

AMERICAN BELL TELEPHONE INSTRUMENT SCHEMATICS

*Common Battery and Local Battery
Wall and Desk Stand Telephones*

Compiled by Steve Hilsz

A Handy Reference Guide

With Explanation of Schematic Representations

**Copyright © February, 2001
By Steve Hilsz**

**Copyright © February, 2001
by Steve Hilsz**

All rights reserved

INDEX

SECTION ONE – UNDERSTANDING SCHEMATICS

SUBJECT	PAGE
Schematic Diagrams Explained	1
Schematic Diagrams Explained	2
Basic Telephone Circuit, Common-Battery	3
Basic Telephone Circuit, Local-Battery	4

SECTION TWO – COMMON-BATTERY SETS

SUBSCRIBER SET BY PART NUMBER	PAGE
10-A Desk Stand	5
20-B Desk Stand	6
85 Wall Set	7
85-W Wall Set	8
98 Wall Set	9
101 Subset	10
101-G with Desk Stand	11
101-K Subset	12
105-A Subset	13
109-E Wall Set	14
120 C.B. Extension Set	15
124-A, 124-J, 124-N, 124-P Wall Sets	16
124-F Wall Set	17
124-L Wall Set	18
128-A Wall Set	19
130-A Wall Set, 131A Subset	20
131-A Subset with Desk Stand	21
135-A Wall Set	22
137-A with Desk Stand	23
212-A with Desk Stand	24
212-E with 20-B Desk Stand	25
212-H with 20-B Desk Stand	26
281-A Subset	27

SECTION THREE – LOCAL BATTERY SETS

SUBSCRIBER SET BY PART NUMBER	PAGE
21-A Top Box	28
21-AD Top Box	29
21-K Top Box	30
85 Wall Set	31
119-A Top Box	32
138-A with Desk Stand	33
138-E with Desk Stand	34
240-A Wall Set	35
240-E Wall Set	36
252-A Wall Set	37
284-J with Desk Stand	38

SECTION FOUR – MISCELLANEOUS

TOPIC	Page
#10 Desk Stand, Old & New Terminal Markings & Cord Colors	39
#20 Desk Stand, Old & New Terminal Markings & Cord Colors	40
#40 Desk Stand, Old & New Terminal Markings & Cord Colors	41
Cord Connections, C. B. Sets, with Desk Stands or Trans. Arms	42
Connections, C. B. Signaling, Local-Battery Talking	43
Connections, Local-Battery, with Desk Stands or Trans. Arms	44
Side Tone Reduction in Subscriber's Sets	45
Side Tone Reduction in Desk Stands	46
Method of Tying Cord to No. 122 Receiver	47
Method of Tying Cord to No. 144 Receiver	48

UNDERSTANDING INSTRUMENT SCHEMATICS

The schematics presented in this series will use the same diagrams as depicted below:

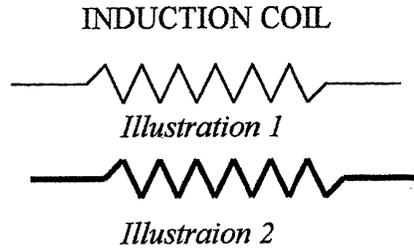


Illustration 1 depicts the Secondary winding of an Induction Coil. Illustration 2 depicts the Primary, or Battery, winding. In this series of schematics, the Primary winding will always be represented in bold lines. The function of the Induction Coil is to boost the voltage of the Primary, or Battery, circuit to allow reception of electrical waves at a distant receiver. It also changes direct-current battery voltage to alternating-current voltage, to which the telephone receiver is most sensitive.

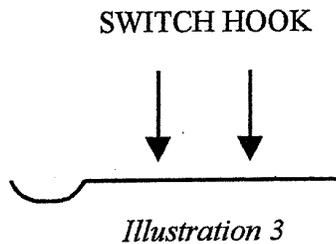
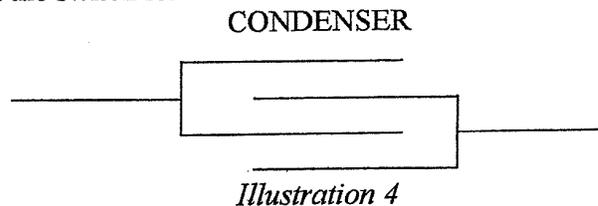


Illustration 3 depicts the arrangement of a typical Hook Switch as used in bell “side-tone” circuits. Side-tone is the reception of induced voice signals in the receiver of the local station equipment, a sort of “echo.” Later circuitry reduced the incidence of side-tone, but will not appear in the early schematics in this manual. The bottom part of the Hook Switch is the movable arm that incorporates the actual hook., while the arrows indicate points of contact of the switch leaves.



The Condenser is comprised of two metallic foil strips that are separated by a non-conductive substance. The strips are of large area, but are rolled to fit into a metal housing, which is soldered shut. The Condenser has the ability to pass alternating-current voice signals while blocking direct-current battery voltages, and is used to isolate the Secondary, or receiver, circuit. It also blocks the Ringer from the telephone line, allowing only alternating-current ringing voltages to pass through.

RECEIVER

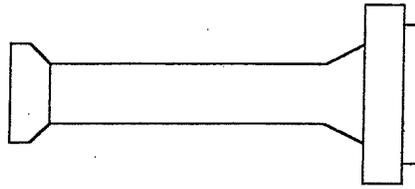
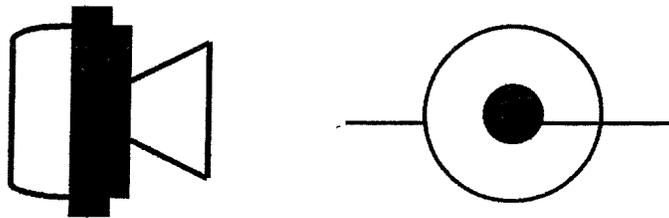


Illustration 5

The Receiver is comprised internally of a permanent magnet which supplies the reference field, and a coil or coils of wire which add or detract from the reference field to produce an undulating magnetic field that directly corresponds to the amplitude (strength) of the alternating-current produce by the Induction Coil. In front of the magnet bobbin or bobbins is a metal diaphragm, located directly beneath the opening in the receiver cap. The diaphragm is pulled towards or released from the reference field and reproduces voice signals. The Receiver is the heart of the telephone set.

TRANSMITTER



Illustrations 6 and 7

The Transmitter consists of a chamber that, in early Bell circuits, is grounded to the telephone frame and has a movable, insulated contact that is attached to a metal diaphragm located just in front of the opening in the transmitter face plate. The mouthpiece is screwed into the opening and funnels sound waves against the diaphragm. Inside of the chamber is a quantity of carbon granules that are in loose contact with each other.

High amplitude (pressure) sound waves cause the diaphragm to push harder against the moveable contact, which compresses the carbon granules much tighter. This, in turn, lowers the electrical resistance of the carbon granules and allows a higher battery current to flow through the transmitter. Thus, the electrical resistance of the transmitter is higher at rest and lower when louder sounds are impressed upon it.

The variable resistance of the Transmitter causes higher or lower battery current to flow through the Primary winding of the Induction Coil. This undulating direct-current is transformed by the Induction Coil into alternating-current voltages of a much higher power, which are then sent over the telephone line.

BASIC TELEPHONE CIRCUIT

Local Battery

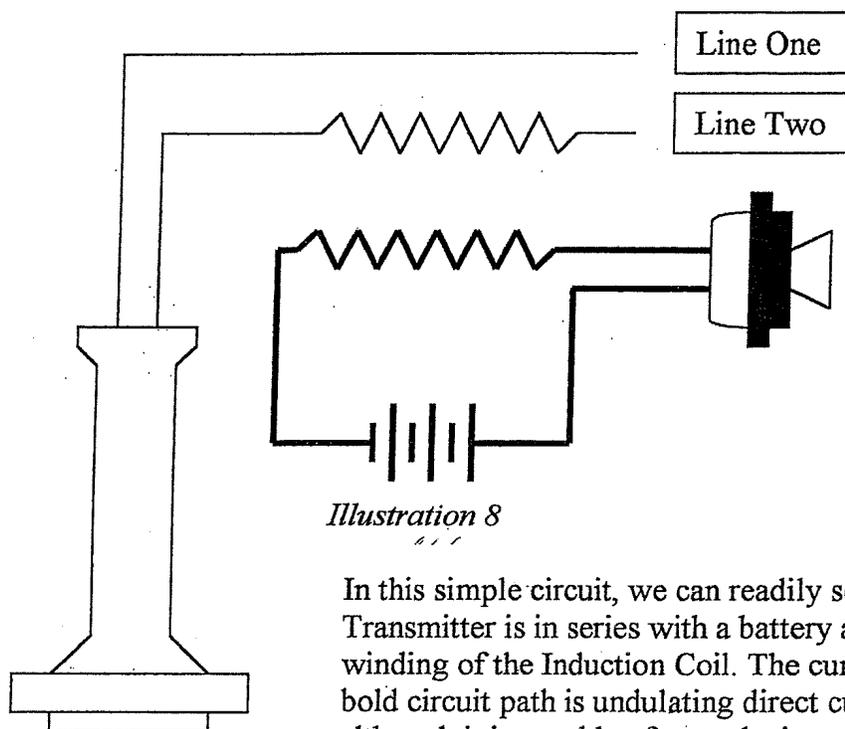


Illustration 8

In this simple circuit, we can readily see that the Transmitter is in series with a battery and the primary winding of the Induction Coil. The current in the bold circuit path is undulating direct current which, although it is capable of reproducing speech sounds, is unsuitable for long distances.

The secondary winding of the Induction Coil removes battery current from the signal and gives the signal a higher amplitude of voltage. This alternating-current voltage can carry for many miles and the distant receiver is very sensitive to it. The switch hook has been eliminated to simplify this diagram.

Battery cells in early telephones averaged two volts of direct-current. Long distance telephone instruments used several cells arranged side-by-side or one above the other. The Induction Coil of a long distance instrument will usually be much larger than that found in telephones designed for local service, and in many cases it was placed under the base of the transmitter arm.

BASIC TELEPHONE CIRCUIT

Common Battery

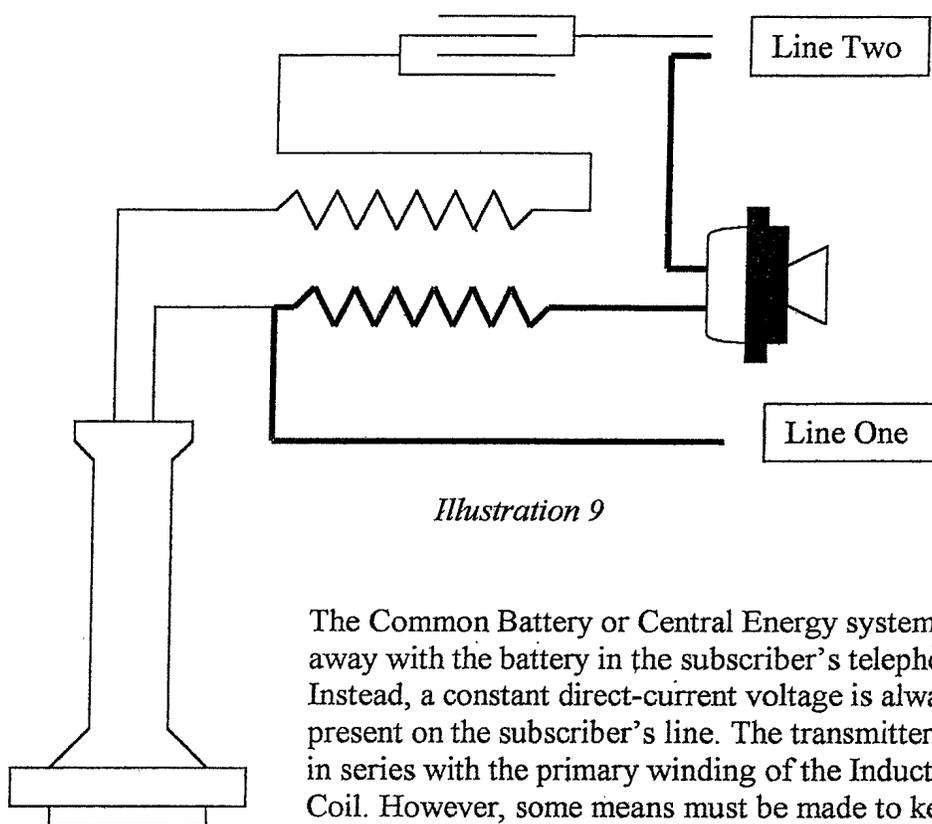


Illustration 9

The Common Battery or Central Energy system does away with the battery in the subscriber's telephone set. Instead, a constant direct-current voltage is always present on the subscriber's line. The transmitter is still in series with the primary winding of the Induction Coil. However, some means must be made to keep the Direct-current away from the secondary winding and from the receiver .

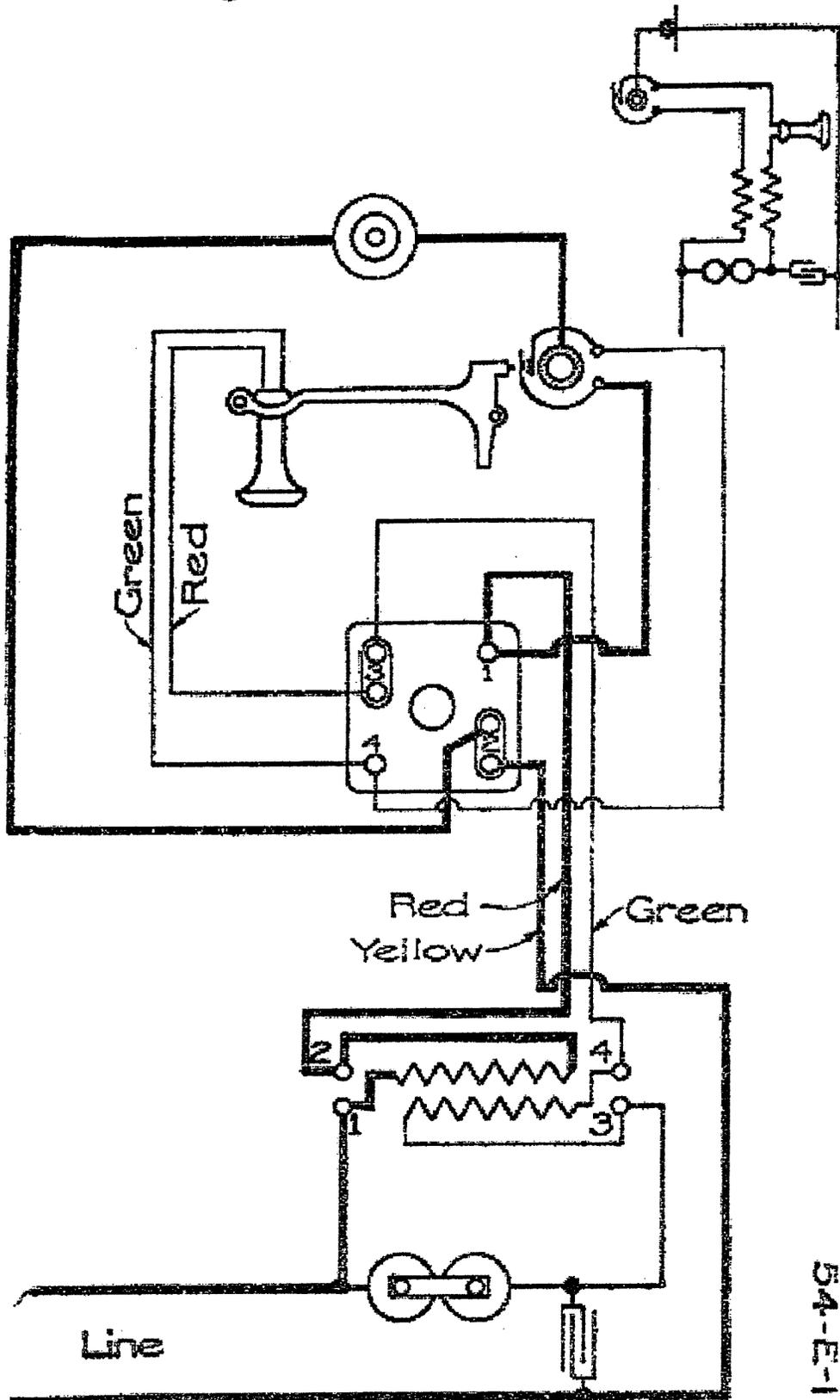
Note that a Condenser has been placed in series with the secondary winding of the Induction Coil. The Condenser prevents direct-current from passing through it, yet it readily permits alternating-current to flow. Thus, speech sounds amplified by the Induction Coil can be impressed on the telephone line, incoming alternating-current speech sounds can be readily sent to the receiver, and no direct-current will be present in the secondary circuit.

To simplify the diagram in Illustration 9, the switch hook has not been drawn into the circuit.

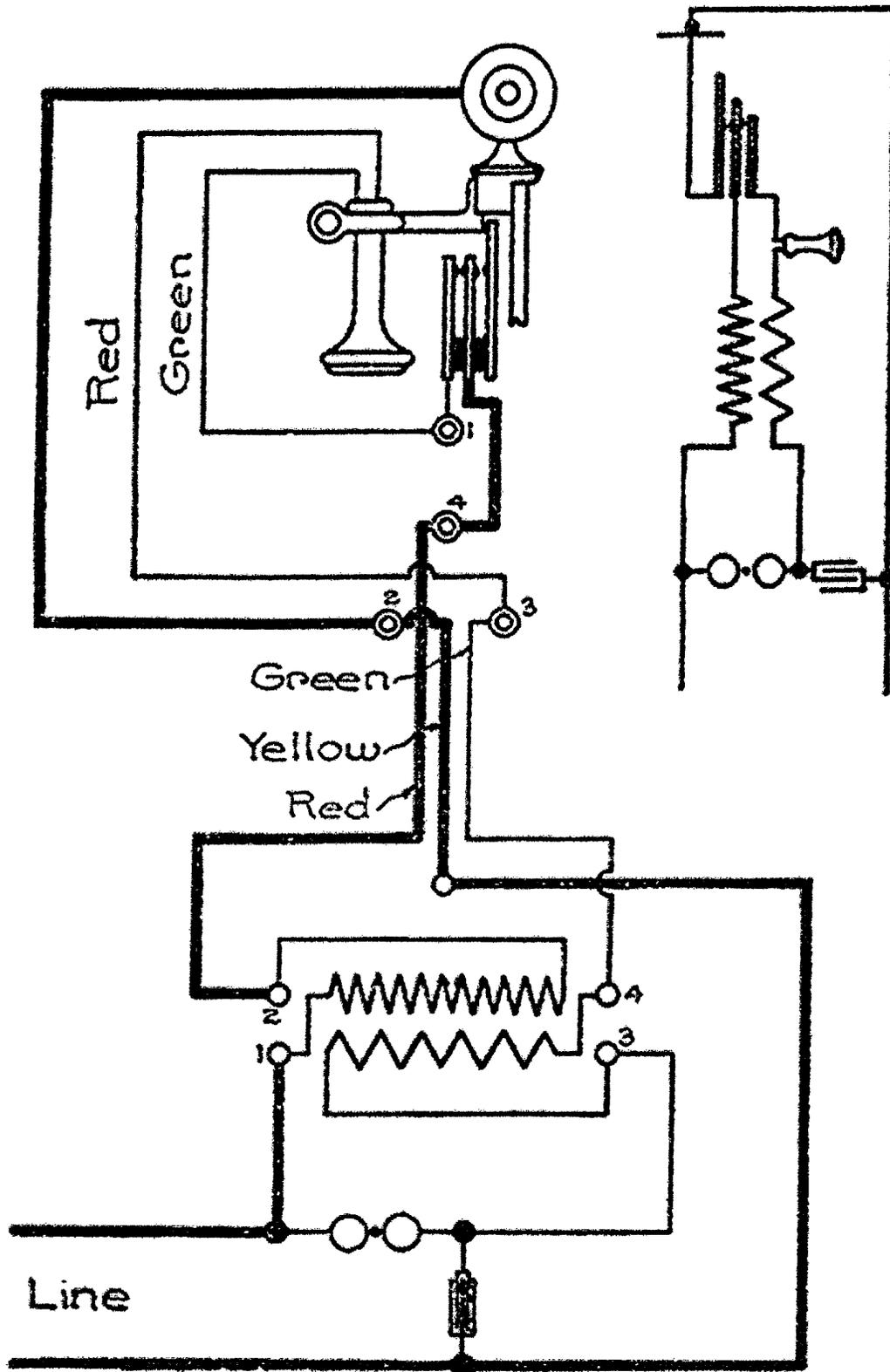
SECTION TWO

COMMON-BATTERY SCHEMATICS

Subscribers' Sets.
No. 10-A Desk Stand.
Detail Drawing of Connections.

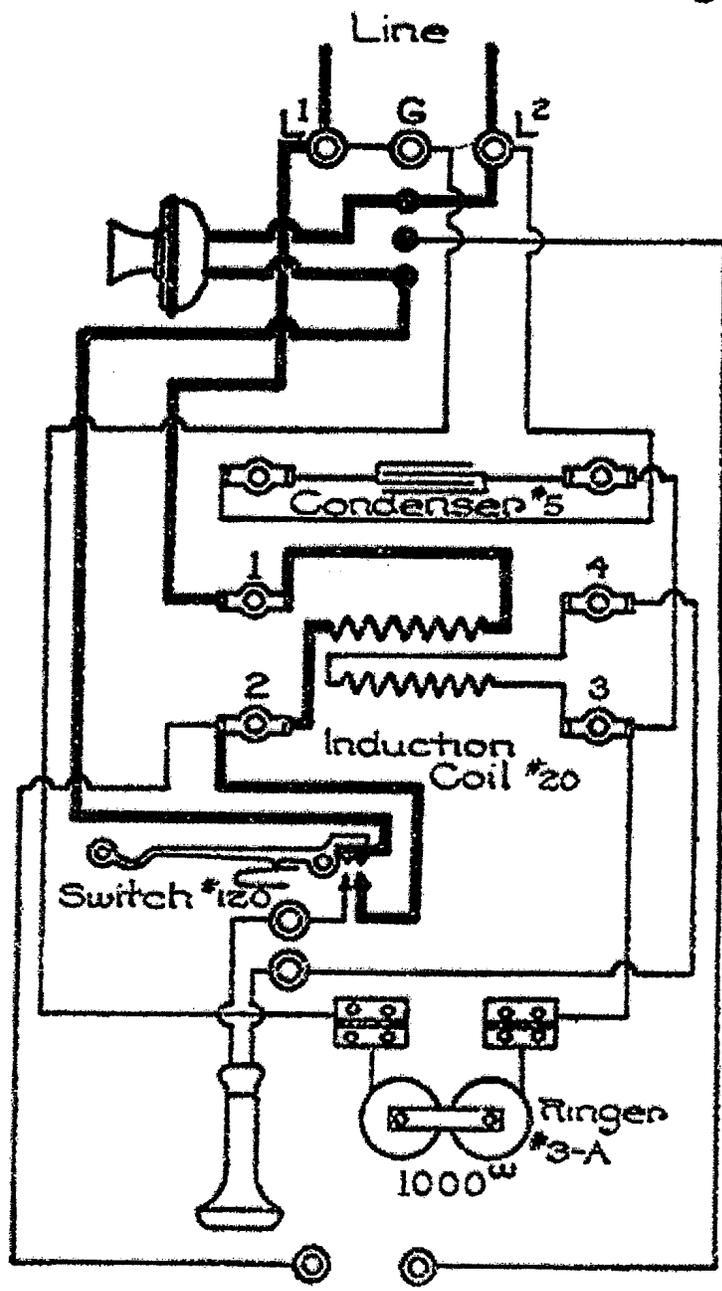
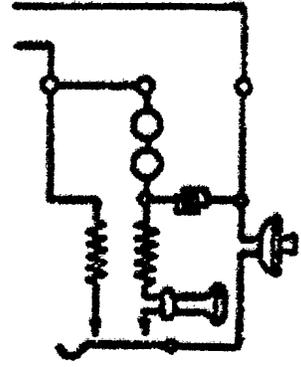


Subscribers' Sets.
 No. 20-B Desk Stand.
 Detail Drawing of Connections.



