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Union Switch & Signal Company

Union Switch & Signal Construction Company

J. E. McCAULLEY,
RESIDENT MANAGER

1101 MATSON BUILDING
SAN FRANCISCO

Southern Pacific Company
Emergency Control Units

May 21, 1945

Mr. R. D. Moore, Sig. Engr.
Southern Pacific Company
65 Market Street
San Francisco, 5, California

Dear Sir:

Since writing you under date of January 8, above subject, we have developed a system of remote control for manual block signals using carrier currents. For your information, we enclose one print of Drawing TM19A1, Sheets 1 and 2, together with description D6.5.10, covering this system.

Respectfully yours,

J. E. McCaulley

Resident Manager

Remote Control of Manual Block Signals

Using Carrier Frequencies and Safety Circuits

Typical Circuits TM19A1 Sheets 1 and 2

The signal system here described is for the purpose of remote control of manual block signals. The aim is to imitate as nearly as possible the dispatcher calling to an operator and asking him to display a particular signal, and the calling back of the operator to the dispatcher saying that the signal has been displayed. Also there shall be an indication sent from the field to the dispatcher that the train is intact, and has passed a particular point. These operations are to be performed by the use of safety circuits, and the following of standard signaling practices as far as possible.

The system provides means to control the block signals to display either a permissive or a clear aspect,and indicate their position by lights on the control machine. A train accepting a proceed signal restores the signal to the stop position, and this is indicated at the office. In order to "OS" the train by the unattended block stations, a rear end clearing device is used which indicates whether the last train to pass a location was completely intact.

The "report clear" device consists of a coil similar to the wayside inductor of the intermittent train control system fastened to the ties in the center of the track between the signals at the block station. The train carried portion of the "report clear" device consists of a permanent magnet attached to the rear coupler of the train in such a way that it is impossible to connect another car on the rear of the train unless the "report clear" device is removed. The responsibility for attaching this device to the rear coupler would be the same as that for the placing of the proper markers on the rear of the train. Thus when the report clear indication is received on the control machine, it indicates that the entire train is intact and has passed the wayside receiver at the particular block station. It is understood that in the event of other than "through" train movements the train would be reported clear by telephone.

The controls and indications between the office and the field stations are transmitted by carrier frequencies in the 10 to 25 K.C. range furnished by the individual carrier transmitters and receivers for safety circuits. Each field station consists of two 3-position signals, a short tripping track section, and a report clear device. Two frequencies will be assigned for controlling the signals at each field station. One frequency to control the right signal, and another frequency to control the left signal.

The frequencies are interrupted at standard code speeds in order to select the various aspects. One frequency is assigned for indicating all information from one field station. Here again the frequency is interrupted at standard code speeds in order to indicate the various signal aspects, and the operation of the "report clear" device.

Carrier frequency from the control point coded at the rate of 120 per minute controls the signal to its premissive aspect, 180 per minute controls the signal to its clear aspect. For indication codes carrier frequency interrupted at the 75 rate indicates a clear signal, 120 rate a permissive signal, and 180 rate for both signals at stop and the track relay down. A code of 240 interruptions per minute indicates both signals at stop, the track relay picked up, and that the report clear device operated satisfactorily at the time the last train passed.

The code frequencies which have been selected correspond to those in standard use in the cab and coded wayside signaling systems. The use of these code frequencies permits the use of code transmitters, decoding units, relays, and transformers, which are now well established as standard pieces of signaling apparatus.

The control machine may be similar to our Style B-30 machine consisting of a track model, the necessary levers for controlling the signals, and the necessary lights for informing the operator of conditions existing in the field. Each block station consisting of a left and right signal requires a 3-position permissive safety lever H for controlling the permissive (45 degree) aspect on the signals, and a 3-position clear safety lever D for controlling the clear (90 degree) aspect. Both levers are of the push-turn type requiring pushing in order to unlock for turning. The permissive lever contains four push contacts which are closed when the lever is pushed. The indication lights for each field station consist of yellow lights over the L and R positions of the permissive lever, and green lights over the L and R positions of the clear lever. In addition a red light over the normal position of the permissive lever indicates that the signal is at stop, and a white light below the permissive lever indicates that the report clear device operated when the last train passed over the tripping track circuit.

