Centralized Traffic Control System
Typical Circuits
Drawing TE10G9

The centralized traffic control system shown on Dwg. TE10G9, sheets 1 to 3 inclusive, has been designed for use in territory where the amount of traffic involved does not warrant the use of a standard C.T.C. system employing power operated switches. The system shown on Dwg. TE10G9 is designed to provide the operating advantages of directing train movements by signal indication and doing away with train orders.

The signaling arrangement provides for a two-arm signal at each end of passing sidings for governing facing point movements. The top arm governing movements on the main line is a standard position light signal providing the usual three aspects. The second arm is a take siding indicator. When the take siding indicator is displayed, a train approaching that signal will take siding on the authority of the take siding indicator without having any other proceed signal aspect displayed. The switch will be hand-operated.

At each end of the passing siding, a one-arm high signal governs trailing movements over the main line and a 4-indication dwarf signal governs movements from the siding. When a move is to be made from the siding, the dwarf signal will first display a leave siding indicator, giving authority to the trainman to reverse the switch. When the switch is reversed, the dwarf signal will

display yellow or green, depending on the block ahead, thus giving the train authority to proceed into the block.

All of the above signals are under the control of the operator.

Intermediate automatic signals are provided in the single track stretch between the ends of sidings. On the basis of light traffic and sidings approximately seven to nine miles apart, not many intermediate signals are required and blocks can be made long, since short blocks are required for heavy following moves and not for opposing protection. A distant signal to each entering headblock signal is provided for proper protection at the headblock location. This distant signal is placed at just maximum braking distance from the entering headblock signal. An intermediate signal is provided opposite this distant signal to enable a following train which has been passed at the siding by another train to receive a leave siding signal as soon as possible. The block between the two pairs of intermediates may be quite long.

The usual signal and OS indications are provided. The OS indication is controlled by the short track circuit at each end of the passing siding. A block indication is provided on the control panel for indicating the entire territory between sidings. An indicator is also provided on the control panel for indicating the track circuits on the main track at each siding.

Stick locking is provided in connection with the C.T.C. controlled signals. This locking is used to introduce a time interval if it becomes necessary to take away a proceed signal and set up the control for an opposing signal. This stick locking also

provides for a time interval if it becomes necessary to change to a proceed indication from the main line to a leave siding signal or from a leave siding to a main line signal. It is not considered necessary to provide time locking in connection with a change from take siding signal to a top arm signal for facing move or vice versa because of the fact that the switches are manually operated by the trainman and therefore if a train should not be able to stop at the signal when the signal aspect is changed from proceed or approach to take siding, there would be no more danger involved than if the signal were placed at stop by the operator in the face of the train. Also, if the signal is changed from take siding to approach or proceed, there would appear to be no danger involved which would require the use of time locking.

The system is based on the use of our time code scheme of control using either standard C.T.C. storage units or similar units modified to eliminate unnecessary controls or indications.

Coded track circuits are used for detector purposes for the long circuits between sidings where they show economy whereas conventional track circuits are used for the short track circuits at each headblock location and for the track circuits between ends of a siding when the siding is short. For long sidings, it may be economical to use a coded track circuit between ends. The code speed is normally 180 cycles per minute. This code speed is changed to 120 cycles per minute under certain conditions of occupied block as will be described later. Thus the coded track circuits are used for detector purposes and for the purpose of giving an occupied block indication. For the long block between distant

and signal locations if several coded track circuits are necessary, they are cascaded (from left to right) and decoded only at a signal location.

The signal control is based on a two-wire A.P.B. scheme under C.T.C. control. Two types of line circuits are shown in connection with signal control. The control circuits for the signals for moves on the main track at the sidings must differ somewhat from the circuits for the signals governing moves from siding to siding because of the effect of manual operation of the siding switches.

