

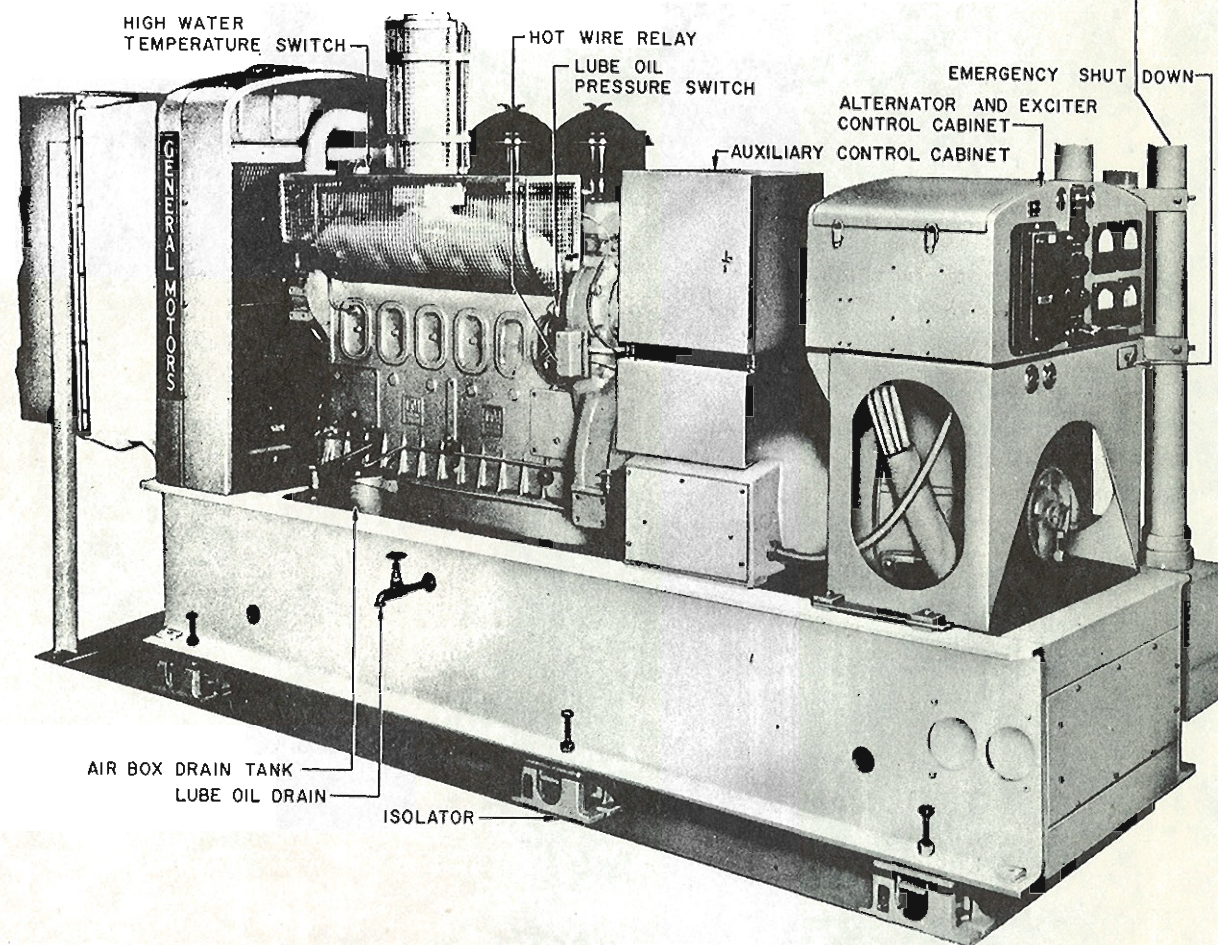
Lesson No. 1

FUNDAMENTALS OF TELEPHONY

Section 7

CENTRAL OFFICE POWER PLANT

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EMERGENCY POWER PLANT
200/230-v, 3 Phase, 60 Cycle A-C Diesel
Engine Alternator

Public Service Company
200/230-v, 3 Phase, 60
Cycle A-C Power Mains

200/230-v, 3-Phase, 60-Cycle A.C.

SECOND AND
THIRD FLOOR
LIGHTING

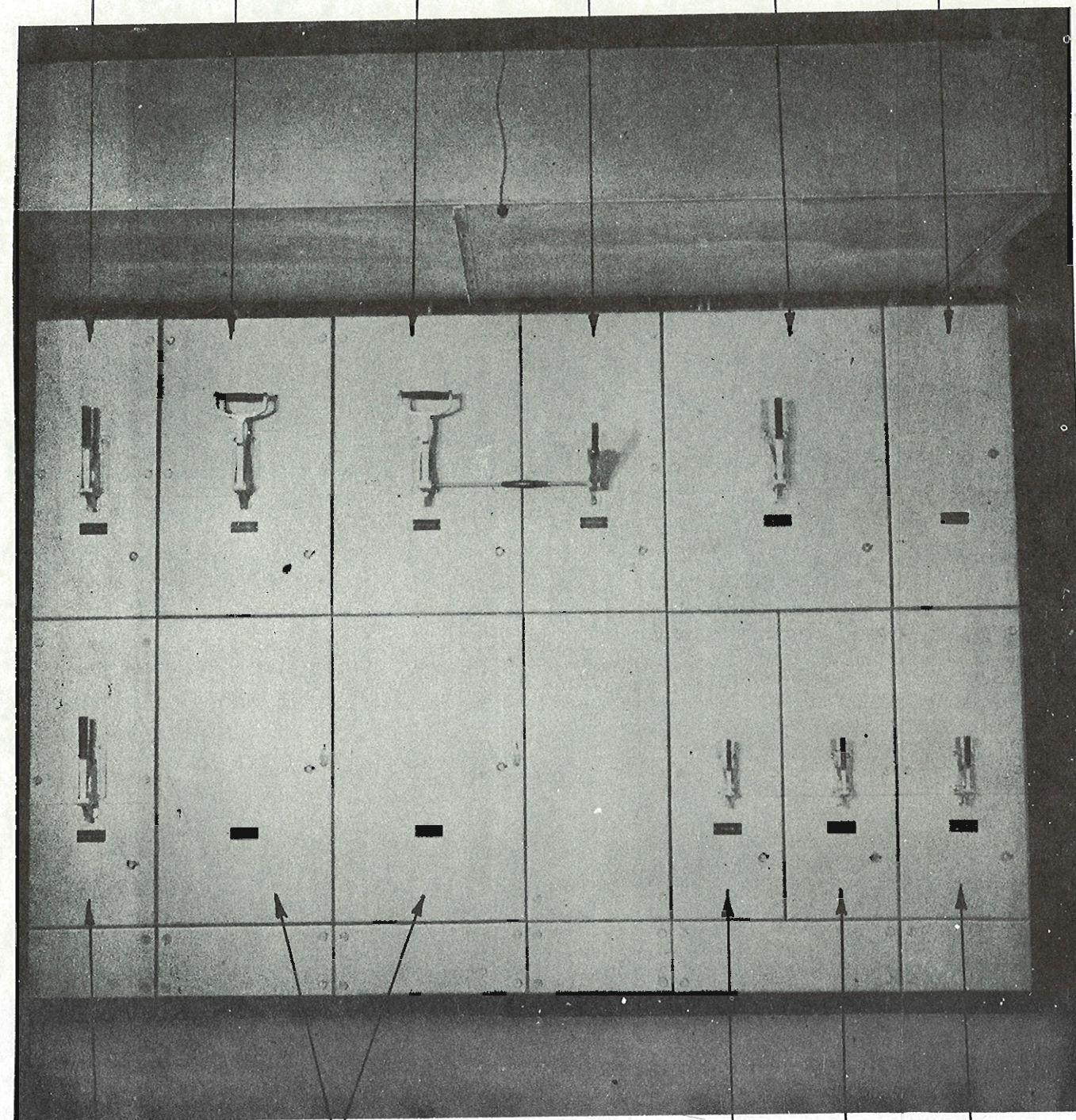
MAIN
LIGHTING
SERVICE

MAIN
POWER
SERVICE

EMERGENCY
POWER

TELEPHONE
EQUIPMENT
POWER

FUSE
STORAGE



BASEMENT
AND FIRST FLOOR
LIGHTING

COMMONWEALTH
EDISON COMPANY
EQUIPMENT

KITCHEN
POWER

BOILER
ROOM
POWER

MACHINE
ROOM
POWER

HOUSE SERVICE PANEL

ENCY
ER

TELEPHONE
EQUIPMENT
POWER

FUSE
STORAGE

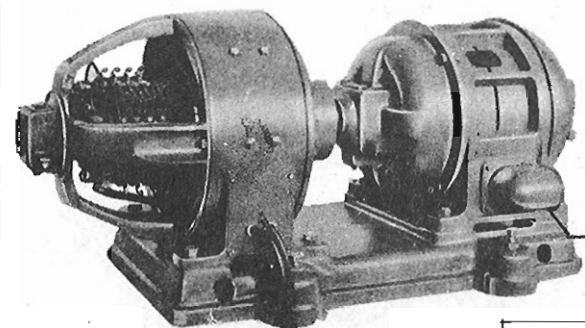
KITCHEN
POWER

BOILER
ROOM
POWER

MACHINE
ROOM
POWER

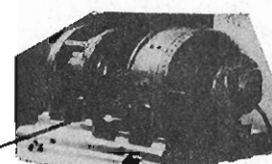
CE PANEL

- THE CENTRAL OFFICE POWER PLANT -



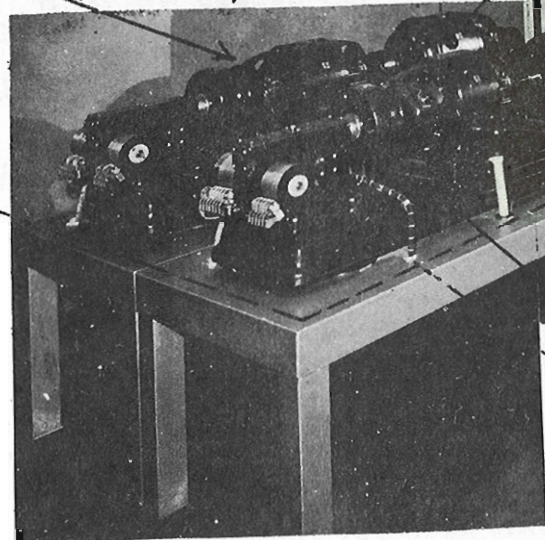
%65-v Motor Generator Set

CHARGING EQUIPMENT



%33-v Motor Generator Set

Ringling Machine No. 2
(D-C Motor)



Ringling Machine No. 1
(A-C Motor)

+130-V
Battery
(Standby)

* +130-v
Regulated
Tube
Rectifier

To Telephone Repeater and
Carrier Equipment Bays, etc.

* -130-v
Regulated
Tube
Rectifier

To Telegraph and Carrier
Equipment

-130-V
Battery
(Standby)

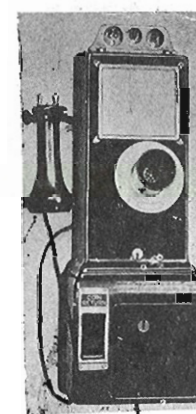
% - Regulated Rectifiers may be
used, as well as Motor-Generator
Sets - (See next page.)

Power Board for
Control & Distri-
bution of Power to
Switching Equipment

Ringling Power Board

Through
Switching
Equipment

20-Cycle Ringing Current
Dial Tone
Busy Tone
Coin Control Current

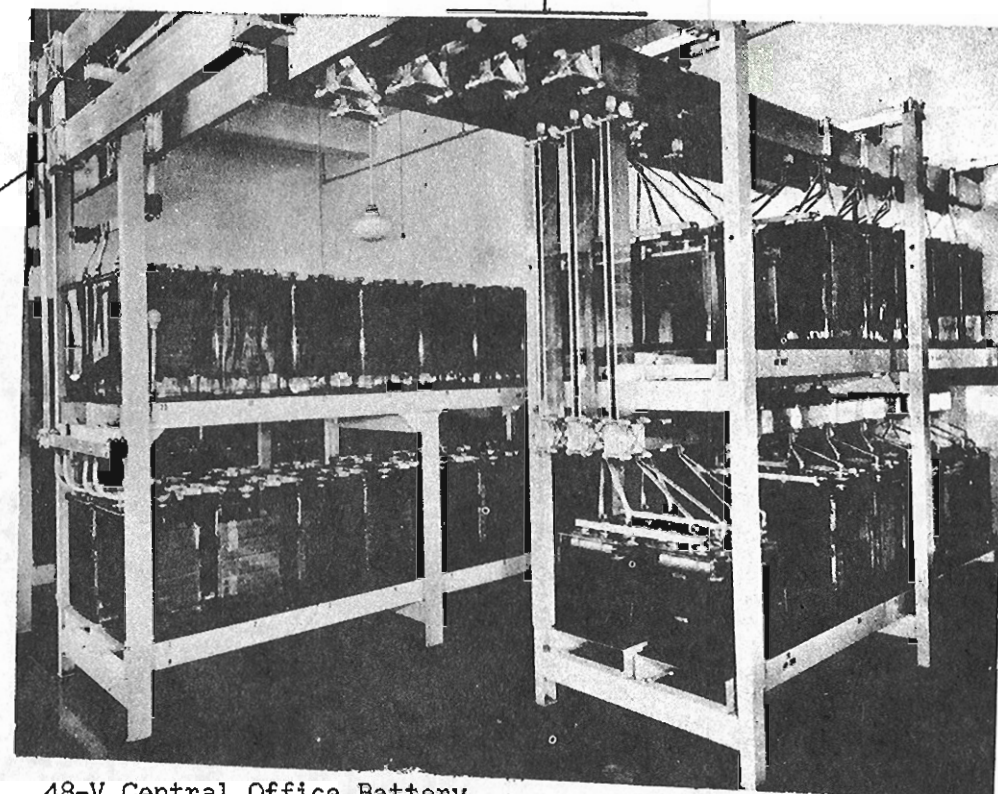


Pay Station

24-v D.C.

Switchboard Lamp

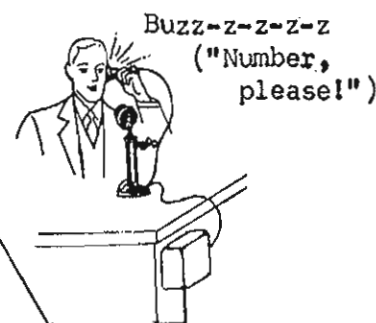
24-v D.C.



48-V Central Office Battery

24-v Central Office Battery

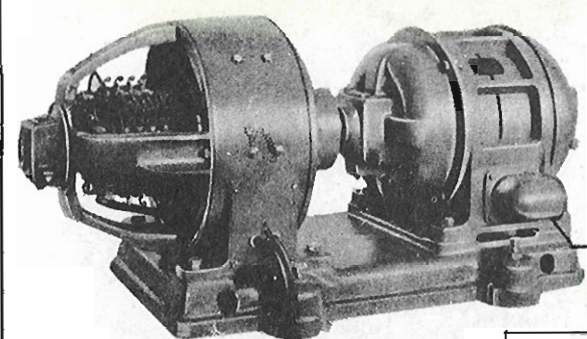
48-v D.C.



Buzz-Buzz-Buzz
(60 IPM)

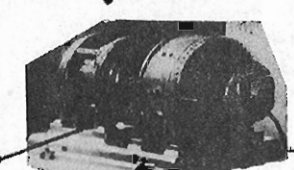


Switchboard Lamp



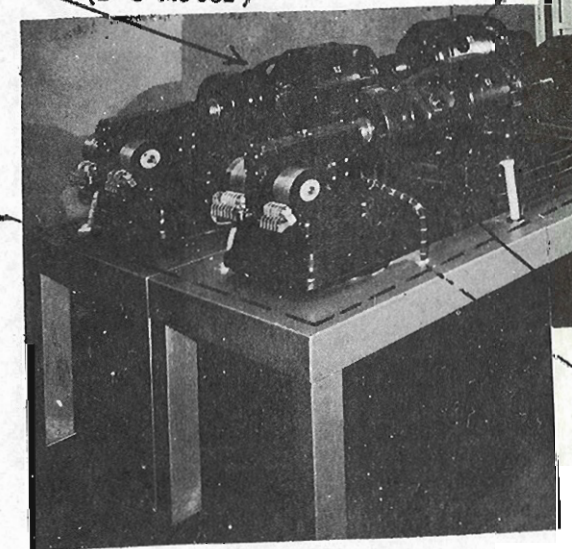
%65-v Motor Generator Set

CHARGING EQUIPMENT

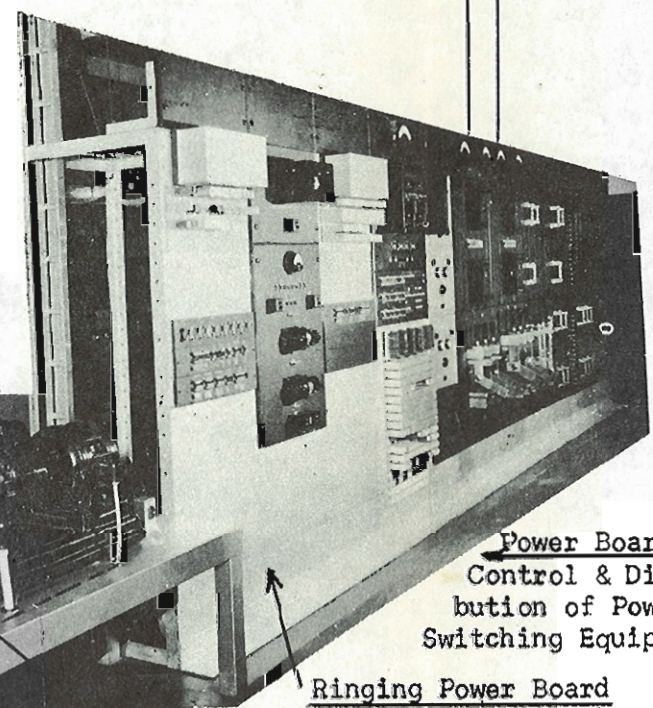


%33-v Motor Generator Set

Ringine Machine No. 2 (D-C Motor)



% - Regulated Rectifiers may be used, as well as Motor-Generator Sets - (See next page.)



Ringine Machine No. 1 (A-C Motor)

+130-V Battery (Standby)

* +130-v Regulated Tube Rectifier

* -130-v Regulated Tube Rectifier

To Telephone Repeater and Carrier Equipment Bays, etc.

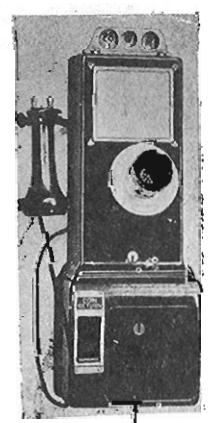
* - Motor-Generator Sets replace Regulated Tube Rectifiers where 130-v Current Drain is heavy.

To Telegraph and Carrier Equipment

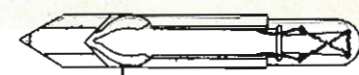
-130-V Battery (Standby)

Through Switching Equipment

20-Cycle Ringing Current
Dial Tone
Busy Tone
Coin Control Current



Pay Station



Switchboard Lamp



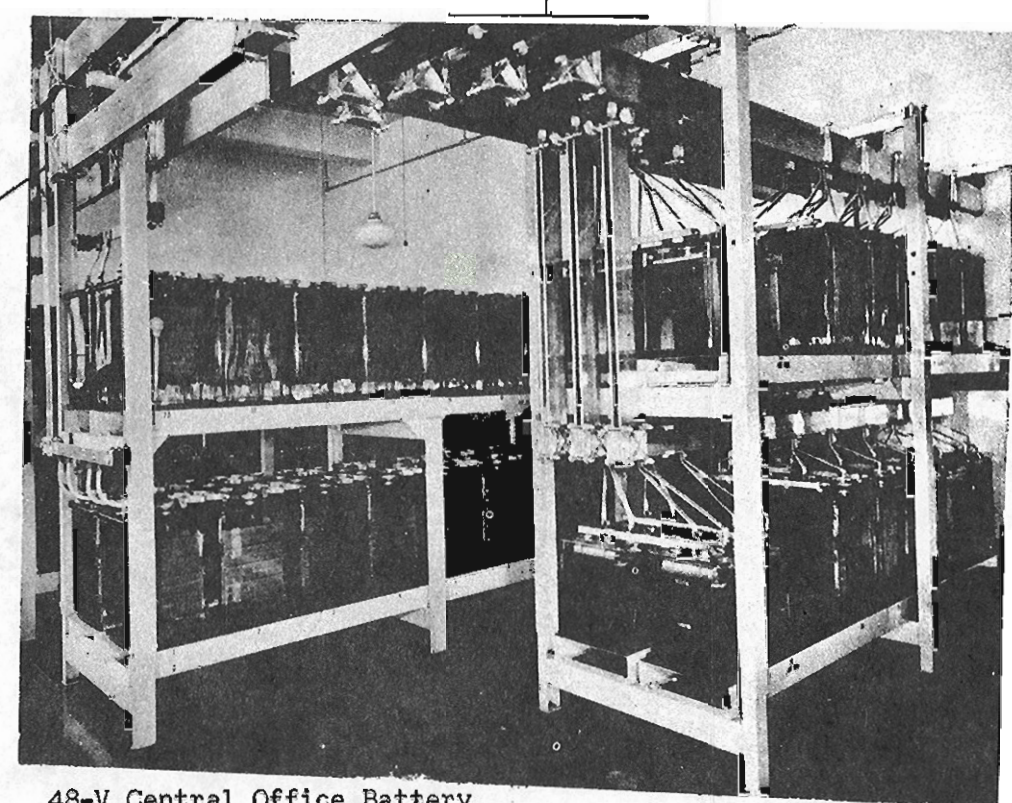
Relay



Switchboard

24-v D.C.

24-v D.C.



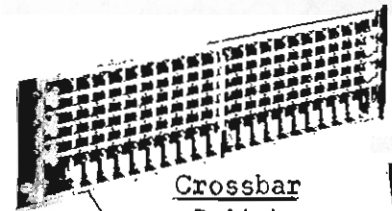
48-V Central Office Battery

48-v D.C.

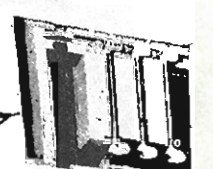
24-v Central Office Battery



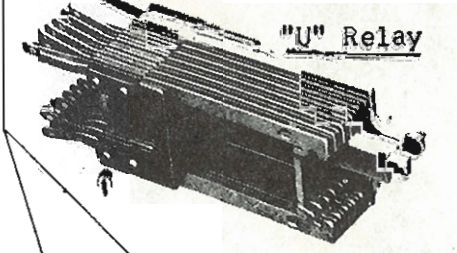
Local Test Desk



Crossbar Switch



Multicontact Relay



"U" Relay

48-v D.C.



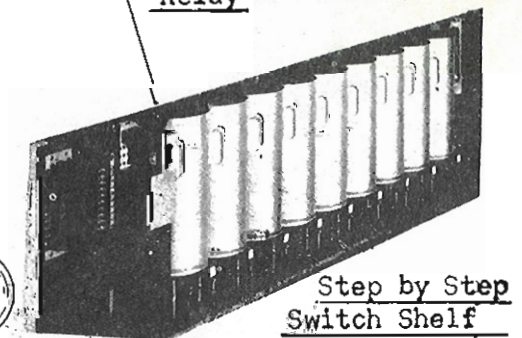
Buzz-z-z-z-z ("Number, please!")



