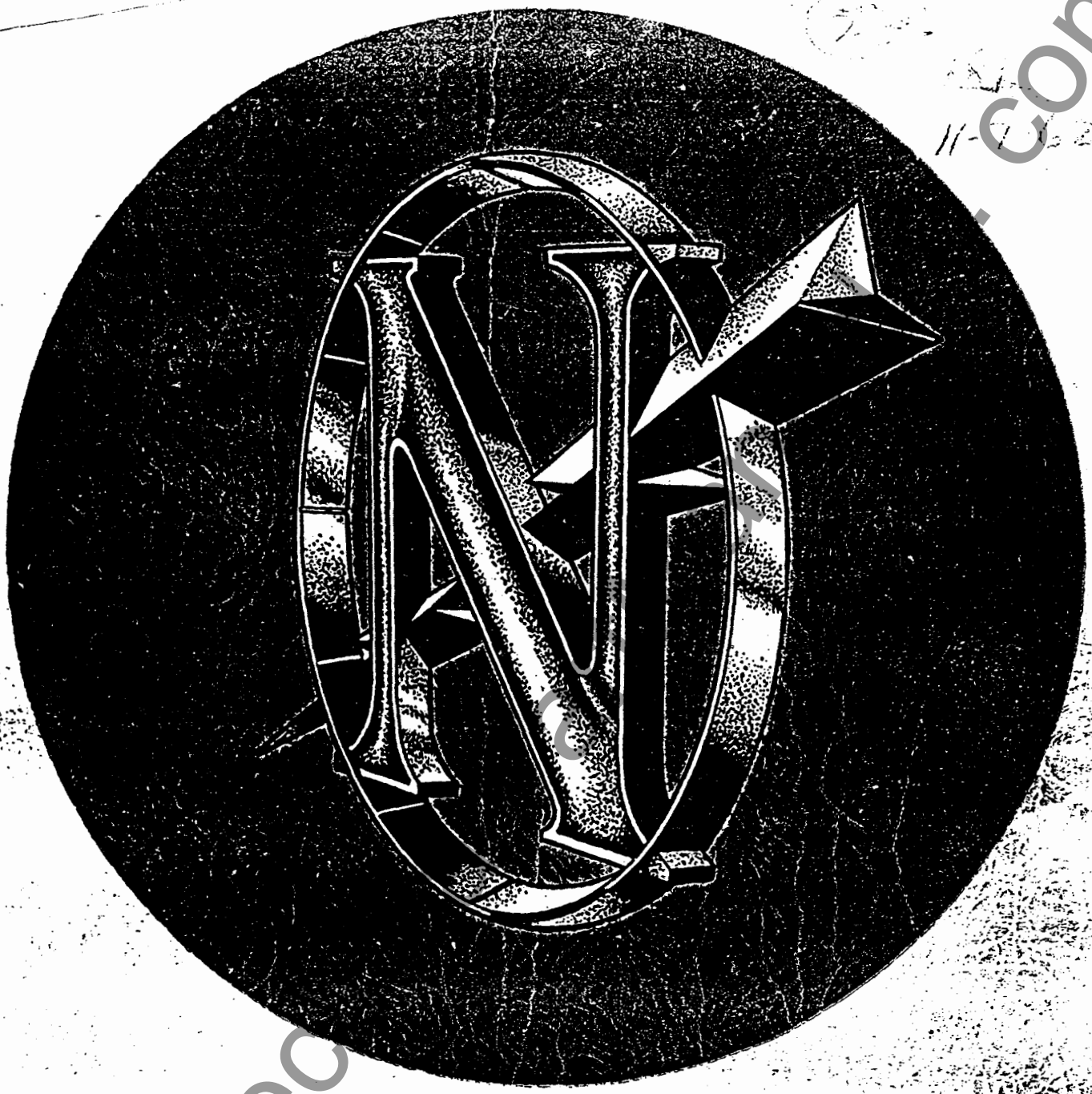

Type NT

NELSON

ELECTRIC MFG. CO.

TULSA, OKLAHOMA

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OPERATION AND MAINTENANCE MANUALS

AND RENEWAL PART LISTS

CL. 726 SWITCHGEAR

FOR

CITY OF CHICAGO

CENTRAL DISTRICT FILTRATION PLANT

Contract #23242

NELSON ELECTRIC MANUFACTURING CO.

TULSA, OKLAHOMA

S.O. CA-481-S1, S2 & S3

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I N D E X

a. APPLICABLE DRAWINGS (NOT INCLUDED)

Dwg. NO.	Title
DCA-148-1	Assembly, Incoming Switchgear
DCA-148-2	Assembly, Low Lift Pump Room East-Switchgear
DCA-148-3	Assembly Low Lift Pump Room West-Switchgear
DCA-148-10	Three Line & Control Diagram, Incoming Switchgear
DCA-148-17	Three Line & Control Diagram, Low Lift Pump Room East & West-Switchgear
DCA-148-23	Wiring Diagram, Incoming Switchgear
DCA-148-21	Wiring Diagram, L.L.P.R. - East Switchgear
DCA-148-24	Wiring Diagram, L.L.P.R. - East Switchgear
DCA-148-22	Wiring Diagram, L.L.P.R. - West Switchgear
DCA-148-25	Wiring Diagram, L.L.P.R. - West Switchgear
DC-844	Breaker Wiring & Control Diagram
DC-849	Test Cabinet
DCA-148-12	4.16 KV, 2000A - Bus Duct (Incoming)
DCA-148-11	4.16 KV, 2000A, Bus Duct (Feeder)
DCA-148-13	4.16 KV, 2000A, Bus Duct - Ass'y Details

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INSTALLATION AND MAINTENANCE INSTRUCTIONS

FOR

CLASS 726

HORIZONTAL DRAWOUT, METAL-CLAD

MAGNETIC AIR CIRCUIT BREAKER

SWITCHGEAR

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CAUTION

UNPACKING THE SWITCHGEAR

KEEP THIS SWITCHGEAR COVERED

This switchgear has been carefully packed to protect the finish and the delicate glass enclosed instruments which are mounted on the panel. The equipment consists of apparatus which must be carefully protected from the weather and extreme changes in temperature.

If it is necessary to unpack the switchgear before final installation it must be kept covered, dry and warm enough to prevent condensation until placed in service.

Great care should be exercised in uncrating and handling to prevent damage to the instruments, and scratching the painted surface.

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1. General Information

The shipment of this switchgear will include, besides breakers and cubicles, standard switchgear accessories which are required for proper operation and/or maintenance.

For Indoor-Switchgear

1-Crank for moving the breaker from test to operating position and vise versa.

1- Pair of Breaker Guides. These have to be hooked to the floor frame when rolling the breaker in-or out of the cubicle.

1- Breaker Moving Dolly, for easy handling of the breaker out of the cubicle.

1- Arc Chute Maintenance Support, for easy inspection of arc chutes and main contacts.

For Outdoor-Switchgear (not walk in)

1- Crank (as for indoor)

1- Transfer truck to replace breakers and for removing breaker out of the cubicle for maintenance.

1- Arc Chute Maintenance Support (as for indoor.)

Other Optional Accessories are:

-Test Cabinet. This is provided with a control-switch and a plug which allows it to operate the breaker outside of the cubicle for maintenance.

-Mechanical Interlock. Mounted on the drawout-device with kirk key interlock to lock the breaker in "open" position. For locking, trip the breaker, turn drawout device two or three revolution anti-clock-wise from "Operating" in position, lock and remove key.

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2-Foundation

-Note: Foundation should be made in accordance with the "foundation" drawing, which is specially made for each order.

-Indoor. The strong floor frame of each cubicle allows it to place the switchgear directly on any floor, and after leveling each separate cubicle it can be bolted down with anchor-bolts. The floor has to be of course of sufficient strength to withstand the weight of the switchgear and should have a certain level accuracy.

The installation will be of course much simpler and quicker when two base channels are inserted in the concrete. They should be parallel with the front, in line with the switchgear anchor-bolt-holes, and should extend the floor level approximately 1/8".

These base channels will be shipped with the switchgear if specified. The floor directly in front of the switchgear should be straight, hard and smooth in order to remove and/or replace a breaker quickly in case of emergency.

-Outdoor. (Not walk in). The base for an outdoor switchgear should be a well leveled, smooth concrete floor with anchor bolts located as shown on the "foundation" drawing. Special attention has to be given to the floor in front of the switchgear which has to be on the same level as the first base channel in order to keep the height of the transfer truck in line with the floor frame of the breaker compartment, to allow the breaker to roll from the transfer truck into the breaker compartment without difficulties.

-Conduits for the main cable and control wiring should be located in accordance with the "foundation" drawing.

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3. Installation

The indoor and outdoor (not walk in) cubicles will be shipped complete assembled and bolted together as one complete unit or in groups of shipping sections depending on quantity or size. They are ready to be bolted to the floor and hardware will be included to bolt the shipping sections together and make electrical joints as required.

Special attention should be given to the following parts:

-The Breakers will be shipped disassembled with the following parts:

1- Basic Breaker	(Fig.1-1a)*
3- Arc Shutes	(Fig.1-b)*
1- Front Panel	(Fig.1-c)*
2- Side Panels	(Fig.3-8a,8b)*
2- Interphase barriers	(Fig.3-5*)
1- Tie Bar	(Fig.3-8d)*

(*Fig. and item number refer to "Nelson Magnetic Air Circuit Breaker Instruction Book.")

For the assembly refer to the "Nelson Magnetic Air Circuit Breaker Instruction Book" which will be included in this booklet.- Breakers for an outdoor switchgear should be assembled, one at the time, on the transfer truck and rolled into the breaker compartment, in order to prevent any lifting.

-Outdoor Switchgear. In case an outdoor switchgear is shipped in two or more shipping sections and/or a connection throat or a bus duct is attached there will be either a package of "Mortite" and/or "weather-strip" in the shipment included. Either of these or both should be used, depending on the design, to seal the sheet-metal joints.

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-Bus Bars and/or Connection Throat Bus. If "Bus Bar Joint Boxes" are included in the shipment (see assembly drawing and drawing list) these have to be placed over the bus bar joints and fastened with two or three layers of electrical tape on the left and right hand side of the "Bus Bar Joint Box." No filling compound is required.

Where no "Bus Bar Joint Boxes" are shown or are not included in the shipment, the bus bar joints have to be taped with a quantity of layers of "Duct Seal" and "Vinyl Tape", corresponding to the rated voltage. "Duct Seal" and "Vinyl Tape" will be included in the shipment.

-Incoming Cable Connections. Pothead or cable lug connections have to be taped as described above. Do not fail to complete taping before putting switchgear into service.

-The Ground Bus has to be permanently connected to the station ground.

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4. Putting Into Service

After the switchgear is installed as described before and the control circuits are connected the "Magnetic Air Circuit Breaker" may be rolled into the cubicle. Proceed as follows:

-Check if the "nut"of the drawout device is completely in the "test" (front) position. (The operation of the drawout device with its different interlocks is described in the "Nelson Magnetic Air Circuit Breaker Instruction Book").

-Check if the breaker blades are in open position.

-Roll the breaker into the breaker compartment, using "breaker guides" (for indoor) or "transfer truck" (for outdoor), till the breaker-latch engages and locks with the drawout-device nut.

-The breaker is now in "test position." The control circuits are connected, but not the main circuits. The automatic shutter is still closed. Operate the breaker a few times to check general operation.

-Close outer door (for indoor) or instrument panel (for outdoor) and move breaker with crank into "operating position." A positive stop will be felt when the breaker is fully engaged.

-For meters, relays, recorders, etc. refer to the corresponding instructions books which are included in this booklet.

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5. Maintenance

The switchgear should be given a thorough, overall maintenance check at least once a year, when operation conditions are normal. Where operating or atmospheric conditions are abnormal more frequent inspection and maintenance is necessary.

-General. After de-energizing the primary and secondary circuits remove all coverplates and remove all accumulations of dust with a vacuum cleaner or dry cloth. Clean all bus bars, bus supports and spouts with a cloth dampened with carbon tetracloride. Check all main and auxiliary wire connections, as far as accessible.