The circuit for the control of signals on the main track at sidings may be seen by connecting the left hand end of sheet 1 to the right hand end of sheet 3 of drawing TE10G9. A battery is located at each end of the circuit and under normal conditions when no signal control has been set up, these batteries are connected positive to positive through the line circuit so that the only current which would flow would be produced by the difference in the battery voltages. This current would be further restricted by the valve rectifier units shown in series with each battery. If it is desired to clear signal 4RA, for a move from left to right, the operator will transmit a C.T.C. code which will pick up relays 4RHSR and 3NWSR. This will pick up relay 4EFR by a circuit including front contacts of 4RHSR, 3NWSR and back contact of relay 4RZR. The picking up of relay 4EFR transfers the line circuit from battery to the winding of relay 4RHDR. Relay 4RHDR will now be energized from the battery at signal R2. The positive side of this circuit is from battery wire 2 B through valve rectifier, the winding of relay 2LZR,

front contact of relay 2LASR, pole changing contacts on relay 2RAPCR, back contact of traffic relay 2WFR, front contacts of relays 1TR, 4TR, 3TR, 4EFR, 4RHSR to the winding of relay 4RHDR. The current now flowing in this circuit should energize relay 2LZR to prevent storage of signal control for clearing the opposing signal 2L. The picking up of relay 2LSR closes one contact in the circuit for relay 2RAPCR and if signal 2RA moves to caution or clear, the circuit for relay 2RAPCR will be complete and this relay will pick up to pole change the line circuit so as to display a clear indication at signal 4RA. The reason for using relay 2RAPCR controlled in the above manner is to prevent the pole changing of the circuit until after the control of signal 4RA has been established and thus prevent connecting the line batteries in series.

If, under the above condition, the operator should now code signal 4RA to stop, the release of relay 4RHSR will open the line circuit and also open the circuit of relay 4EFR. It is necessary that relay 4EFR be slow in releasing so as to permit relays 2LZR and 2RAPCR to release first so as to prevent the batteries located at each end of the siding being connected in series through the line circuit.

If it is desired to display a take siding signal at signal 4R, the operatorwould transmit a C.T.C. code which would pick up relay 4RHSR but would not pick up relay 3NWSR. This control picks up relay 4RBHR and the take siding indicator light is lighted through one of its front contacts.

The circuit for the control of signals from siding to siding may be traced from the right hand end of sheet 1 through sheet 2 and continued on the left hand end of sheet 3 of drawing

TE10G9. As shown on the drawing, battery is being fed from signal 4R to energize relay 104HDR at intermediate signal 104. This circuit may be traced from the battery at signal 4R through pole changing contacts on relay 4RAPCR, front contacts on relays 4LASR, 4WFR, 104TPR, and back contacts of relays 103HDGPR and 103SR to the winding of relay 104HDR. Relay 104HDR controls signal 104. Energy is now fed from the battery at signal 104 through the line circuit to pick up relay 102HDR. The circuit may be traced from the battery through resistor R1, front contacts of relay 104HDGPR, 102-3TPR and back contacts of relays 101HDGPR and 101SR to the winding of signal 102. Energy is then fed from the battery at signal 102 through a line circuit similar to the above to pick up relay 2RHDR. This circuit includes back contacts of relay 2EFR. It will be noted that the back contact of 2RHDR opens the circuit of relay 2EFR so that the line circuit is maintained in the above condition until it is interrupted by the storing of a control for the clearing of the opposing signal 4L or by train entering the single track stretch. If the operator desires to control signal 2RA, he will transmit a C.T.C. code which will pick up relay 2RHSR and 1NWPR. The picking up of these relays will release stick locking relay 2RASR. This then completes the circuit for signal 2RA.

It will be noted that the stick circuit for relay 1NWSR under the above condition is controlled by a front contact of relay 2RHSR so that a change in control to set signal 2RA st stop and set up the control for signal 2RB for leaving siding would require that a stop signal code be transmitted which would

de-energize relay 2RHSR and 1NWSR. The pick up of circuits for both of these relays are controlled over front contacts of relay 2RASR so that the control for signal 2RB cannot be established until after the stick locking has been released. To establish the control for leave siding dwarf signal 2RB, the operator would have to send a CTC code to pick up relay 2RHSR but not to pick up relay 1NWSR.

