaf type A.C. automatic oil immersed motor starter consists of a normal drum type oil immersed starter, on the cover of which the control mechanism, including auxiliary motor is mounted. (Fig. 20).

The starter may be the type O.C. for slip ring motors, or the type O.S.D. which has been spe-

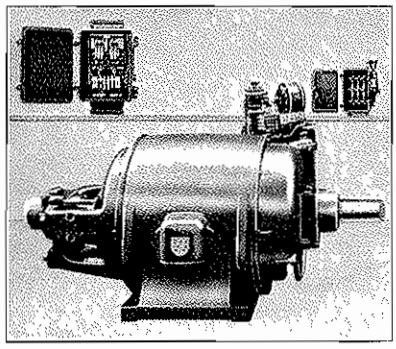


Fig. 21. 65 B.H.P. slipringmotor with automatic starter, magnetic- and limit switch for hydraulic accumulator plant.

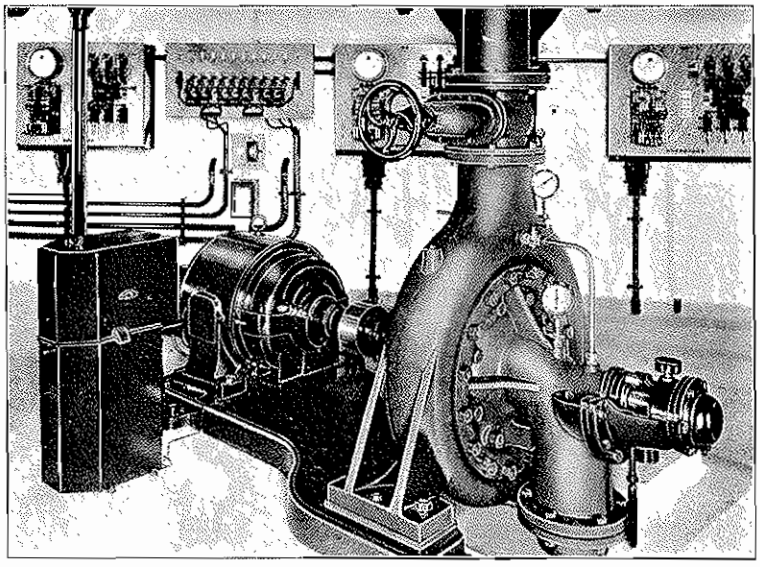


Fig. 22. Automatically controlled electric driven pump.

cially designed for our type „S.K.A." high torque squirrel cage motors, of which particulars are given elsewhere in this number.

Both types have the appearance as shown in fig. 22. The complete equipment for an automatically driven motor consists of:

1. main motor.
2. automatic starter.
3. magnetic switch.
4. auxiliary switch (floatswitch, air pressure switch, etc. with accessories), and
5. main switch (optional).

Fig. 21 shows a threephase A.C. slip ring motor of 65 BHP. 550 volts, 50 periods 500 r.p.m. synchronous speed, with automatic starter, magnetic switch and limit switch for a hydraulic accumulator plant in a steel works in Engeland, while fig. 22 and 23 represent an automatic pumping station.

The principle of operation for slip ring motors is as follows:

As soon as the auxiliary switch is closed, the magnetic switch is energized and connects the stator terminals of the main- and auxiliary motors to the supply. The auxiliary motor, running in one direction, gradually cuts out the starting resistance, thus bringing the main motor up to speed and automatically stops as soon as the end position has been reached. When the auxiliary switch is opened the main motor is stopped; the auxiliary motor is however automatically started again, but now runs in the opposite direction and stops when the starting position is reached.

Due to the fact, that the coil of the magnetic switch is connected across two of the supply mains, a no-voltage protection is therefore provided. At the same time the connections are arranged in such a way, that it is impossible to close the magnetic switch, unless the starting resistance has been put in circuit, i.e. unless the starter has been set in the starting position. By installing a main switch with fuses or overload coils, the plant is completely protected against overloads, as well as against no-voltage.

The apparatus required for an automatically started motor, driving a pump to feed a tank, is shown in fig. 24.

Due to the many automatically operated motors,

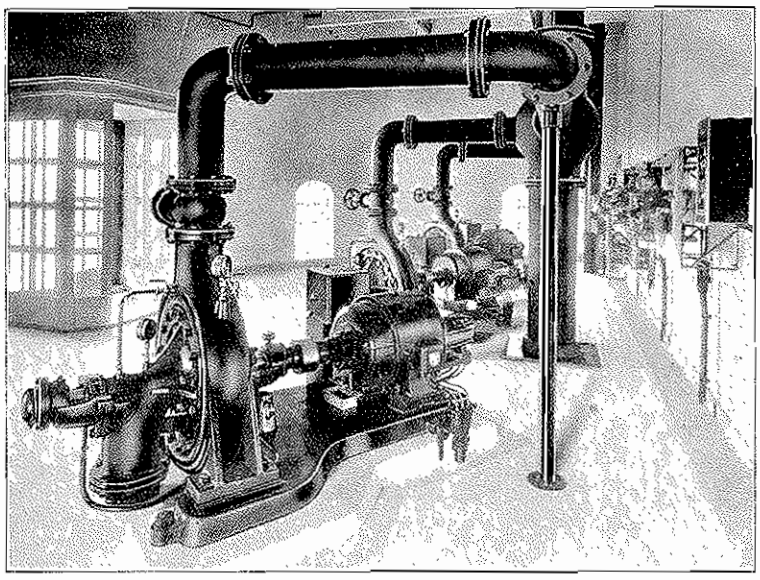


Fig. 23. Pumping station consisting of 3 electric driven pumps with automatic starting gear.

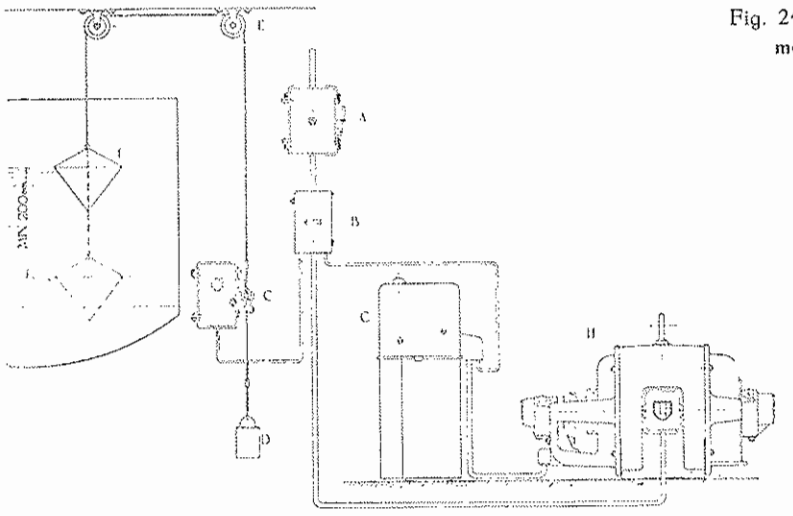


Fig. 24. Apparatus for an automatically started motor driving a pump for tank feeding.

a. main switch.
b. magnetic switch.
c. float switch.
d. counter weight.
e. idler pulley.
f. float.
g. automatic controller.
h. pump motor.

