hardware manual

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RC 4000 AC Power System

Keyword : RC 4000 / AC Power System

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RC 4000 AC POWER SYSTEM

Interconnection Plans

KEY: AC Power System.

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1. INTRODUCTION

This paper describes the interconnection between the different AC Power Units in the RC 4000 AC Power System. Under normal circumstances the AC Power System includes a motor generator, and the interconnection plans are then given in section 2.1. In some special cases the motor generator has been omitted, and the interconnection plans are then given in section 2.2.

2. BLOCK DIAGRAMS AND WIRING DIAGRAMS

2.1. AC Power System including Motor Generator.

The AC Power System consists of four units and two ground rods. The four units are the below mentioned,

MGU 401: Motor Generator Unit.
DTU 401: Disk Transformer Unit.
GCP 401: Generator Control Panel.
MDP 401: Main Distribution Panel.

The MDP 401 is placed in the computerroom, while the other units are placed outside this room. A block diagram of the system is given on Fig. 2.1.1., and Fig. 2.1.2. shows the corresponding wiring diagram.

2.2. AC Power System without Motor Generator.

In this case the AC Power System consists of only two units and one ground rod. The units are MDP 401 and MDP 405. The MDP 405 is a cabinet for the Disk Transformer Unit DTU 401.

A block diagram of the system is given on Fig. 2.2.1., and the corresponding wiring diagram is given on Fig. 2.2.2.

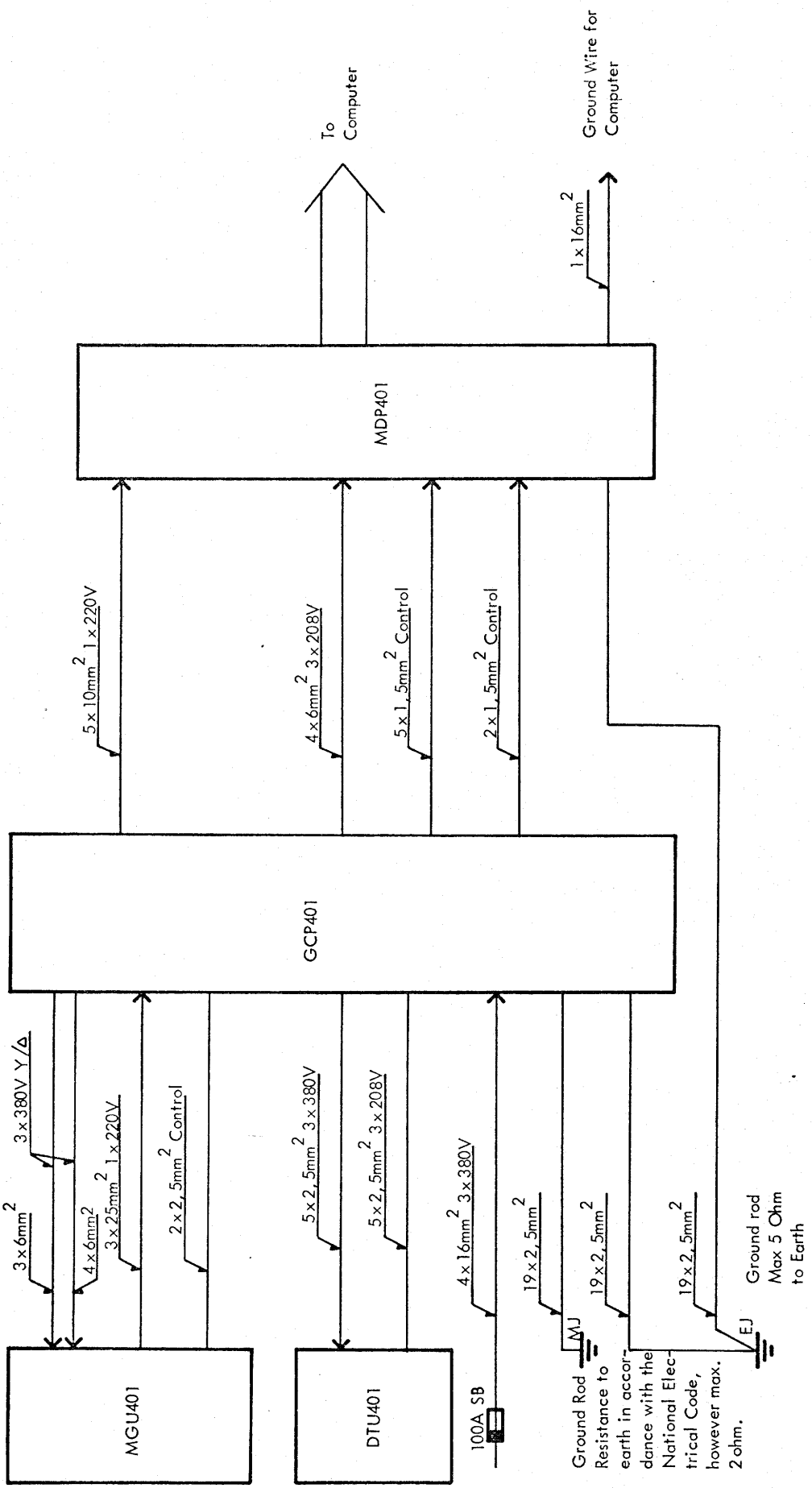

Fig. 2.1.1.

AC Power System including motor generator

Block Diagram

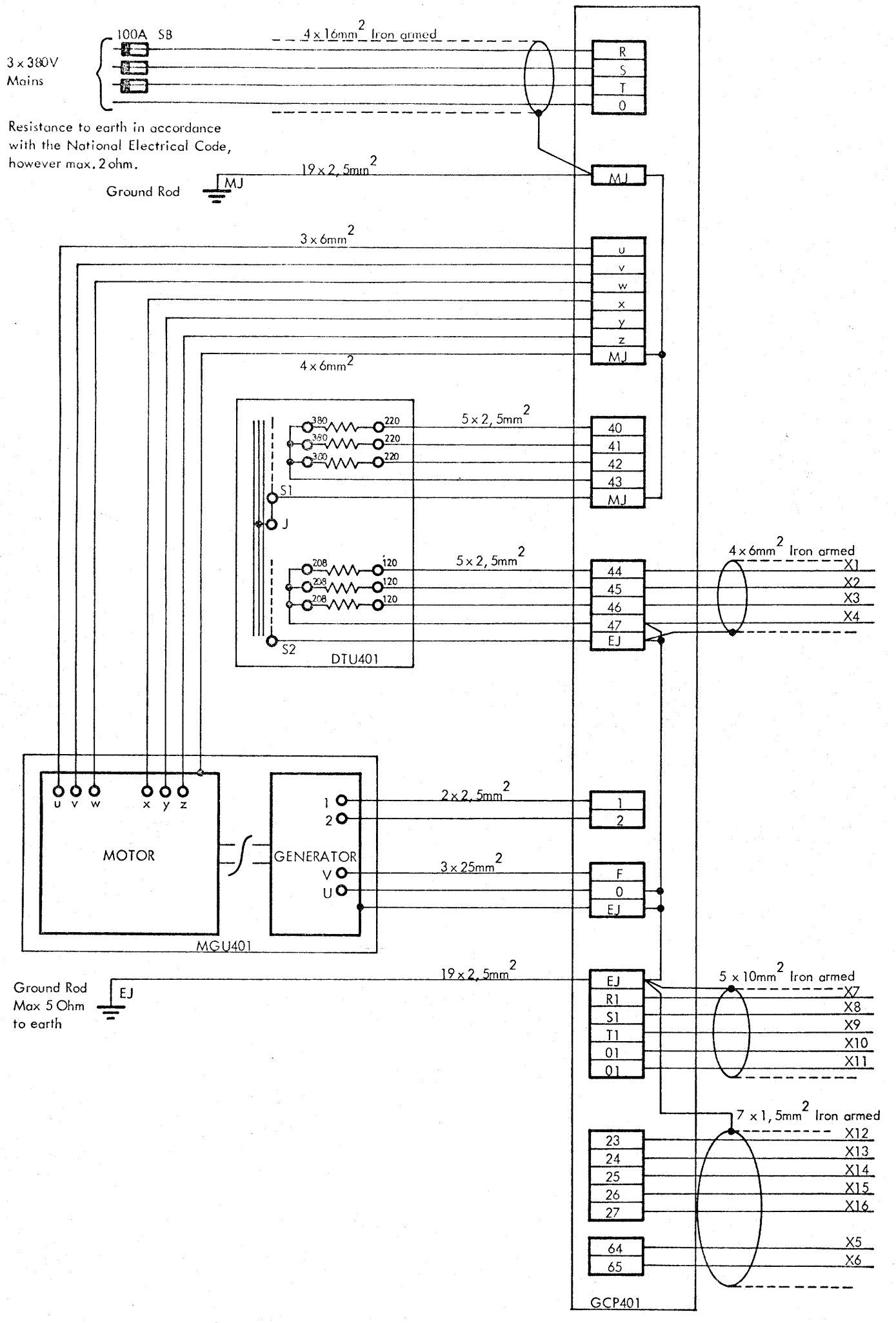

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Fig. 2.1.2. AC Power System including motor generator Wiring Diagram.

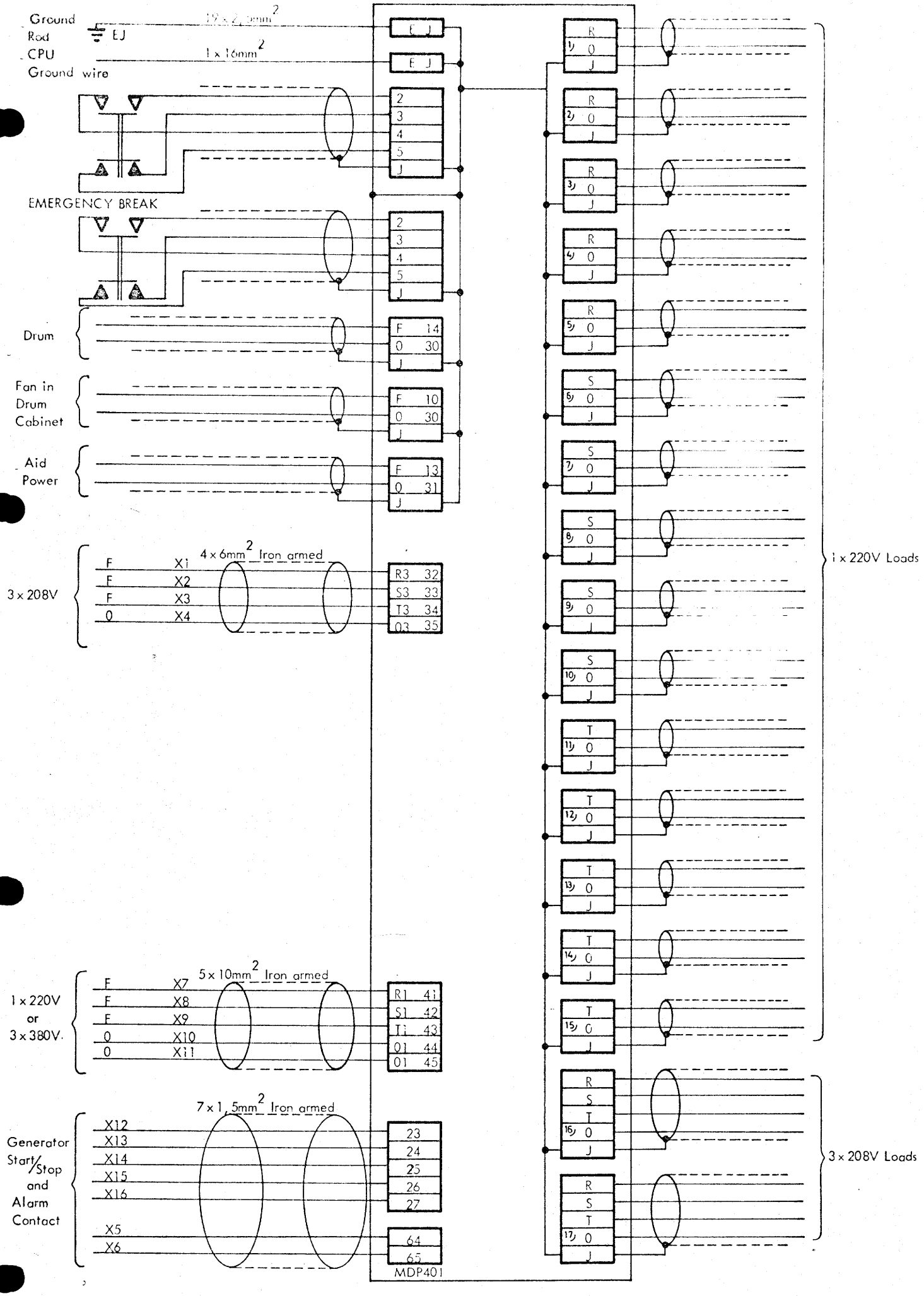

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Fig. 2.1.2. AC Power System including motor generator

Wiring Diagram

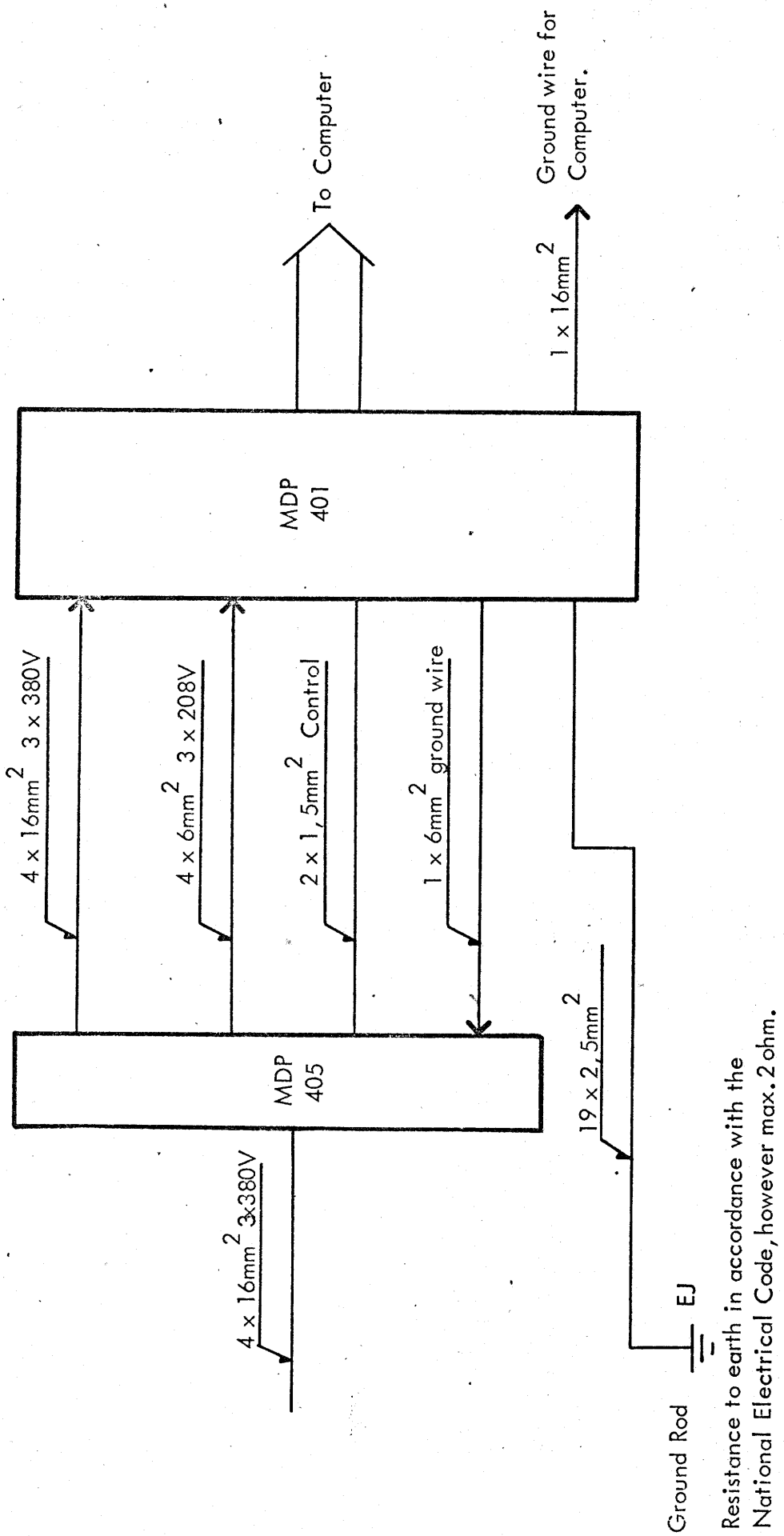

Fig. 2.2.1.

