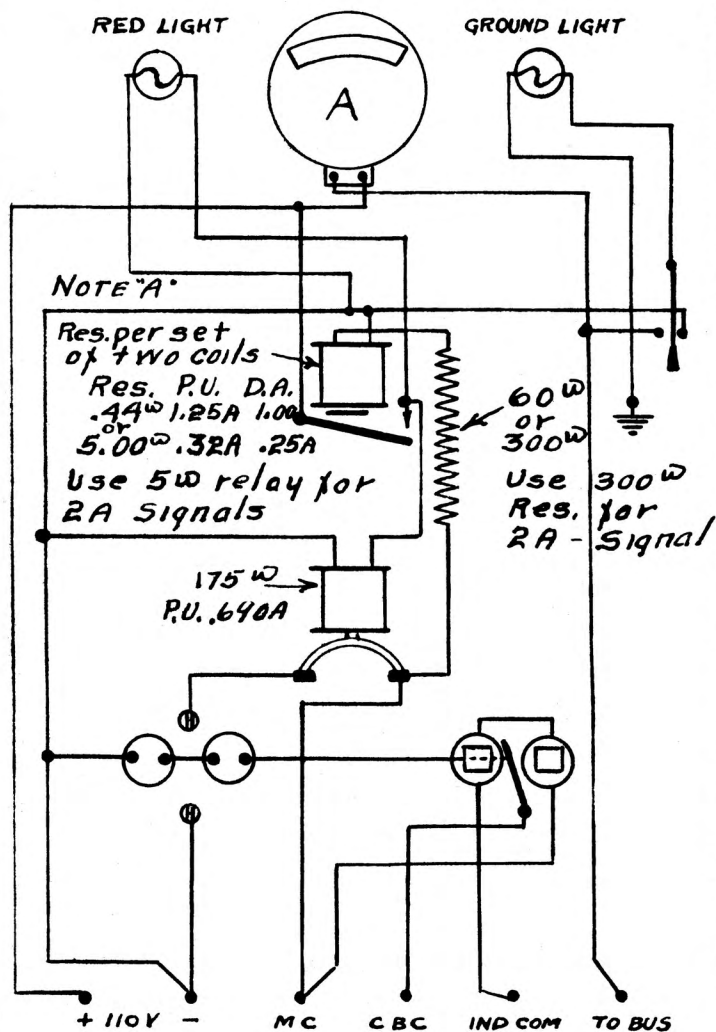


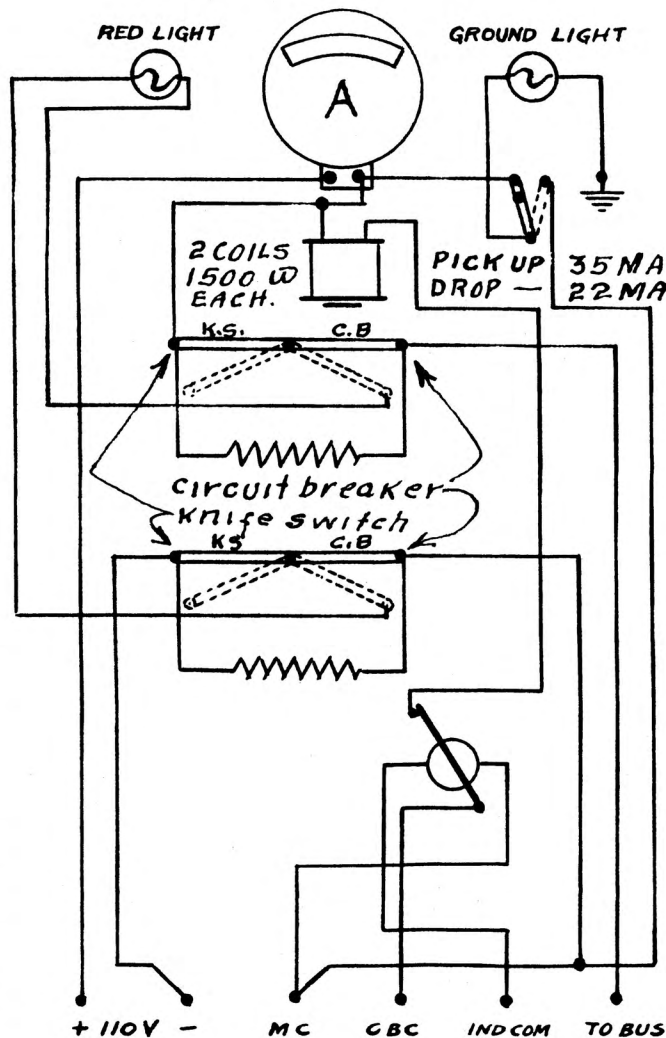
TYPICAL CIRCUITS

CIRCUITS OF THE THREE MOST USED OPERATING SWITCHBOARDS IN CHICAGO TERMINAL

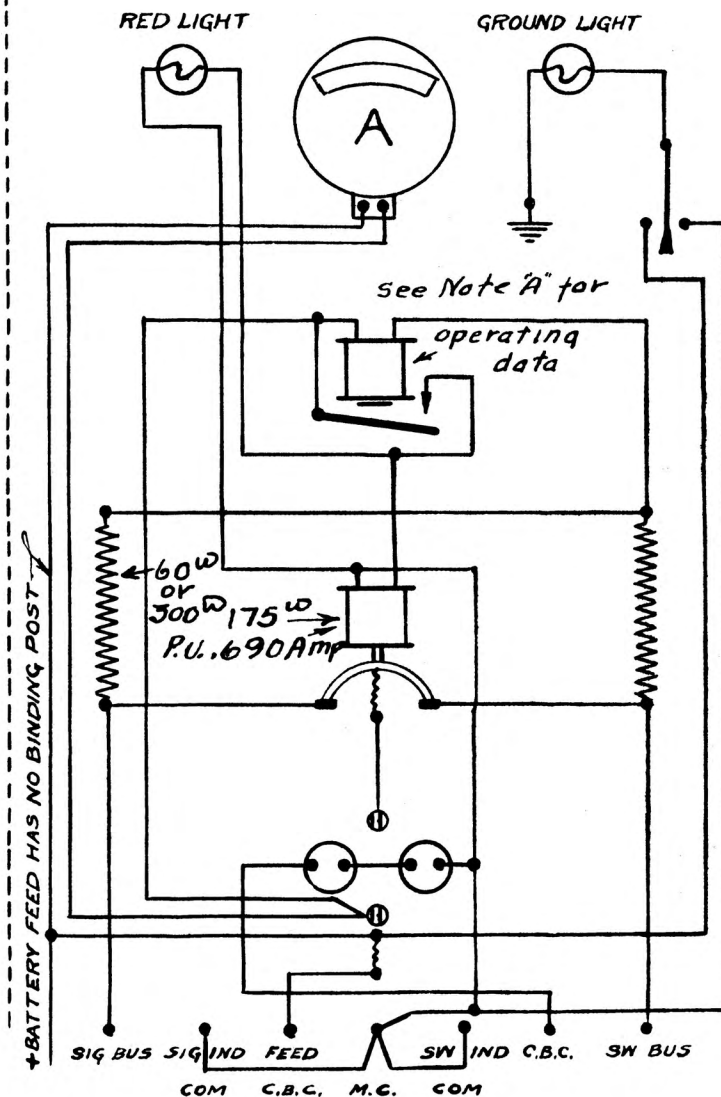


CLINTON ST. CARPENTER ST
DIVISION ST. MAIN ST. NOBLE ST.

Red light indicates that breaker is open.

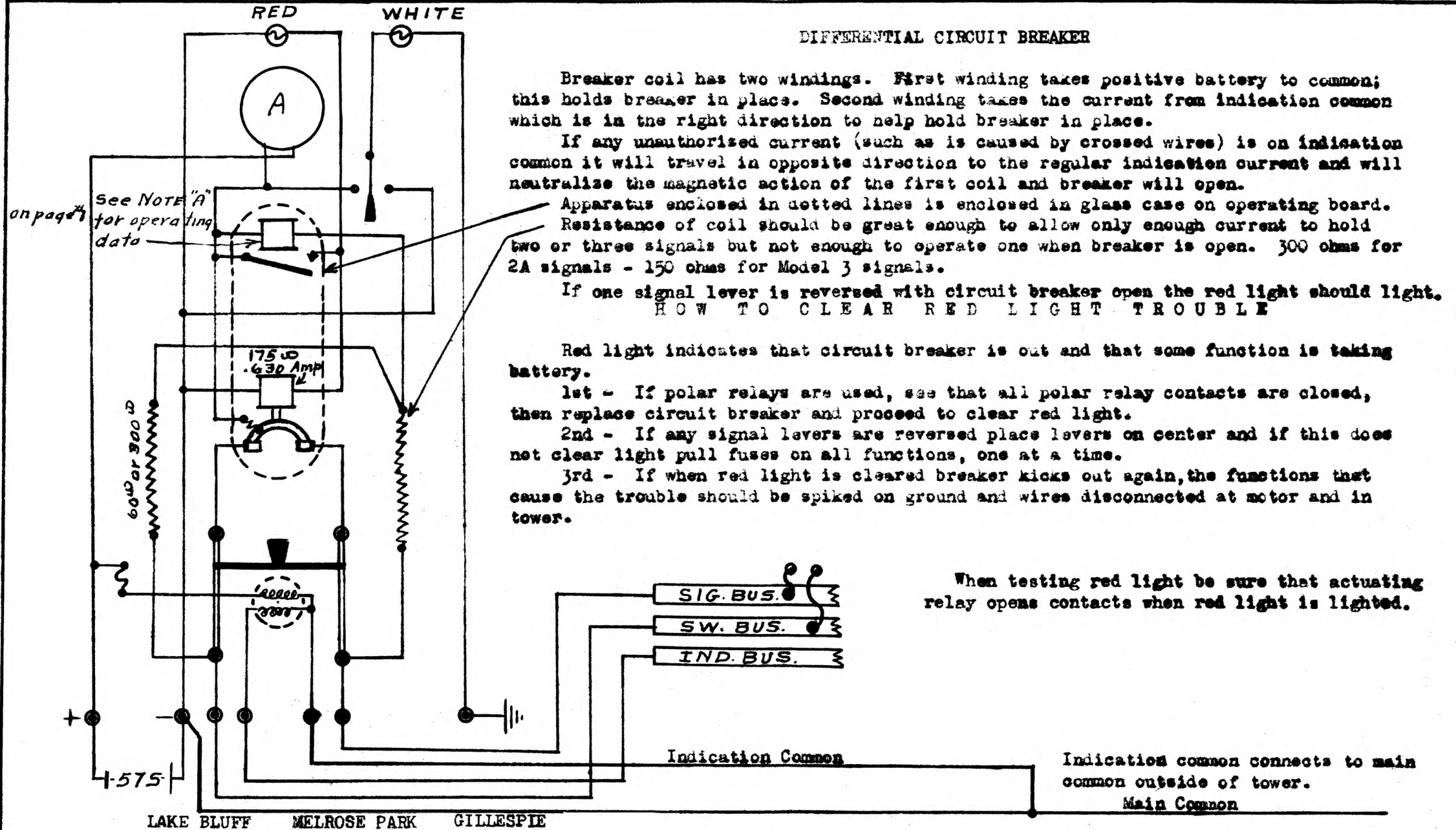


LAKE ST. HUNTING AVE. DEERING
ILLINOIS RIVER DRAWBRIDGE

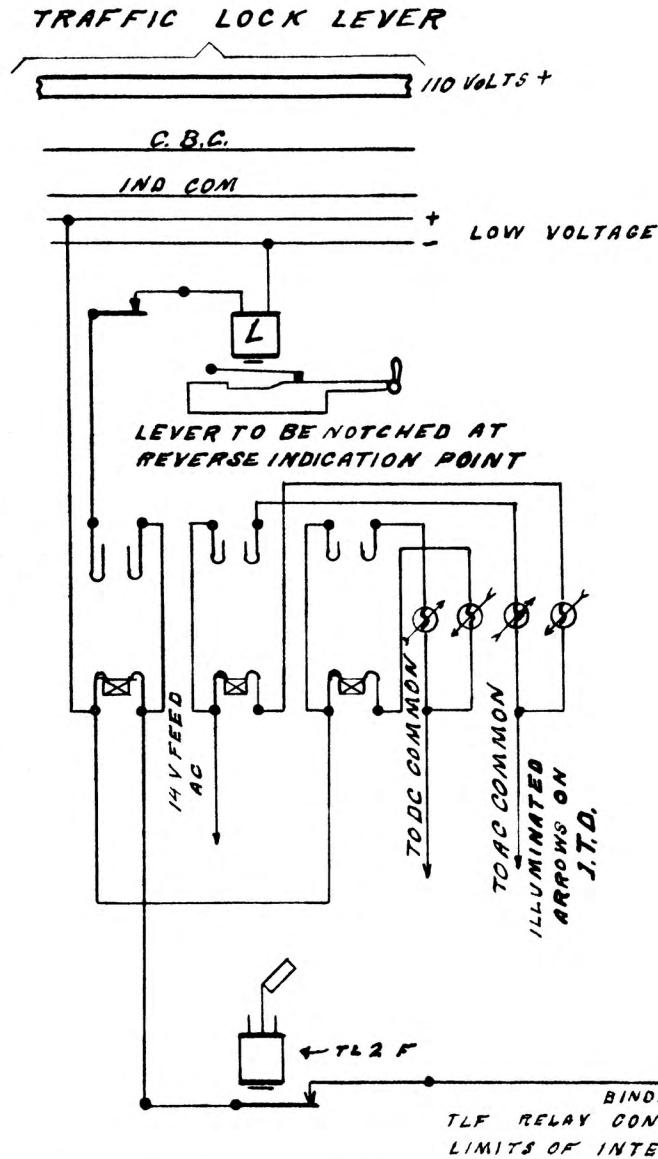


MAYFAIR KEDZIE AVE

DIFFERENTIAL CIRCUIT BREAKER



TYPICAL CIRCUIT FOR TRAFFIC LOCK LEVERS

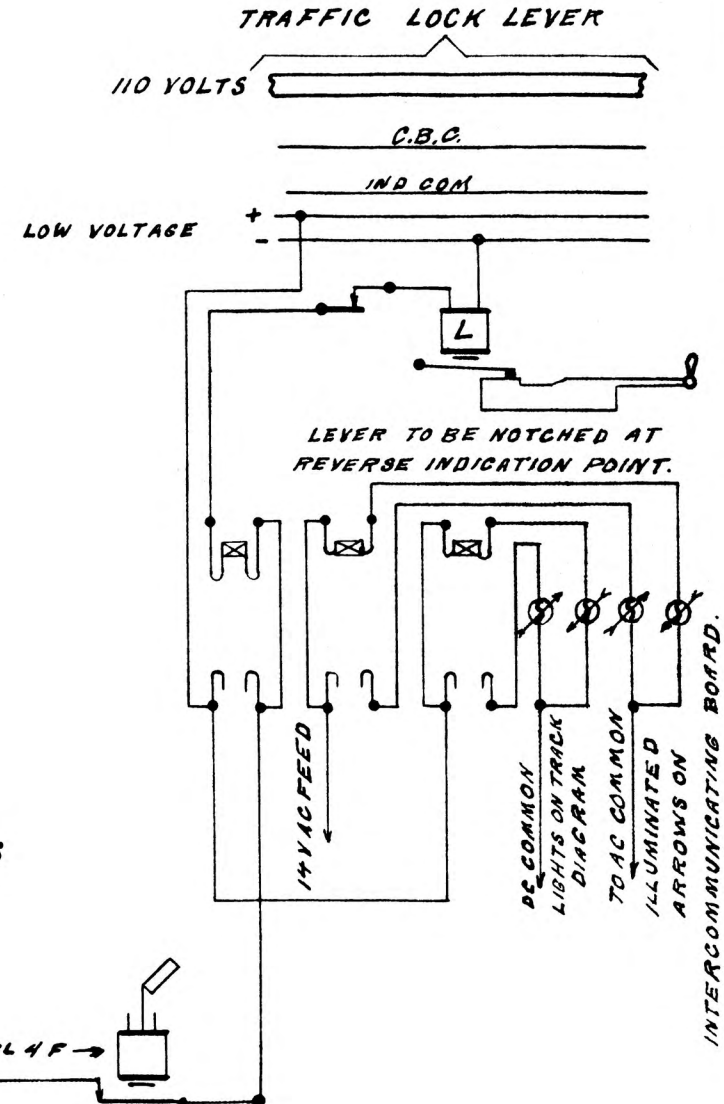


TRAFFIC LOCK LEVER IS LOCKED
REVERSE BY ALL OUTBOUND SIGNALS.