Buzz-Buzz-Buzz (60 IPM)



Wire Spring Relay



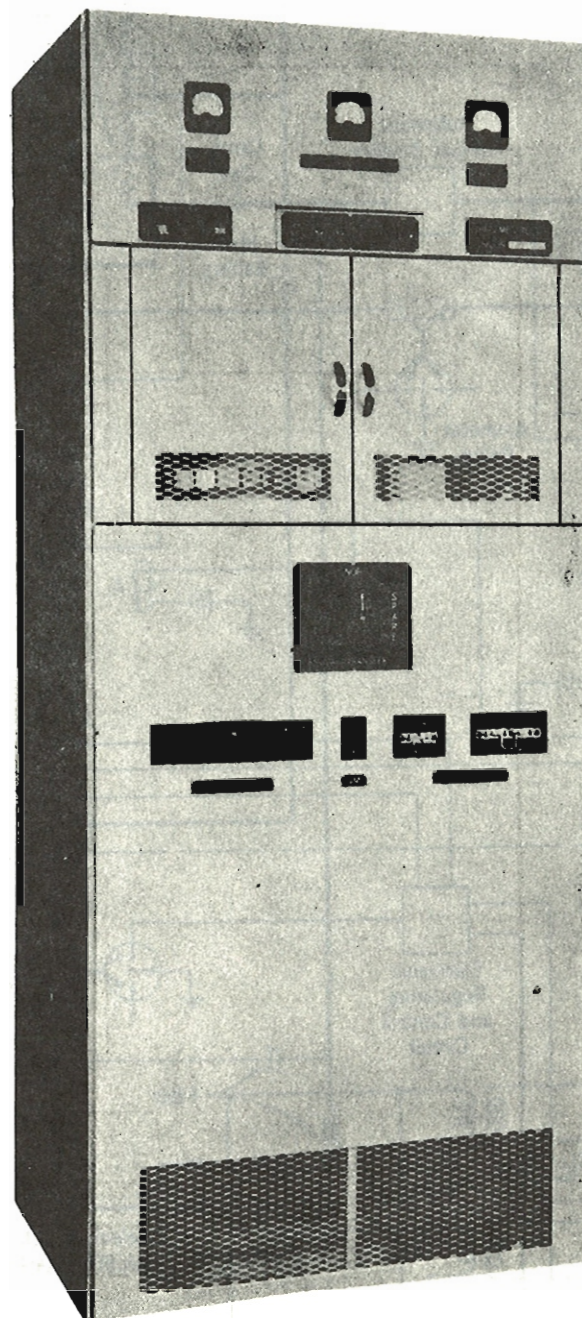
Step by Step Switch Shelf



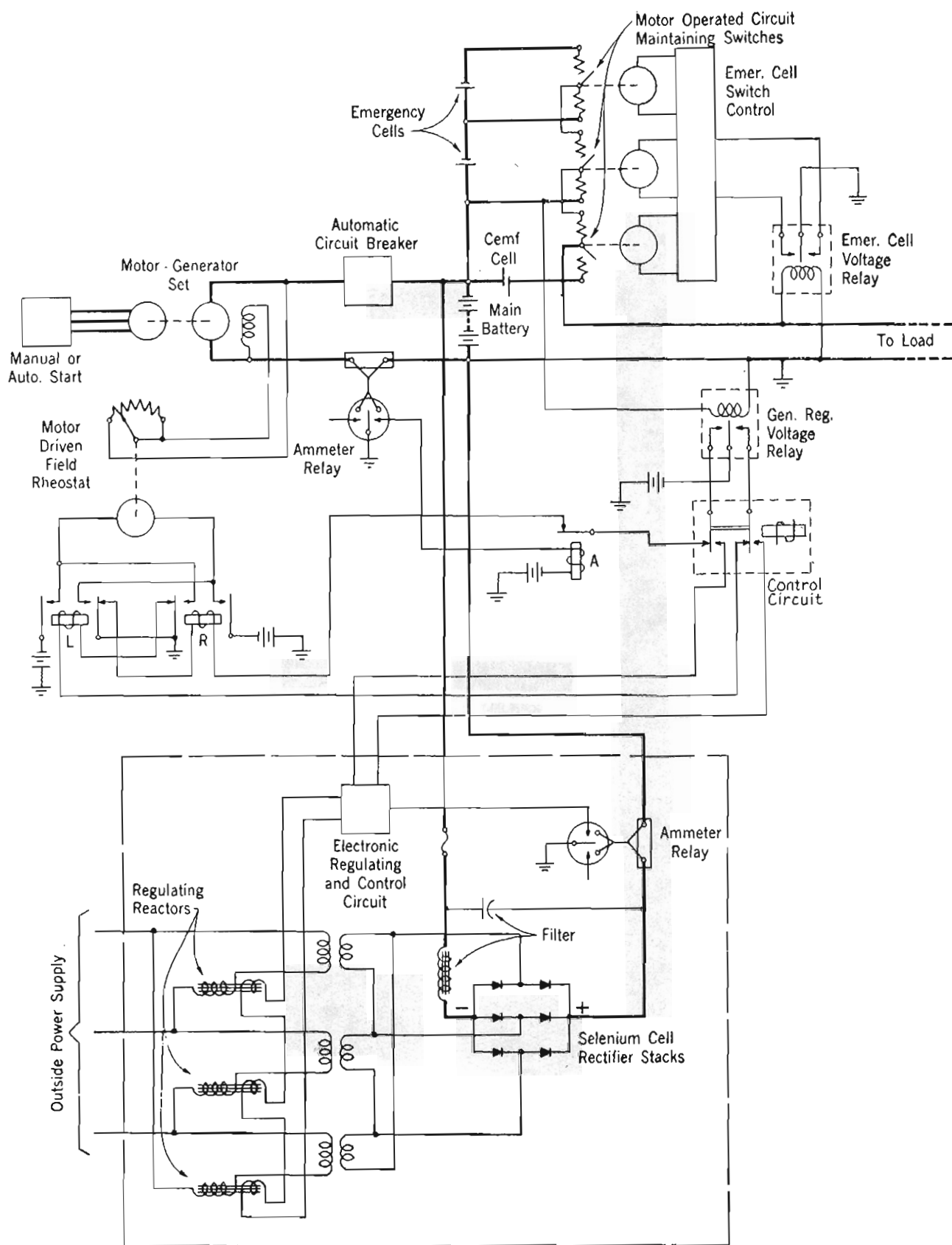
Switchboard Lamp



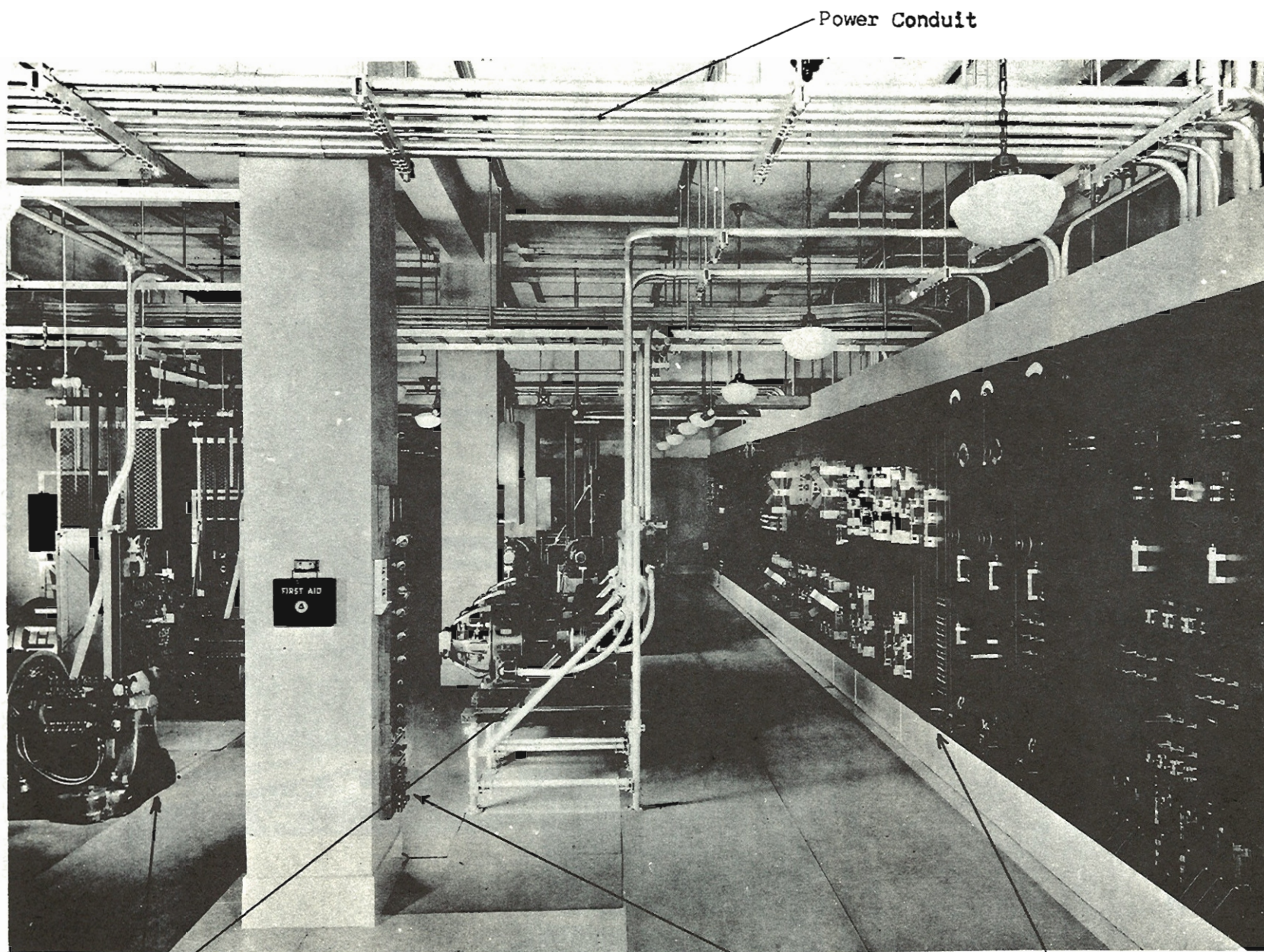
Lamp Cap



200 Ampere Metallic Rectifier
Charging Unit



Simplified Schematic of Fully Automatic Charging Equipment
(48-v or 24-v D.C.)



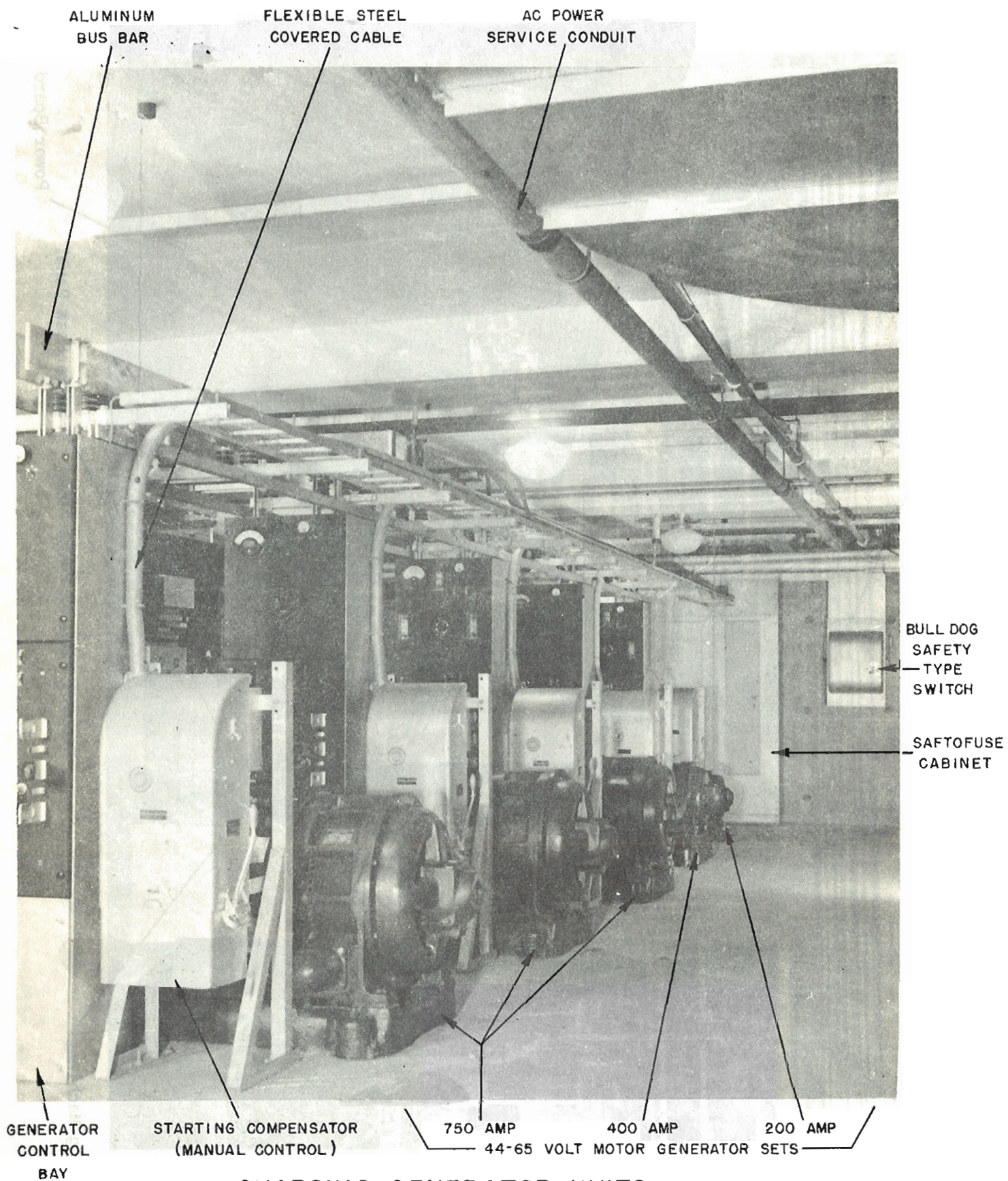
Power Conduit

Charging Machines

General View of Power Room

Spare Fuse Panel

Power Board



CHARGING GENERATOR UNITS

OAKLAND OFFICE, CHICAGO

PANEL
(IMPREGNATED
ASBESTOS
COMPOSITION)

WESTON
AMMETER

ALUMINUM
BUSBARS

WESTON
VOLTMETER

FLEXIBLE STEEL
COVERED
CABLE

HANDWHEEL
(RHEOSTAT
IN REAR)

MAGNETIC
CONTACTOR
(CH. CO)

STARTING
COMPENSATOR
(MANUAL)

TRANSFER SW.
(SINGLE POLE
DBL. THROW
KNIFE TYPE)

AUTOMATIC
REVERSE
CURRENT
RELAY
(CH. CO)

GENERATOR END

GENERATOR CONTROL
BAY

250 VOLT-450 AMP. NON-INDICATING
CARTRIDGE TYPE FUSE(CHARGE)

MOTOR END

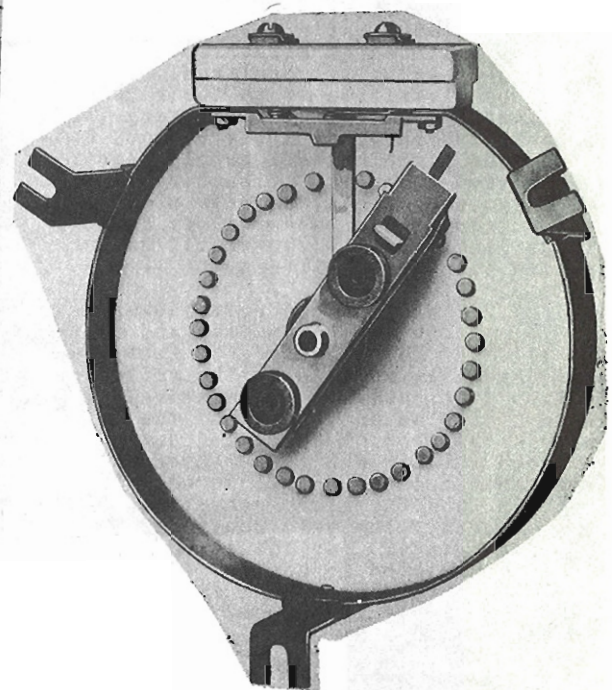
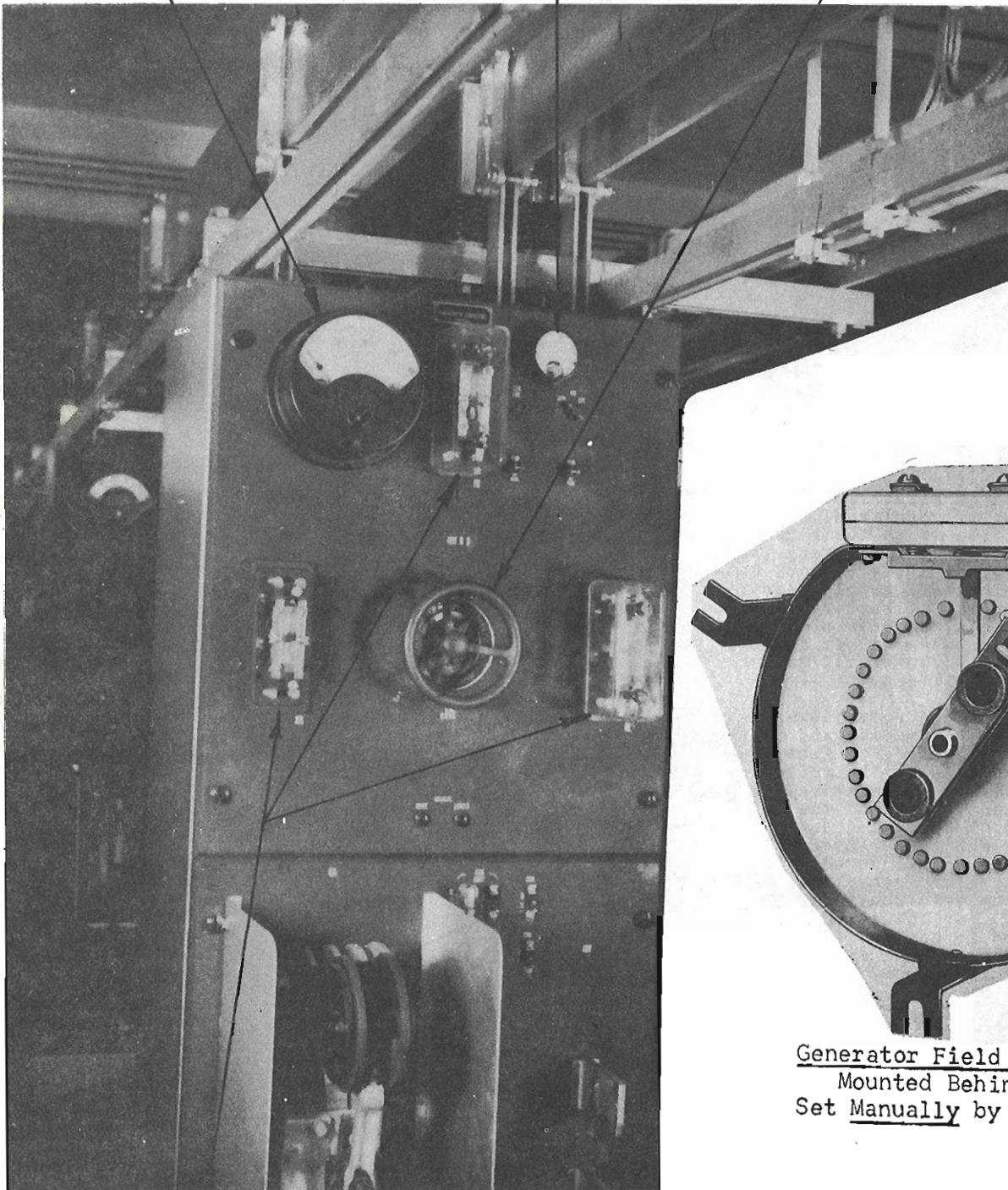
CHARGING GENERATOR UNIT

OAKLAND OFFICE, CHICAGO
Manual Operation

DIRECT CURRENT AMMETER
RELAY

VOLTMETER
(MODEL 301)

234 HAND WHEEL

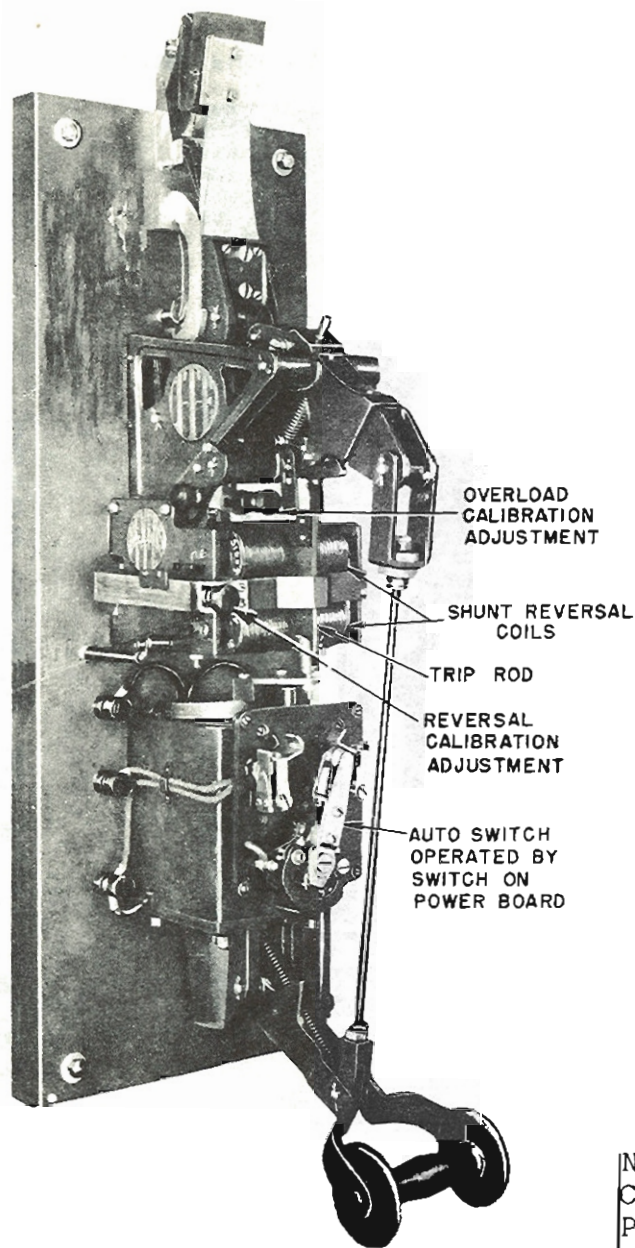


Generator Field Rheostat
Mounted Behind Panel.
Set Manually by Handwheel.

CONTROL RELAYS
(NUN CO.)

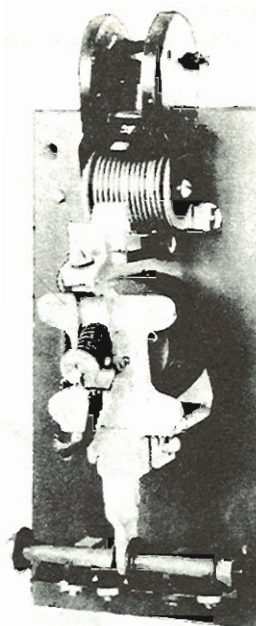
Meter and Control Panel
Charging Generator Unit

Control Relays operated by Voltage Controller on
Battery Control Board for Automatic Operation

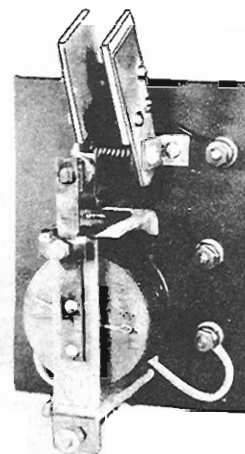


Circuit Breaker

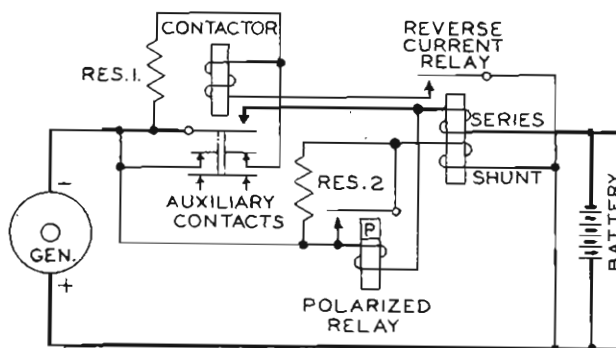
Formerly used on Power Boards, between the Charging Unit and the Battery, for Overload and Reverse Current protection.



CONTACTOR

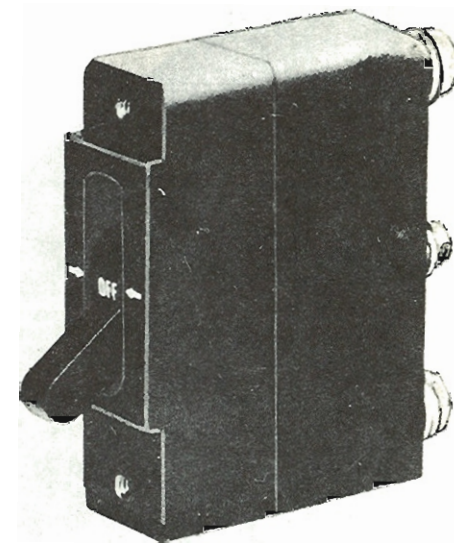


REVERSE CURRENT RELAY



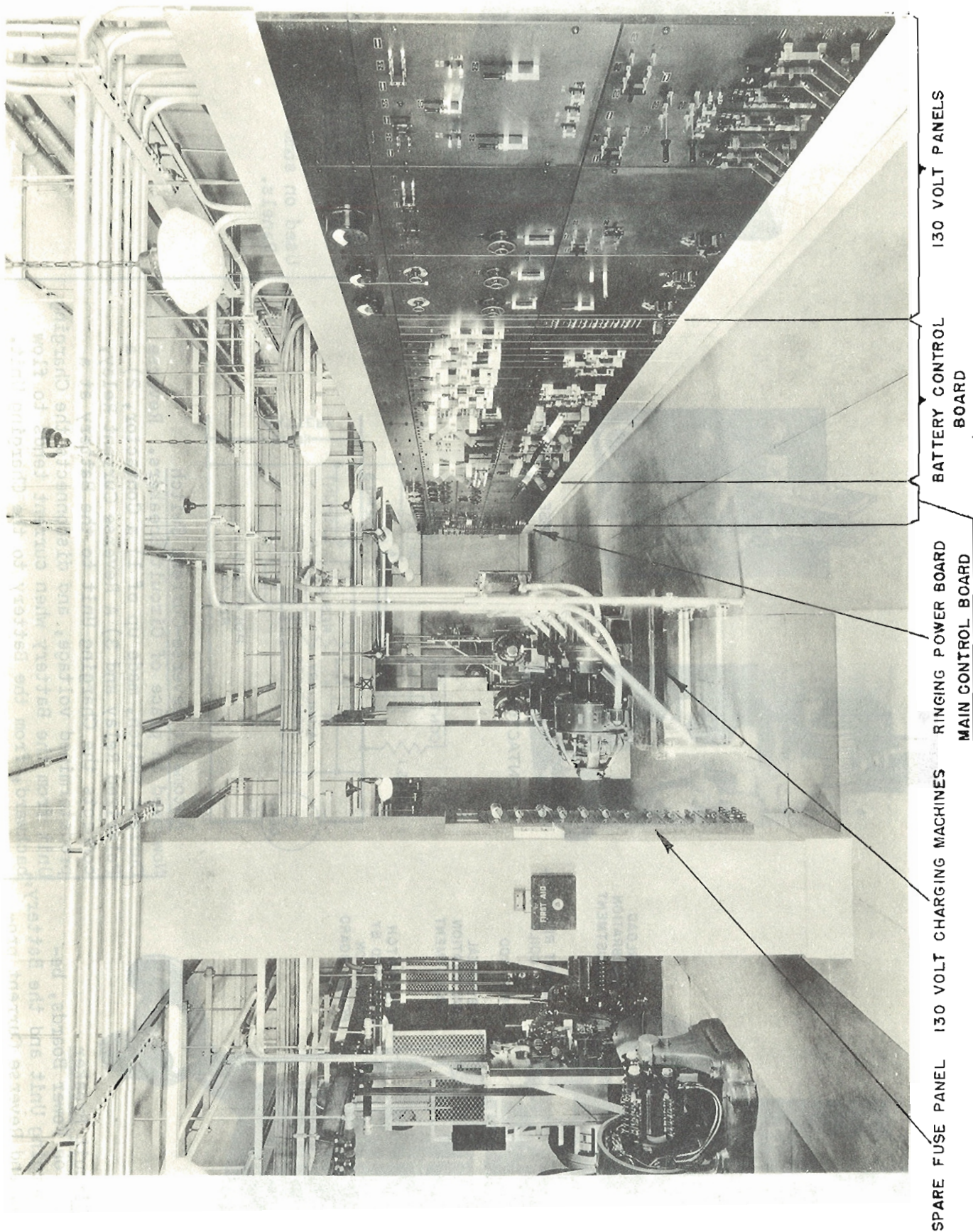
Automatic Reverse-Current Switch

Now used in place of Circuit Breakers. Reverse Current Switch, made up of 1) a Contactor, 2) a Polarized Relay and 3) A Reverse Current Relay, connects the Charging Unit to the Battery at a predetermined voltage, and disconnects the Charging Unit from the Battery when current tends to flow backward, from the Battery to the Charging Unit.