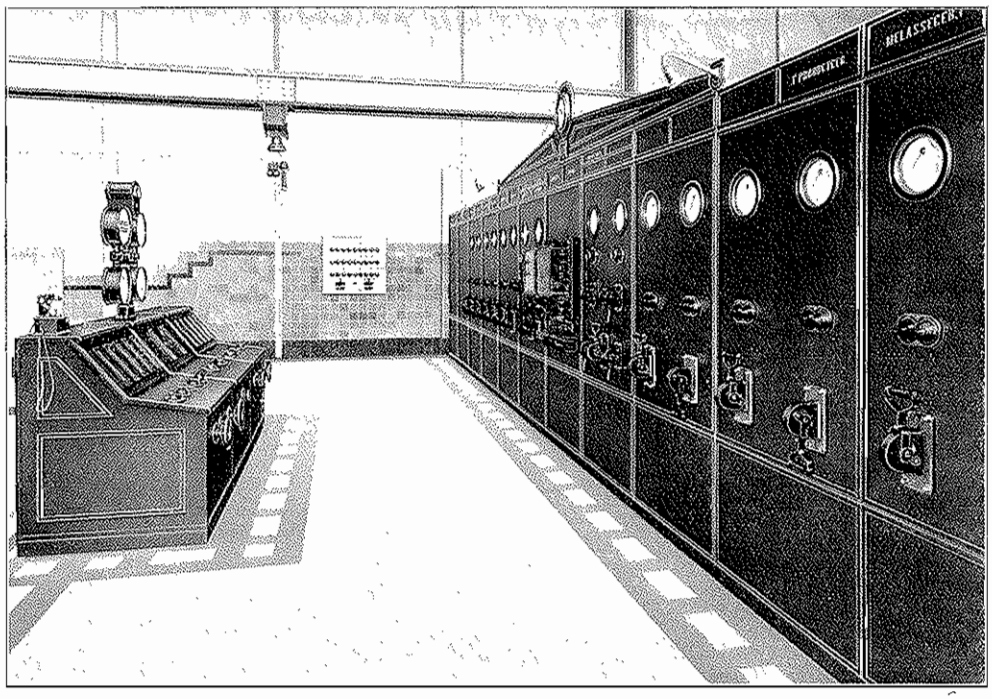
which the Heemaf Co. has supplied for different purposes we have gained a considerable experience in this type of gear which is at the service of our customers.

Switchboards.

The Heemaf Co. has a special department entirely devoted to the manufacture of switchboards, the majority of which are built of standardized parts, so that quick deliveries can be made. Particular attention is paid to the choice and arrangement of apparatus and instruments, in order to combine a pleasing appearance of the board with facility in operation and safety.

Where formerly marble and slate were almost exclusively used for the panels, due to the fact that current carrying parts were mounted also on the front of the board, present day practice has

Fig. 25. Standard switchboard and switchdesk.



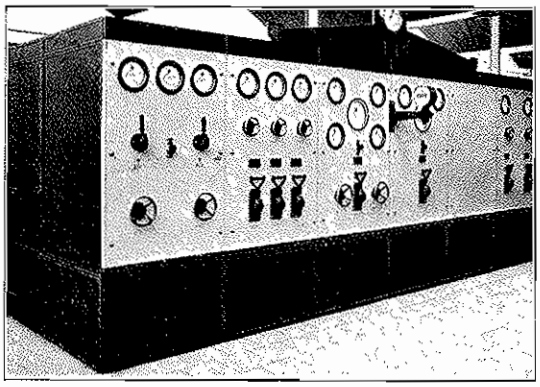


Fig. 26. Switchboard with marble panels.

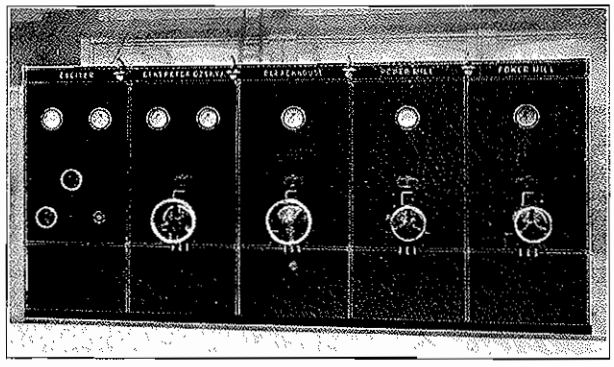


Fig 27. Switchboard with sheet steel panels.

now practically replaced these by panels of specially rolled sheet steel. This is due to the fact that switches and automatic devices, are invariably mounted at the back of the board and operated from the front.

This arrangement has many advantages as it keeps live parts from the front of the panels, thus providing a greater safety to the switchboard attendant, while at the same time it permits the rear connections to be considerably simplified.

When using the flush type instruments with nickel plated edges, this design, together with the dull black colour of the panels furnishes a very neat appearance.

The ever increasing turnover in switchboards and ironclad switchboards shipped abroad must without doubt be attributed to the facts that our export methods are appreciated and that we are able to comply with the requirements and regulations ruling in the different countries to which we have supplied our manufactures.

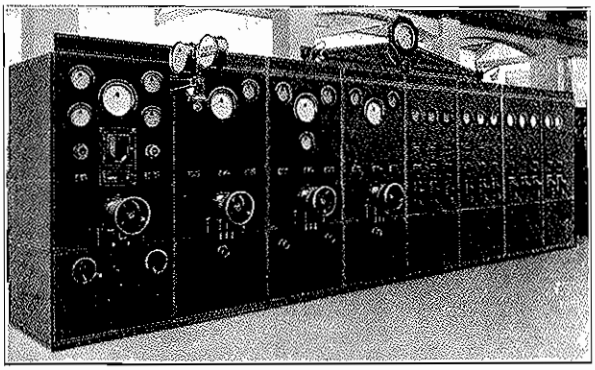


Fig. 28. Switchboard for a sugar mill on Java (D.E.I.) Heemaf automatic voltage regulator on first panel at left hand side.

In the first place great care is exercised in the proper lay out of the switchboards and further all parts are continuously inspected during manufacture as well as during erection and assembly. If necessary to meet shipping requirements, special designs are made. In all cases the switchboards are completely assembled and tested in our works and totally dismantled before shipment. In order to facilitate erection on site, for which often only unskilled labour is available, every part, including framework,

Fig 29. Switchboard for the „Royal Dutch".