49-E-15

Subscribers' Sets.
Common Battery No. 85.
Detail Drawing of Set Connections.



49-E-16

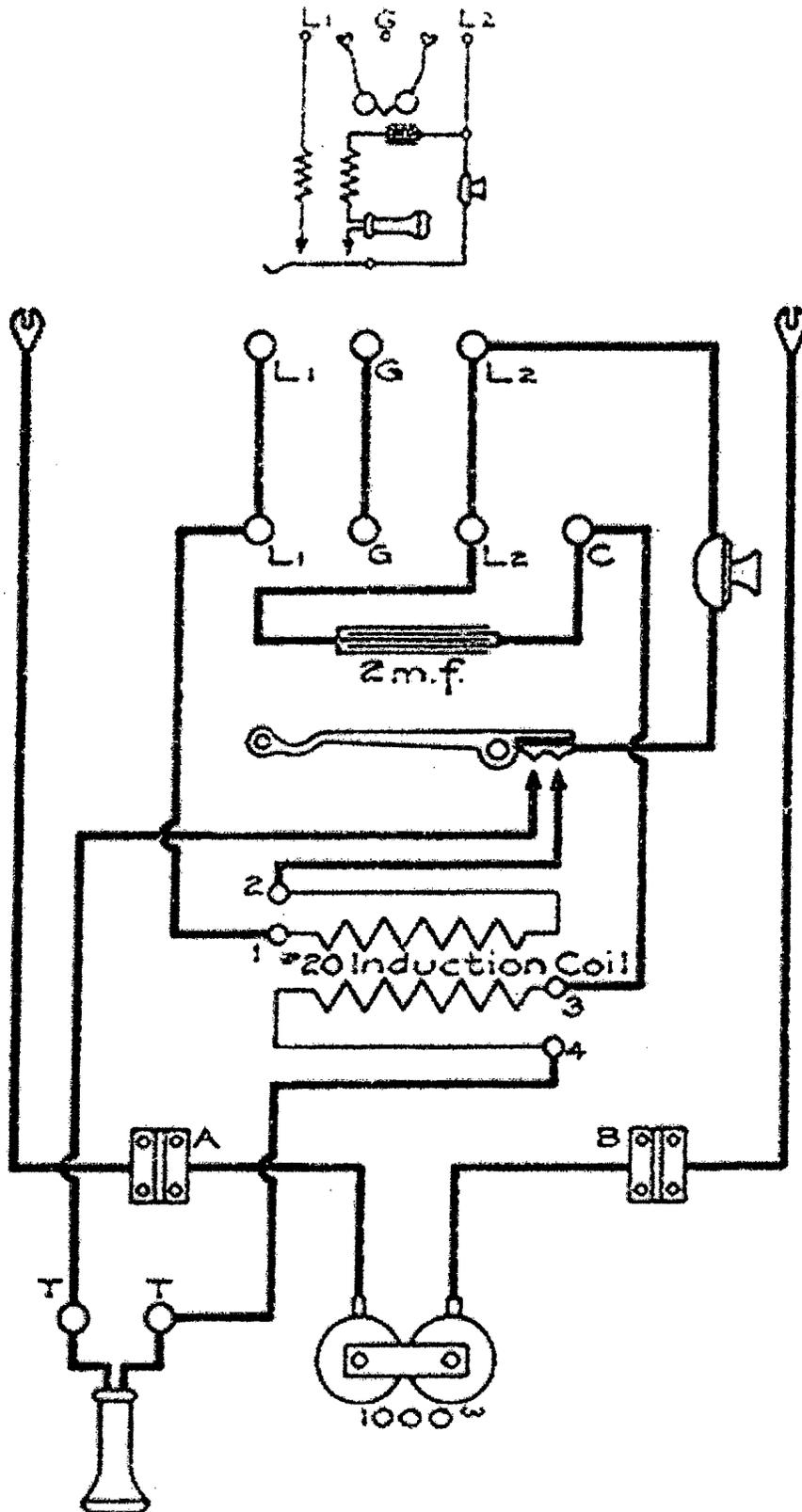
60-E-31.

Subscriber's Sets

Common Battery No. 85-W

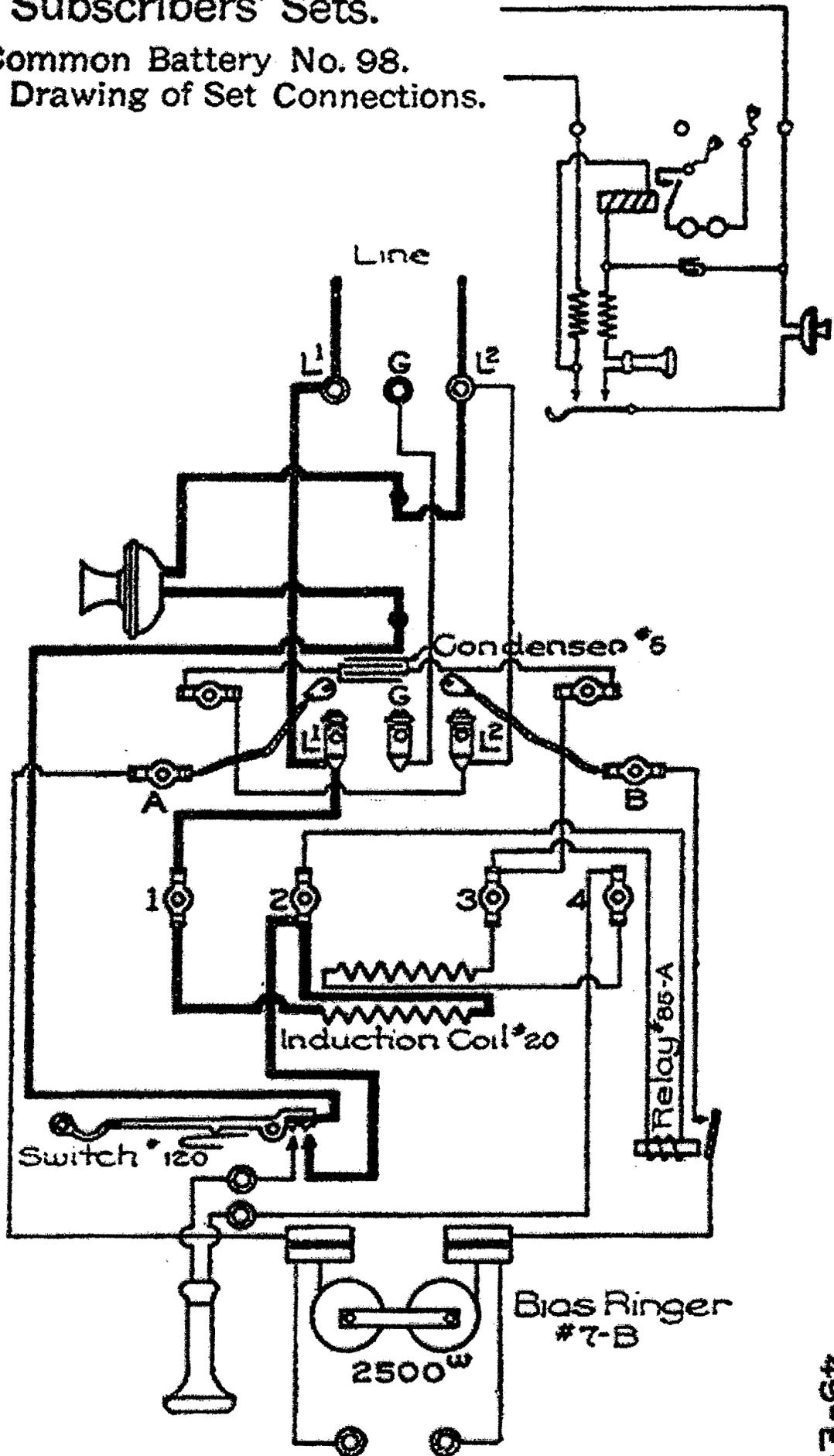
Sept 9, 1905.

Detail Drawing of Set Connections



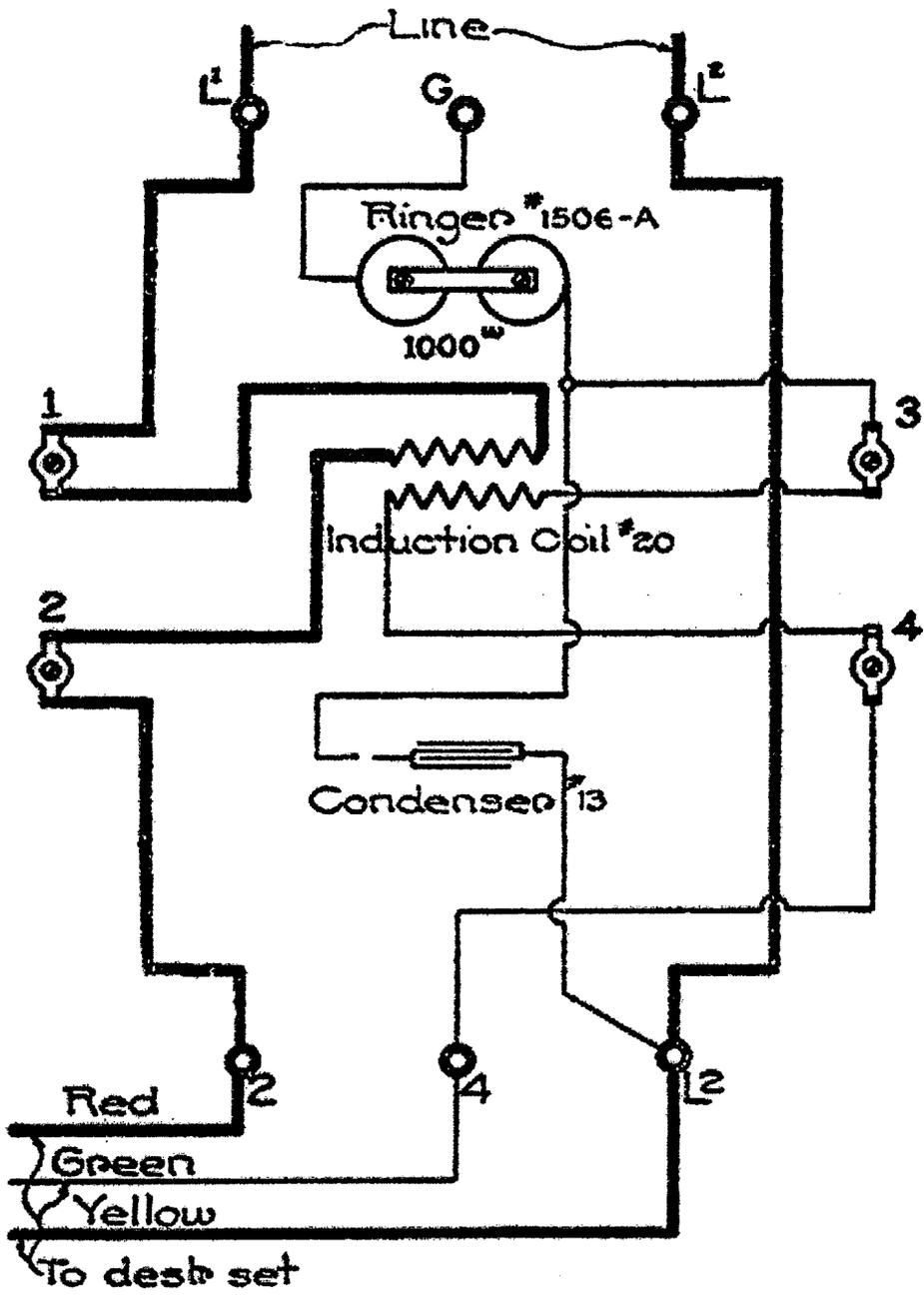
Subscribers' Sets.

Common Battery No. 98.
Detail Drawing of Set Connections.



49-E-18

Subscribers' Sets.
Common Battery No. 101.
Detail Drawing of Set Connections.



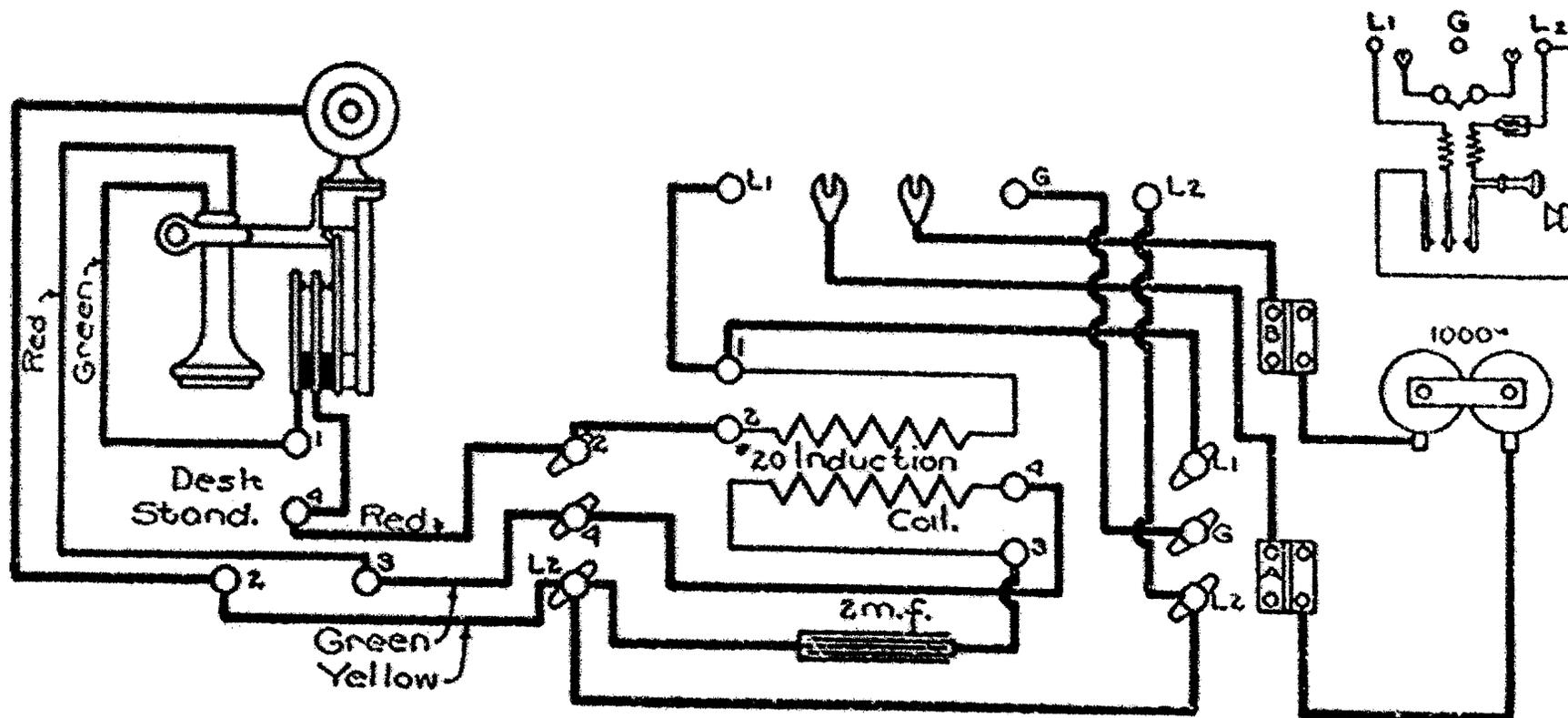
49-E-20

60-E-32.

Subscriber's Sets

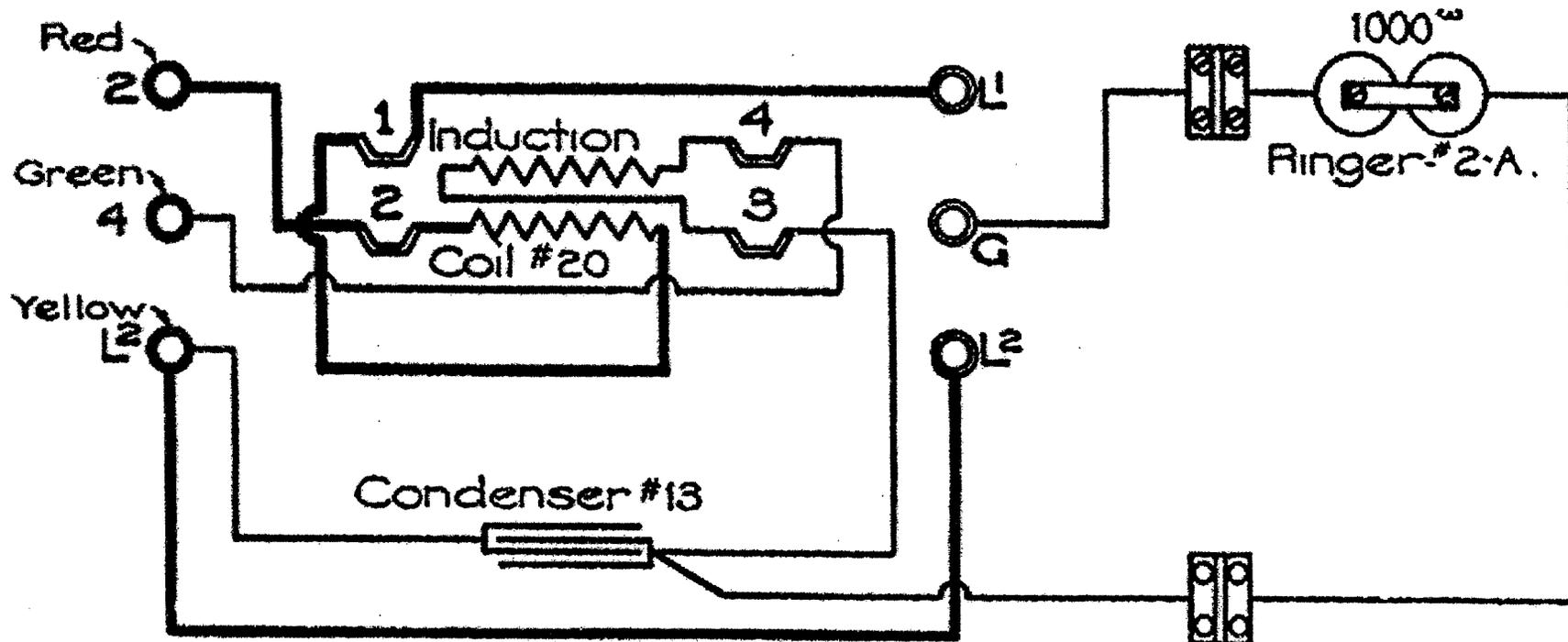
Common Battery No. 101-Q
Detail Drawing of Set Connections
when used with Desk Stand

Sept 9, 1905.



Subscribers' Sets.
Common Battery No. 101-K.
Detail Drawing of Set Connections.

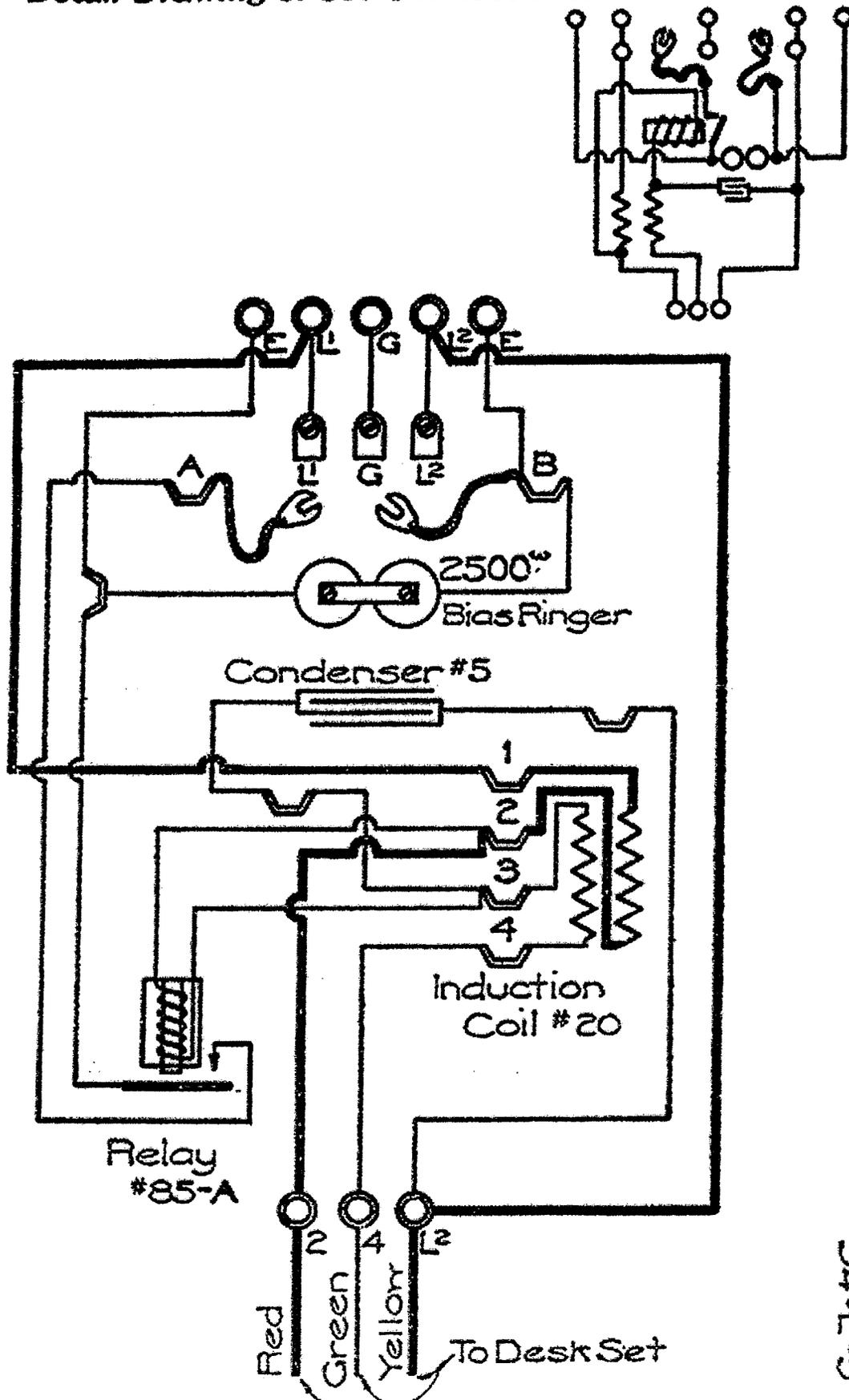
54-E-4



Subscribers' Sets.