A diagram on sheet 1 shows the layout of a typical control machine for controlling signals at three field stations. The typical circuit is a schematic representation of one field station, and the office equipment required for the control and the receiving of indications from that field station. It is understood that other field stations may be added, and that the same amount of apparatus which is shown at the office on sheet 1, with the exception of the code transmitters which can be made common to all office equipment, will be required for each additional field station. Different control and indication frequencies would be assigned to each field station.

Let us explain the operation of the apparatus by assuming that the operator at the office clears signal 4R at the field for the movement of traffic to the right, and that a train accepts the clear signal and passes the tripping track section. As previously pointed out, there are two signal levers per station on the office panel. Movement of a lever to the right controls a right signal for traffic to the operators right, and movement of a lever to the left controls a left signal for movement of traffic to the operators left. In this system a step by step procedure must be followed in order to clear a signal. It is necessary that the signal be made to display permissive aspect, before it can be made display the clear aspect. With both levers in panel 4 in the normal positions manually pushing the permissive lever 4H closes the circuit to start all the code transmitters at the office. A second push contact on the permissive lever 4H closes a circuit to supply 75 code over the normal contacts of both the permissive and the clear levers and a back contact of relay 4PBSR to operate relay 4RCTPR. Relay4RCTPR following 75 code causes the 4R control transmitter to apply high frequency pulsed at 75 code speed to the line circuit. This coded frequency will be received at the field by 4R control receiver causing relay 4RCPR to operate in synchronism with relay 4RCTPR in the office. The contacts of relay 4RCPR energizes a decoding transformer and, through a mechanical rectification circuit, energize relay 4RCDR. The relay 4RCDR at the field location picking up starts the 75, 120, and 240 code transmitters and picks up the track relay which sticks over its own front contact if the track circuit is unoccupied. The 240 code transmitter operates if relay 4TPSR is energized and the 180 code transmitter operates if relay 4TPSR is de-energized.

An indication code is sent back to the office by relay 4CTPR following 180 or 240 code by the circuit over a front contact of the track relay, back contacts of decoding relays 4HR and 4DR, a front contact of relay 4RCDR and a back contact of relay 4LCDR to a heel of relay 4TPSR. If the last train operated the "report clear" device, relay 4TPSR will be up and 240 code will be fed to relay 4CTPR. If the last train failed to operate the "report clear" device, relay 4TPSR will be down and 180 code will be fed to relay 4CTPR. This causes the indication transmitter at the field location to apply high frequency to the line circuit which, through the indication receiver at the office, operates relay 4CPR. The contacts of relay 4CPR energize the decoding transformer picking up relay 4DKR and either relay 4TKR or 4NKR, depending upon whether the "report clear" device functioned properly at the last passage of a train. A front contact of relay 4NKR will cause the white and red lamps to be illuminated on the panel, the red lamp indicating that both signals are at stop and the white lamp that the "report clear" device has functioned properly.

While the permissive lever 4H is depressed the operator now moves it to the right which closes the circuit to pick up relay 4PBSR over a front contact of either relay 4NKR or 4TKR, an R contact on permissive lever 4H, contacts of permissive lever 6H to check that signal 6 is either normal or right in order to prevent the possibility of an opposing move, and a push contact of 4H permissive lever. The permissive lever 4H is now let out in the

right-hand position opening the pick-up circuit of relay 4PBSR at the push button contact. However, relay 4PBSR is held energized by its stick circuit including a front contact of relay 4DKR. The code transmitters are now energized by battery over a front contact of relay 4PBSR. With the clear lever 4D in its normal position, 120 code is fed over a right contact of lever 4H and a front contact of relay 4PBSR to operate relay 4RCTPR at 120 code speed. The frequency of the 4R control transmitter is now coded at 120 code speed which is received by the 4R control receiver at the field location, holding relay 4RCDR energized and picking up relay 4HR through the 120 decoding unit. Relay 4HR, being picked up, causes the permissive right signal to be displayed in the field by battery over a front contact of relay 4RCDR, front contact of relay relay 4TSR, back contact of relay 4DR, and a front contact of relay 4HR. The field relay 4CTPR then responds to 120 code which is delivered over a front contact of a track relay 4TSR, a back contact of relay 4DR, and a front contact of relay 4HR. Relay 4CTPR now codes the indication frequency at 120 per minute to the line. The office receives this code frequency through 4 indication receiver, operating relay 4CPR, holding up relay 4DKR, dropping relay 4TKR or relay 4NKR, and picking up relay 4HKR. A circuit is now completed over the back contacts of relays 4NKR and 4TKR, an R contact of lever 4H, a front contact of relay 4HKR to the yellow indication lamp over the R position of lever 4H, thus indicating that the signal in the field is displaying a permissive aspect.