Special attentions should be given to the following parts:

-Stationary Main Contacts. Check if these are burned. If only slightly burned they may be dressed with a fine file. Remove only the high spots. Do not attempt to file out pits. Any badly burned contacts should be replaced. Remove spout cover in the rear compartment, disconnect bus bar, remove retaining ring and push contact forward. To assemble proceed in reverse order.

-Drawout Device. Check if nut moves freely. Tighten all screws. Lubricate worm screw and other moveable parts. Do not try to replace parts or to repair the drawout device, because its proper operation depends on close tolerances. Any defective drawout device should be replaced by a new one.

-Stationary Auxiliary Contacts. Check spring actior of each contact and wire connections. If a contact or the complete contact block has to be replaced its alignment with the breaker contacts can be checked by inserting the breaker slowly and carefully, using a flash-light.

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-Breaker Rails. These should be cleaned carefully, because any accumulation of dirt would cause misalignment of main and auxiliary contacts.

-Shutter, Check if shutter-plates move freely and lubricate all moveable parts.

-Dust Filter should be cleaned or replaced at least once a year.

-Instruments, relays and other devices should be maintained according to their specific instruction books.

-Before putting switchgear back into service operate the breaker a few times in test position to assure proper operation.

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6. Spare Parts

The following items are suggested for a typical order, although recommendations may vary for particular installation.

Quantity	Description	Part No.
3	Stat. Main Contacts for 1000A brk.	DB-678-1
3	Stat. Main Contacts for 1200A brk.	DB-678-2
3	Stat. Main Contacts for 2000A brk.	DB-678-3
1	Stat. Auxiliary contact assembly	DC-721

Other recommended parts are:

- 1 Set primary fuses for voltage transformer, etc.
- 2 Sets secondary fuses
- 2 Sets Indicating lamps

Note: When ordering spare parts please refer to:

-Name of installation, original purchase order and corresponding Nelson Electric Shop Order number.

Full Nelson nameplate data of switchgear.

-Quantity, description and location of required part.

-Please give this information also when ordering "as per enclosed sample."

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OPERATION - MAINTENANCE

INSTRUCTIONS

NELSON

Magnetic Air Circuit Breaker

4.16, 7.2 & 13.8 KV - 75 to 500 MVA

NELSON ELECTRIC MANUFACTURING CO.
P. O. BOX 5385
TULSA, OKLA.

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INSTRUCTIONS FOR OPERATION AND MAINTENANCE MAGNETIC AIR CIRCUIT BREAKER TYPE NT

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1. GENERAL DESCRIPTION

Basically the magnetic air circuit breaker consists of three parts (fig. 1).

a. **The Breaker Carriage** (fig. 17) with built in power storage drive, the main contact system, the control block and the air blow-out mechanism.

b. **The Arc-chutes** (fig. 7) are mounted over the main contacts. They are built up of arc resisting material and have arcing horns for the guidance of the arc. A U-shaped magnetic system with blow out coils is located in the lower part of the arc chute. In the upper part of the insulating chambers numerous metallic and insulating laminations are arranged for the purpose of splitting up the arc and thus completing the interruption.

c. **The insulating and protecting panels** consisting of two interphase barriers 5 (fig. 3) and a metallic front panel C (fig. 1).

The closing and tripping of the breaker is accomplished by a charged spring which offers the assurance that once the closing cycle is started it will definitely be completed, no "Kissing" and burning of contacts due to low control voltage, etc.

Also the breaker will not close unless the spring is sufficiently charged to make a complete "closing and opening" cycle.

If the breaker is already closed the spring charge has sufficient power to "open, close and re-open" the breaker.

The spring is normally charged automatically by a small electric motor. However, it may be charged by a foot pedal in case of control power failure.

2. OPERATION OF THE BREAKER

a. **Charging of the Spring**

The operation of the breaker is quite simple. Refer to figures 25, 25A, 25B, and 25C.

Charge the main spring either by motor or foot pedal. For convenience we will let the motor charge the spring.

The power delivered by the motor 33 compresses or charges the spring 38 via the differential gear assembly 36, 37a and 37b, constant torque cam 35 and chain 34.

The motor is controlled by a limit switch 61 which is actuated by a cam 53 and lever 60. This is illustrated in figures 25b and 25c. When the spring is partially discharged the motor starts and rewinds or charges the spring. When it is fully charged the cut-off switch is opened and stops the motor.

While the motor is charging the spring it rotates ring gear 37a but the other ring gear 37b holds still since it is blocked by one of the two blocking cams 39. These cams and ring gear 37b are rigidly keyed to shaft 40.

Since one ring gear rotates and the other holds still, then the pinion gear 36 must rotate and revolve around its axis.

A constant torque cam 35 moves along with the pinion gear thus pulling chain 34 and compressing or charging spring 38.

Notice that ring gear item 37a differs from item 37b in that it has ratchet teeth on its outer edge into which latch 101a engages. This means that ring gear 37a *always* turns in the same direction thereby retaining any charge that is stored in the spring until such time as a close or trip function is executed.

One of the ratchet latches 101a holds the ring gear and spring charge while the other is only used when charging the spring by the foot pedal.

b. **Indicating Device**

Indicating devices in windows in the front panel fig. 1 are showing adjacent to one another whether the operating spring is "extended" or "released" and whether the breaker is "open" or "closed". The latter indication is operated automatically from the control shaft 29 (fig. 25).

The indication "extended" indicates only the fully charged condition of the spring.

The indication "released" means that the spring is not fully charged but it may be in any position between fully charged and completely discharged condition.

Before undertaking any manipulations with the operating mechanism or with the breaker contacts, the spring must be completely discharged and thus not dangerous. This is done by holding down on "close blocking lever" 56 (fig. 10) and closing and opening the breaker repeatedly until it will no longer operate.

c. **Closing the Breaker** (fig. 25, 25a, 25b, 25c)

Assuming the main spring 38 to be fully charged press the close button item 31-I on the front of the control unit. This pushes the release arm 55 forward causing the toggle assembly immediately above it to unlatch and collapse. Lever 25 is then free to be pulled downward by spring 26. The clevice 25a/b, being rigidly attached to lever 25, strikes the power toggle unit allowing it to collapse. This unblocks cam 39 from damping device 47 leaving shaft 40 free to rotate from the charged main spring 38 via chain 34, cam 35, pinion 36 and ring gear 37b (37a is held stationary now).

As shaft 40 rotates cam 41 follows, pushing pitman rod 42 upward. This upward movement causes breaker shaft 50 to rotate and transmit power, via the three insulated rods 49, to all three main switch blades 52 simultaneously, thus closing the breaker.

At this point the main spring is still partially charged, at least enough to open the breaker. The spring discharge must be stopped some way, otherwise the breaker would immediately open. However, a sec-

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ond cam 39 rotates with shaft 40 until at 180° of rotation of shaft 40 the second cam 39 is blocked by the oil dash pot damper unit 47 thus stopping the spring discharge and further movement of all parts including the main switch.

The spring is now partially discharged and limit switch 61 goes closed starting the wind-up motor to recharge the main spring 38.

d. Tripping the Breaker (fig. 25, 25a, 25b, 25c)

The tripping of the breaker is done by the same main spring that closed it. This causes a very fast and positive opening function.

The tripping mechanism is almost identical to the closing mechanism and the operation is exactly the same.

To trip the breaker press the "trip" button 31-0 on the front of the control unit assembly. This pushes release arm 55 forward allowing the tripping toggle unit to collapse.

Spring 26 now pulls lever 25 and clevice 25 a/b downward against the power toggle lever 45d thus collapsing the tripping power toggle. This unblocks cam 39 allowing shaft 40 to be rotated by the main spring via chain 34, cam 35 and ring gear 37b.

As shaft 40 rotates the main switch is pulled open via pitman rod 42, shaft 50, insulated rods 49 and the switch blades 52.

Here again at the end of 180° of rotation of shaft 40 cam 39 strikes the oil damper unit 47 and stops its rotation and further movement of the main switch.

The main spring is now partially discharged and the limit switch 61 closes. This starts the rewind motor 33 to recharging the main spring 38.

By now you will have noticed that ring gear 37a always rotates in one direction and 37b in the other direction. Also that their associated pinion gear 36 both rotates and revolves first one way and then the other depending upon whether the main spring is being charged or discharged.

Shaft 40 always rotates in the same direction regardless of whether the breaker is opening or closing. Also it only rotates 180° during either a closing or an opening operation.

At the end of each 180° of rotation one or the other of the two blocking cams 39 will be stopped by one of the two power toggles and its respective oil filled damper units (shock absorbers).

e. The Control Block (fig. 25, see also fig. 12)

The control block is a completely assembled unit of toggles, linkages, etc.

Basically it is a small trigger operated trip hammer that triggers a larger power toggle system to close or open the main switch.

The unit can be operated either mechanically by the close or trip push buttons on the front, or it can be operated electrically by energizing either of the two coils 32 from an external electrical source. These coils are available in almost any voltage for either AC or DC. Each coil may be used for either tripping or closing service, since they are identical.

Either closing or opening the main switch automatically resets the opposite control unit toggle mechanism so it is ready to perform the next function.

This is accomplished by the rotation of shaft 50 during either operation transmitting power via rod 28, shaft 29 and two cams 30 which are secured to shaft 29 at 90° apart. One cam 30 resets the closing toggle when the breaker opens and the other cam resets the tripping toggle when the breaker closes.

This feature eliminates the necessity of "latch check" switches that are necessary on other circuit breakers when used with reclosing relays.

f. Blocking of the Closing Operation (fig. 25b)

The breaker cannot be closed until the spring 38 is sufficiently charged to make a "close-open" cycle.

The cam 53, which rotates as the spring 38 charges or discharges, is so designed that when there is insufficient power for the complete "close-open" cycle the roller on lever 60 leaves the cam 53 allowing spring 59 to pull lever 60, flag rod 58 and pin 57 upward. This causes lever 56 to turn slightly about its pivot in a counter clockwise direction. Lever 56 strikes lever 55 and pushes it downward enough to unlatch lever 55 from the toggle assembly thus rendering the "close" push button 31 inoperative until the spring is sufficiently recharged to make a complete "close-open" cycle.

A second blocking action of the "closing" mechanism is provided by rod 27 (fig. 25). When lever 25 of the control block moves downward and closes the breaker, rod 27 moves downward against lever 55 and, as explained above, unlatches lever 55 from the control toggle as long as the mechanical "close" push button 31 is pushed in or the "closing" coil is energized. This insures that one closing impulse, independent of its duration, can provide *only one* closing operation and consequently the breaker is "pump free".

From this it may be seen that if for any reason the breaker trips immediately after being closed and the operator is still holding the "close" button 31, or a remote electrical "close" button in the "close" position, the breaker will not re-close until the button is returned to its "normally off" position and a second closing impulse purposely initiated.

g. Air Blowout Mechanism (fig. 18)

In case of small interrupting currents, producing only a weak magnetic field, the arc has to be blown

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onto the arcing horns by means of air blowing. For this purpose the breaker is equipped with a pneumatic device, consisting of the piston 21d driven from the shaft 50, and compressing air in the cylinder 21c thus blowing air via the flexible hose 21b to the nozzle 21a.

h. The Main Contacts (fig. 22)

When treated according to the directions for maintenance, the contacts will close without difficulty on any short-circuit with currents not exceeding the breaker capacity. The shape of the finger contacts item 12 and 210 reduces the electrodynamic forces.

The opening of the contacts is performed in two steps in order to reduce the wear on the main contacts carrying the sustained current. The moving contact 11 leaves the main finger contacts 210 first and afterward the arcing contacts 12a and b which have a shape favoring a rapid transplantation of the arc (see phase I of fig. 18).

i. The Interruption (fig. 18)

As soon as the moving contact 11 leaves the arcing contact 12, the arc will jump to the arcing horn 14 (from phase I to phase II), whereby the magnetic blow out coil 16 is inserted in the circuit. The magnetic field produced by the coil drives the arc upward, causing the other end of the arc to jump from the moving contact 11 to the arcing horn 15 (phase III). The arc has now reached the arc-chute and is divided into a series of partial arcs between the connecting horns 18. Under the influence of the magnetic field these arcs move upward, simultaneously being turned 90° due to the shape of the connecting horns.