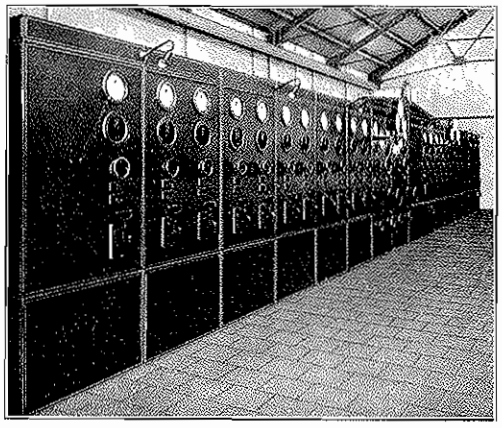
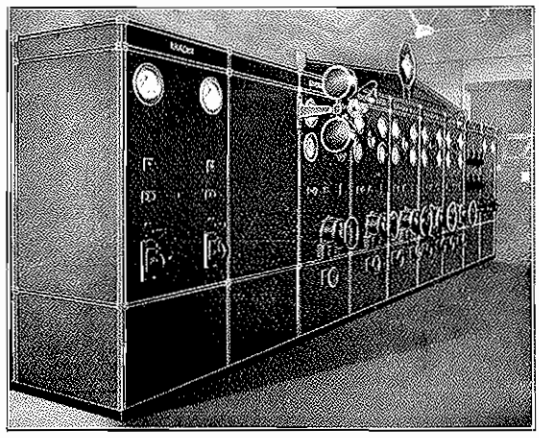


Fig. 30. Switchboard for a sugar mill on Java (D.E.I.)



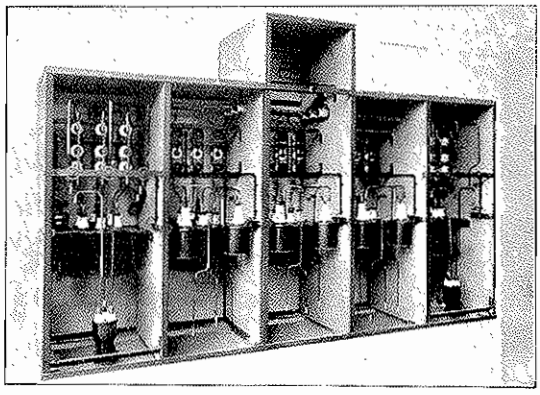


Fig. 31. Rear view of H.T. cubicles of fig. 32 during erection. The Heemaf oil switches are operated by handwheels, mounted on the front side of the cubicles.

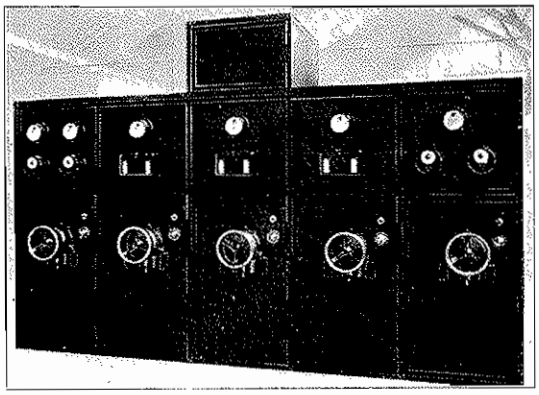


Fig. 32. H.T. cubicles for the control of incoming feeders and motors.

panels and apparatus is carefully marked by painting plainly visible white letters and figures or by attaching small brass marking plates with stenciled numbers on same. A complete set of photo's of front and rear-view of the board, clearly shows the markings as well as the wiring of the board, which together with the necessary erection drawings and diagrams of connections provided, enables the assembling on site without any difficulty.

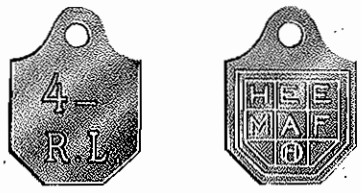


Fig. 33. Brassplates for marking the switchboard details to facilitate re-erection on site.

The figures in this publication are mainly intended to show our readers the variety of types, which we can supply and to illustrate the above description of practice, workmanship and design of this class of work.

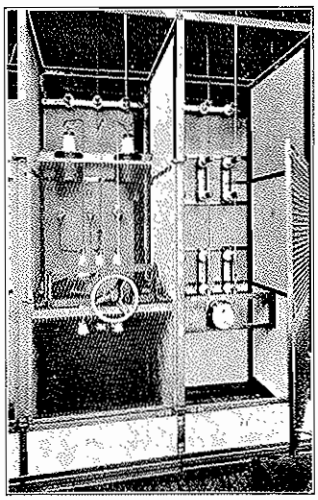


Fig. 34. Rear view of H. T. cubicles. Round copper connections and our concentric connectors are used throughout.

Switchboards as described above are most suitable for use in engine rooms and power stations, and it is our opinion that in factories and works at all points of distribution or centralisation the unit type ironclad switchboard should be used. A complete line of ironclad switchgear, including switch- and fuseboxes, automatic circuit breakers, bus-bar boxes etc. is manufactured by the Heemaf Co., which can be used to build up low tension ironclad switchboards to every specification and of every normal size.

The individual units bolted together form one complete board, which is capable of *unlimited* extension. The whole is arranged for mounting on an angle iron frame. The fuse-, switch- and distribution-boxes can either be mounted above or below the bus-bar box units, depending on the particular local requirements.

Each bus-bar box unit contains the necessary bus-bars, which are provided with end-clips to prevent the rails from shifting their position. Branch terminals for making the connections between fuse and switch boxes are also supplied with each unit.

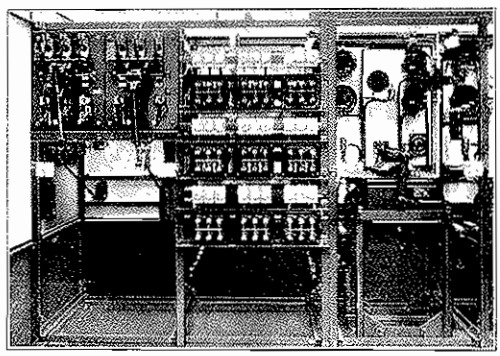


Fig. 35. Rear view of part of a switchboard in a sugar mill on Java.

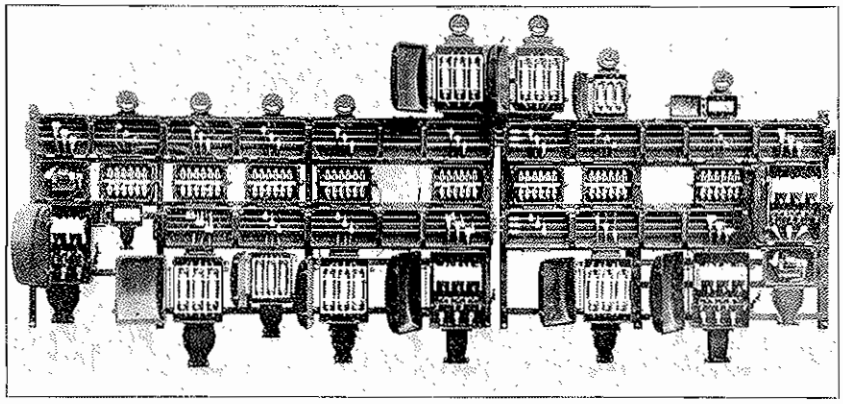


Fig. 36. Ironclad switchboard with cover removed.

for incoming and outgoing feeders, together with terminal boxes for the cables are mounted on a steel framing. The cubicle is closed by means of hinged doors and is efficiently ventilated.