With the circuits in the normal condition as shown on the drawing, the operator may transmit code to clear signal 4LA or 4LB. Either of these codes would pick up relay 4LHSR and a back contact of this relay would open the circuit of relay 4WFR. The release of relay 4WFR will disconnect the battery at signal 4R from the line circuit which will release in sequence relays 104HDR, signal 104, 104HDGPR, signal 102, 102HDGPR and 2RHDR. The release of the latter relay will complete the circuit for picking up relay 2EFR which will connect the battery at signal 2L to the line circuit to pick up in sequence relays 101HDR, signal 101, 101HDGPR, signal 103, 103HDGPR and 4LHDR. The above operation amounts to a reversal of traffic control and permits the clearing of signal 4LA or signal 4LB.

Let us assume that the circuits are in the condition shown on the drawing except that signal 2RA has been cleared. When a train moving from left to right accepts signal 2RA and enters track circuit 1T, relay 2EFSR will pick up over back contact of 1TR and front contact of 2RHDR, but will stick up over the back contact of 2RHDR, holding up during the transfer time of this contact from front to back. It will be noted that a back contact of relay 2EFSR

now opens the circuit of relay 2EFR so as to prevent application of energy to the left hand end of the line circuit and so as to keep relay 2RHDR connected to the line circuit. When the train moving from left to right passes signal 102, directional stick relay 102SR will be picked up in the usual manner and this will connect the battery of signal 102 to the line circuit to pick up relay 2RHDR as soon as the train cleared the track circuit 101T. Relay 2RHDR opens the stick circuit for relay 2EFSR and at the same time opens its back contact in the circuit of relay 2EFR, thus maintaining the circuit for relay 2RHDR so that the following move may be made. We believe that the operation of the remainder of the circuits as the train moves from left to right on the single track stretch will be understood from the above description. In order to provide an indication showing that the complete stretch between sidings is unoccupied when two or more intermediate signals are involved, it is necessary to provide some special means of control which will repeat the complete block.

The operation of coded track circuits is explained in our Pamphlet SPL1036. The coded track circuits shown on TE10G9 make use of a 2-point P-4 relay and "mechanical rectification" for decoding the code following relay. A change in the code speed is utilized for obtaining a block indication as follows:

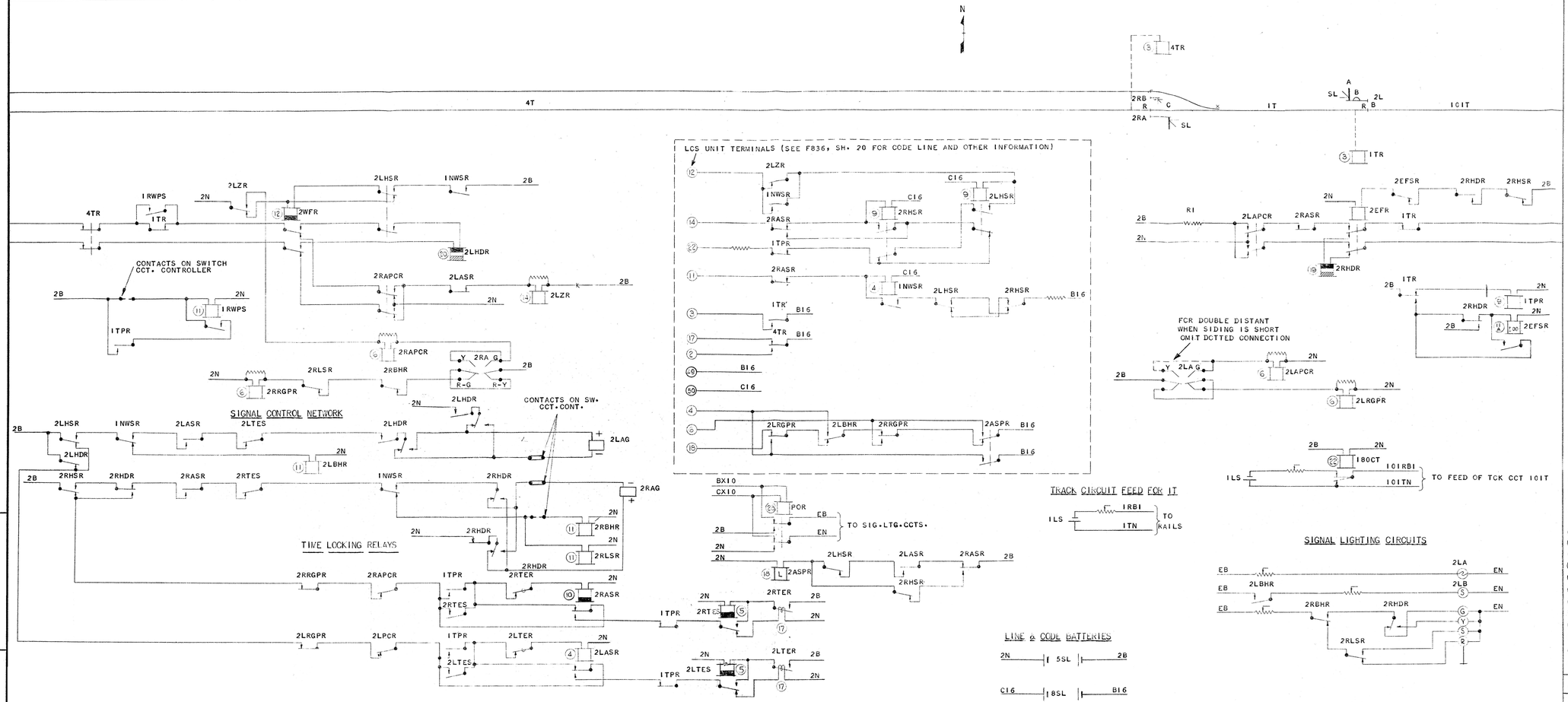
All of the coded track circuits have the battery at the left end and the relay at the right end of the circuit. The normal code speed, when the section between signals 2L and 4L is unoccupied is 180 cycles per minute. If track circuit 101T is occupied, decoding relay 101TP becomes de-energized and the feed to track