Note in particular that before it was possible to transmit a code for the permissive signal it was necessary to have an indication in the office that both signals were at stop.

If the operator now desires to place signal 4R in the clear position he merely operates the clear lever for D to the right to a position corresponding to that of the permissive lever 4H. Relay 4RCTPR at the office will now respond to 180 code over R contacts of levers 4H and 4D and a front contact of relay 4PBSR. The 4R control transmitter frequency is now coded at 180 which is received by the R control receiver in the field operating relay 4RCPR at 180 code speed, thus holding relay 4RCDR picked up and picking up relay 4DR. Relay 4HR now drops but it will be noted that relay 4DR picks up over a front contact of relay 4HR and sticks over its own front contact. This insures that the signal at the field station must be placed in the permissive position before it can be cleared. The right signal will now display the clear aspect. Relay 4CTPR at the field location will now operate at 75 code speed coding the output of the indication transmitter to the line. The 75 code will be received by relay 4CPR in the office through the indication receiver and relay 4DKR will be the only decoding relay to remain picked up. This will cause the right signal to be indicated in the clear position on the office panel by a green light over lever 4D.

The train moving from left to right will be assumed to accept the clear signal and pass through the tripping track circuit. The release of track relay 4TSR will put the signal to stop, open the circuit to relay 4CTPR in the field and discontinue the indication code. This will result in the code following relay 4CPR in

the office becoming stationary thus causing all decoding relays to drop. Relay 4PBSR will drop, stopping all the code transmitters in the office and causing relay 4RCTPR to be stationary. All indication lamps on the panel will be extinguished for about two seconds. Relay 4RCTPR at the office becoming stationary, removes code frequency from the line circuit resulting in the release of relays 4DR and 4RCDR in the field. The release of the track relay opened the circuit of relay 4TPSR causing it to release. The 180 code transmitter in the field is kept operating by battery over a back contact of relay 4TPSR after relay 4RCDR released. A circuit may now be traced from the 180 code transmitter contact over back contacts of relays 4TPSR, 4LCDR, 4RCDR, and 4TSR to operate relay 4CTPR at 180 code speed. The indication transmitter frequency being applied to the line is interrupted at 180 code speed which will be received at the office causing the pick up of relays 4DKR and 4TKR. The red light above the permissive lever 4H will be illuminated by battery over a front contact of relay 4TKR during the time a train is passing over the tripping circuit until the rear of the train passes the "report clear" device.

When the rear end of the train passes over the "report clear" device, a permanent magnet attached to the rear coupler will induce a voltage in the receiving coil which is mounted between the rails of the track circuit. This impulse energizes relay 4DSR which sticks over its own normal contact and a back contact of the track relay 4TSR. Relay 4TPSR picks up over a normal contact of relay 4DSR, a back contact of track relay 4TSR, and back contacts of relays 4HR and 4DR. Relay 4TPSR, picking up, de-energized the 180 code transmitter and the red light on the control machine goes out giving a dark panel.

The operator may then return both signal levers to their normal positions. In order to obtain an absolute check that the complete train passed over the tripping track circuit the operator must depress the permissive lever with it and the clear lever in their normal positions. This action closes the push contacts thus closing the circuit to operate relay 4RCTPR at the office at 75 code speed. The R control transmitter transmits the coded frequency operating relay 4RCPR in the field which causes relay 4RCDR to pick up. Relays 4RCDR and 4TPSR up cause the 75, 120, and 240 code transmitters to operate. Also relay 4RCDR closes a circuit through its front contact and back contacts of relays 4DR and 4HR to energize the track circuit. If the train has cleared the track circuit, track relay 4TSR picks up de-energizing relay 4DSR, connecting its coil to the inductor for the next train movement. Relay 4DSR going reverse also closes the stick circuit for relay 4TPSR over a front contact of track relay 4TSR. We now have a circuit from a contact of the 240 code transmitter, front contact of track relay 4TSR, stick relay 4TPSR and relay 4RCDR to operate relay 4CTPR at 240 code speed, thus 240 code is received at the office, picking up decoding relays 4NKR and 4DKR. Relay 4NKR lights the white and red lamps on the panel indicating that

the train has cleared the track circuit and that the "report clear" device has functioned properly.