AC Power System without motor generator

Block Diagram

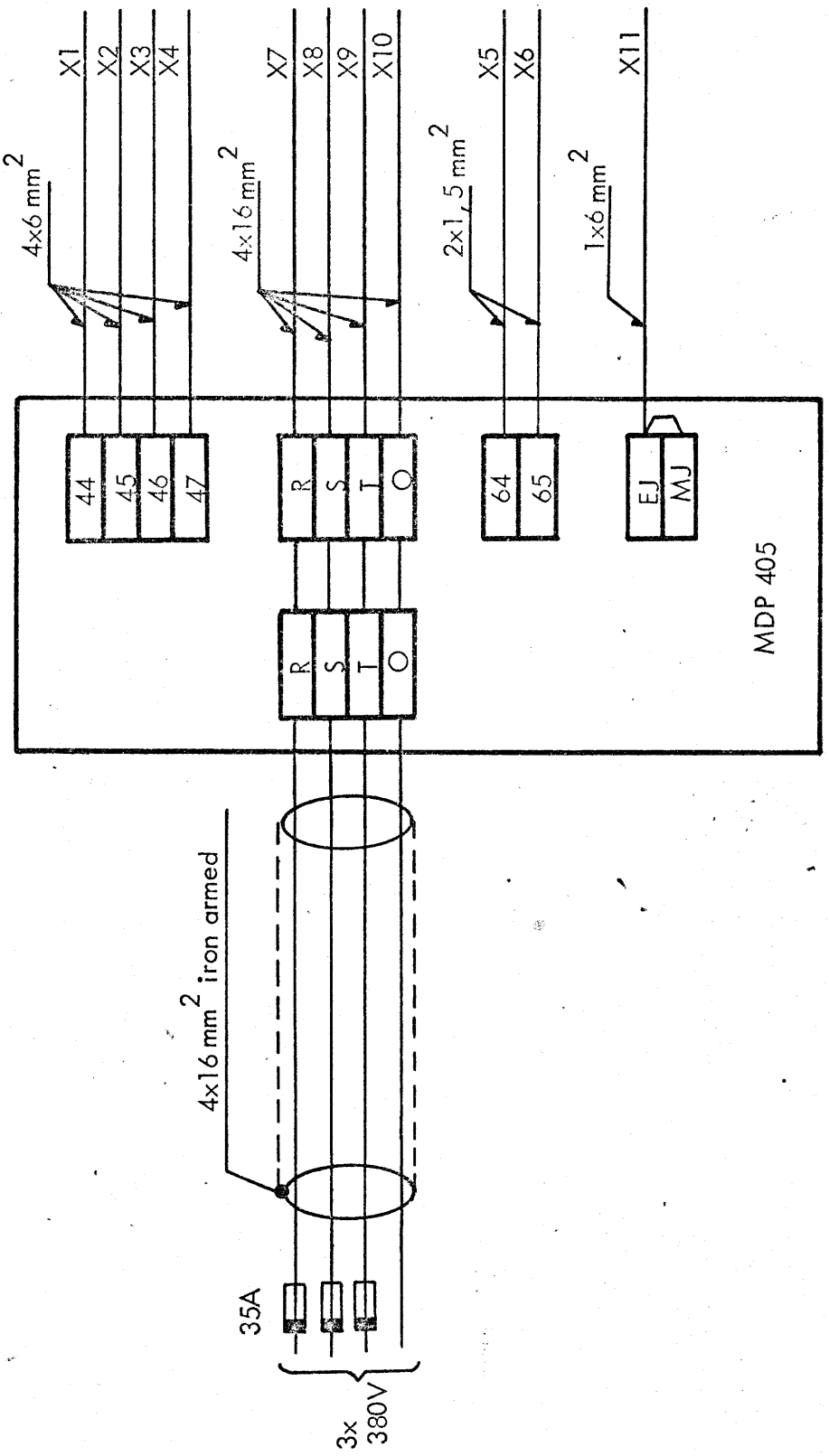

Fig. 2.2.2. AC Power System without motorgenerator
Wiring Diagram

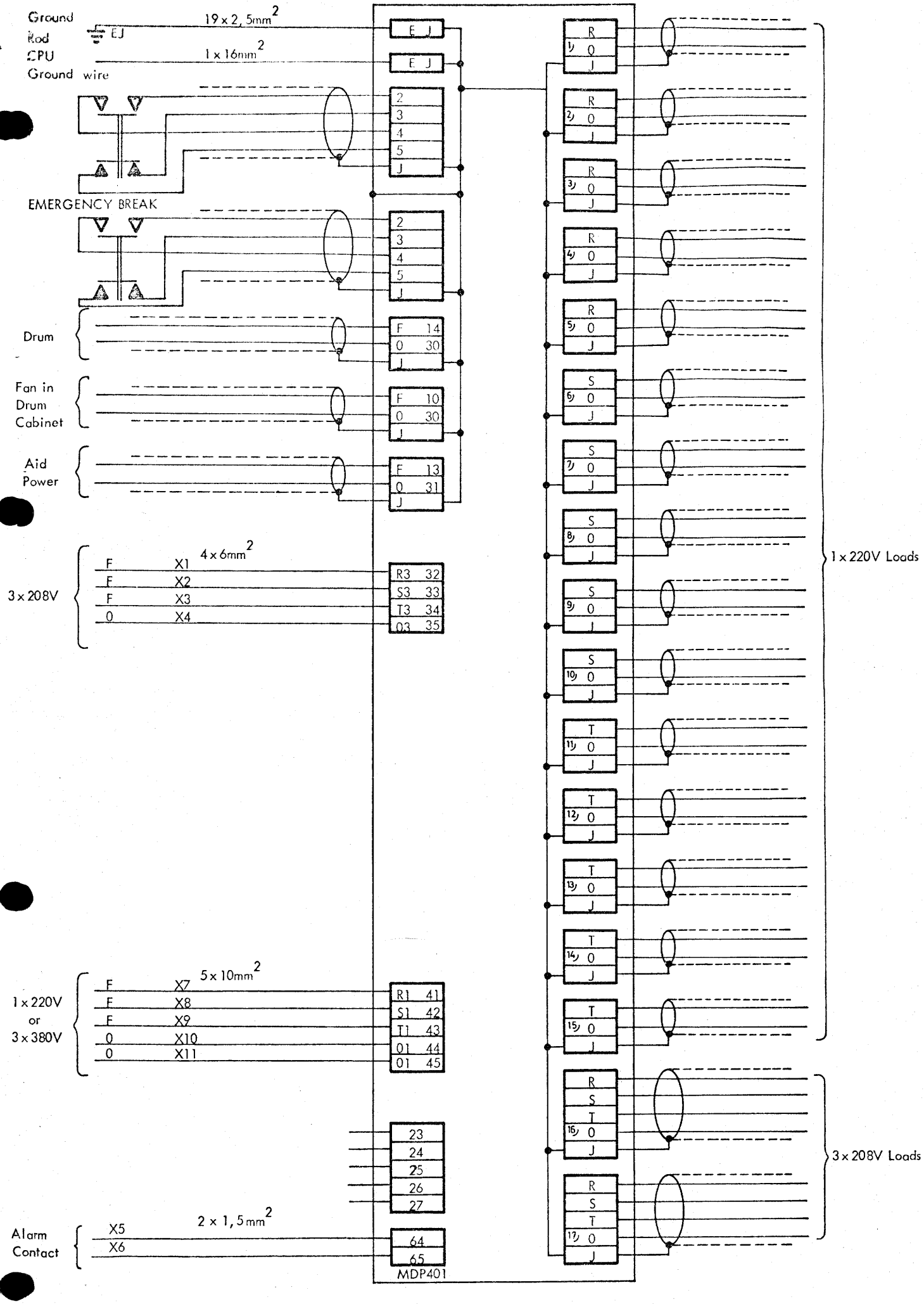

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Fig. 2.2.2. AC Power System without motor generator

2 of. 2.

Wiring Diagram

MOTOR GENERATOR UNIT MGU 401
AND
MOTOR GENERATOR UNIT CONTROL PANEL MGP 401

1. MAIN CHARACTERISTICS

The Motor Generator Unit MGU 401 is designed as power source for the RC 4000 computer system. The unit consists of a 30 Hp asynchronous motor and a 13.5 KVA single phase generator mounted on a detached engine frame supplied with vibration dampers. The clutch between the motor and the generator is worked out as a fly-wheel. The fly-wheel has a moment of inertia of 50 kgm^2. This is sufficient energy to deliver power at full load in 0.35 sec if the mains are switched off at nominal frequency. The housing of the generator is electrically separated from the engine frame. The generator is short-circuit proof.

The control panel includes the necessary control circuits for the motor and the generator. The motor is equipped with a star-delta switch to reduce the start current. Furthermore, the control panel includes connection for the three-phase transformer for the disk drive motors. In case of fault conditions for the motor generator it is possible to switch the output direct to the input mains.

The generator output is equipped with a voltmeter. The control panel is designed as a wall panel.

2. SPECIFICATIONS

Power Input:

Voltage:	3x380 Vac 50 Hz
Line Current:	38 A. at full load (including disk transformer)

Start Current:	Approximately 160 A.
Main Fuses:	Min. 100 A. slow blow
Power Output:	
Voltage:	220 Vac ±2.5 per cent
Line Current:	60 A cos Ø = 0.8 -1
Overload:	Max. 50 per cent in 5 minutes. Max. 10 per cent in 1 hour.
Distortion:	Less than 8 per cent.
Frequency:	Max. frequency deviation 1/4 load: ≤ -0.33 Hz 1/2 load: ≤ -0.60 Hz 3/4 load: ≤ -0.77 Hz 1/1 load: ≤ -0.93 Hz Max. frequency deviation when input power is disconnected 1/4 load: ≤ -1.2 Hz/sec. 1/2 load: ≤ -1.7 Hz/sec. 3/4 load: ≤ -2.3 Hz/sec. 1/1 load: ≤ -3.1 Hz/sec.
Efficiency:	0.75 at full load (loss: 3.5 KW, i.e. 3000 kcal/hour.
Output Disk Transformer:	3x208 V ±10 per cent 4.0 k VA.
Ambient Air:	Temperature: -20 degrees C to +40 degrees C Relative Humidity: 20 per cent to 80 per cent.
Earth Wires:	19x25 mm^2 for earthing of motor and machine frame. Resistance to earth in accordance with the National Electric Code, however max 2 Ω. In special cases connection to the neutral line can be permitted.

19x2.5 mm^2 for earthing the generator housing and to generate the neutral for the generator cutput. Max. resistance to earth 5 ohms. This wire must be connected to a separate rod. The distance between the two rod-systems should be minimum 10 m.

Dimensions:

MGU 401:	Width:	140 cm
	Depth:	70 cm
	Height:	70 cm
	Weight:	1100 kg
MGP 401:	Width:	70 cm
	Depth:	20 cm
	Height:	70 cm
	Weight:	30 kg
Disk Transformer:	Width:	49.5 cm
	Depth:	27.7 cm
	Height:	42.5 cm
	Weight:	70 kg

DISK TRANSFORMER PANEL MDP 405

1. MAIN CHARACTERISTICS

The Disk Transformer Panel MDP 405 is designed for housing the disk transformer in the case where no motor generator is used. The panel includes fuses for the three-phase input to the transformer and a thermal overload switch for monitoring the neutral line current. The overload switch controlles an alarm indicator on the main distribution panel MDP 401.
The terminal board in MDP 405 is designed for linking the main three-phase input cable for MDP 401.

2. SPECIFICATIONS

Power Input:

Voltage:	3x380 Vac 50 Hz ±0.5 per cent.
Line Current:	7 A. at full load.
Main Fuses:	10 A. DZ2.

Power Output:

Voltage:	3x208 Vac
Line Current:	11 A. at full load.

Dimensions:

Width:	70 cm
Depth:	20 cm
Height:	77 cm
Weight:	90 kg

MAIN DISTRIBUTION PANEL MDP 401

1. MAIN CHARACTERISTICS

The Main Distribution Panel MDP 401 is designed as a complete AC power distribution panel for the RC 4000 computer system. The panel is the link between the motor generator and the different units in the computer system. The start-stop pushbuttons for the motor generator are placed on the panel, as well as the belonging indicators. The start-stop pushbuttons for the RC 4000 system and the matching indicators are also placed on this panel. In addition, the emergency stop is mounted here. Further, it is possible to connect two more emergency stops to the panel.
The panel contains a frequency relay which supervises the frequency of the generator. This frequency relay is connected with the stop circuits for the RC 4000 system in such a way that the computer will receive a stop command if the frequency is going to be too low.