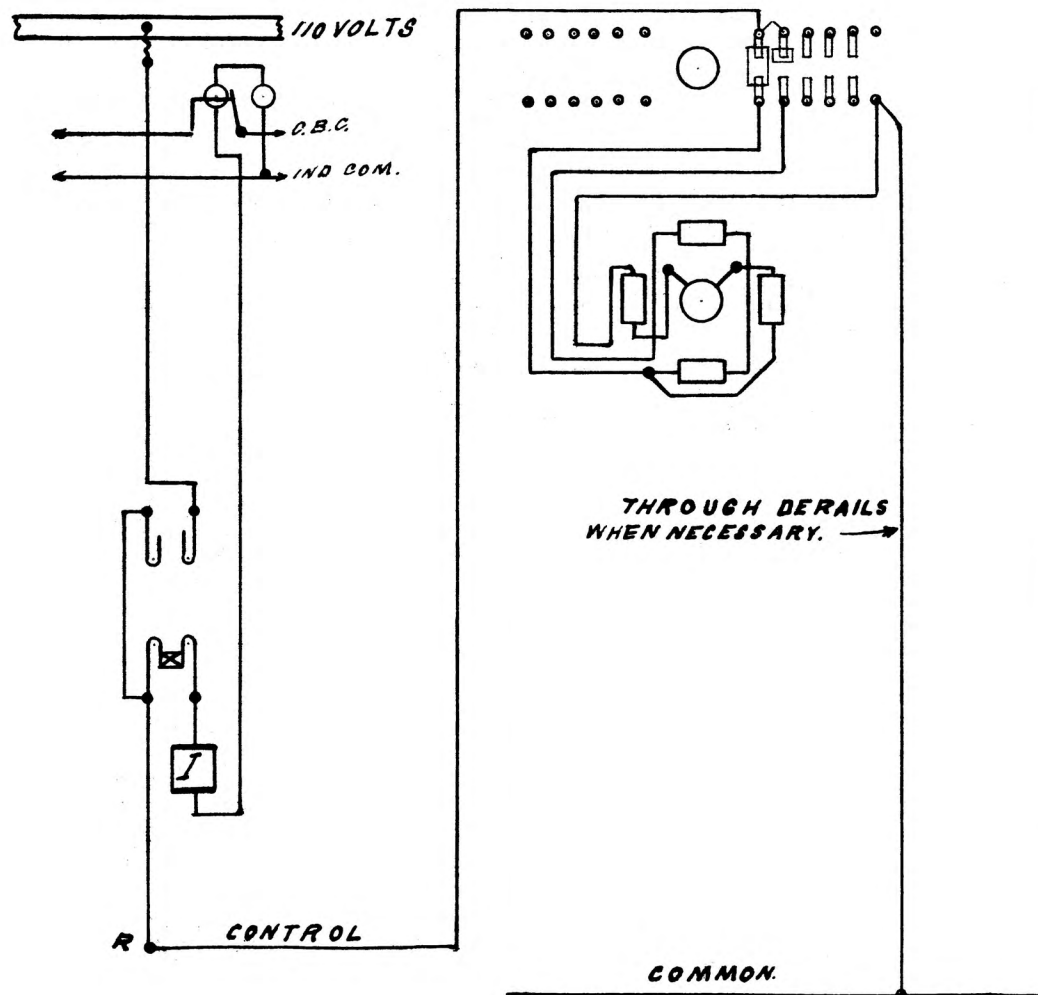
TRACK LINED UP

ALL EXCEPT THE TL OPERATING WIRES
MAY BE ON COMBINATION BOARD

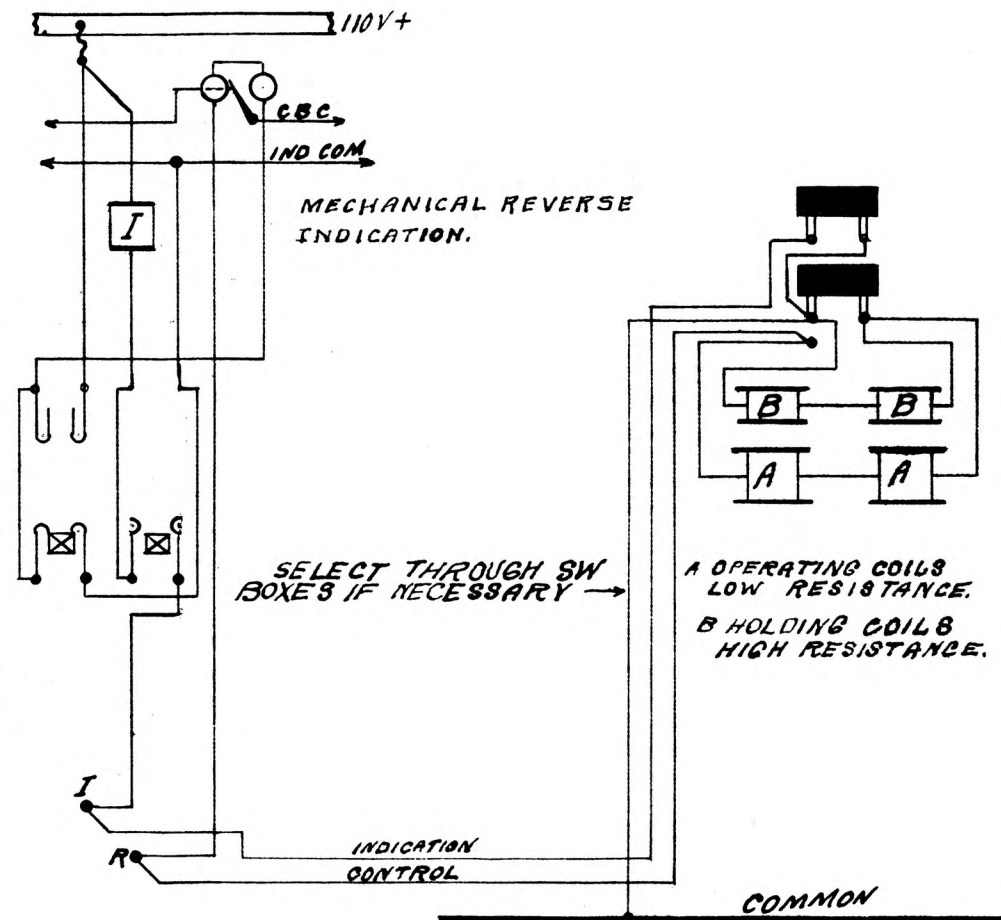
NOTE. THIS WIRE TO BE BROKEN THROUGH
FRONT POINT OF INTERMEDIATE TRACK
RELAYS IF ANY.



WIRING DIAGRAM FOR MODEL 2A TWO POSITION DWARF OR CALL-ON SIGNAL.



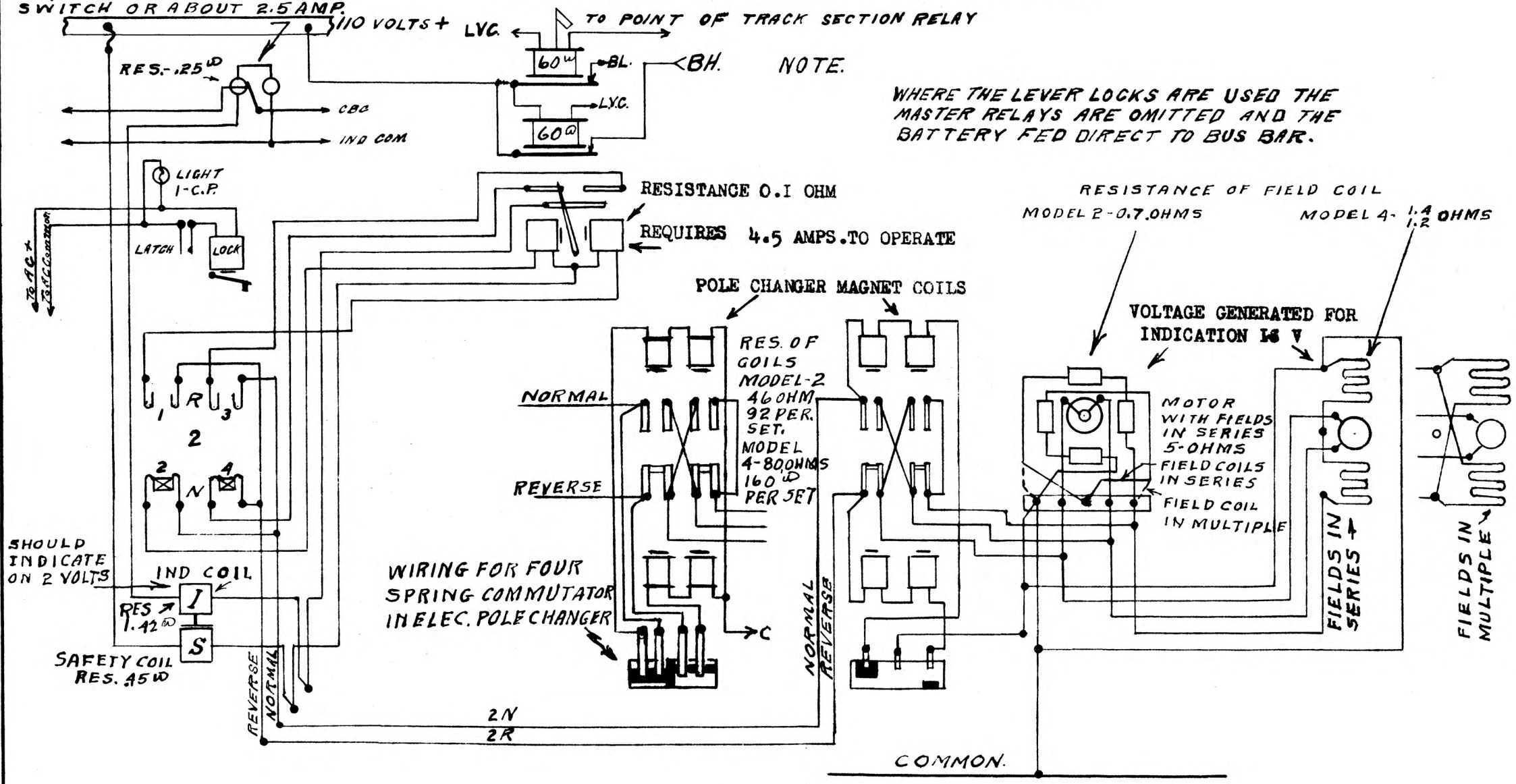
TYPICAL CIRCUIT COMPLETE FOR MODEL 2 DWARF SIGNAL.



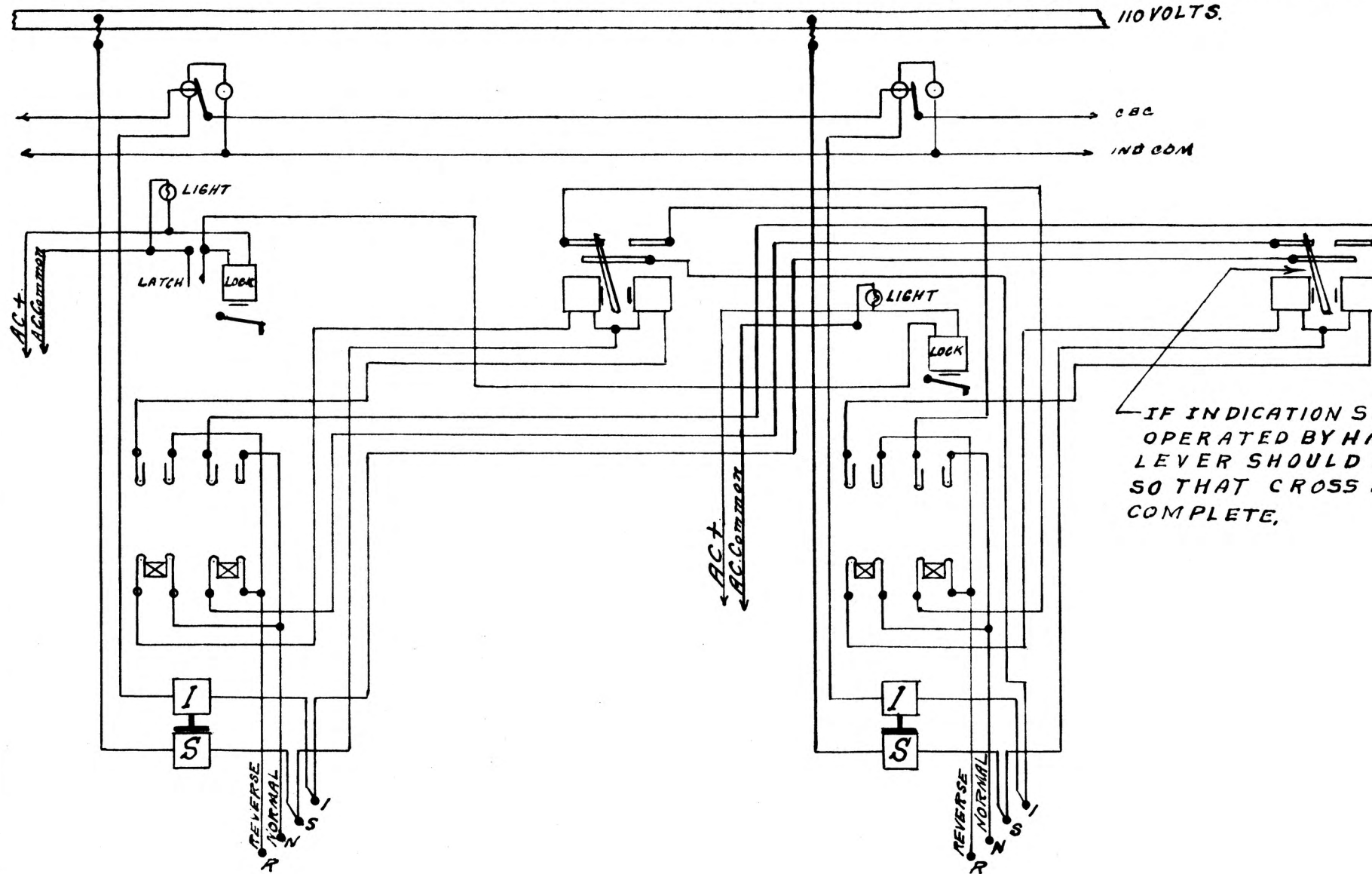
12/1

POLAR RELAY SHOULD REVERSE ON ONE HALF THE CURRENT REQUIRED TO JUST MOVE THE SWITCH OR ABOUT 2.5 AMP.

WIRING DIAGRAM FOR MODEL 2 SWITCH MACHINE. ALSO WIRING FOR MODEL 4 SWITCH MOTOR.

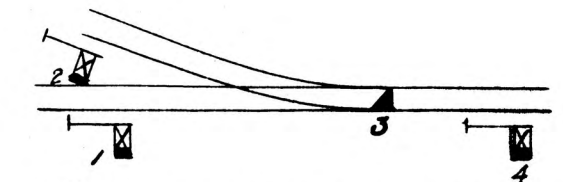
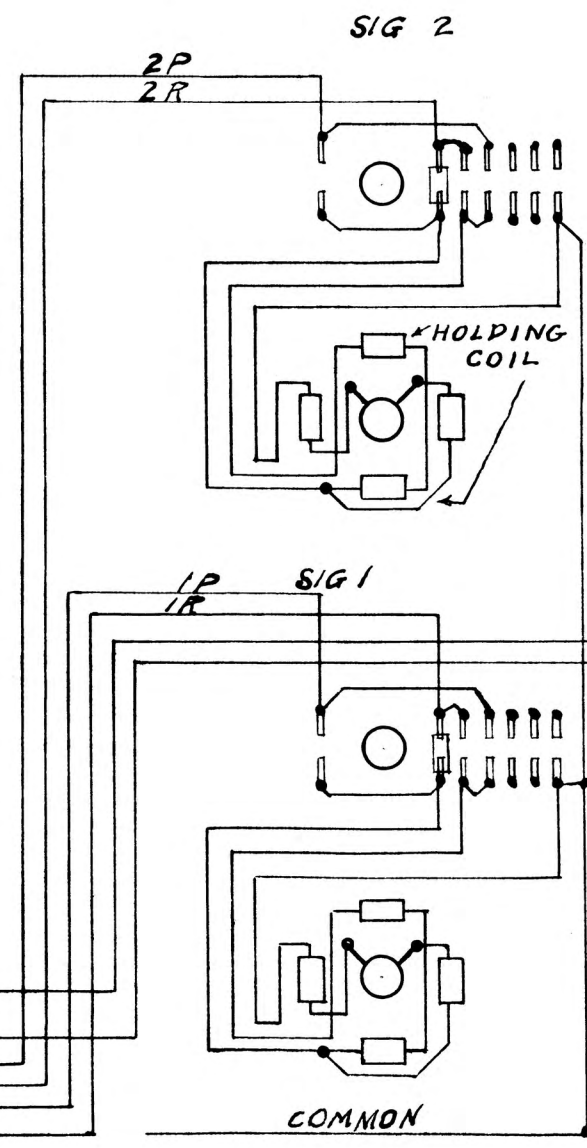
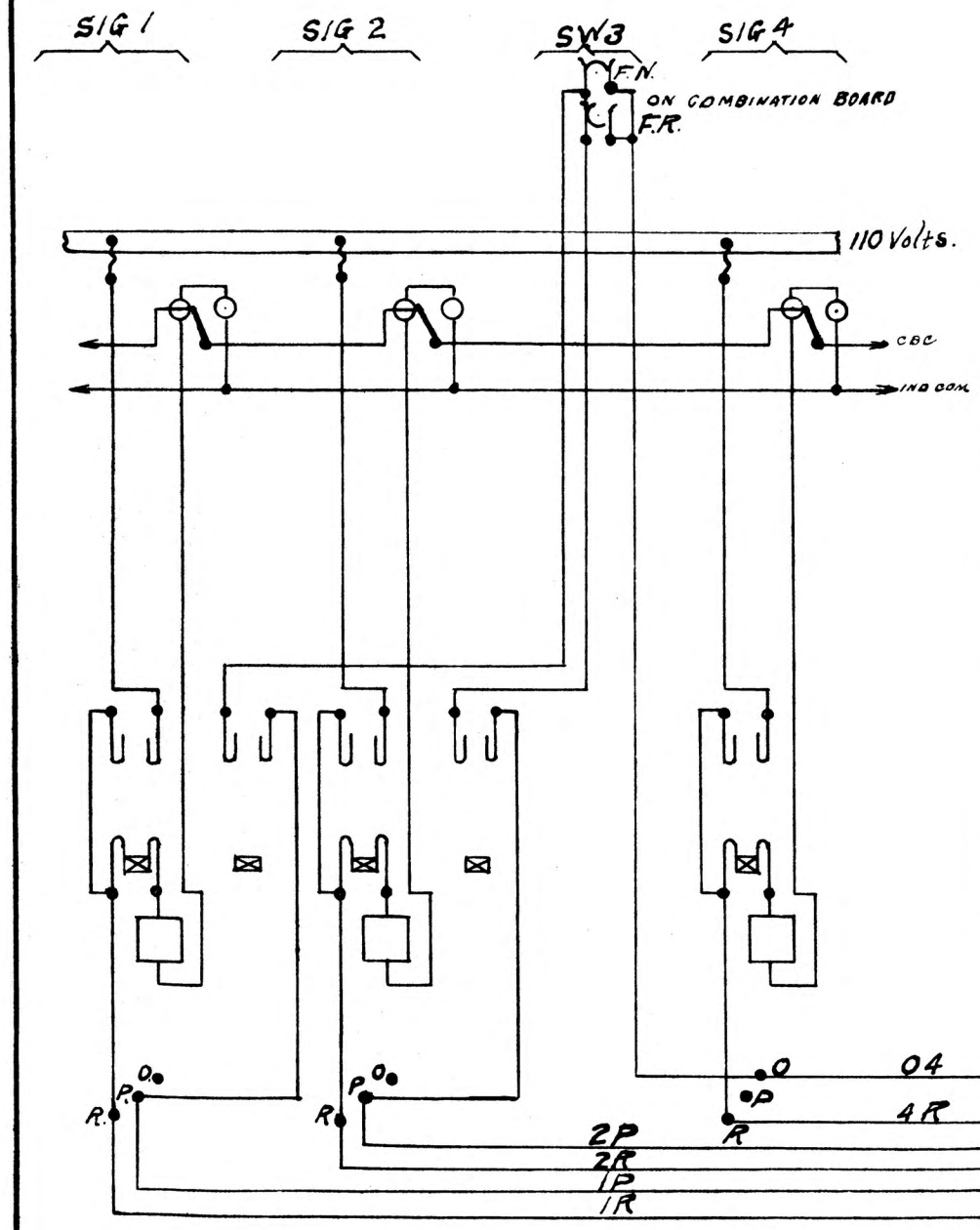


CROSS CONNECTED INDICATION WIRING FOR DOUBLE SWITCH LEVERS.

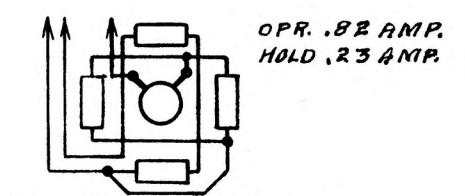


IF INDICATION SELECTOR SHOULD BE OPERATED BY HAND, THE SWITCH LEVER SHOULD BE OPERATED AT ONCE SO THAT CROSS PROTECTION WILL BE COMPLETE.