Common Battery No. 105-A.

Detail Drawing of Set Connections.

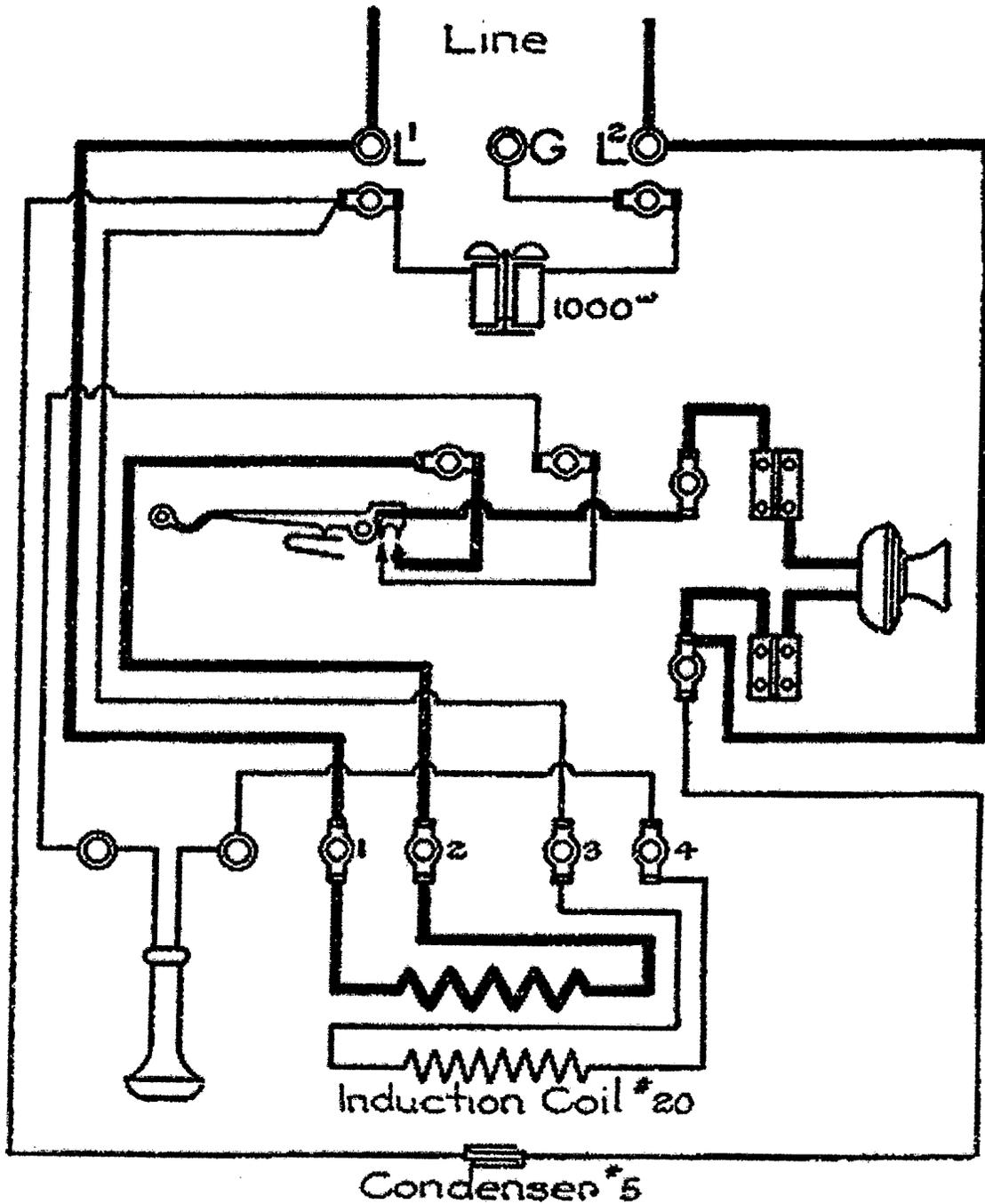
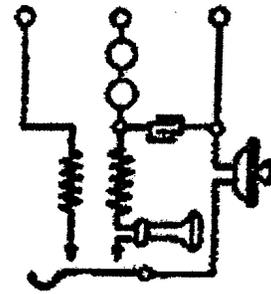


Subscribers' Sets.

Common Battery No. 109-E

Hotel Type.

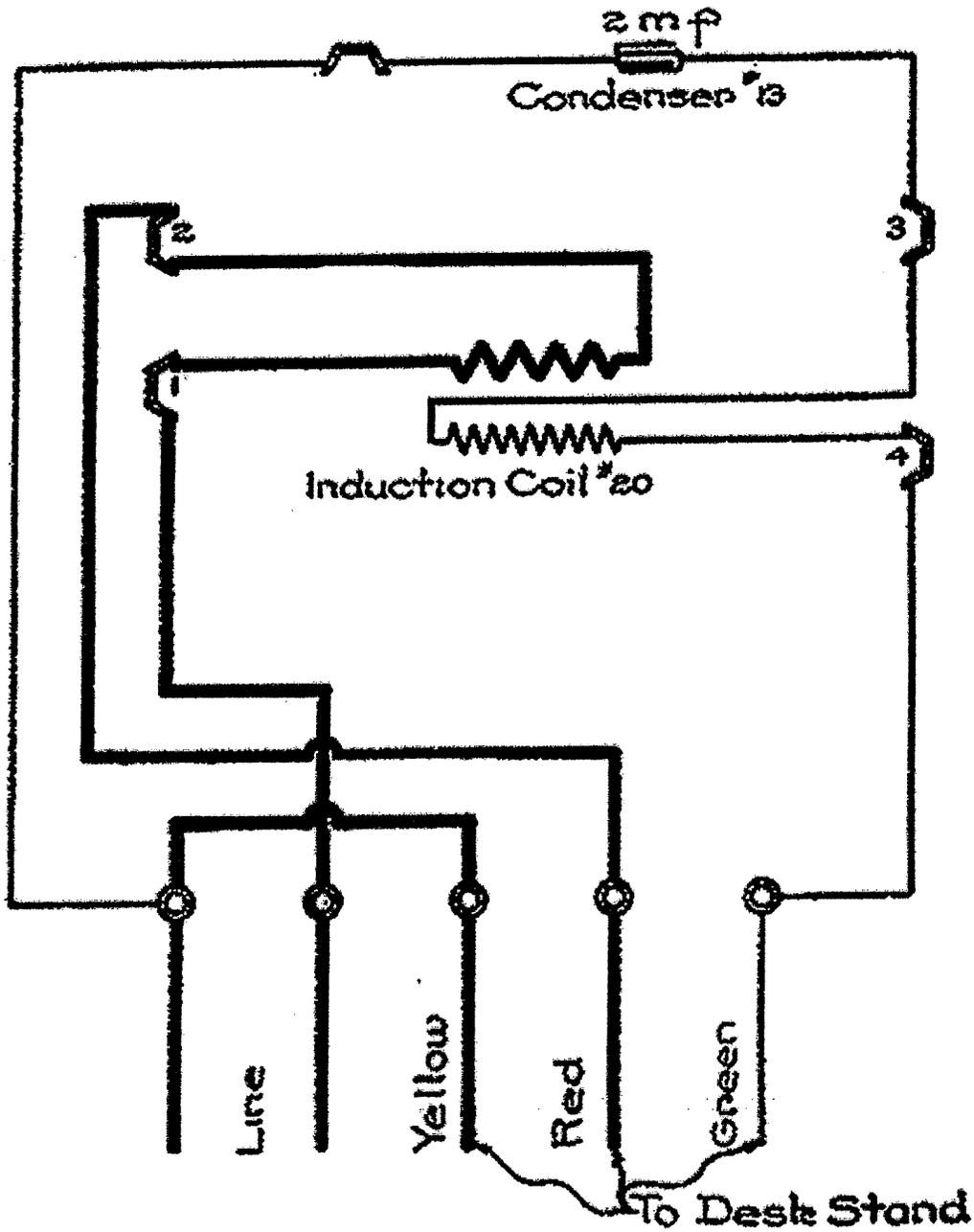
Detail Drawing of Set Connections.



43-E-21

Subscribers' Sets.

Common Battery Extension Set No. 120.
Detail Drawing of Set Connections.



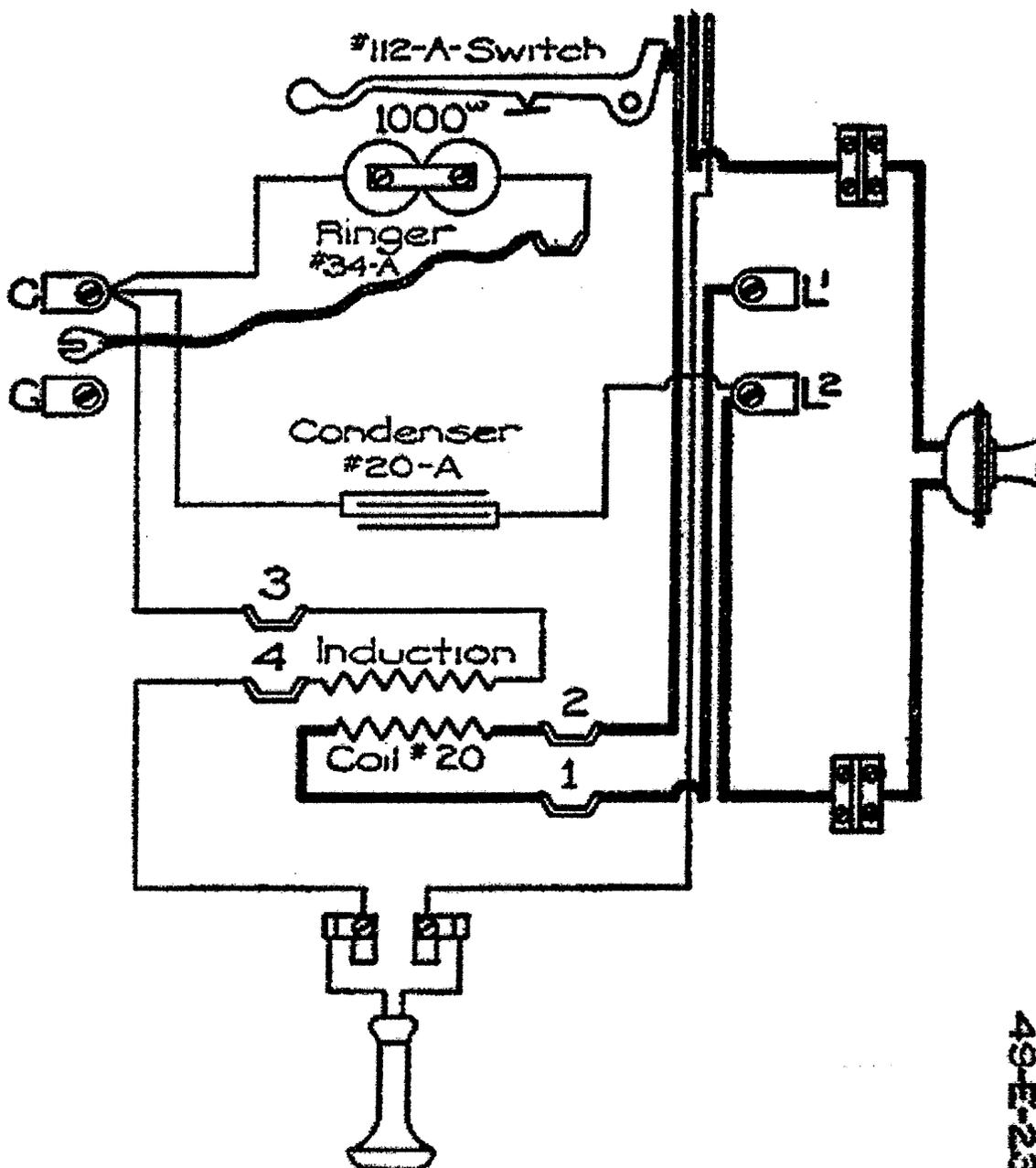
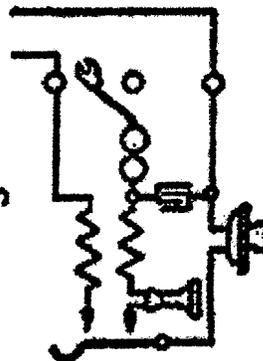
49-E-22

Subscribers' Sets.

Common Battery

Nos. 124-A, 124-J, 124-N & 124-P.
Detail Drawing of Set Connections.

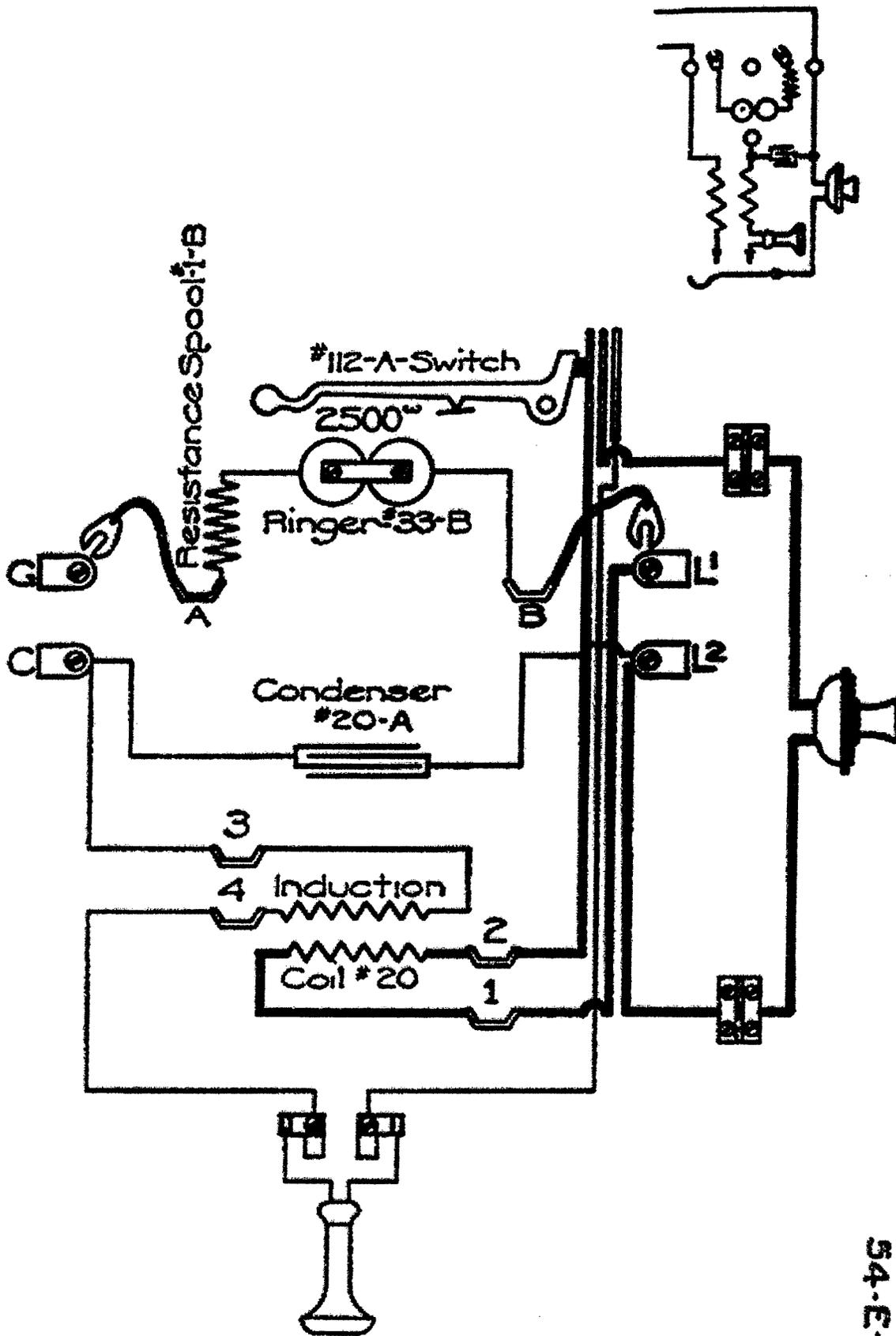
Note. Set No. 124-N is provided with a 1000 ohm ringer No. 35-A.
Set No. 124-P is provided with a 2500 ohm ringer No. 34-B.



49-E-23

Subscribers' Sets.

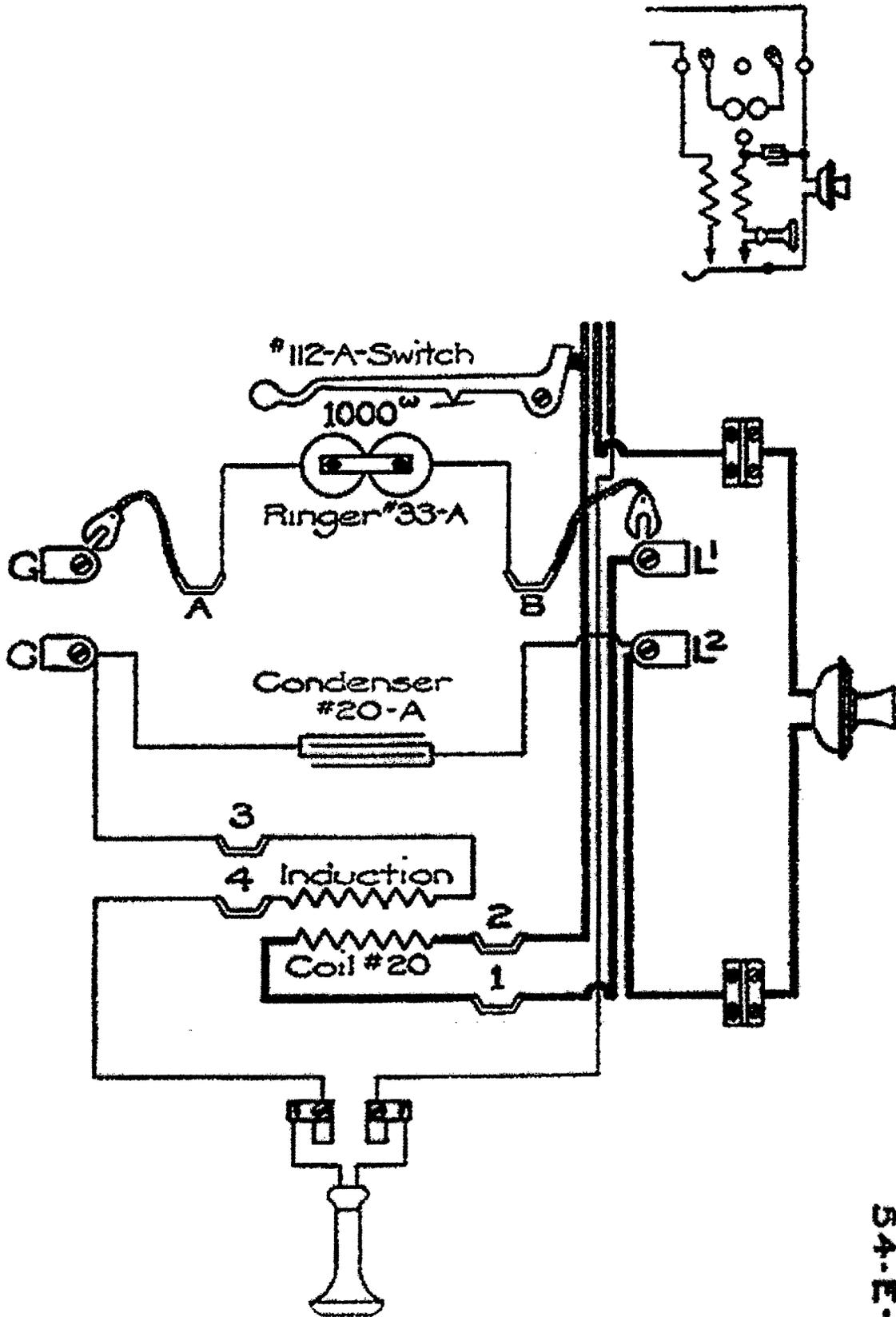
Common Battery No. 124-F.
Detail Drawing of Set Connections.



54-E-7

Subscribers' Sets.

Common Battery No. 124-L.
Detail Drawing of Set Connections.