2. SPECIFICATIONS

Power Input:	
From Generator:	220 Vac ±2.5 per cent max. 180 A
Single Phase:	distributed on 3 lines and a double neutral.
From 3 phase Transformer:	3x208 Vac ±10 per cent
	50 Hz +1.-2 per cent max. 16 A

Power Output:

220 Vac ±2.5 per cent	Max. 15 output cables with separate fuses, plus two special output cables for the cabinet including drum.
3x208 Vac ±10 per cent	Two groups of fuses with max. 2 output cables each.
Earth Wires:	Input: 19x2.5 mm^2 earth wire
	Output: 1x16 mm^2 multiwire for the central processor.
Dimensions:	Width: 70 cm Depth: 20 cm Height: 147 cm Weight: 60 kg

RCSL: 51-VB971
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Edited: August 1970

RC 4000 AC POWER SYSTEM

MOTOR GENERATOR UNIT MGU 401

KEY: Technical Description.

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Appendix: DAE Self-Regulating and Statically Excited Alternators Type GB 2-3 519.E.1

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1. GENERAL

The MGU 401 consists of a 3 phase 30 Hp asyncronous motor and a 13,5 KVA single phase alternator. The clutch between the motor and the alternator is worked out as a fly-wheel. The motor and the alternator are mounted on a detached engine-frame supplied with vibration dampers.

2. MOTOR

The motor is a TT-ASEA jacket cooled asyncronous squirrel-cage motor, type M 180L. The windings are under normal running conditions connected in delta for 3x380V input. Under start-up is used star-connection, and the start current is approx. 160A. In running conditions with full loaded alternator are the line currents 3x30A.

3. FLY-WHEEL

The clutch between the motor and the alternator is worked out as a fly-wheel. The fly-wheel consists of two parts, one on the motor shaft and the other on the alternator shaft. These two parts, each having a moment of inertia of 25 kgm, are interconnected with 6 drag bolts. The drag bolts are equipped with rubber sleeves making electrical seperation between motor and alternator.

4. ALTERNATOR

The alternator is a DAE self-regulating and statically excited alternator type GB3.445. The housing of the alternator is electrical isolated from the engine frame. This is done to get the best separation between the input mains and the RC 4000 power system. The engine frame and the alternator are grounded via separate earth wires.

Further description of the alternator is given in the DAE Instructions (519.E) (Appendix).

Two modifications are done on the standard GB3.445. The magnetizing circuit is modified to reduce the influence of the thyristor regulator on the output voltage. The alternator is made short circuit proof by connecting an over-voltage protection across the output terminals.

These two modifications are shown on the diagram E-37.350.

APPENDIX

DAE INSTRUCTIONS.

SELF-REGULATING AND STATICALLY EXCITED ALTERNATORS TYPE GB 2-3

OPERATING INSTRUCTIONS AND SPARE PARTS LIST

NO. _____

CONTENTS

A/S DAE

Ørstedsgade 10 . DK 5100 Odense . Denmark . Telephone: Odense 12 14 23
Telex: 9805 . Telegram: Akkumotor

Electrical Design (Sectional Drawing on page 9)

The alternator is an external pole machine with stationary magnetic field. The rotor carries the A.C. winding (2o) which is brought out to the slip rings (11). The electronic regulator (13), which is supplied with current from the main terminals, will supply D.C. to the magnetic field winding (19) proportionally to the deviation of the alternator terminal voltage from the pre-set value. In this manner the voltage variation is maintained within $\pm$ 2% from no-load to full load, at power factor between o.8 and 1.o and at a speed variation of - 5%.

By means of the shunt-field regulator, included in our supply, the terminal voltage can be adjusted by approx. $\pm$ 1o%.

Erection

Examination of the alternator should be made to see if it has sustained damage during transit.

If it is to be stored for a considerable time before installation, it should be kept in a dry place - free from corrosive vapours.

Couplings or pulleys, which are mounted on the shaft, must be balanced carefully, and force must not be used when mounting.

It must be ensured that the alternator is absolutely firm and level on its bed, as there will otherwise be a risk of distortion of the alternator.

If the alternator is to be coupled direct to the prime mover, it is important that alignment is correct, in order to avoid the risk of damaging vibrations.

The room, where the alternator is erected should be well ventilated with regard to the operating temperature of the alternator. The alternator is designed for a maximum ambient temperature of 4o-5o° C in accordance with the standards for which it has been designed.

Fouling of the alternator should be avoided, sources could be exhaust gas and oil vapour from the prime mover.

The output cable and the shunt-field regulator are connected as shown in the wiring diagram.

From the works the alternator is normally connected for clock-wise rotation as seen against the bare shaft end. For anti-clock-wise rotation the wire from the voltage regulator to terminal 7 should be shifted to terminal 8 on the terminal board.

The alternator is earthed by means of the red screw (1) at the base of the alternator. A good earthing is essential for an effective suppression of radio interference. If it is also desired to earth the neutral point the red screw should be connected with the alternator terminal marked "0".

Starting

Before the first starting the alternator and the shunt-field regulator must be connected to the external circuit.

Then the prime mover is started and adjusted for the rated speed of the alternator plus 4% (e.g. 1500 r.p.m. + 4% = 1560 r.p.m.). The alternator will now produce voltage, and after fine-adjustment of the voltage by means of the shunt regulator to 2% above nominal voltage the load can be applied.

The voltage build-up requires a certain remanent magnetism which is normally present in the iron of the alternator. If the alternator is out of operation for a longer period the remanence can be reduced, and it may be necessary to re-magnetize the iron in order to make the alternator produce voltage. The re-magnetizing is carried out as follows: The blue wire from the regulator is removed from terminal 6 on the terminal board. In order to avoid short circuits the cable lug of the wire can be placed loose on terminal 5. With the machine running a 6-12 volts battery is connected for some seconds to the terminals 4 and 5, with plus to terminal 5. This is most important as a wrong polarity may cause damage to the regulator. After the magnetizing the machine is stopped and the blue wire from the regulator is again connected to terminal 6.

Operation and Maintenance

It is recommended once per month or every second month to open the inspection covers in order to check whether anything abnormal can be seen. In case of exceptional vibrations or shocks it must be controlled that all components are correctly fastened.

If necessary, the alternator should be cleaned once or twice per year, depending on the operation conditions.

For effective ventilation the openings for air intake and delivery must be kept clean.

The ball bearings do not require any lubrication as they are from the factory lubricated for the lifetime of the bearings, normally 2o-3o,ooo hours. When the bearings start making noise and become abnormally hot they should be replaced. An over-temperature of approx. $4o^{o}$ C at the bearing is acceptable.

Dismantling of Regulator

The wires from the regulator are removed from the terminal board. After removing the two nylon screws, which are fixing the regulator box to the terminal board, the box can be taken out through one of the side openings of the end shield. When mounting the nylon screws are tightened with care.

Insulation Test

IMPORTANT! When testing the insulation by means of megger or high voltage apparatus <u>all</u> terminals of the terminal board must be inter-connected.

Slip Rings and Carbon Brushes

It is important to examine the slip rings and brushes from time to time, the frequency of inspection being dependent on how much the alternator is used. Any dirt or carbon dust is removed by means of a dry cloth, and if there are any indications on the slip rings of discolouration or burning, these should be polished off with fine sandpaper. This should be done while the alternator is not energized in order to avoid short circuits. Subsequently, all metallic dust and sand which may have resulted from this operation must be blown out of the alternator.

In no circumstances the slip rings are allowed to come into contact with oil or grease. Should this happen, the parts must be carefully washed with petrol or other cleaning fluid, and the alternator must not be restarted before it is thoroughly dry.

The lifetime of the brushes is dependent upon the standard of maintenance of the alternator, and how often it is used. When, after lengthy operation, the carbon brushes have worn down to about 10 mm, they should be changed. When this is necessary, it is important to use the same size and quality as specified, and to ensure that they are bedded-in so that they lie flush over the entire surface. The best way of doing this is to grind them down with a strip of fine sandpaper placed between the brush and the slip ring, in such a way that the sandpaper follows the surface of the slip ring. Carbon dust and sand from the sand paper must be carefully removed.

The carbon brushes must lie centrally on the slip rings. It must be ensured that the brush pressure is correct, this must be approx. 180 gram/cm^2.

Overload

The alternator is short-circuit proof. It can sustain an overload of 50% for 5 minutes, 25% for 20 minutes, and 10% for one hour.

Parallel Operation

The DAE alternators, type GB, will normally be suitable for mutual parallel operation, and for parallel operation with the DAE alternators, type GA, without special equipotential connections.

When planning the operation in parallel with other types or makes DAE should be contacted in connection with the lay out of the plant. At the same time the following particulars of the prime movers should be submitted to DAE:

quaranteed degree of irregularity
number of cylinders and strokes
flywheel effect (GD^2)

The regulators of the diesel engines must be adjusted for the same speed drop. Normally 4%. The speed drop may be 3-6%, but it must be identical for all the engines. If the speed drop of the engines differ, the alternator running with the smallest speed drop will take over a too large proportion of the load (kW). If one or more engine regulators are adjusted for a too small speed drop there will be the risk of reverse-power on one of the alternators.

The speed drop of a diesel engine is controlled by running the machine alone at full load (kW). The frequency should be 5o cycles (6o cycles). When the load is disconnected the frequency should be 52 cycles (62,5 cycles), i.e. 4% change of speed.

If it is difficult to distribute the active effect (kW) the reason is always to be found with the engine and never with the alternator. If the alternators are sharing the kW correctly, but not the current (amps or kVA), the fault is normally to be found at the alternators.

Coupling in Parallel

When the load on the alternators in operation has reached approx. 80% of their capacity, and a further increase in load is anticipated, the next alternator should be coupled in.

1. The prime mover is started. The no-load speed should be adjusted to correspond to the speed of the loaded alternators (same frequency).
2. It is checked that the line voltage and the no-load voltage of the alternator are identical. The voltage may have to be adjusted, but normally this will not be necessary.
3. By means of the synchronizing equipment the frequency is adjusted and the alternators are synchronized together.
4. Subsequently, the alternator is made to take over its share of the load by adjusting the motor regulator for increasing speed, until the alternator has taken over a suitable share of the total load in accordance with its capacity. After this adjustment the regulators of the diesel engines will handle the distribution of variable load, whereas voltage regulation is carried out by the automatic controls built into the alternators.

With parallel operation not more than one alternator at a time should have its neutral point connected to the neutral bus-bar (earth), in order to avoid circulating currents in the neutral wires.

Fault Finding

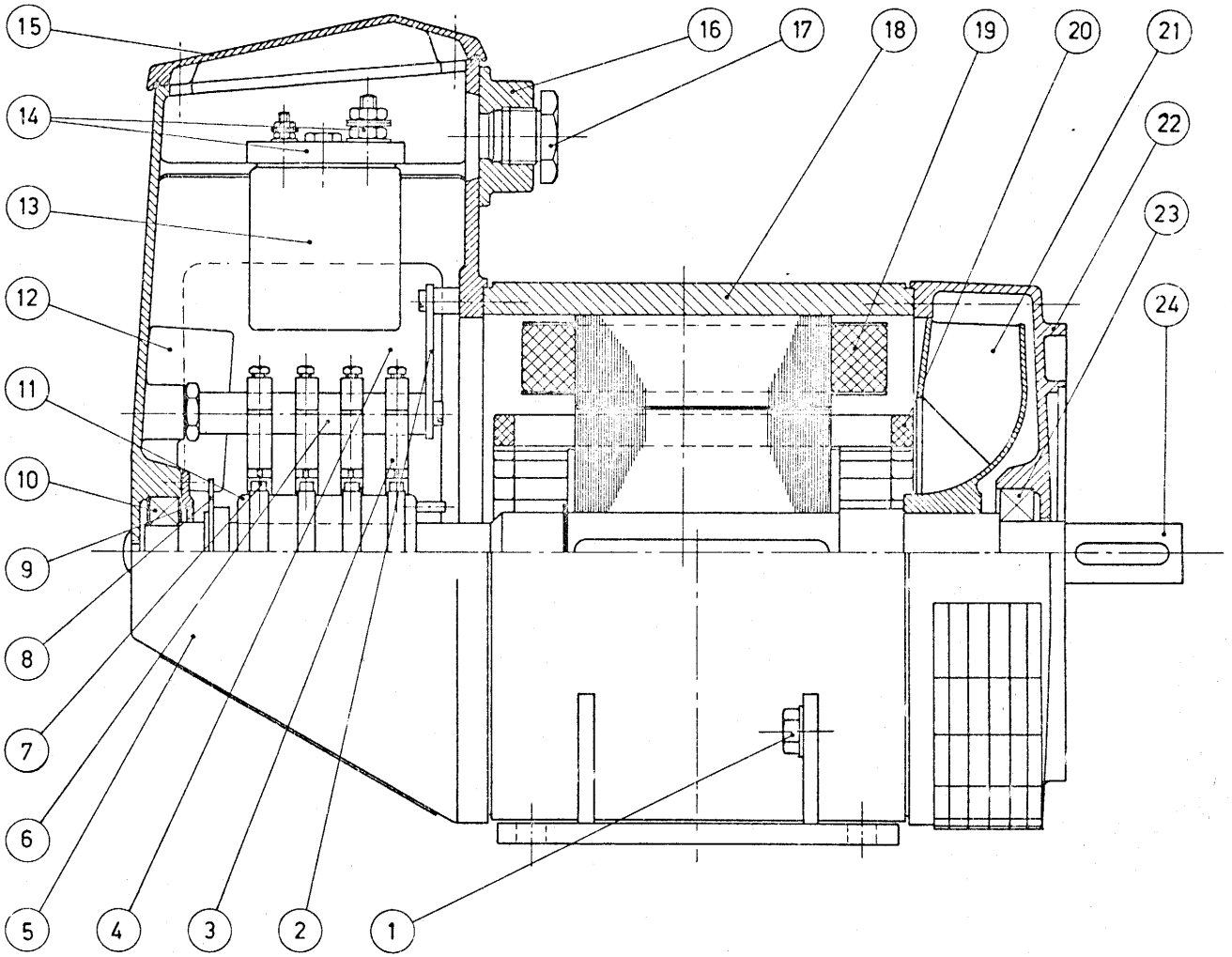
The alternator is thoroughly tested and adjusted before leaving the factory, and, with correct treatment, should not normally be subject to operational disturbances.

However, should a fault arise the list of faults and their causes given below will be of assistance in locating the fault:

Fault	Cause
The alternator at starting gives no voltage.	a. The load is not disengaged b. The alternator speed is too low. c. The brushes do not lie correctly against the slip rings. d. The slip rings are greasy. e. Alternator demagnetized. (See under Starting). f. Fault in the voltage regulator.
The voltage is dropping sharply when load is applied.	a. Loose connection in the main circuit: slip rings, brushes, terminals. b. The alternator speed is too low. c. Fault in the voltage regulator.
The shunt-field regulator does not work.	a. Disconnection or short-circuit in the regulator or its connections. b. Fault in the voltage regulator.
The alternator gets too hot.	a. Alternator overloaded. b. Suction or discharge of ventilating air is blocked. c. Fault in the windings.
The voltage fluctuates with fast variations	a. With belt drive: vibrations in the belt. b. Fault in the voltage regulator.