Typical KS-Type Circuit Breaker

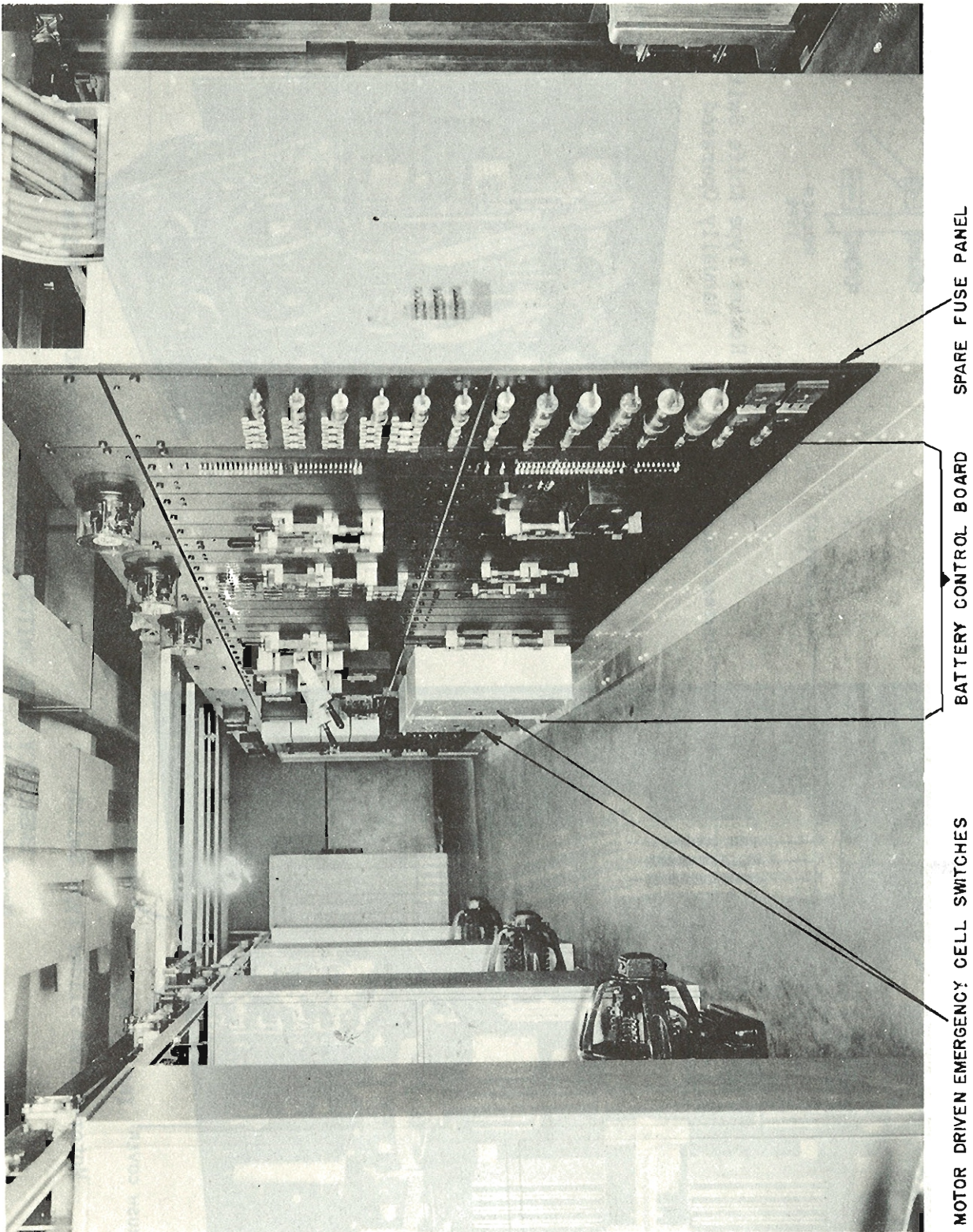
Used on some Rectifier Panels.



FRONT VIEW OF POWER BOARD

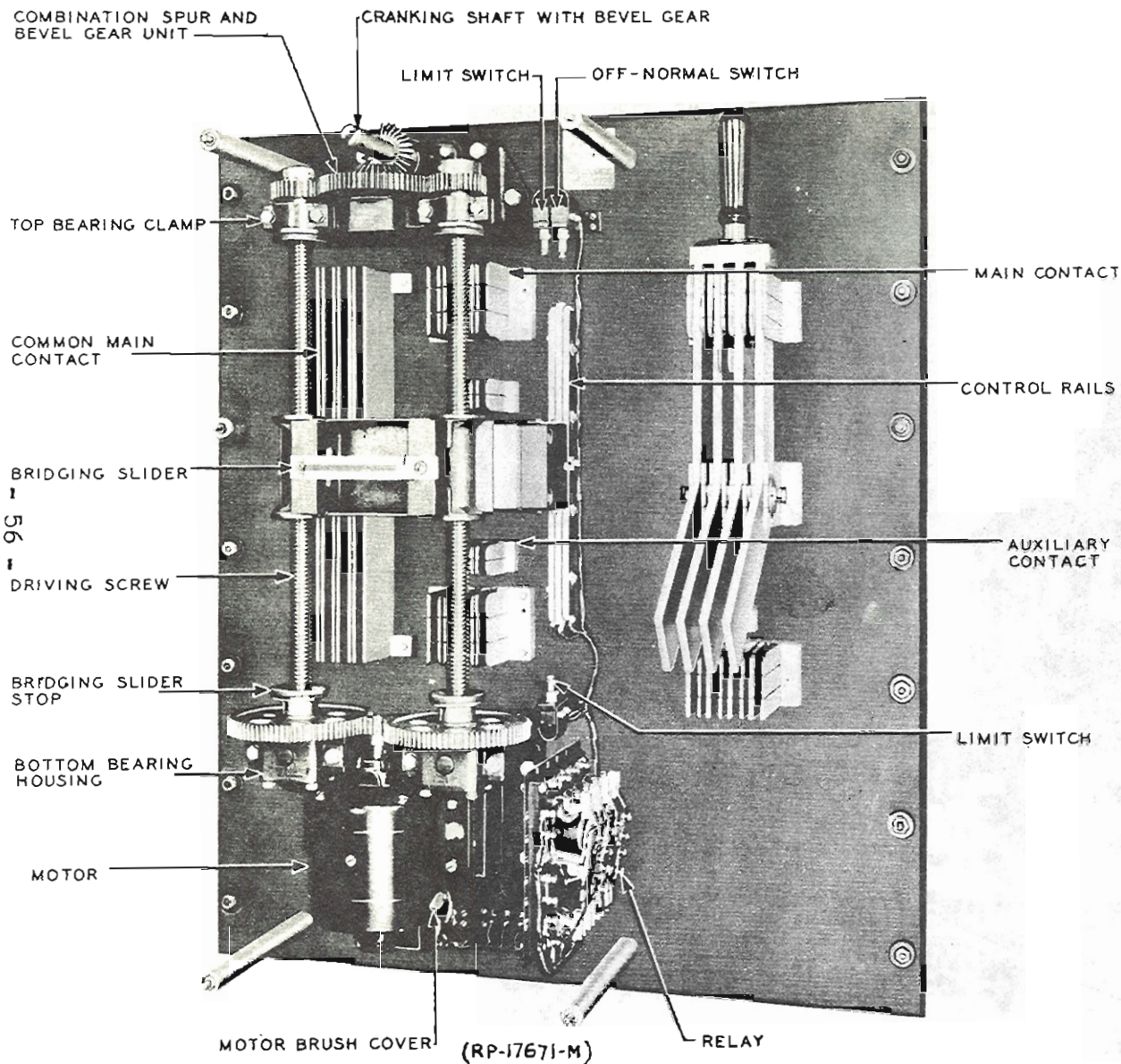
MAIN OFFICE, DENVER, COLO.

DEC. 1927

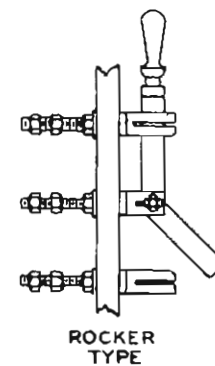


FRONT VIEW OF POWER BOARD
 (FROM BATTERY CONTROL BOARD END)
 ROANOKE, VA.

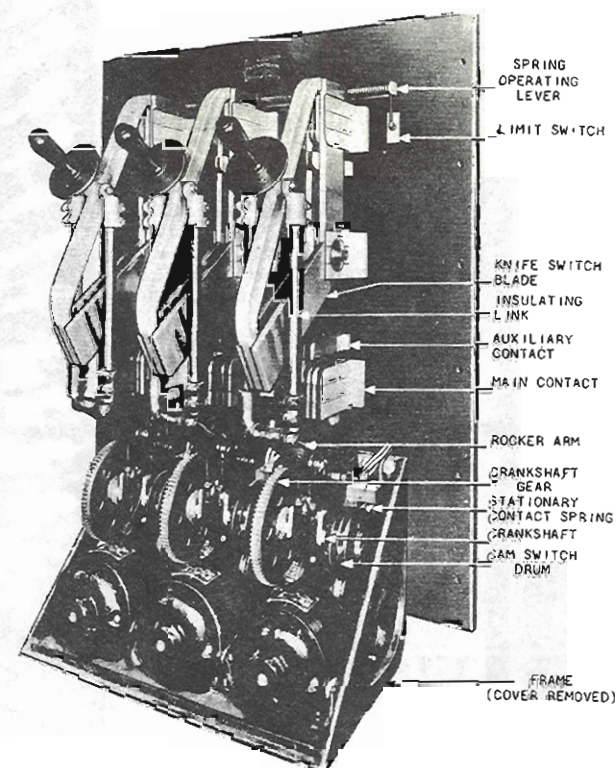
SEPT. 1934



Motor-Driven Slider Type Switch

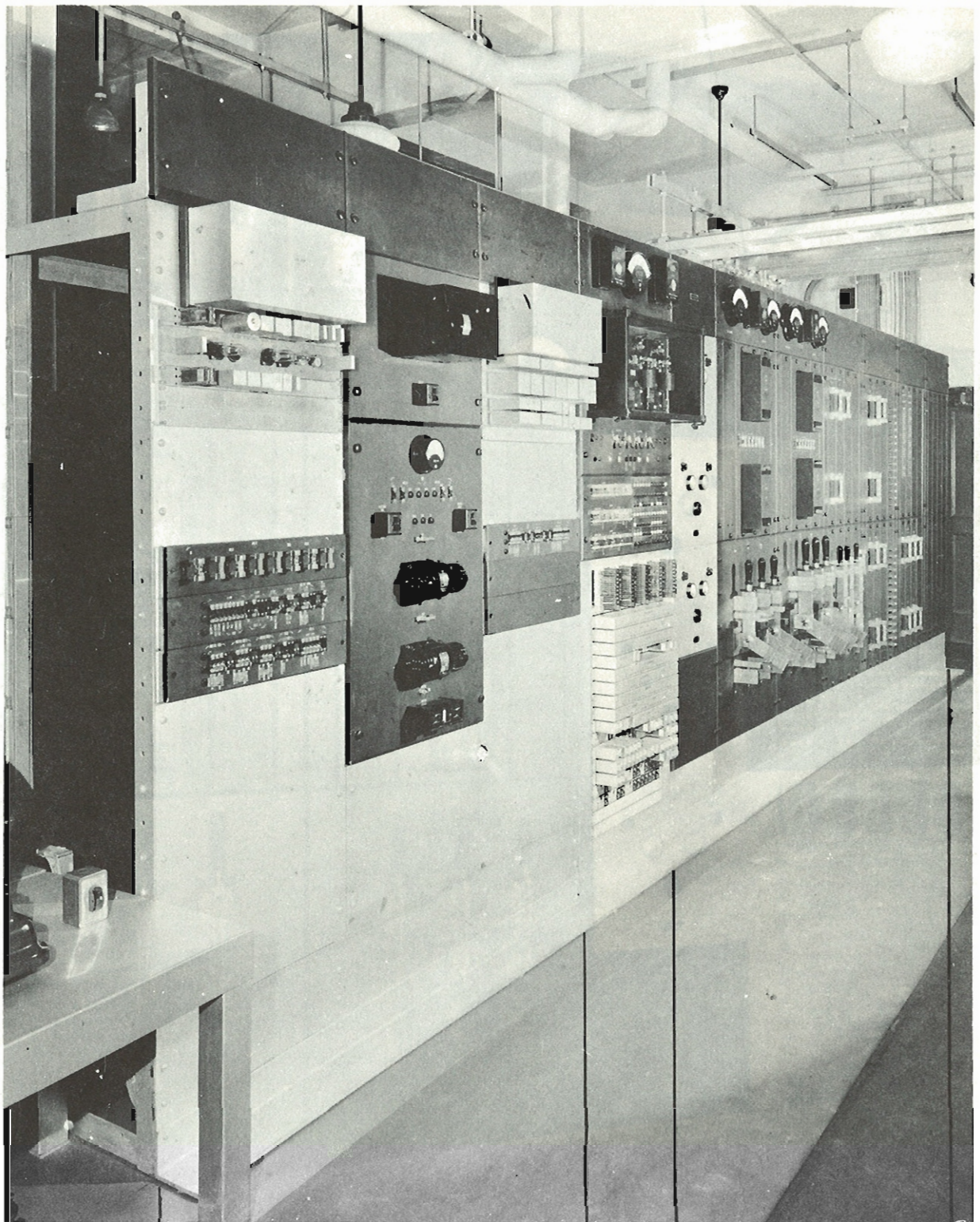


Rocker Type Knife Switch
Manually Operated



Motor-Driven Knife Blade Type Switch

EMERGENCY CELL SWITCHES
Mounted on Battery Control Board

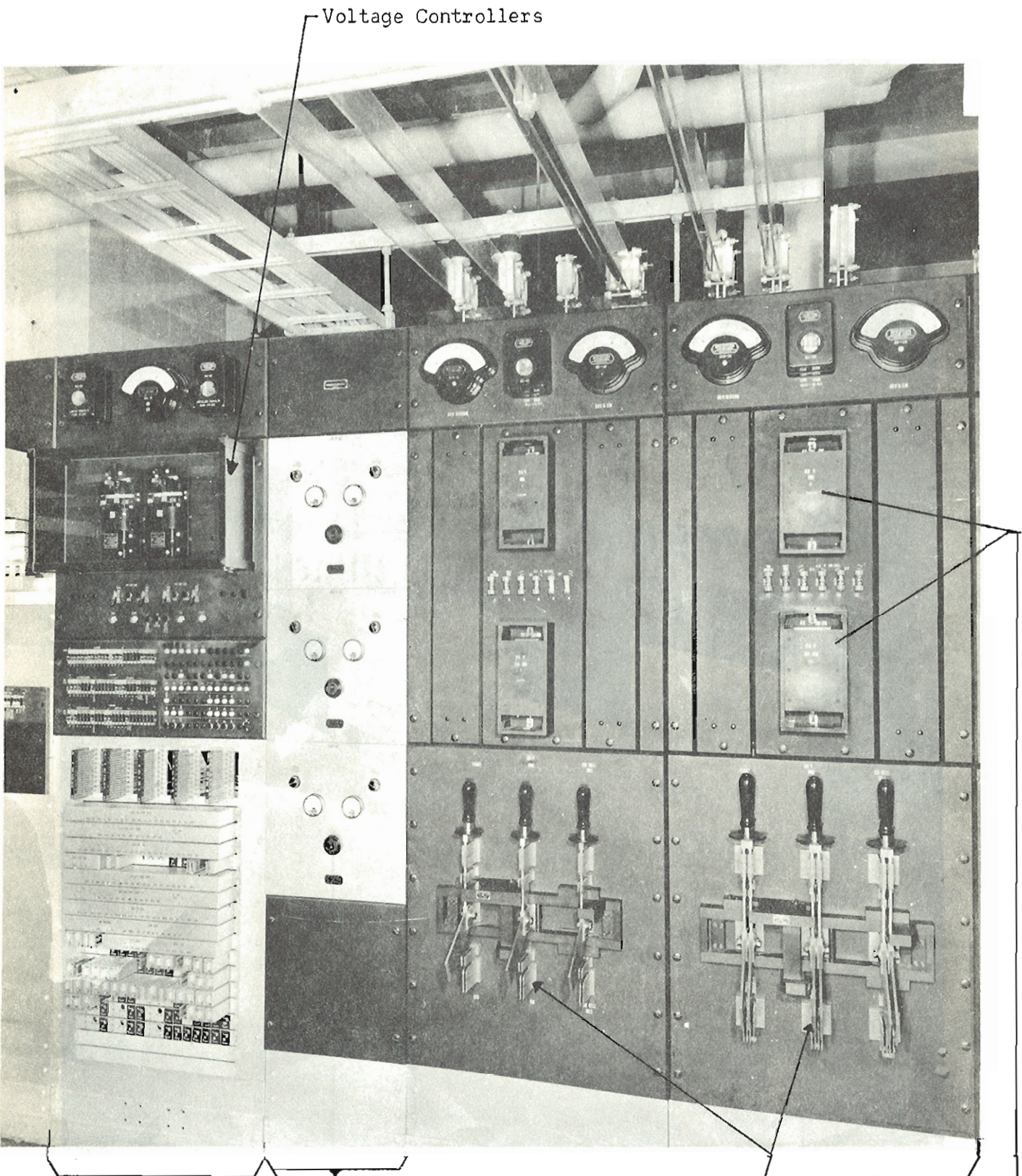


RINGING POWER BOARD

MAIN
CONTROL
BOARD

BATTERY CONTROL BOARD

FRONT VIEW OF POWER BOARD
(FROM RINGING PANEL END)
150TH ST.N.Y.



MAIN CONTROL BOARD

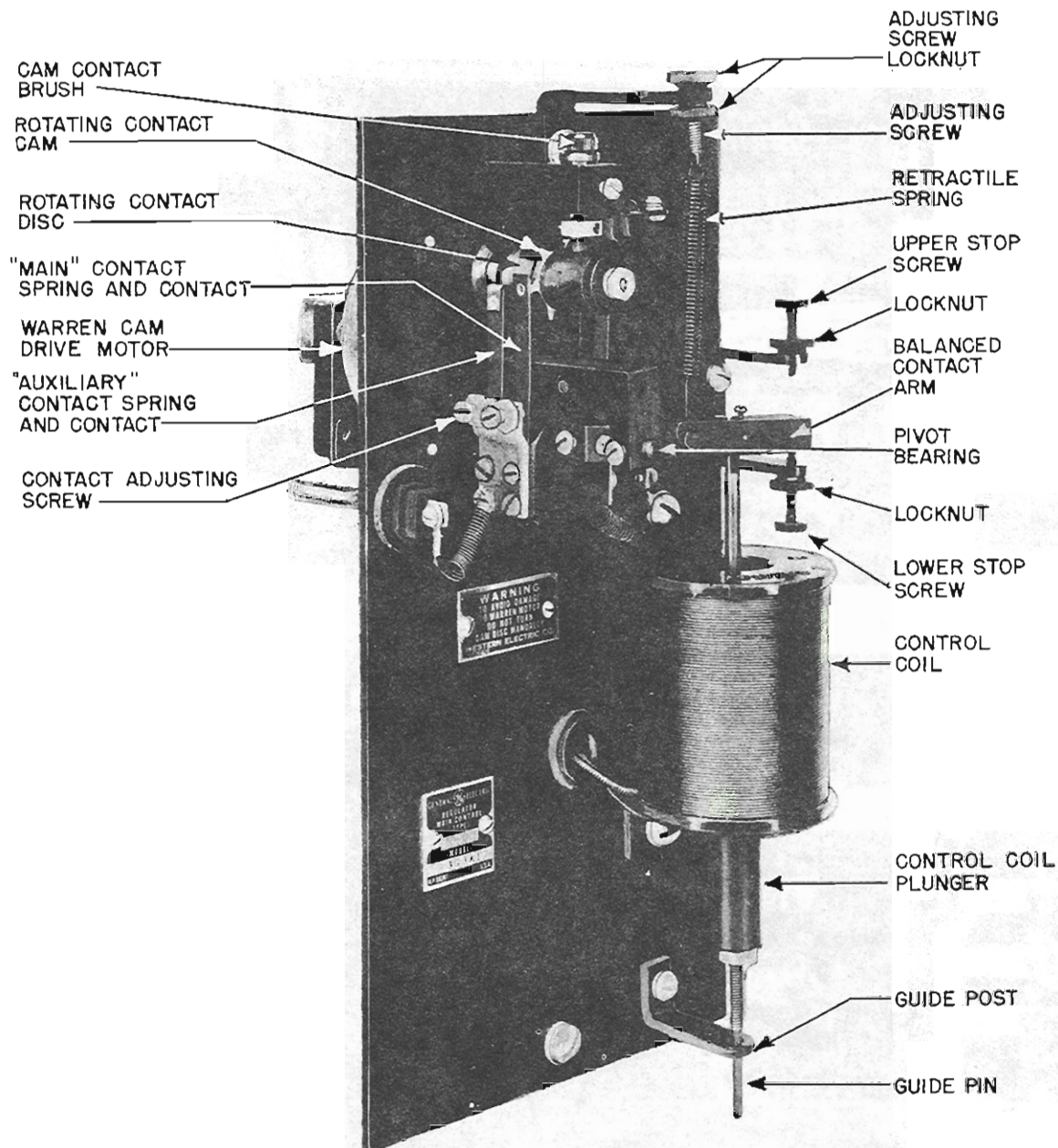
TRICKLE CHARGE RECTIFIERS

BATTERY CONTROL BOARD

POWER BOARD
(PARTIAL VIEW)
150TH ST. N.Y.

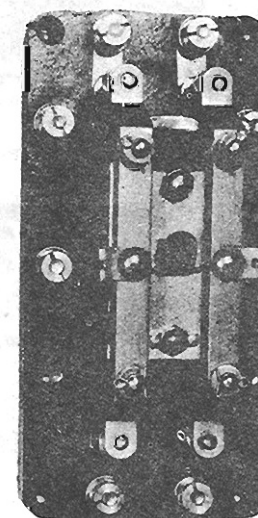
Link Type Fuses & Barriers

Rocker Type Inter-locking Emergency Cell Switches



Voltage Controller

Voltage Controller on Main Control Board (Power Board) operates Control Relays on Charging Generator Unit Meter and Control Panel, to maintain automatically the proper Output Voltage. Voltage Relays are also used to operate Alarm Circuits and control Emergency Cell Switching Circuits.



Control Relay

Mounted on Charging Generator Unit Meter and Control Panel, and operated by Voltage Controller on Main Control Board.

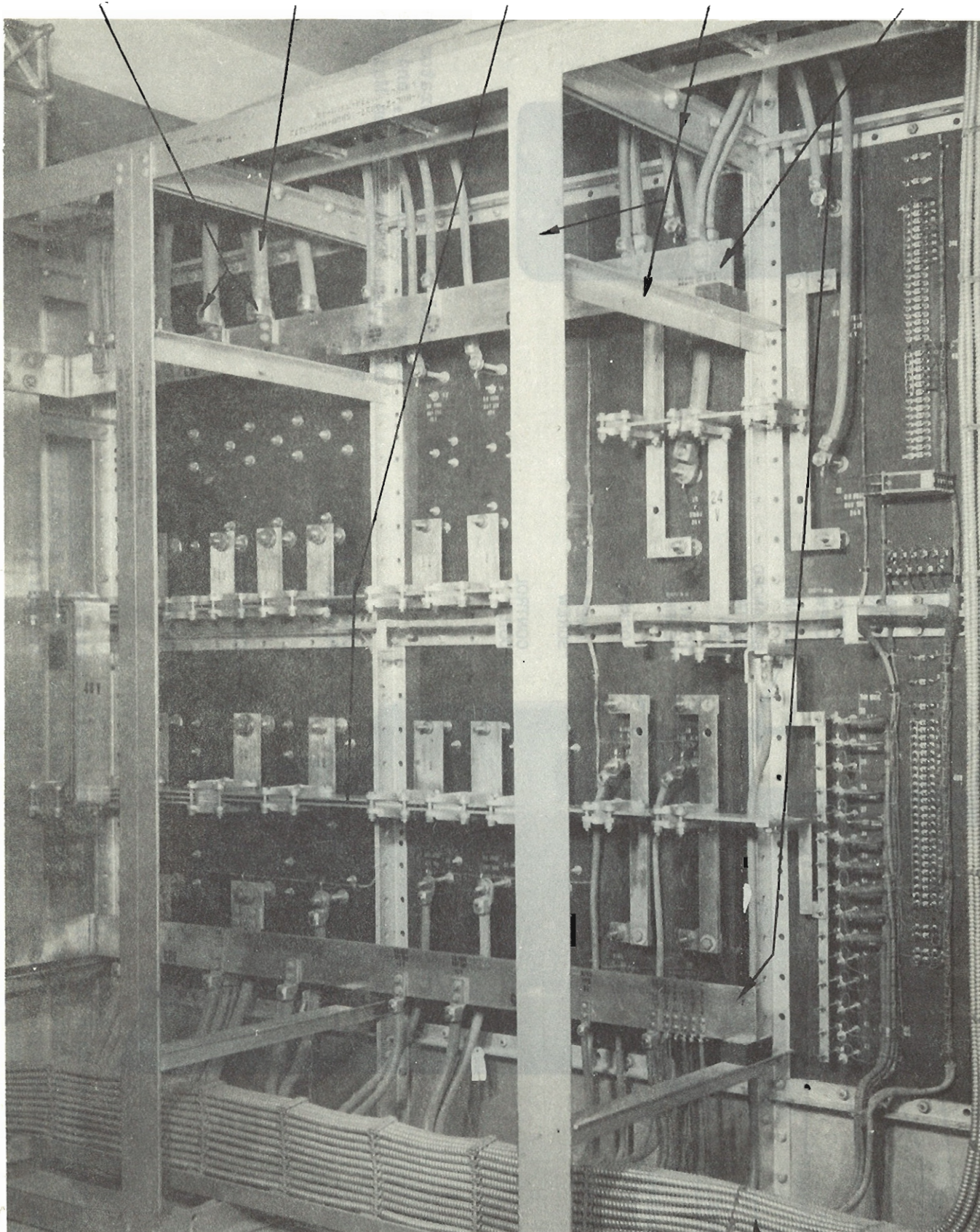
SOLDERLESS
TERMINAL LUGS

STRANDED
POWER CABLE

ALUMINUM BUS BAR
(48 V. BATTERY FEEDER)

BOX TYPE
FRAMEWORK

ALUMINUM
BUS BAR (GRD.)