The partial arcs are thus now burning parallel to each other and together with the connecting horns they produce a solenoid-shaped current path. The magnetic field of this path pushes the arcs further upward into the region of the metal plates 19 (phase IV), where they are divided into many short arcs which after passing through zero current are extinguished and are unable to reignite. The insulating barriers 20 following the metal plates prevent partial arcs from leaving the arc-chute. The hot gases from the interruption are finally stopped by the covering hoods and deflected downward.

j. Drawout Device (fig. 20)

The breaker is moved between the test and operating positions by means of a drawout device as shown schematically in fig. 20. When pushing the breaker into the cubicle, the stopper 73 will reach the nut 74 and couple to it, which however is only possible if the moving nut is in the correct outer end position (test position). If this nut is in any other position, the arm 75 will have swung upward, thus preventing the coupling between breaker and drawout device.

When the coupling is established the breaker can be moved between the test and operating positions with the crank 71. The coupling can only be released in the test position; a release in the operating position or during movement is prevented by the lifting cog 72 sliding on the rail 77.

In order to prevent burning of the tulip contacts 9a of the breaker and stationary contacts of the cubicle, by inserting or withdrawing the breaker to or from the operating position when closed, a mechanical interlock system is built in (see fig. 20).

As an example when the breaker is closed, rod 68 and roller 69 are raised thus allowing release latch 70 to drop into a notch on blocking ring 79. When 78 and 79 are so engaged it is impossible to crank the breaker from test position to operating position or vise versa.

Also it is impossible to close the breaker while in transit from "test" to "operating" positions because roller 66 travels on rail 76 which is designed like a cam so that in between the test and operating positions of the breaker the roller 66 raises, pushing rod 67 upward. This causes lever 56 to push lever 55 downward and unlatch from the closing toggle mechanism such that the closing push button 31 is inoperative.

However, when the breaker is in either the operating or test position, or even out of the cubicle, the roller leaves the rail and allows the lever 55 to recouple the closing toggle such that the push button is now effective for closing the breaker.

3. MAINTENANCE

In order to maintain high reliability in operation and to prevent breakdowns, it is recommended to do the maintenance work specified below after:

—500 normal breaker operations

—as soon as possible after short circuit operations

—at least once a year

Caution: The breaker must be removed from the cubicle before the front panel is removed. The power storage spring must be fully discharged before any manipulations are made with the contacts or the operating mechanism. Note that the spring may still be partially charged even though the breaker will not close by operating the close push button, because an interlock is provided that prevents the closing of the breaker unless the spring is sufficiently charged to make a complete "closing and opening" cycle. Discharge the spring by holding down on "close blocking lever" 56 (fig. 10) and closing and opening the breaker repeatedly until it will no longer operate.

a. Protecting Panels (fig. 3)

Remove the front panel 7, the interphase barriers 5 and side panels. Clean with a dry cloth.

b. Arc-Chutes (fig. 9)

Swing out the arc-chutes utilizing the supporting bracket 10. Clean all accessible parts with a dry cloth. If the heat-resistant insulating walls of the arcing zone are heavily covered with carbon and copper, they are

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to be cleaned with a suitable steel brush, but no disassembly is required. Check if there are any cracks or damage in the small chambers and barriers.

c. Main Contacts

To check the alignment and operation of the movable and stationary contacts the breaker may be *closed very slowly*. To do this some means of "cheating" must be resorted to as follows: (fig. 10)

a. Completely discharge the main operating spring 38 by holding down on "close blocking lever" 56 and closing and opening the breaker repeatedly until it will no longer operate.
b. Hold down on "close blocking lever" 56, and also press the close button 31.
c. Operate the foot pedal 101, *slowly*. The breaker blades will now close *slowly* so their operation and alignment can be watched.

It will perhaps be necessary to disconnect the insulated rod 49 from the blade 52 so each blade can be tested separately by hand movement.

When replacing contacts follow instruction of fig. 22, 23 and 24.

The moving contacts 11 should enter the stationary arcing contacts 12a and 12b and also the main finger assemblies 210 squarely and evenly on the sides. If necessary add or remove spacers, item 211, on either side of moving contact 11 for proper alignment.

Any badly burned contacts should be replaced. If only slightly burned, they may be dressed with a fine file. Remove only the high spots that would cause gouging or plowing when the contacts close. *Do not* attempt to file out pits.

Apply a good grade of graphite oil or Molykote to the contacts to reduce friction. Wipe off any surplus oil so it will not gather dust, grit, etc.

To replace the stationary contacts, 12a, 12b or 210, remove the nuts 208, springs 206, washers 222, and stud 207 and replace contacts. These are special shoulder type nuts and studs. No gauging nor calibrating is necessary. When the nuts are screwed on the stud until the shoulders jam, the proper spring pressure is applied on the contacts.

If the springs are burned or splattered with copper they should also be replaced.

Wipe off any smoke, carbon or other foreign material from all insulated parts including the push rods 49. Lubricate all moving joints with graphite oil or a dry lubricant such as Molykote powder.

d. Air Blow-out Mechanism

Clean the nozzles, check to see that the air can flow freely through the hoses and that there is no leakage.

e. Operating Mechanism

The mechanical parts are cleaned with cloth, brushes and maybe with a vacuum cleaner.

Oil spots in the bottom suggest either too much lubrication on previous occasions or that the shock absorbers 47, (fig. 4 and 27) are leaking.

After cleaning grease slightly *all* bearings and parts subject to friction with graphite oil (see fig. 31).

Finally perform a few operations to obtain a better distribution of the oil.

4. OVERHAUL

The length of service until overhauling becomes necessary depends on the operating conditions of the breaker and on other local factors.

If the maintenance work is performed regularly and carefully it will be obvious when the breaker should be overhauled.

Caution: The breaker must be removed from the cubicle before the front panel is removed. The power storage spring must be fully discharged before any manipulations are made with the contacts or the operating mechanism. Note that the spring may still be partially charged even though the breaker will not close by operating the close pushbutton, because an interlock is provided that prevents the closing of the breaker unless the spring is sufficiently charged to make a complete "closing and opening" cycle. Discharge the spring by holding down on close blocking lever 56 (fig. 10) and closing and opening the breaker repeatedly until it will no longer operate.

In connection with the overhauling work specified below the maintenance instructions of section 3 must simultaneously be followed.

a. The Arc Chutes

To remove the arc chutes:

–Remove the side and front panels 8a, 8b and 7 (fig. 3).
–Remove plastic interphase barriers (fig. 3).
–Remove two shoulder studs 3d one on each side of each arc chute (fig. 4).
–Install the supporting bracket 10, for arc chutes (fig. 9).
–Tilt the arc chutes forward one at a time, allowing it to pivot on bolt 22, until the arc chute assembly rests on the supporting bracket 10. (fig. 9).
–Clean all accessible parts with a dry cloth. If the heat-resistant insulating walls of the arcing zone are heavily covered with carbon and copper, they are to be cleaned with a suitable steel brush, but no disassembly is required. Check to see if there are any cracks or damage in the small chambers and barriers. The arc-chutes shall never be taken apart more than indicated on fig. 19. The numerous metal plates and insulating barriers can not be properly reassembled without special tools and training.

The screws 1a, (fig. 4) are tightened with a torque of 14–15 ft. lbs and locked with the lock nuts.

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The wear due to burning on the arcing horns 14, 15 and 18, (fig. 18) will be small, even after many operations and short circuit trips. The insulating walls in the arcing zone I-III will be copper covered and the inside of the chambers will show layers of carbon and copper oxide, which must be removed as far as possible without further disassembly. After cleaning with brushes all the channels in the arc-chutes should be blown out with compressed air. If the inner channels appear to be "burned out", a voltage test is recommended. A low frequency voltage of 2.5 times the operating voltage should be applied to the connection points 13 and 22, of the arc-chute, completely assembled with the magnet poles. If the arc-chute does not withstand this test, the active part 1, (fig. 19) must be replaced.

b. Main Contacts

Replace and align main contacts as described under maintenance paragraph "C".

c. The Air Blowout Mechanism

While the breaker is stripped for overhaul the air system is accessible for inspection.

Usually about all that is necessary in the way of maintenance of this system is to clean the parts and apply lubricant. See that the hoses and nozzles are not restricted in any way so the air moves freely through them.

d. The Control Block

The control block is only to be removed if parts of the toggle units 45 (fig. 27) are not otherwise accessible.

To remove the control block:

–Disconnect the closing and tripping coil wires at the terminal block.

–Disconnect the "on-off" flag shaft from the control block mechanism by removing the pin.

–Also pull the pin disconnecting rod 28 from shaft 29 (fig. 4).

–Remove ½" bolt 23e, and washer 23f (fig. 17 or 12).

–Remove the entire control assembly by pulling it outward.

e. Changing or Replacing Coils (Fig. 11, 12 and 13)

–Remove control block assembly, item 23, from the breaker (see paragraph d).

–Unhook the four springs 26, from tripping lever 25.

–From the back side of the back plate remove the two flathead screws 23g.

–Disconnect coil leads from the terminal block.

–Remove back plate with coils attached over the two guide pins 45h, which remain in the aluminum coil housing 32a, and serve also as guides when replacing control block on the breaker.

–Coils can now be removed.

–Re-assemble in the reverse order.

f. The Main Power Unit

This includes drive motor, differential gear, main shaft, power spring, shock absorber and control block.

Do not operate this mechanism unless it is installed in the breaker and coupled to the contacts. To do this would cause extreme overstressing of certain parts and thus endanger the operational reliability of the mechanism.

To remove the main power unit proceed as follows:

–Remove pitman rod, item 42 (fig. 4).

–Disconnect wiring from terminal blocks, auxiliary switch, etc.

–Remove flag operator shafts (fig. 4).

–Remove four ½" shoulder bolts 145b, two on each side of breaker carriage (fig. 4).

–Withdraw entire power drive assembly from breaker carriage by pulling it forward (fig. 17).

–*A general overhauling* covering cleaning with brushes and kerosene and a careful inspection pertaining to defects, wear, loose screws and positioning rings can be performed without further disassembly.

–The *ball and roller bearings* 106, 107 and 144, (fig. 27 and 30) are filled with a very durable grease from the factory. They need no further lubrication provided that the original grease has not been washed out with cleaning liquid.

–*A careful lubrication* with graphite oil of all links and points subject to friction is essential for reliable operation. (See lubrication chart, (fig. 31).

Inspect *oil level in shock absorbers* as follows:(fig. 27)

–Remove the snap rings from the retaining shaft 112, that passes through the top of shock absorber pistons 47b.

–Push shaft 112 to either right or left as required to free the piston.

–Lift piston 47b upward.

–Inspect oil level in cylinder with the piston 47b removed. The oil level in the cylinder should be up to the shoulder where the cylinder changes diameter (see arrow).

–Use ordinary transformer oil in the cylinder.

Caution: Keep sand, grit, etc. out of these parts and see that the gasket at the top of the cylinder is not damaged when re-assembling.

–*Oil changing in the motor gear* is only necessary after approximately 20,000 CO operations of the breaker. For this purpose the complete motor with gear is removed, whereby it is easy to drain out the oil, flush with new oil through the two oil draining openings and then fill in new oil, of a quality suitable for gears, up to the red circle mark on the oil level gauge (fig. 27).

g. Control Circuits

When the operating mechanism is put back in the breaker carriage the control wires are to be reconnected in the former sequence and according to the diagram. Check all contact screws, also on the auxiliary switch 98, terminal block 99 (fig. 4).

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5. SPARE PARTS

When ordering spare parts please refer to:

1. Name of installation and if possible the original purchase order and the correspondingNelson Electric shop order number.
2. Full Nelson name plate data of breaker.
3. Quantity, designations, and item numbers as given in this book for the desired parts.
4. When ordering coils and/or motor specify voltage and frequency.