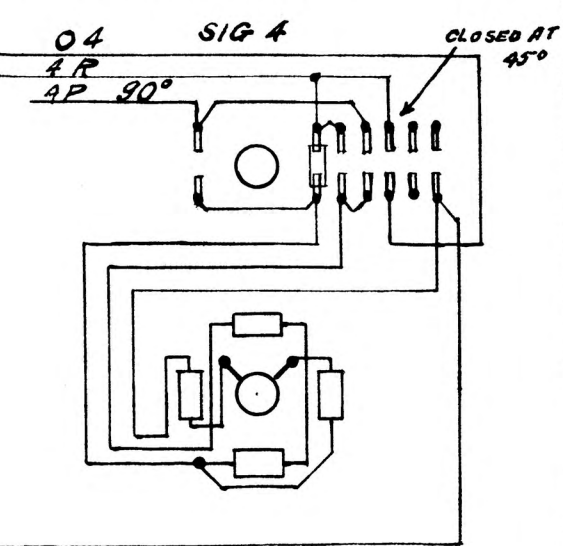
TYPICAL CIRCUIT FOR MODEL 2A-3 POSITION DWARF SIGNAL.
USED AT LAKE STREET.



90° POSITION OF LAST INBOUND
DWARF IS CONTROLLED BY TRACK
CIRCUIT OF TRAIN SHED.



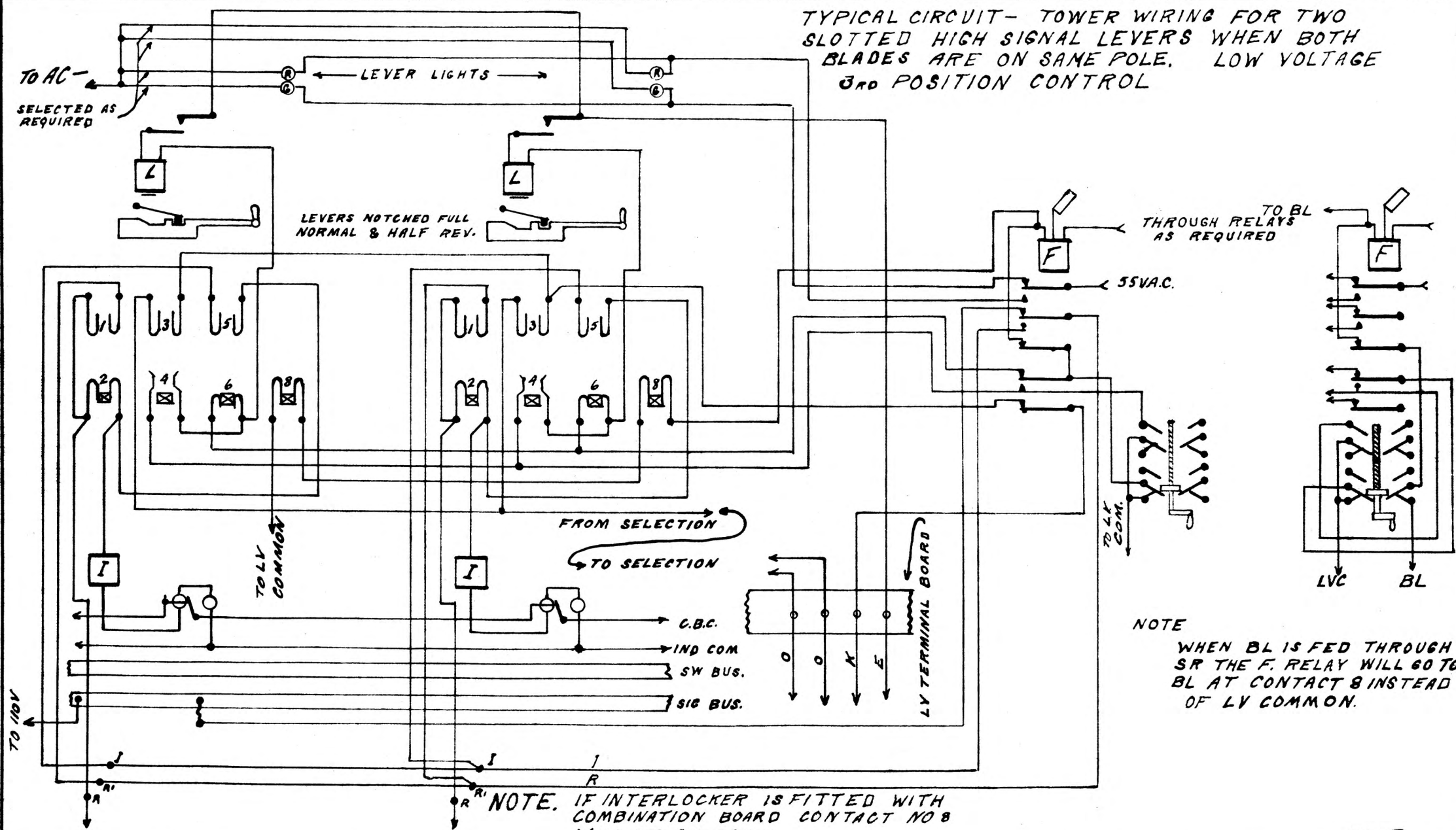
SPECIAL AT LAKE ST ONLY

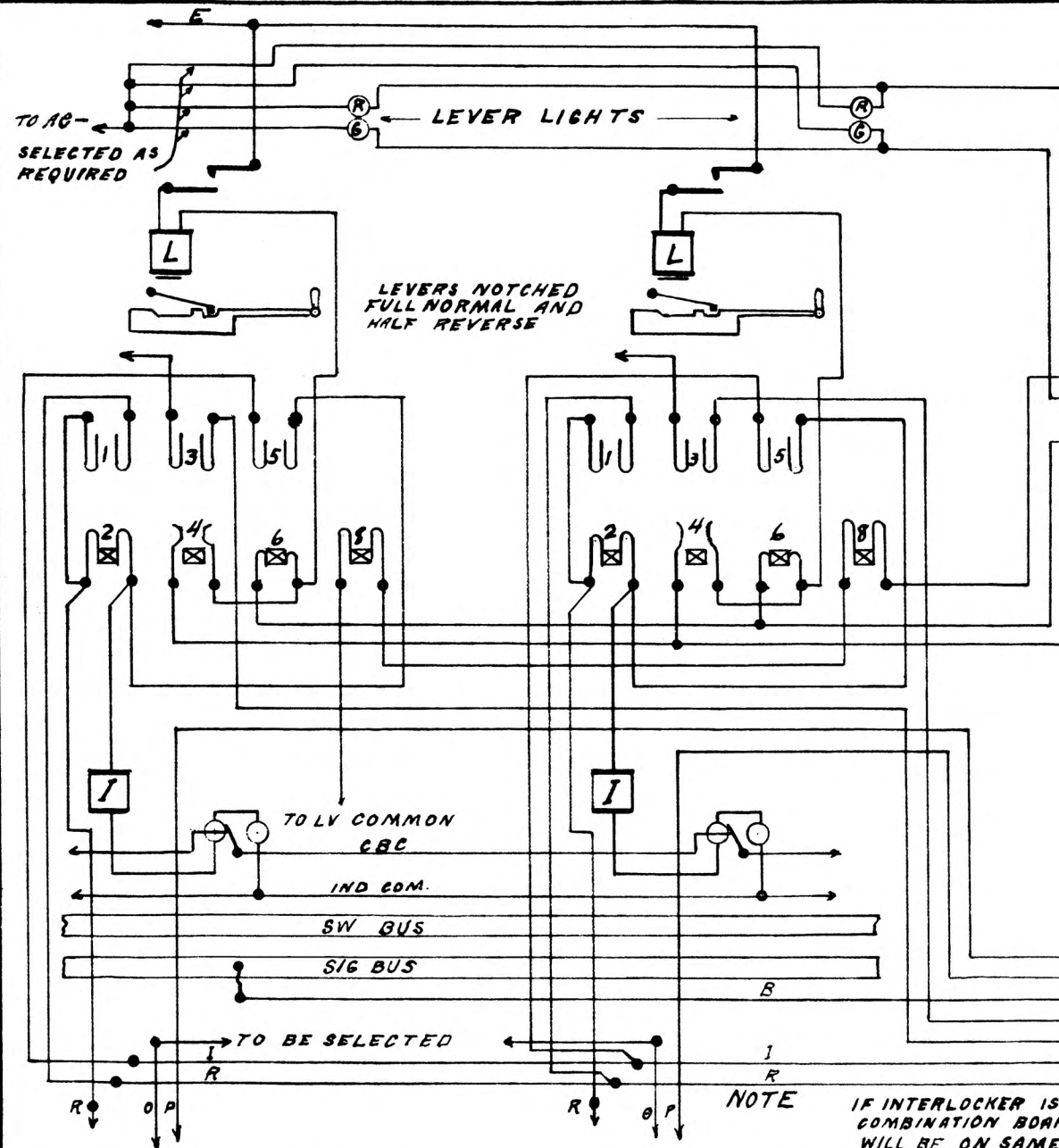


LAKE ST

1370

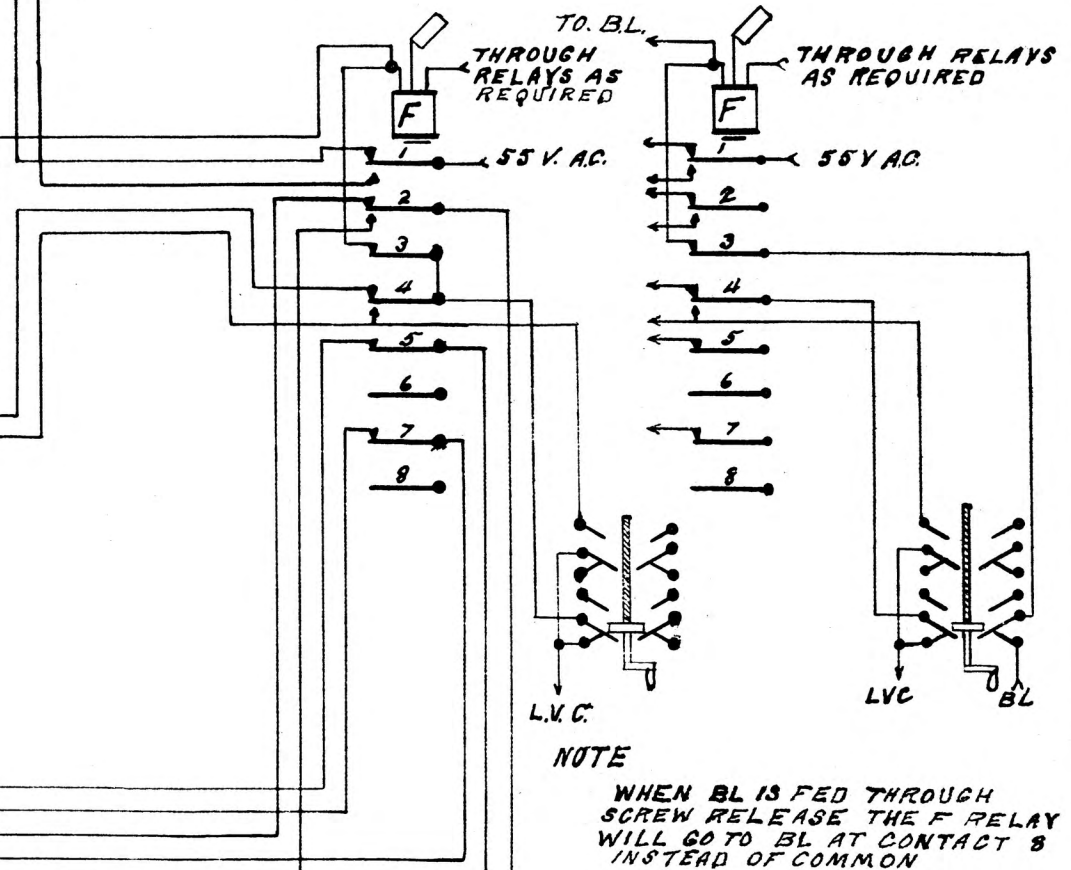
TYPICAL CIRCUIT- TOWER WIRING FOR TWO
SLOTTED HIGH SIGNAL LEVERS WHEN BOTH
BLADES ARE ON SAME POLE. LOW VOLTAGE
3RD POSITION CONTROL





TYPICAL CIRCUIT TOWER-WIRING FOR TWO
SLOTTED HIGH SIGNAL LEVERS.
WHEN BOTH BLADES ARE ON SAME POLE
HIGH VOLTAGE THIRD POSITION CONTROL.

CLINTON ST - CANAL



IF INTERLOCKER IS EQUIPPED WITH
COMBINATION BOARD CONTACT NO 8
WILL BE ON SAME.

MUST BE CLOSED AT
NORMAL INDICATION POINT.

ON COMBINATION BOARD

TYPICAL CIRCUIT TOWER WIRING FOR
SLOTTED HIGH SIGNAL LOW VOLTAGE
3RD POSITION CONTROL.

LIGHTS ON SIGNAL LEVERS ARE SELECTED TO SHOW
NO LIGHT WHEN NO ROUTE IS LINED UP
GREEN LIGHT WHEN ROUTE IS LINED UP AND UNOCCUPIED
RED LIGHT WHEN ROUTE IS LINED UP AND OCCUPIED.

TO LV COMMON
SEE NOTE.

110 VOLTS +

C.B.C.

IND BUS

LATCH

LOCK

TO AC
COMMON

LEVER
LIGHTS

SELECTED AS REQD.

LV-BOARD

TO BL.
(THROUGH RELAYS
AS REQUIRED)

(THROUGH RELAYS
AS REQUIRED.)

55V AC FEED

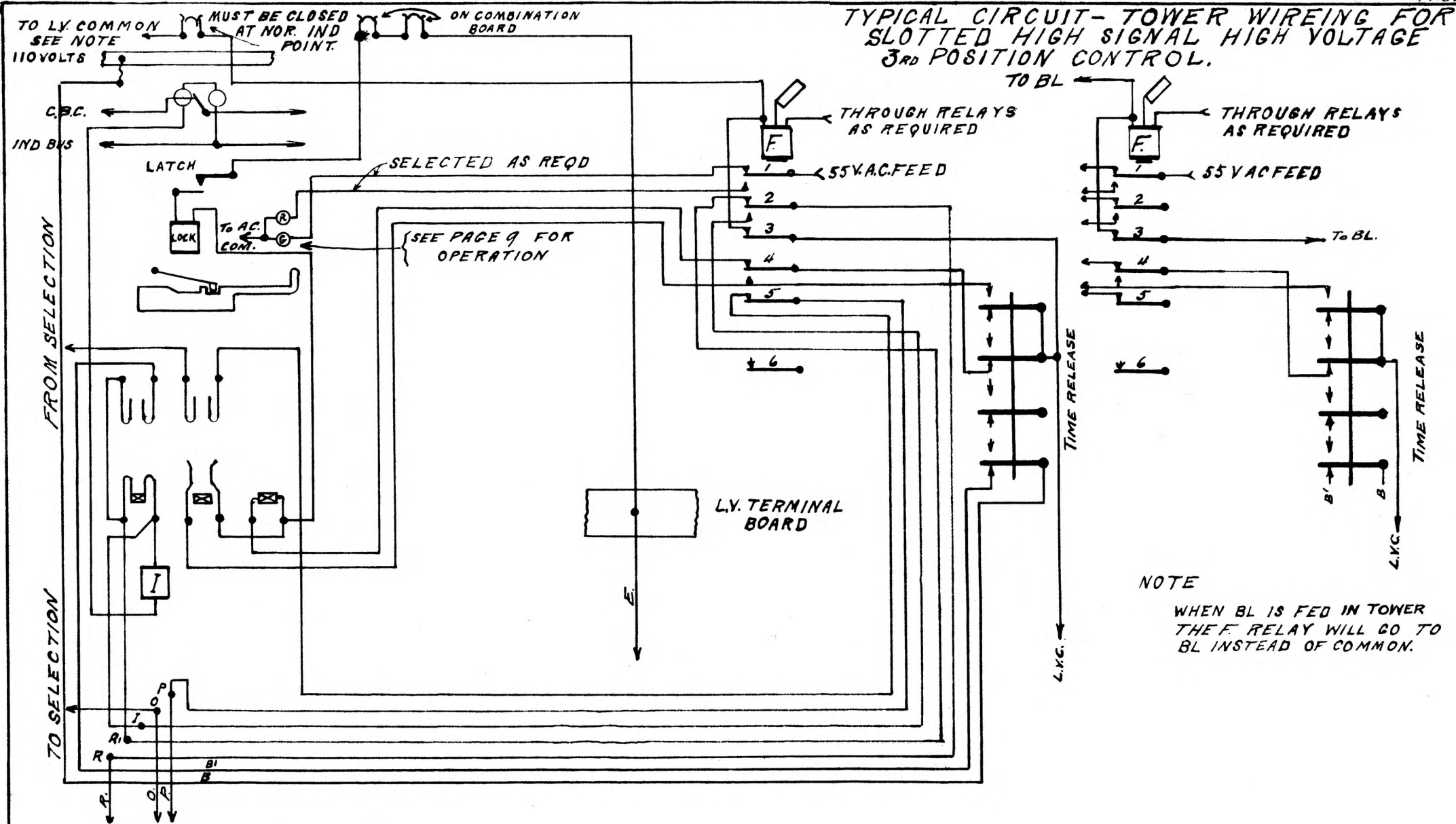
55V AC FEED

B.L.