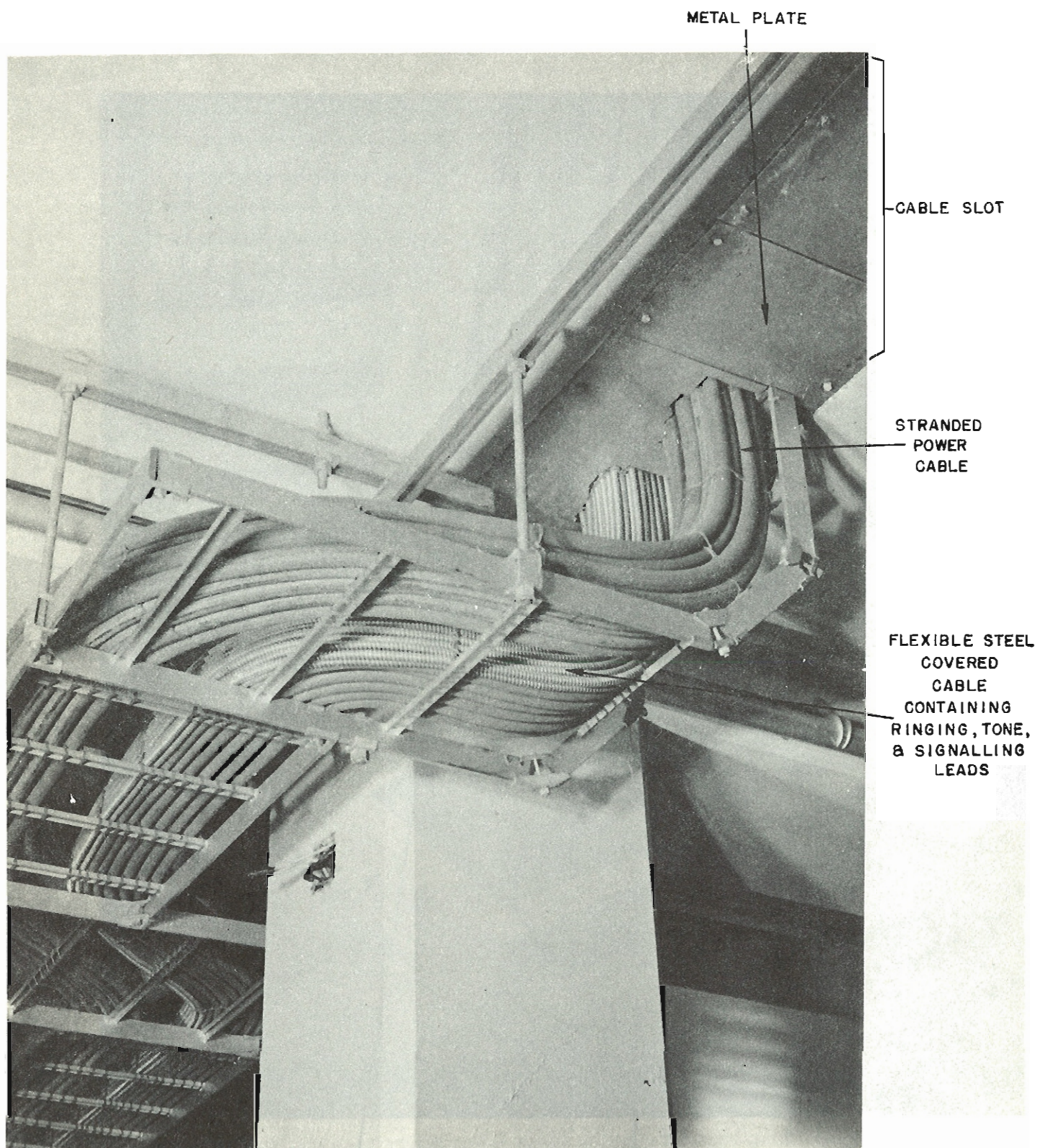


RINGING, TONE, & SIGNALLING
LEADS. (FLEXIBLE STEEL CABLE)

BATTERY CONTROL BOARD (REAR VIEW)

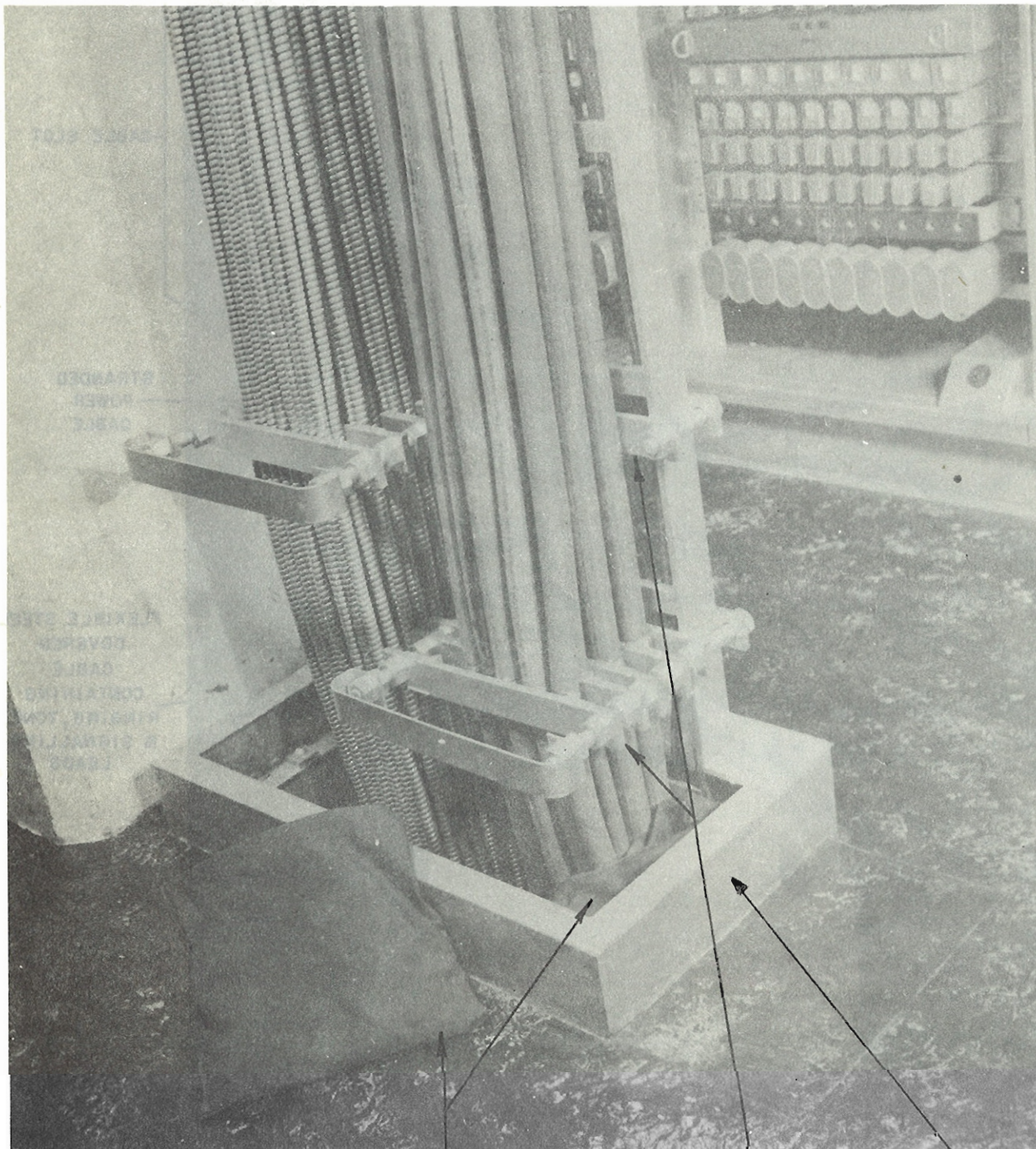
OAKLAND OFFICE, CHICAGO

AUG. 1940



POWER CABLING - CABLE SLOT

OAKLAND OFFICE, CHICAGO



CANVAS BAGS FILLED
WITH MINERAL WOOL

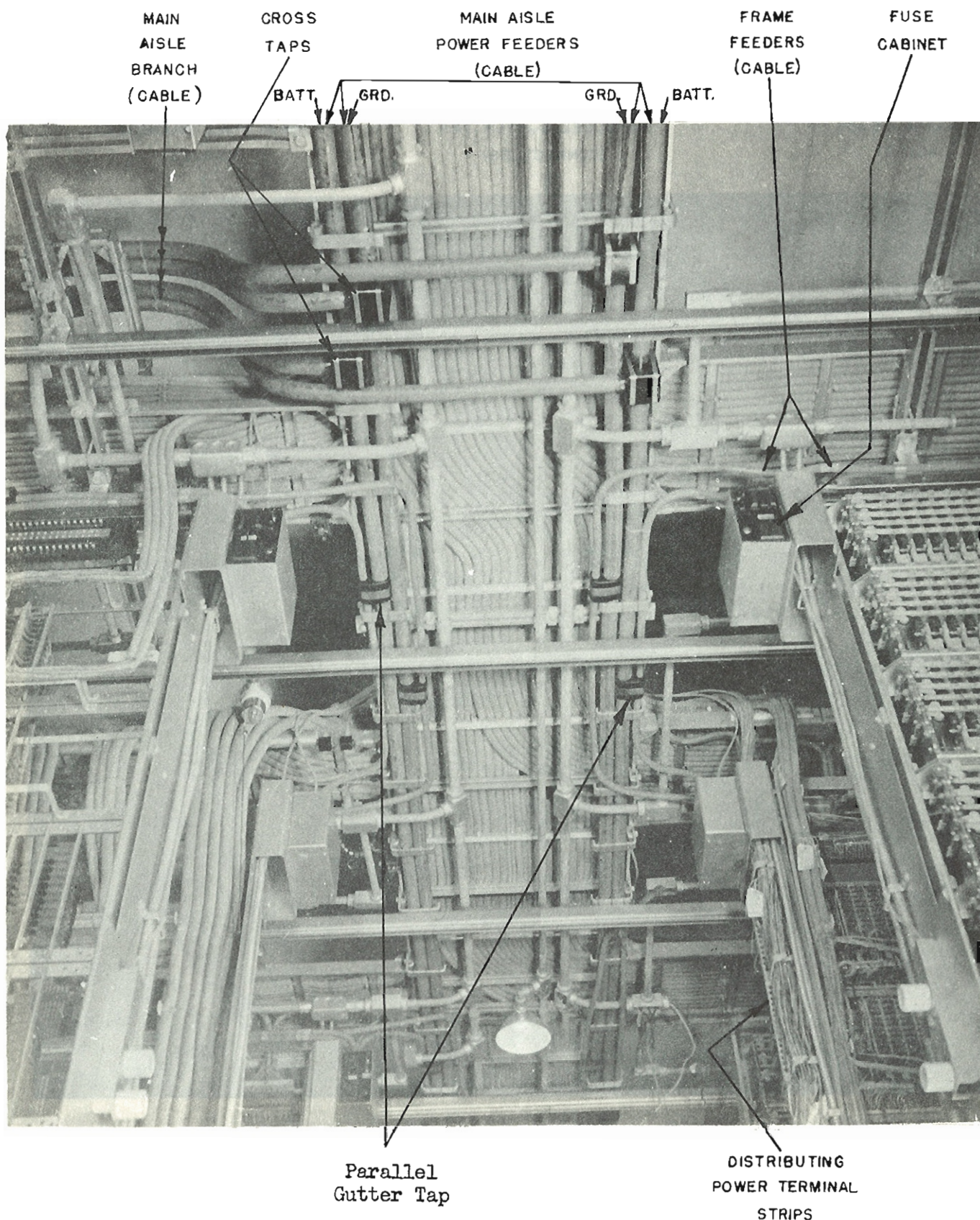
POWER CABLE CLAMPS

Cable Well

POWER CABLING BETWEEN FLOORS

OAKLAND OFFICE, CHICAGO
- 62 -

AUG. 1940



POWER CABLING-MAIN AISLE

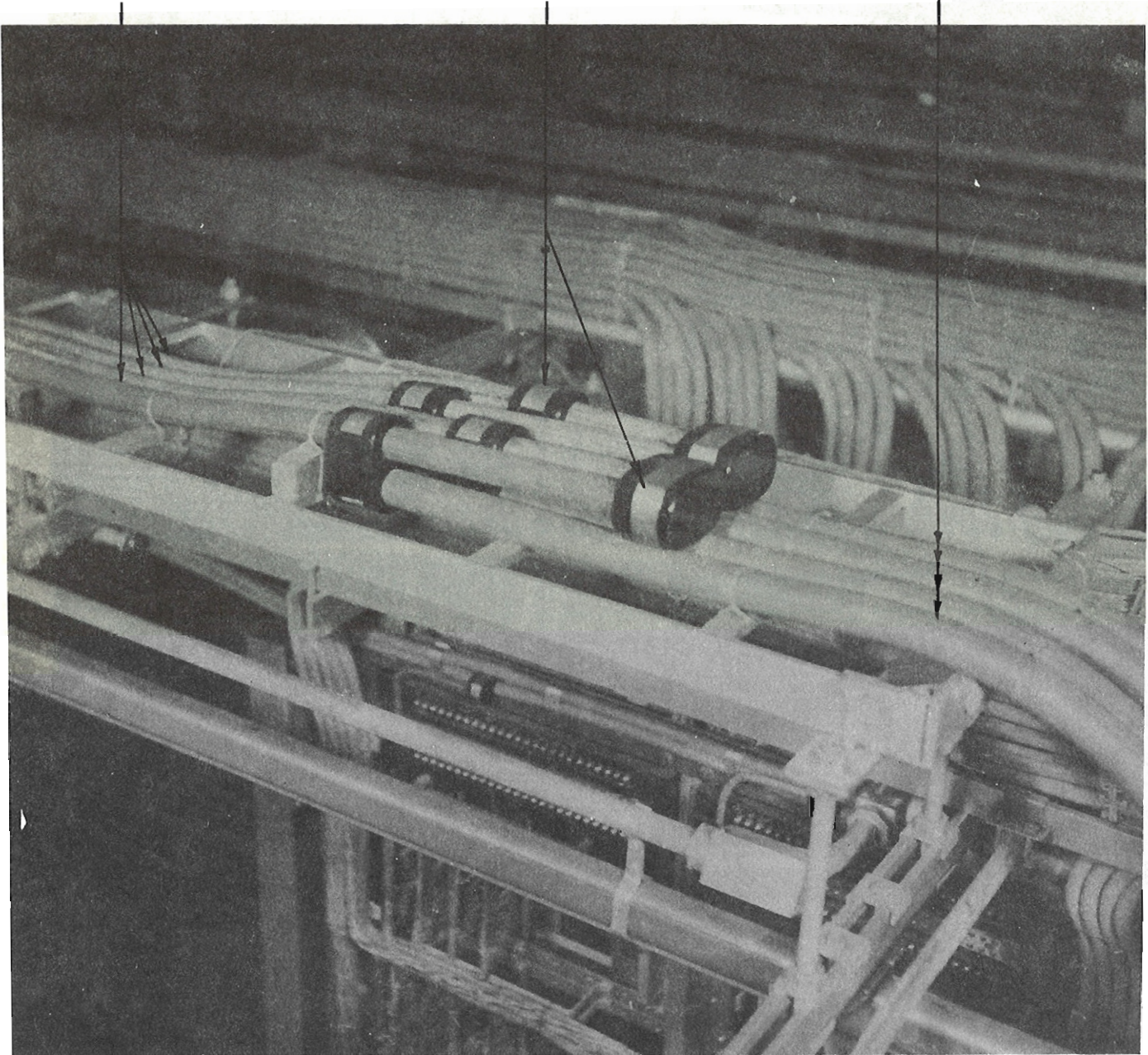
OAKLAND OFFICE, CHICAGO
- 63 -

AUG. 1940

DISCHARGE LEADS
(CABLES)

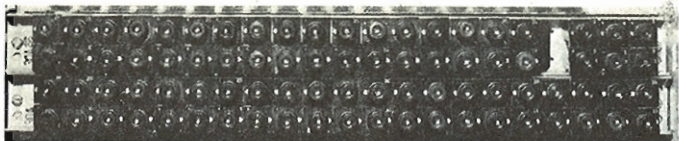
PARALLEL GUTTER TAP
(CONNECTORS)

MAIN AISLE BRANCHES
(CABLES)



EQUALIZING CENTER

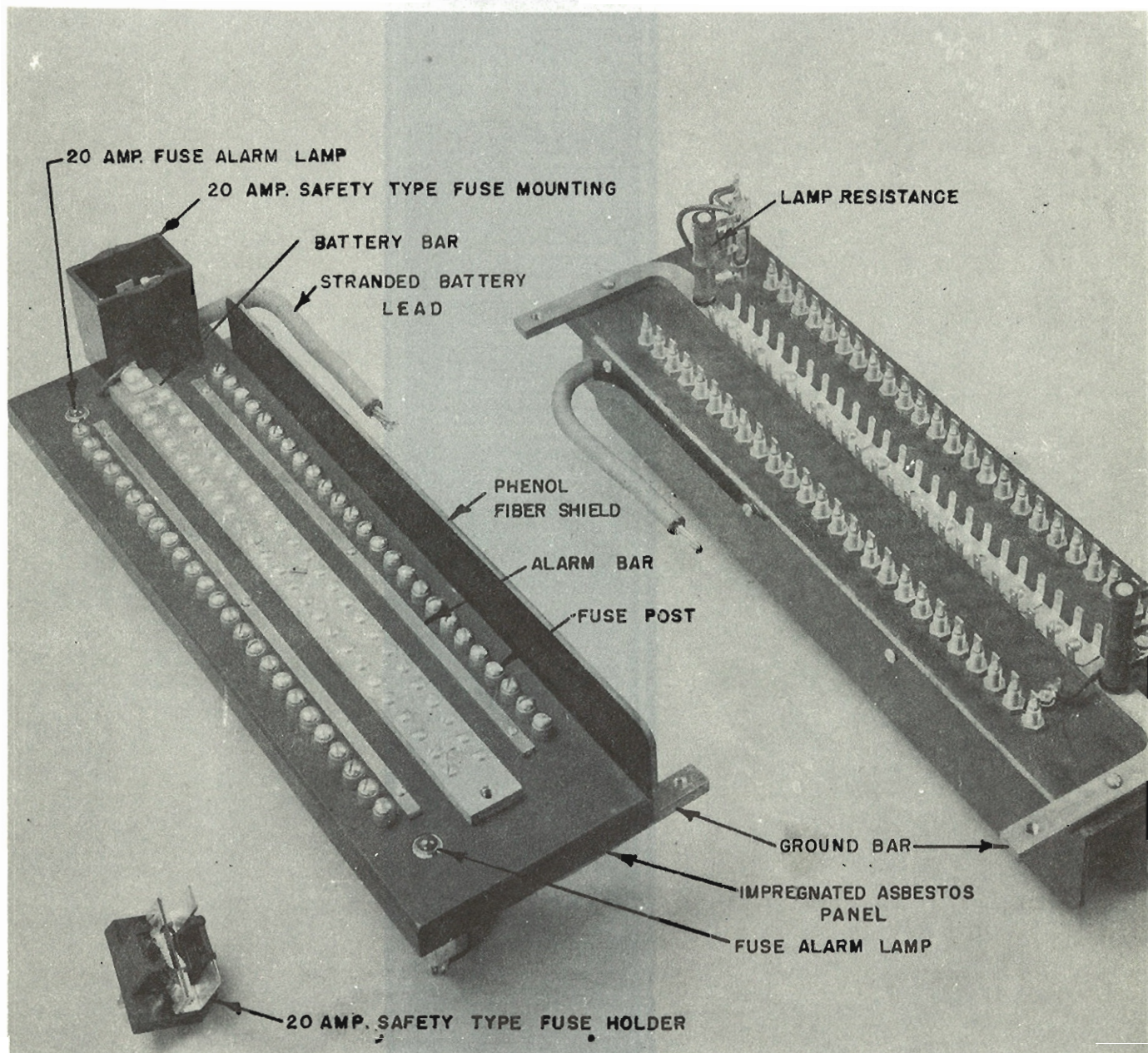
OAKLAND OFFICE, CHICAGO



New Fuse Panel

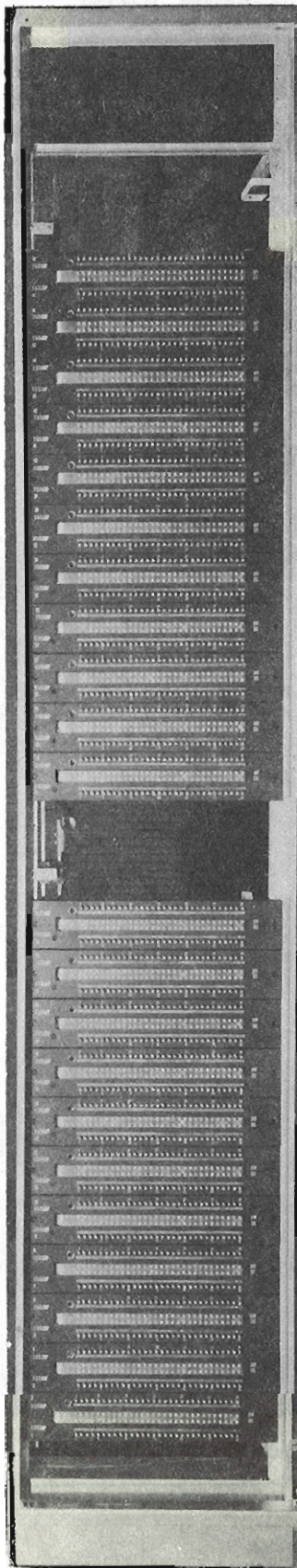
Mounts 70-Type tubular fuses. Fuse element is under spring tension. Operation of fuse releases spring,

forcing metal cap of fuse against alarm terminal of fuse block. The colored indicator protrudes through a hole in the fuse mounting cap, indicating the operated fuse.