circuit 102 is transferred from front to back contact of relay 101TP which selects a contact of the 120 coder instead of the 180 coder in this track feed circuit and changes the code speed to 120 cycles per minute. These code impulses are cascaded at the cut section between track circuits 102 and 103 and thus track relay 103TR follows 180 code. Decoding relay 102-103TP at signal location 103-104 stays energized on either 120 or 180 code but relay 101-3-3TKR by virtue of the tuned 180 decoding unit stays energized only when the code speed is 180. Thus, with a train in 101T, relay 101-2-3TKR is de-energized. It is also de-energized when the train is in 102T or 103T. Relay 101-2-3TKR de-energized, changes the code speed in track circuit 104 to 120 cycles per minute. Relay BKR at location 4R is therefore de-energized because it responds only to 180 code. BKR also stays de-energized when 104T or 3T are occupied. Thus relay BKR is de-energized if there is a train anywhere between signals 2L and 4L. Contact of relay 3TR is added in the decoding circuit for BKR so as to send the block indication and the "OS" indication for track circuit 3T in the same code. This is necessary to prevent defeat of the lock-out circuit shown in dotted rectangle on sheet 3 of TE10G9 in the case where a light train going from right to left passes off track circuit 3T de-energizing relay 3TK at the control station before relay BK picks up due to a code delay, thus enabling the operator to reverse the lockout relay 2-4LPR at the control station and send a code to pick up relay 2RHSR which will place intermediate signals to stop in the face of the train. Relay 1TKS is provided

at the control station to prevent this defeat of the lockout circuit in the case of a light train moving from left to right.

With relays 1TK, BK, 1TKS, 4LHK and 4RHK at the control office de-energized, the operator may hold lever 2 to the right to position the polar contact of relay 2-4LPR to a position for transmitting a code to clear signal 2R or the operator may position lever 4 to the left which will complete a circuit to position the contact of relay 2-4LPR to a position to transmit a code for clearing signal 4L.

When the stretch between signals 2R and 4L is occupied, either or both of relays 1TK and BK will be energized so that the operator cannot establish a circuit to change the position of the polar contact of relay 2-4LPR and therefore the operator cannot transmit a code to clear an opposing signal. The operator is, however, privileged to transmit a code to clear a signal for a following move at any time.