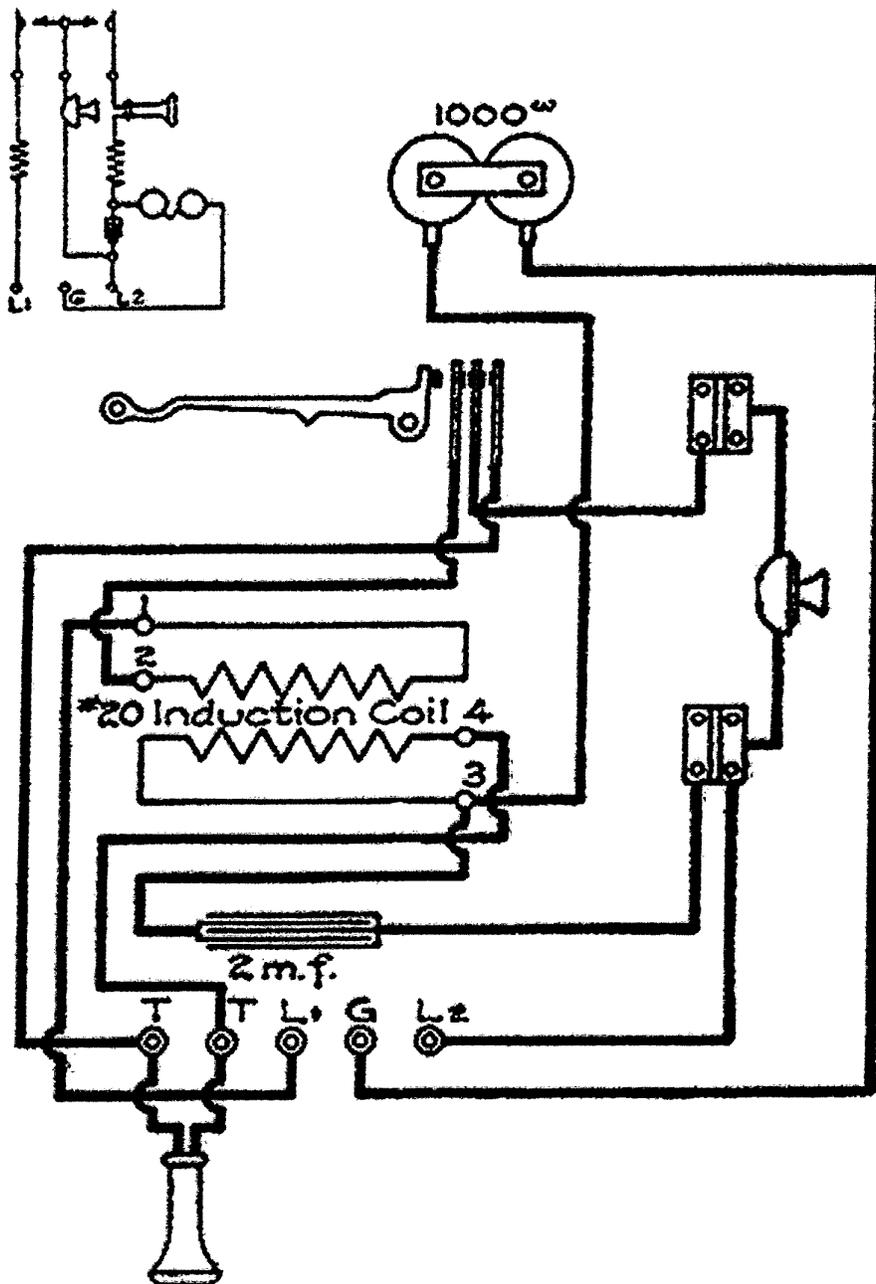


60-E-33.

Subscriber's Sets

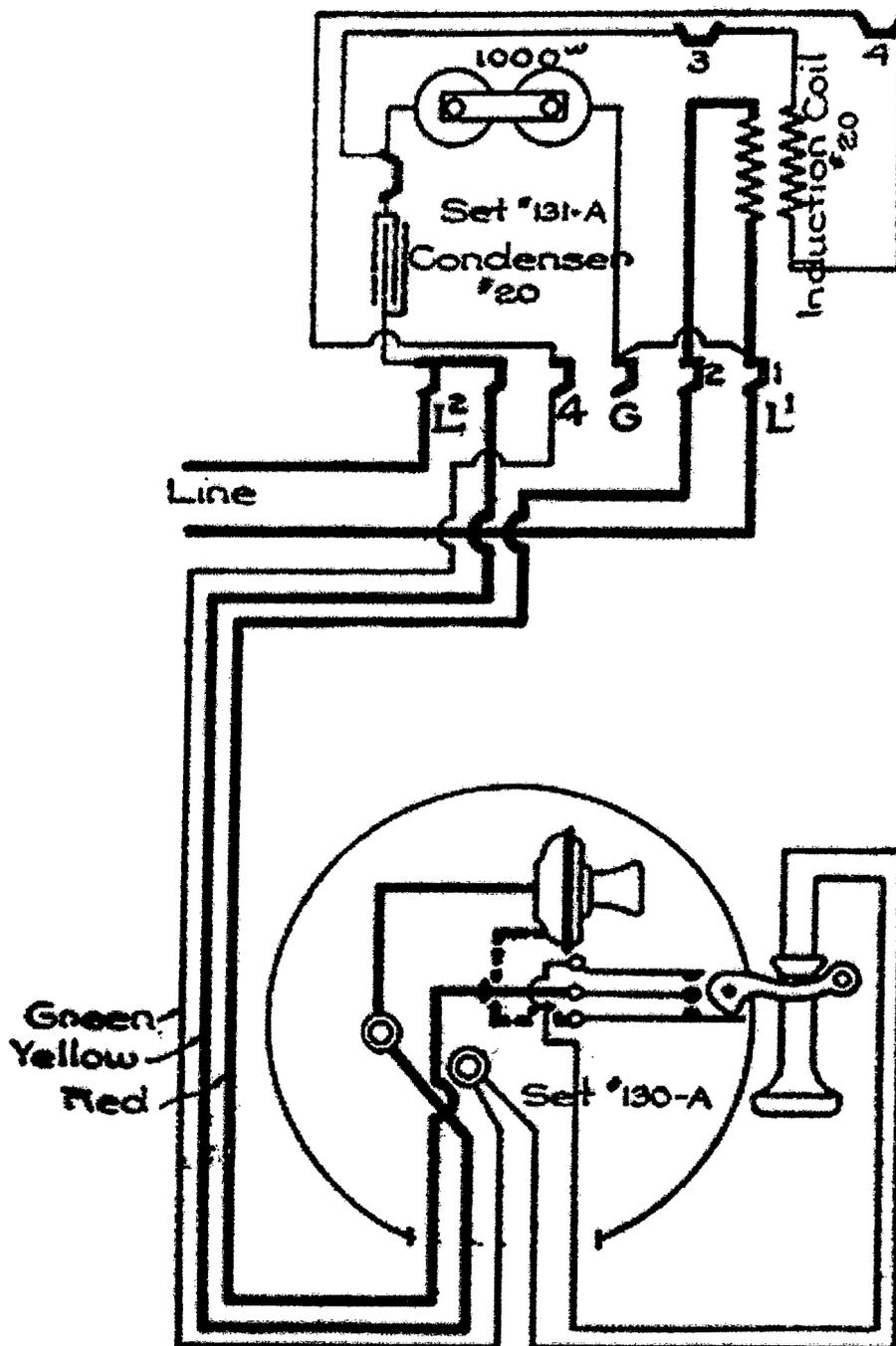
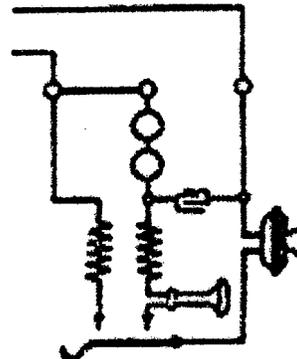
9-9-05.

Common Battery No. 128-A Detail Drawing of Set Connections



Subscribers' Sets.

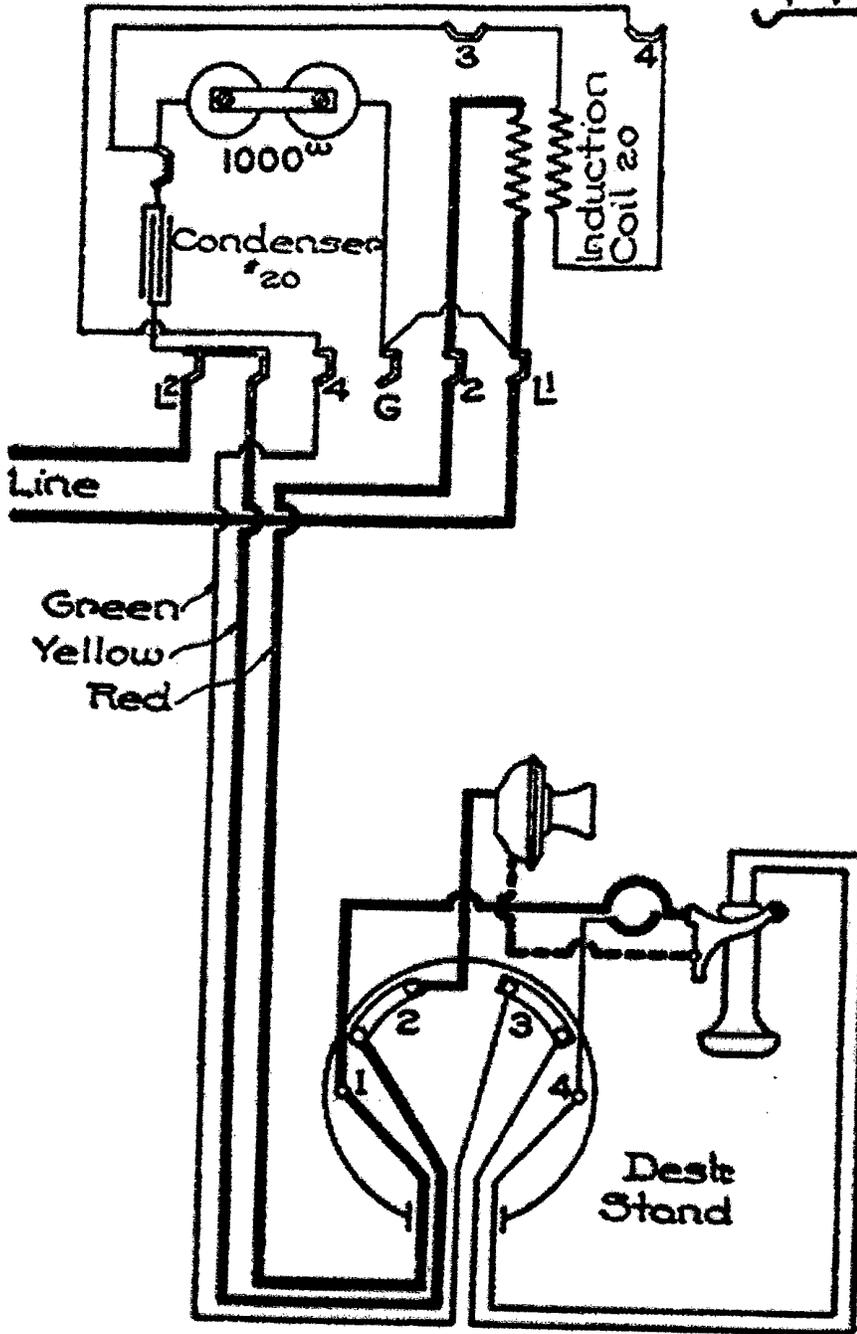
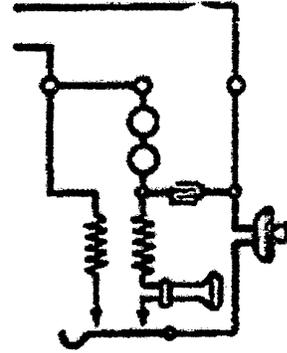
Common Battery No. 130-A and 131-A.
Detail Drawing of Connections.



49-E-24

Subscribers' Sets.

Common Battery No. 131-A.
Detail Drawing of Connections when
used with Desk Stand.

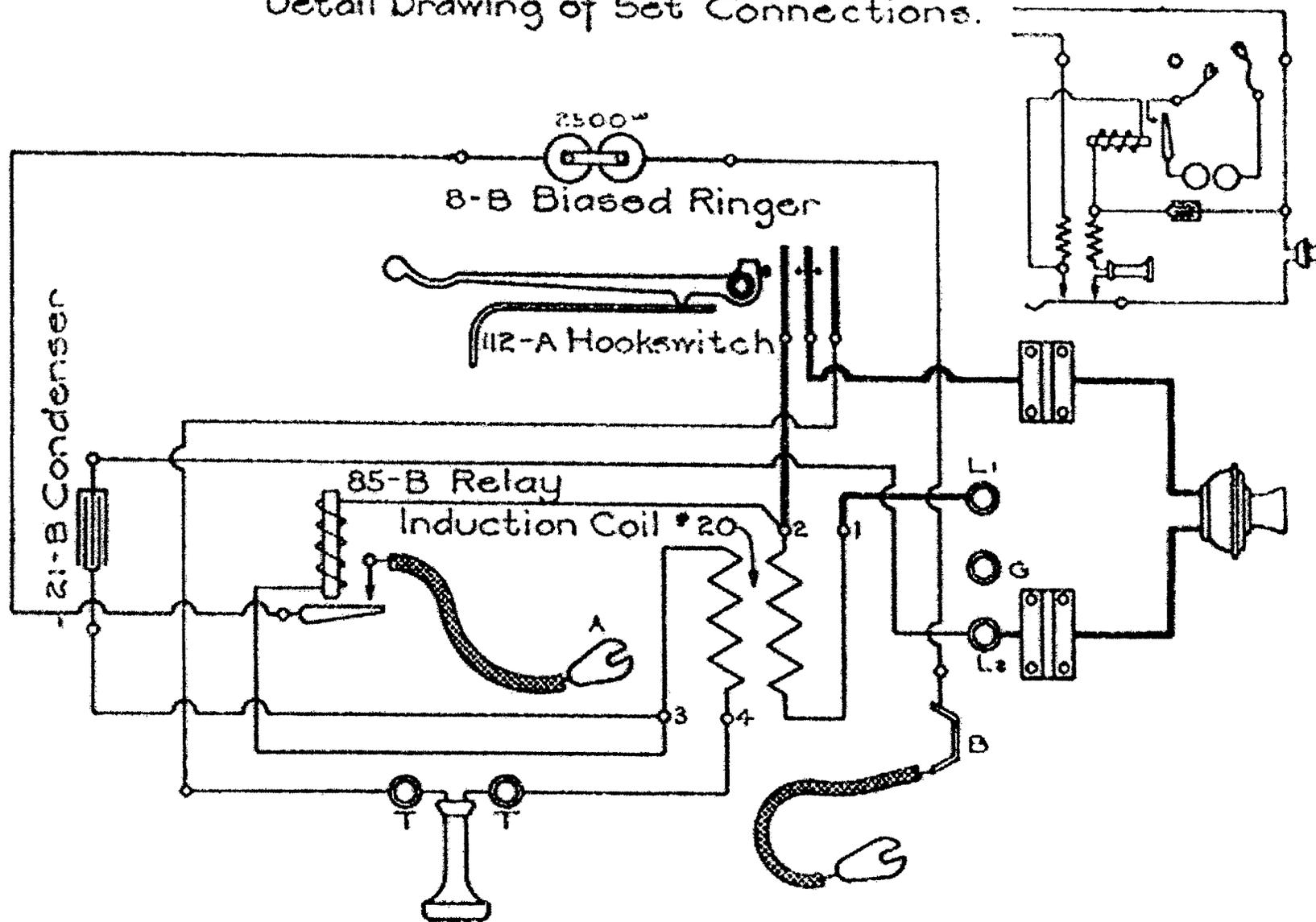


49-E-25

SUBSCRIBERS SETS

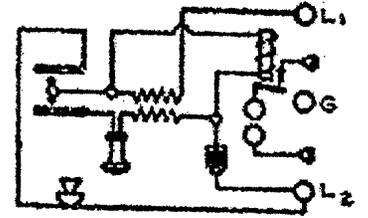
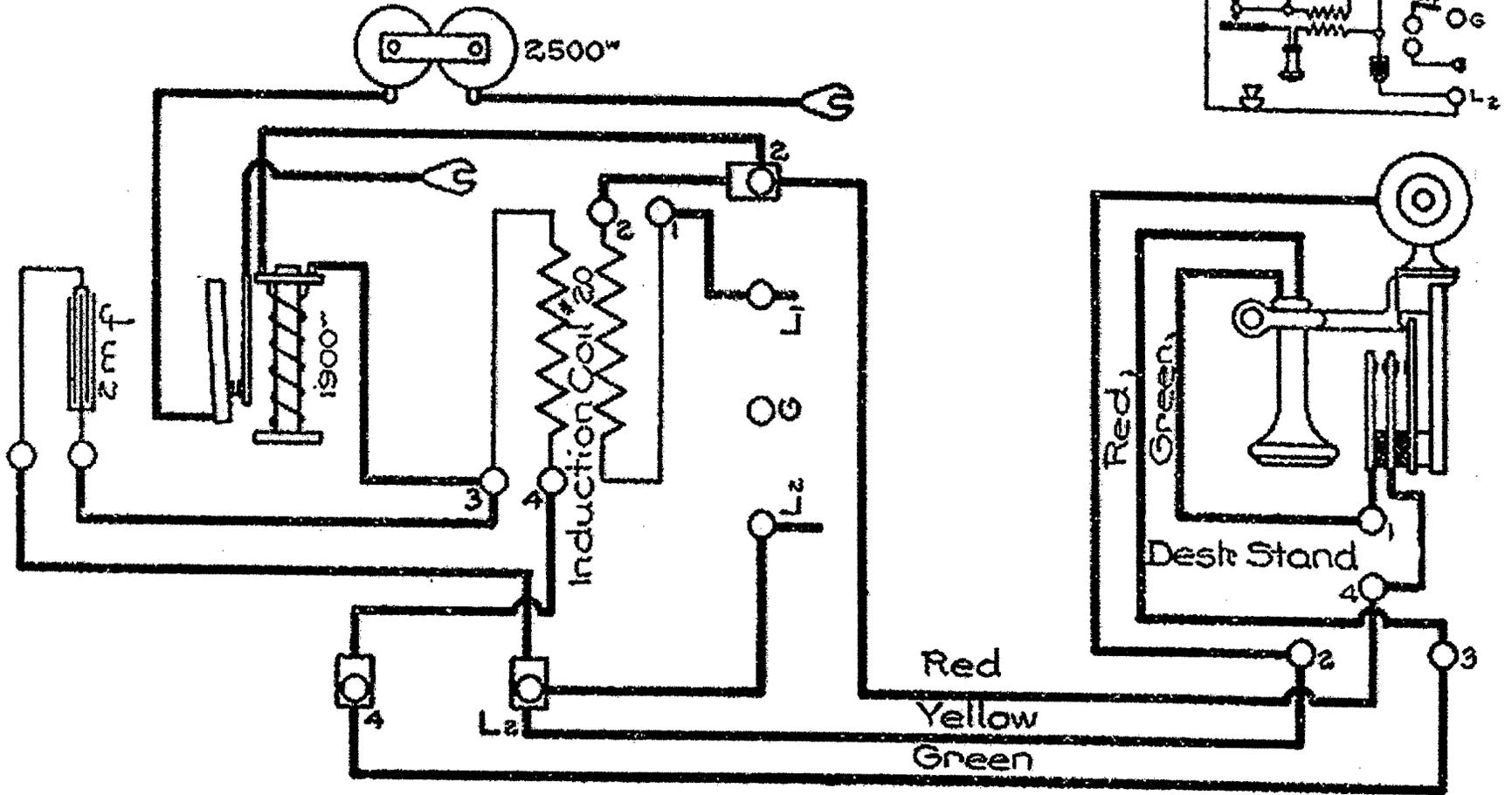
Common Battery No.135-A
Detail Drawing of Set Connections.

57-E-50



Subscriber's Sets

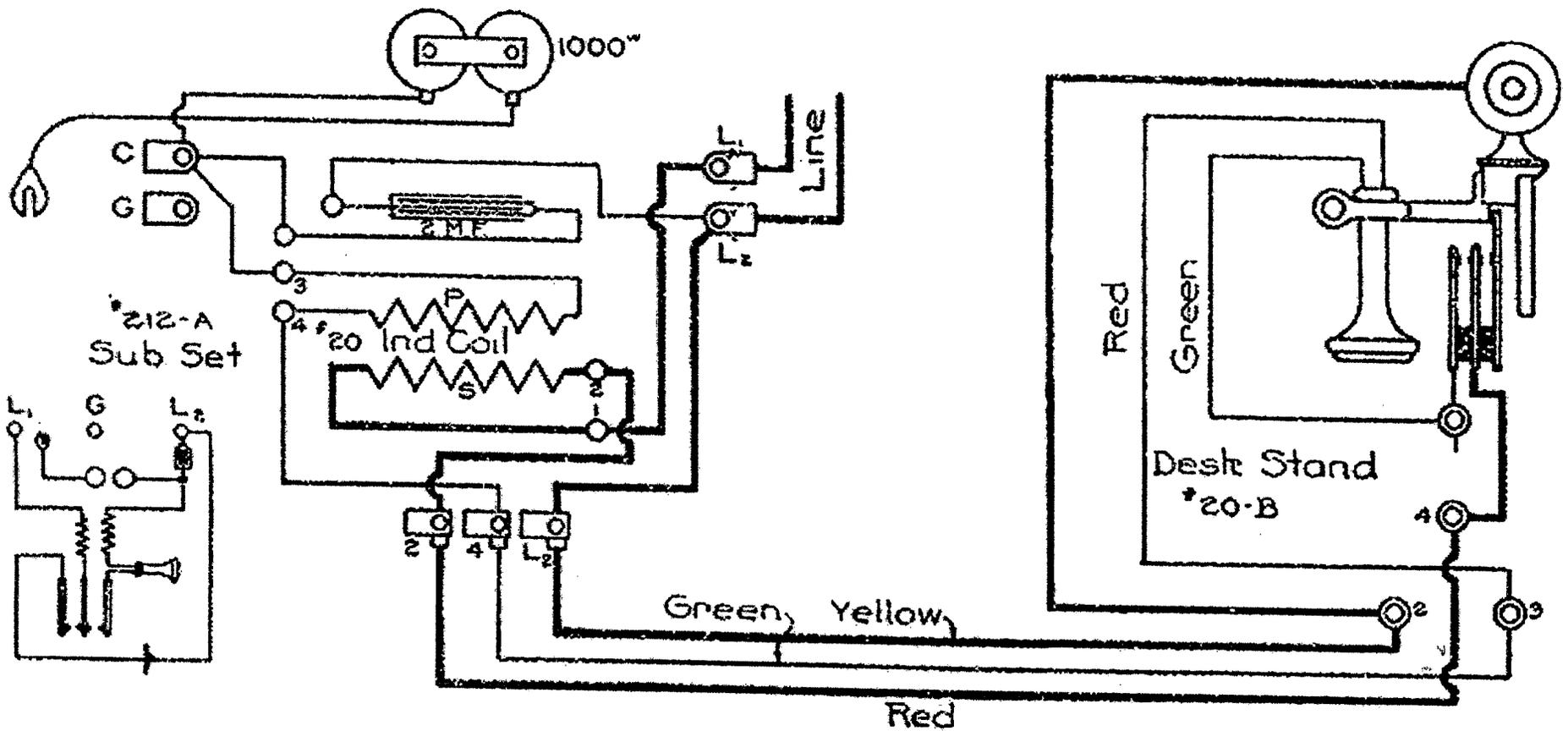
Common Battery No. 137-A
Detail Drawing of Set Connections
when used with Desk Stand