Fuse Panel Mounting "Grasshopper," 35-Type Fuses

FUSE PANELS

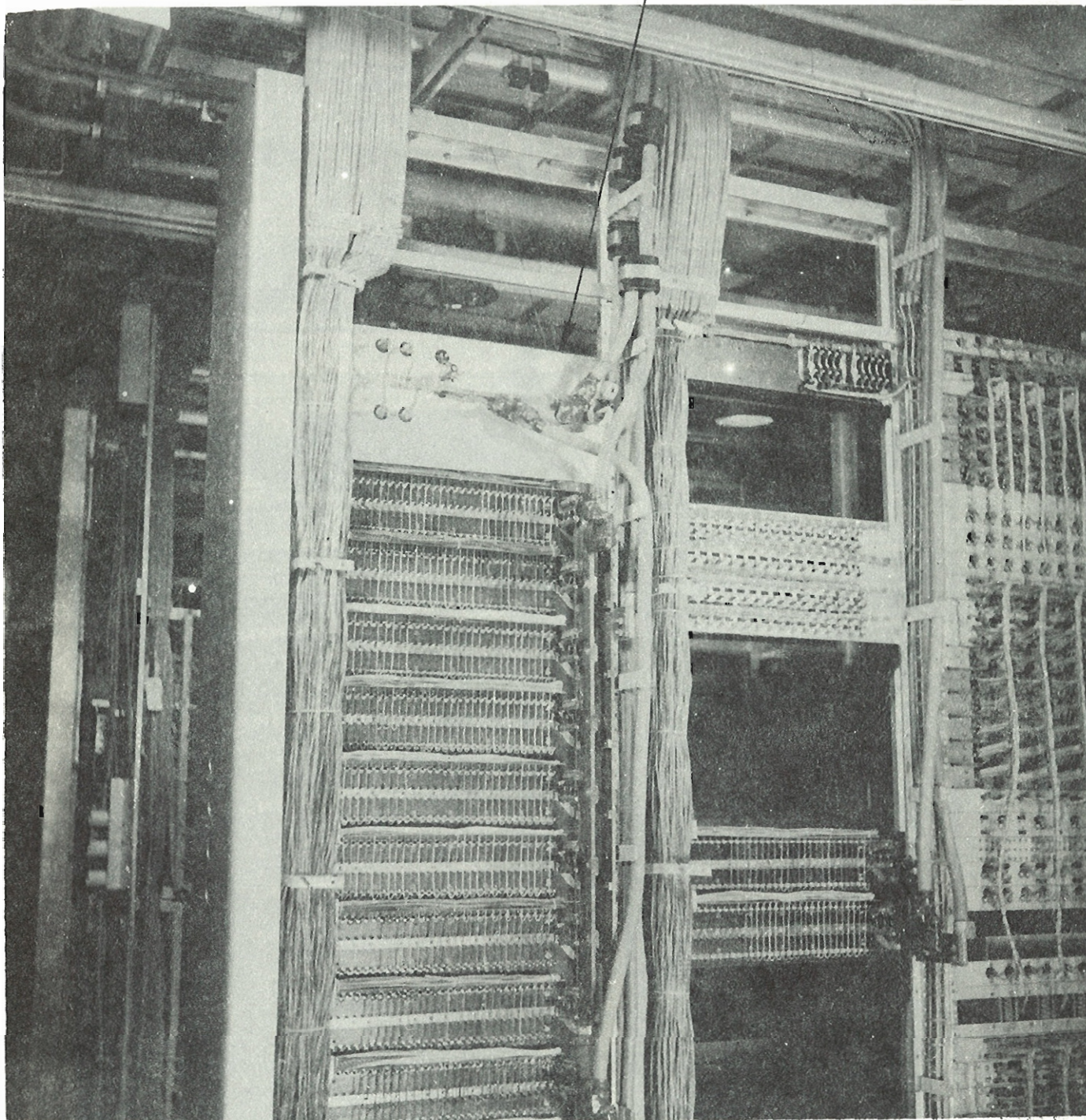


FUSING BAY

(FRONT VIEW)

CABLES TO FRAMES, RACKS & DESKS

FILTER PANEL



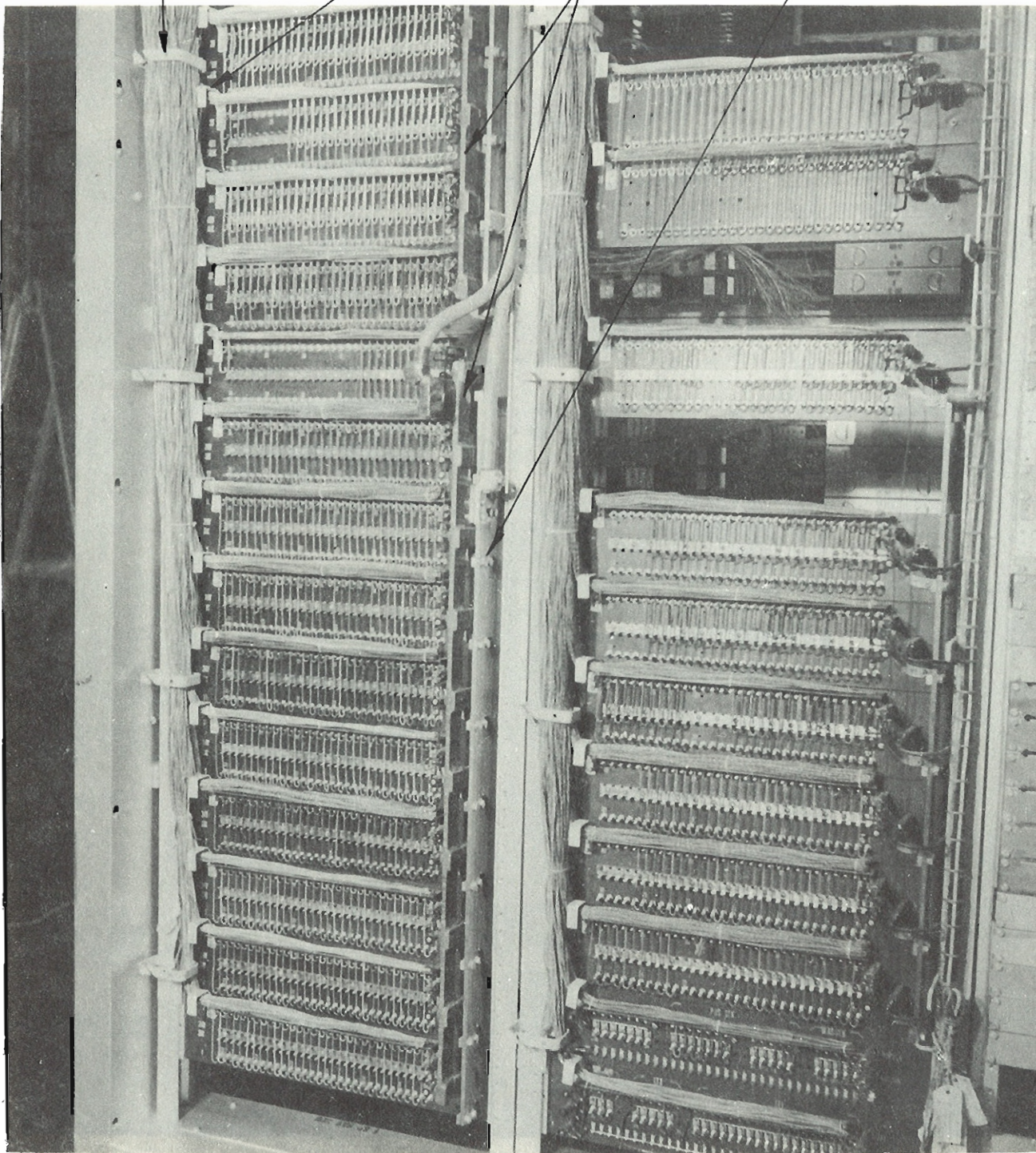
FUSING BAY

(UPPER PART REAR VIEW)
OAKLAND OFFICE, CHICAGO

- 64C -

AUG. 1940

FANNING RING CABLE BRACKET VERTICAL BUS BAR
BATT. (TAPED) VERTICAL BUS BAR
GRD.

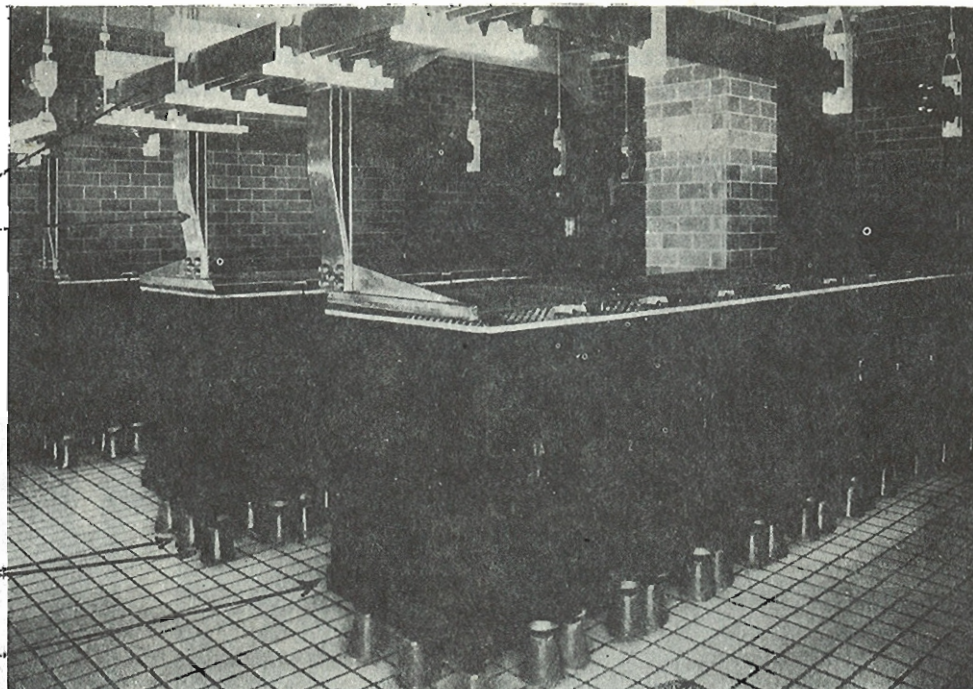


FUSING BAY
(LOWER PART REAR VIEW)
OAKLAND OFFICE, CHICAGO

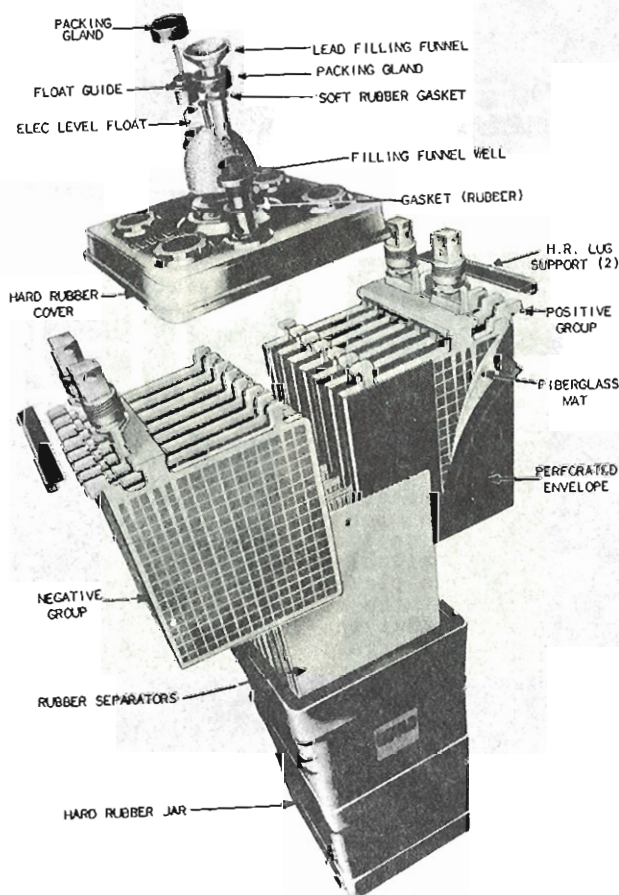
Bus Bar

Oil-Filled
Insulators

Lead-Lined Wood
Tank

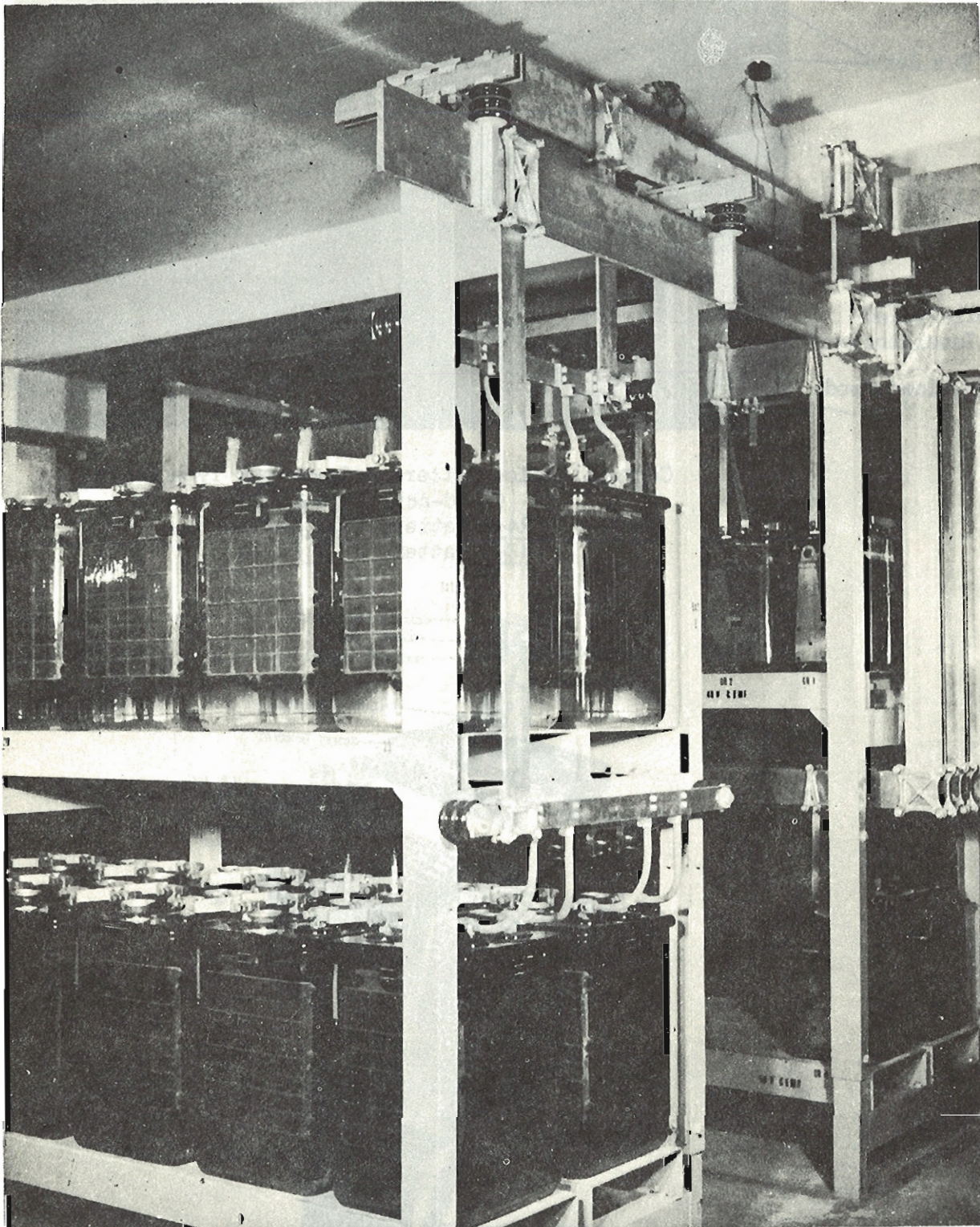


Central Office Battery - Open-Tank Type Cells
(Lead-Acid Type Cell)
24-V Battery - 12 Cells
48-V Battery - 23 Cells

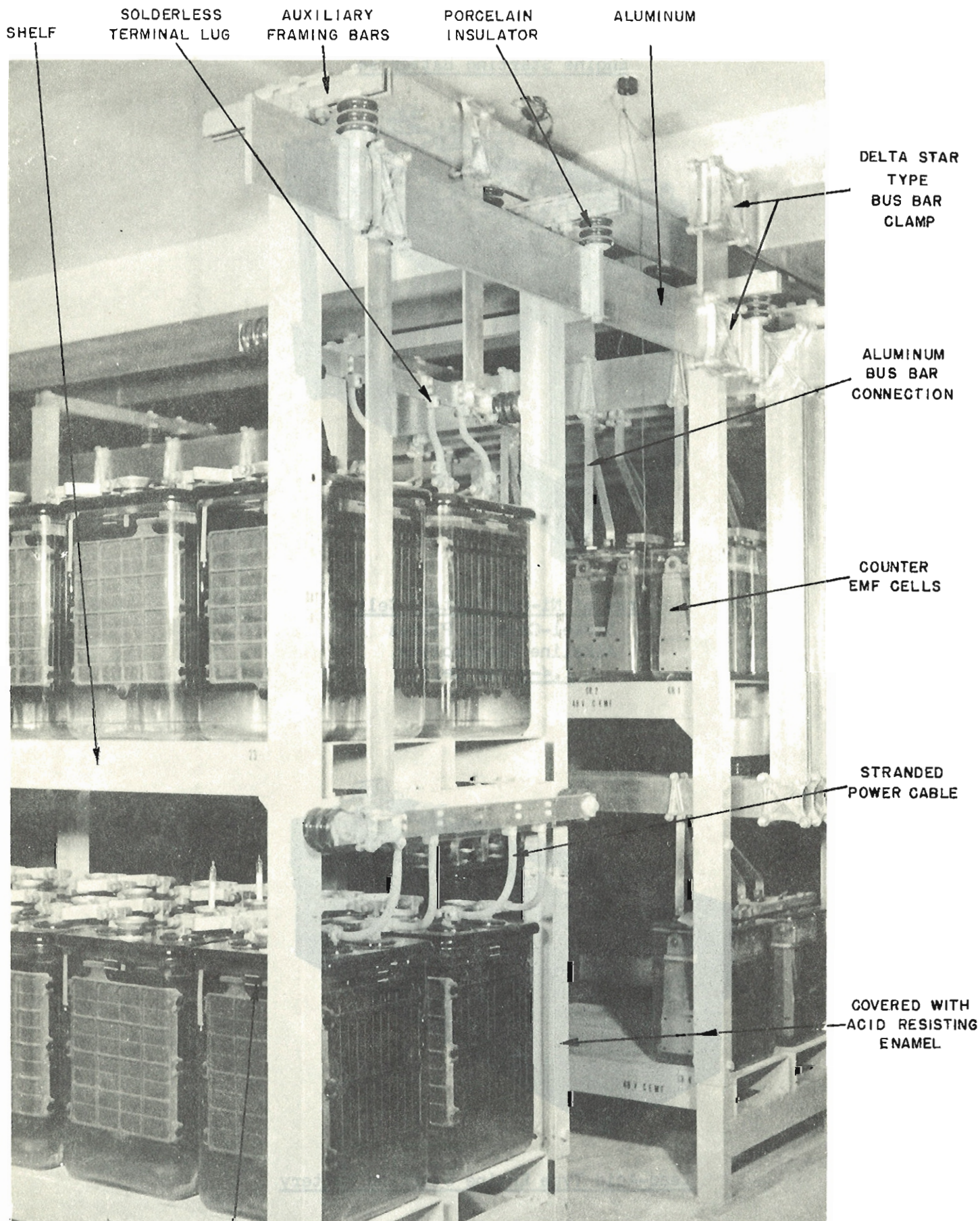


Fully Enclosed Rubber Jar Type Cell
(Exploded View)
(Lead-Acid Type Cell)

Open-Tank Type Cells must be installed in a separate, well-ventilated Battery Room, as they gas quite freely on charge. Enclosed Jar Type Cells are installed in the Power Room, directly in back of the Power Board.



Central Office Battery - Enclosed Glass Jar Type Cell
(Lead-Acid Type Cell)
Cell Voltage - 2.55-v At Full Charge
2.17-v Normal Voltage
1.75-v When Discharged.

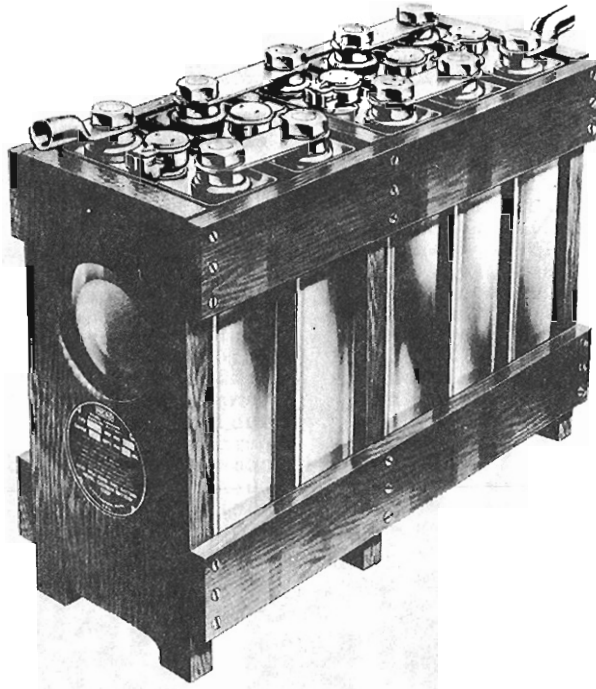


BUS BAR CONNECTIONS AT BATTERY STAND

OAKLAND OFFICE, CHICAGO

AUG. 1940

Engine Starting Batteries

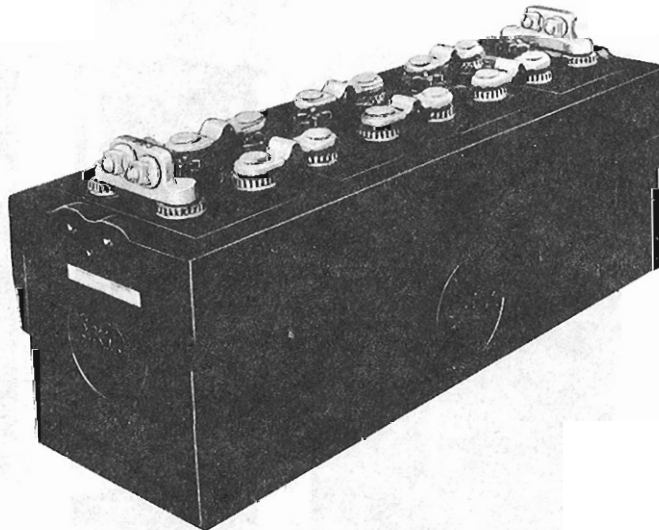


Tray of Ni-Cad Battery Cells

Nickel-Cadmium Plates

Alkaline Electrolyte

1.4-v Per Cell

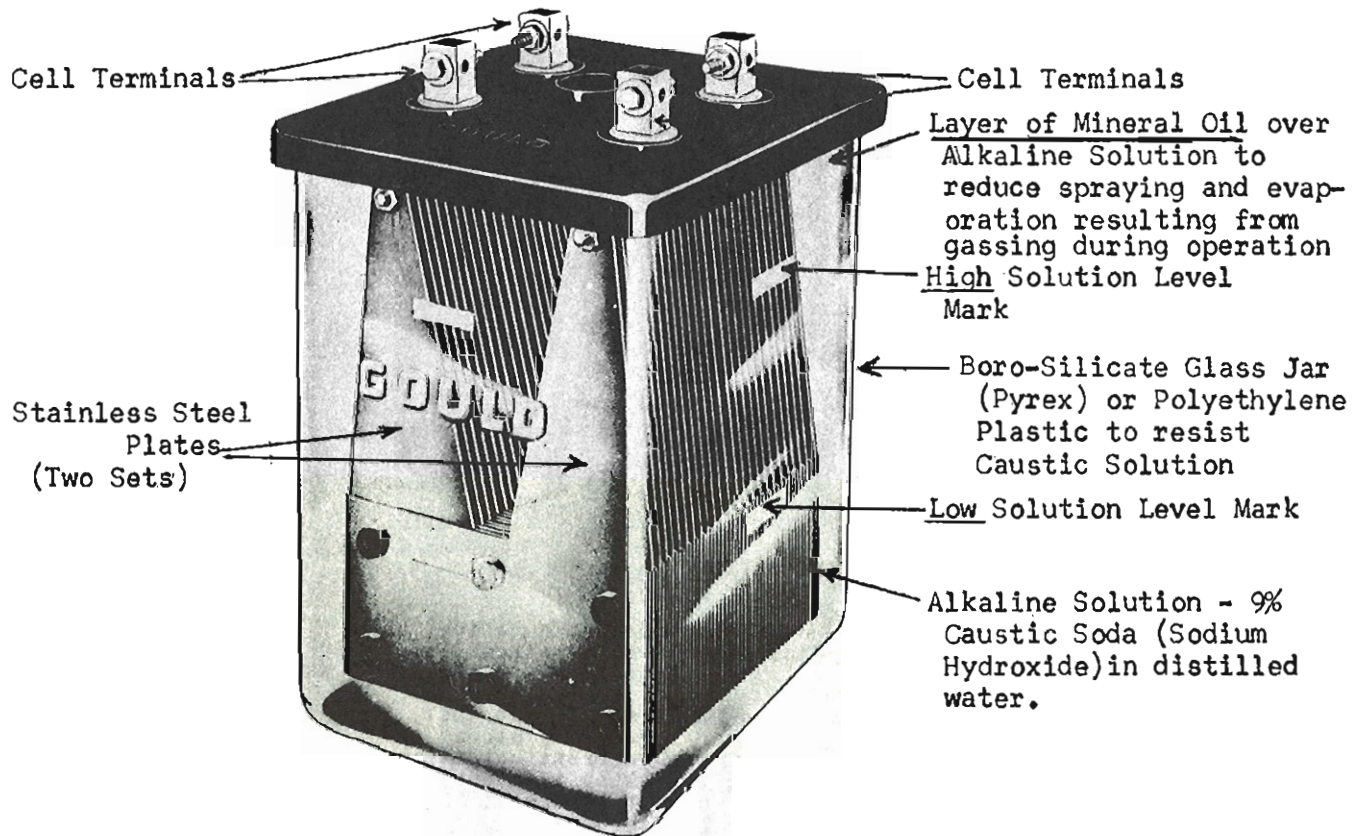


Lead-Acid Type Engine Starting Battery

CEMF (Counter-Electromotive Force) CELLS

In Series with the Central Office Battery and the Load (Switching Equipment) to:

- 1) Prevent higher battery-charging voltage from reaching the Switching Equipment, or
- 2) Provide a continuous reduced-voltage supply; such as 48-v to 24-v, when the 24-v current drain is relatively light.



Voltage drop in the CEMF Cell is the voltage expended in forcing the current through the Caustic Solution, from one set of plates to the other.

Voltage Drop per Cell: 1.85-v at 10% Rated Load
2.15-v at Full Load.

A CEMF Cell does not have a storage capacity. The Cell has no polarity; therefore it may be connected for either direction of current flow.