SPARE PARTS LIST

Item No.	Designation
1	Earthing screw
2	Brush-holder arm
3	Brush-holder
4	Inspection cover
5	End shield - non-driven end
6	Brush-pin
7	Carbon brush
8	Balancing disc
9	Inner ball bearing cover - non-driven end
10	Ball bearing - non-driven end
11	Collector
12	Condenser
13	Voltage regulator
14	Terminal board with terminals
15	Terminal box cover
16	Cable gland flange
17	Cable gland
18	Alternator housing
19	Shunt winding
20	Rotor winding
21	Ventilating fan
22	End shield - driven end
23	Ball bearing
24	Rotor

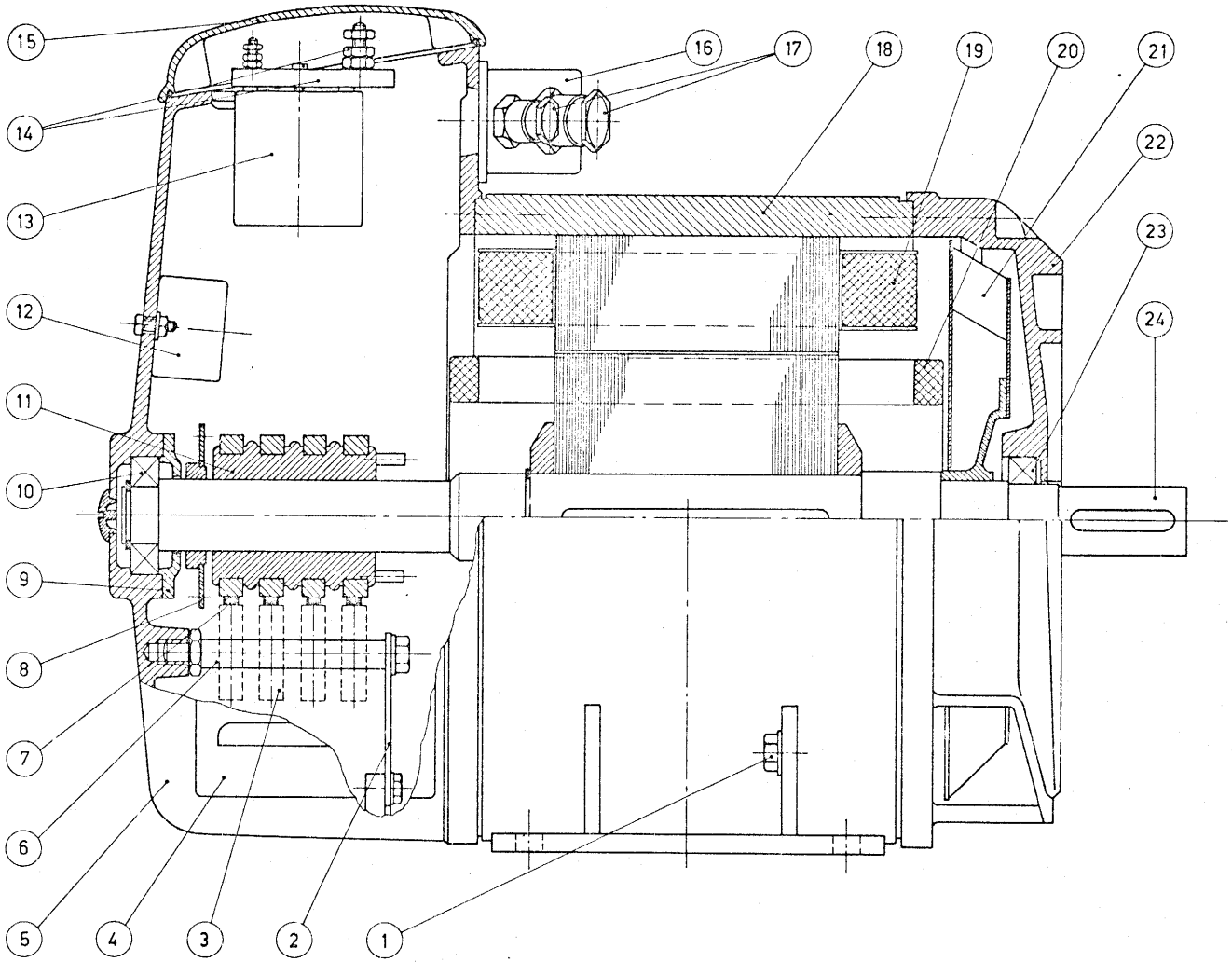


When ordering spare parts the serial number and the type designation of the alternator as well as the item number of the spare part should be indicated in the order.

TYPE GB 2

SPARE PARTS LIST

Item No.	Designation
1	Earthing screw
2	Brush-holder arm
3	Brush-holder
4	Inspection cover
5	End shield - non-driven end
6	Brush-pin
7	Carbon brush
8	Balancing disc
9	Inner ball bearing cover - non-driven end
10	Ball bearing - non-driven end
11	Collector
12	Condenser
13	Voltage regulator
14	Terminal board with terminals
15	Terminal box cover
16	Cable gland flange
17	Cable gland
18	Alternator housing
19	Shunt winding
20	Rotor winding
21	Ventilating fan
22	End shield - driven end
23	Ball bearing
24	Rotor



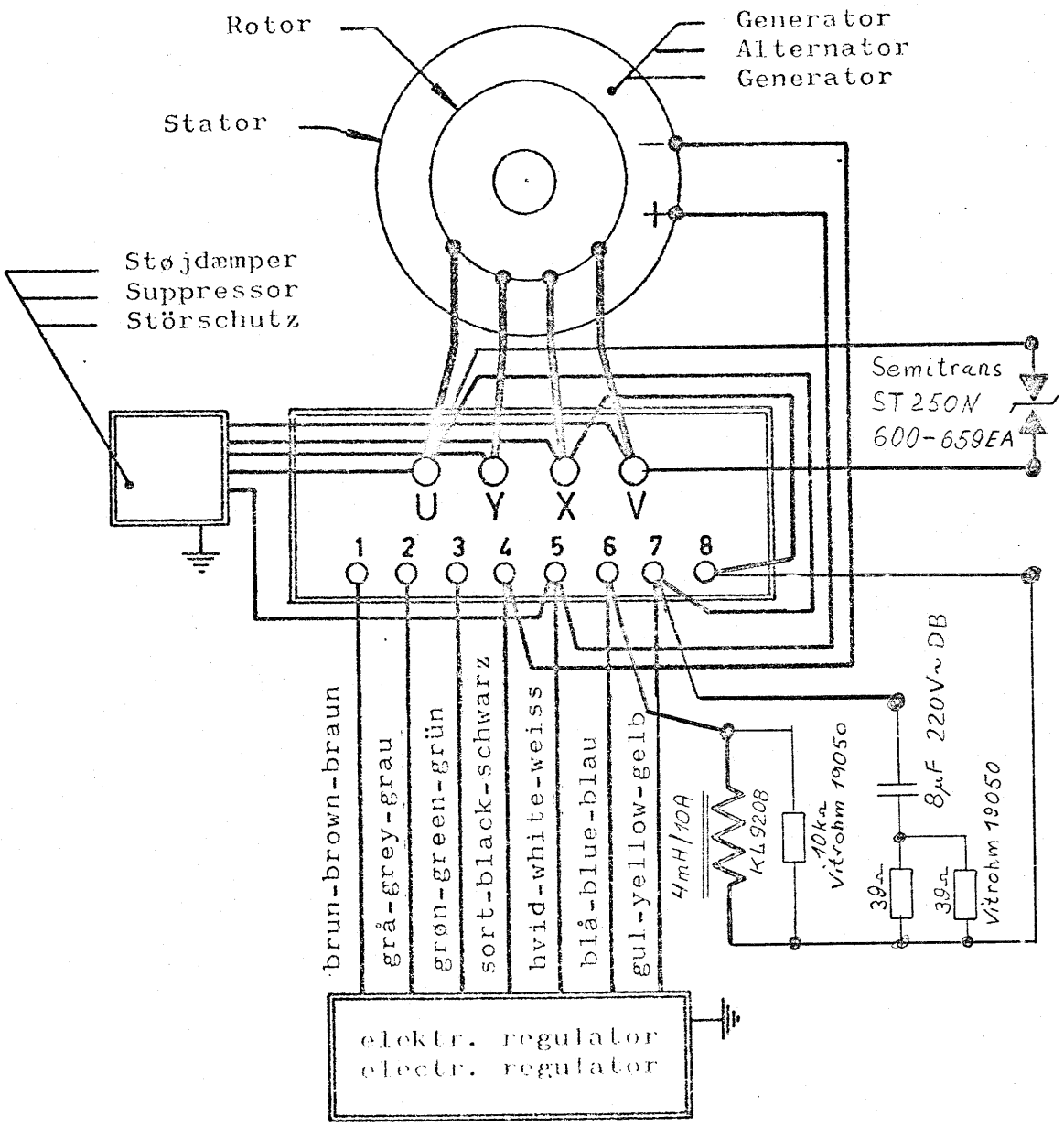
When ordering spare parts the serial number and the type designation of the alternator as well as the item number of the spare part should be indicated in the order.

TYPE GB 3

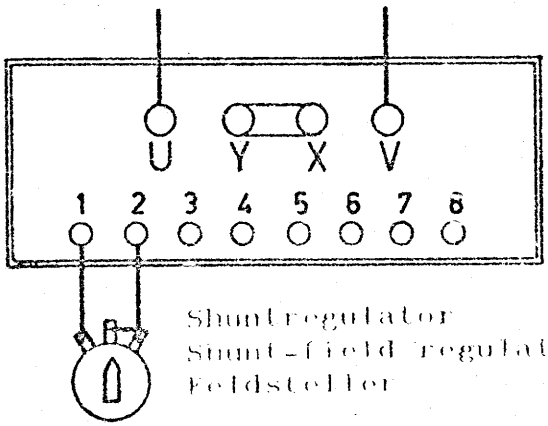
Forbindelsesdiagram GBE 2 - 3
Wiring Diagram GBE 2 - 3
Schaltbild GBE 2 - 3

E - 37.350

Modified by RC.

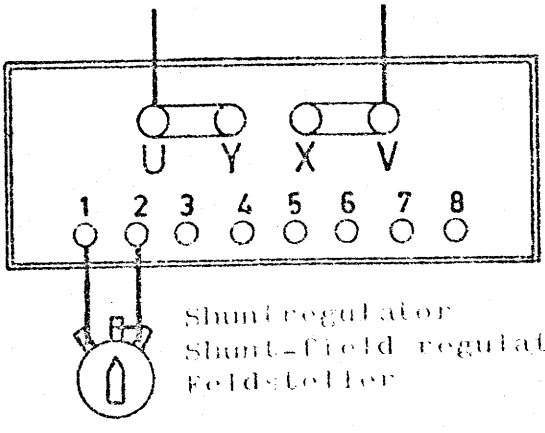


Højeste spænding
Highest Voltage
Höchste Spannung



Shuntregulator
Shunt-field regulator
Feldsteller

Laveste spænding
Lowest Voltage
Niedrigste Spannung

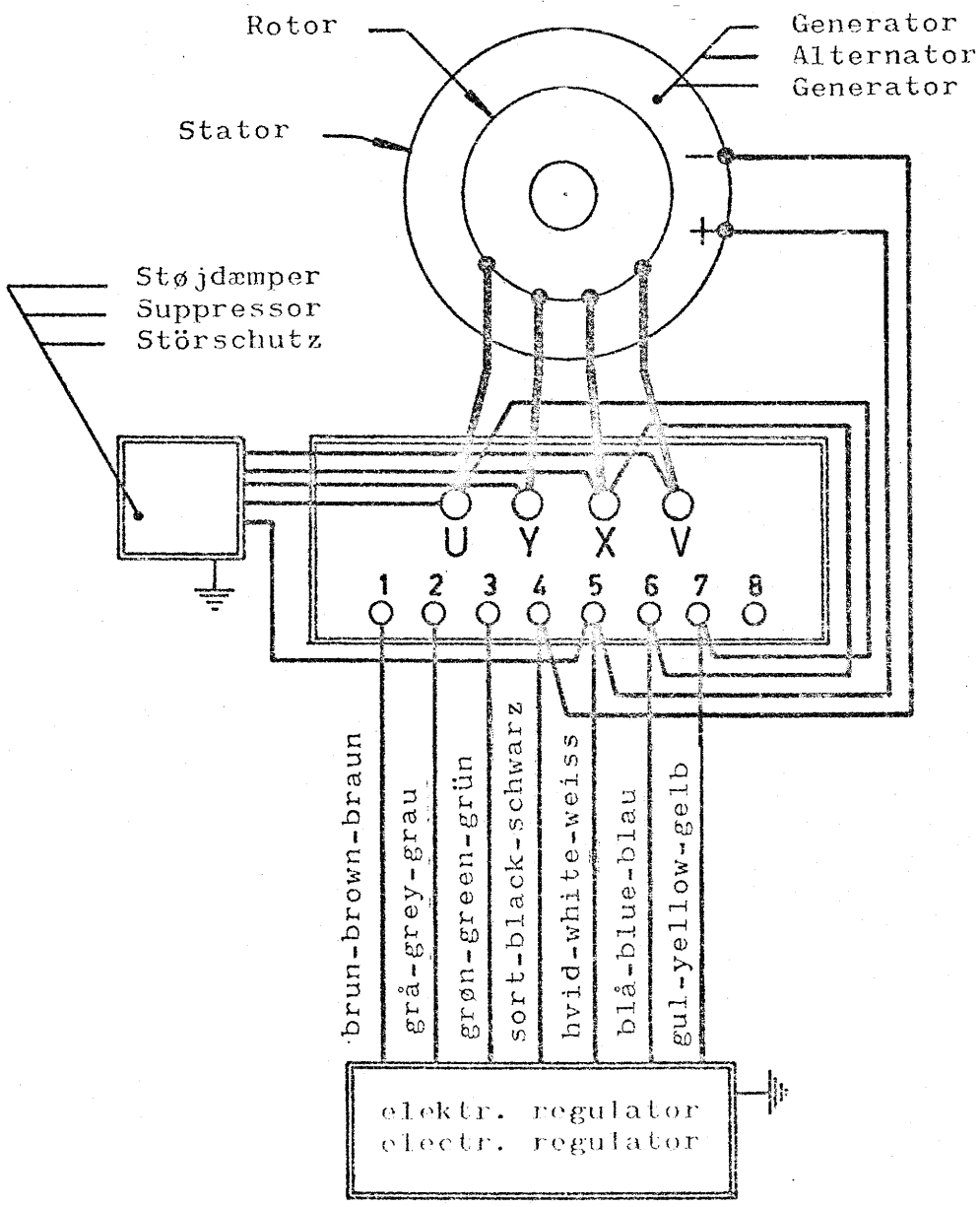


Shuntregulator
Shunt-field regulator
Feldsteller

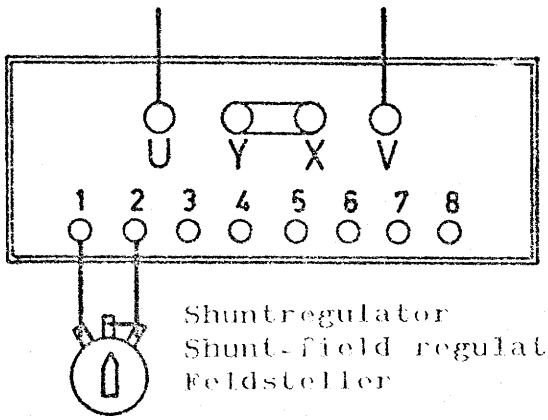
DAE Ørstedsgade 10 . Odense . Telf. (09) 12 14 23