All instruments and apparatus, used with our switchboards and cubicles are made by the Heemaf Co. unless otherwise specified by customers.

In case it is stipulated that the main feeder should be disconnected from the switchboard, and where the current exceeds 350 Amps., medium tension oil switches should be used.

For currents not exceeding 350 Amps. on circuits of max. 550 Volts, ironclad air break circuit breakers can be applied.

When required voltmeters, ammeters, or watthour meters and other instruments with or without current or potential transformers may be supplied for mounting on the switch- or fuse boxes.

The accompanying illustrations represent some of the boards recently supplied and as will be readily seen this type is particularly adapted for locations where a substantial type of apparatus is required, due to surrounding conditions, as in factories mines, boilerhouses etc.

Fig. 38 is representing our normal L.T. distribution kiosk which is specially suitable for mounting in the open. They are of rigid design and fuses

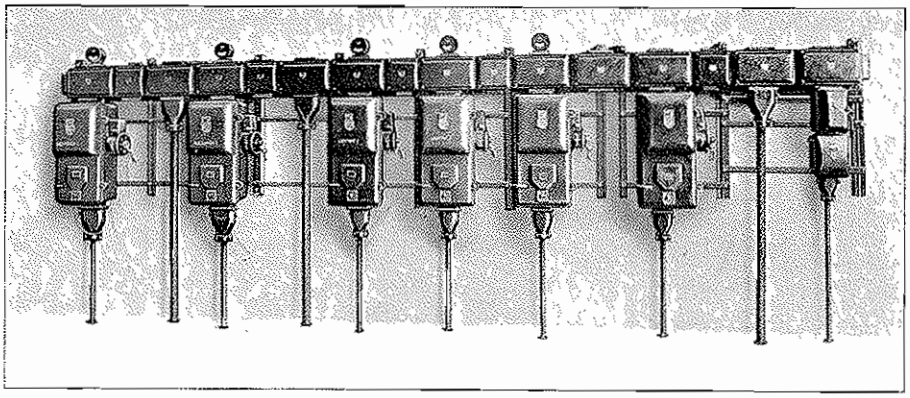


Fig. 37. Ironclad switchboard.

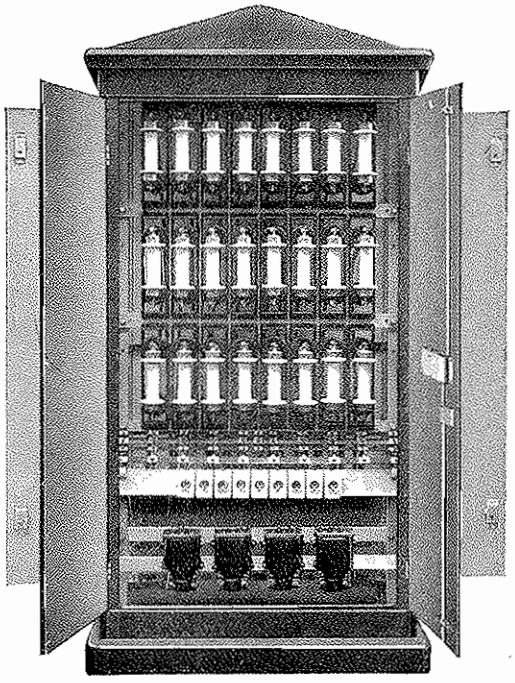


Fig. 38. L. T. distribution kiosk.

Electric motors for tube mill drive.

The tube mill, as is well known, consists of a rotating cylinder, partially filled with a grinding medium, such as C.I. balls, flint pebbles etc. and the material to be ground. With individual motor drive, a fairly high torque is required in starting to overcome the static friction and to accelerate the mill to its proper speed; usually 150 % to 175 % normal torque at starting is considered necessary to guarantee satisfactory operation of the plant. When taking into consideration that motors for this class of work are mostly placed in dusty rooms, that they are subjected to severe mechanical and electrical stresses, and that they mostly operate for months and months with little time allowed for overhauling or repairs, it is obvious that only thorough familiarity with the actual conditions enables the manufacturer to build a machine, which will meet these rigid requirements. The Heemaf Co. has made an extensive study of motors for tube mill drive and many of them are in use on gold mines, cement works and other industries in various countries all over the world.

Some of the motors recently supplied, are described hereunder as we assume that our readers will be interested to know the characteristics of this kind of motor.

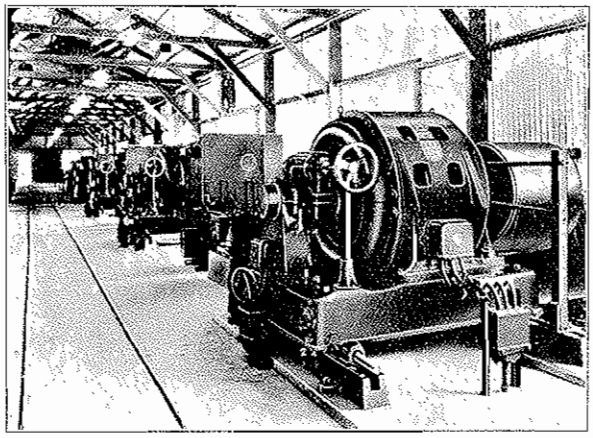


Fig. 39. 5 of an order on 12 slipringmotors 250 B.H.P. 2000 Volts 500 r.p.m. for tube mill drive.

Fig. 39 shows 5 of an order of 12 threephase A.C. motors, each of 250 B.H.P. 2000 volts, 50 per. p. sec. 500 r.p.m. synchronous speed, supplied for tube mill drive in a gold mine and for a cement works. The motors as will be readily seen from fig. 40 and 41 are of rigid design. They are of the slip ring type, provided with short circuiting- and brush-lifting device, and with three pedestal bearings on a common C.I. bedplate.

Fig. 44 shows the stator of one of the 250 B.H.P. motors, in course of winding, while fig. 43 shows part of our winding shop, where the motors of this order, which also included 9 slip ring motors of 50 B.H.P. 2000 volts, 600 rpm., were wound.

The tests carried out at these motors gave the following data at full load:

efficiency	93.5 %
Cos. φ	0.83
slip	1.7 %

All motors, except two, were shipped assem-

Fig. 40. 250 B.H.P. tube mill motor.