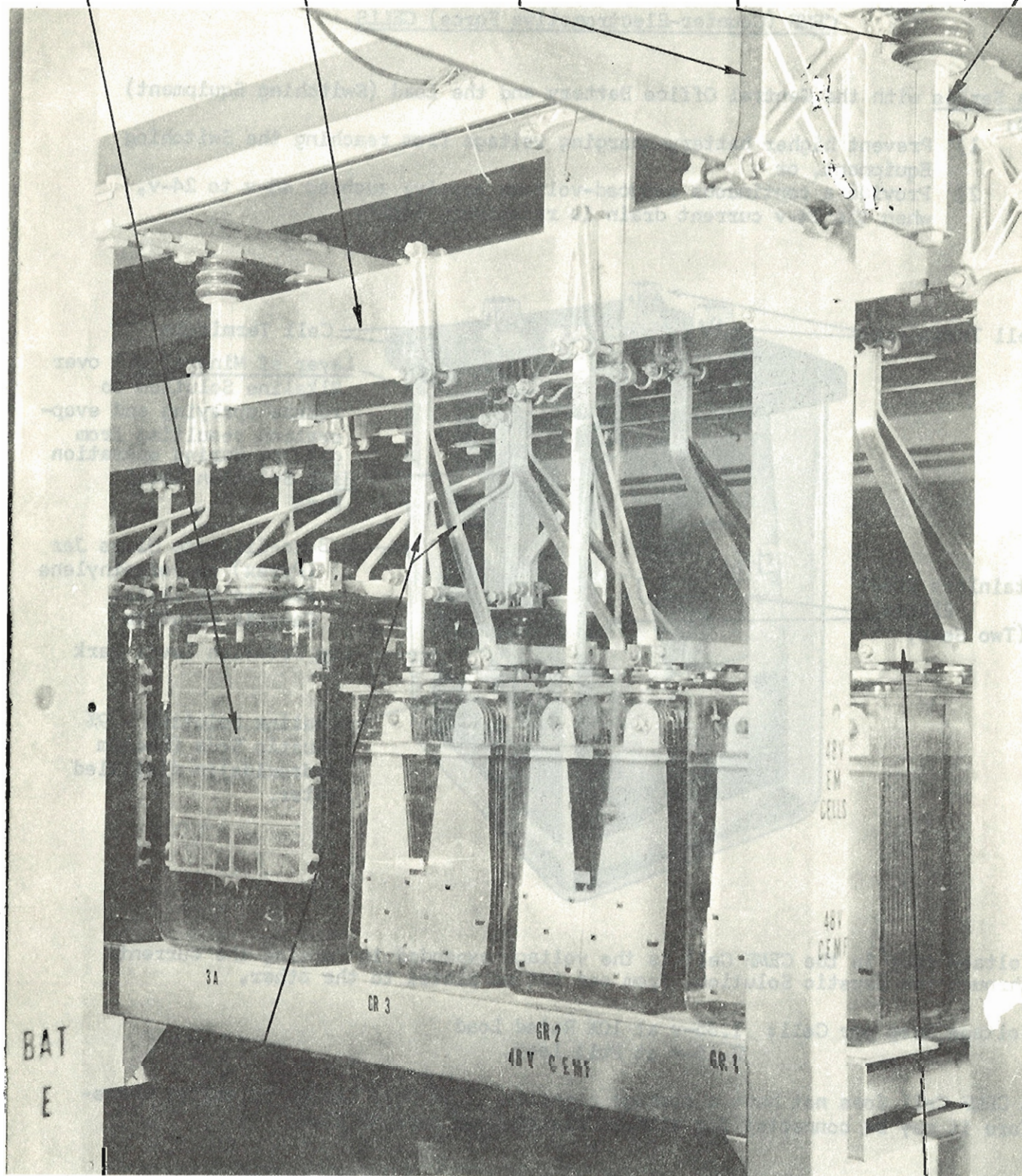
48 VOLT
EMERGENCY CELL

ALUMINUM
BUS BAR

DELTA STAR TYPE
BUS BAR CLAMP

PORCELAIN
INSULATOR

BOLT
ASSEMBLY



ALUMINUM BUS
BAR DETAILS

ONE CELL
(NAK-TYPE)

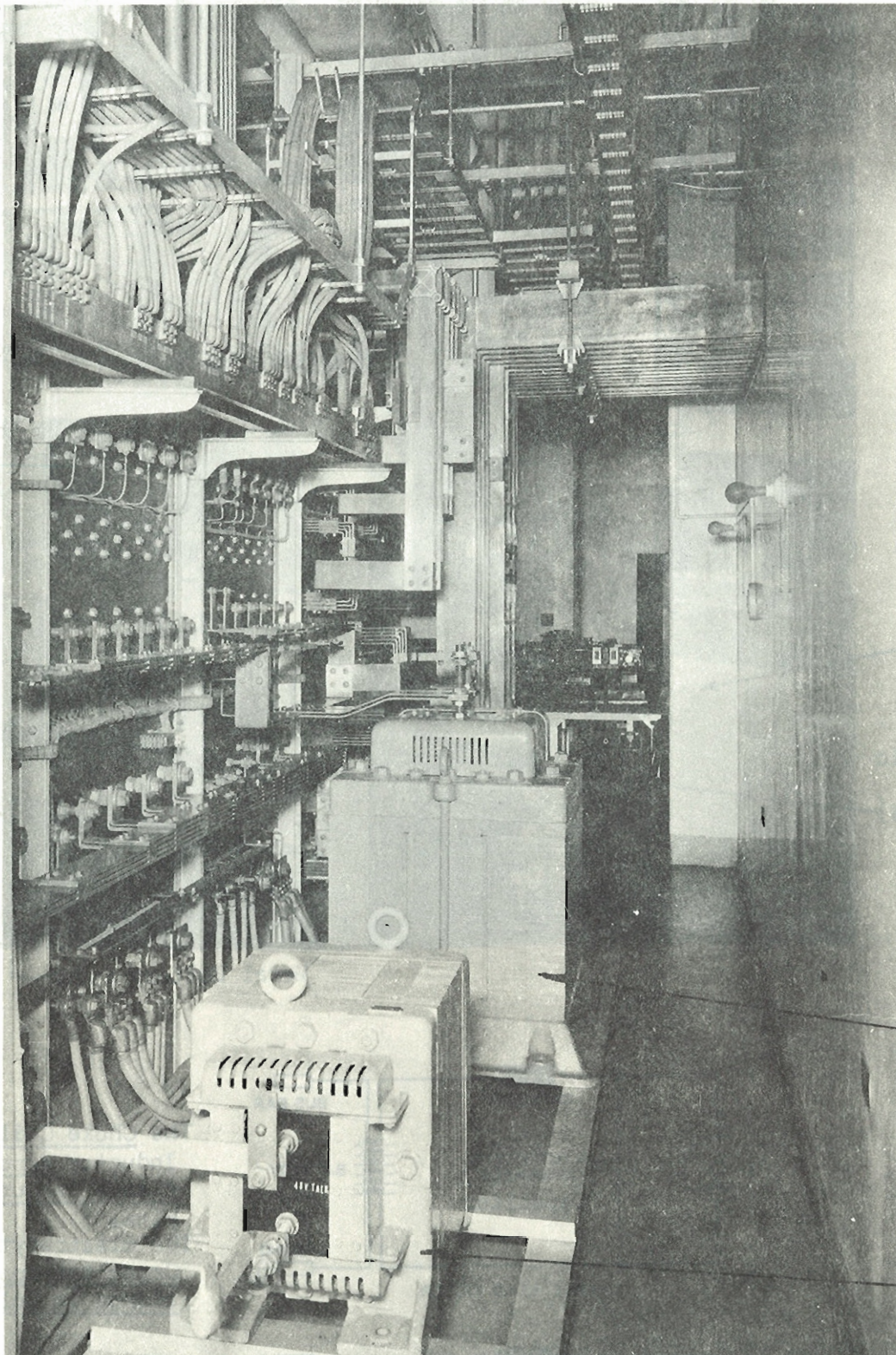
INTERROW
CONNECTOR

48 VOLT COUNTER ELECTROMOTIVE FORCE (CEMF) CELLS

OAKLAND OFFICE, CHICAGO

AUG. 1940

Large Common TALKING BATTERY FILTERS located behind Power Board in Older Offices.
Decentralized Filters mounted on Relay Rack Bays, Fuse Bays, Cable Racks, at top
of frames. etc., in newer offices.



15 A
CHOKE COIL
1000 AMP.
(3920 LBS.)
24-v.
Talking
Battery
Supply

12 A
CHOKE COIL
400 AMP.
(1128 LBS.)
48-v.
Talking
Battery
Supply

Signal Battery, unfiltered 24-v. or 48-v. from Motor-Generator Charging
Units. Used for operating relays and switches, lighting switchboard
lamps, etc.

"Quiet" or Talking Battery, 24-v. or 48-v., filtered Signal Battery.

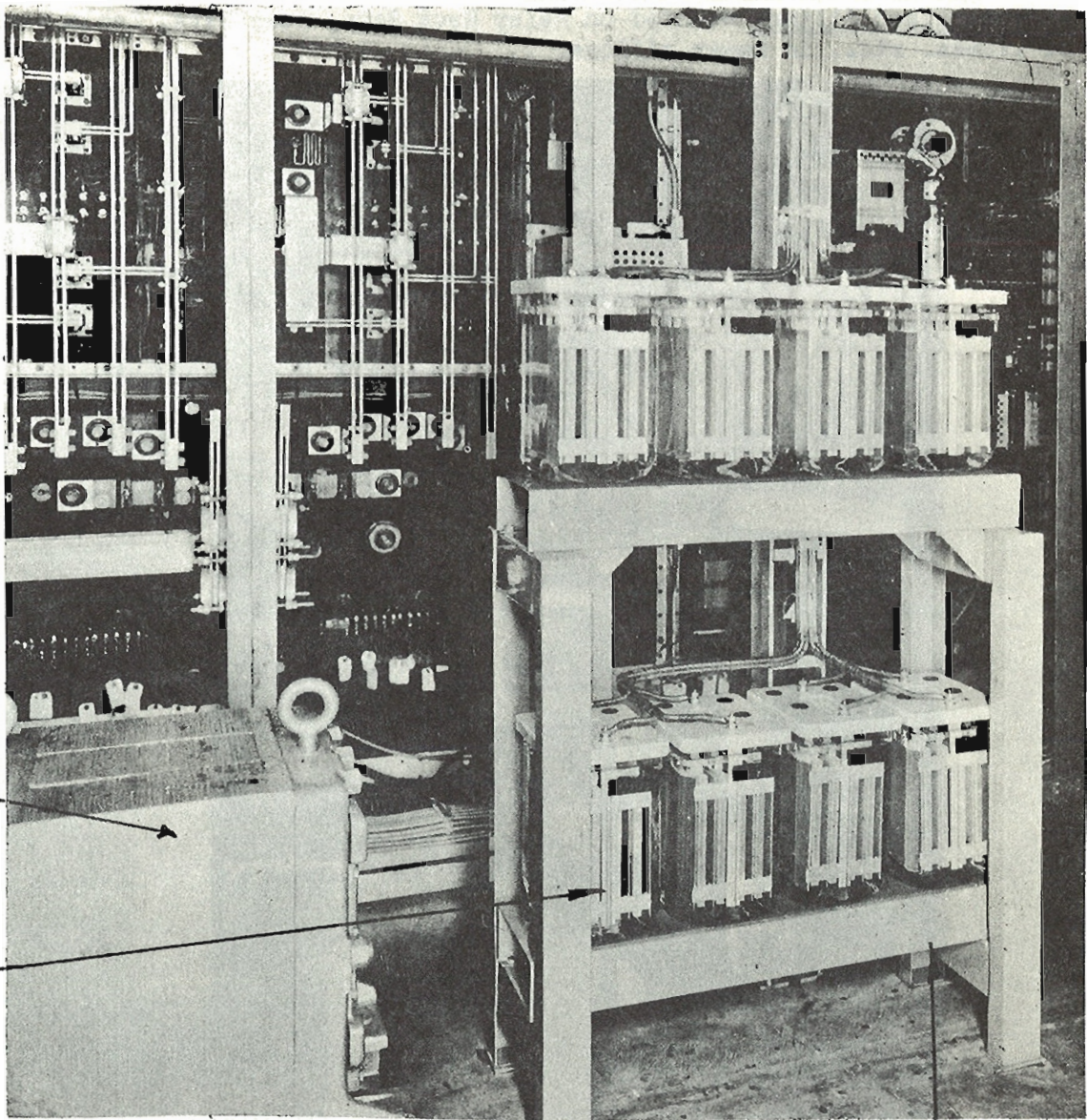
CHOKE COILS

WABASH OFFICE, CHICAGO

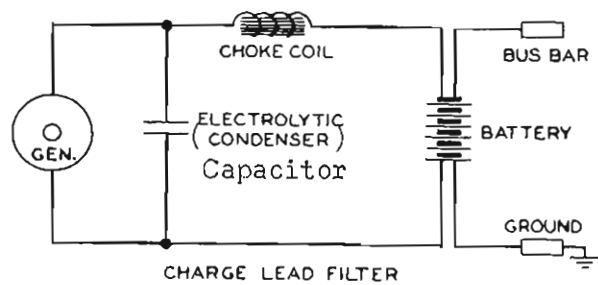
Talking Battery Filter

Choke Coil

Electrolytic
Capacitors
(Condensers)
"Wet" Type

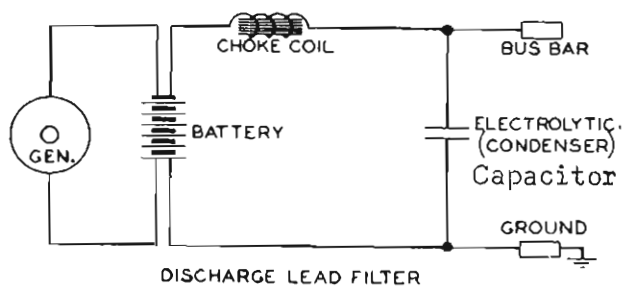


Metal Battery Stand



The Choke Coil or
Inductor opposes any
change in Current
Flow.

The Electrolytic
Capacitor opposes any
change in Voltage.



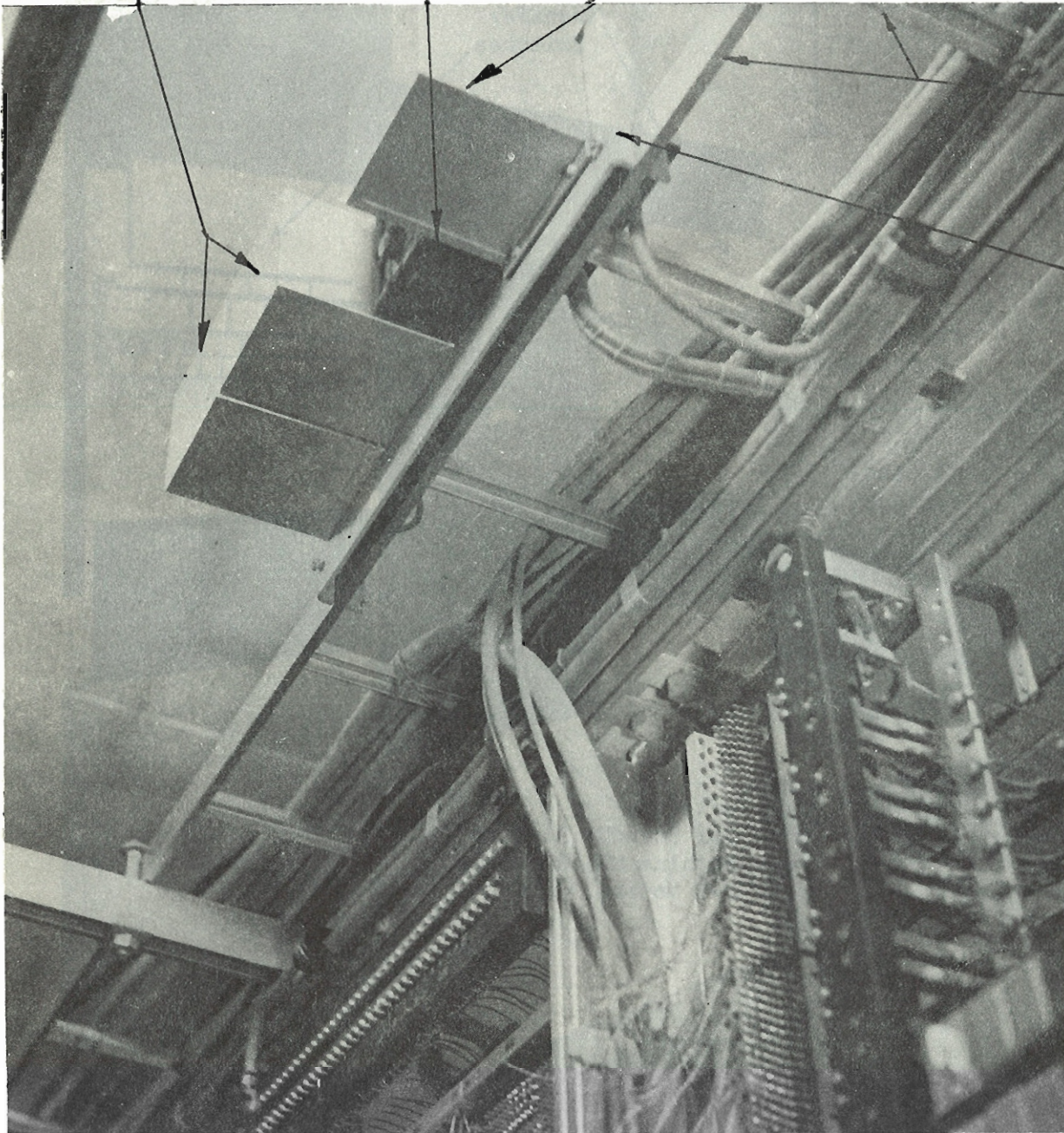
DRY TYPE
ELECTROLYTIC
CONDENSERS

SAFTOFUSE
UNIT

Inductor
(Retard Coil)

CABLE RACK

PANEL

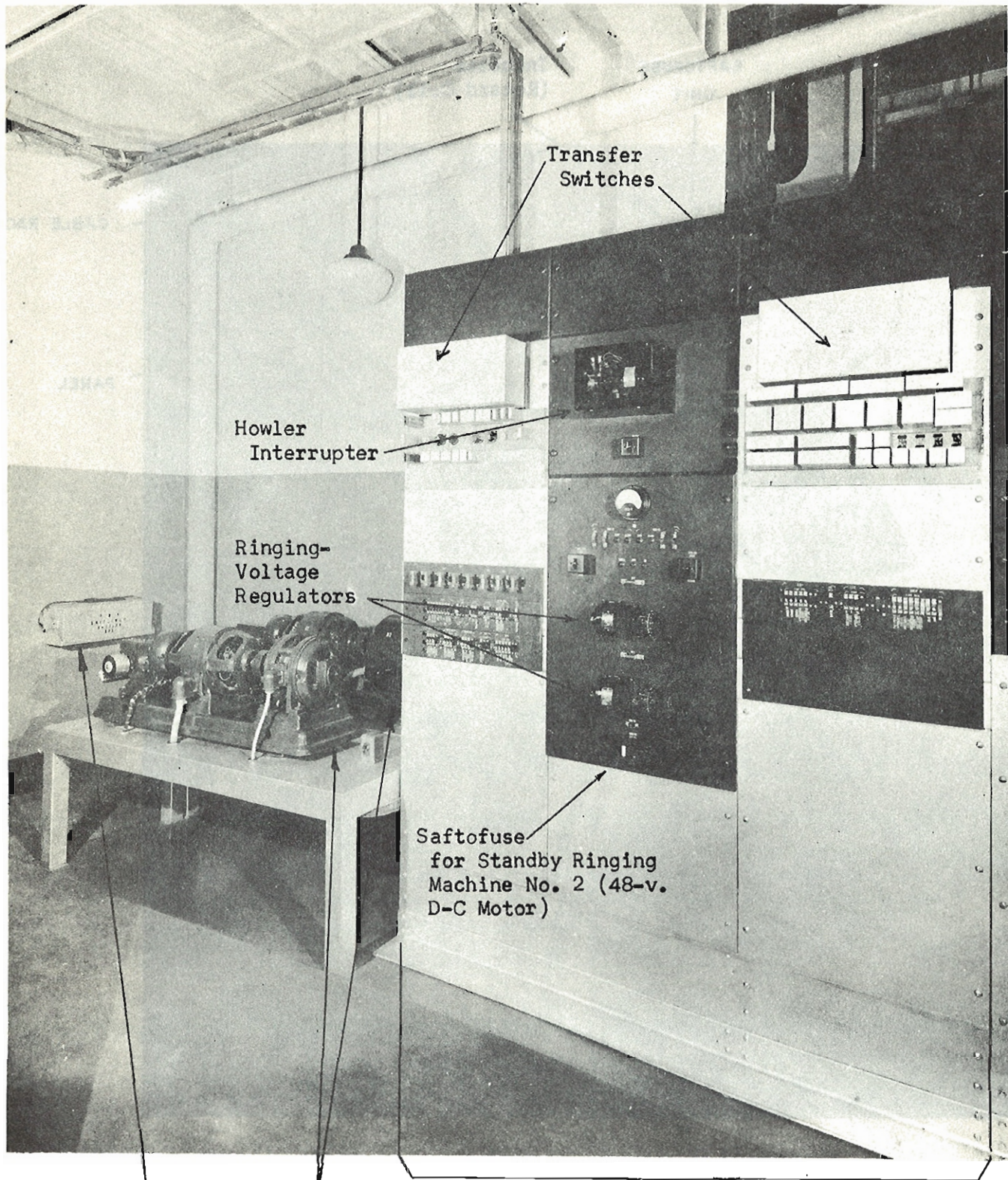


TALKING BATTERY SUPPLY FILTER

OAKLAND OFFICE, CHICAGO

RINGING POWER PLANTS

The Ringing Power Plant must furnish not only 20-cycle Ringing Current and Tones for Signaling, but various interruptions of Ringing Current and Tones.



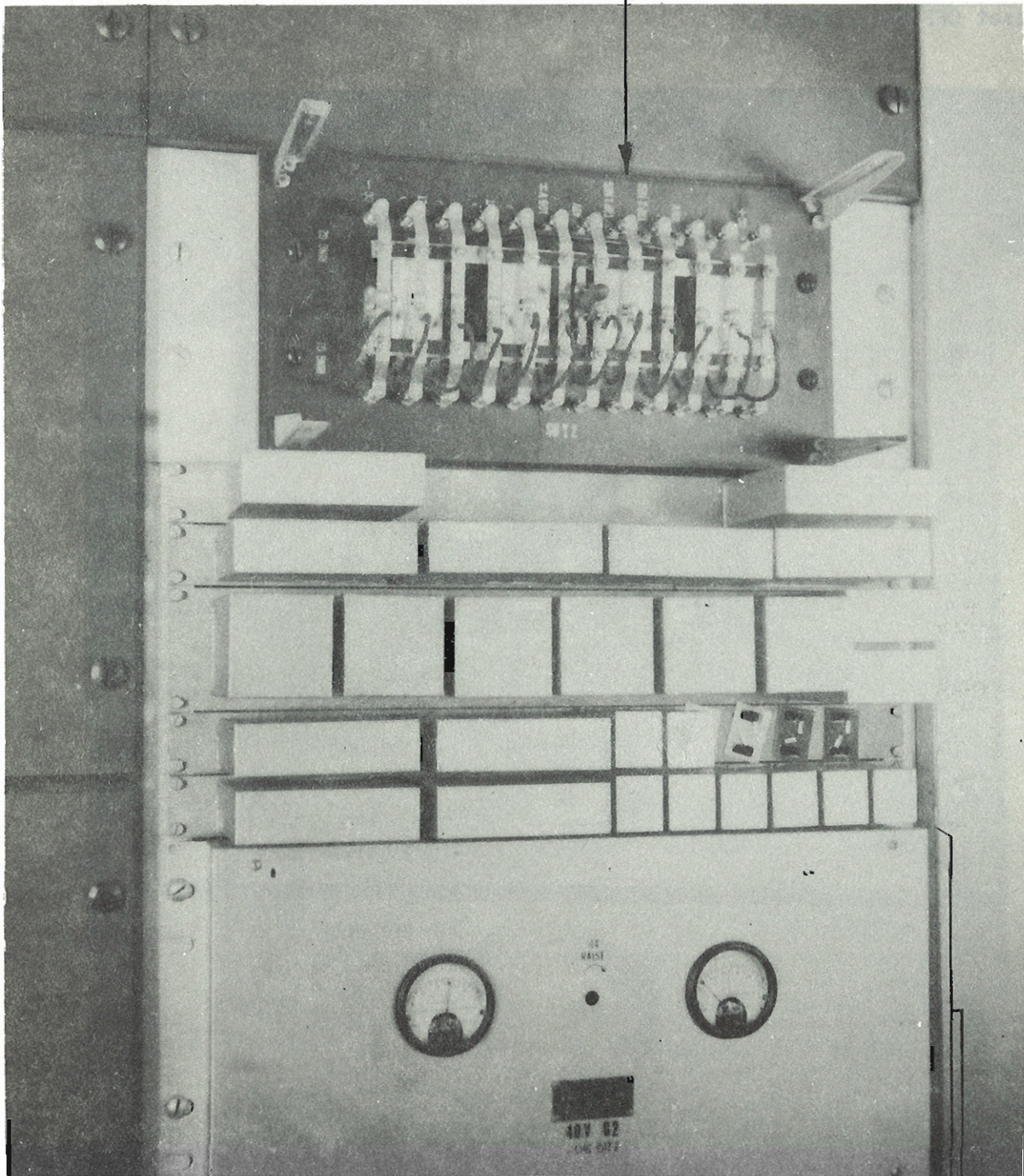
RINGING MACHINES

RINGING POWER BOARD

EMERGENCY BATTERY FOR P.B.X.