Subscriber's Sets

Common Battery No. 212-A

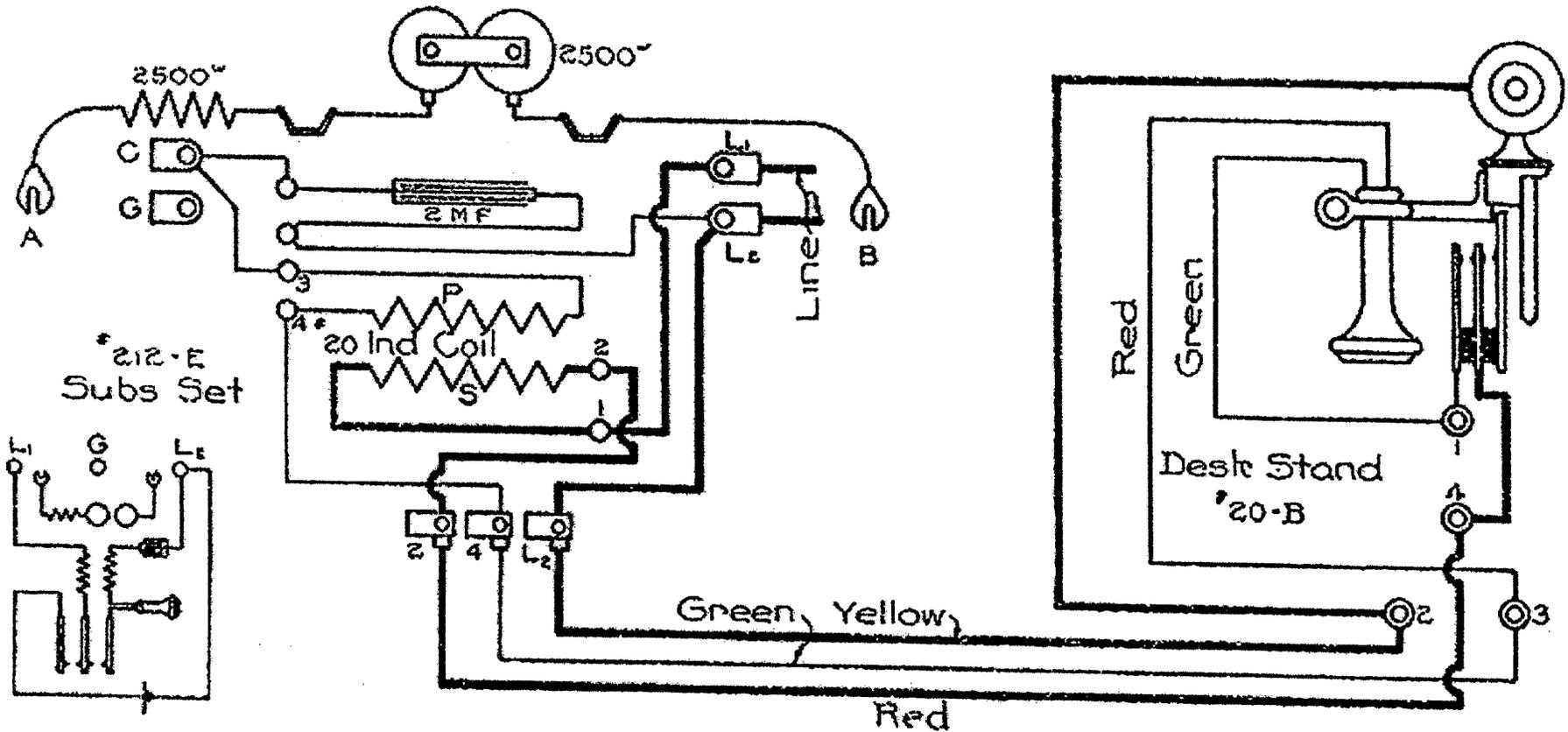
Detail Drawing of Set Connections
when used with No. 20-B Desk Stand



Subscriber's Sets

Common Battery No. 212-E

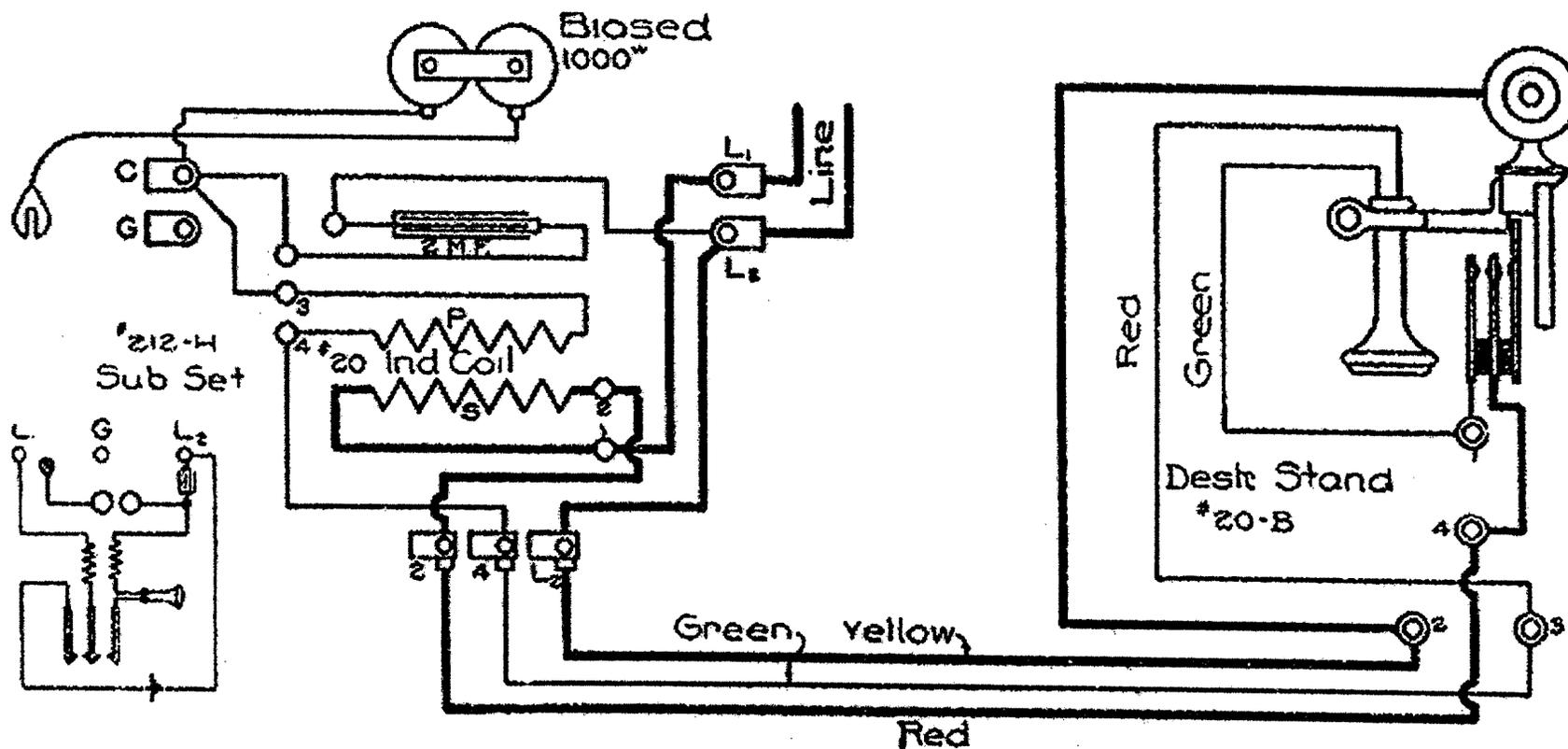
Detail Drawing of Set Connections when used with No. 20-B Desk Stand



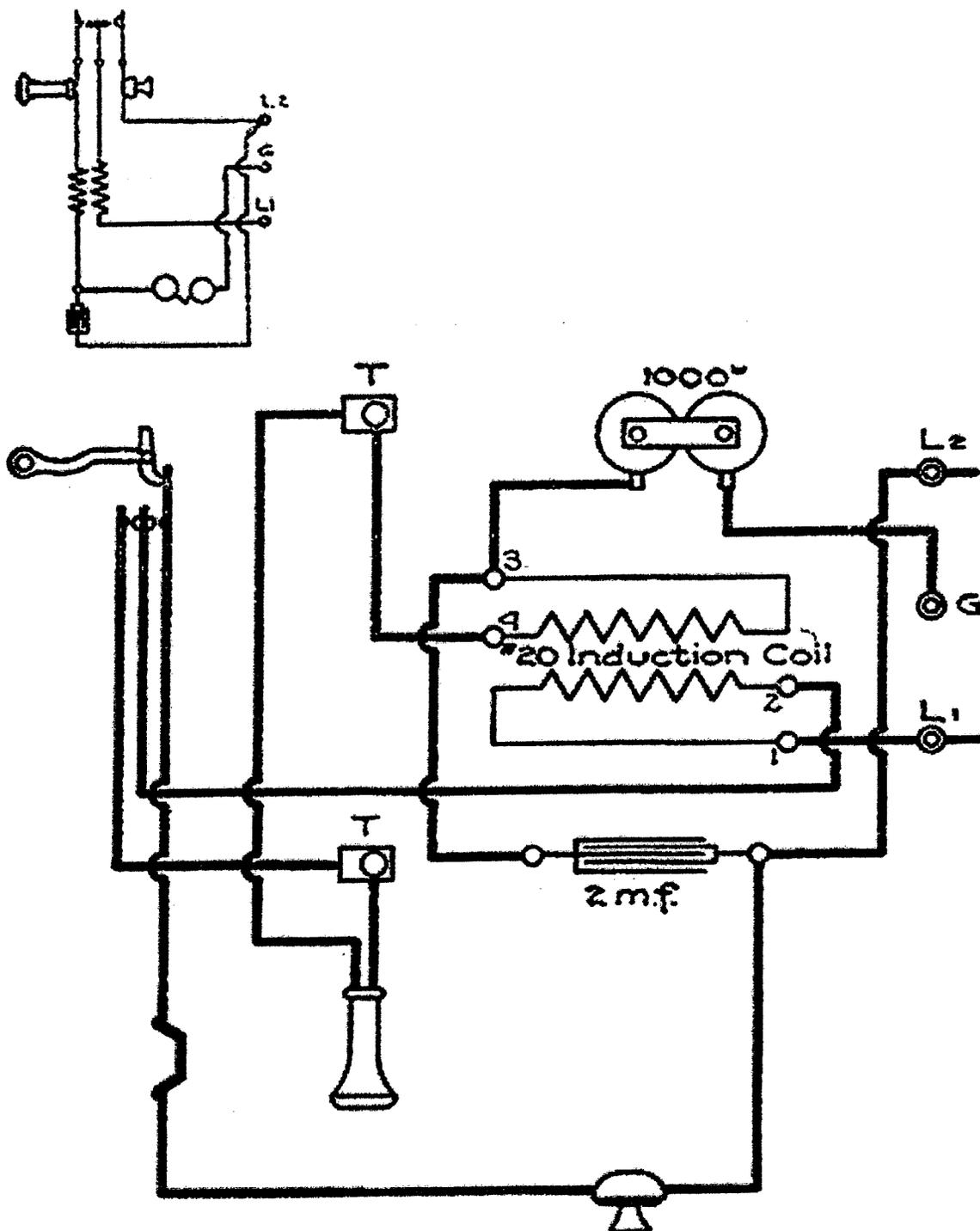
Subscriber's Sets

Common Battery No. 212-H

Detail Drawing of Set Connections
when used with No. 20-B Desk Stand



Common Battery No. 281-A Detail Drawing of Set Connections

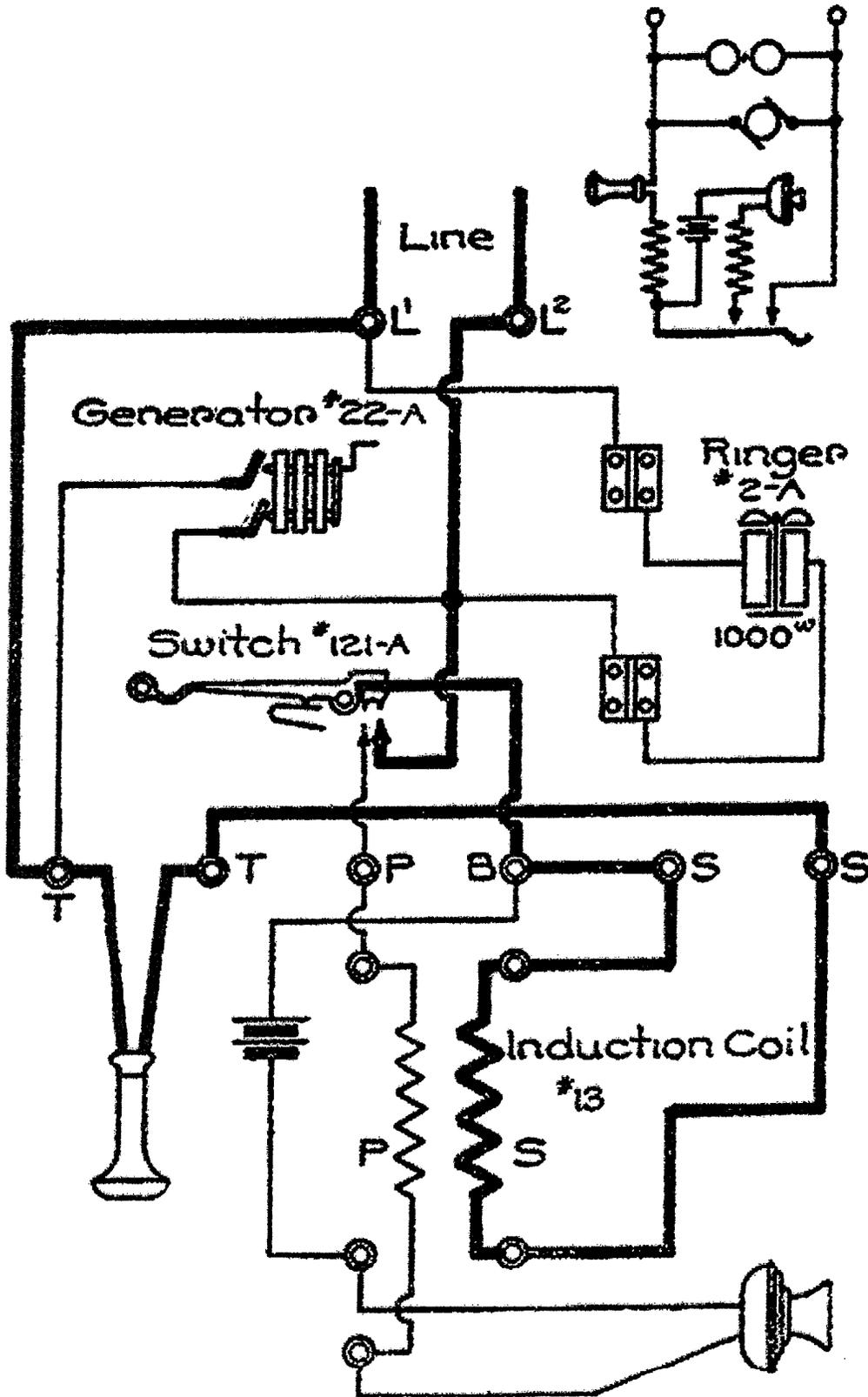


SECTION THREE

LOCAL-BATTERY INSTRUMENTS

Subscribers' Sets.

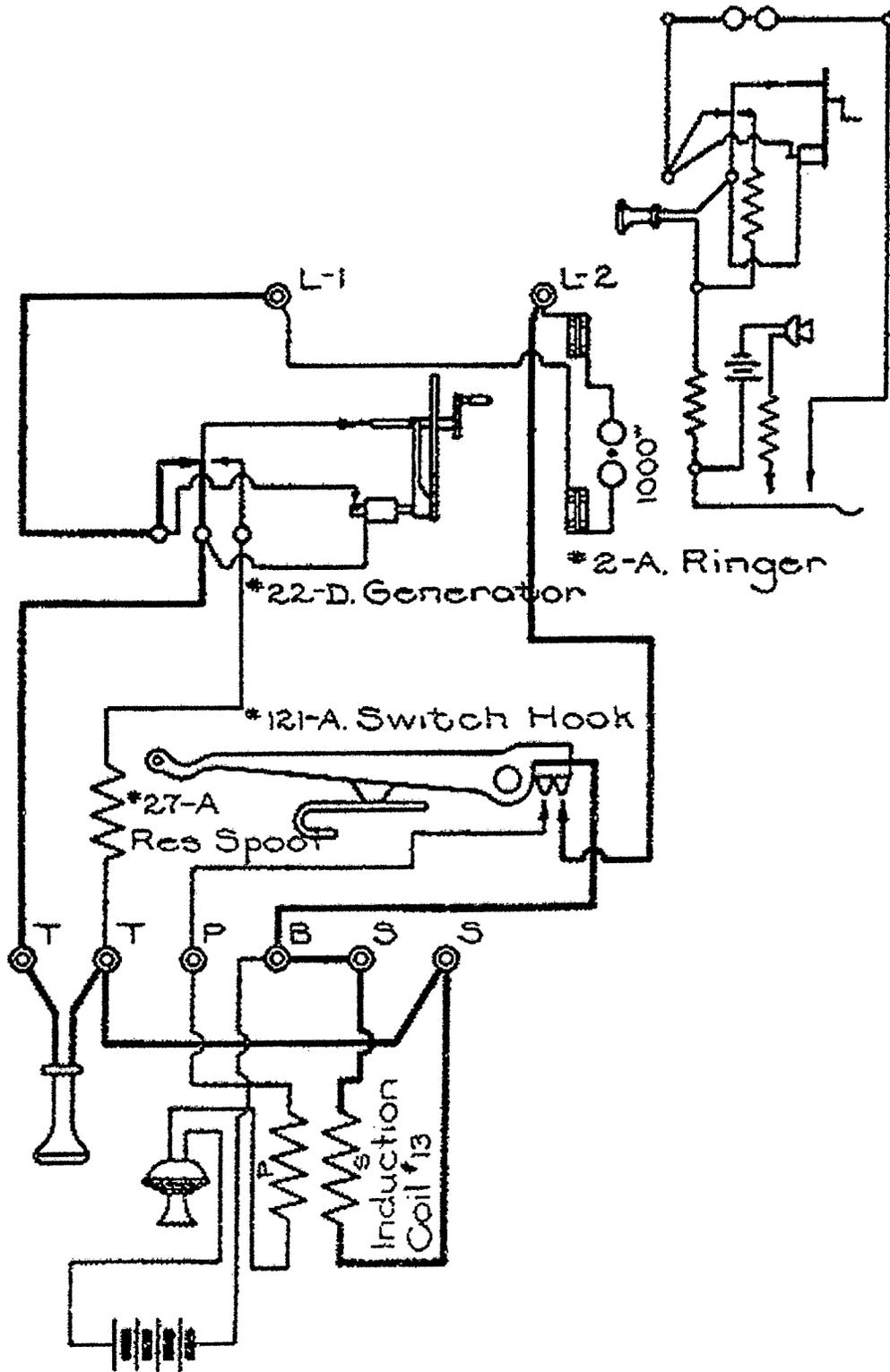
Local Battery No. 21-A.
Detail Drawing of Set Connections.



34-E-2

SUBSCRIBERS - SETS.

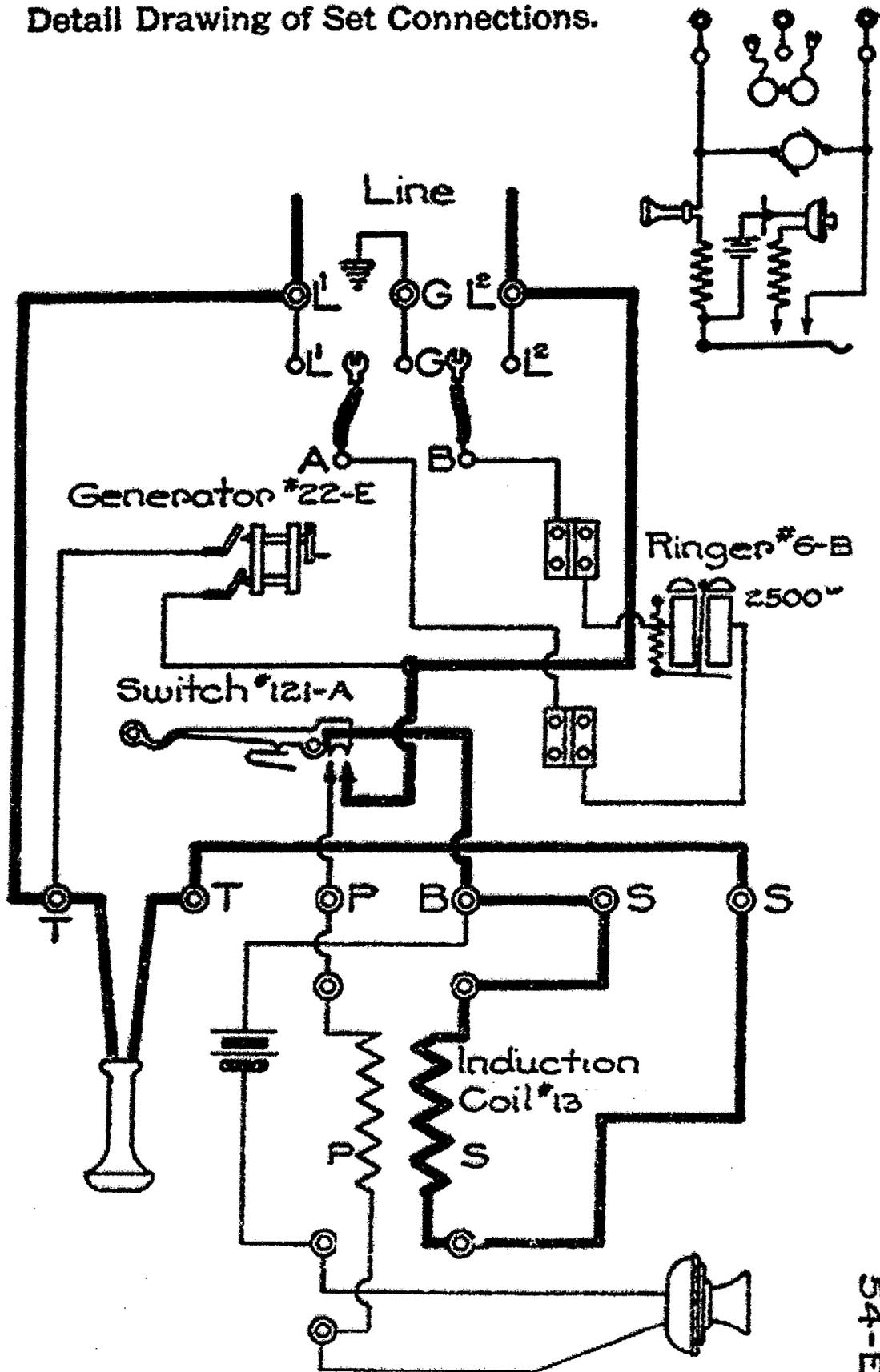
Local Battery No 21AD
Detail Drawing of Set Connections



60-E-3

Subscribers' Sets.

Local Battery No. 21-K.
Detail Drawing of Set Connections.