Forbindelsesdiagram GBE 2 - 3
Wiring Diagram GBE 2 - 3
Schaltbild GBE 2 - 3

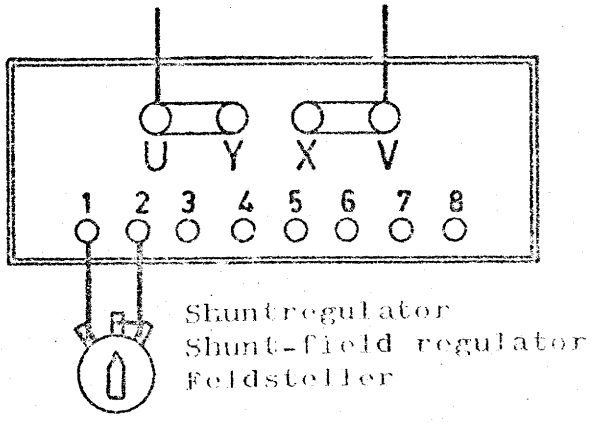
E-37.350



Højeste spænding
Highest Voltage
Höchste Spannung



Laveste spænding
Lowest Voltage
Niedrigste Spannung



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RCSL: 51-VB1018
Author: L. Prøhl-Hansen
Edited: October 1970

RC 4000 AC POWER SYSTEM

GENERATOR CONTROL PANEL GCP 401

KEY: Technical Description.

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1. GENERAL

The Generator Control Panel GCP 401 includes the necessary circuits for protection of the motor and for the automatic star-delta switch.

2. START-UP OF MOTOR GENERATOR

Terminal 24 of the Motor Generator ON/OFF pushbutton is always carrying the phase. When the pushbutton is activated, the contactor ST draws immediately and connects the motor in star. This causes the main contactor MK to draw and the motor starts running. MK will remain drawn over its own contacts. The timing relay DF with delayed switch off draws together with MK. The timing relay DF makes it possible to disconnect the input mains for a time shorter than the fall time of DF. It means that the generator restarts after a short interruption on the mains. The fall time of DF is set to 1 sec. The timing relay DD with delayed drawing starts drawing at the same time as ST draws. When the timing relay DD has drawn, the contactor ST switches off and the contactor D draws. The motor is then running in delta connection. The time of drawing for DD is set to 20 sec.
The motor is overload protected by the thermal switch TH.

3. SHUT-DOWN OF MOTOR GENERATOR

When the Motor Generator OFF pushbutton is activated, the contactors MK and D switch off, but it is necessary to activate the pushbutton longer than the fall time of the timing relay DF to secure that the motor does not restart.

4. GENERATOR CONTACTOR

Provided that the contactor MK is drawn, the contactor SP will draw when the voltage from the generator reach 200 Volts causing the generator contactor GK to draw. Once drawn, the contactor SP, and therefore the generator contactor GK, remain drawn independent of MK as long as the generator voltage is above 190 Volts. Belove 190 Volts SP and therefore GK drops out.

5. OUTPUT SWITCH

The output switch is a five-time two-position switch. In position I the generator is connected to the output lines R1, S1, T1, O1, and O1. R1, S1, and T1 are carrying the same phase, and O1 + O1 are forming the neutral line generated from electronic earth EJ.
In position II the output lines are connected to the three-phase input mains through 35 A fuses. The neutral lines O1 + O1 are generated from the main input.
N.B. The output switch must only be operated when the generator contactor is switched off.

6. DISK TRANSFORMER CONNECTION

The disk transformer unit DTU 401 is connected to the mains through 10 A fuses. The output from DTU 401 is linked through GCP 401 to the main distribution panel MDP 401. The neutral line for the primary of the transfer is fed through the thermal protection TP. This protection gives alarm when one of the primary fuses has blown off.

7. GROUND WIRES

To the GCP 401 is connected two ground wires, each of 19×2.5 mm^2. The one MJ is connected to the engine frame and the primary shield of the disk transformer DTU401. The other one EJ is connected to the housing of the generator and the secondary shield and the iron core of the DTU 401. EJ is also generating the neutral lines for DTU 401 and the generator.
The ground wire MJ should have a resistance to earth in accordance with the National Electrical Code, however max 2 ohm.
The ground wire EJ should have a resistance to earth of max. 5 ohm.
The ground wires should be connected to separate ground rods spaced at least 10 m.

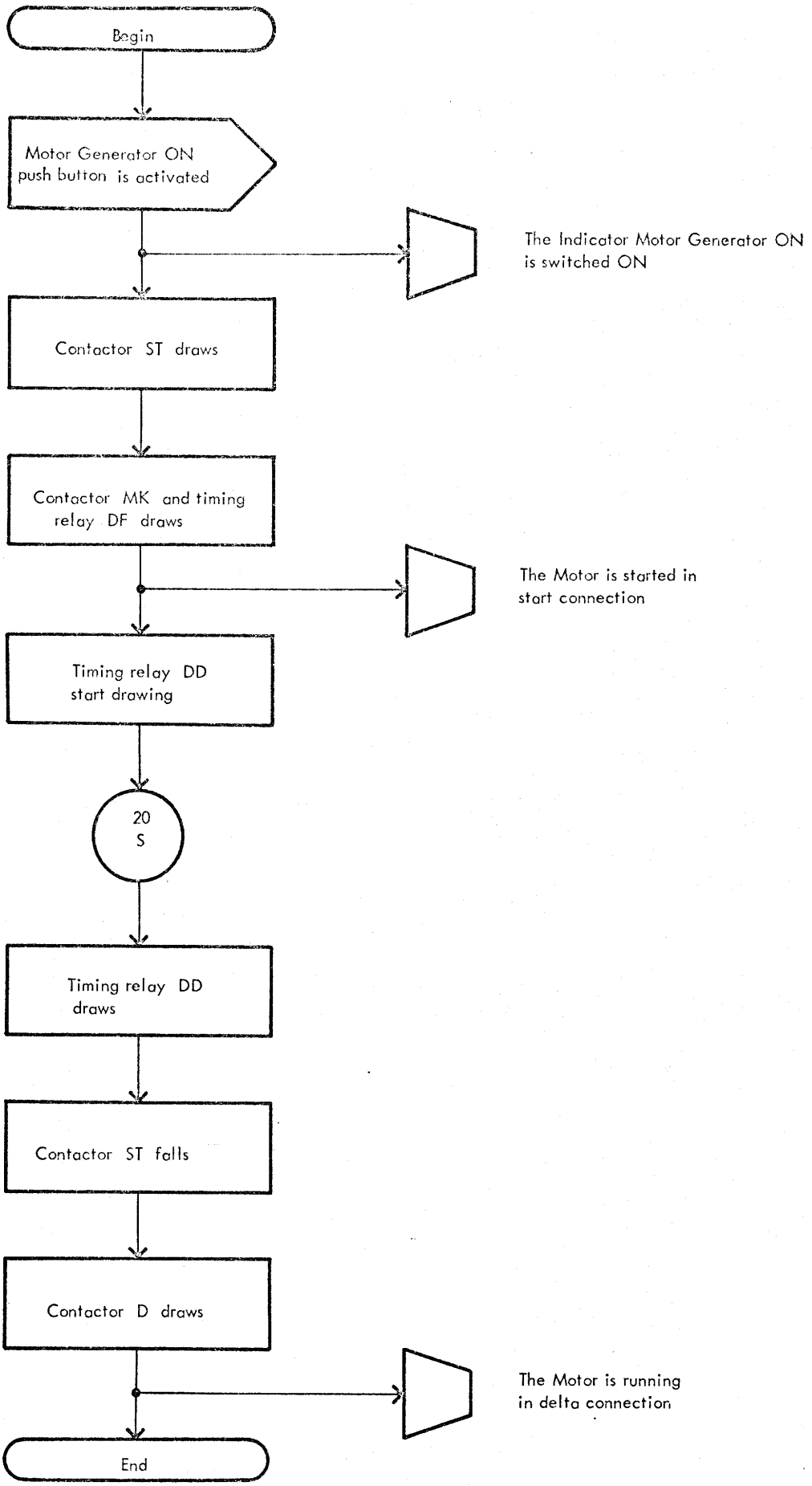


Fig. 8.1.