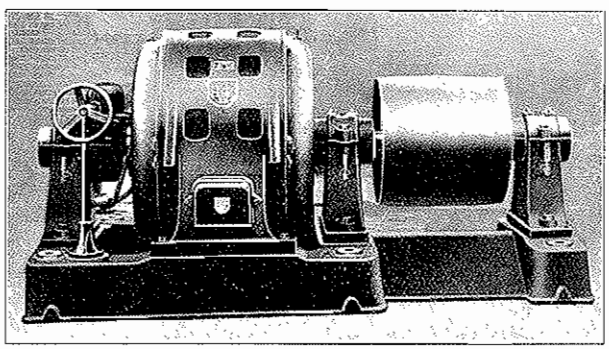
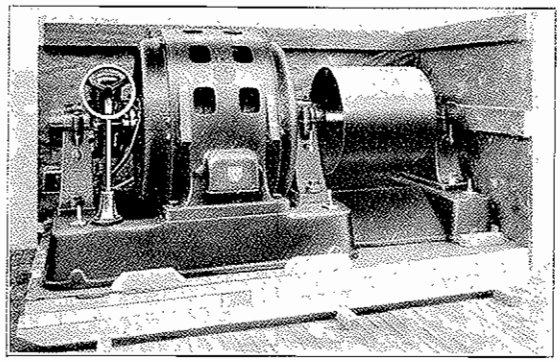


Fig. 41. Packing case for 250 B.H.P. tube mill motor.



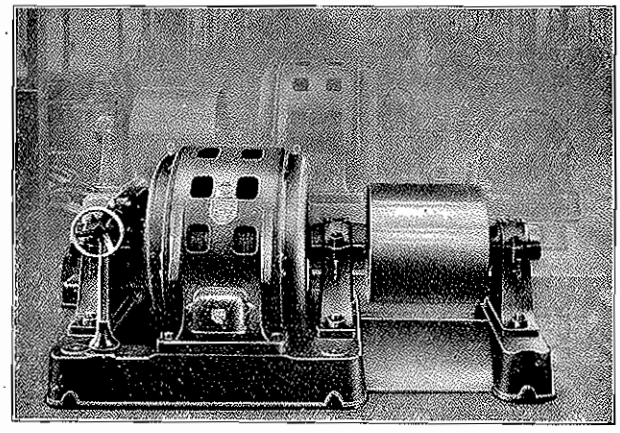


Fig. 42. 250 B.H.P. tube mill motors ready for shipment and on the test floor.

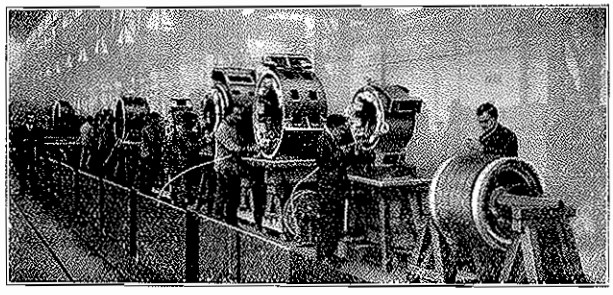


Fig. 43. Part of winding shop for large size motors.

bled, each in a strong wooden case as shown in fig. 41 and could be erected and put into service on site immediately after having arrived at their destination. The nett weight of these motors was 4380 Kg. or 9600 lbs. Reports, since received, show that they are giving full satisfaction complying with all the requirements.

Fig. 47 represents a slow speed type of tube mill motor for driving a Krupp tube mill, which, as specified, required 160 % to 200 % full load torque at starting. This motor is a three-phase A.C. motor of the slip ring type with short circuiting and brush lifting gear, two pedestals on common bedplate and free endshaft for direct coupling to tube mill gearing. The continuous output at 184 r.p.m. full load speed is 350 B.H.P. 220/380 or 440/760 volts, 50 periods, line voltage, momentary overload capacity without undue heating 850 BHP.

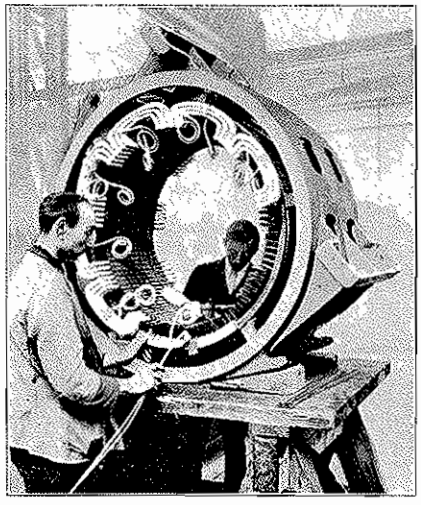


Fig. 44. Partly wound stator of 250 B.H.P. slipringmotor.

Efficiency and P.F. as determined from tests at various loads are as follows:

Load	$^5/_4$	$^4/_4$	$^3/_4$	$^1/_2$
Eff. %	95.5	93	93	91.5
Cos. φ	0.85	0.83	0.79	0.70

The total nett weight of this machine was 7350 Kg. or 16160 lbs.

The rigid construction guarantees the suitability of this type for its special duty.

Figs. 45 and 46 show a 150 B.H.P. and a 200

Fig. 45. 150 B.H.P. slipringmotor in a cement works.

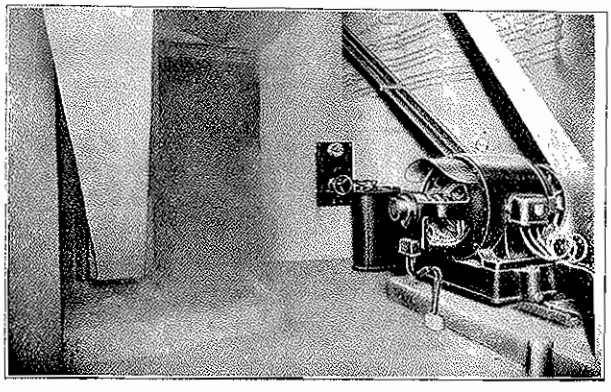
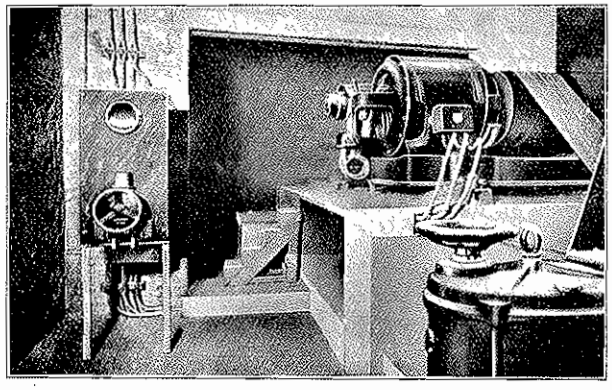


Fig. 46. 200 B.H.P. slipringmotor in a cement works.



B.H.P. threephase A.C. slip ring motor installed in a cement works and many repeat orders, received since the delivery of these machines, indicate that they are giving every satisfaction.

Generally speaking tube mills require from 100 to 400 BHP. which sizes have been thoroughly standardized by the Heemaf Co.

This Company is therefore prepared to undertake the complete electrification of tube mill plants.