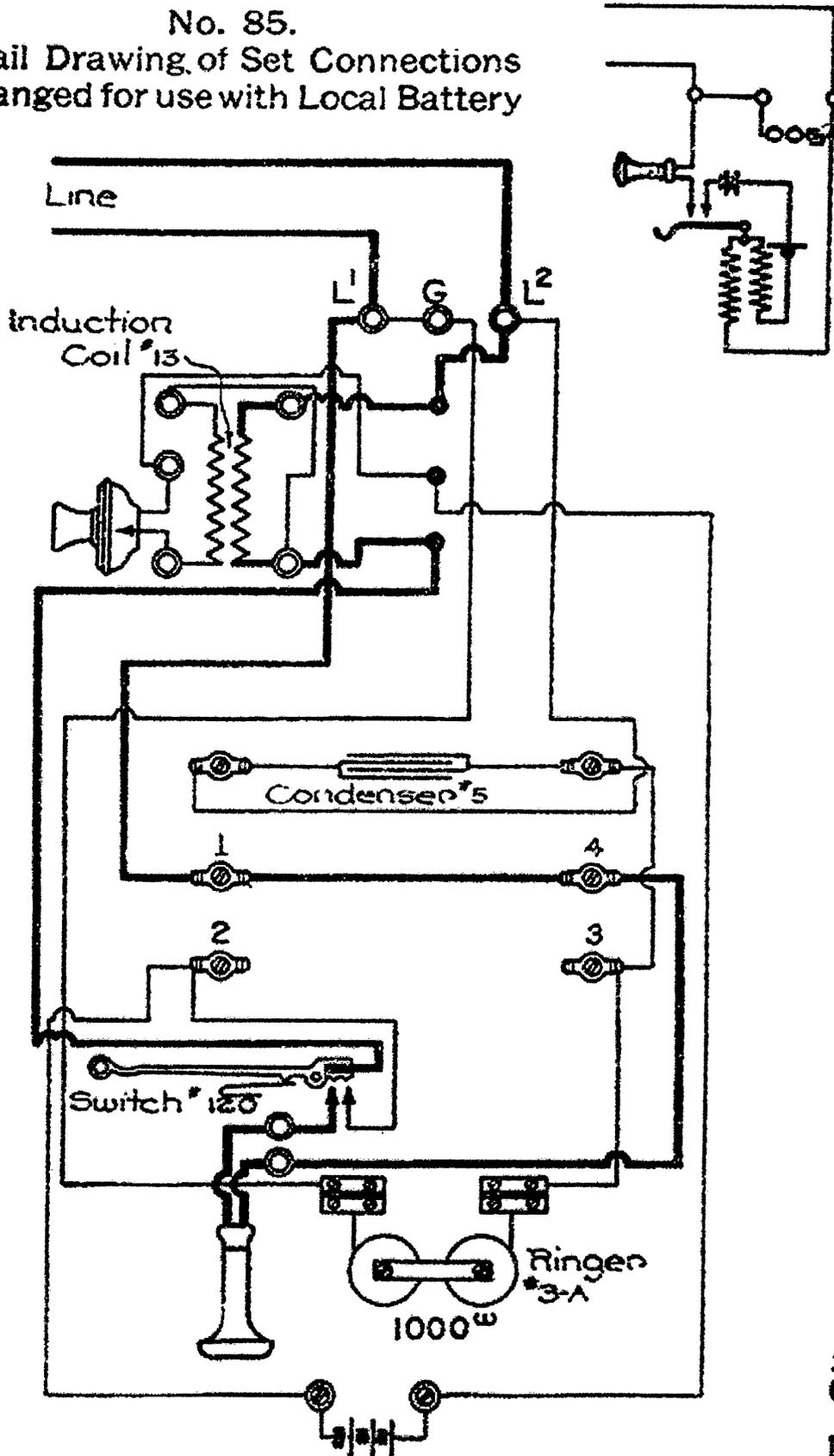


54-E-3

Subscribers' Sets.

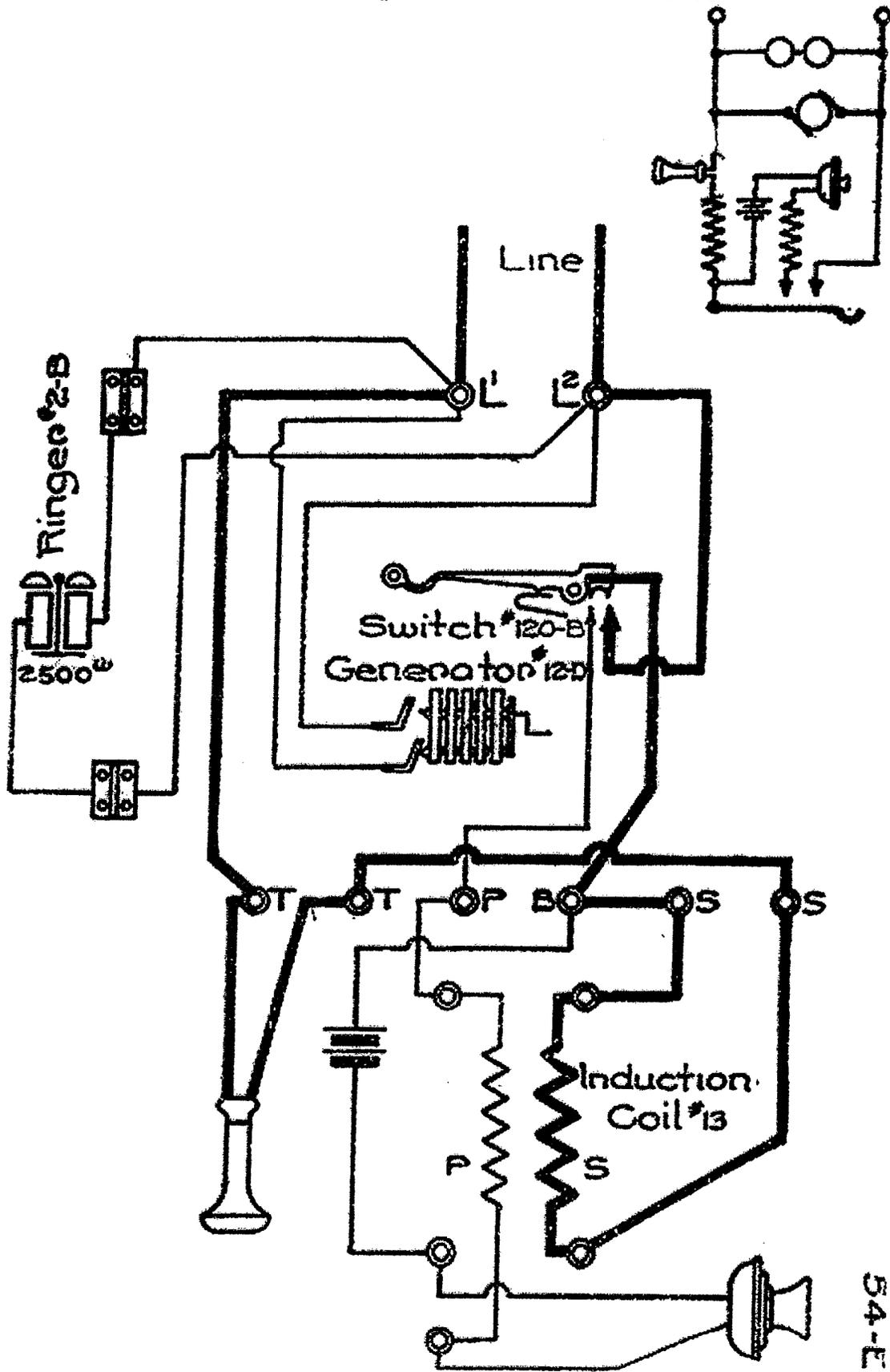
No. 85.

Detail Drawing of Set Connections
arranged for use with Local Battery



49-E-17

Subscribers' Sets.
 Local Battery No. 119-A.
 Detail Drawing of Set Connections.

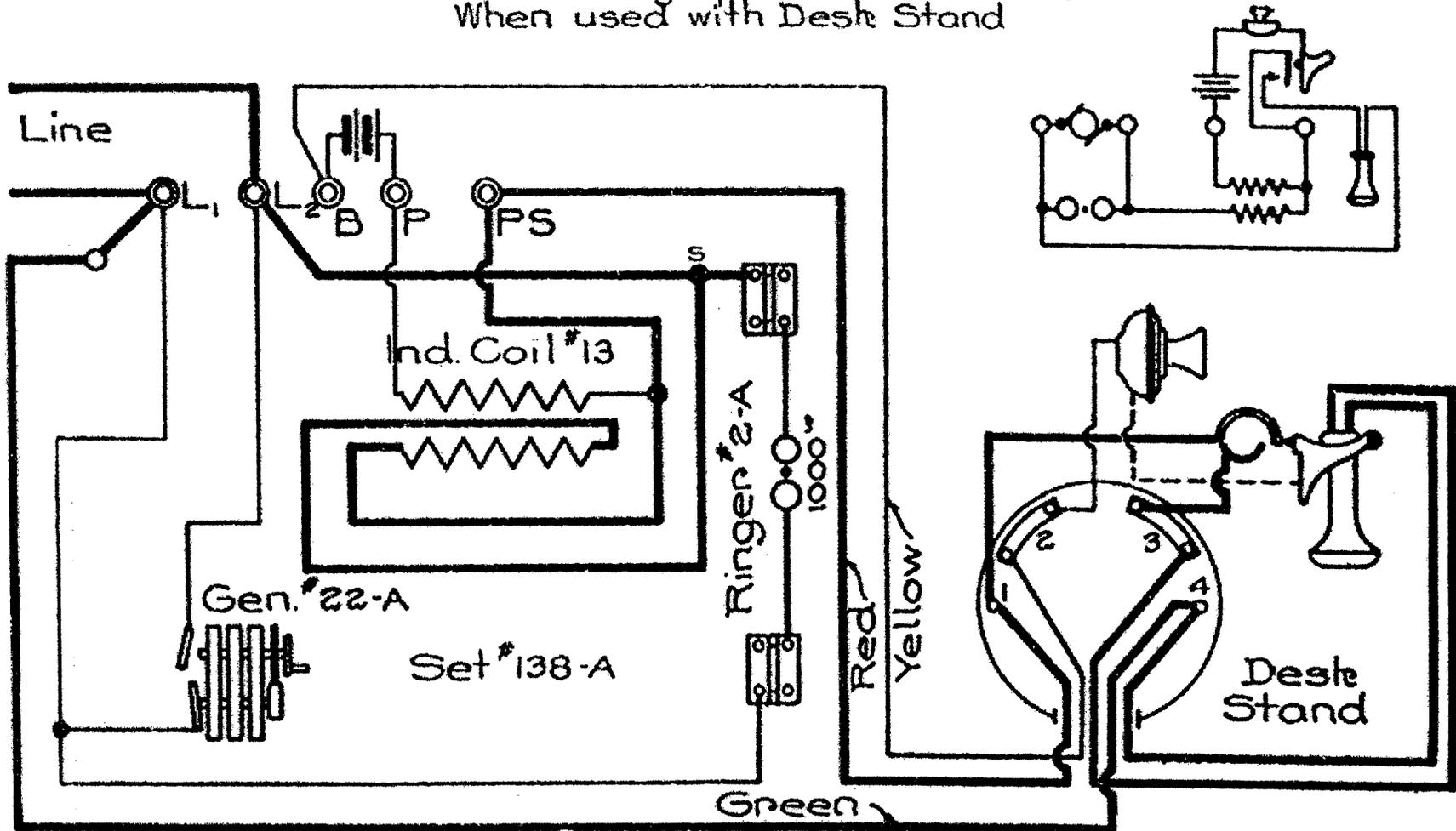


54-E-8

SUBSCRIBERS SETS

Local Battery No. 138-A
Detail Drawing of Set Connections
When used with Desk Stand

57-E-41

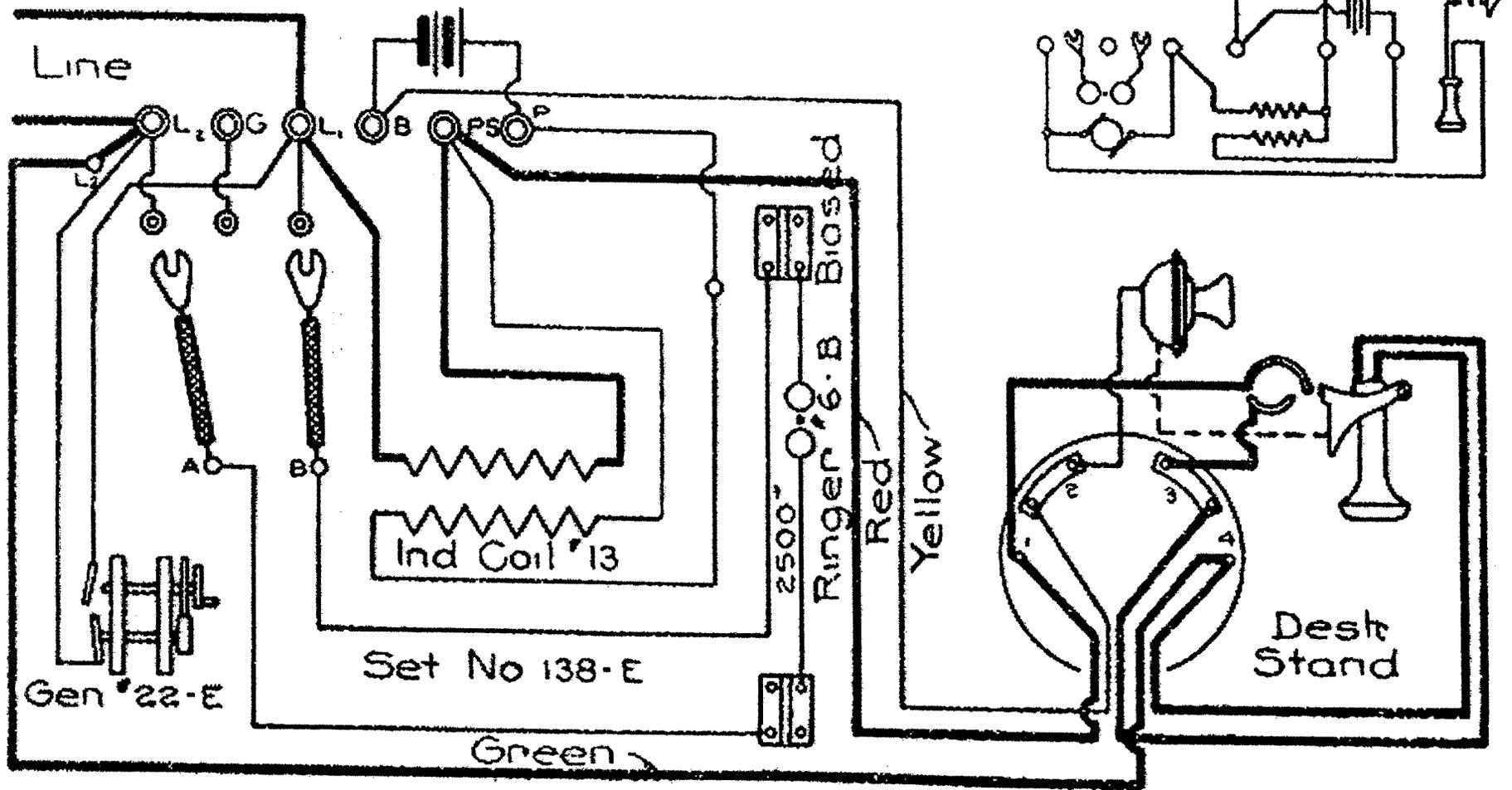


33

SUBSCRIBERS' SETS

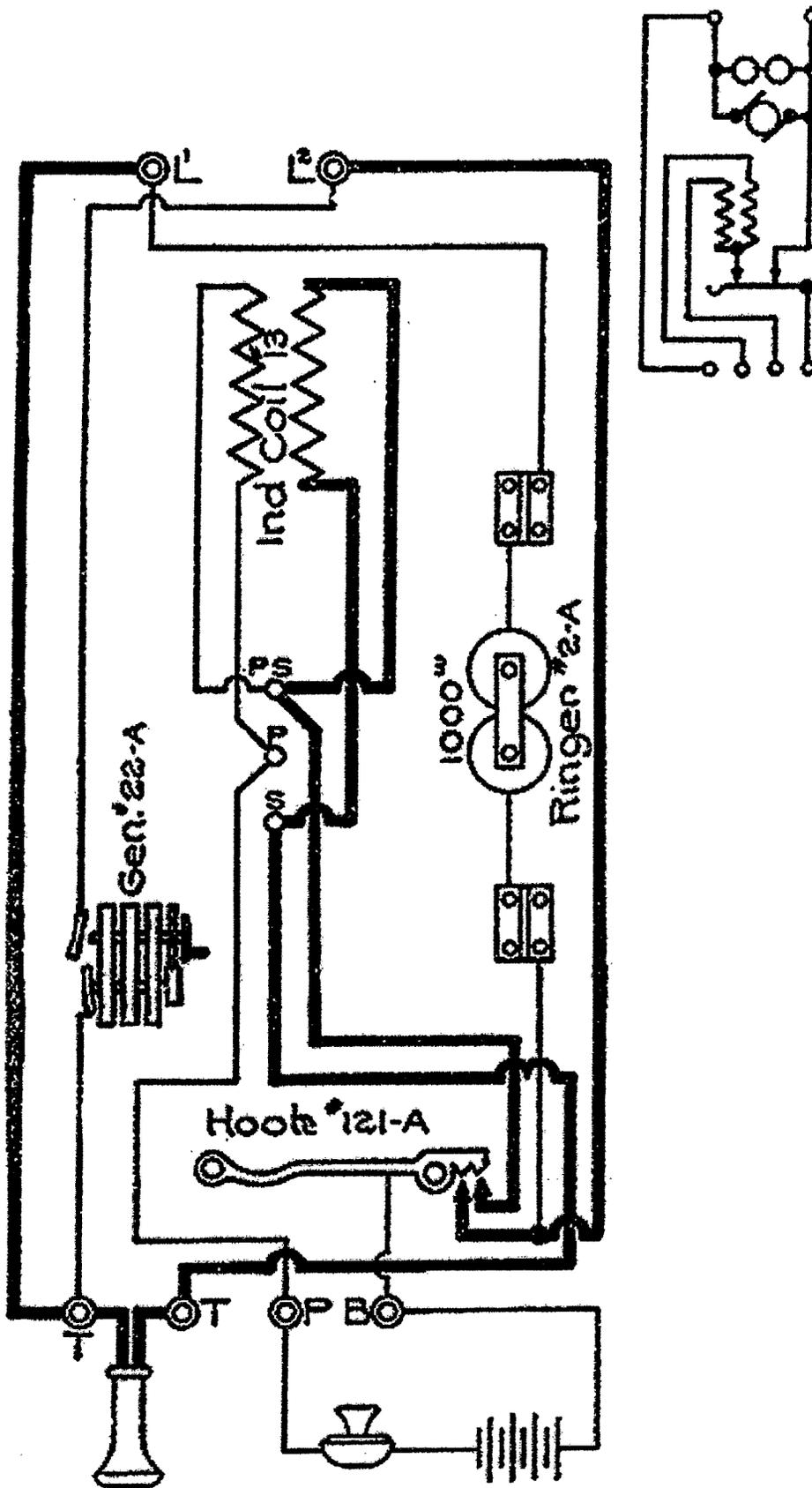
Local Battery No 138-E
 Detail Drawing of Set Connection:
 When used with Desk Stand

57-E-42



SUBSCRIBERS SETS

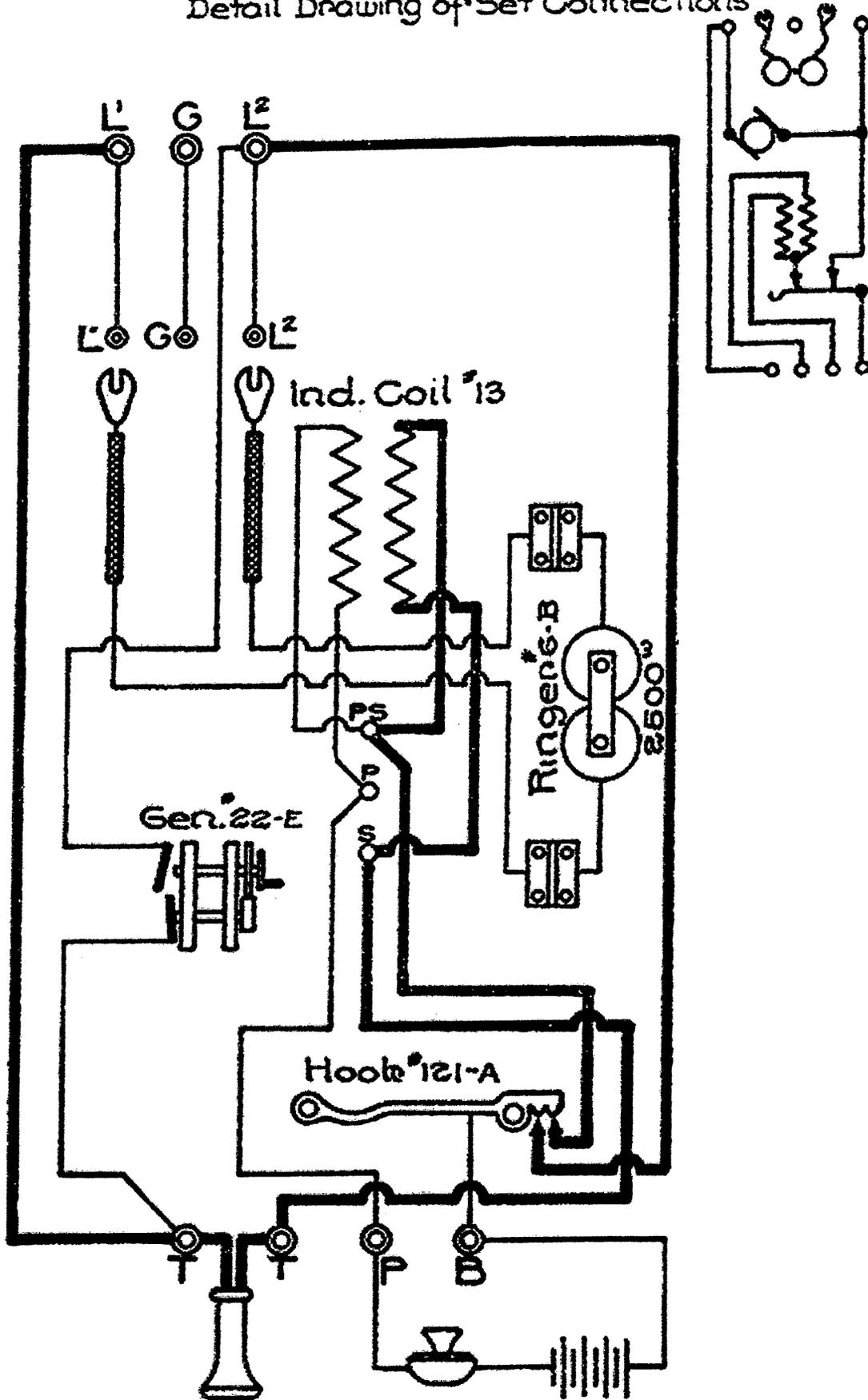
Local Battery No 240-A
Detail Drawing of Set Connections