NOTES

A TRACK REPEATING CIRCUITS TO BE DOUBLE BREAK WHEN TRACK RELAY AND REPEATER ARE NOT IN SAME HOUSING.

B RESISTOR RI USED TO LIMIT CURRENT IF LINE BATTERIES ARE MOMENTARILY CONNECTED IN SERIES.

C REFERENCES FOR CODED TRACK CIRCUIT APPARATUS, RELAYS ZR AND SERIES RECTIFIER, AND DP21 RELAY IN SERIES WITH 2R TO BE OBTAINED FROM ENGINEERS.

D AAR CODE RULE 291, STOP AND PROCEED SIGNALS DESIGNATED BY

1 - NUMBER PLATE, OR

2 - MARKER LIGHT, OR

3 - COMBINATION OF THESE DISTINGUISHING FEATURES.

REFERENCES

1. P4 TRACK RELAY - 2 POINT POLAR BIASED NEUTRAL
2. P4 TRACK RELAY - 1 POINT POLAR BIASED NEUTRAL
3. DN11 - TRACK RELAY 4 POINT ORD. ACT.
4. DN11 - LINE RELAY 4 POINT ORD. ACT.
5. DN11 - LINE RELAY 4 POINT SLOW RELEASE
6. DN11 - LINE RELAY 4 POINT WITH RESISTOR SNUB
7. DN11C - LINE RELAY 4 POINT WITH RESISTOR SNUB
8. DN11C - LINE RELAY 4 POINT WITH RESISTOR SNUB & 1 H.D. CONTACT.
9. DN11 - LINE RELAY 6 POINT ORD. ACT.
10. DN11 - LINE RELAY 6 POINT SLOW RELEASE
11. DN22 - LINE RELAY 2 POINT ORD. ACT.
12. DN22 - LINE RELAY 2 POINT ORD. ACT 500 Ω
13. DN22 - LINE RELAY 2 POINT SLOW RELEASE
14. DN22 - LINE RELAY 2 POINT WITH RESISTOR SNUB
15. DN22 - LINE RELAY 2 POINT SERIES-WITH RESISTOR SNUB
16. DN22C - LINE RELAY 2 POINT 180 DECODING
17. DN18 - LINE RELAY 4 POINT S.P.SR.
18. TH10 - THERMAL RELAY 2 POINT
19. L10 - LINE RELAY 2 POINT
20. DP21 - LINE RELAY 4F-2B,4N-4R POLAR RETAINED NEUTRAL
21. DP21 - LINE RELAY 4F-2B,2N-2R POLAR RETAINED NEUTRAL
22. DM TYPE CODE TRANSMITTER 2F-2B, 120 CODE
23. DM TYPE CODE TRANSMITTER 2F-2B, 180 CODE
24. W7 DECODING TRANSFORMER
25. W5A DECODING TRANSFORMER
26. 7MF CONDENSER
27. .94MF CONDENSER
28. Y10 - 180 DECODING UNIT
29. ANL30 - POWER TRANSFER RELAY

TIME CODE SCHEME, SINGLE TRACK, DOUBLE WIRE A.P.B. SIGNALING, D.C. SCHEME

TWO WIRES ONLY FOR SIGNAL CONTROL, SEARCHLIGHT SIGNALS, TAKE AND LEAVE SIDING INDICATORS, MANUALLY OPERATED SWITCHES, D.C. CODED & NON-CODED TRACK CIRCUITS, BLOCK INDICATOR CASCADED BY 180 CODE FROM LEFT TO RIGHT AND SENT IN FROM OTC STATION AT LEFT END OF SIDING