Please give this information also when ordering "as per enclosed sample".

We recommend stocking at least the spare parts listed below:

PART	ITEM	FIGURE
Moving contact	11	22
Arcing contacts	12a/b	22
Finger contact	210	22
Screw for finger contact	207	22
Spring for finger contact	206	22
Nut for finger contact	208	22
Close or trip coil	32	12

6. LEGEND OF COMPONENTS

1 Arc Chute
1a Screw
2a Hood
2b Belleville washer
2c Cap screw
3a Spacer
3b Connection piece
3c Washer
3d Cap screw
3e Belleville washer
3f Cap screw
5 Interphase barrier
6 Barrier spacer
7 Front panel
8a Side panel
8b Side panel
8c Back panel
8d Tie bar
8e Cap screw
8f Nut
8g Countersunk screw
9a Tulip contact
9b Ring
9c Belleville washer
9d Cap screw
9e Insulating tube
10 Maintenance bracket for arc-chutes
11 Moving contact
12a Arcing contact
12b Arcing contact
13 Bolt
14 Arcing horn
15 Arcing horn
16 Coil
17 Magnetic circuit
17a Magnet pole
17b Magnet pole
17c Insulating tube
17d Magnet core
17e Cap screw
17f Cap screw
18 Connecting horn
19 Metal plates
20 Insulating barriers
21a Nozzle
21b Hose
21c Air blow cylinder
21d Piston
22 Bolt
23 Control block
23a Spring
23b Spring
23c/d Terminal block
23e Cap screw
23f Belleville washer
23g Countersunk screw
24 Toggle joint
25 Lever
25a/b Clevis
26 Stored energy spring
26a Eye
26b Ring
26c Ring
27 Pin
28 Rod
28a Snap washer
28b On-off flag rod
29 Shaft
30 Cam
31 Pushbuttons "close"/ "trip"
32 Coils "close"/"trip"
32a Spacer
33 Spring winding motor complete
33a Worm gear
33b Spring
33c Pinion
33d/e Lock pins
33f Lock washer
33g Motor (without gear)
33h Lock washer
33i Cap screw
34 Link chain
34a/b Master link

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34c Lock pin
35 Constant torque cam
36 Pinion
36a Pinion shaft
36b Disc
36c Lock pin
37a Ring gear
37b Ring gear
37c Key
38a Power storage spring
38b Power storage spring
38c Spring plate
38d Chain holder
38e Pin
38f Roller
38g Pin
38h Snap washer
39 Damping cams
39a Key
40 Shaft
41 Drive cam
41a Washer
41b Snap washer
42 Rod
43 Roller
44a Spring
44b Spring
45 Toggle unit
45a Link
45b Link
45c Washer
45d Toggle lever
45e Pin
45f Snap washer
45g Pin
45h Lock pin
46 Spring
46a Pin
47 Damping device
47a Cylinder
47b Piston
47c Ring
47d O-Ring
47e Lip gasket
47f Position ring
49 Insulating rod
50 Breaker shaft
52 Moving contact blade
52a Bar
52b Bar
53 Control cam
54 Plate for indicating device
55 Release arm
56 Lever
57 Stop pin
58 Rod
59 Spring
60 Blocking device
61 Limit switch
62 Rectifier
63 Condenser
65 Latch
66 Roller
67 Rod
68 Rod
69 Roller
70 Release latch
71 Crank
72 Lifting cog
73 Stopper
74 Moving nut
75 Blocking arm
76 Blocking rail
77 Rail
78 Worm screw
79 Blocking ring
85a Stationary aux. contact
85b Moving aux. contact
85c End piece
85d End piece
85e Bridle
85f Dove-tail rail
98 Auxiliary switch
98a Rapid closing, or retarded opening contact
98b Contact
99 Terminal block
99a End piece
99b Supporting bracket
99c Positioning device
100 Gear wheel
100a Allen head screw
100b Lock washer
100c Cap screw
101 Spring charging pedal
101a Ratchet latch
101b Pin
101c Spring
101d Pin
101e Snap washer
101f Lock pins
101g Pin
101h Leaf spring
103 Nut
104 Lock pin
105 Washer
106 Thrust bearing
107 Ball bearing

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108	Cap screw
109	Bushing
110	Nut
111	Washer
112	Axle
113	Snap washer
114	Ring
115	Spacer tube
125	Lock pin
126	Lock pin
127	Screw
128	Locking plate
130/130a	Gear
130b	Bearing
130c	Link
130d	Shaft
130e	Lock pin
130f	Cap screw
130g	Positioning plate
130h	Belleville washer
130i	Link
130k	Pinion
130l	Countersunk screw
140	Gear assembly
140a	Support
140b	Pinion
140c	Bearing
140d	Key
140e	Gear
140f	Disc
140g	Snap washer
140h	Shaft
140i	Lock pin
141	Spring plate
142	Roller
143	Pin
144	Ball bearing
145a	Nut
145b	Cap screw
145c	Belleville washer
146a	Pin
146b	Snap washer
150	Operation counter
160	Roller
200	Contact assembly
201	Bolt
202	Belleville washer
203	Spacer
204	Lock pin
205	Nut
206	Spring
207	Screw
208	Nut
209	Bolt
210	Contact finger
211	Spacer
212	Belleville washer
213	Nut
214	Snap washer
215	Screw
216	Cotter pin
217	Lock nut
218	Contact disc
219	Bearing bushing
220	Belleville washer
221	Bolt
222	Washer
223	Lock pin
224	Spring disc
225	Eccentric boss
226	Bolt
227	Bolt
228	Snap washer

7. LEGEND OF ILLUSTRATIONS

Fig. 1	Breaker front view, without side panels.
Fig. 3	Breaker rear view.
Fig. 4	Breaker front view, without front panel and interphase barriers.
Fig. 7	Breaker with 2 arc-chutes removed.
Fig. 9	Arc-chute resting on supporting bracket.
Fig. 10	Release of "close blocking".
Fig. 11	Control block opened for changing tripping or closing coil.
Fig. 12	Section of control block.
Fig. 13	Rear view of control block.
Fig. 14	Winding motor diagrams.
	14a – For single phase AC with rectifier and DC motor.
	14b – With DC motor.
Fig. 15	Auxiliary switch.
	15a – Position of operating device when breaker open.
	15b – Position of operating device when breaker closed.
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Fig. 16	Moving and stationary auxiliary contacts.
Fig. 17	Disassembly of operating mechanism.
Fig. 18	Breaker interruption.
Fig. 19	Components of arc-chutes.
Fig. 20	Drawout device with interlocks.
Fig. 22,23,24	Assembly of main contacts.
Fig. 25	Operating mechanism.
Fig. 25a	Power storage spring.
Fig. 25b/c	Operation of charging motor limit switch, "close blocking" and spring position indicator.
Fig. 26	Schematic diagram.
Fig. 27	Assembly of operating mechanism.
Fig. 28	Assembly of winding motor gear for "26" wide breaker".
Fig. 29	Assembly of winding motor gear for "36" wide breaker".
Fig. 30	Assembly of power storage for "36" wide breaker".
Fig. 31	Lubrication chart.

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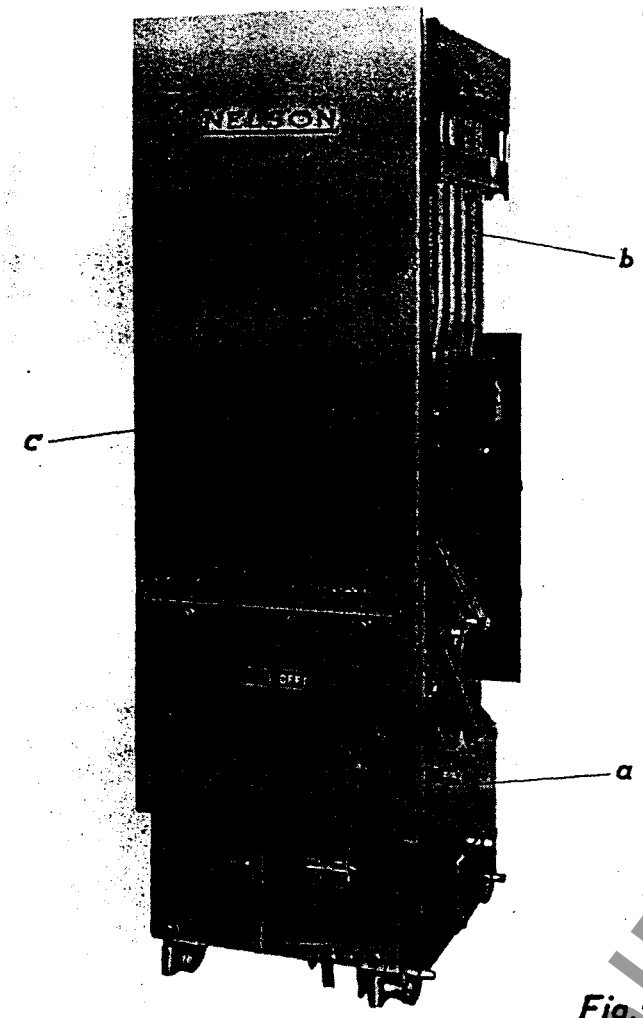