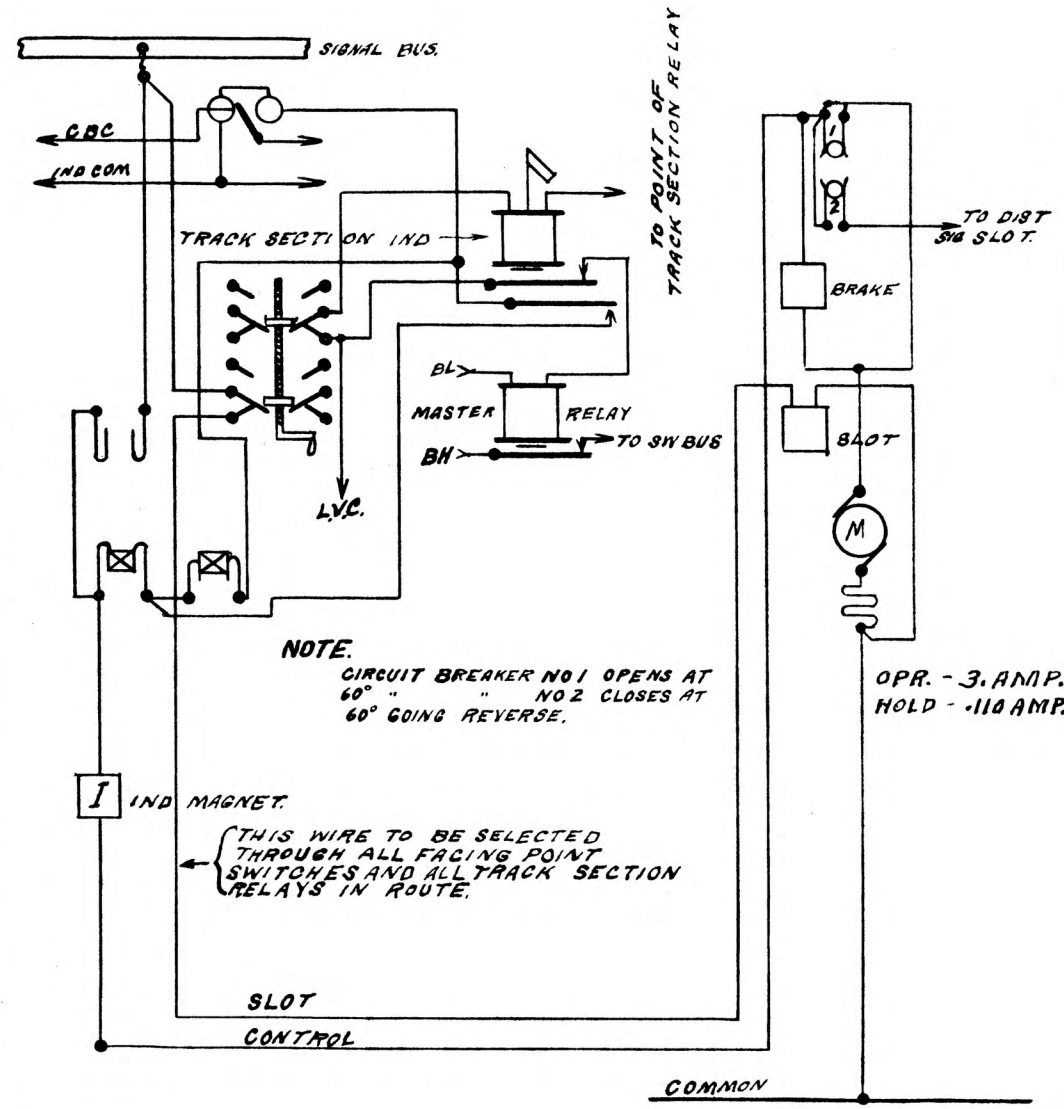
NOTE

WHEN B.L. IS FED THROUGH S.R.
THE F. RELAY WILL GO TO
B.L. INSTEAD OF COMMON

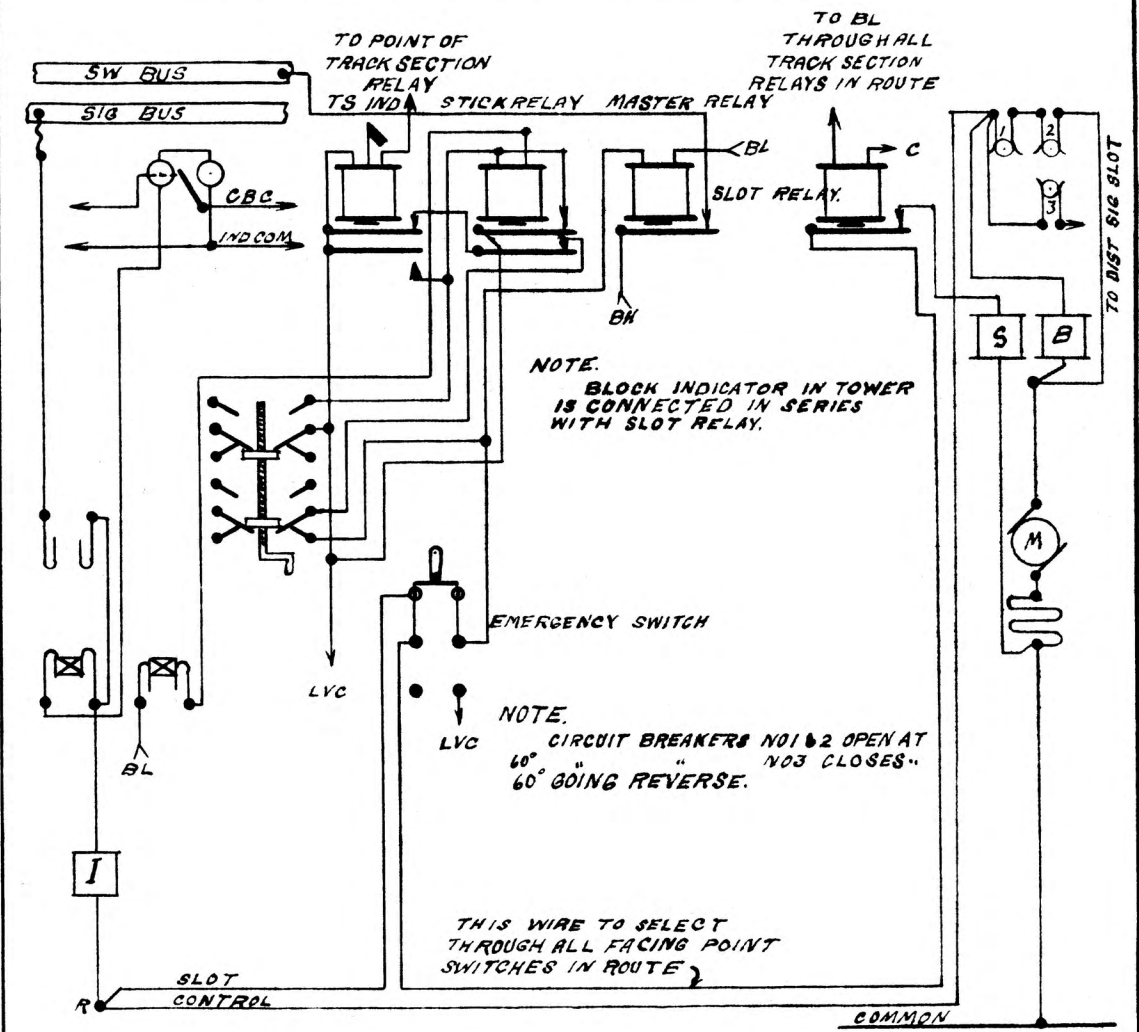
TYPICAL CIRCUIT-TOWER WIREING FOR SLOTTED HIGH SIGNAL HIGH VOLTAGE 3RD POSITION CONTROL.



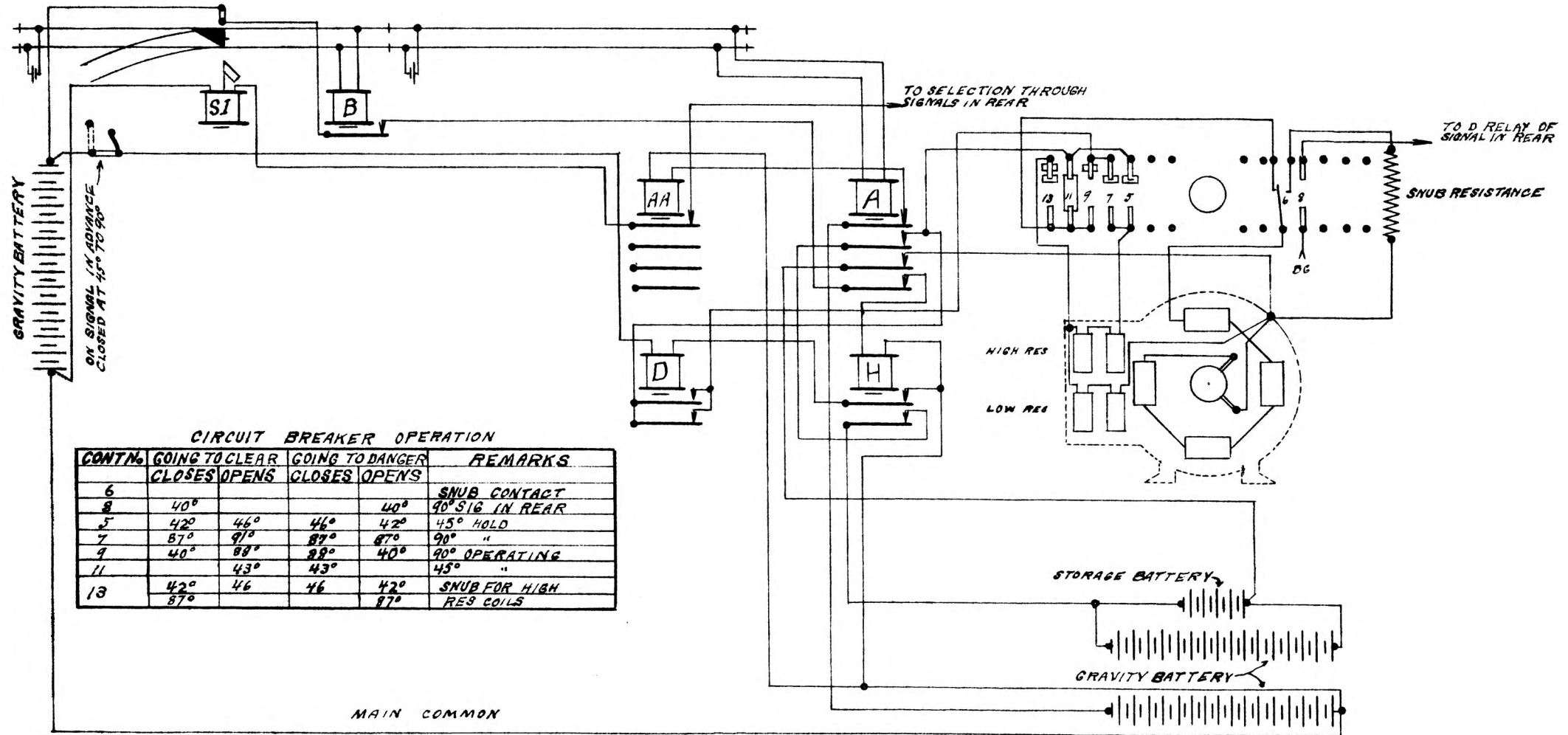
TYPICAL CIRCUIT COMPLETE FOR MODEL 3
TWO POSITION SLOTTED HOME SIGNAL.



TYPICAL CIRCUIT COMPLETE FOR MODEL 3
TWO POSITION SLOTTED HOME SIGNAL



TYPICAL CIRCUIT COMPLETE FOR A MODEL 2A THREE POSITION AUTOMATIC SIGNAL



note 1: On Machines to operate black type derails transpose wires ③ & ④ on motor terminal post 3 & 4.

note 2: All wires to motor are tagged as shown

note 3: Crank contact opens motor circuit when hand crank is inserted

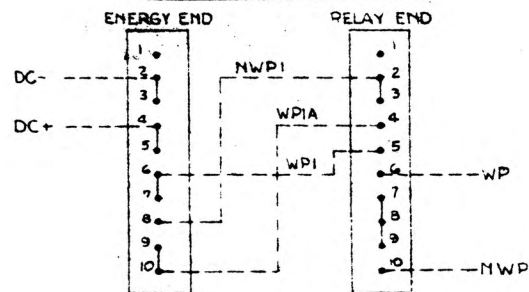
note 4: The "OUT" leads of all Coils is the one nearest to tag

note 5: Dynamic snub resistor supplied only in 110V. Machs.

note 6: Connections are shown for single switch with R.H. point normally closed as viewed from Point Detector end of machine

note 7: When applying machine to a Crossover be sure to arrange terminal board metal connectors as shown

CROSSOVER WIRING



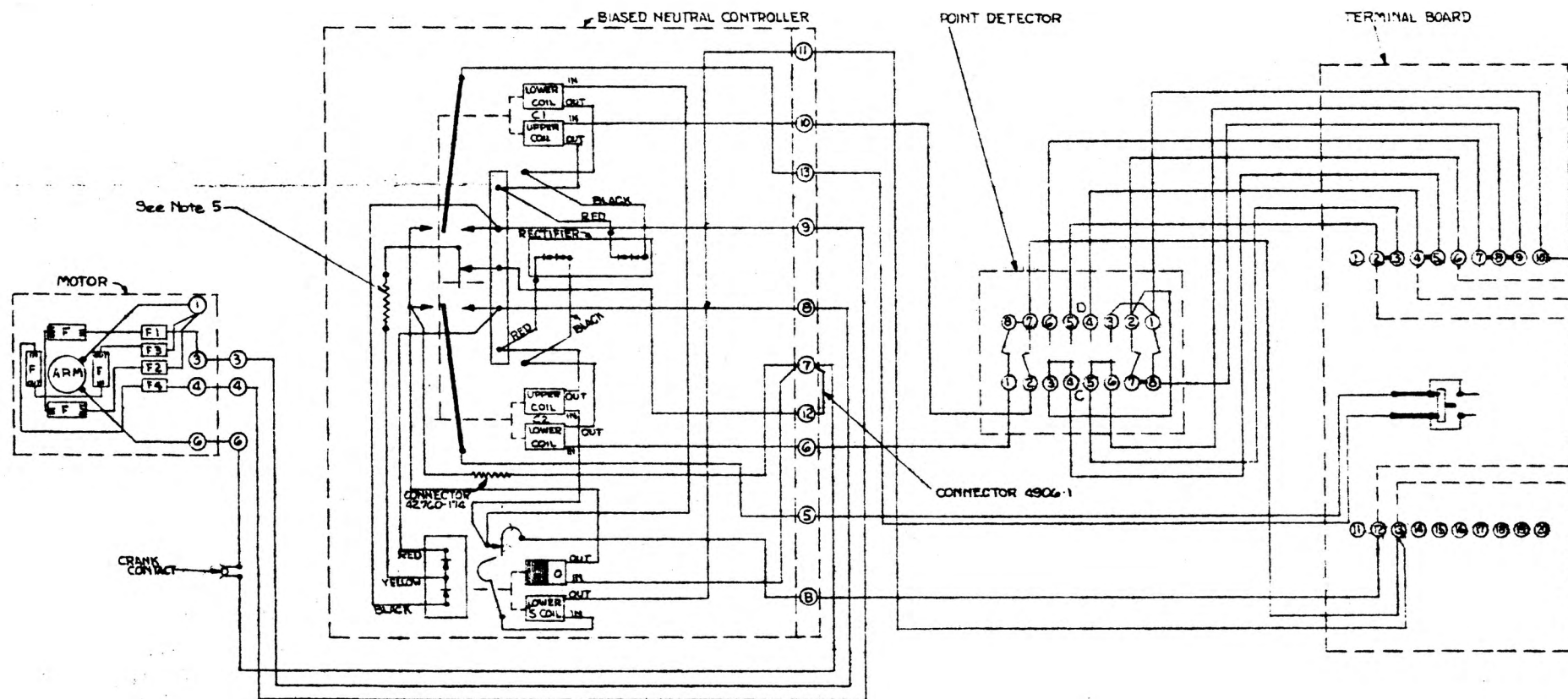
WIRING DIAGRAM 45620-3

FOR MOD. 5C SWITCH MACHINE 54510-411 & 415
WITH BIASED NEUTRAL CONTROLLER & DYNAMIC SHUBBING
CONTROL VOLTAGE SHOWN ON CONTROLLER NAME PLATE
OPERATING VOLTAGE SHOWN ON SW. MACH. NAME PLATE

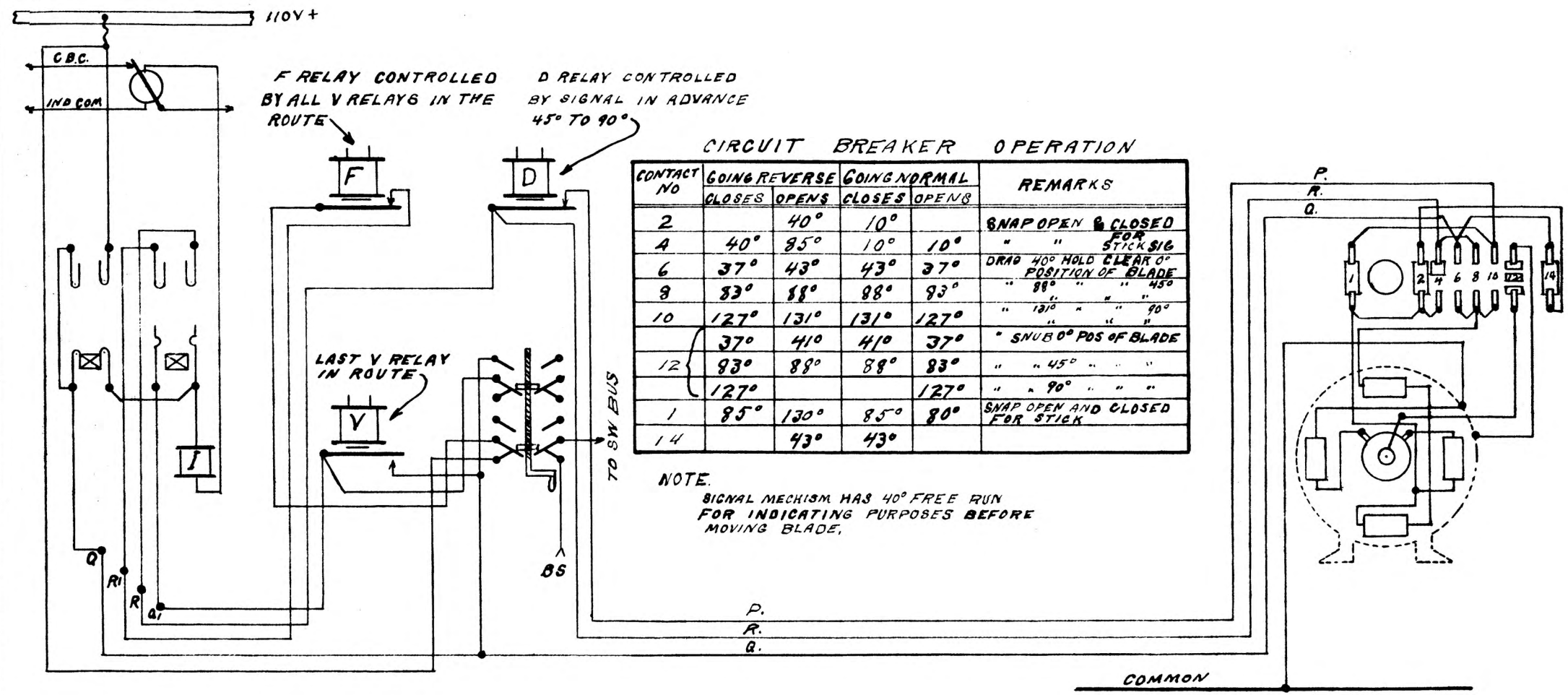
GENERAL RAILWAY SIGNAL CO. ROCHESTER, N.Y.