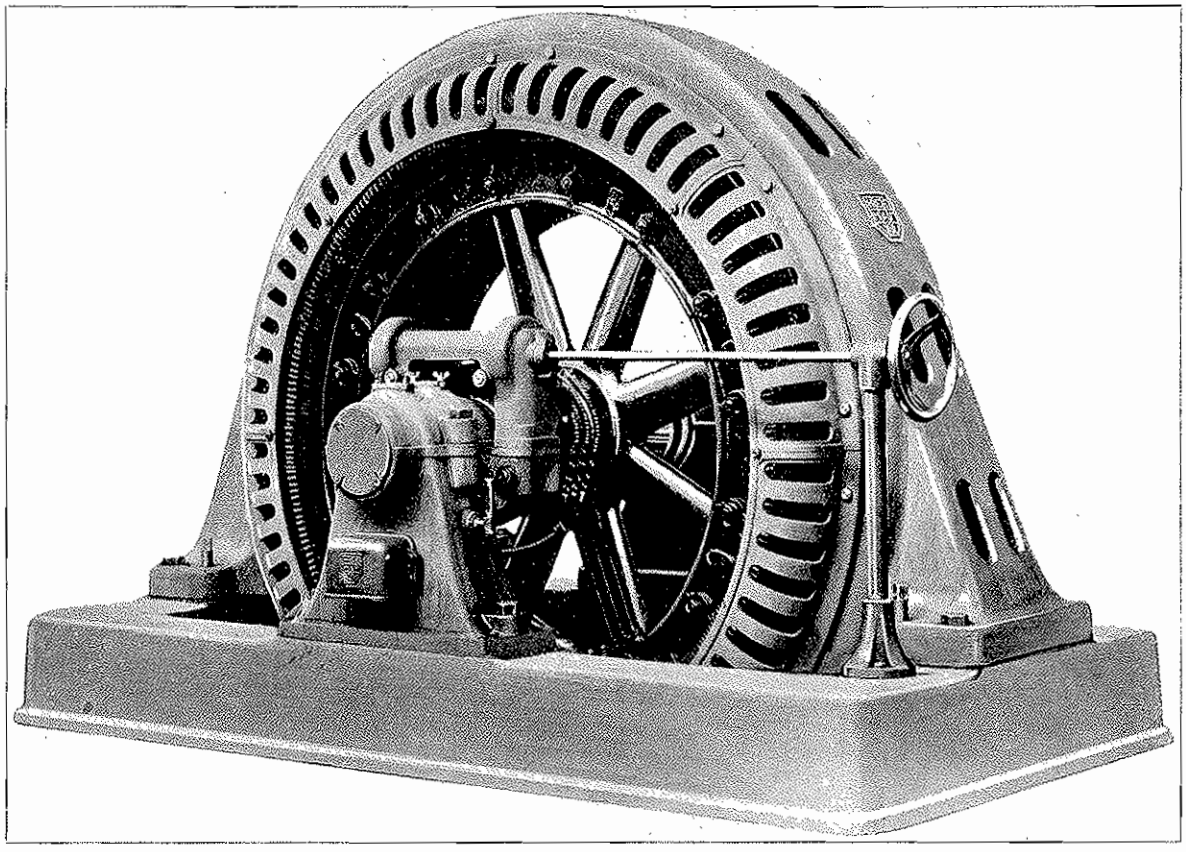


Fig. 47. Tube mill motor 350 B.H.P. 440 Volts. 187 r.p.m.

The Protection of Threephase A.C. Motors.

The object of the following lines is to describe some further developments in our starting controllers for slipring- and squirrelcage type motors, in connection with the protection of the machines against overload and novoltage.

For this purpose the starting controllers type O.C. (for slip ring motors) and type O.S.D. (for our special squirrel cage motors, type S.K.A.) can be provided with novolt and overload releases.

Overload protection is required to prevent a motor being overloaded during both starting and running periods.

No-volt protection is used for automatically disconnecting the motor from the line, in case the supply voltage should fall below a predetermined value.

With our starting controllers the arrangement is such that, in case of overload or failure of voltage, the motor is disconnected from the line, whilst the handle of the controller is left in the „on" position. An interlock is however provided to ensure that the motor can not be started untill the handle has first been moved into the „off" position.

Fig. 48 shows our type O.C. starting controllers fitted with overload- and novolt protection. The overload coils, which include a time lag device, are mounted in a cast iron box mounted

on the back of the controller, while the no-volt coil is fitted inside to the cover.

Where a motor is protected by a separate circuitbreaker, with automatic features, a non-automatic rotorstarter may be used. Heemaf

Fig. 49. Wiring diagram for special no-volt protection of a group of slipring motors (Dutch patent no. 6271).

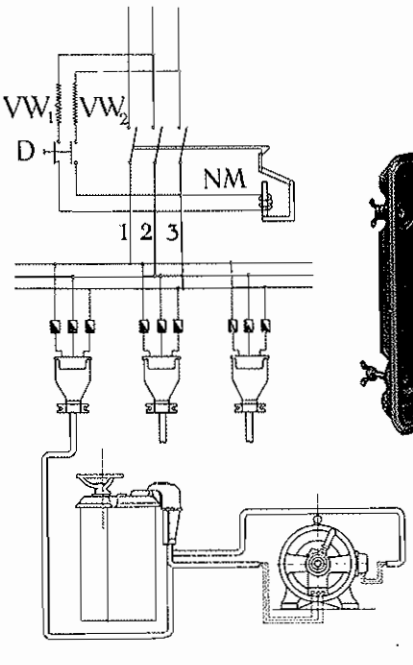


Fig. 48. Controller fitted with overload- and no-volt protection.

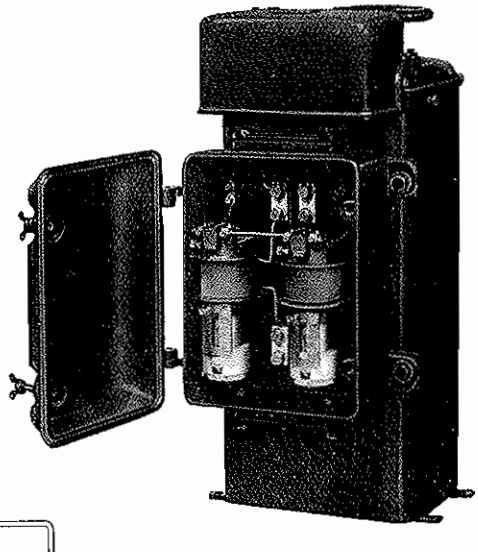
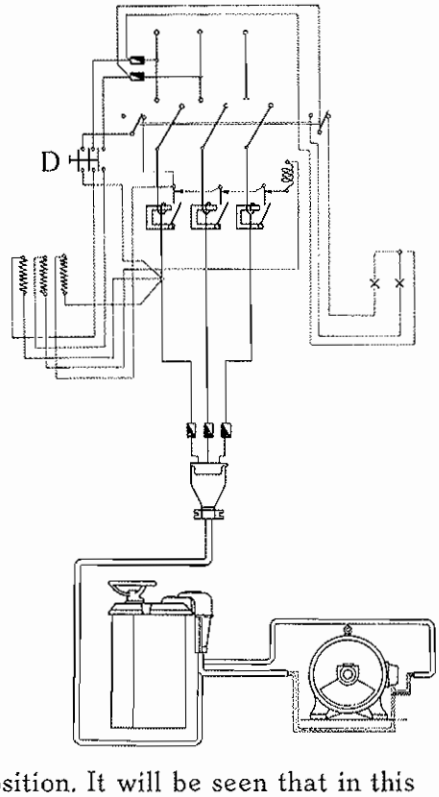


Fig. 50. Wiring diagram for special no-volt protection of a special squirrel cage (type S.K.A.) motor.



circuitbreakers can be provided with an interlocking device, which makes it impossible to start the motor, in case the circuitbreaker has tripped, without first bringing the starter handle to the „off" position, and thus inserting the total starting resistance into the circuit. To this end the no-volt coil is connected in such a manner that the circuitbreaker can not be closed unless the coil is first energized. This is effected by a push button, which can be released as soon as the breaker is in the closed position.