The Motor Generator start-up sequence

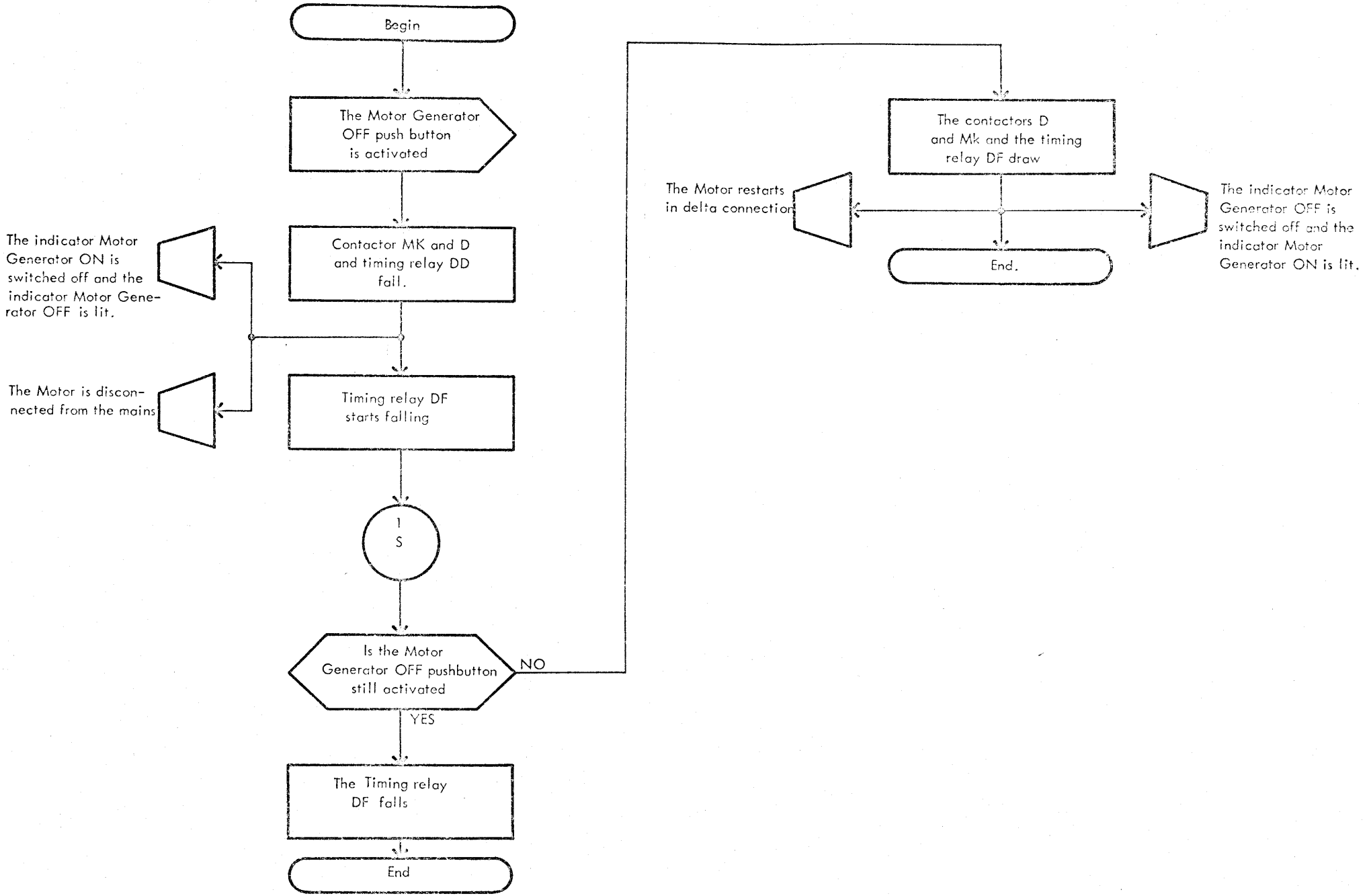


Fig 8.2

The Motor Generator Shut-down Sequence

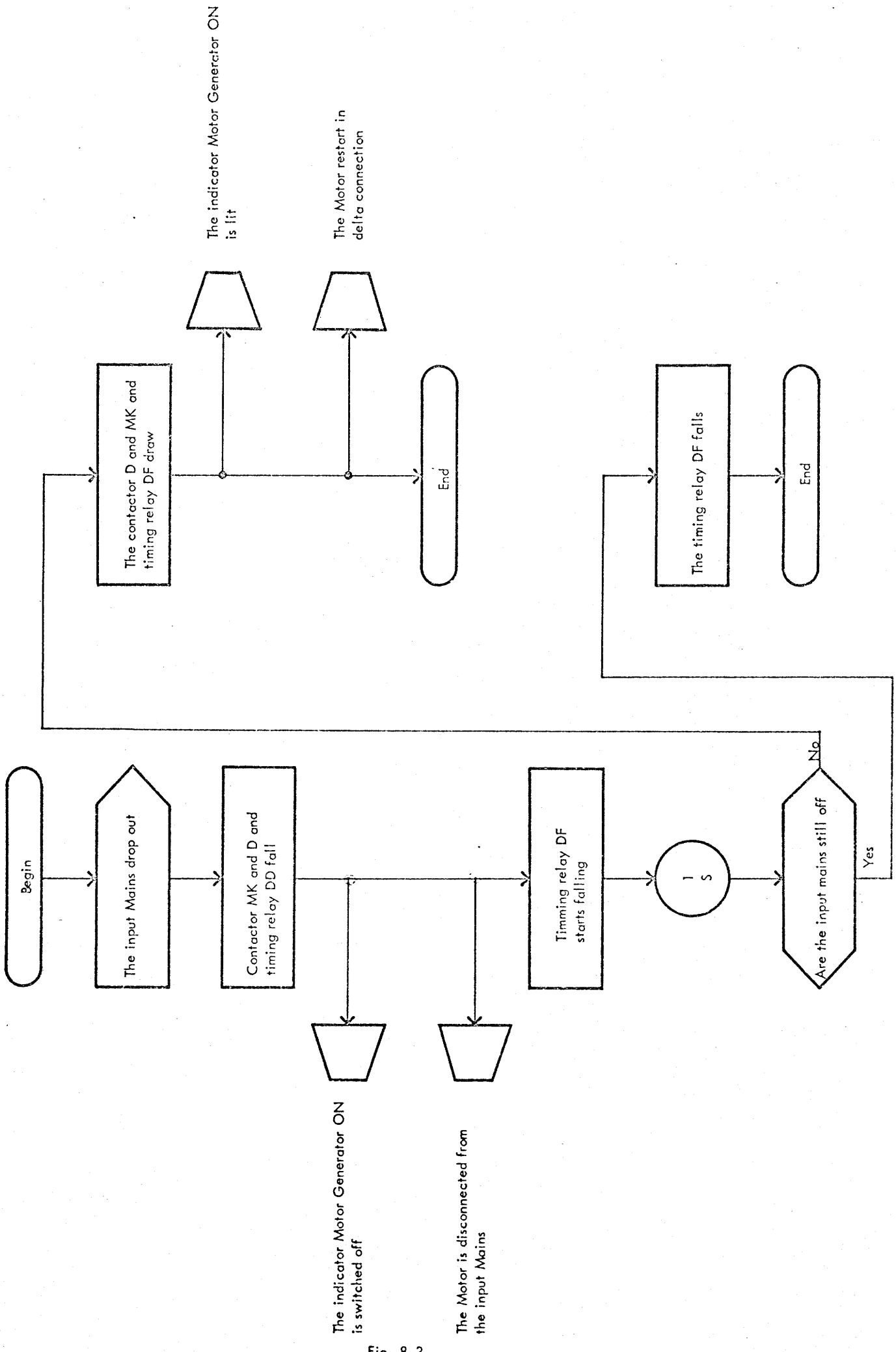
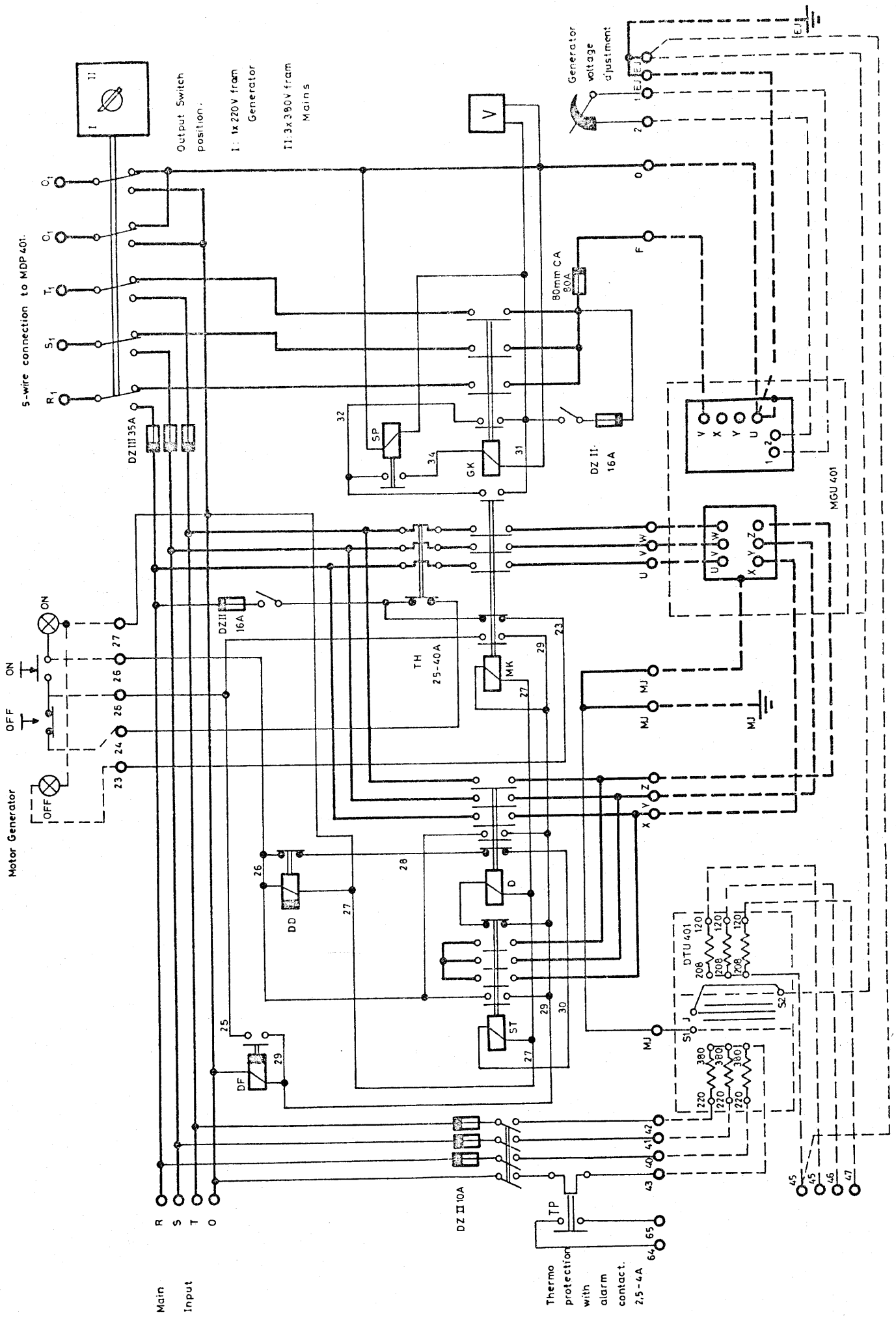


Fig. 8.3.

The Motor Generator sequence for input mains drop-out


Output Switch position:
I: 1x 220V from Generator
II: 3x 380V from Mains
5-wire connection to MDP 401:
Generator voltage adjustment
80mm CA 8.0A
DZ III 35A
DZ II 16A
DZ II 16A
SP
GK
MGU 401
TH 25-40A
MK
ON
OFF
Motor Generator
DD
D
DF
ST
DTU 401
DZ II 10A
TP
Thermo protection with alarm contact. 2.5-4A
Main Input
R
S
T
O

RCSL: 51-VB 1019
Author: L. Prøhl-Hansen
Edited: October 1970

RC 4000 AC POWER SYSTEM

MAIN DISTRIBUTION PANEL MDP 401

KEY: Technical Description.

A/S REGNECENTRALEN
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1. GENERAL

The Main Distribution Panel MDP 401 is the link between the RC 4000 computer system and the power source for the system. The main inputs are divided in two groups: 1 one-phase 1×220-volt group connected to the terminals R1, S1, T1, 01, and 01. Under normal conditions the terminals R1, S1, and T1 are carrying the same phase and the two terminals 01 are used as double neutral lines. But it is possible to feed this group from a 3×380-volt four-wire power source, as the output loads on this group are divided equally on R1, S1, and T1.
One three-phase 3×208-volt four-wire input on the terminals R3, S3, T3, and 03. This three-phase group is used for the disk memories.
By means of a four-position switch, the voltmeter V can be connected to the one-phase group as the three-phase group for monitoring the input voltages.

2. THE MOTOR GENERATOR ON-OFF SWITCHES

The motor generator is started and stopped from the MDP 401. The start pushbutton, called Motor Generator On, and the stop pushbutton, called Motor Generator Off, and their associated lamps are placed on the front cover. It must be noted that the stop pushbutton must be activated at least 2 sec. to stop the generator, as the start circuits in the motor generator control panel are able to jump over short interruptions in the input mains.

3. DRUM START CIRCUITS

The drum must always be running if possible, and therefore the drum circuits by-pass the ON/OFF pushbuttons for the computer system.
Supposing that the line breaker D and the thermal switch Hbv are closed, the contactor MK is drawn and the drum gets power from terminal 14, by-passing the thermal motor protection MT. Furthermore the timing relay Mtr starts running, and, when about 4 minutes have gone, Mtr draws and this causes MV to draw and remain drawn over its own contacts. When MV draws, MK and Mtr will be released. The drum is then protected by the thermal protection MT. The motor protection is short circuited under the start-up, because the start time is very long and because the drum needs more power when the heads have to be drawn to the drum surface.
If the emergency stop is activated, the thermal relay Hbv switches off, and the neutral for the contactors MK, Mtr on MV is disconnected. The drum power is then disconnected and remains disconnected until the thermal relay is reset.
The fans in the drum cabinet gets power from terminal 10 over contactor ThK. This contactor is drawn as long as Hbv is reset. The contactor MK activates an impulse counter 'It' each time MK is drawn. Therefore 'It' indicates how many times the drum has been started.

4. SYSTEM START-UP

Provided that the line breaker C and the thermal switch Hbv are closed, the contactor Hjk draws when the pushbutton <System Mains ON> is activated. Hjk remains drawn over its own contacts and Aid power is sent to the computer via the terminal 13. At the same time as Hjk draws, the timing relay Satr. starts drawing and the yellow lamp Start Sequence> is switched on. After about 3 sec. Satr. is drawn and the main contactors, 1FHK for the single-phase loads, and 3FHK for the three-phase loads, are drawn. The indicator <Start Sequence> is switched off and the green indicator <System Mains ON> is switched on.

The computer receives start command from the relay Sir. This relay will draw as soon as the main contactor 1FHK is drawn provided that the frequency from the motor generator is above the permissible limit determined by the frequency supervising circuits Fr. in connection with Tr. Tr. is drawn with the frequency above this limit. The lower limit is set to 48.5 cps. The relay SR is only drawn under the shut-down procedure.

If the frequency becomes less than the adjusted value, Tr. falls causing the relay Sir to fall and the computer receives stop command. When Tr. falls a normal stop sequence is released via the contactor Hjk.

5. SYSTEM SHUT-DOWN

The stop sequence is released when the pushbutton <System Mains OFF> is activated. The timing relay Str. starts running and the relay SR draws causing Sir to fal. The red lamp <Stop Sequence> is switched on, but <System Mains ON> remains. 1 to 4 minutes later Str. draws which causes that all relays and contactors are released with the exception of drum circuits. The indicators <Stop Sequence> and <System Mains ON> are switched off.

The timing relay Str. is adjustable, and the time is determined by the computer configuration.

6. EMERGENCY BREAK

If the pushbutton <Emergency Break> is activated, the normal closed contact will cause all relays and contactors to fall, with the exception of the drum circuits. The normal open contact releases the thermal switch Hbv. and the drum circuits are disconnected.
When the <Emergency Break> is used, the power is switched off from the computer without warning, and the normal shut-down procedure will be destroyed. After the use of <Emergency Break> it is necessary to reset the thermal switch Hbv. manually.

The thermal switch Hbv is placed in the upper right section.