5-5-59

SINGLE SWITCH

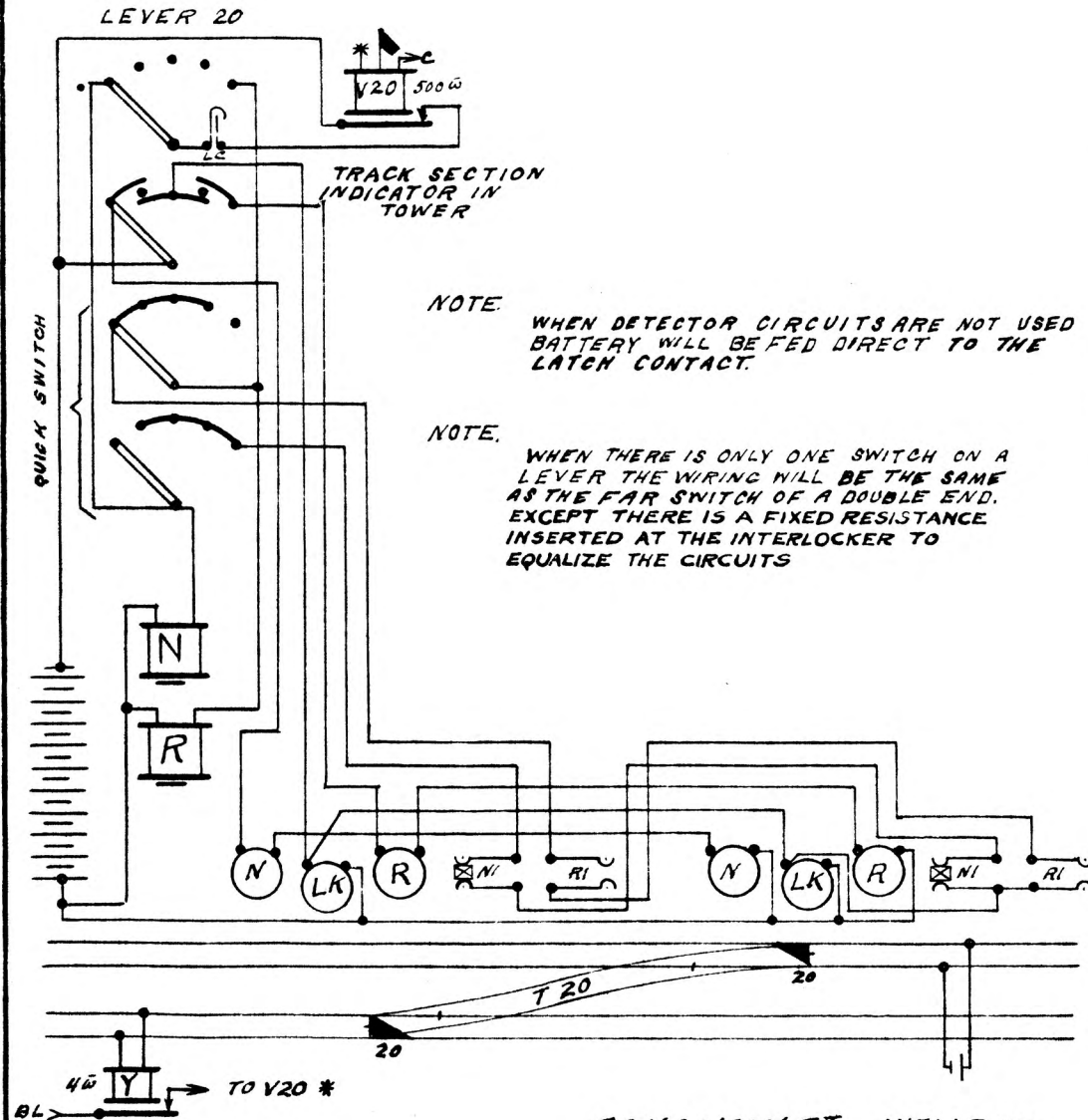


TYPICAL CIRCUIT COMPLETE FOR MODEL 2A FOUR POSITION STICK SIGNAL.



1347

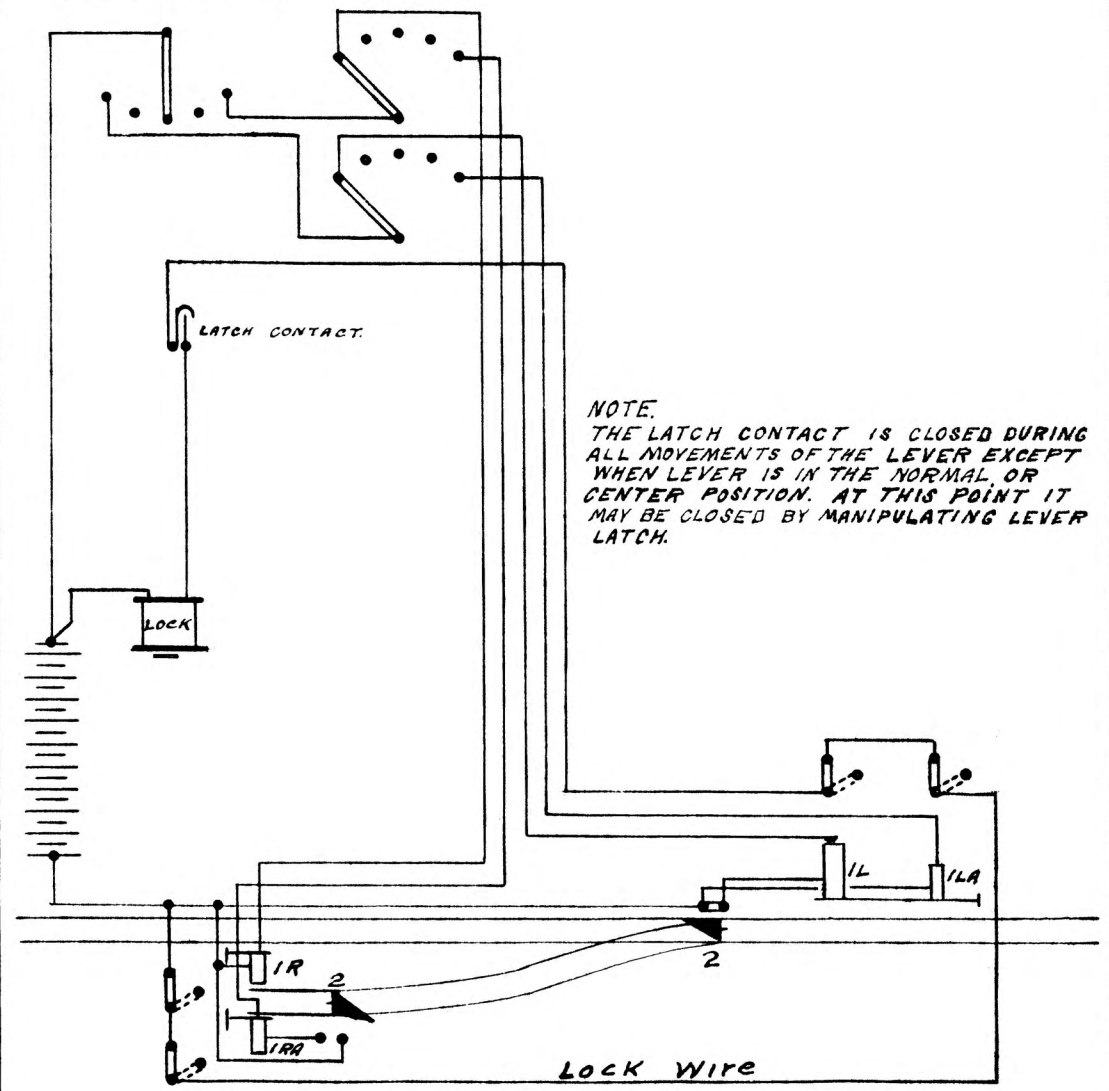
TYPICAL CIRCUIT OF A ELECTRO-PNEUMATIC DOUBLE END SWITCH



SANGAMON ST WELLS ST.
(WITH OUT TRACK SEC)

TYPICAL CIRCUIT OF A ELECTRO-PNEUMATIC SIGNAL SHOWING FOUR SIGNALS CONTROLLED BY ONE LEVER.

SIG. LEVER 1 SW LEVER 2



SANGAMON ST - WELLS ST

CONDUCTOR - TOWERMAN - GATEMAN - ANNUNCIATOR - SYSTEM

TOWER

CONDR BOXES

SUB GATE

MAIN GATE

CONDUCTORS LIGHT
TOWERMANS "
GATEMANS "
TOWERMANS BUTTON

Sec. "C" Sec. "B"

CROSS HATCHED
LINES OUT

SPECIAL CONTACT ON FIRST OUT-BOUND
SIGNAL CONTROLLER

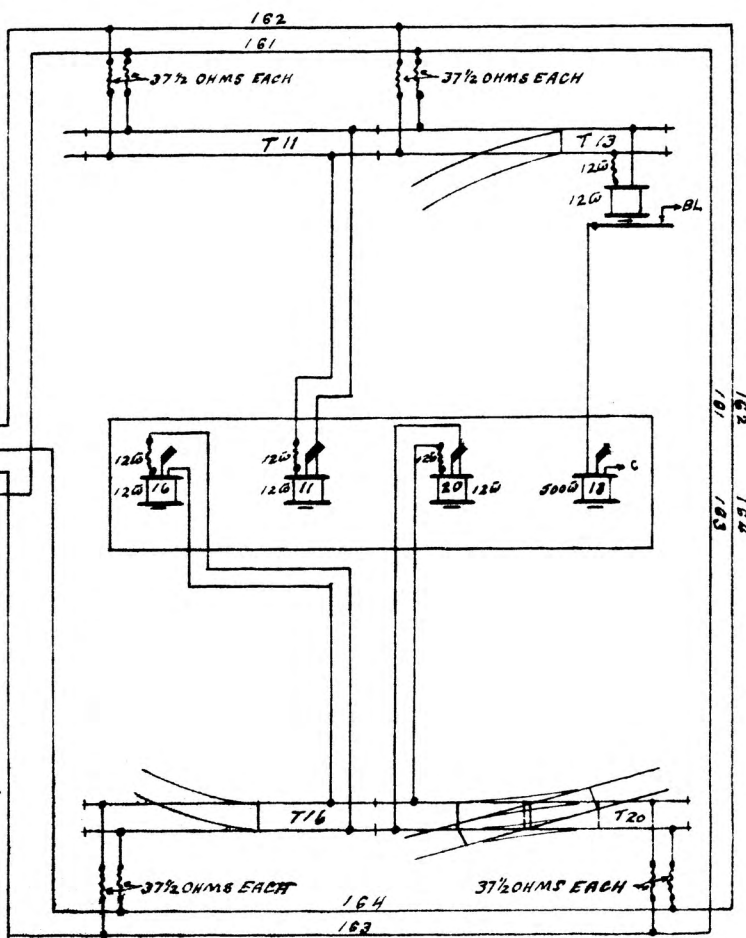
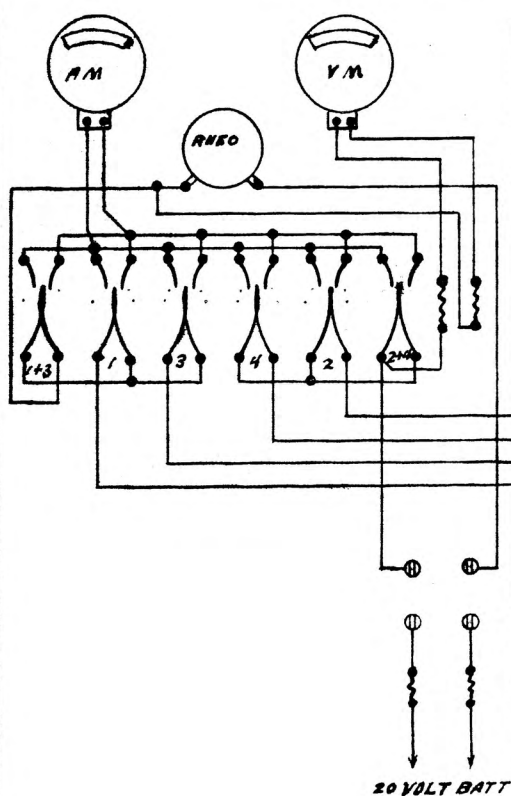
NOTE.

FUSES 1 AND 2 ARE
LOCATED ON FUSE
BOARD UNDER DIRECTORS
DESK

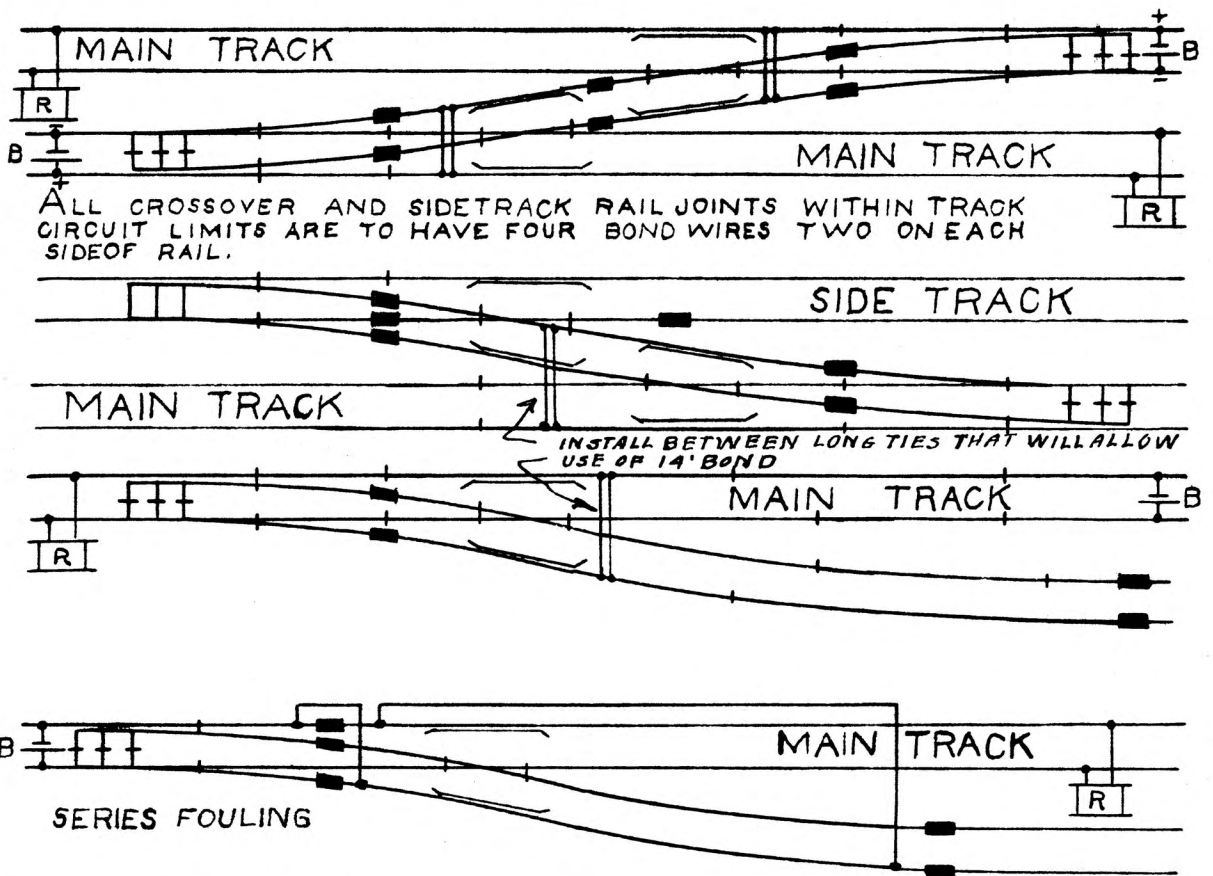
20 VOLTS

LAKE ST. ONLY

TYPICAL CIRCUIT OF TRACK CIRCUIT FEED

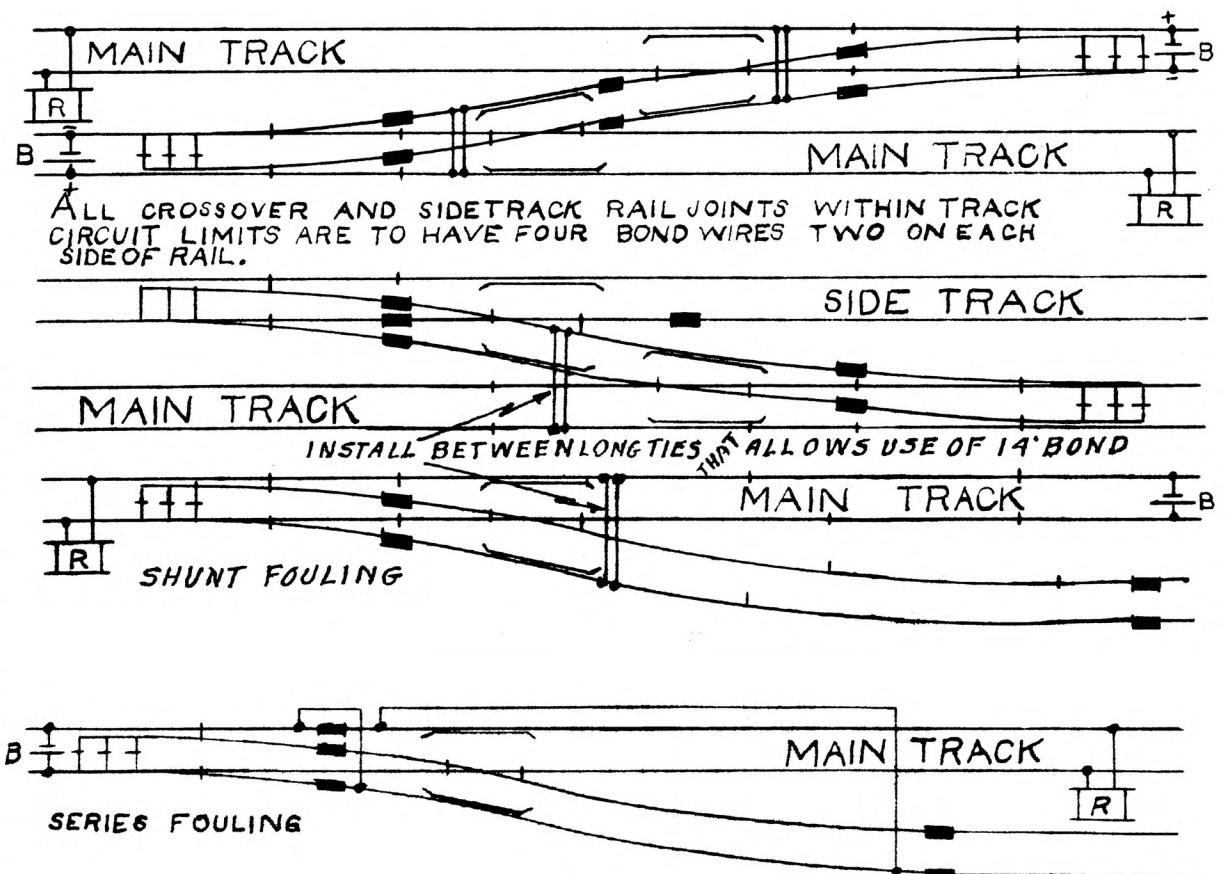


LAKE ST.
CLINTON ST.
DIVISION ST.
CARPENTER ST.
NOBLE ST.