Fig. 49 shows the diagram of connections for the protection of one motor or of a group of slip ring motors. The controller should be fitted with a stator switch thus disconnecting the motor in the „off" position of the starter.

When pressing the push button D. the novolt coil is energized unless the controller of one of the motors of a group is still in the „on" or an intermediate position. It will be seen that in this case the no-volt coil NM is short-circuited by two of the stator phases (see Fig. 51), and consequently is not magnetized, thus making it impossible to close the circuit breaker.

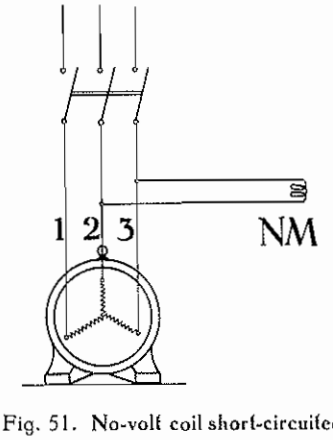


Fig. 51. No-volt coil short-circuited by stator phases of motor, thus preventing to close the circuit breaker.

The connections for our type S.K.A.-motors, with non-automatic type O.S.D. controller, are illustrated in Fig. 50, and *it should be noted that neither with slip ring motors, nor with squirrelcage motors, auxiliary wiring is required.*

Fig. 52 is showing the 350 amps. 550 Volts type of ironclad circuit breaker, with cover removed; the

push button is clearly indicated at Fig. 53 at the bottom of the door. This device of preventing the breaker being closed unless all the apparatus in the circuit are disconnected from the supply (Dutch patent Nr. 6271) can be furnished with all Heemaf circuit breakers and offers many possibilities and advantages. The question which of the above methods of protection should be applied, depends upon so many conditions, that it is not possible to make a general rule and of course the price is also to be considered. The Heemaf Company is prepared upon request to give their advice for individual installations.

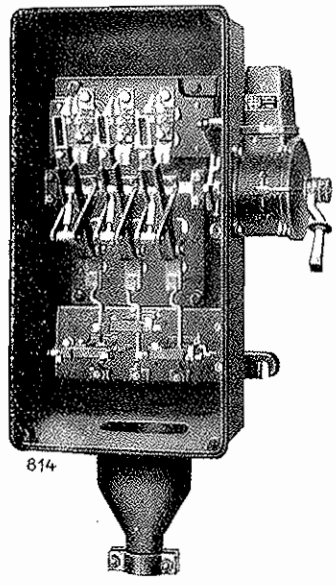


Fig. 52. C.I. switchbox type S.K.N. with overload and no-volt releases (cover removed).

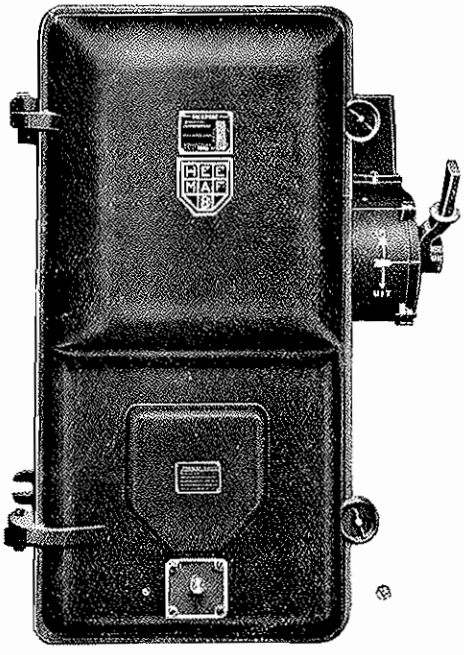


Fig. 53. C.I. switchbox type S.K.N. with overload and central no-volt protection. (Dutch patent 6271) Push button is shown at the bottom side of the cover.

Heemaf High Tension Rectifiers.

As is well known, for the testing of distributing systems of any extent, the use of alternating current is practically impossible owing to capacity effect, so that to carry out extra high tension tests involves the provision of heavy and costly apparatus which is difficult to handle and expensive to provide, and where cable manufacturers, supply authorities, consulting engineers, insulator and switchgearmakers, railway companies desire to make these tests, they have often to consider very seriously the initial outlay on the apparatus.

The Heemaf Company have therefore produced a Rectifier to overcome the foregoing objections, which has been specially designed for the testing of high tension distributing mains, cables, overhead equipment, switch- gear insulators and any other purpose where the use of high tension direct current may be applicable, and enables these tests to be made without any inconvenience or delay.

The rectifier consists of a high tension valve connected to one of the ends of the high tension

winding of a potentialtransformer, and to earth. The line to be tested is connected to the other end of the high tension winding.

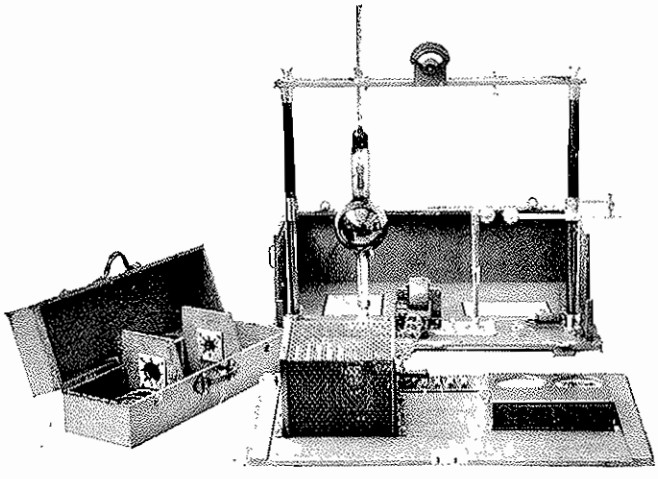


Fig. 54. H.T. Rectifier ready for use without Potential Transformer.

The value of the D.C. Voltage depends on the high tension A.C.pressure of the potential transformer as shown in the table below.

4250	Volts	A.C.	will	give	a	max.	of	ca.	6000	Volts	D.C.
7000	"	"	"	"	"	"	"	"	10000	"	"
14000	"	"	"	"	"	"	"	"	20000	"	"
35000	"	"	"	"	"	"	"	"	50000	"	"
57000	"	"	"	"	"	"	"	"	80000	"	"
70000	"	"	"	"	"	"	"	"	100000	"	"

D.C. voltages lower than the above max. values can be obtained by means of an adjustable resistance at the low tension side of the potential transformer to which a Voltmeter is connected to show the voltage applied. The D.C. voltage can be measured by means of an adjustable spark micrometer.