REVISIONS

REFERENCES

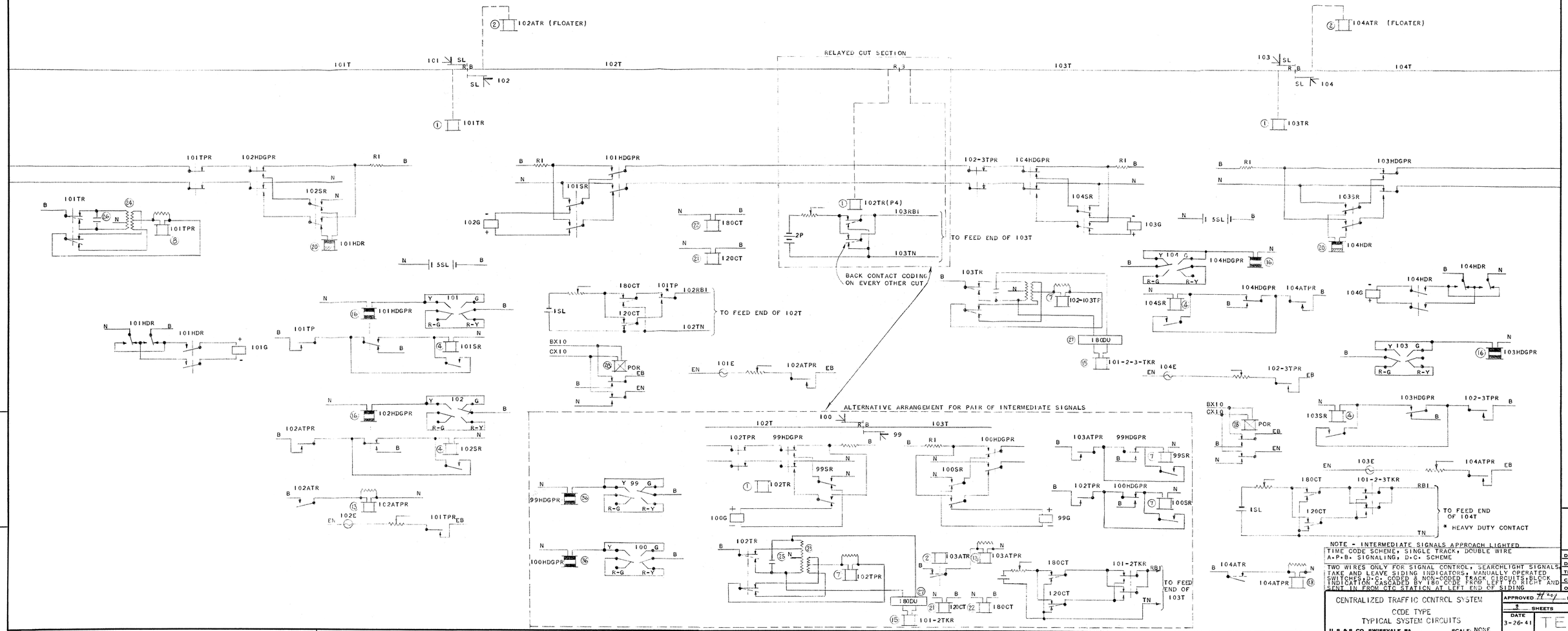
DESIGNED JMP
DRAWN TTR-H
TRACED
CHECKED RAM
O.K'D

CENTRALIZED TRAFFIC CONTROL SYSTEM
CODE TYPE
TYPICAL SYSTEM CIRCUITS

APPROVED H.P. DATE 4-11-41
3 SHEETS SHEET NO. 1
DATE 3-26-41
SCALE: NONE

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

TE1069



NOTE - INTERMEDIATE SIGNALS APPROACH LIGHTED

TIME CODE SCHEME, SINGLE TRACK, DOUBLE WIRE A.P.B. SIGNALING, D.C. SCHEME

TWO WIRES ONLY FOR SIGNAL CONTROL, SEARCHLIGHT SIGNALS, TAKE AND LEAVE SIDING INDICATORS, MANUALLY OPERATED SWITCHES, D.C. CODED & NON-CODED TRACK CIRCUITS, BLOCK INDICATION CASCADED BY 180 CODE FROM LEFT TO RIGHT AND SENT IN FROM CTC STATION AT LEFT END OF SIDING