Fig.1

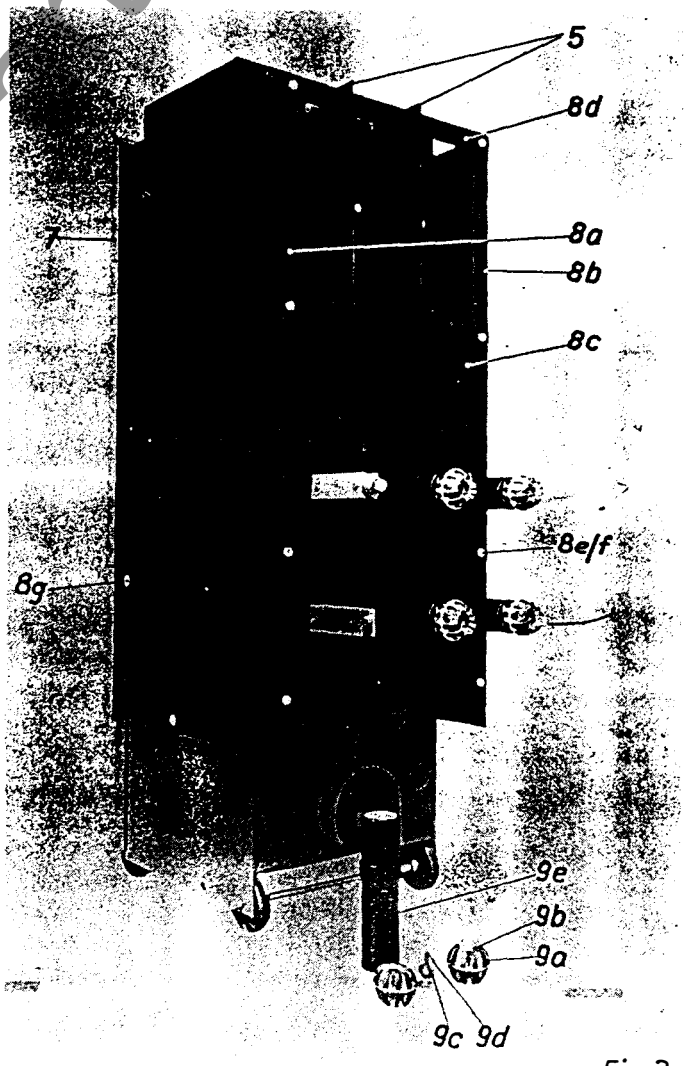

Fig.3

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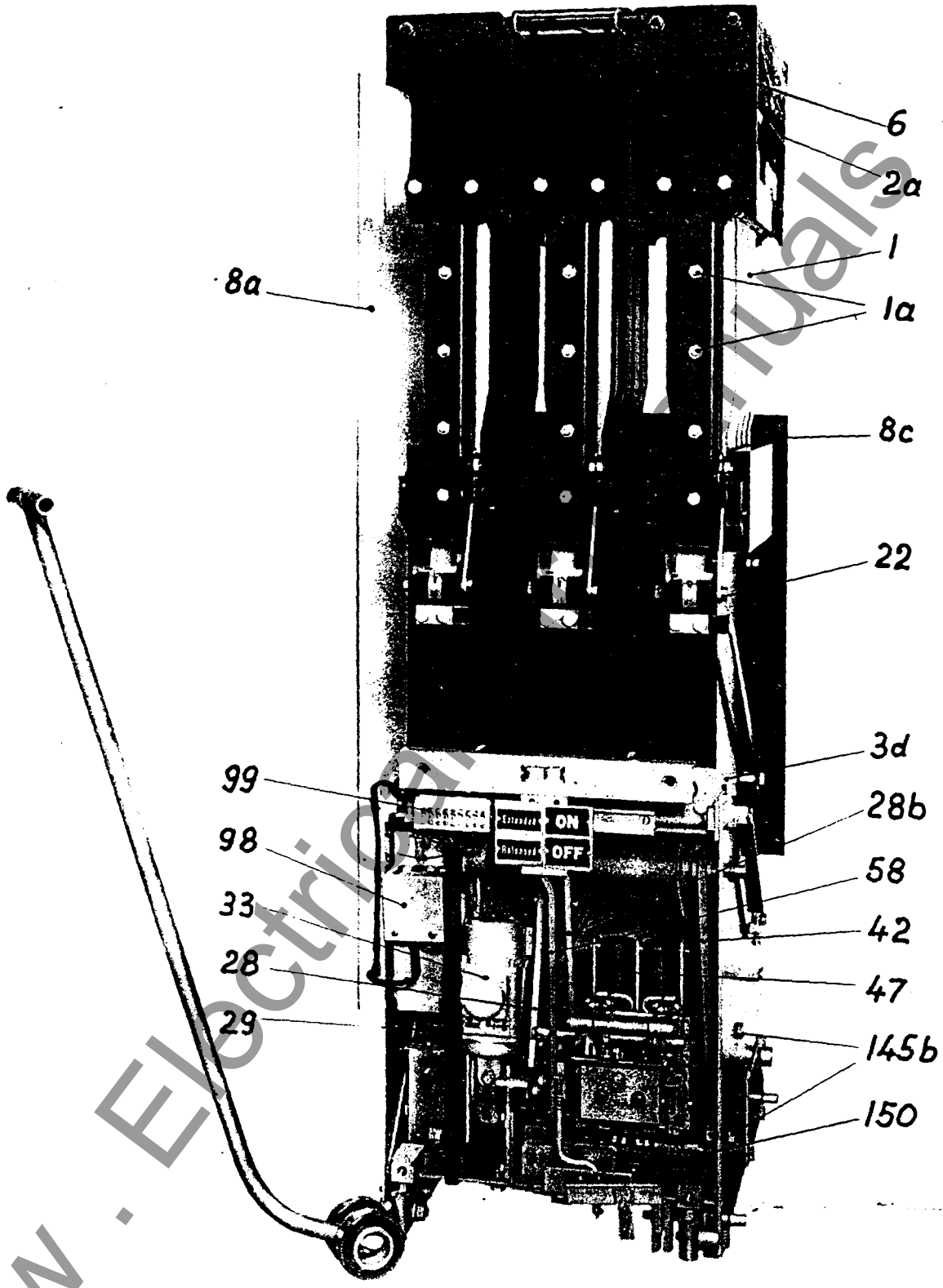

Fig.4

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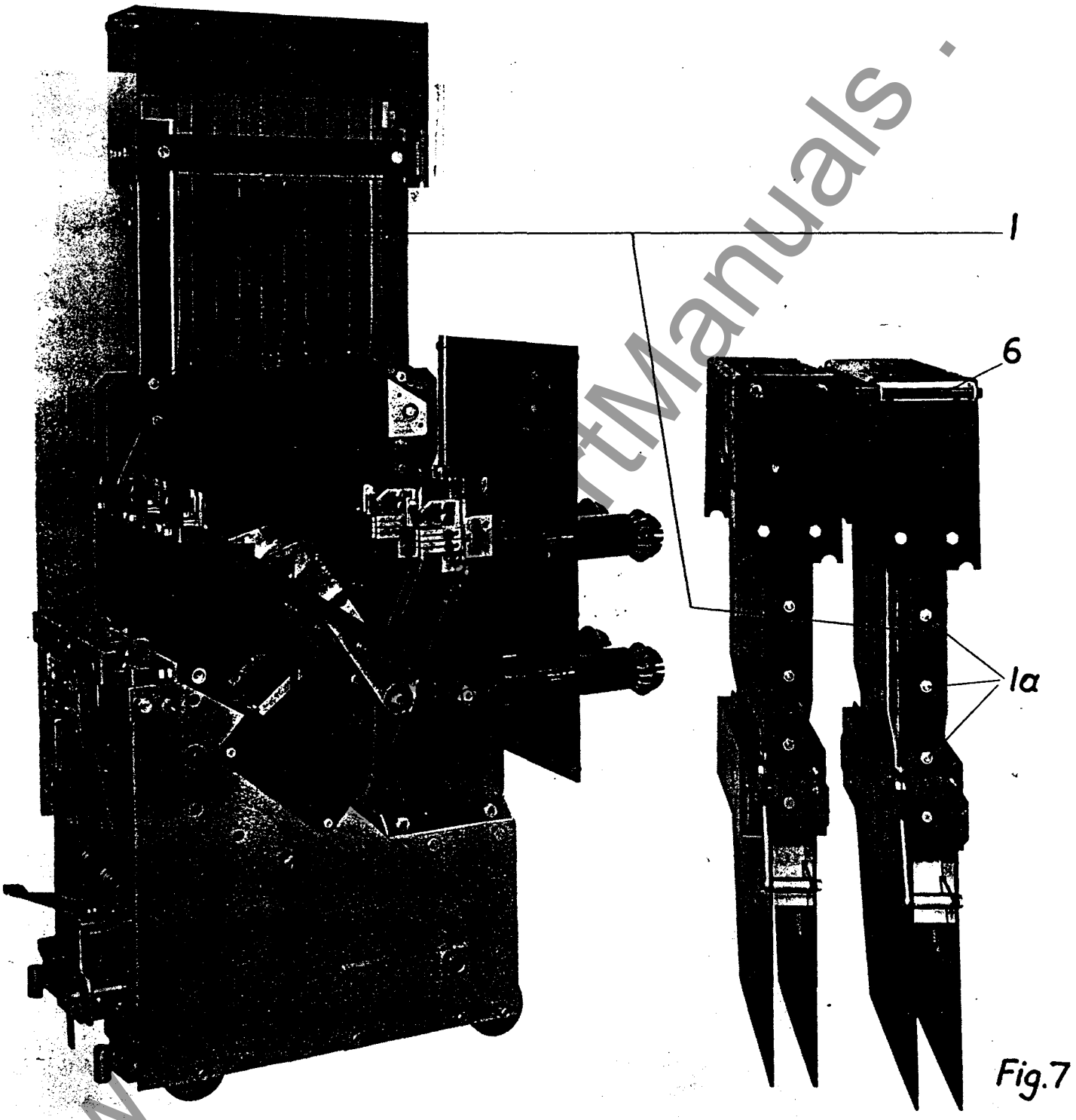

Fig.7

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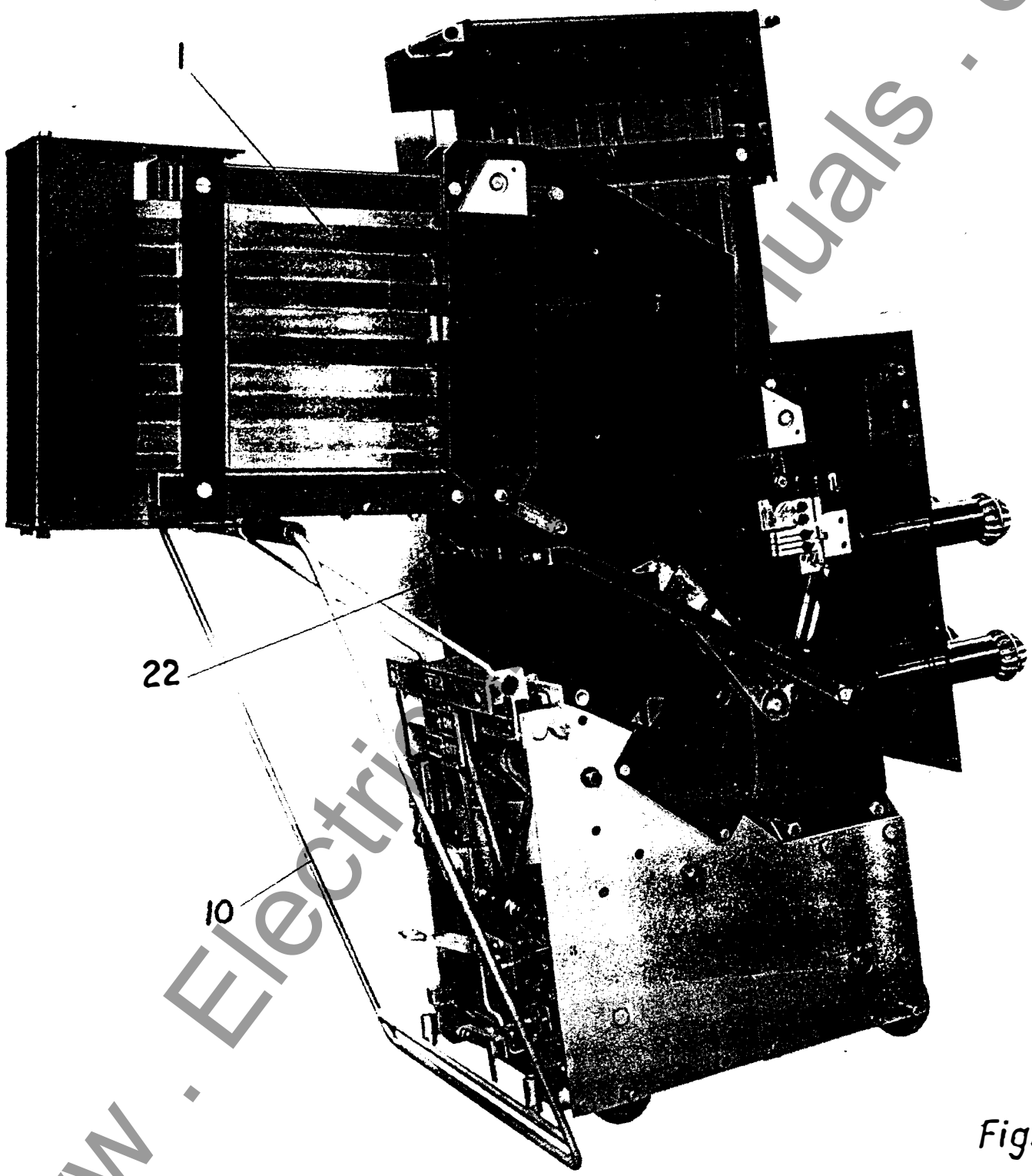