Fig. 54 shows the general arrangement of the apparatus when ready for use, (the potential transformer is not shown), the low tension side of which is connected up through the adjustable resistance to the instruments in circuit, whilst the high tension is connected through the valve and high tension milliammeter, the high potential being insulated with micanite rod supports. The small transformer shown energises the filament of the valve and is connected across the line.

Fig. 55 shows the apparatus dismantled for transit, and the wooden box into which the whole apparatus can be packed. The bulb is packed in a separate box as shown on the left.

The Heemaf Rectifier has a number of outstanding features. Should a cable or other apparatus break down under test, the rectifier is not damaged as the saturating current fully protects the valve, which is able to withstand a maximum A.C. voltage of 100.000 volts when cold between filament and plate. The small filament transformer will also stand a voltage of 2000 Volts between primary and secondary and between primary and iron core. The filament current is alternating so that it is not necessary to arrange for any direct current supply.

In most instances it will be possible to burn down the insulation to such a low resistance

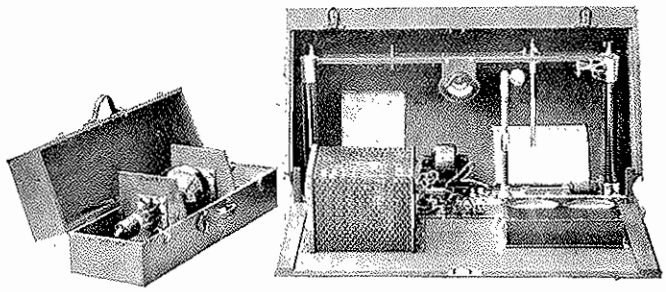


Fig. 55. H.T. Rectifier showing the apparatus as it is packed into the wooden boxes.

between cores or core and earth, that the fault can be localized with ordinary instruments.

The rectifier itself complete with its transformer weighs 88 lbs., so that it can be easily handled by two men.

SOME HEEMAF PRODUCTS:

A.C. and D.C. Motors and Generators.

Starters and Regulators.

Automatic Controllers.

Textile Motors.

Low Tension Switchgear.

Instruments.

Instrument Transformers.

High Tension Switchgear.

Oil Circuit Breakers.

High Tension Rectifiers.

Protective Gear.

Rectifiers.

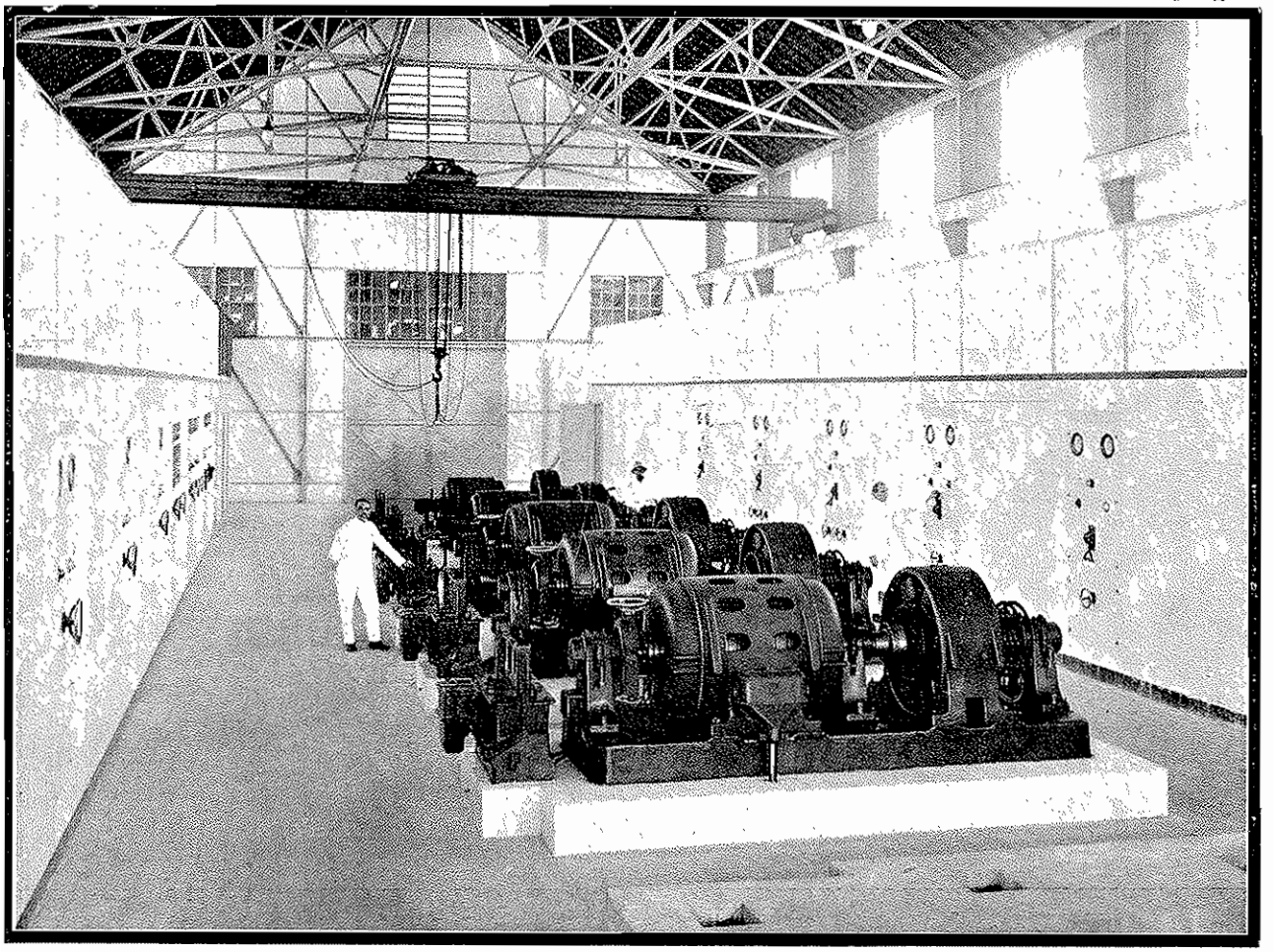
Arc Welding Plants.

Complete Crane and

Lift Equipments.

Bowl Fires.

HEEMAF MOTOR-GENERATORS.



SUB-STATION AT SOERABAYA (D.E.I.)

3 MOTOR-GENERATOR SETS 216 K.W. 980 r.p.m.

A.C. 6000 VOLTS, 50 CYCLES
- D.C. 230-360 VOLTS -

2 MOTOR-GENERATOR SETS 144 K.W. 980 r.p.m.

A.C. 220 VOLTS, 50 CYCLES
- - D.C. 5-360 VOLTS - -

HEE
MAF

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