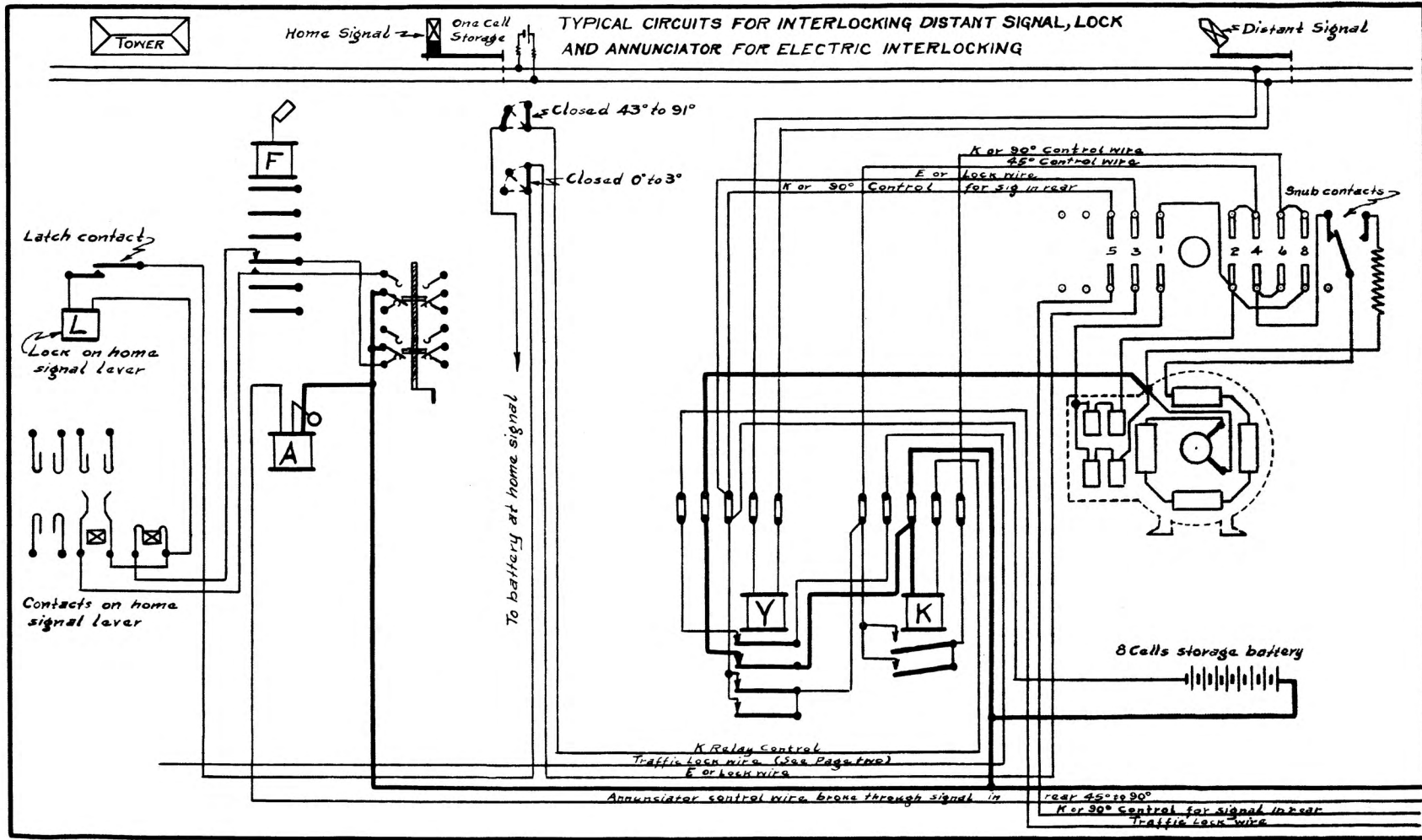
ALL ADJOINING TRACK CIRCUITS SHOULD HAVE LIKE POLARITY

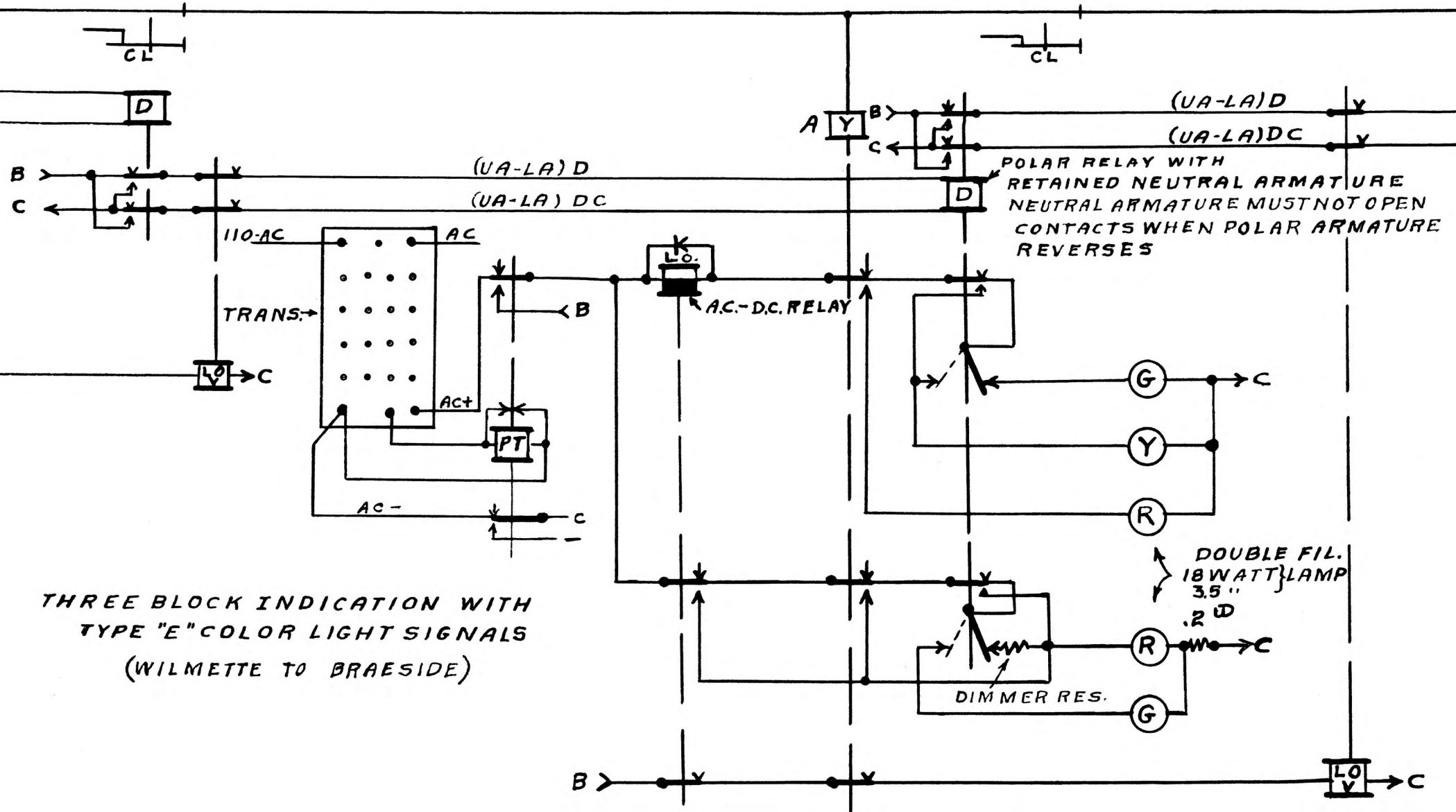
BHP

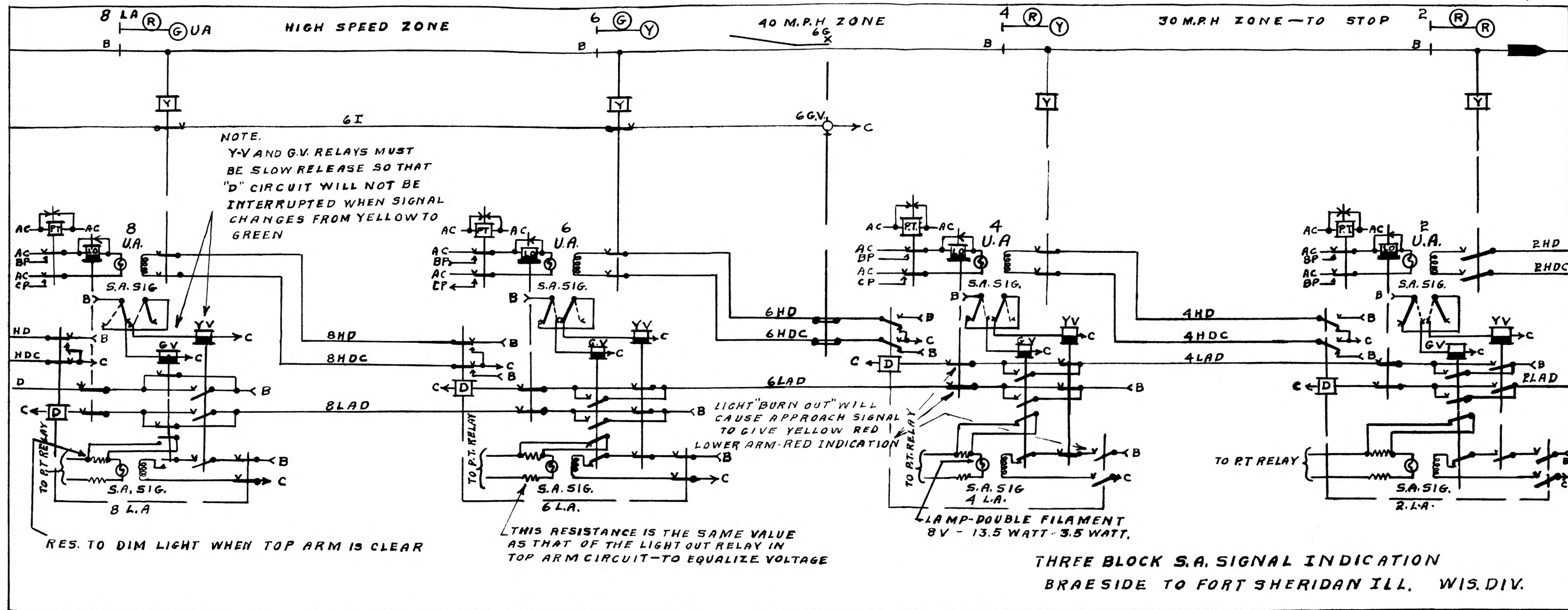


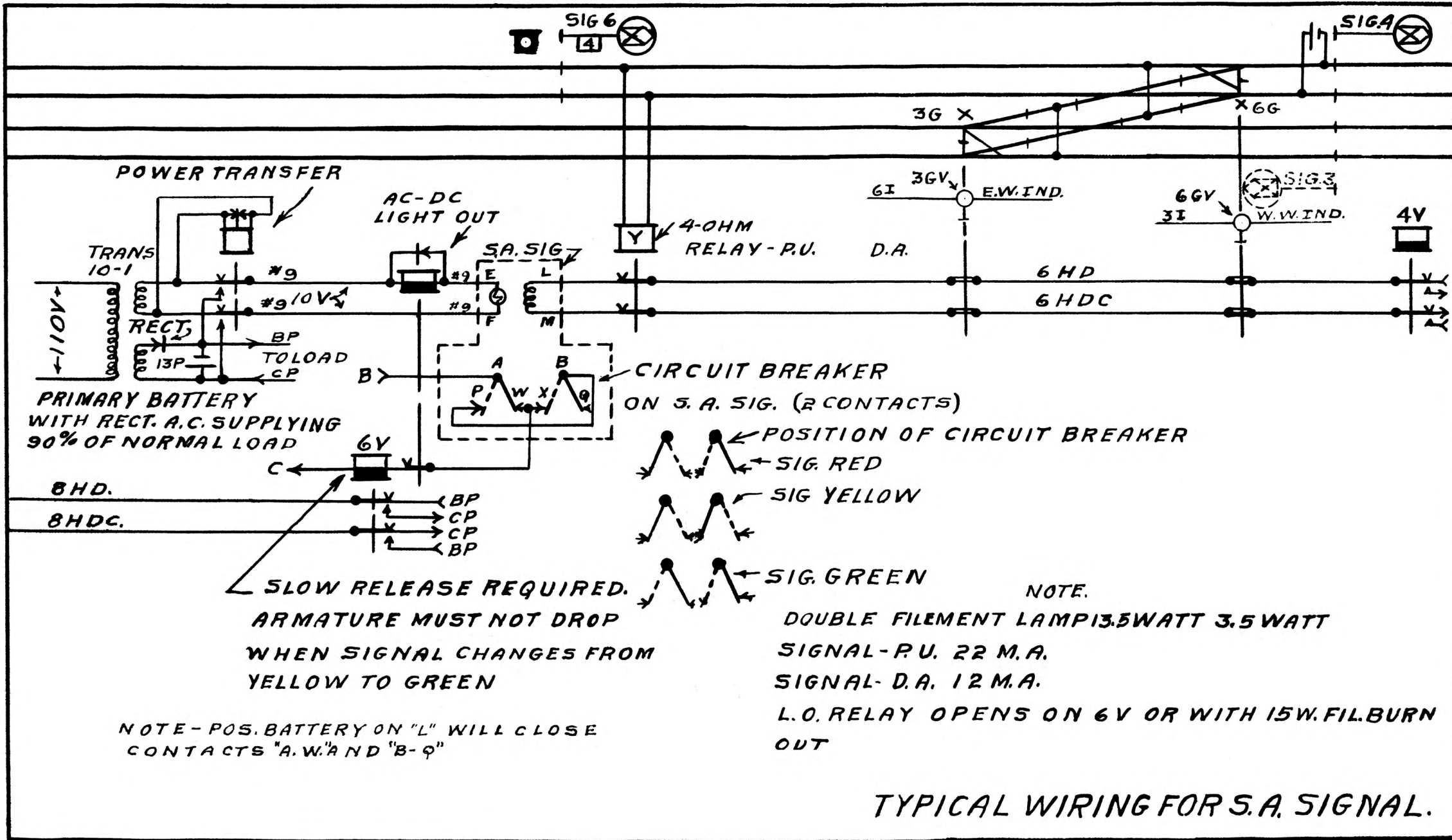
ALL ADJOINING TRACK CIRCUITS SHOULD HAVE LIKE POLARITY

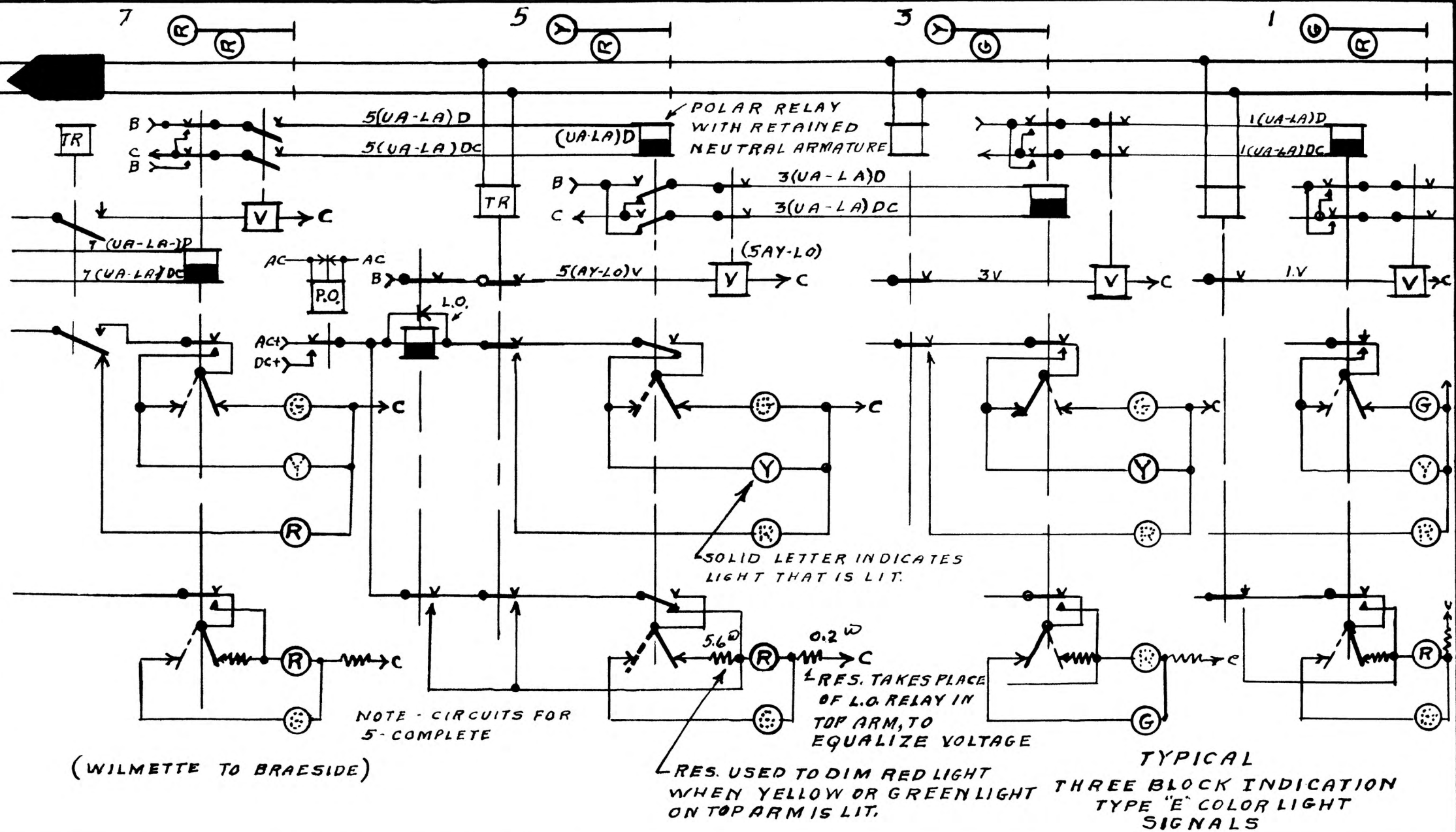
BHP











IF THIS CONTACT
IS OPENED BY MOVEMENT
OF SWITCH SAFETY RELAY
BACK CONTACT WILL RESTORE
BATTERY TO LOCK.

IND. BOX.

RES. OF MAGNET $125\ \Omega$

5 WIRE CABLE

COM. OR GROUND

(AIR PIPE) RETURN

NOTE.

E.P. VALVE TYPE "C" IS DIFFERENT
THAN ORIGINAL VALVE IN THAT AIR
IS CUT OFF THE CYLINDER WHEN
SWITCH IS AT REST.