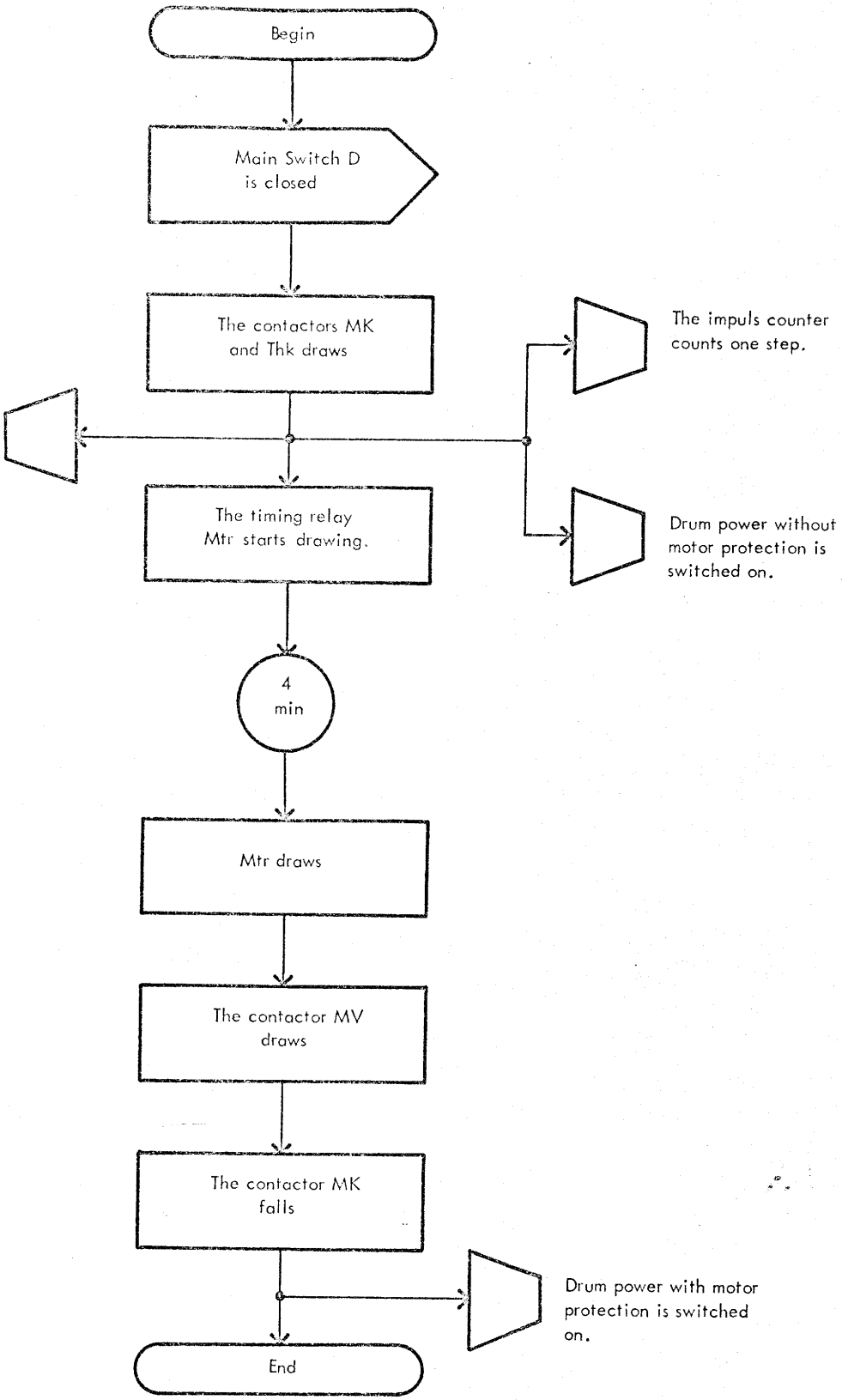


Fig 7.1

MDP 401 Drum Start-sequence

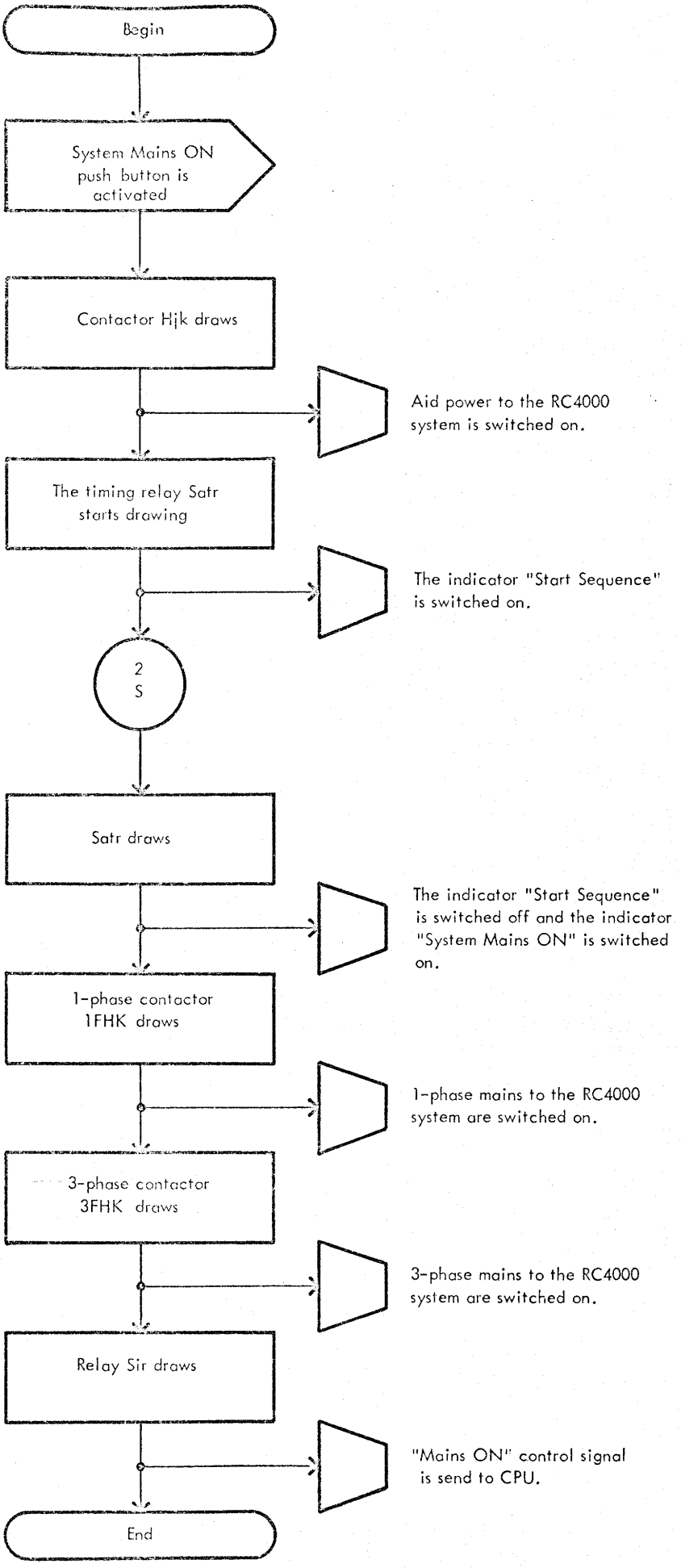

Begin
System Mains ON push button is activated
Contactor Hjk draws
Aid power to the RC4000 system is switched on.
The timing relay Satr starts drawing
The indicator "Start Sequence" is switched on.
2 S
Satr draws
The indicator "Start Sequence" is switched off and the indicator "System Mains ON" is switched on.
1-phase contactor 1FHK draws
1-phase mains to the RC4000 system are switched on.
3-phase contactor 3FHK draws
3-phase mains to the RC4000 system are switched on.
Relay Sir draws
"Mains ON" control signal is send to CPU.
End

Fig 7.2

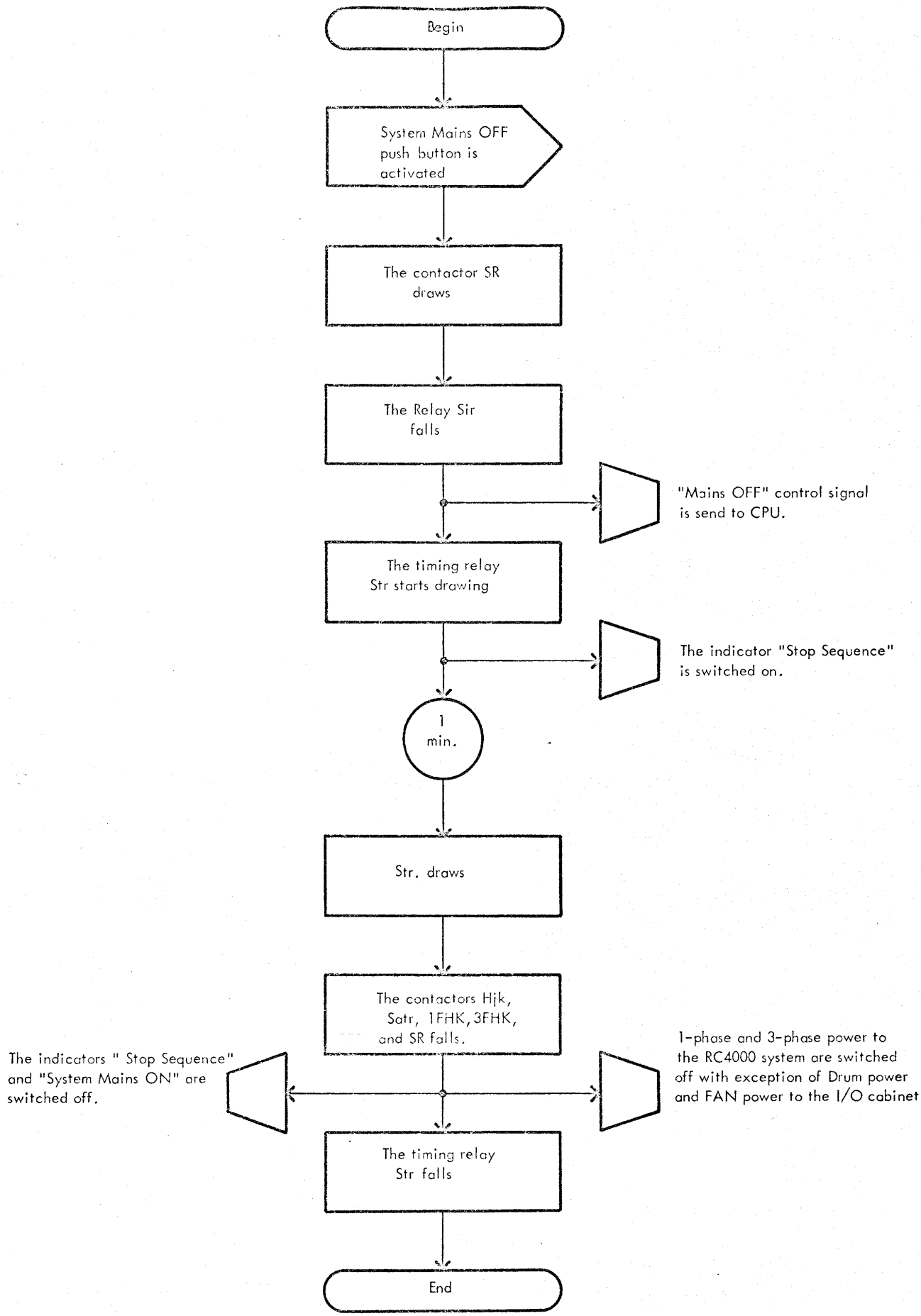

Begin
System Mains OFF push button is activated
The contactor SR draws
The Relay Sir falls
"Mains OFF" control signal is send to CPU.
The timing relay Str starts drawing
The indicator "Stop Sequence" is switched on.
1 min.
Str. draws
The contactors Hjk, Satr, 1FHK, 3FHK, and SR falls.
The indicators " Stop Sequence" and "System Mains ON" are switched off.
1-phase and 3-phase power to the RC4000 system are switched off with exception of Drum power and FAN power to the I/O cabinet
The timing relay Str falls
End

Fig 7.3

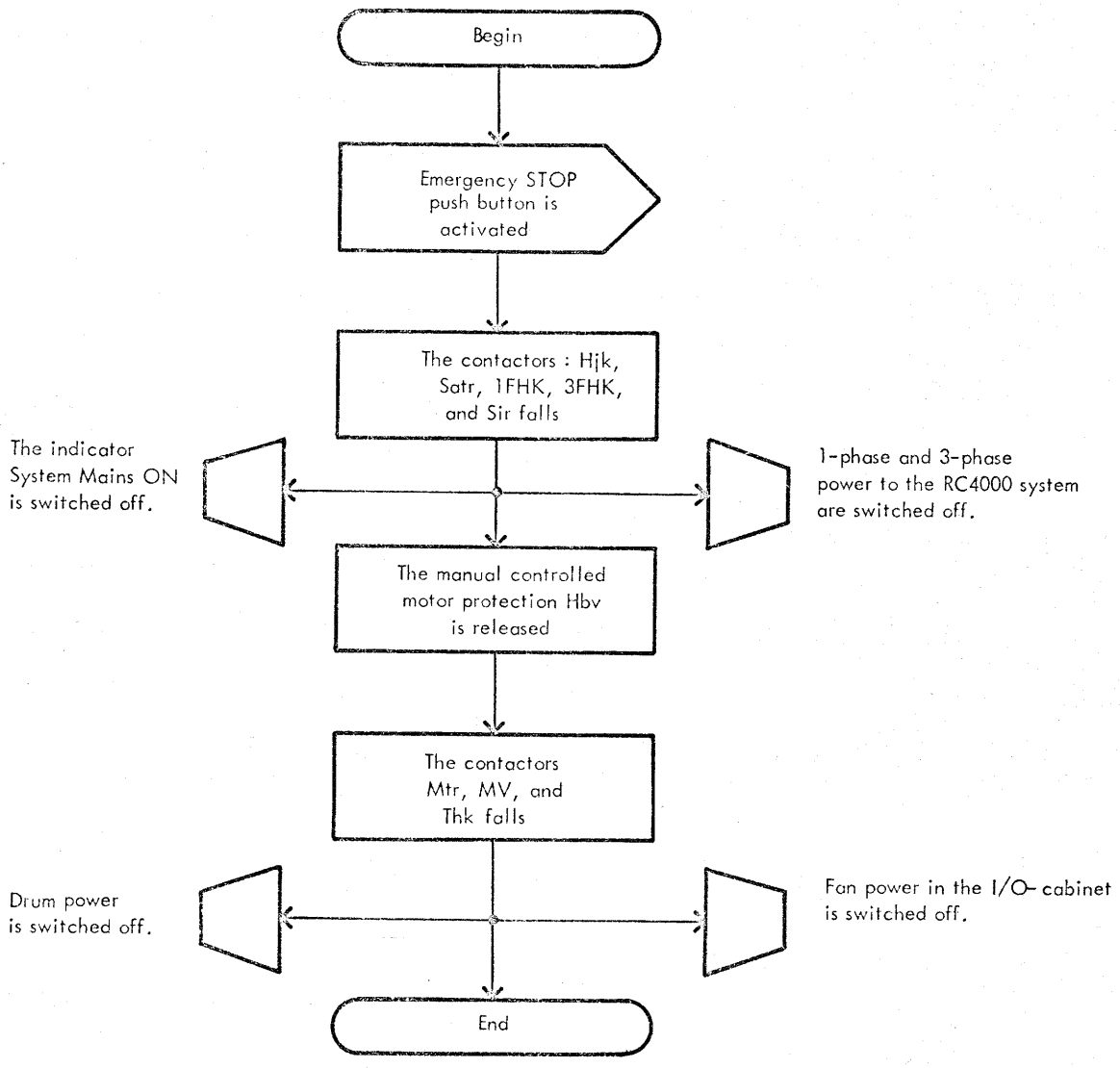
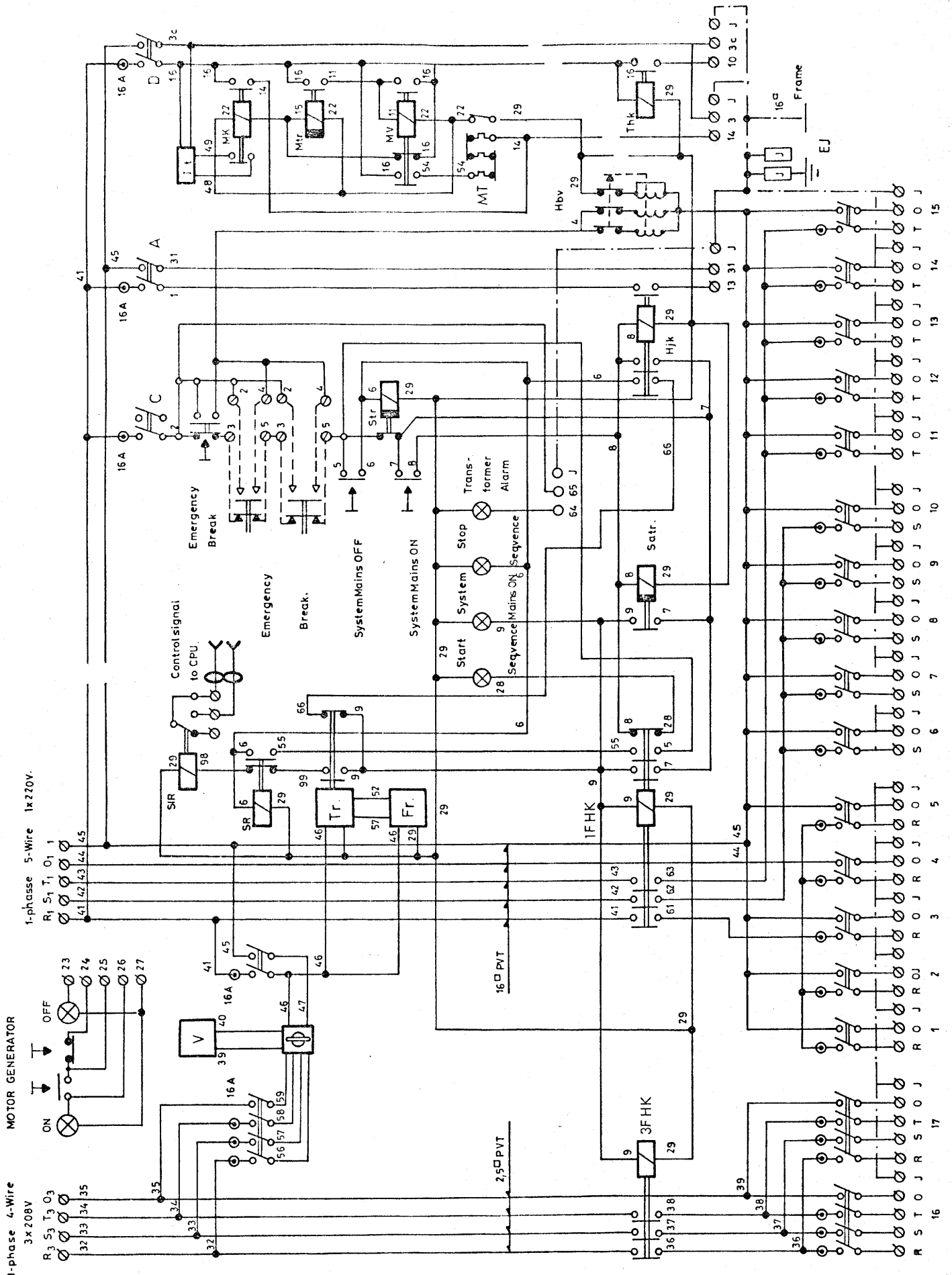

Begin
Emergency STOP push button is activated
The contactors : Hjk, Satr, 1FHK, 3FHK, and Sir falls
The indicator System Mains ON is switched off.
1-phase and 3-phase power to the RC4000 system are switched off.
The manual controlled motor protection Hbv is released
The contactors Mtr, MV, and Thk falls
Drum power is switched off.
Fan power in the I/O- cabinet is switched off.
End

Fig 7.4


MOTOR GENERATOR
3-phase 4-Wire
3x208V
1-phase 5-Wire 1x220V.
ON
OFF
Emergency Break
Emergency Break.
Control signal to CPU.
System Mains OFF
System Mains ON
Start
System Sequence
Stop
System Mains ON Sequence
Trans-former Alarm
Frame
EJ
1FHK
3FHK
16□ PVT
2,5□ PVT

RCSL: 51-VB1020
Author: L. Prøhl-Hansen
Edited: October 1970

RC 4000 AC POWER SYSTEM

Main Distribution Panel MDP 405

KEY: Wiring Diagrams.