803C TYPE
RINGING POWER PLANT
150TH ST. N.Y.
2- to 6-Ampere Capacity

TRANSFER SWITCH FOR RINGING GENERATOR



Regulated Tube Rectifier for Superimposed Ringing Battery

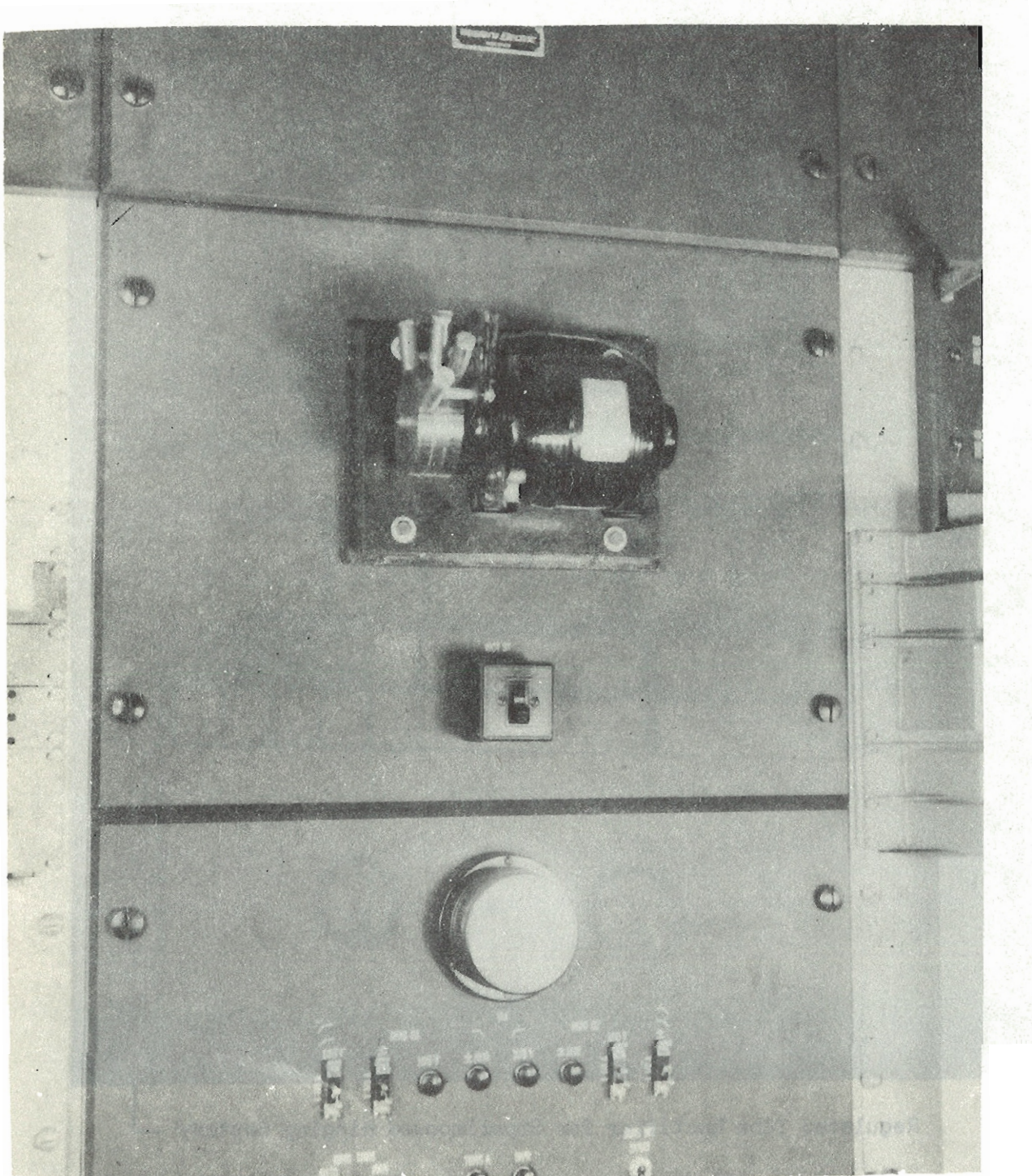
MULTI-POLE ELECTRICALLY OPERATED TRANSFER SWITCH

OAKLAND OFFICE, CHICAGO

- 75 -

AUG. 1940

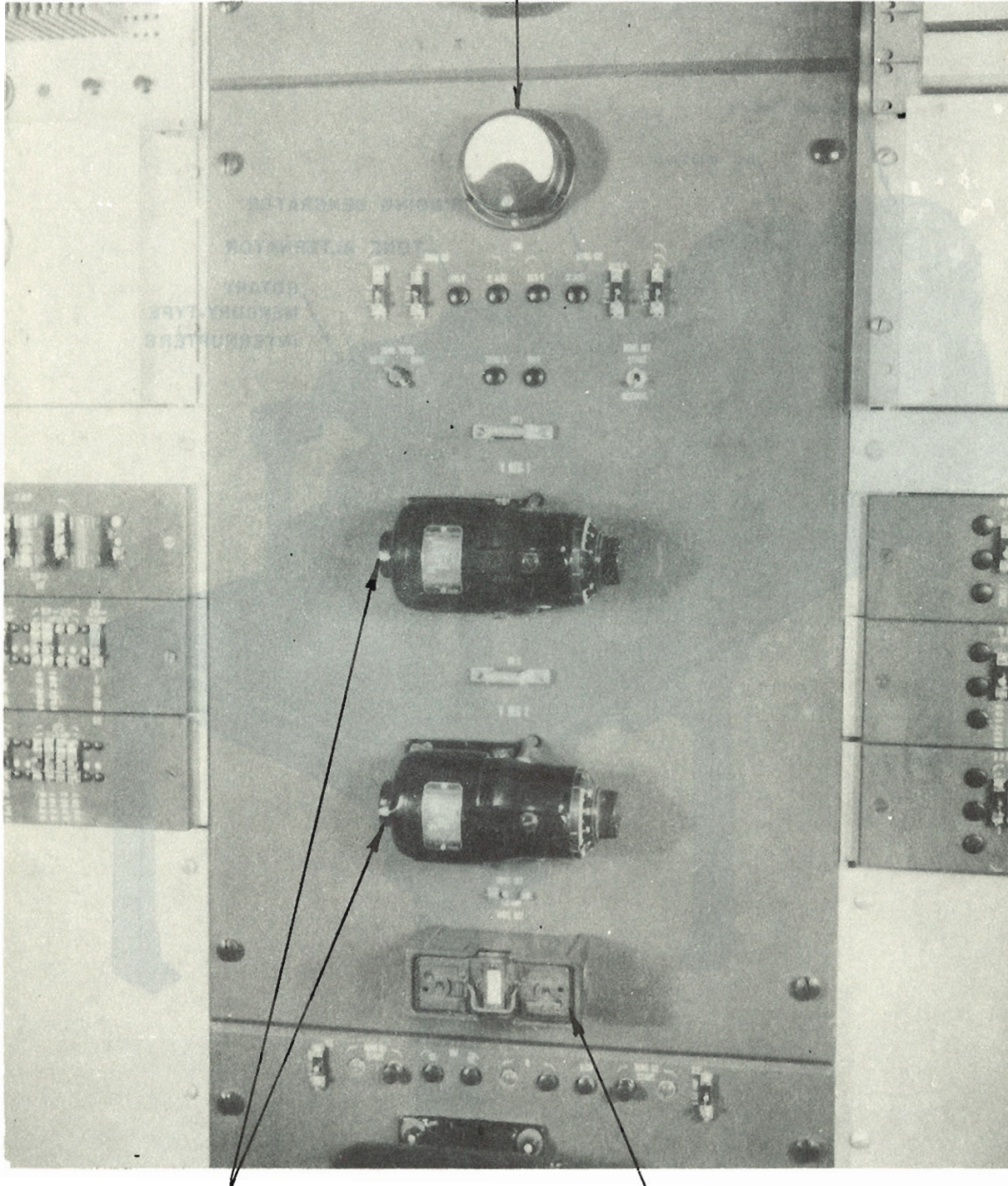
Howler Interrupter Tone is applied to a Subscriber Line at the Local Test Desk or DSA Board (Dial System "A" Switchboard) Sender-Monitor Position, by means of a Howler Cord, to attract the Subscriber's attention in case of a "Permanent" (Handset OFF Switchhook).



MOTOR DRIVEN HOWLER INTERRUPTER

OAKLAND OFFICE, CHICAGO

WESTON VOLTMETER

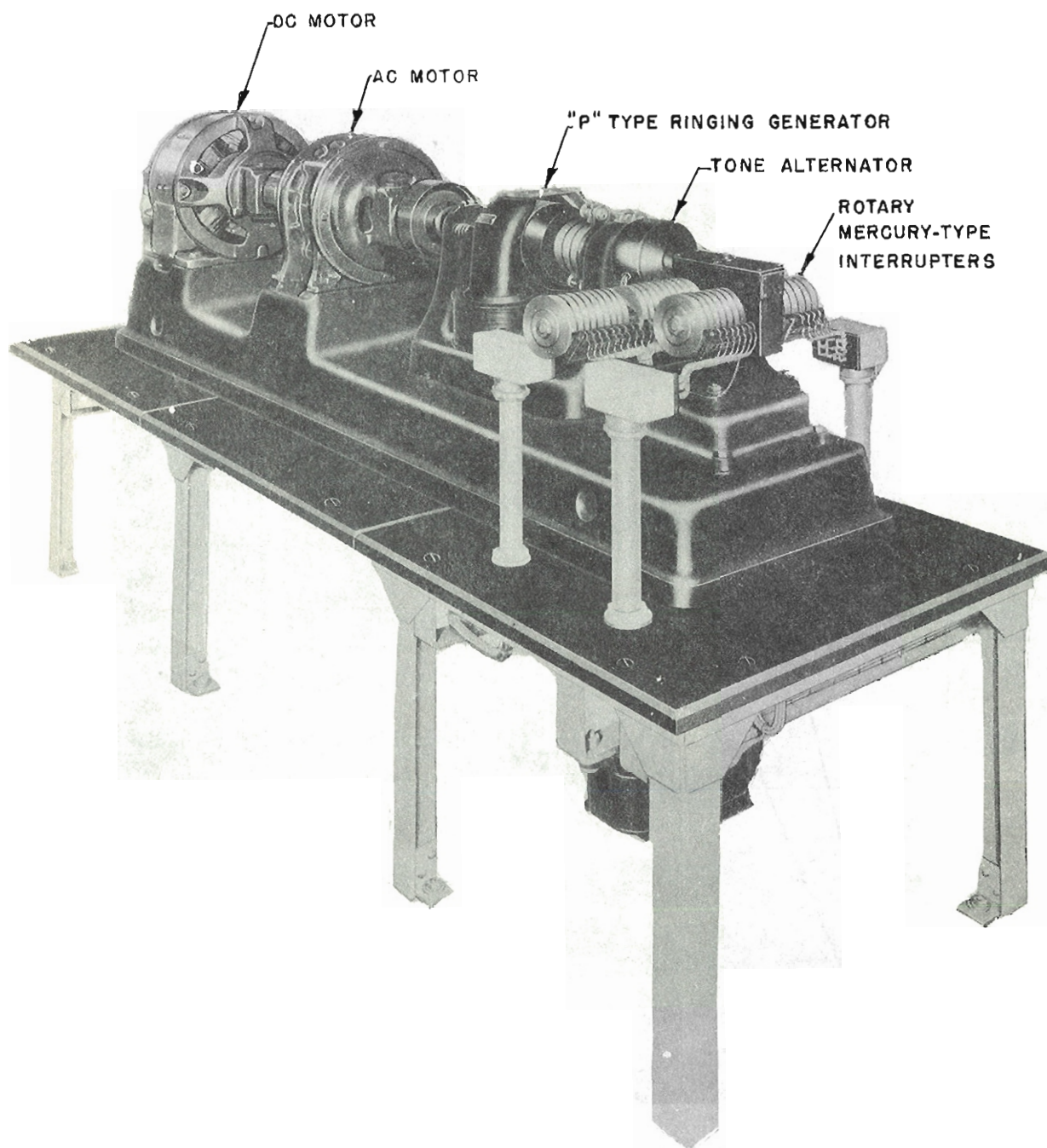


CENTRIFUGAL TYPE AUTOMATIC VOLTAGE REGULATOR
(TYPE BY)

SAFTOFUSE UNIT

CENTRIFUGAL TYPE AUTOMATIC VOLTAGE REGULATOR

OAKLAND OFFICE, CHICAGO

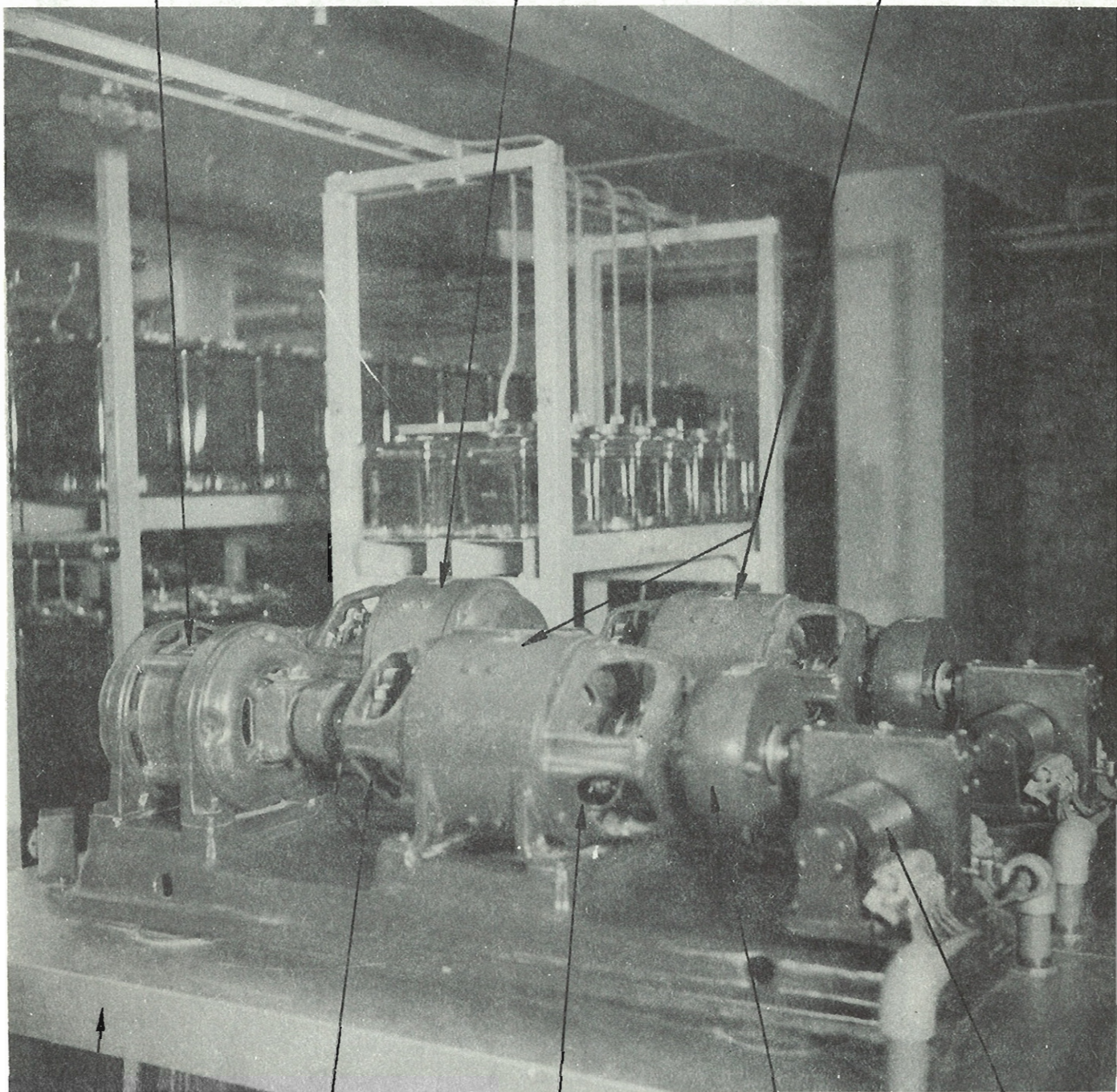


"P" TYPE RINGING MACHINE
WITH TONE ALTERNATOR & MERCURY INTERRUPTER
- 78 -

Regular Ringing Machine
M1
ALTERNATING
CURRENT MOTOR

Standby Ringing Machine
M2 - 48-V.
DIRECT
CURRENT MOTOR

RINGING AND
COIN CONTROL
GENERATORS



RINGING MACHINE
TABLE (METAL)

DC END
Coin Control
Current

AC END
20-Cycle Ringing
Current

STONE
ALTERNATOR
Continuous
Tones

MERCURY
INTERRUPTER

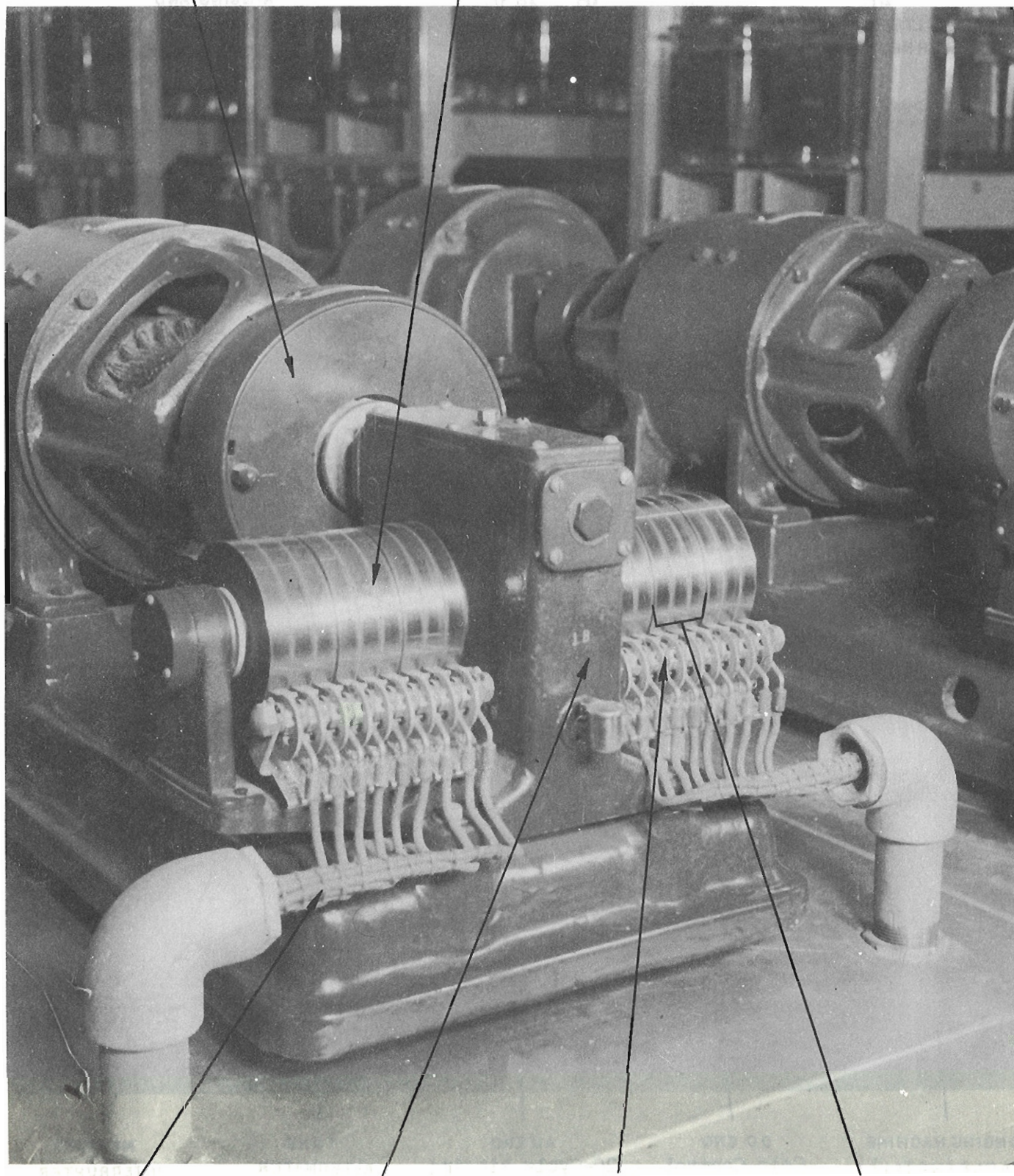
COMMERCIAL TYPE RINGING MACHINES

OAKLAND OFFICE, CHICAGO
- 79 -

AUG. 1940

TONE
ALTERNATOR

MERCURY
INTERRUPTERS



RINGING LEADS

GEAR CASE

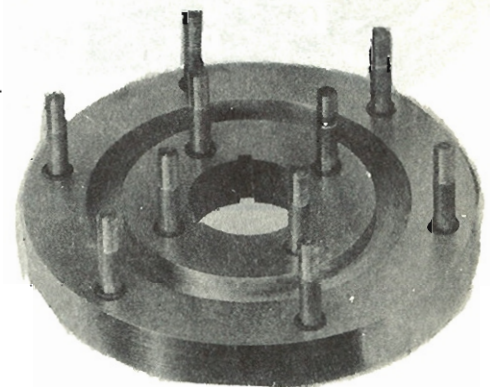
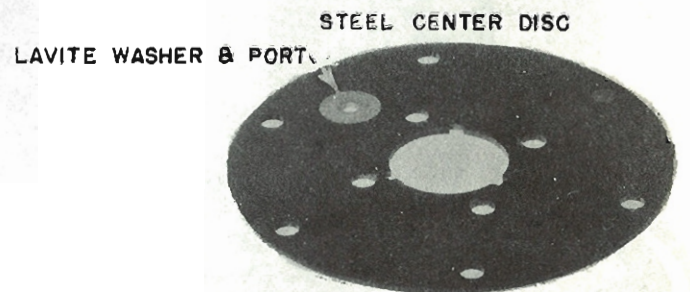
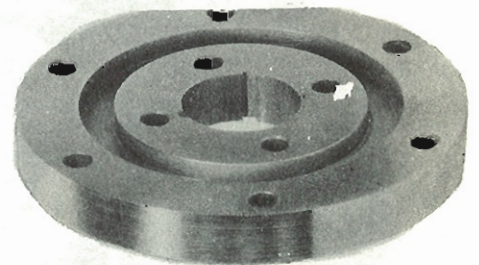
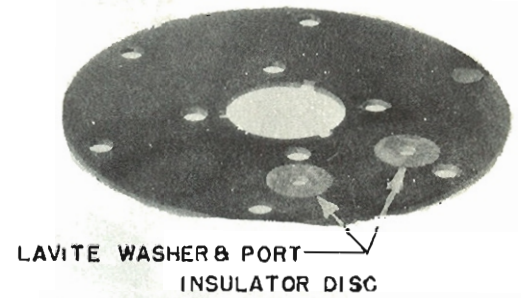
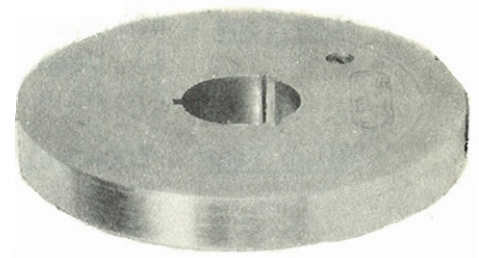
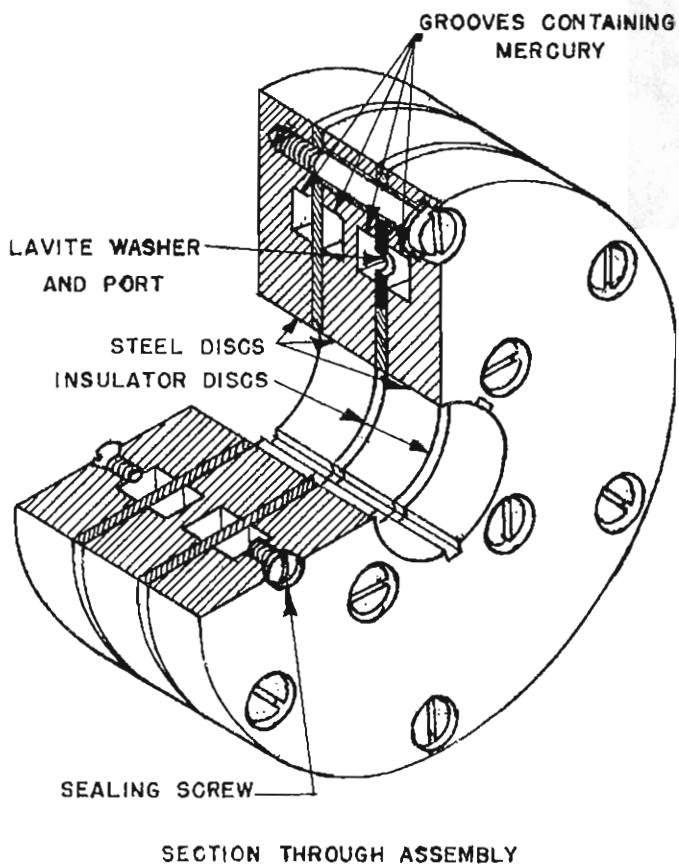
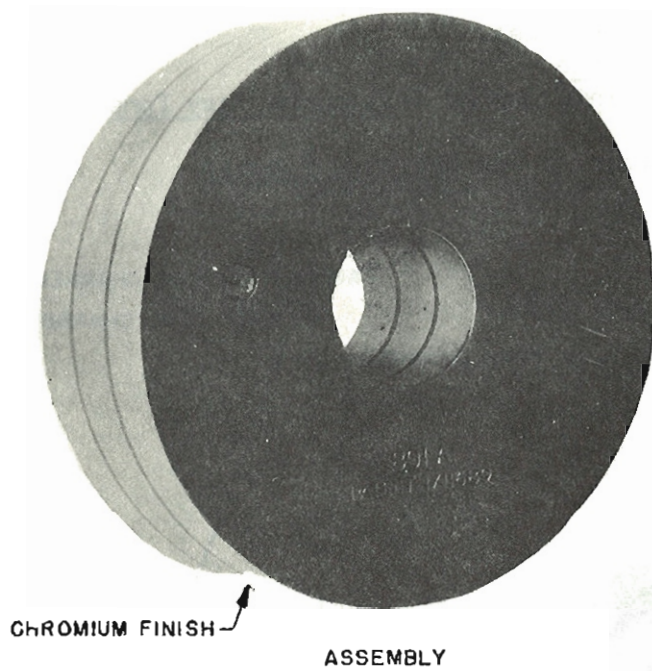
CARBON BRUSHES
AND BRUSH HOLDERS