SAFETY INDICATION RELAY

LATCH CONTACT OPERATED BY TURNING
KNOB ON LEVER BEFORE LEVER
IS MOVED THIS OPERATES THE
DETECTOR CIRCUIT

NI $250\ \Omega$
RI $250\ \Omega$

N $125\ \Omega$

R $125\ \Omega$

NI

RI

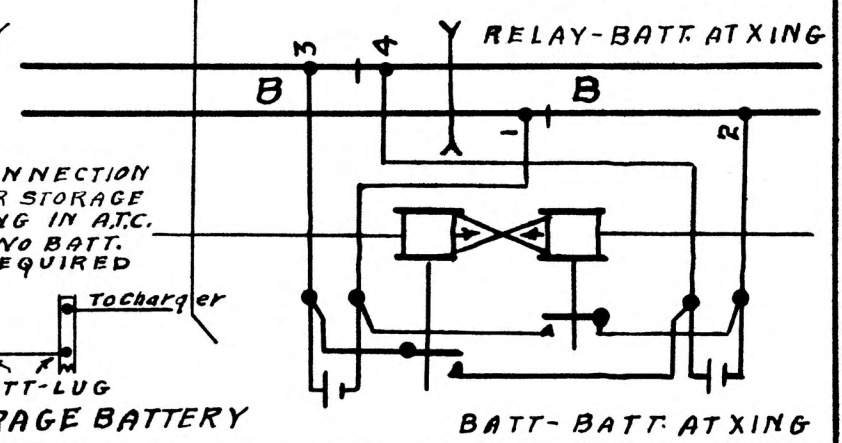
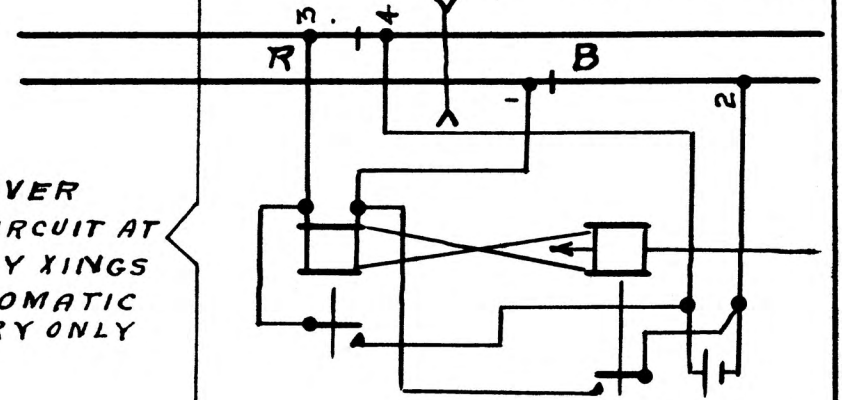
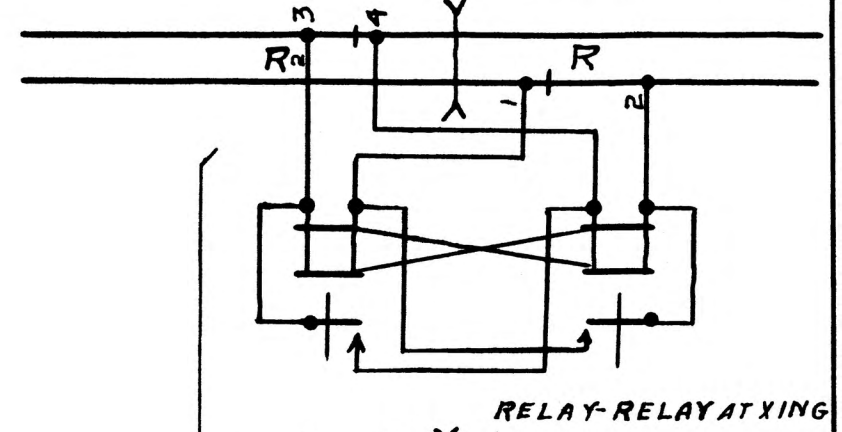
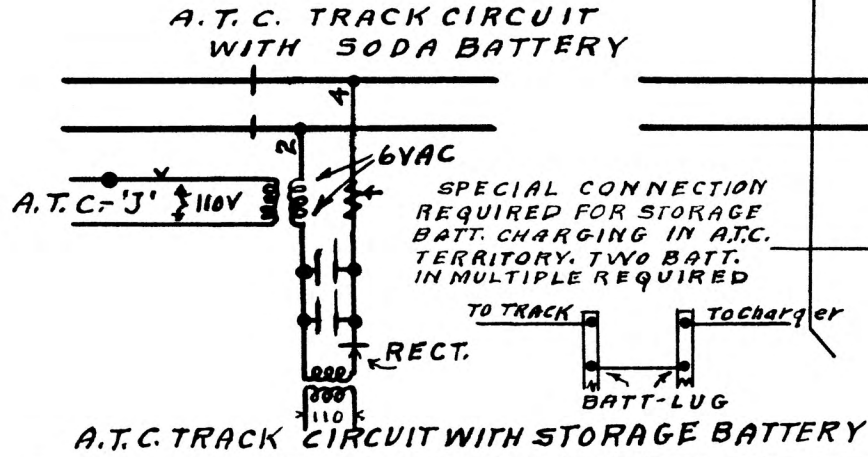
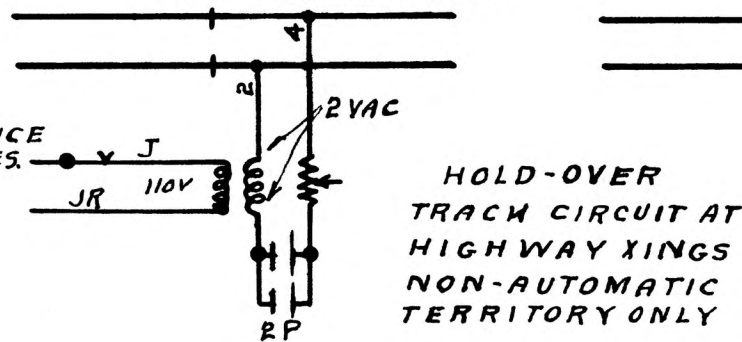
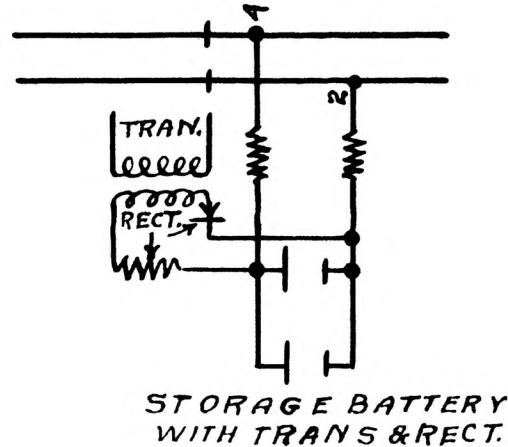
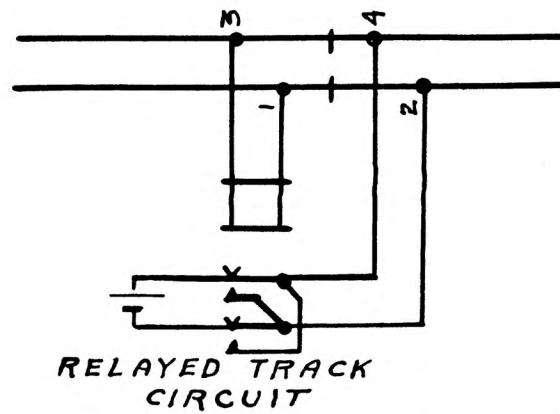
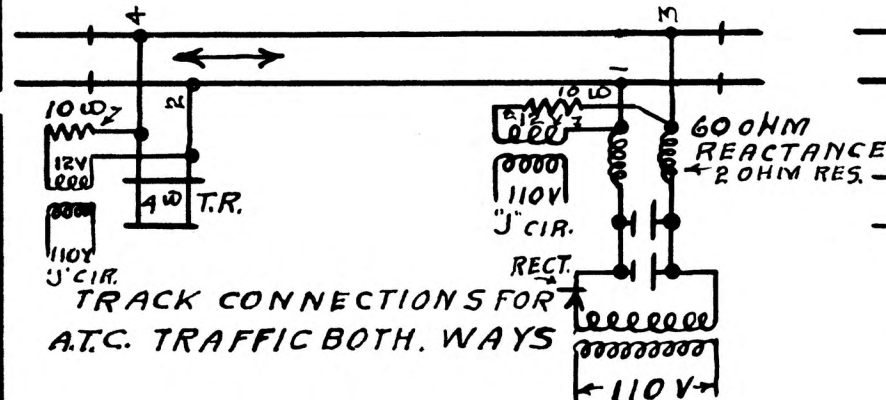
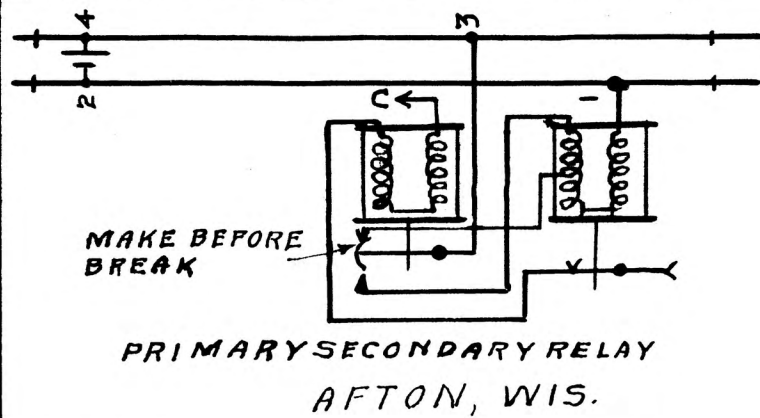
QUICK
SWITCH

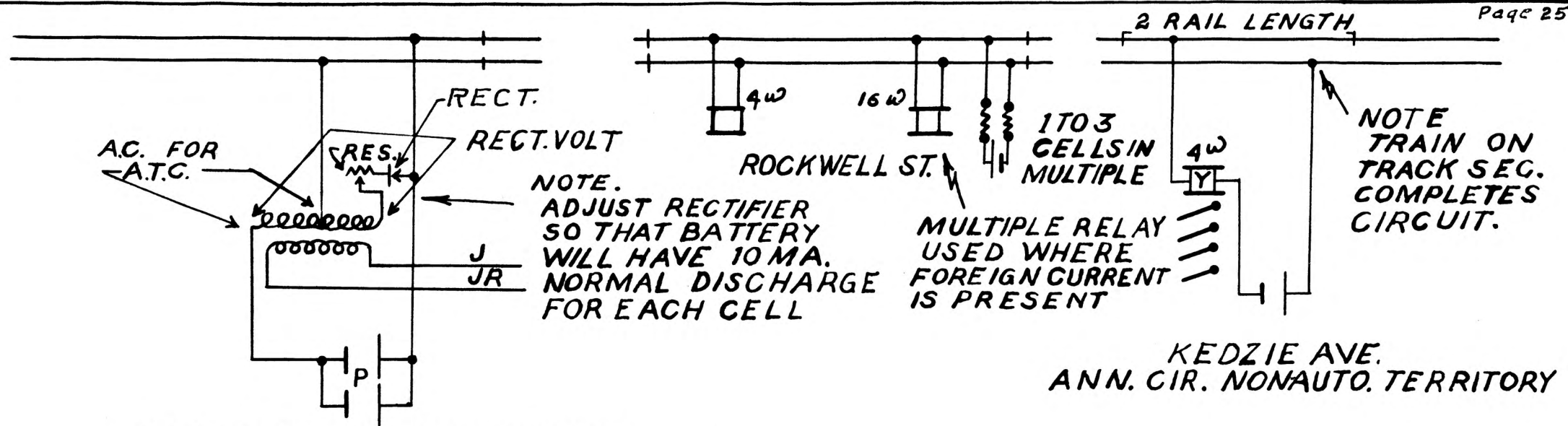
TOWER

WELLS ST.

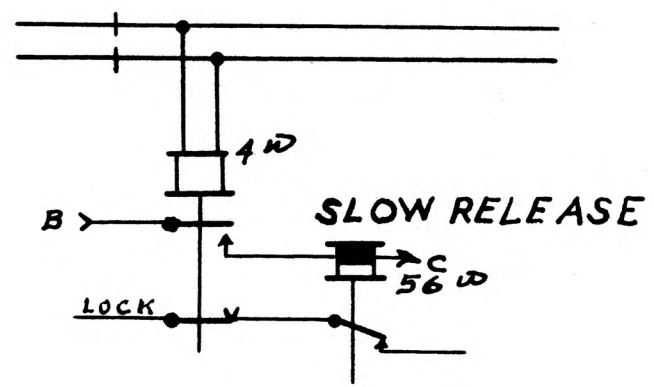
AIR PIPE

CIRCUIT FOR ELECTRIC PNEUMATIC SWITCH
WITH TYPE "C" VALVE

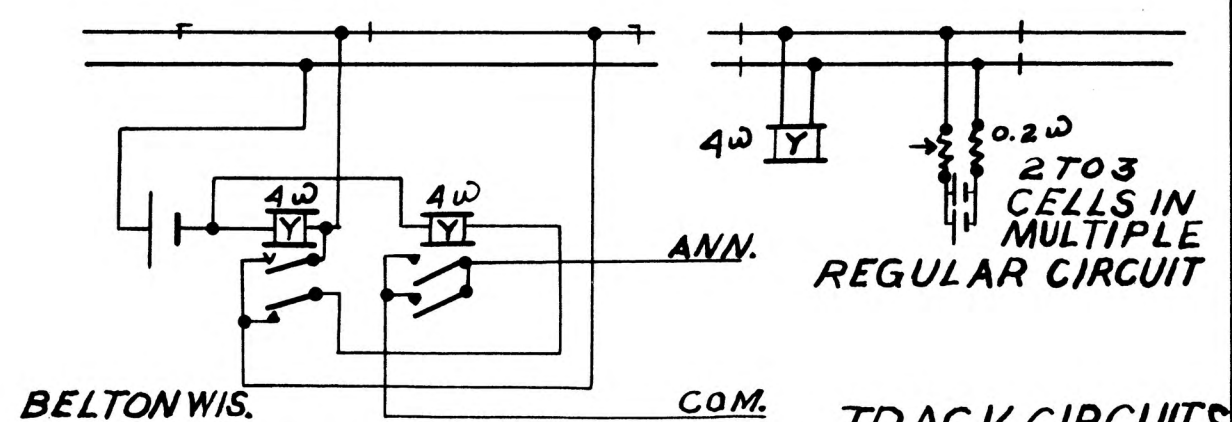




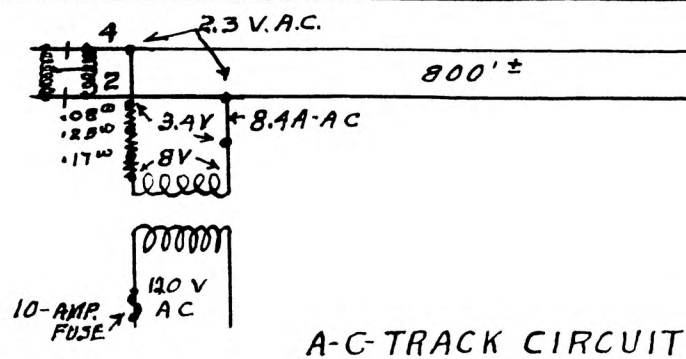
RECTIFIED TRACK CIRCUIT WITH SODA BATTERY IN A.T.C. TERRITORY



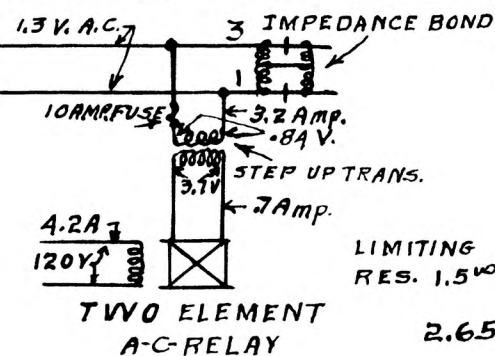
LAKE ST.



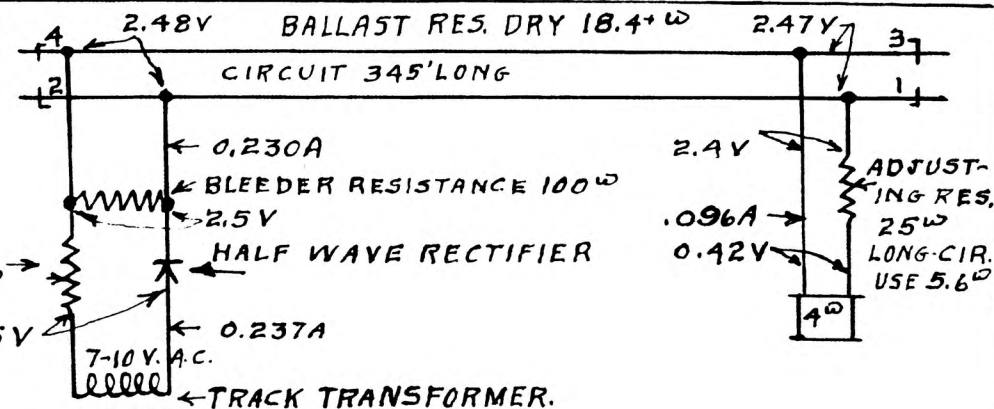
DIRECTIONAL ANN. CIRCUIT FOR SINGLE TRACK NONAUTO. TERRITORY



SKOKIE.