REVISIONS

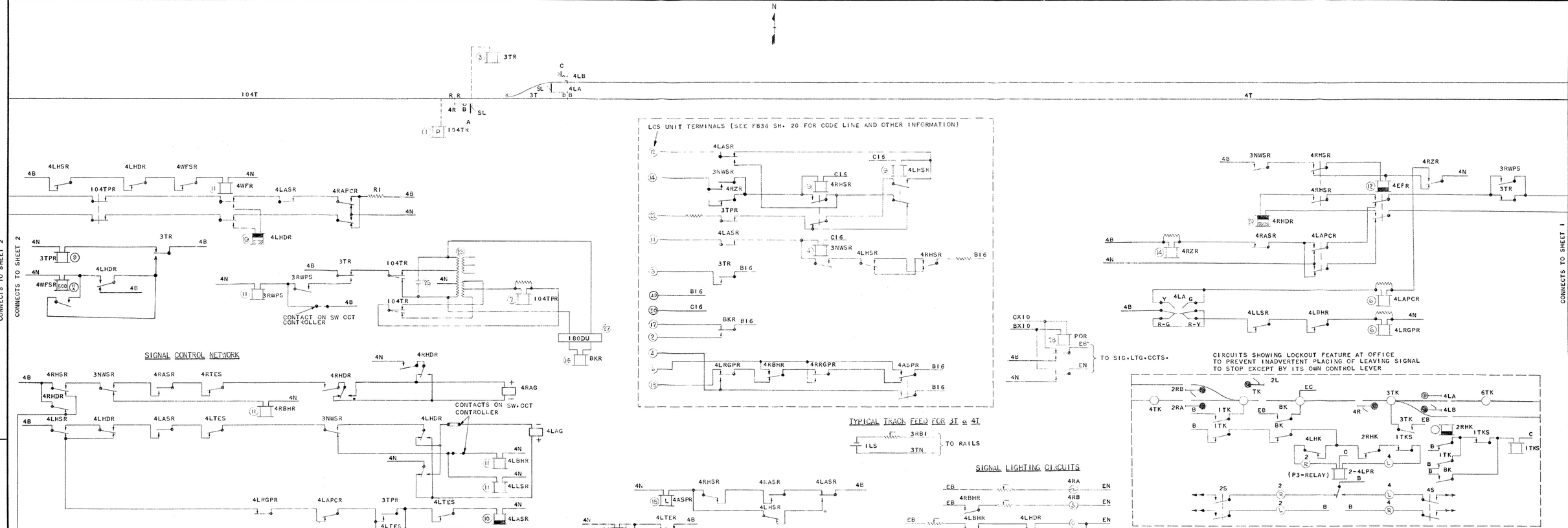
REFERENCES

DESIGNED	JMP
DRAWN	JMM-H
TRACED	
CHECKED	
O.K'D	
APPROVED	H.A.J.
DATE	4-10-41
SHEETS	3
SHEET NO.	2
DATE	3-26-41

CENTRALIZED TRAFFIC CONTROL SYSTEM
CODE TYPE
TYPICAL SYSTEM CIRCUITS

U. S. & S. CO., SWISSVALE, PA. SCALE, NONE

TE1069



REVISIONS

REFERENCES

TIME CODE SCHEME, SINGLE TRACK, DOUBLE WIRE A.P.B. SIGNALING, D.C. SCHEME

TWO WIRES ONLY FOR SIGNAL CONTROL, SEARCHLIGHT SIGNALS, TAKE AND LEAVE SIDING INDICATORS, MANUALLY OPERATED SWITCHES, D.C. CODED & NON-CODED TRACK CIRCUITS, BLOCK INDICATION, CASCADED BY 180 CODE FROM LEFT TO RIGHT AND SENT IN FROM OTC STATION AT LEFT END OF SIDING.

CENTRALIZED TRAFFIC CONTROL SYSTEM
CODE TYPE
TYPICAL SYSTEM CIRCUITS

U. S. S & S. CO., SWISSVALE, PA. SCALE: NONE

DESIGNED	JMP
DRAWN	TIR-H
TRACED	
CHECKED	RMC
O.K'D	
APPROVED	JMP
DATE	4-11-41
SHEETS	7
SHEET NO.	3
DATE	3-26-41

TE1069