Fig.9

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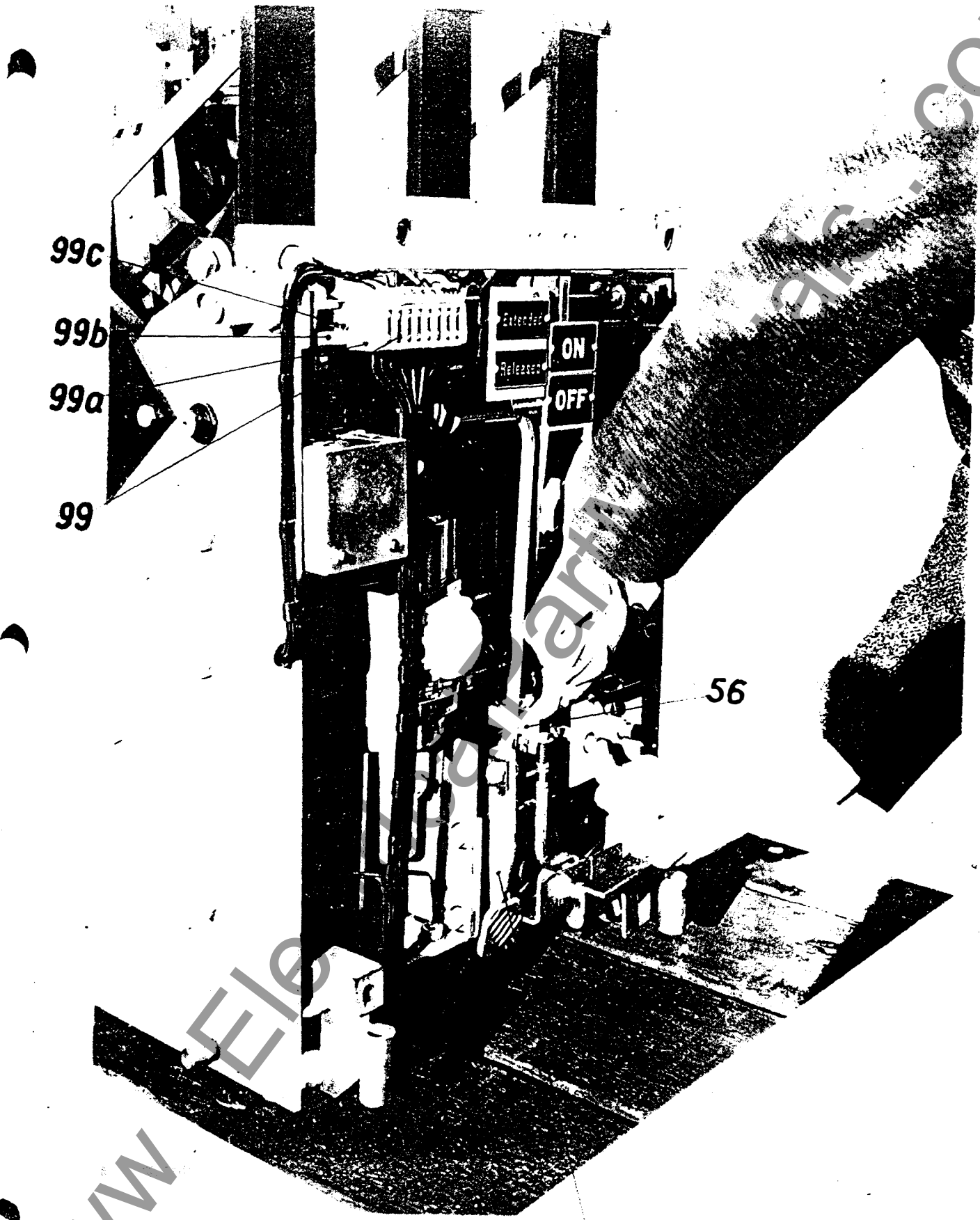

Fig. 10

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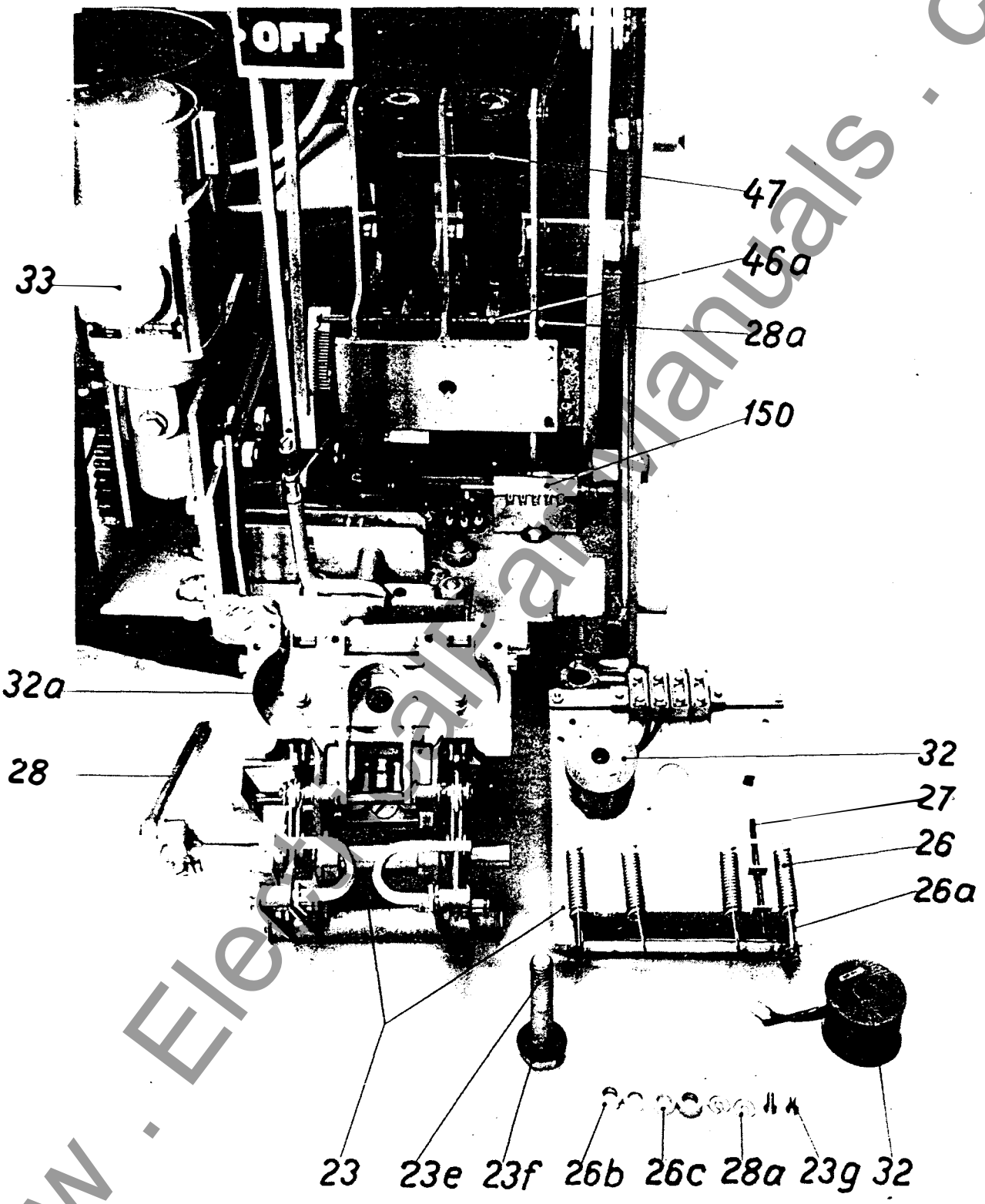

Fig.11

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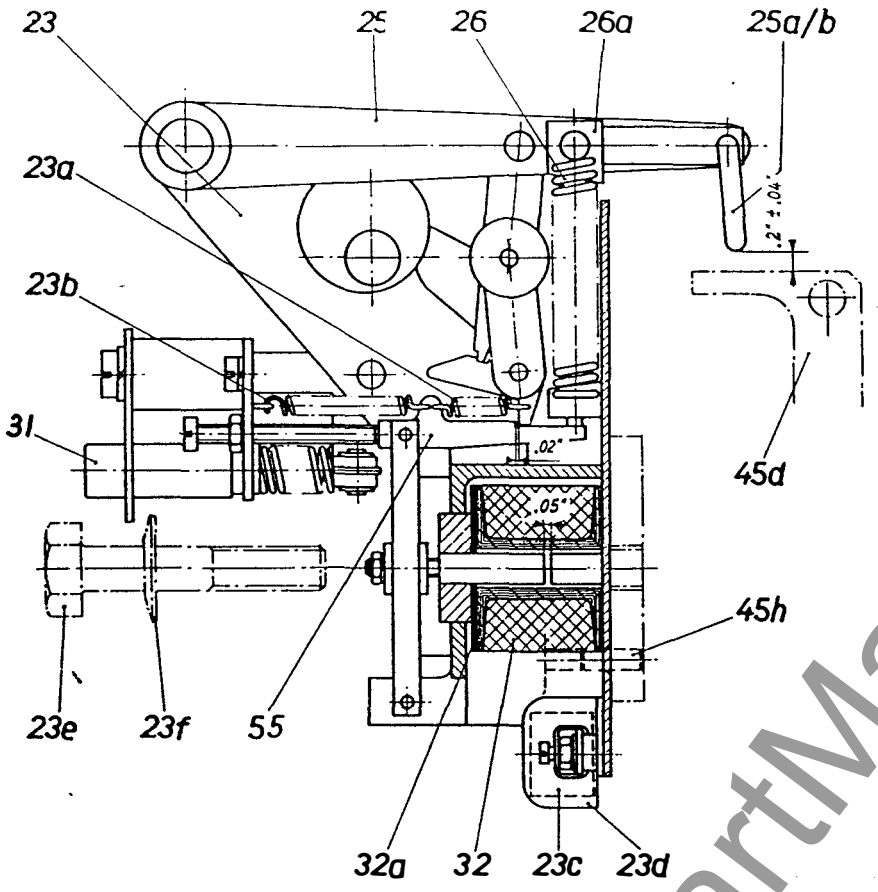

Fig. 12

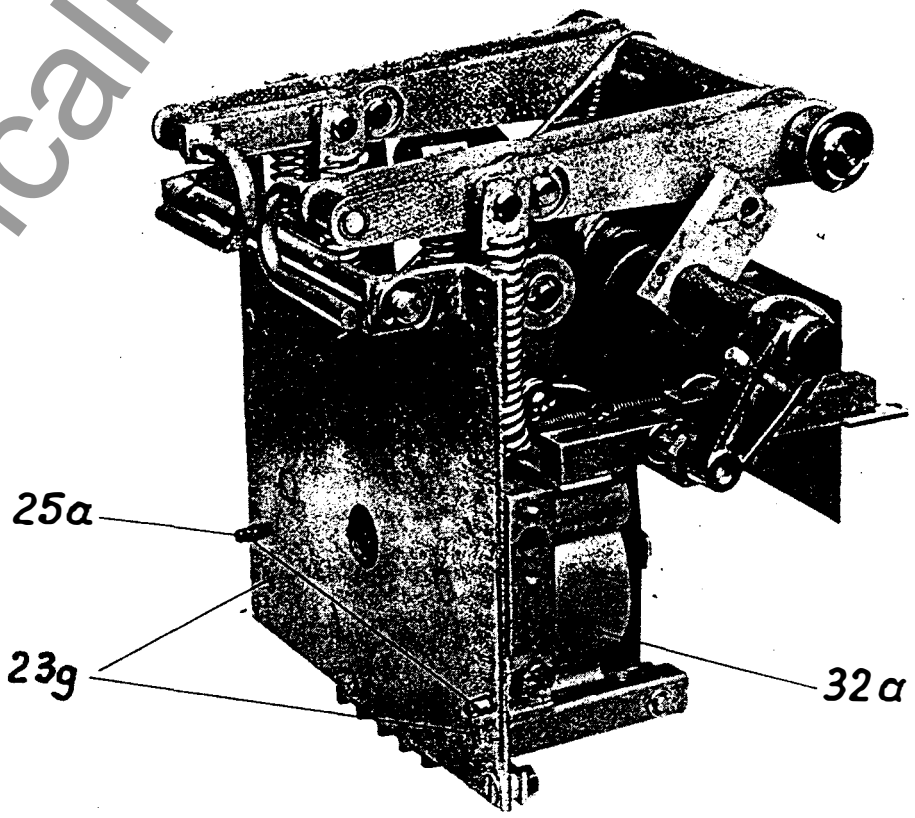

Fig. 13

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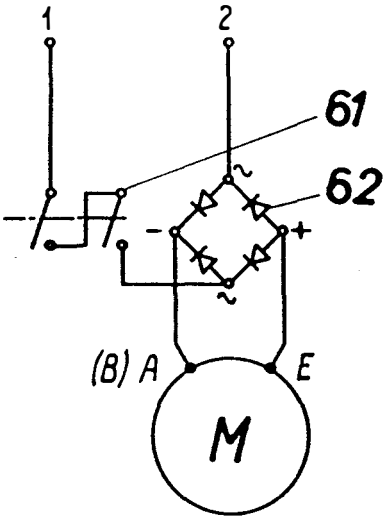