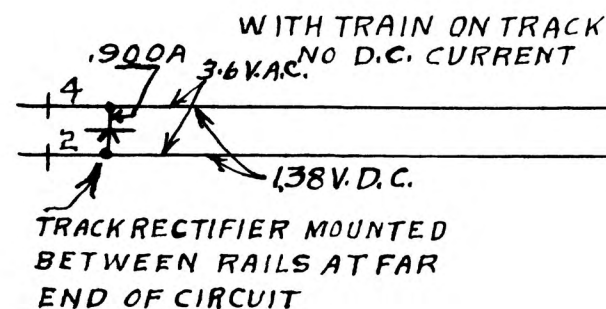
LIMITING RES. 1.5 ω

2.65V

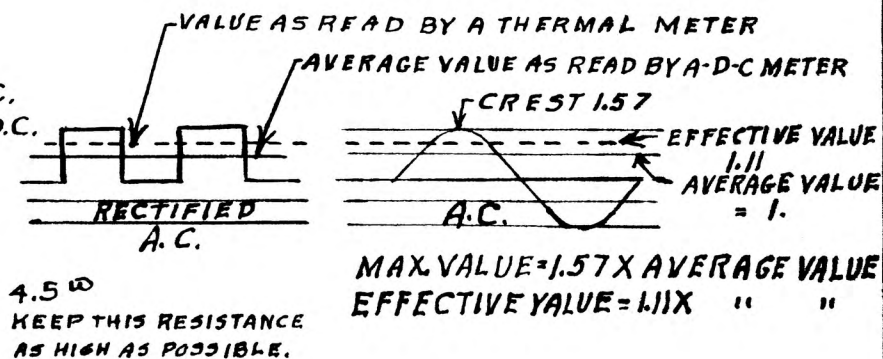
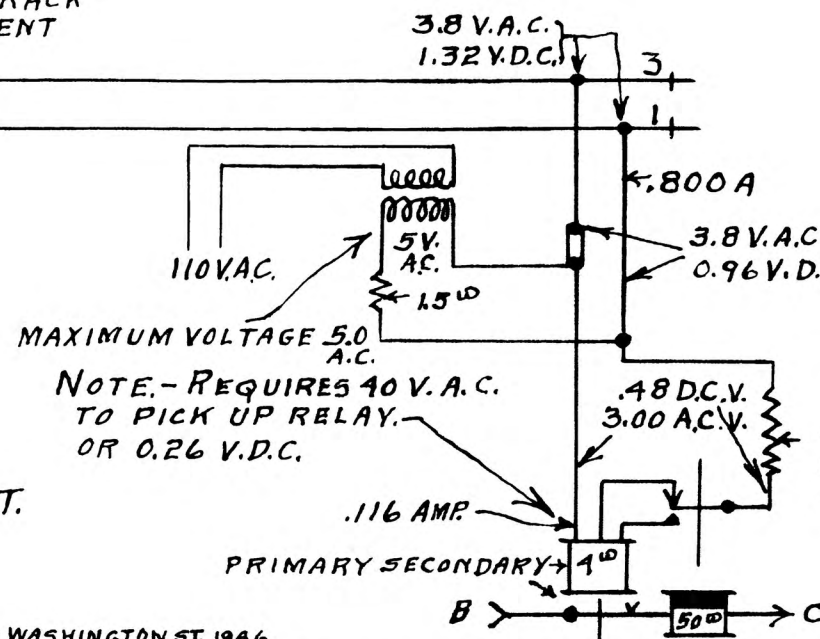


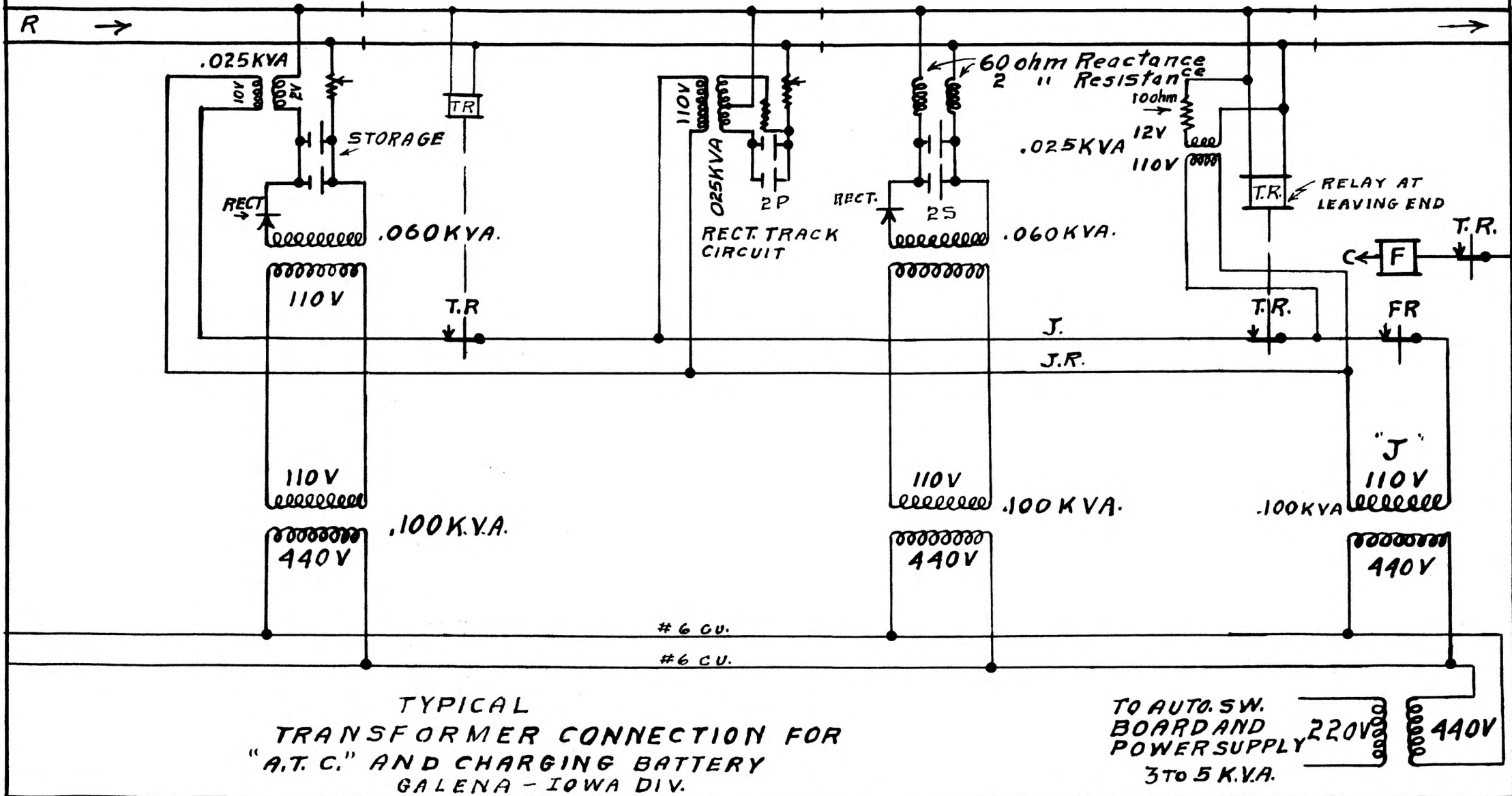
NOTE-BLEEDER RESISTANCE SHOULD BE 100 ω UNLESS RELAY FAILS WHEN BALLAST RES. IS HIGH, THEN REDUCE RES. JUST ENOUGH TO MAKE RELAY PICK UP.
LAYARD AVE RACINE, 1945

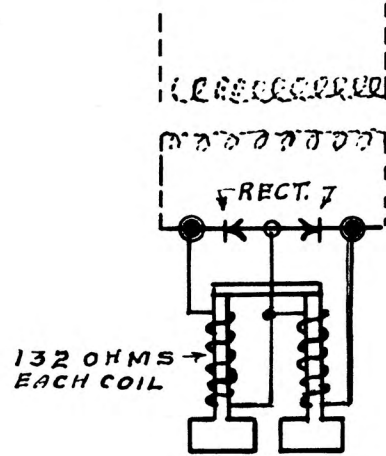
HIGH INTER-RAIL POTENTIAL IMPULSE CIRCUIT.



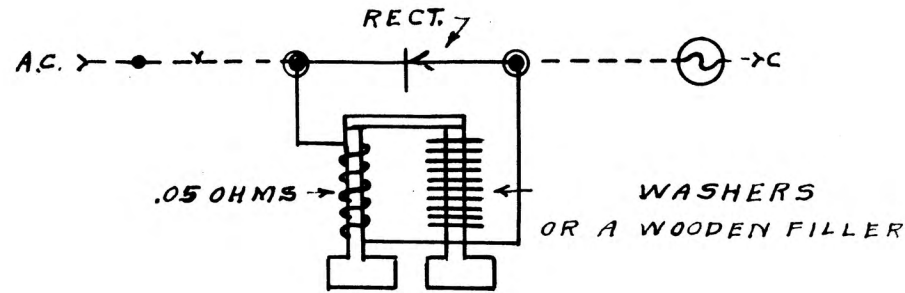
A-C-D.C. TRACK CIRCUIT.



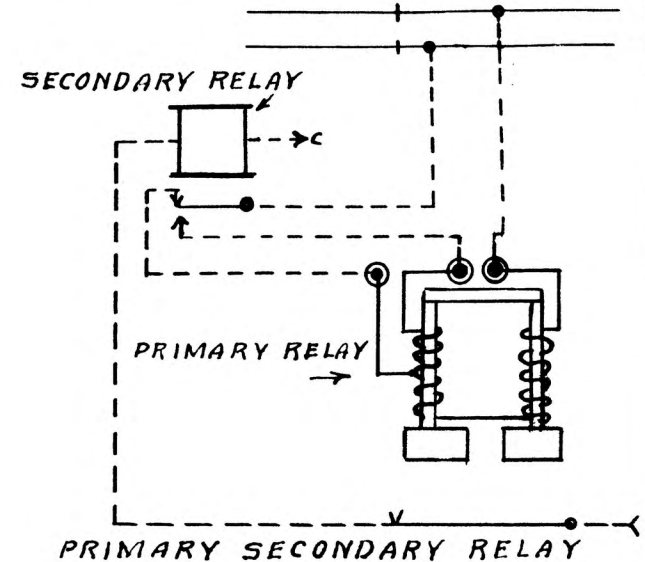




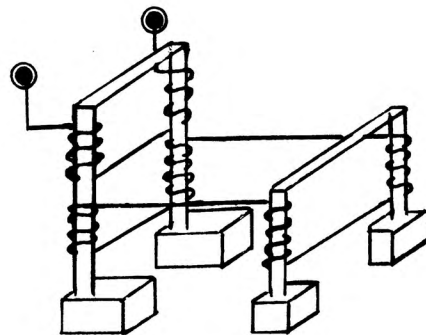
POWER TRANSFER RELAY



LIGHT OUT RELAY

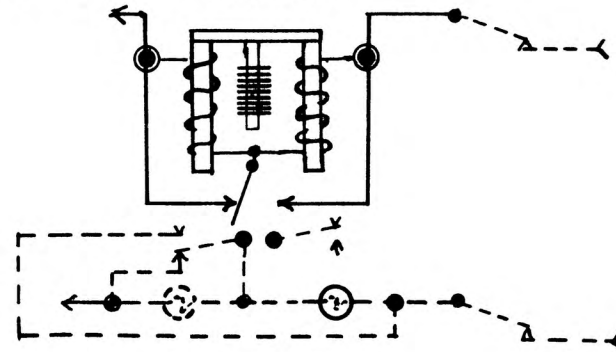


PRIMARY SECONDARY RELAY
USED WHERE SPECIAL SHUNTING
IS REQUIRED

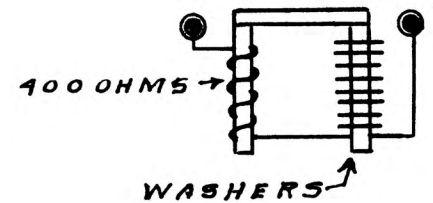


RETAINED NEUTRAL
POLAR RELAY.

COPPER WASHERS REGULATE
NUMBER OF FLASHES



FLASHING RELAY
30 TO 40 FLASHES PER MIN.
A.R.A.



SLOW RELEASE RELAY.
USED WITH S.A. SIGNALS

USEFUL INFORMATION

		Operating Volts	Amp.	Holding Amp.
Wig-wags		8 Volts	2 1/2 Amp.	.030 Amp.
Rotating Stop Signs	Mech.	10 Volts	8 Amp.	.015 Amp.
Crossing Bell #222C		6 Volts	.225 Amp.	
F.L. Lights)				
Flood Light)		10 Volts	1 Amp.	
Flashing Lights		10 Volts	1 Amp. 10 Watt	
		10 Volts	1.8 Amp. 18 Watt	
Auto. Crossing Gates		32 Volts	15 Amp. 10 Sec. Up	
			10 Sec. Down	
Hall Disc Signal	38 Ohms	5 Volts	.125 Amp.	
Dwarf Signal Model 2		110 Volts	4 Amp.	
Model 3 Signal		110 Volts	3 Amp.	
Model 2A Signal		110 Volts	.82 Amp.	
2A Signal		8-10 Volts	2.5 Amp.	
Color light signal single filament light		10 Volts	18 Watt	
			10 Watt for dwfs.	
Color light signal double filament light		8 Volts	2.7 Amp. 21.5 Watt	
S.A. Signal	Mech.	8 Volts	.042 Amp.	
	Light	8 Volts	2.04 Amp. 13 Watt)	
			3.5 Watt)	

A.C. in track circuit for automatic train control. (Reading to be taken with ammeter in shunt with relay at relay end of circuit)

.7 Amp. to .9 Amp.
(Direct proportion to length of circuit).

Model 2 - Sw.	110 Volts	5 - 10 Amp.
4 - Sw.	110 Volts-	5 - 10 Amp.
5 - Sw.	20 Volts	5 - 6 Amp.

	Indication Res. of Coils	Volts	Amp.
Solenoid Dwarf	800 Ohms	90	.112
Model 3 Signal	1.42	1.85	1.3
Model 2A Signal	6.80	3.06	.45
L.V. Battery indication	13.60	4.35	.32
Switch Machine	1.42	1.85	1.30

Cross Protection

Polar relay for cross protection should operate on 1/2 the current required to just move the function it is protecting.

Distance or Time Required for Operation of-

Time Release - 30 Seconds for each 1000 ft. between home and distant signals.

Spring Switch with single valve requires 12 seconds.

Spring Switch with double valve requires 7 seconds.

(A train moving 12 M.P.H. there should be only one complete movement of switch points).

Annunciators in gate cabins 40 seconds.

Annunciators in flag cabins 30 seconds.

Wig-wag, flashing lights, etc. 20 seconds.

Indicators back of last signal affected 2500 feet.

Approach light for spring switch 1500 feet Min.

Approach light for switch indicator on siding 400 feet.

Approximate figure for braking distance in A.T.C. territory -

Upgrade 7000 feet.

Level 8000 feet.

Downgrade 9000 feet.

Flagging - 100 ft. for each mile per hour train is traveling.

Example - 50 miles per hour 5000 feet.

Resistance of Rails in 1000 ft. of track

90# ohm	.0222	110# ohm	.0182
100# ohm	.0200	120# ohm	.0167
1 foot - 90# rail	= .0000111 ohms.		
O.B. Bond #2 gauge	= .0001 ohms.		

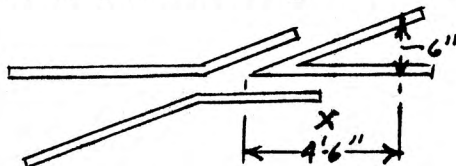
Frog number may be found by -

- (1) Measure across heel of frog at a point where it is 6" gauge; to gauge take distance from this point to point of frog in feet multiply by 2.

Example

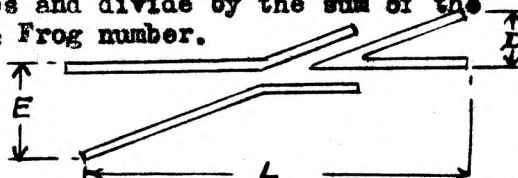
$$x = 4 - 1/2'$$

$$2 \times 4 - 1/2 = \#9$$



- (2) Take length of frog "L" in inches and divide by the sum of the spread at "D" heel and "E" toe = Frog number.

Example



Relay drop away may be slowed up by putting resistance across coil. Maximum discharge on regular soda battery for best results should not exceed 120 MA for continuous output.

Maximum discharge on H.A. soda battery for best results should not exceed 2 Amperes for continuous output.

Regular soda battery with rectified A.C. in multiple should be adjusted so that battery will have a normal discharge of 10 Milamps. If batteries are in multiple 10 MA discharge for each battery.

H.A. soda battery with rectified A.C. in multiple should have the rectified current removed twice a month and allow battery to supply full load for 5 minutes.

The above discharge on battery is required to keep battery in good condition.

Ground rods - maximum resistance 25 ohm.

Volts "E" = AMP x Ohms Megohm = One million ohms

Amp "I" = Volts ÷ by ohms Res. of wire

Ohms "R" = Volts ÷ by AMP 1000' #14 = 2.52 Ohms

Watts "W" = Volts x AMP 1000' 12 = 1.59 Ohms

Amp² x Ohms 1000' 9 = 0.80 Ohms

Volts² ÷ Ohms 1000' 6 = 0.40 Ohms

Power factor True Watts ÷ Apparent Watts

(Watt Meter Reading) ÷ (Volts x Amp Reading)

NOTE: Approximate resistance for 3. No change in size of wire. Resistance is either doubled or divided by 2.

Diameter of circle Multiply Circumference by .31831

Circumference of circle " Diameter by 3.1416

Area of circle " Square of Diameter by .7854

Surface of a ball " Square of Diameter by 3.1416

Cubic inches in ball " Cube of Diameter by .5236

Double diameter of pipe increases its capacity four times.

Start for crossing protection (20 Sec.) = Speed of train x 30.

Miles per hour x 1.466 = Feet per second.

Feet per second x .68 = Miles per hour.

10% under voltage on lamp will give 400% expected life and decrease range to 84%.

5% increase voltage will give 50% expected life.

Acid should be poured into water, never pour water into acid.

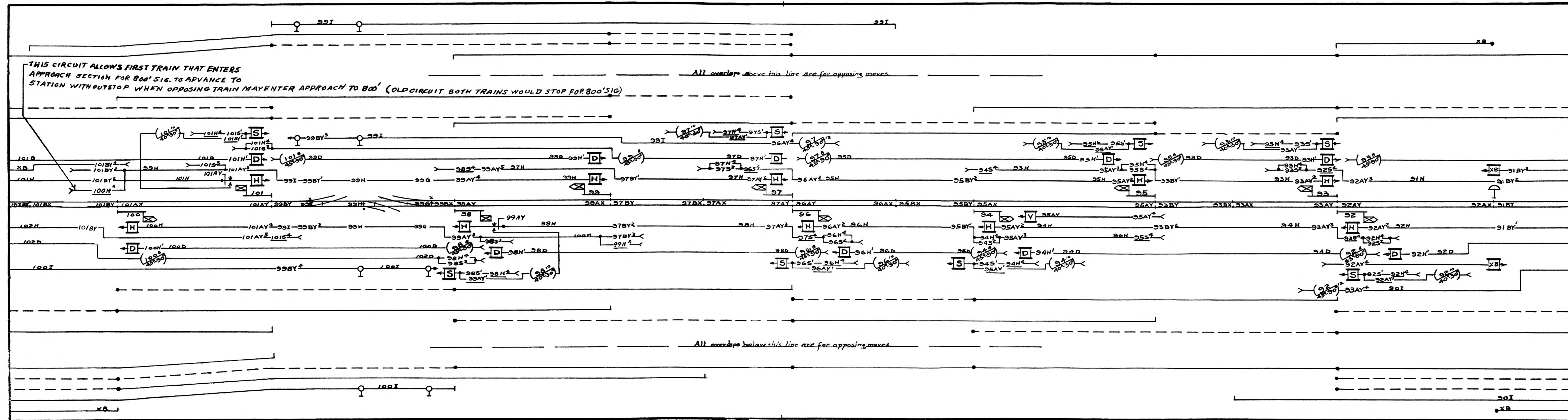
(+) positive battery to right hand post (No.92) - (1935)

Numbering track wires -

Face the west and No.1 will be the west side of joint to the left, No.2 will be the east side of joint to the left, etc.

Top post of arresters connects to negative rail center post to positive rail, bottom post to ground rod.

Polar relay - polar contacts must have positive or negative connected to front or back point, not to heel of contact.



Typical straight line circuits and overlaps
for single track automatic signals

B.H. Rexard
6-28-16