54-E-22

SUBSCRIBERS SETS

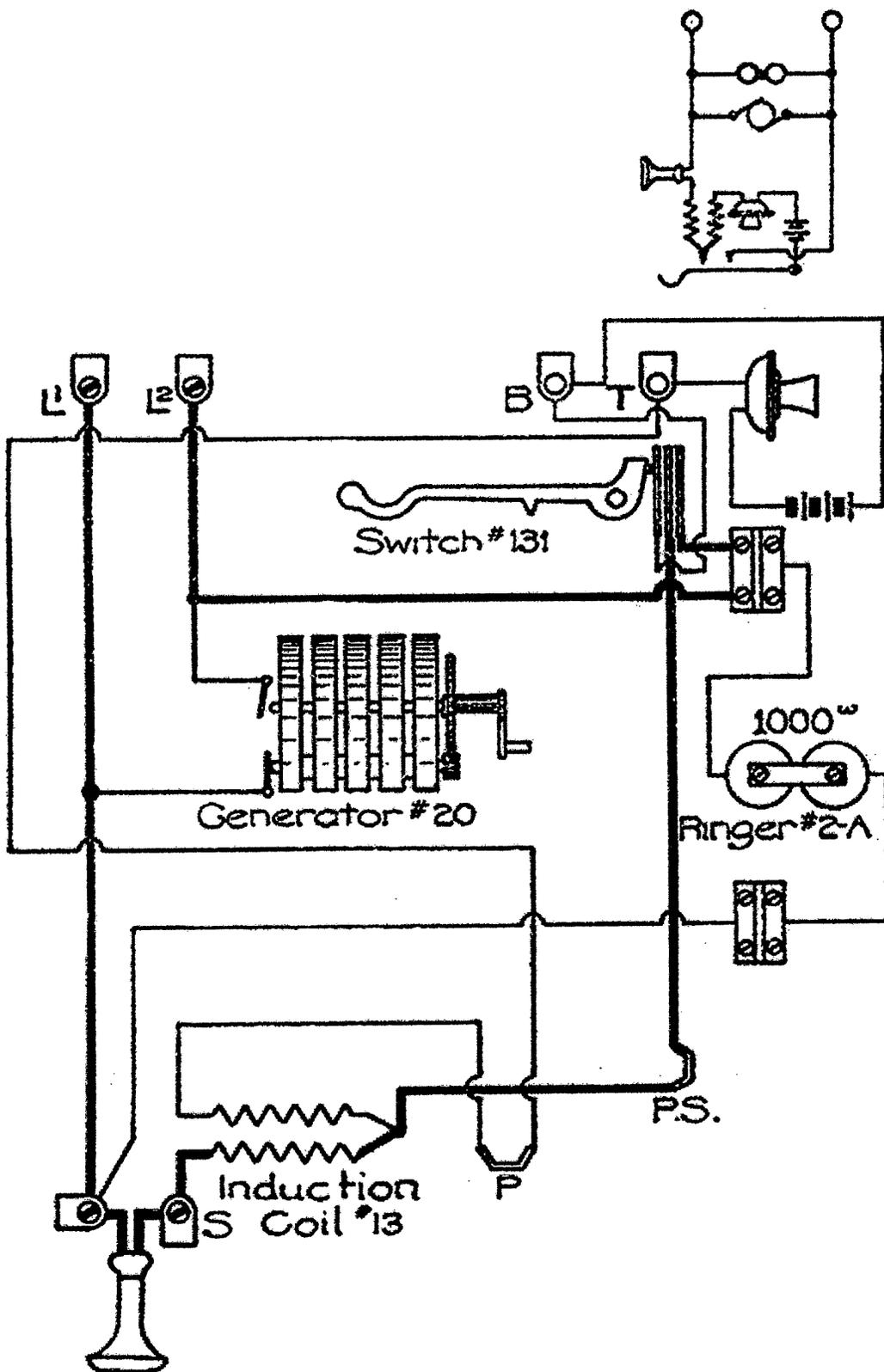
Local Battery No. 240-E
Detail Drawing of Set Connections



54-E-21

Subscribers' Sets.

Local Battery No. 252-A.
Detail Drawing of Set Connections.

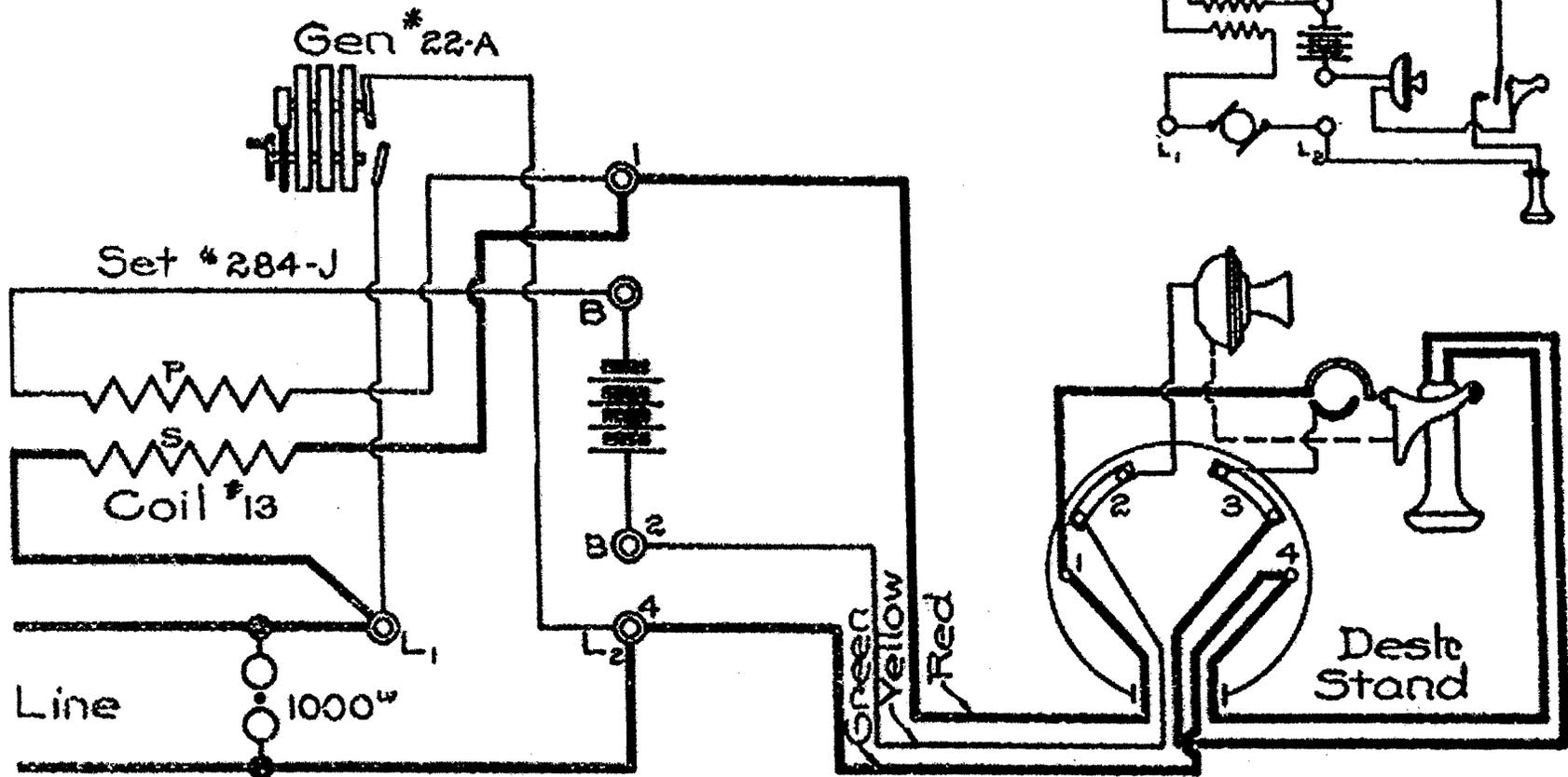


54-E-9

SUBSCRIBERS SETS

Local Battery No 284-J
Detail Drawing of Set Connections
When Used with Desk Stand.

57-E-13



SECTION FOUR

MISCELLANEOUS

Cord Connections for No. 10 Type Desk Stands Showing New and Old Markings of Terminals and New and Old Colors of Cords.

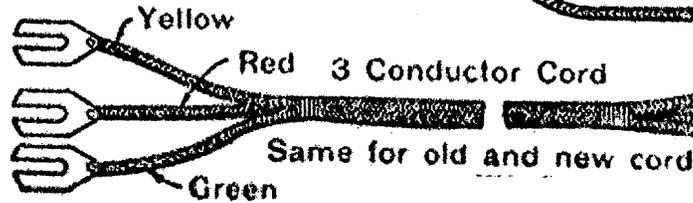
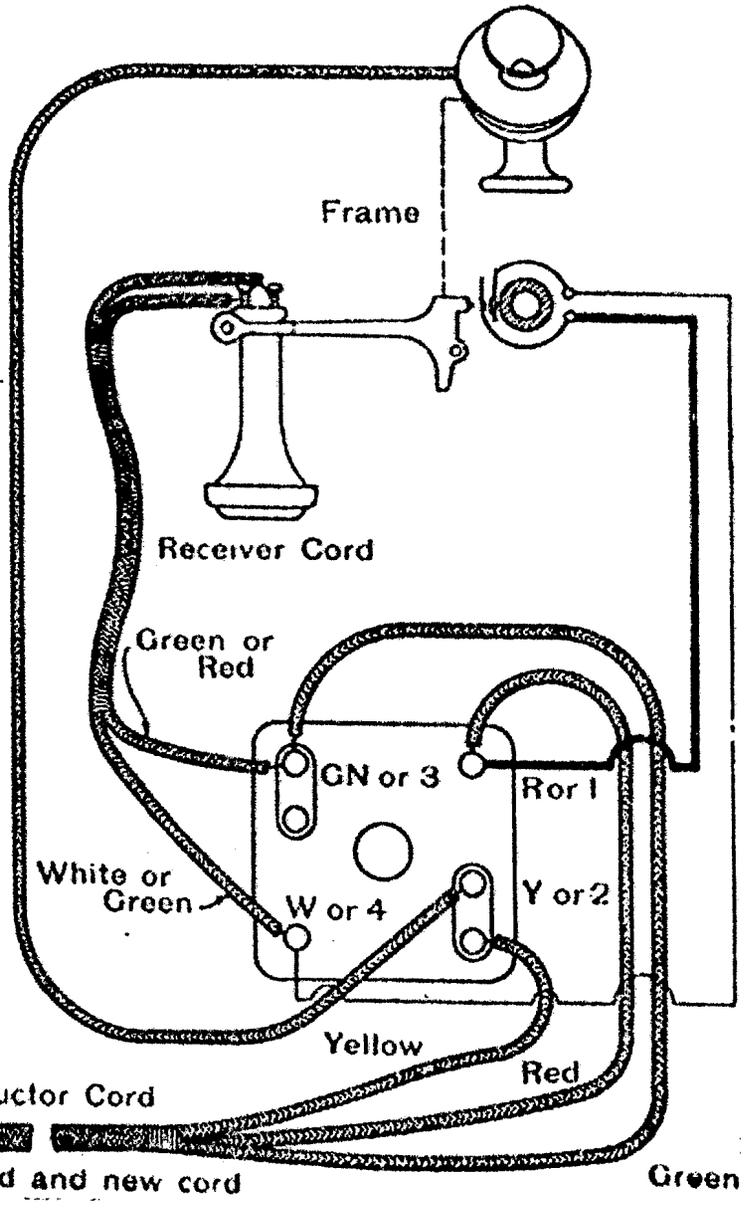
Transmitter Cord
Yellow or Green

New markings for cord terminals are letters "GN", "R", "W", "Y."

Old markings for cord terminals are numbers "3", "1", "4", "2."

Connections at Desk Stand	New Cord	Old Cord
Transmitter cord to "Y" or "2"	Yellow	Green
Receiver cord to ("GN" or "3") ("W" or "4")	Green White	Red Green
3 conductor cord to ("R" or "1") ("Y" or "2") ("GN" or "3")	Red Yellow Green	Red Yellow Green

For connection at set end, see plate 89-E-85 for common battery, or plate 89-E-34 for local battery.



Cord Connections for No. 20 Type Desk Stand; Showing New and Old Markings of Terminals and New and Old Code Numbers and Colors of Cords.

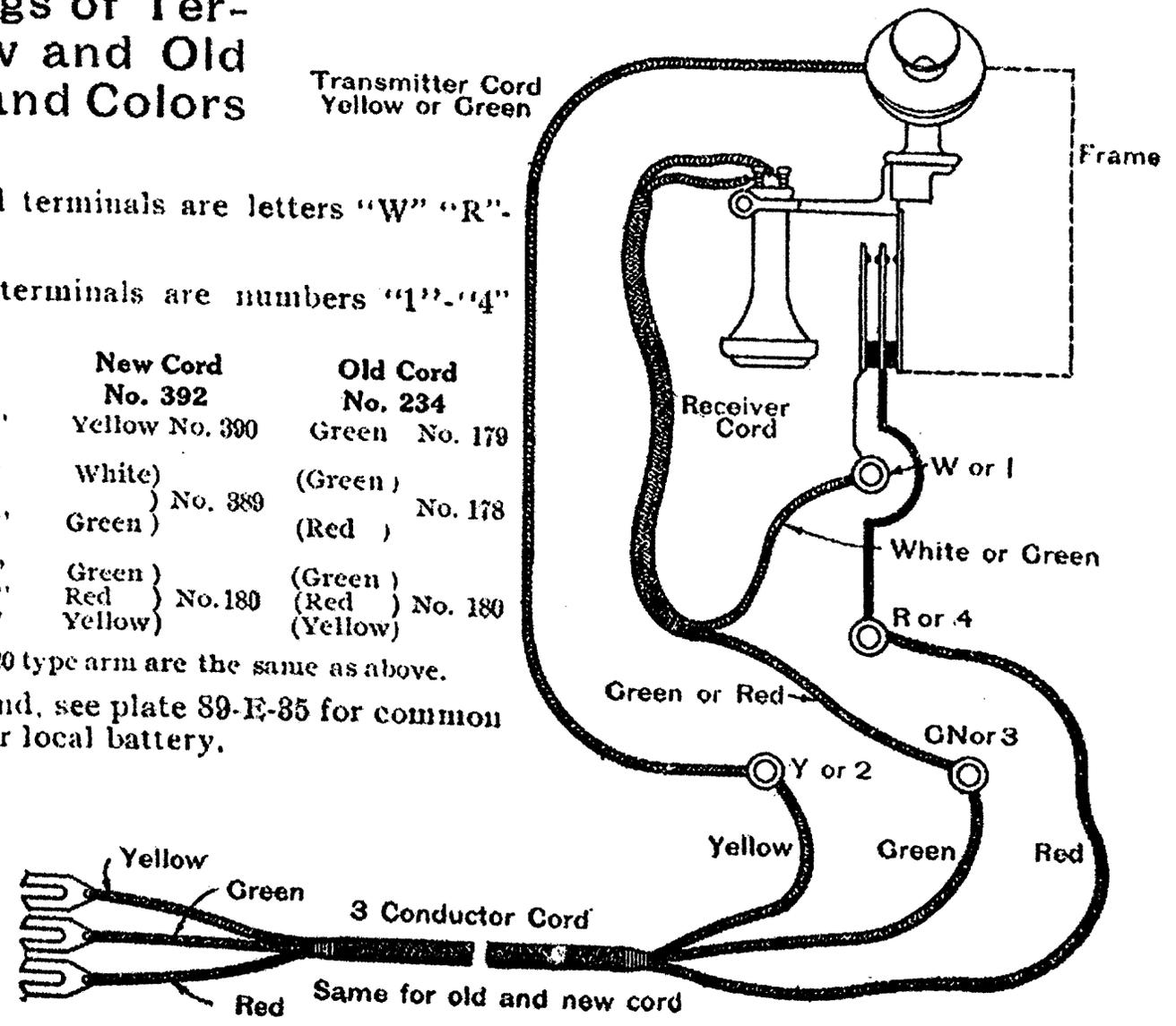
New markings for cord terminals are letters "W" "R" "Y" "GN."

Old markings for cord terminals are numbers "1" "4" "2" "3."

Connections at Desk Stand	New Cord No. 392	Old Cord No. 234
Transmitter cord to "Y" or "2"	Yellow No. 390	Green No. 179
Receiver cord to ("W" or "1")	White) No. 389	(Green) No. 178
	Green)	(Red)
B Conductor cord to ("GN" or "3")	Green)	(Green)
	Red) No. 180	(Red) No. 180
	Yellow)	(Yellow)

NOTE—Connections for No. 20 type arm are the same as above.

For connection at set end, see plate 89-F-35 for common battery or plate 89-F-34 for local battery.



40

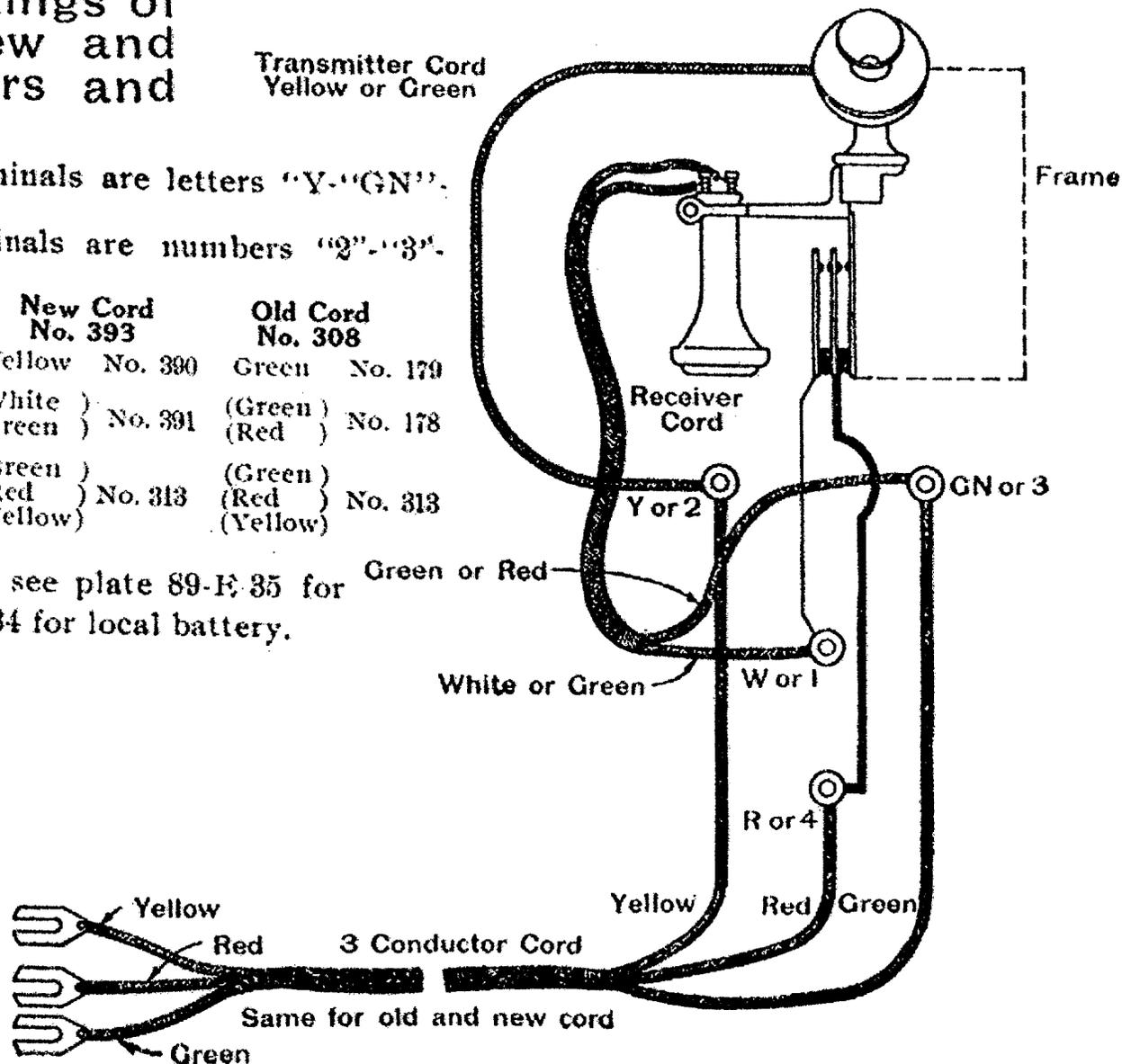
Cord Connections for No. 40 Type Transmitter Arm, Showing New and Old Markings of Terminals and New and Old Code Numbers and Colors of Cords.

New markings of cord terminals are letters "Y," "GN", "W", "R."

Old markings of cord terminals are numbers "2", "3", "1", "4."

Connections at arm	New Cord No. 393	Old Cord No. 308
Transmitter cord to "Y" or "2"	Yellow No. 390	Green No. 179
Receiver cord to ("W" or "1" ("GN" or "3"	White } No. 391 Green }	(Green) No. 178 (Red)
3 Conductor cord to ("GN" or "3" ("R" or "4" ("Y" or "2"	Green } No. 313 Red } Yellow }	(Green) No. 313 (Red) (Yellow)

For connection at set end, see plate 89-E-35 for common battery or plate 89-E-34 for local battery.



Cord Connections for Common Battery Sets Used with Desk Stands or Transmitter Arms Showing New and Old Markings of Cord Terminals.

New markings for cord terminals are "R"- "GN"- "Y."

Old markings for cord terminals are "2"- "4"- "L2."

Three conductor cord should be connected as follows :

Red conductor to "R" or "2."

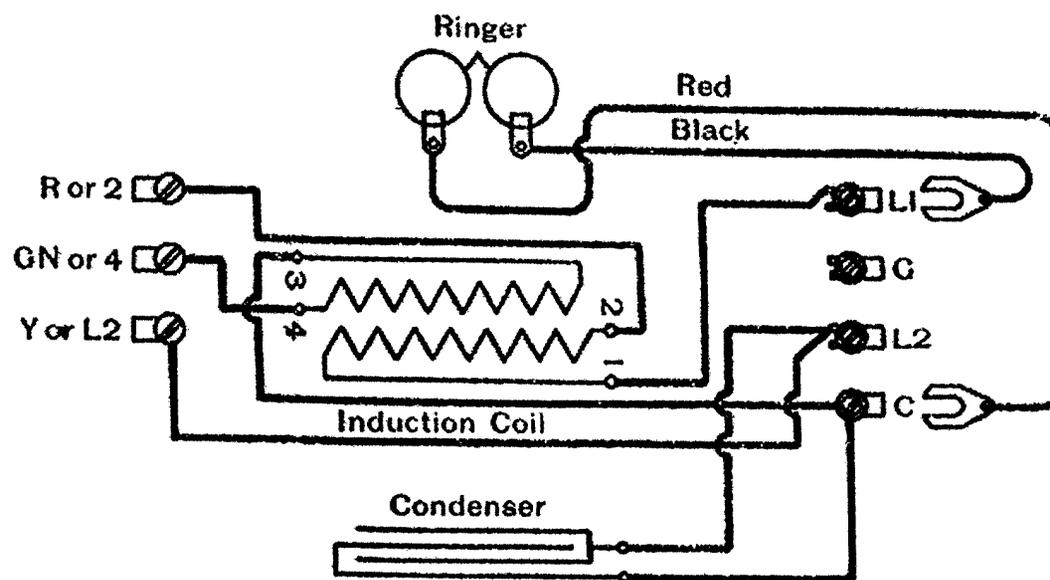
Green conductor to "GN" or "4"

Yellow conductor to "Y" or "L2."