The operator now releases the permissive lever 4H and the 75 code is disconnected which results in relay 4RCDR releasing. Relay 4CTPR in the field now becomes stantionary, disconnecting the indication code from the line and stopping the operation of relay 4CPR in the office, thus de-energizing all decoding relays. All lamps on the office panel are now extinguished, the field and office are both in a dormant condition and will remain that way until they are placed in the active condition either by the operator pushing the permissive lever or by the release of the track relay in the field.

If, for any reason, the track relay releases, regardless of the position of the levers in the office, the field station will transmit the indication frequency interrupted at 180 times per minute and thus cause the red lamp on the office panel to be illuminated. Because of the stick feature of the track relay, this red indication will persist until stopped by closing the push contacts of the permissive lever.

When clearing an L signal the permissive lever must first be pushed and then turned after the indication is received. Turning the lever to the L position causes relay 4LCTPR in the office to operate, thus transmitting the L control frequency which is received by the L control receiver at the field station, operating the LCPR relay, and picking up the LCDR relay in the field. The clearing of the L signal is similar to the clearing of the R signal which has been described in detail.

The "report clear" device, as shown in this circuit, is for information purposes only since the operator has complete control over all signals regardless of the position of relay 4TPSR. It is evident that if desired the control of either permissive or clear signals could be taken over a front contact of relay 4TPSR. It would also be possible to use this "report clear" device independently of the signal control and indication system described.

In the event of a fault on the line in the form of an open or a cross, which prevents the exchange of indication and control codes between the office and the field, all signals beyond the fault will go to the stop position, and indication lamps on the panels at the office corresponding to these field stations will become extinguished. In the event of an open in the line, satisfactory operation of the system will be obtained out as far as the open in the line. With a cross between the two line wires, in general, it will be possible to operate some of the stations between the cross and the office.

hsy/f

CONNECT TO SH. 2

NOTES

A - THE CONTROL MACHINE IS OF THE PANEL TYPE EQUIPPED WITH A TRACK DIAGRAM, INDICATION LIGHTS AND CONTROL LEVERS. ALL LEVERS ARE OF THE PUSH TURN 3 POS. TYPE DESIGNED TO HANDLE SAFETY CIRCUITS. THE LOWER LEVER (H) CONTROLS THE PERMISSIVE SIGNAL ASPECTS AND IS EQUIPPED WITH PUSH CONTACTS AS WELL AS WITH CONTACTS CLOSED IN THE NORMAL, LEFT AND RIGHT POSITIONS. THE UPPER LEVER (D) CONTROLS THE CLEAR SIGNAL ASPECTS AND IS EQUIPPED WITH NORMAL, LEFT AND RIGHT CONTACT.

A YELLOW INDICATION LIGHT OVER THE L OR R POSITION OF THE H LEVER INDICATES THAT A PERMISSIVE SIGNAL IS DISPLAYED AND A GREEN INDICATION LIGHT OVER THE L OR R POSITION OF THE D LEVER INDICATES THAT A CLEAR SIGNAL IS DISPLAYED. THE RED LIGHT OVER THE H LEVER INDICATES THAT THE SIGNALS ARE AT STOP. THE WHITE LIGHT BELOW THE H LEVER INDICATES THAT THE REPORT CLEAR DEVICE OPERATED WHEN THE LAST TRAIN PASSED OVER THE TRACK CIRCUIT. ALL LIGHTS NORMALLY DARK.

B - TWO CARRIER CONTROL FREQUENCIES AND ONE INDICATION FREQUENCY PER STATION, INTERRUPTED AT STANDARD CODE SPEEDS.

C - THE AAR AGREEMENT IN THE RANGE EMPLOYED REQUIRE THAT FREQUENCIES BELOW 17KC SHALL BE TRANSMITTED FROM EAST TO WEST OR NORTH TO SOUTH WHILE 17KC OR GREATER FREQUENCIES SHALL BE TRANSMITTED FROM WEST TO EAST OR SOUTH TO NORTH.

SEE SH. 2 FOR FIELD CIRCUITS AND REFERENCES.

OFFICE
REMOTE CONTROL USING CARRIER FREQUENCIES.