Fig.14a

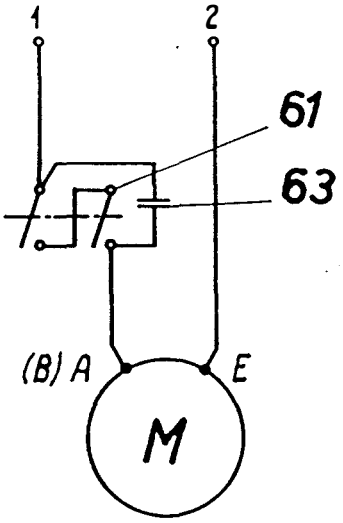


Fig.14b

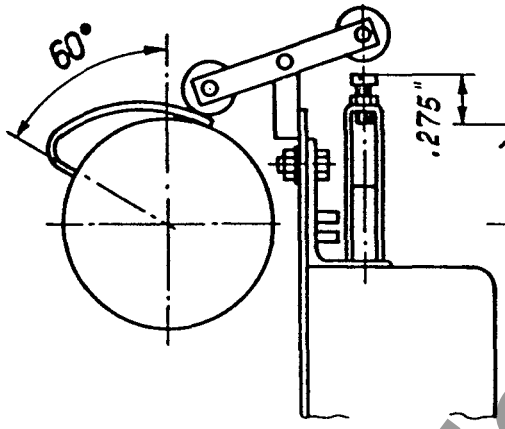


Fig.15a

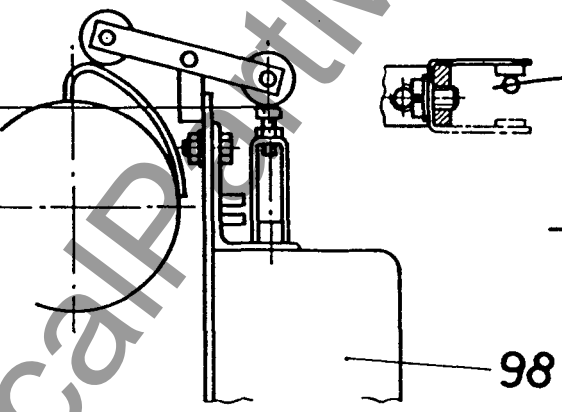


Fig.15b

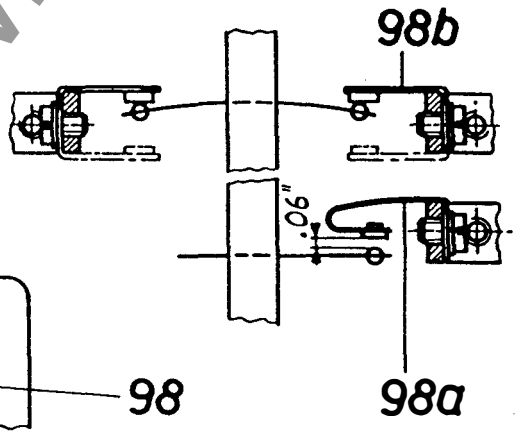
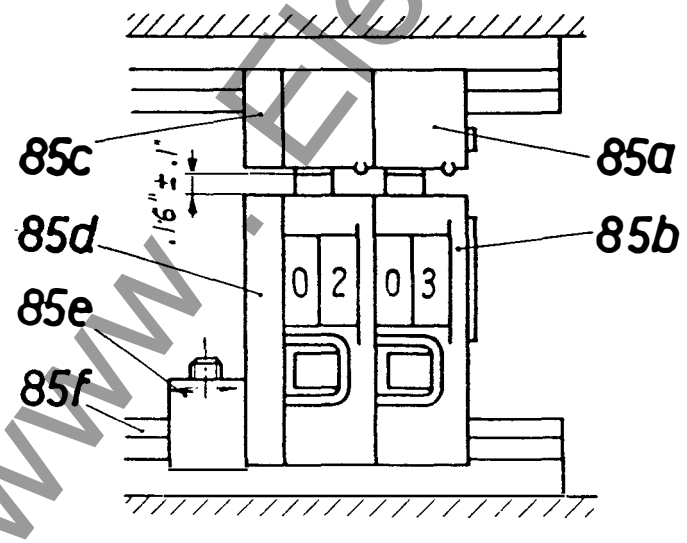


Fig.15c



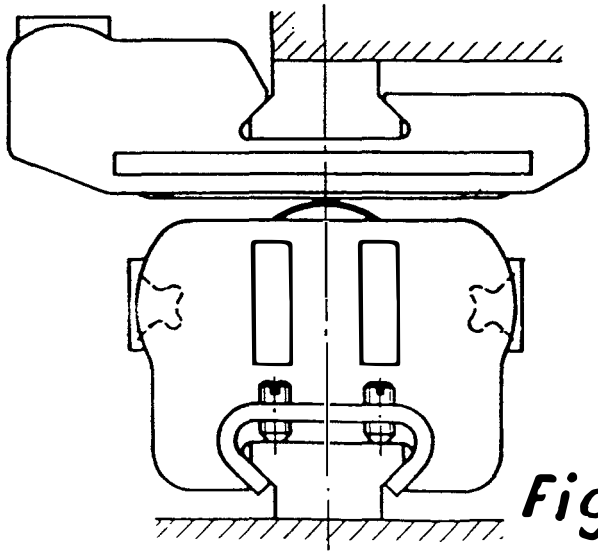


Fig.16

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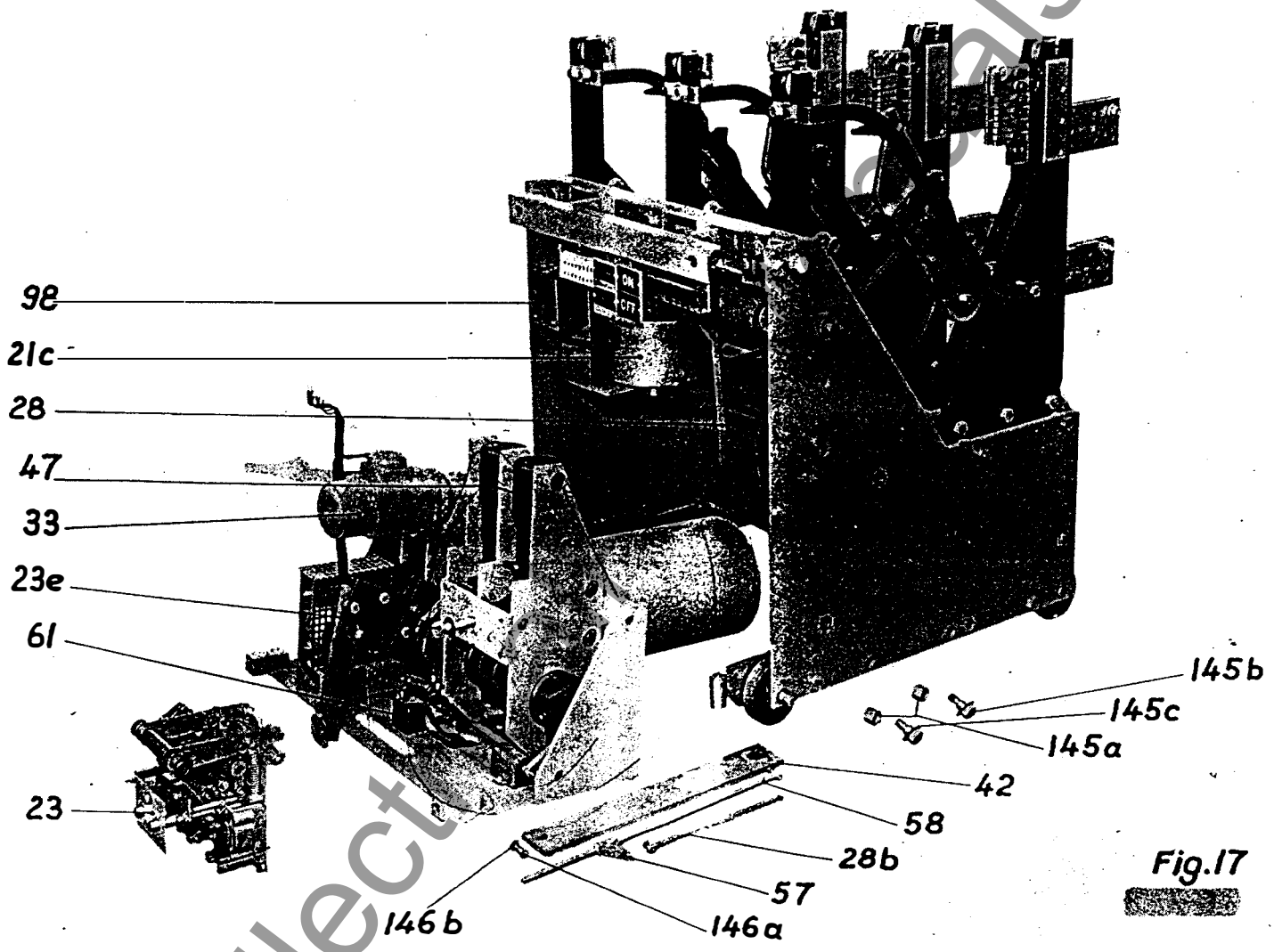

Fig.17

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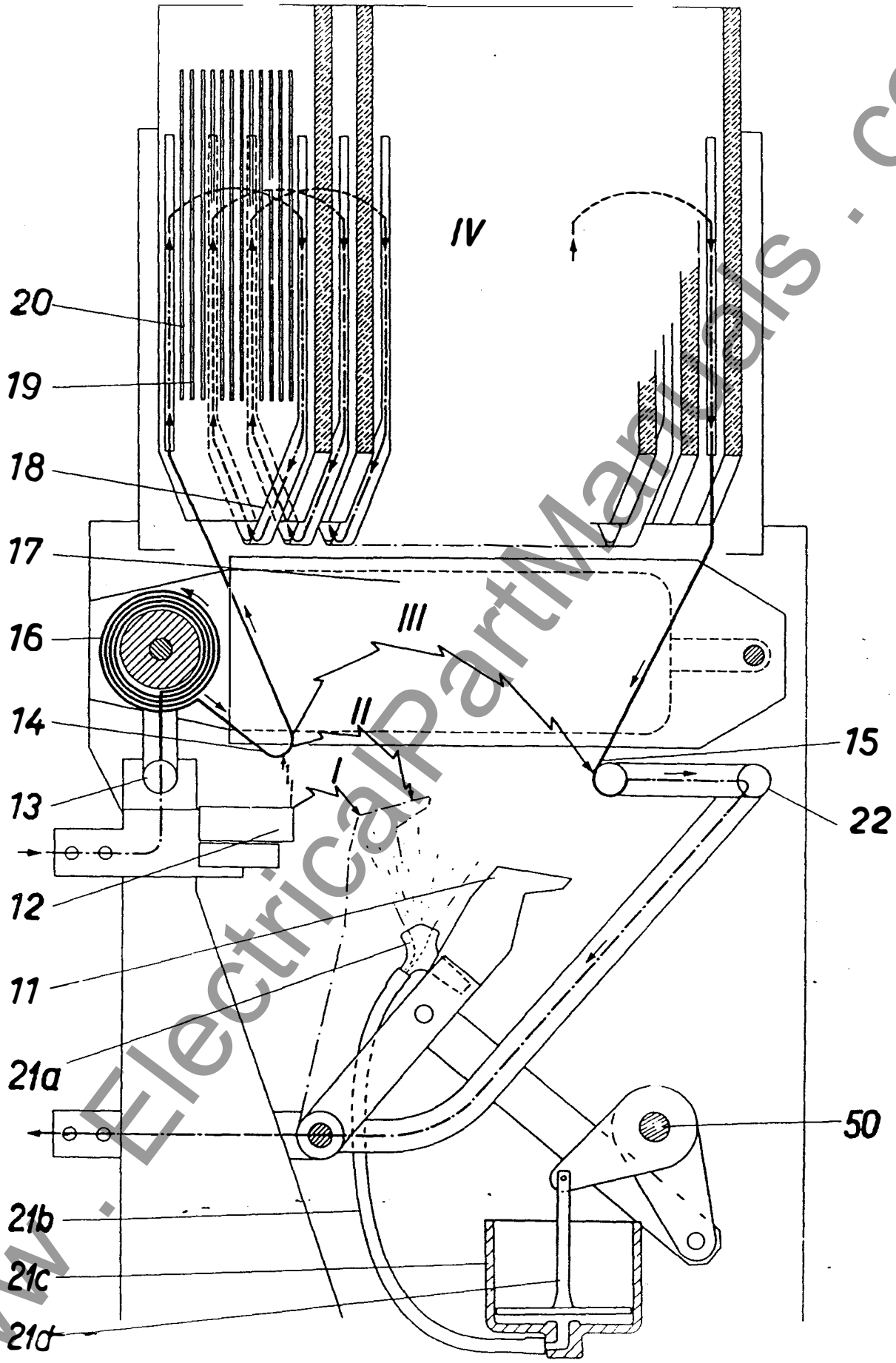