ONE
INTERRUPTER
UNIT

RINGING MACHINE - INTERRUPTER END

OAKLAND OFFICE, CHICAGO

AUG. 1940



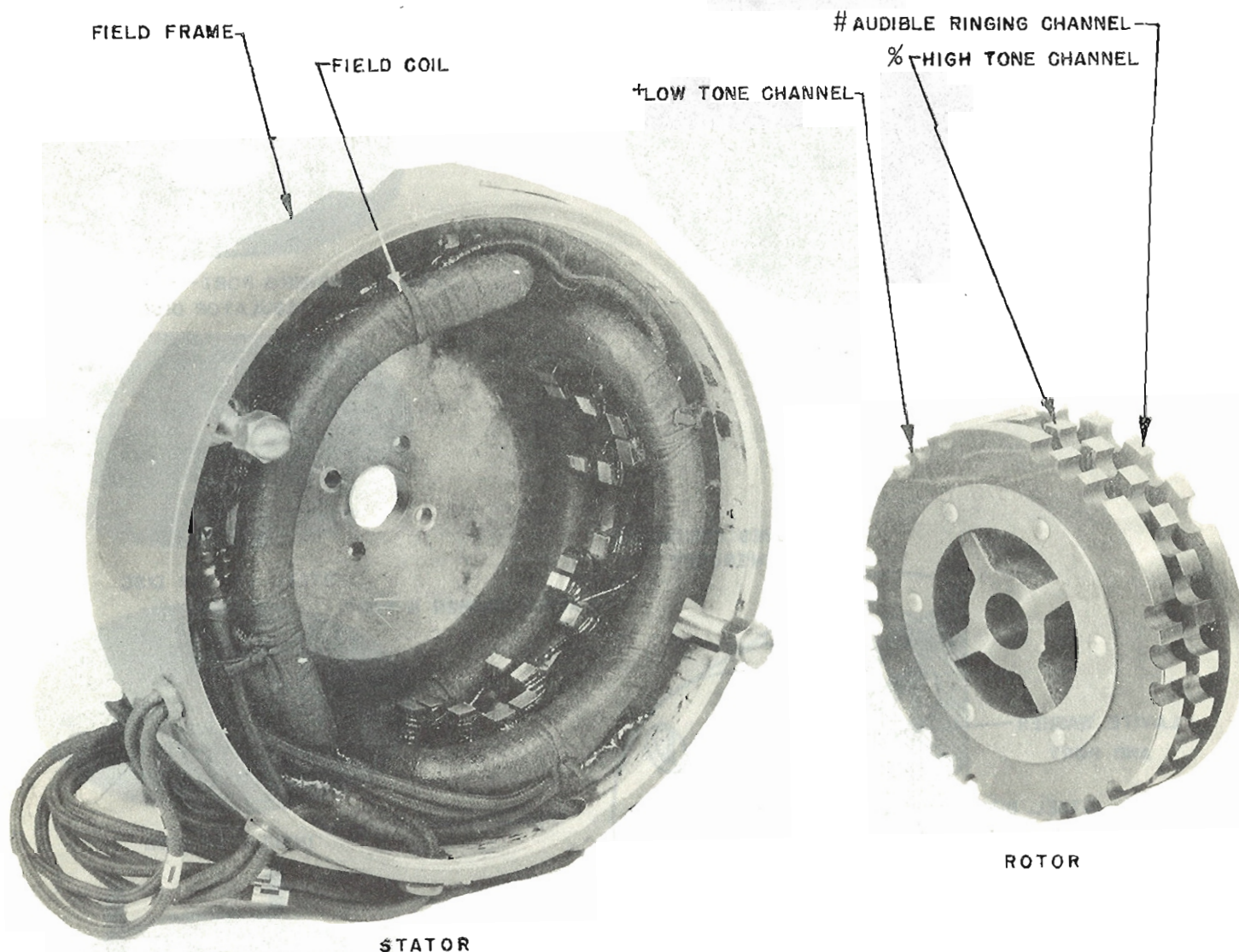
DISASSEMBLED UNIT

MERCURY INTERRUPTER UNIT DOUBLE UNIT

+Low Tone - 600-Cycle, modulated by 120-Cycles:

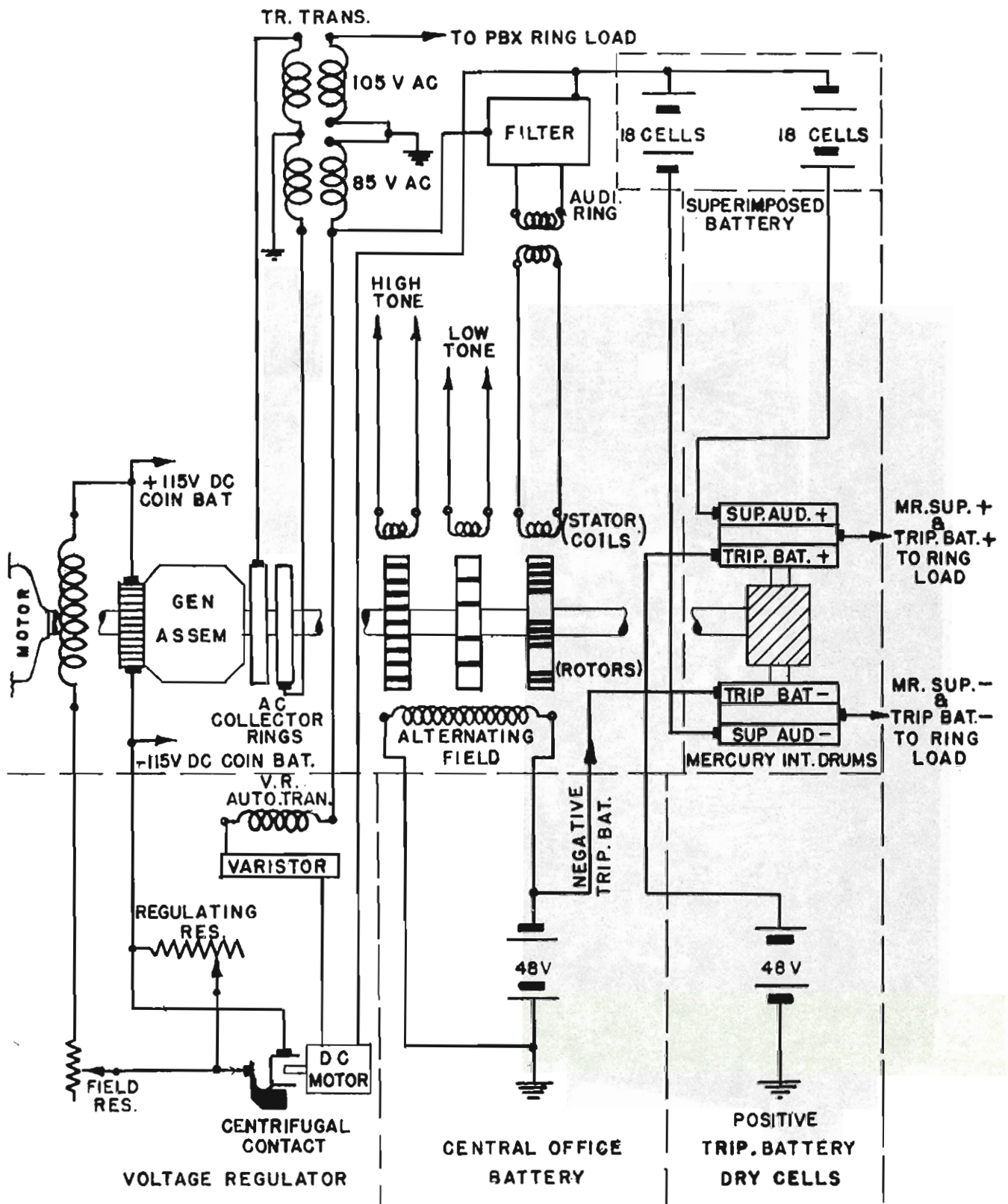
- 1) Used as Standard Dial Tone
- 2) At a higher level and Interrupted - Standard Busy Tone.

%High Tone - 500-Cycle Tone, used primarily for Operator Signals.



#Audible Ringing Tone - 20-Cycle Ringing Current is inaudible. When Ringing Current is applied to the Called Subscriber Line, the Calling Subscriber hears an Audible Ringing Tone developed by modulating High-Tone (500-Cycles) with a 40-Cycle Tone. This combination is superimposed on the 20-Cycle Ringing Current by means of a Network known as a 106A Frequency Generator.

TONE ALTERNATOR



SCHEMATIC OF RINGING MACHINE CONNECTIONS
FULL SELECTIVE SUPERIMPOSED 4 PARTY RINGING

MOUNTING PLATES
CONTAINING FUSES, FUSE ALARM,
AND TESTING EQUIPMENT

DRY CELLS
IN DRAWERS

48-V. Central Office
Battery may be used as
the Negative Tripping
Battery.

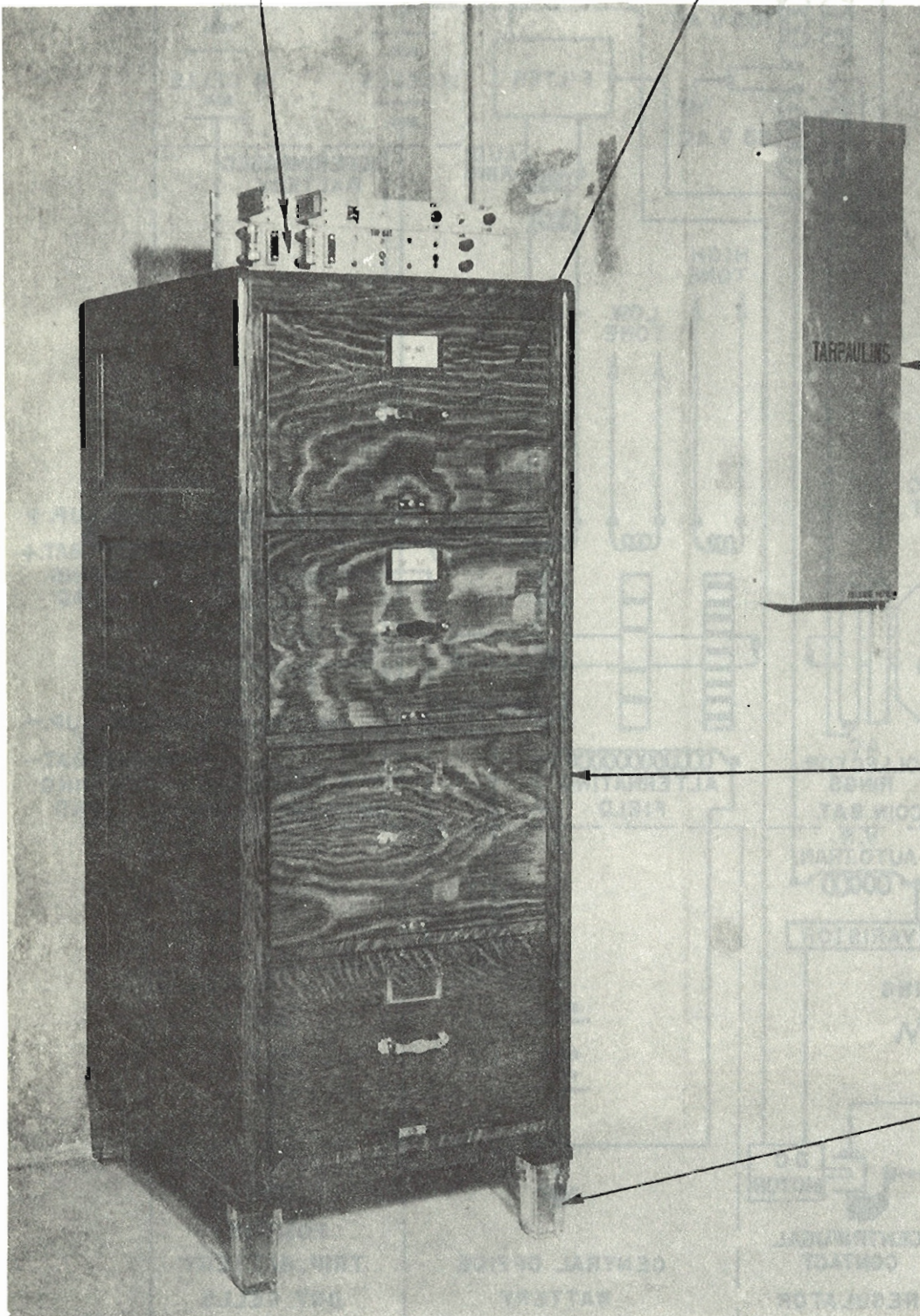
A Regulated Tube
Rectifier may
also be used to
furnish Trip-
ping Voltage.

FIRE
PROTECTION

Tarpaulins are
unfolded and
thrown over a
small fire to
"smother" it.

FILING TYPE
DRY BATTERY
CABINET

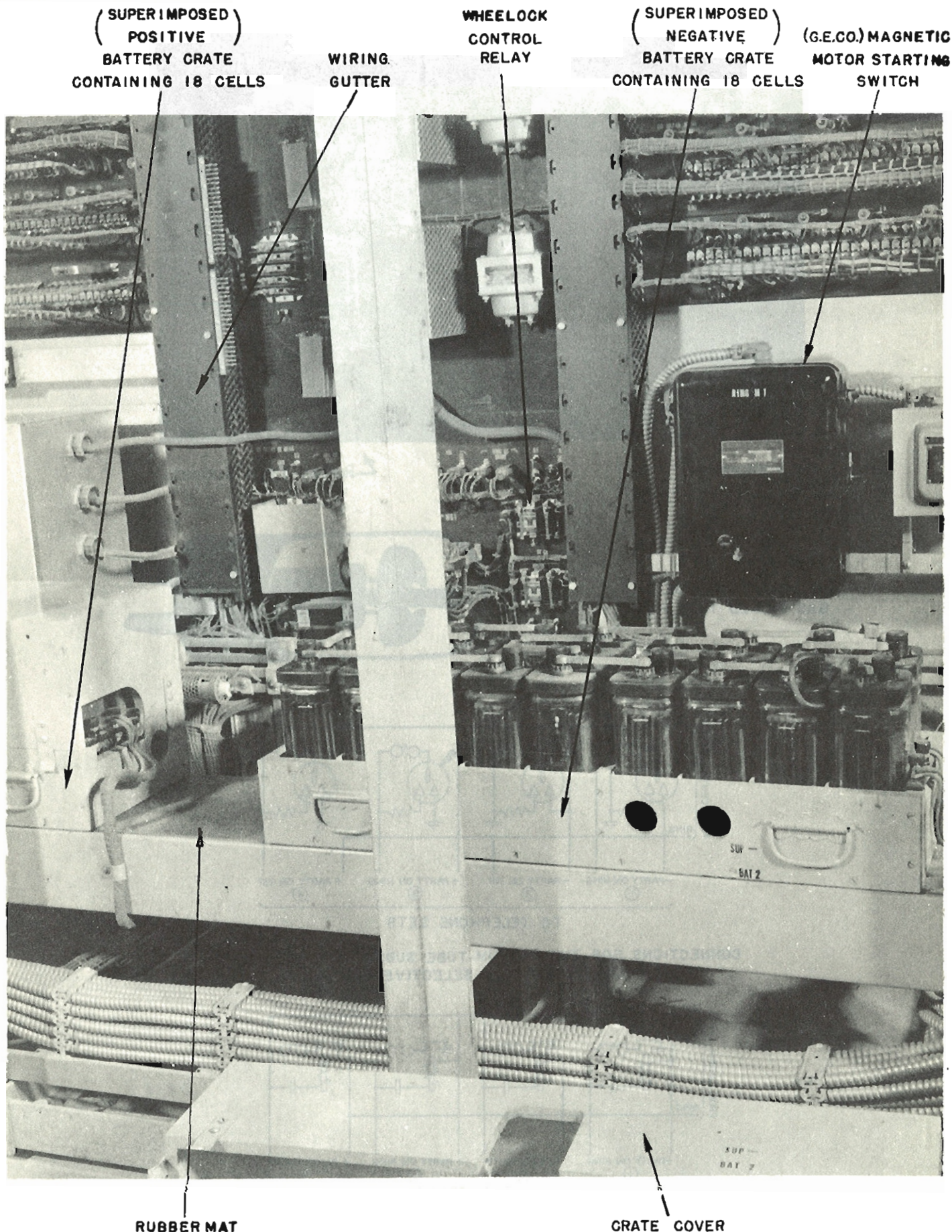
GLASS LEGS



Tripping Battery is furnished through the Low-Speed Interrupters to operate the Tripping (Ringing Cut-Off) Relay when the Called Subscriber answers during the silent interval.

TRIPPING BATTERY EQUIPMENT

OAKLAND OFFICE, CHICAGO

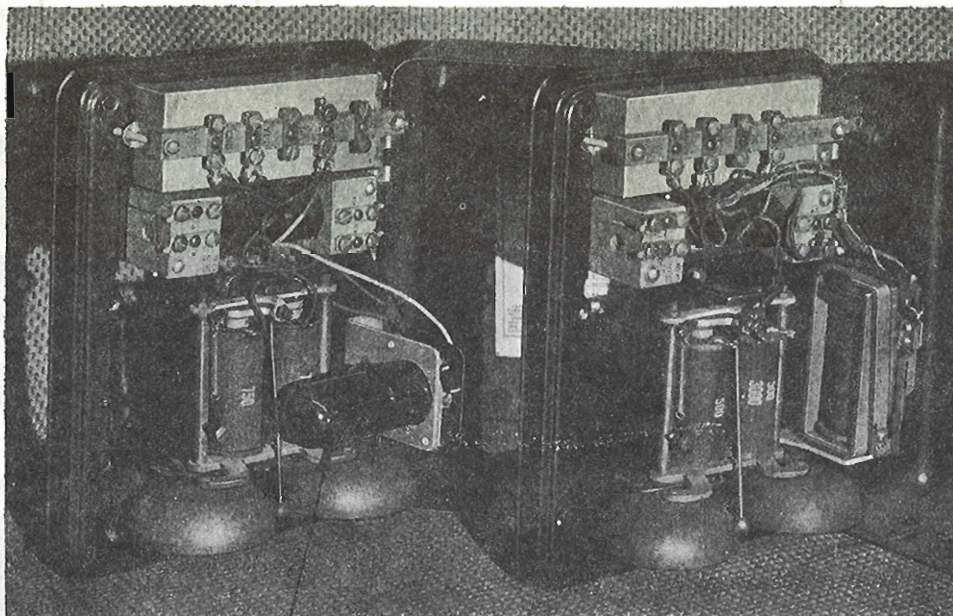


BATTERIES ASSOCIATED WITH RINGING MOUNTED IN REAR OF RINGING POWER BOARD

OAKLAND OFFICE, CHICAGO

Superimposed Battery (+ and -) for Full-Selective Ringing, 4-Party Lines.

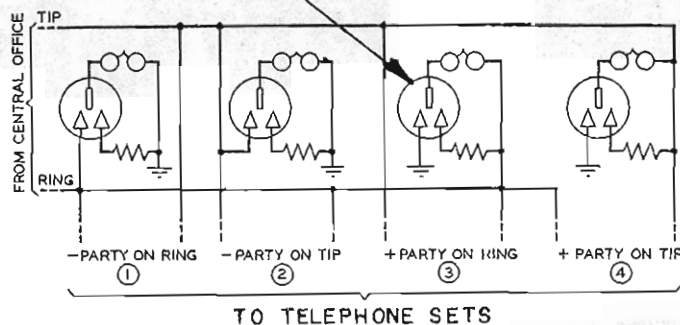
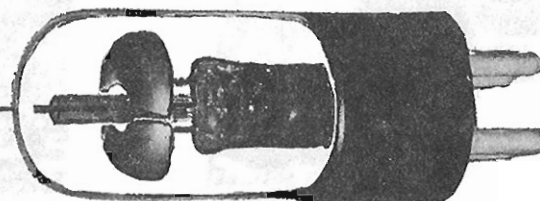
AUG. 1940



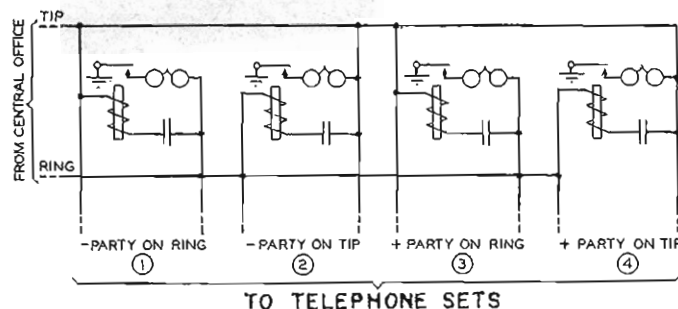
Tube-Type Subset ↗

↖ Relay-Type Subset

313A GOLD CATHODE
GAS FILLED TUBE



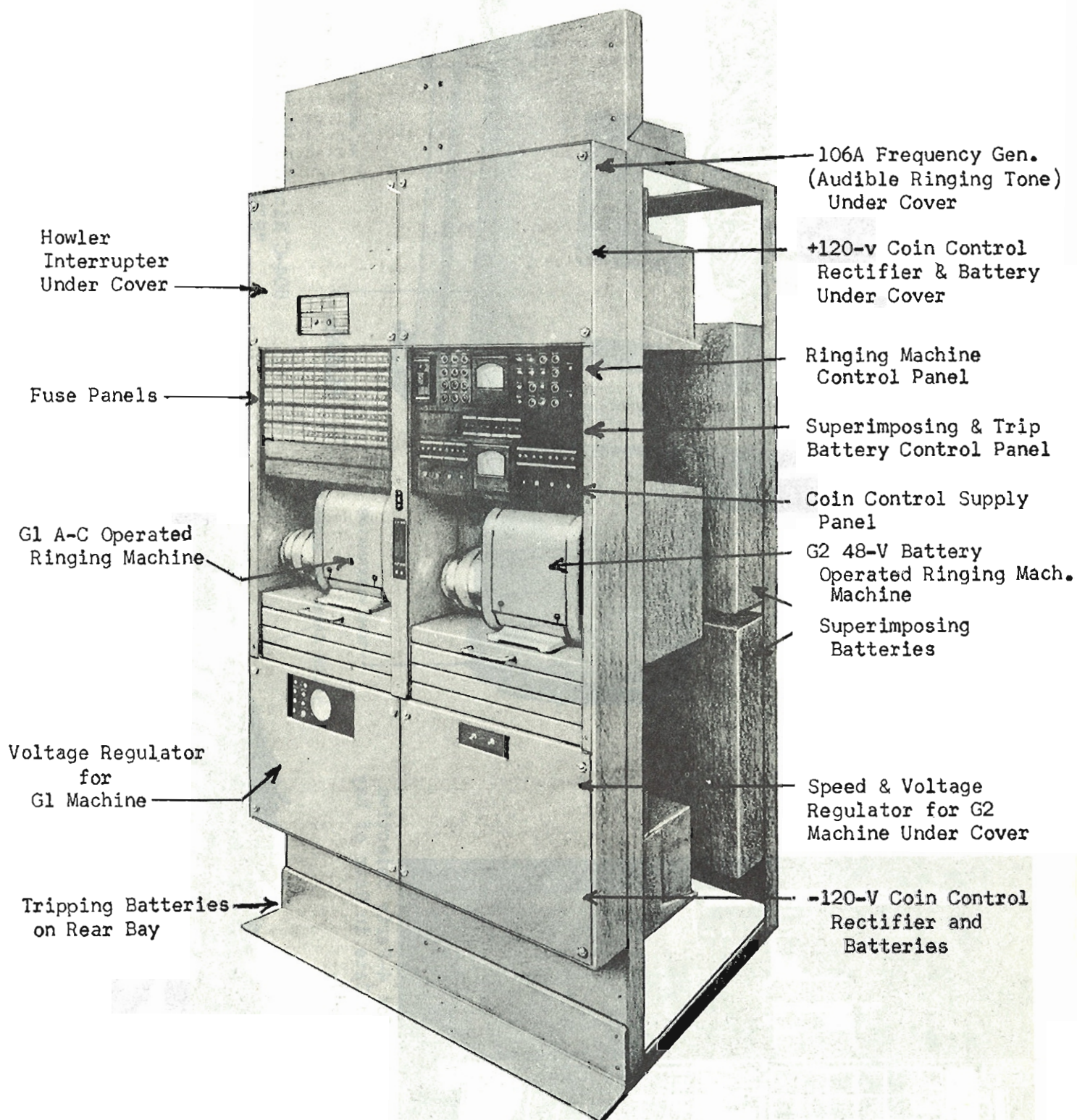
CONNECTIONS FOR THE VACUUM-TUBE SUBSCRIBER SET FOR A
FOUR-PARTY FULL-SELECTIVE CIRCUIT.



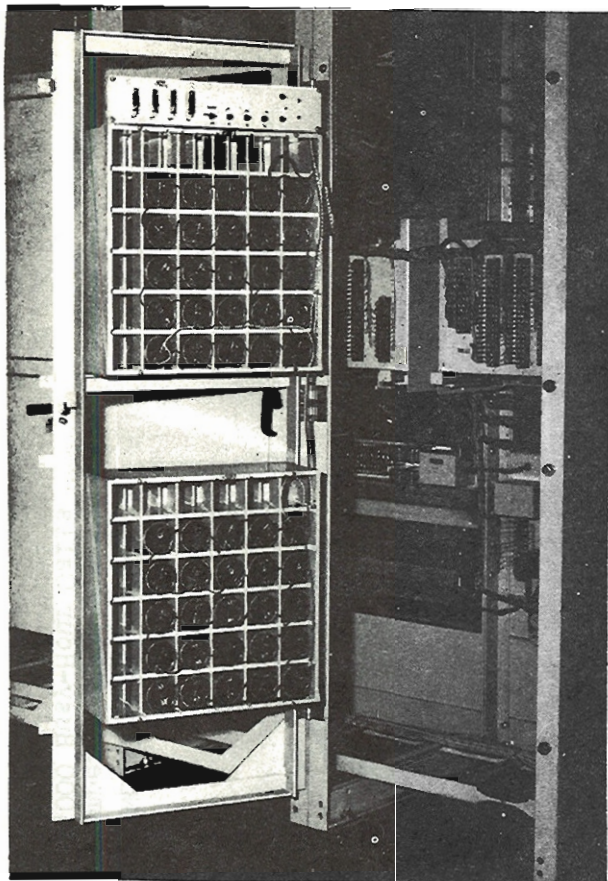
SUBSTATION CONNECTIONS FOR A FOUR-PARTY FULL-SELECTIVE
CIRCUIT USING RELAY-TYPE SUBSCRIBER SETS.

SELECTIVE RINGING

(VACUUM-TUBE OR RELAY OPERATION)



804C RINGING POWER PLANT
1-Ampere Capacity
Up To 50,000 Busy-Hour Calls



Superimposed Batteries for 4-Party Selective Ringing mounted on Hinged Gate in Rear of Bay (Protective Covers removed).

GENERATOR SLIP RINGS UNDER COVER

TONE ALTERNATOR

NYLON CAMS AND BUMPERS

GRAPHITE TYPE BEARING
DO NOT OIL

GEAR BOX OIL HOLES

OIL HOLE UNDER

INTERRUPTERS

GREASE FITTING

GEAR CASE

(RP-18173-M)

AC MOTOR

20 CYCLE GENERATOR

GREASE FITTING

804-C Ringing Machine
"RING G1"

Mechanical Interrupter Used in 806F Type Ringing Power Plant (Capacity $\frac{1}{2}$ -Ampere)