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1. MAIN DISTRIBUTION PANEL MDP 405

The Main Distribution Panel MDP 405 is designed for housing the disk transformer unit DTU 401 in the case where the motor generator is omitted in the RC 4000 AC Power System. The panel includes fuses for the three-phase input to the transformer and a thermal overload switch for monitoring the neutral line current. The overload switch controles the alarm indicator Transformer Alarm on the Main Distribution Panel MDP 401. The terminal board in MDP 405 is designed for linking the three-phase main input to MDP 401.
The diagram for the Disk Transformer Unit DTU 401 is shown on Fig. 1.1. and the wiring diagram for MDP 405 is given on Fig. 1.2.

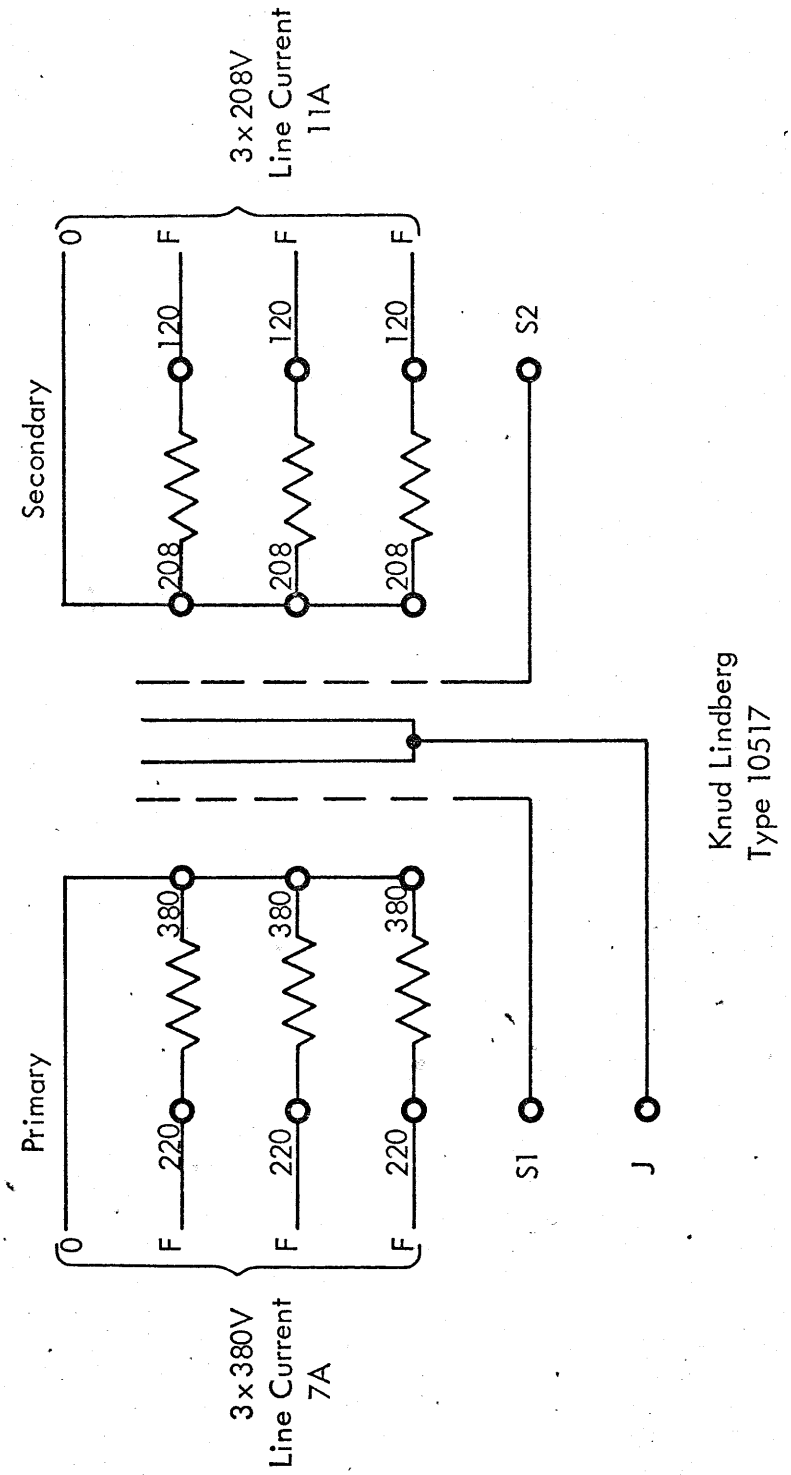


Fig. 1.1.

Disk Transformer Unit DTU 401

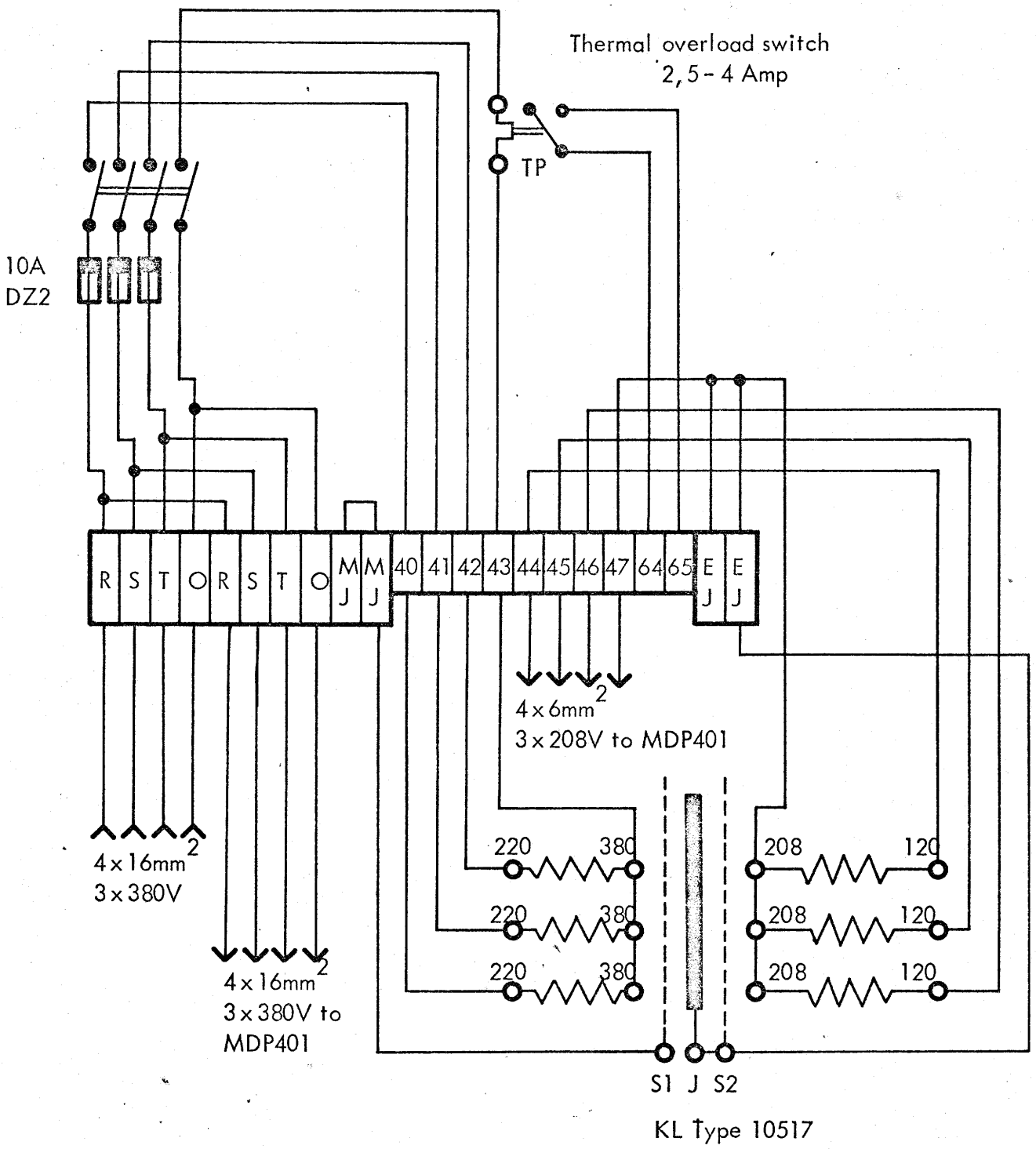
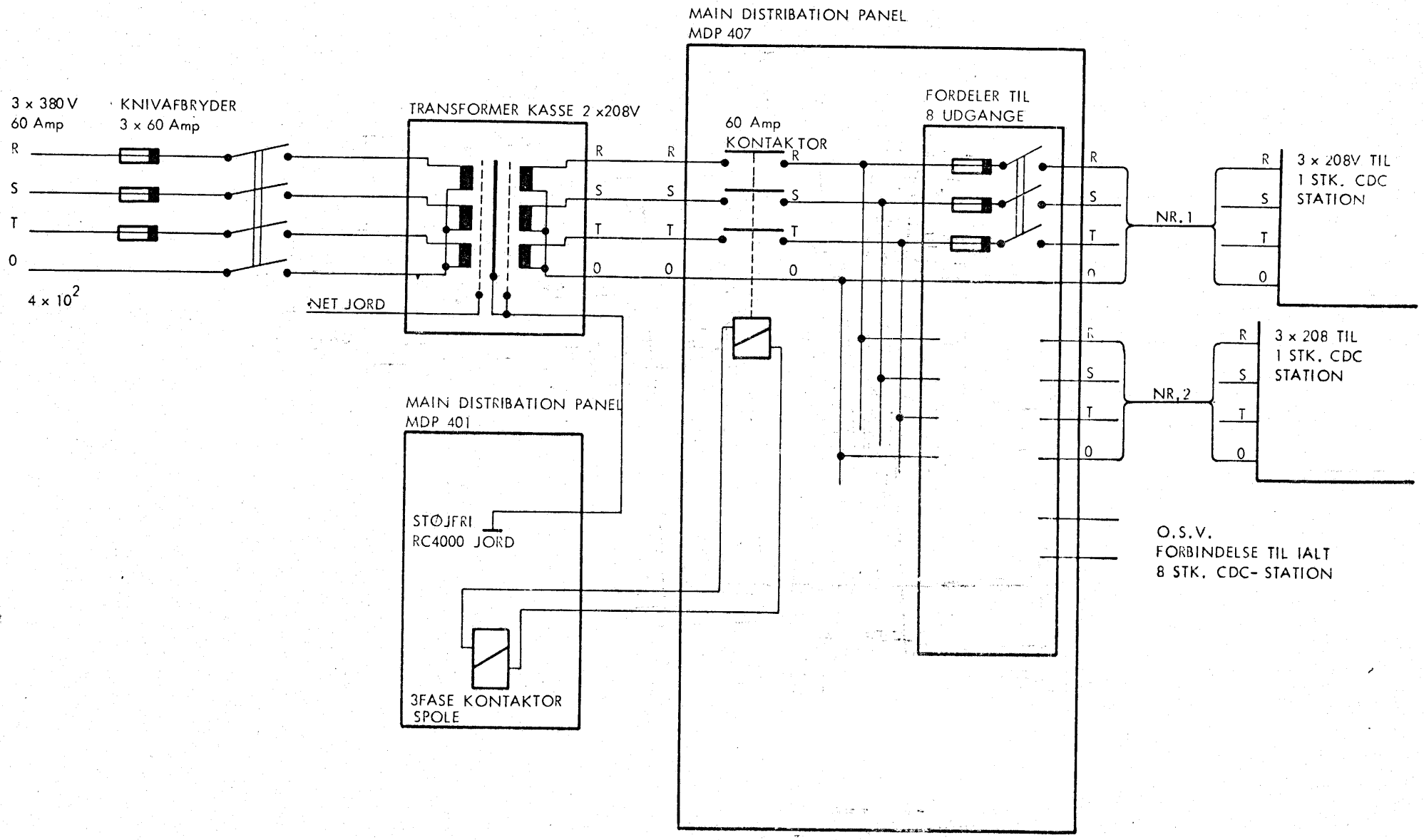


Fig. 1.2.

Disk Transformer Panel MDP 405 Wiring Diagram


MAIN DISTRIBATION PANEL
MDP 407
3 x 380 V
60 Amp
KNIVAFBRYDER
3 x 60 Amp
R
S
T
0
4 x 10²
TRANSFORMER KASSE 2 x208V
NET JORD
60 Amp
KONTAKTOR
FORDELER TIL
8 UDGANGE
NR.1
3 x 208V TIL
1 STK. CDC
STATION
NR.2
3 x 208 TIL
1 STK. CDC
STATION
O.S.V.
FORBINDELSE TIL IALT
8 STK. CDC- STATION
MAIN DISTRIBATION PANEL
MDP 401
STØJFRI
RC4000 JORD
3FASE KONTAKTOR
SPOLE

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