Fig. 18

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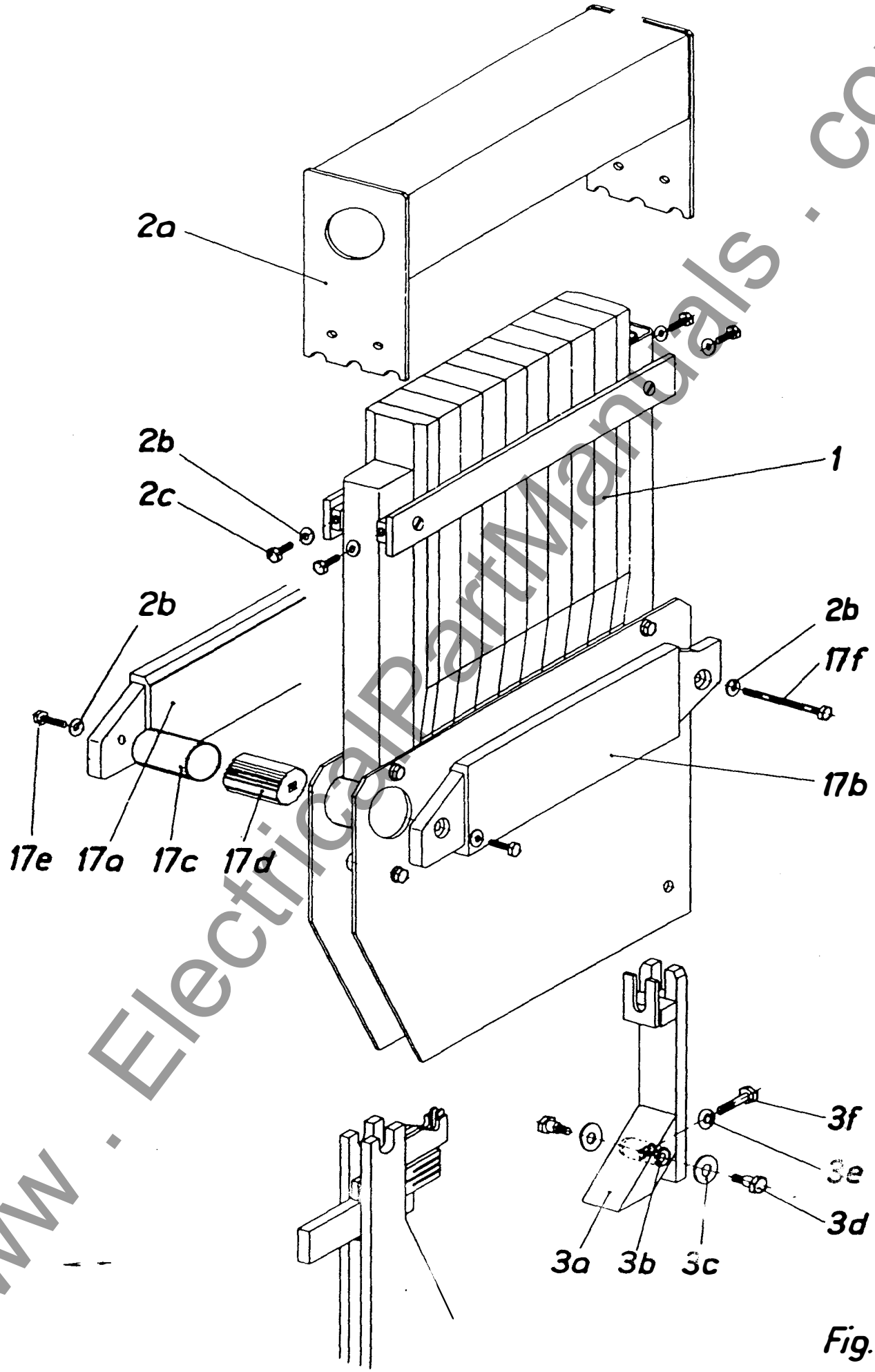

Fig.19

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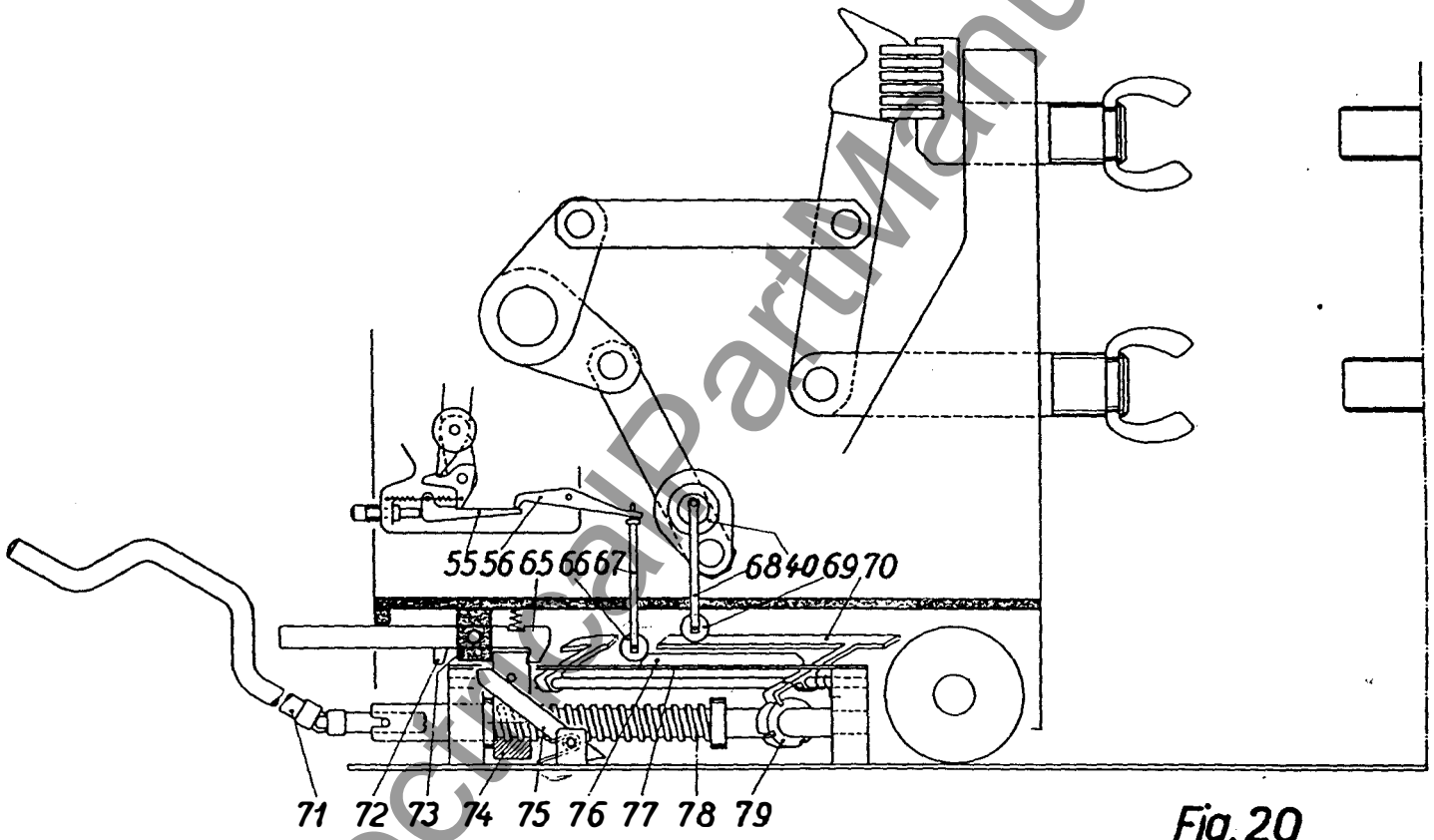

Fig. 20

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NELSON ELECTRIC

TAB #	CAT SECTION	DESCRIPTION	CONTENTS
1		Instruction Book / Maintenance	Type NT MV Magnetic Air Circuit Breaker and Class 726 Metal-Clad Switchgear

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HIGH VOLTAGE AIR CIRCUIT BREAKER TEST REPORT
HV2

Customer: City of Chicago Job No.: CGEW1147
Substation: Filtration Plant Feeder:
Mfr.: NELSON ELECTRIC CO. Type: NTH.8N 250
Style No.: Ser. No.: B1137034 Date Mfd.:
Nominal volts: 4.16 KV Nominal Amps: 1200 Max. Volts:
Short Circuit Amps: Interrupting Time:
Motor/Solenoid Volts: 115 AC Close Volts: 115 AC Trip Volts: 115 AC

VISUAL/MECHANICAL INSPECTION

PHASES	A	B	C
Primary Fingers	B	B	B
Arc Chutes	B	B	B
Main Contacts	B	B	B
Arcing Contacts	B	B	B
Mechanism	A		
Control Fingers	B		
Operations Counter	A 2643		

CODED RESULTS

A - NEW PARTS INSTALLED TO REPLACE DAMAGED PARTS.
B - SATISFACTORY CONDITION, NORMAL WEAR, ACCEPTABLE ADJ.
C - CORRECTIVE ACTION REQUIRED. REFER TO DETAILS, FIELD REPORT, OR BELOW
D - CORRECTION MADE AT TIME OF THIS INSPECTION.
R - RECONDITIONED.

NOTE: USE ANY COMBINATION CODE AS REQUIRED FOR CLARITY.

ELECTRICAL TESTS

INSULATION LEAKAGE VALUES IN MILLI AMPS BREAKER OPEN AT: 9000 VOLTS A.C.	TOP OR FRONT	A - ALL / G	B - ALL / G	C - ALL / G
		.1mA	.1mA	.1mA
	BOTTOM OR REAR	A - ALL / G	B - ALL / G	C - ALL / G
		.1mA	.2mA	.1mA
CONTACT CIRCUIT RES. BY DUCTOR IN MICROHMS		A - A	B - B	C - C
		32	30	31
INS. RES. CONTROL - GND IN MEGOHMS @ 500 V.D.C.		200+		

Comments: REPAIRED CAMSHAFT ASSEMBLY, REPLACED ROLLERS AND PIN ON TRIPPING LINKAGE. CHANGED OIL IN SHOCK ABSARBERS AND MOTOR GEARBOX, LUBRICATED ENTIRE MECHANISM. REPLACED CONTROL COIL TERMINAL BLOCK. CLEANED BREAKER AND TESTED. REPAIRED OPERATIONS COUNTER.

WESTINGHOUSE ENGINEERING SERVICES
16750 CHICAGO AVE. LANSING, IL. 60438
Tested by: V. Torres Sht. of
Date: 4-10-91 Quality ckd. by:

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