For side-tone reduction reverse red and yellow conductors. This should only be done in cases where there is annoyance from noise or side tone

For connection at desk stand or transmitter arm end see plates No. 89-E-30, No. 89-E-31 or No. 89-E-32.

In some of the older types the cord terminals are not grouped or marked as shown and in these cases the circuit as above should be followed.



Cord Connections for Sets, with Common Battery Signaling and Local Battery Talking, Used with Desk Stands or Transmitter Arms; Showing New and Old Markings of Cord Terminals.

New markings for cord terminals are "R", "GN", "Y."

Old markings for cord terminals are "PS", "L2", "P."

Three conductor cord should be connected as follows:

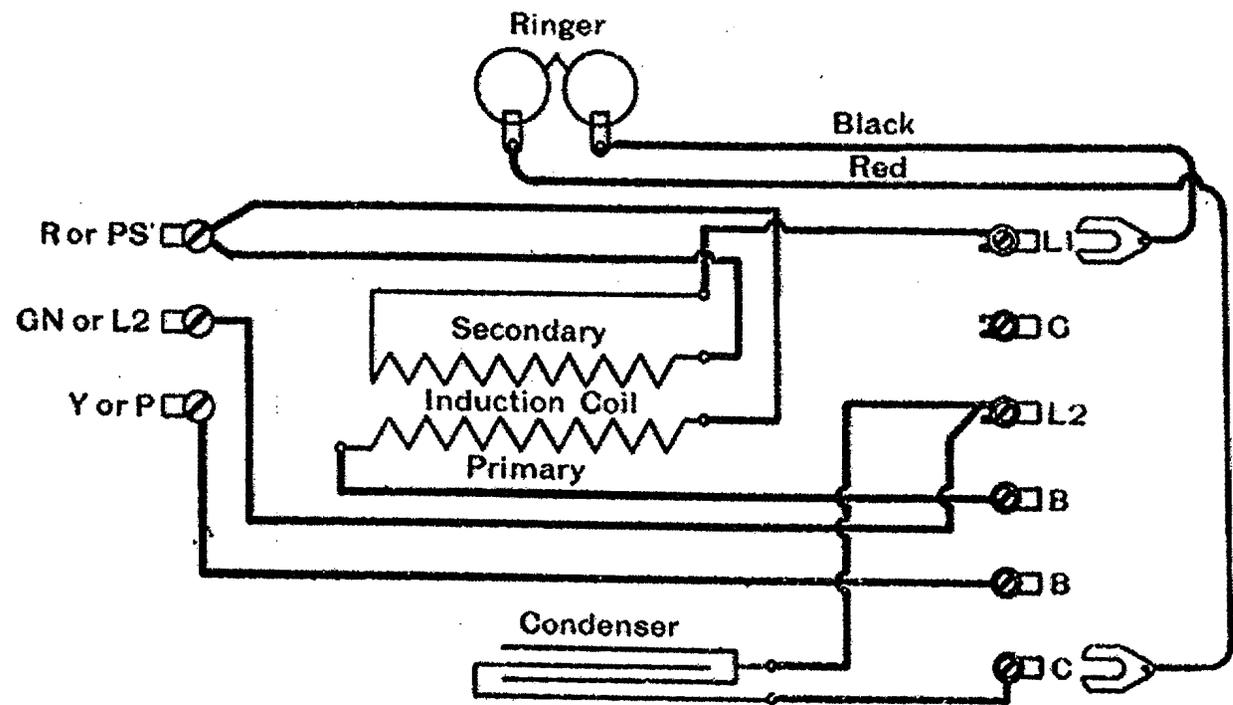
Red conductor to "R" or "PS."

Green conductor to "GN" or "L2."

Yellow conductor to "Y" or "P."

For connection at desk stand or transmitter arm end see plates 89-E-30; 89-E-31 or 89-E-32.

In some of the older types the cord terminals are not grouped or marked as shown and in these cases the circuit as above should be followed.



Cord Connections for Local Battery Sets Used with Desk Stands or Transmitter Arms, Showing New and Old Markings of Cord Terminals.

New markings for cord terminals are "R."
"GN"-"Y."

Old markings for cord terminals are "PS".
"L2"-"P."

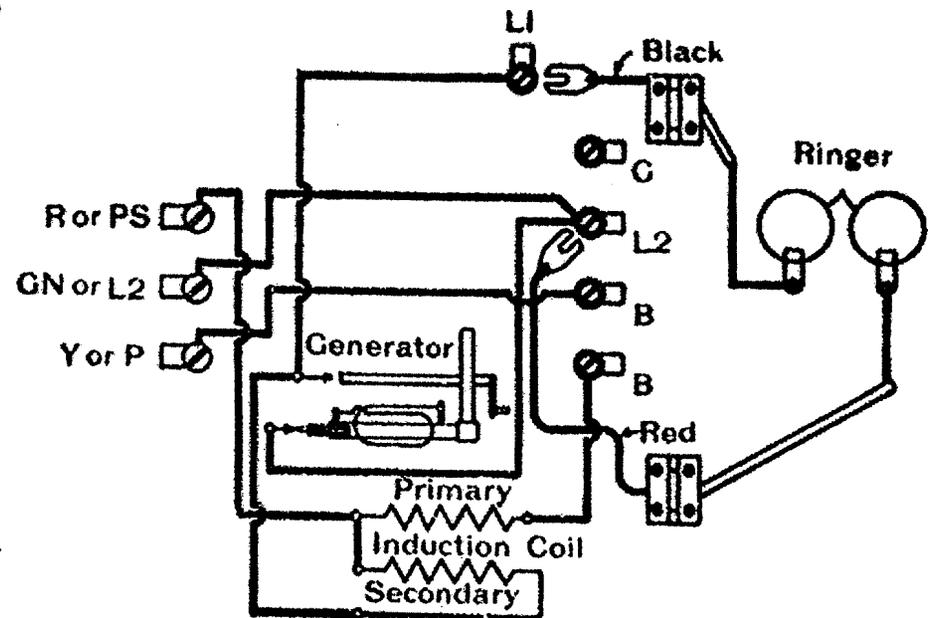
Three conductor cord should be connected as follows :

Red conductor to "R" or "PS."

Green conductor to "GN" or "L2."

Yellow conductor to "Y" or "P."

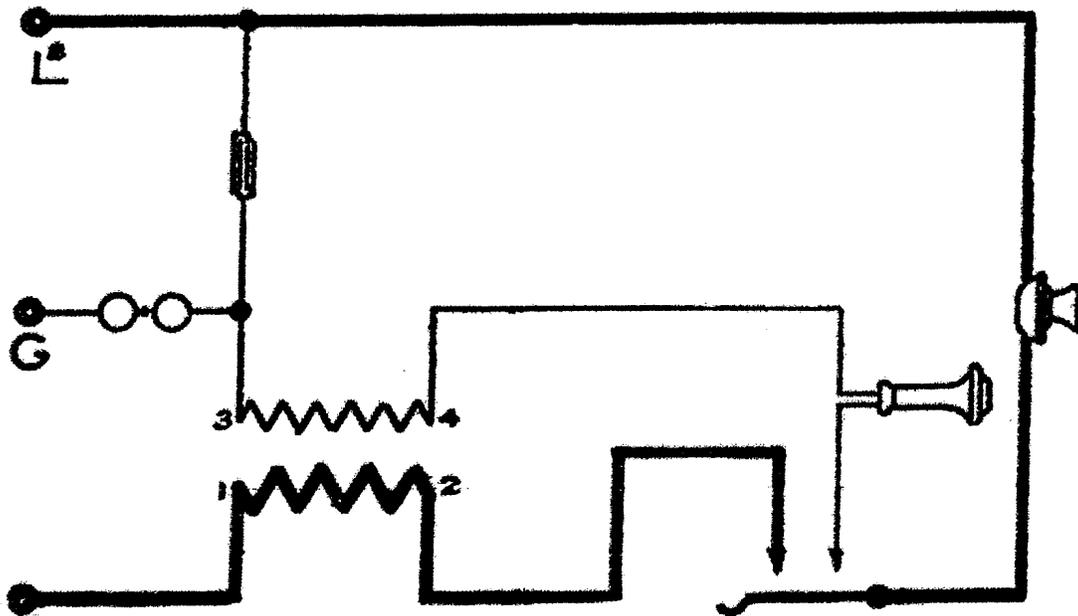
For connection at desk stand or transmitter arm end, see plates 89-E-30; 89 E-31 or 89 E-32.



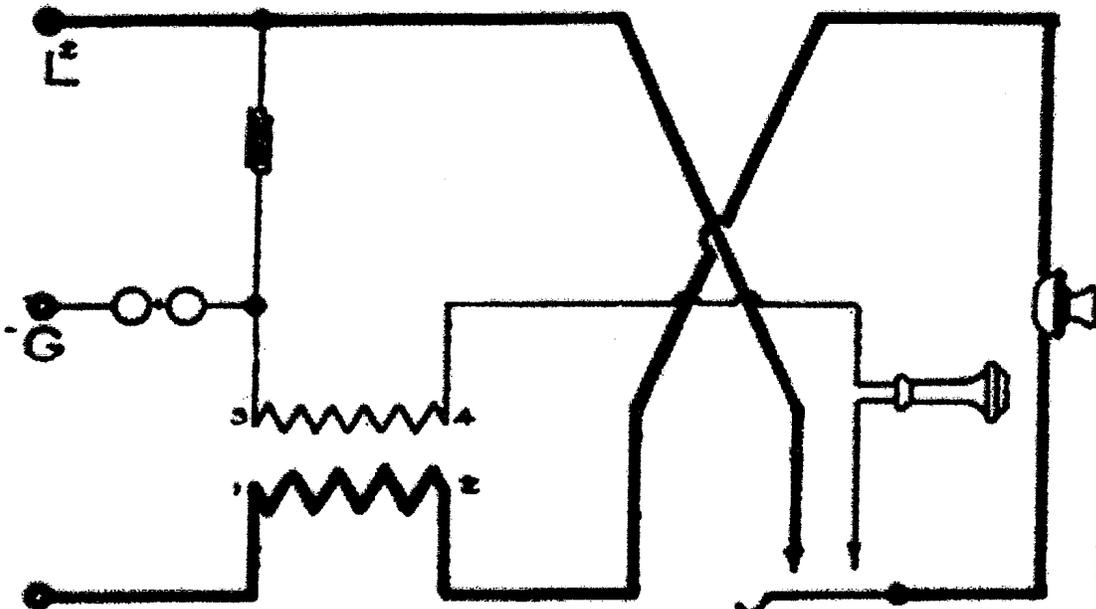
In some of the older types the cord terminals are not grouped or marked as shown, and in these cases the circuit as above should be followed.

Subscribers' Sets.

Diagram showing change in Standard Common Battery Substation Circuit to obtain Side Tone Reduction Circuit.



L^1 Standard Common Battery Substation Circuit.

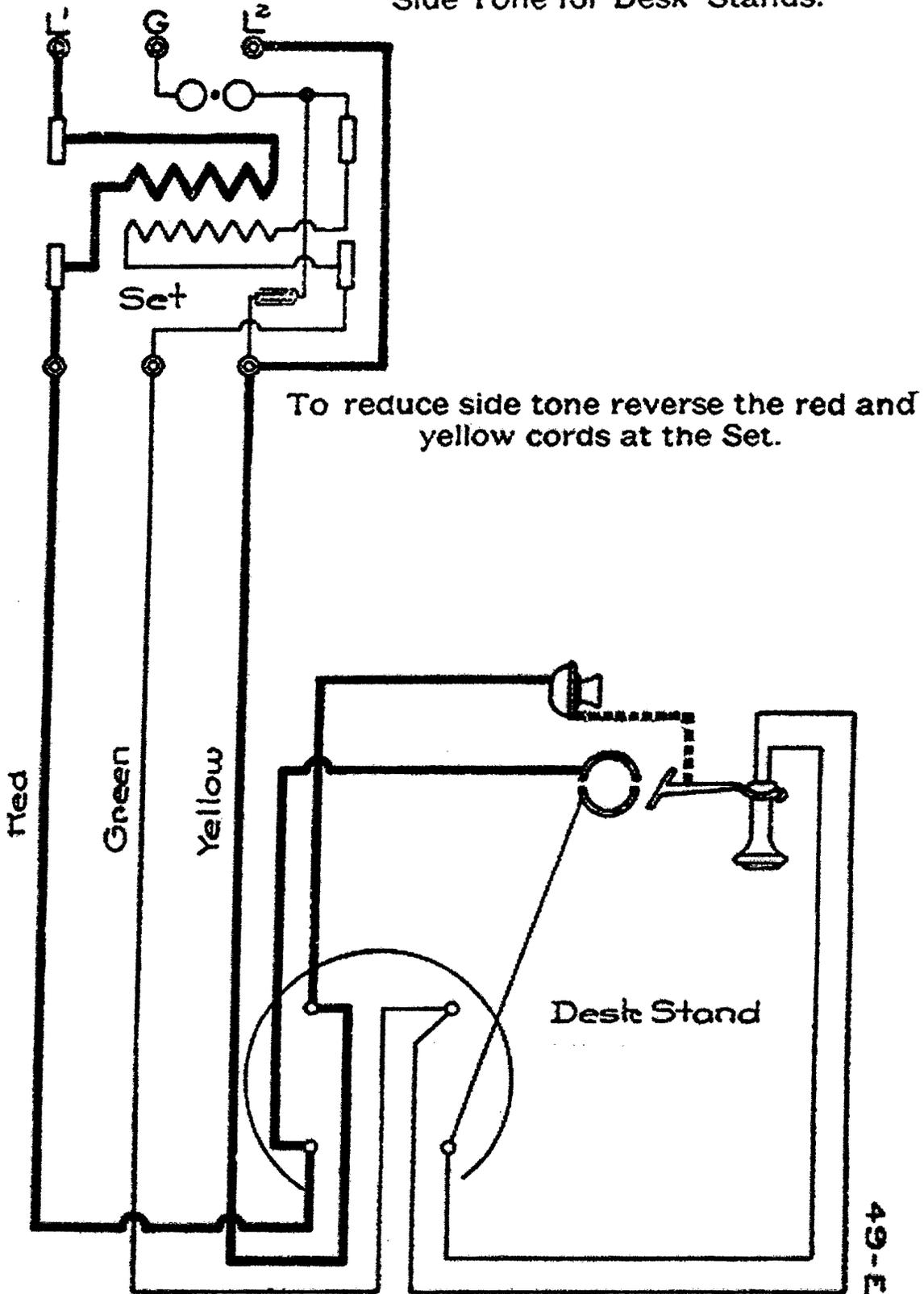


Side Tone Reduction Circuit.

49-E-26

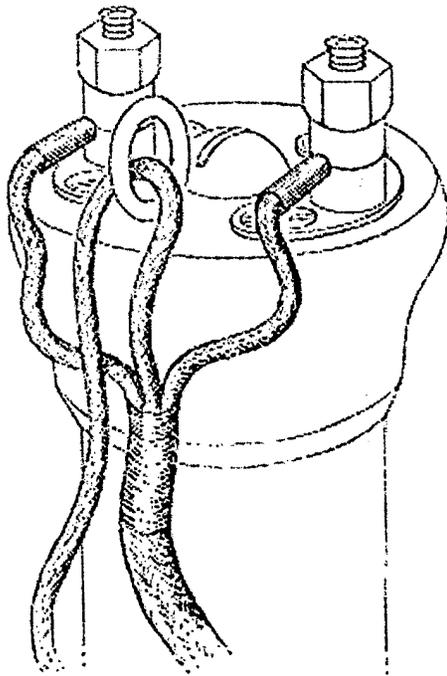
Subscribers' Sets.

Diagram showing method of Reducing Side Tone for Desk Stands.

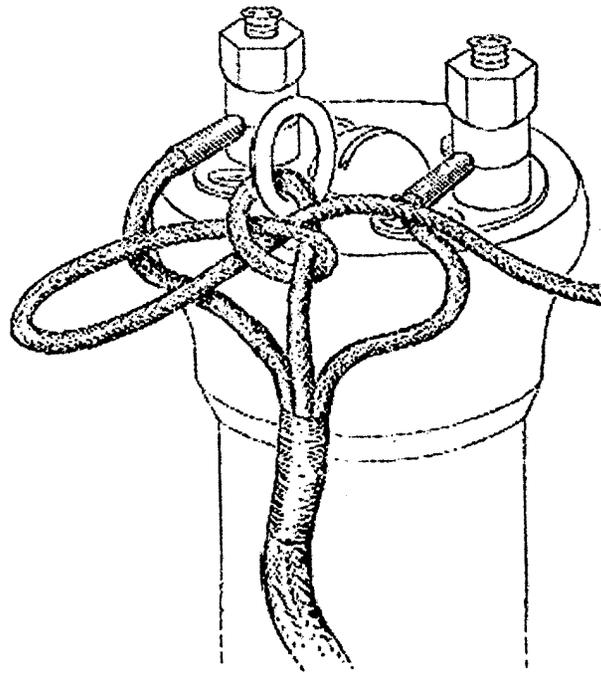


49-E-27

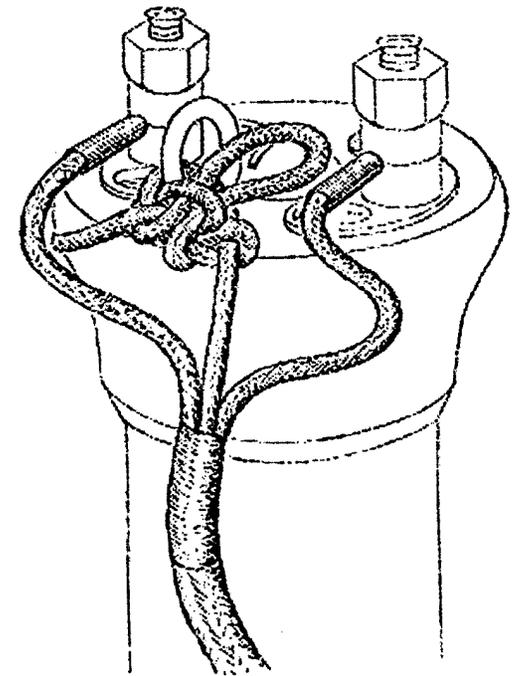
Method of Tying Cord to No. 122 Receiver



The Tie String shall be passed through the screw eye from right to left, to within about $\frac{1}{2}$ of the outer covering of the Receiver Cord.



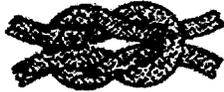
Make a single knot



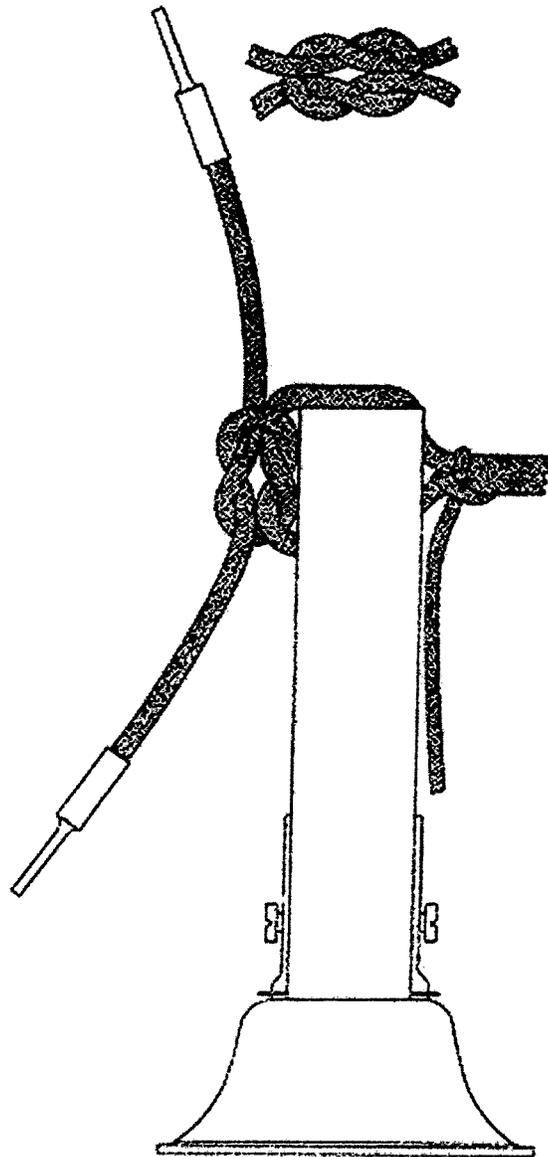
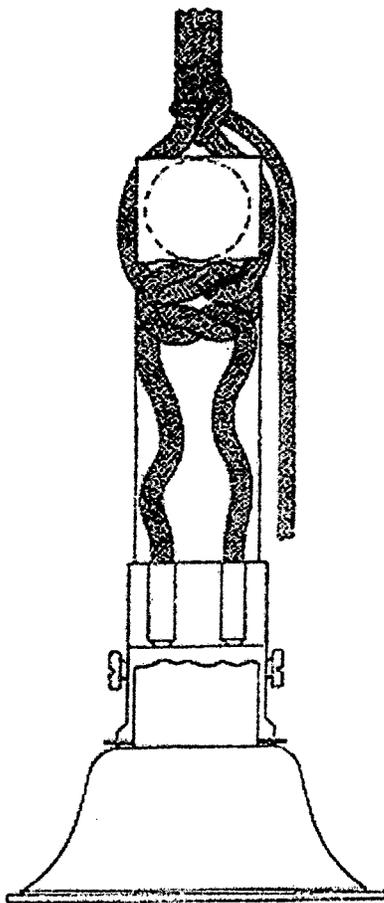
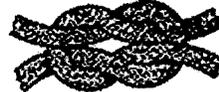
With the end of the Tie String and the loop, tie one single knot.

Method of Tying Cord to No. 144 Receiver

Square Knot
Correct Way



Granny Knot
Wrong Way



Pass conductors one on each side of heel piece and tie with square knot, see correct way, turn knot between limbs of magnet and insert tips in binding posts.

Conductor ends should be $4\frac{1}{2}$ inches long, if less pull the conductors out from under braid binding them together.