PANEL TYPE MACHINE WITH PUSH-TURN LEVERS.
THREE POSITION PERMISSIVE AND CLEAR CONTROL LEVERS.
TRIPPING SECTIONS AND REPORT CLEAR DEVICE AT SIGNALS.
INDIVIDUAL CARRIER FREQUENCY TRANSMITTERS AND RECEIVERS
SIGNAL MUST BE PLACED IN THE PERMISSIVE POSITION
BEFORE THE CLEAR ASPECT CAN BE DISPLAYED.

REVISIONS

REFERENCES
DESCRIPTION
D6.5.10

DESIGNED HSY
DRAWN FEP-JAH
TRACED
CHECKED
OK'D

MANUAL BLOCK SYSTEM
TYPICAL SYSTEM CIRCUITS

U. S. & S. CO., SWISSVALE, PA. SCALE:

APPROVED H.H.H. DATE 5-10-45
2 SHEETS SHEET No. 1
DATE 5-4-45
TM19 AI

REFERENCES

1. OFFICE CONTROL PANEL WITH TRACK DIAGRAM, INDICATION LAMPS AND THREE POSITION PUSH-TURN LEVERS.
2. INDIVIDUAL CARRIER TRANSMITTER D2390, SH.19.
3. INDIVIDUAL CARRIER RECEIVER D2390, SH.20.
4. W-7 DECODING TRANSFORMER 13V.DC. PC.213131-C9228, SH.11
5. ARC SUPPRESSOR PC.237122-B12549, SH.55
6. STYLE DM CODE TRANSMITTER 2F-2B LV CONTACTS 75 CODE PC.242040-C9376, SH. 12.
7. STYLE DM CODE TRANSMITTER 2F-2B LV CONTACTS 120 CODE PC.221553-C9376, SH. 14.
8. STYLE DM CODE TRANSMITTER 2F-2B LV CONTACTS 180 CODE PC #221552-C9376, SH. 14.
9. STYLE DM CODE TRANSMITTER 2F-2B LV CONTACTS 240 CODE SIMILAR TO PC.221552
10. 120DU DECODING UNIT PC.188697-C9454, SH. 6.
11. 180DU DECODING UNIT PC.188694-C9454, SH. 5.
12. 240DU DECODING UNIT SIMILAR TO PC.188694
13. STYLE KP POLAR BIASED RELAY 2N-2R CONTACTS 2140 OHMS, PC.191481-B12786, SH.2 PLUS RACKS.
14. STYLE KP POLAR BIASED RELAY 66 OHMS SIMILAR TO PC.191481
15. STYLE DN-11 RELAY 4F-4B CONTACTS 1000 OHM PC.157187-C9077, SH. 24.
16. STYLE DN-11 RELAY 6F-6B CONTACTS 4 OHM PC.166158-C9077, SH.15
17. STYLE DN-18C RELAY 4F-4B CONTACTS 64 OHMS PC.217453-C9077, SH. 101.
18. STYLE DN-18C RELAY 6F-6B CONTACTS 64 OHMS PC.217454-C9077, SH. 101.
19. STYLE DN-22 RELAY 2F-2B CONTACTS 55 OHMS PC.223421-C9432, SH. 17.
20. STYLE DN-11C RELAY 6F-6B CONTACTS 55 OHMS PC.221112-C9077, SH. 113.
21. STYLE DN-11 SLOW RELEASE RELAY 500 OHM PC.157188-C9077, SH.24
22. STYLE DN-22P POWER TRANSFER RELAY 12V PC.224029-C9432, SH.20
23. W-5 LIGHTING TRANSFORMER C16725, SH. 2.
24. WAYSIDE INDUCTOR. E.O.33530 SH. 2.
25. PORTABLE MAGNET UNIT. E.O.33530 SH. 3.
26. ADJUSTABLE TRACK RESISTOR. 9065, SH. 199.

REVISIONS

REFERENCES

FIELD STATION

MANUAL BLOCK SYSTEM
TYPICAL SYSTEM CIRCUITS

U. S. & S. CO., SWISSVALE, PA.

SCALE: NONE

DESIGNED	HSY
DRAWN	IKS-P
TRACED	
CHECKED	
OK'D	
APPROVED	
DATE	5-10-45
SHEETS	2
SHEET No.	2
DATE	5-2-45
	TM19AI