American Railway Signaling Principles and Practices

CHAPTER XXV

Coded Track Circuits

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CODED TRACK CIRCUITS

The coded track circuit is an important advancement in the history of railway signaling. While the steady energy track circuit serves its purpose well, the coded track circuit affords a more flexible arrangement, not attainable with the steady energy type.

A simple description of a coded track circuit is a track circuit in which the steady rail current is interrupted a predetermined number of times per minute so as to form a code consisting of uniform recurring impulses of rail current. By using codes of different number of impulses per minute, the current in the rails can be employed to perform functions other than detecting the presence of a train and broken rails.

The use of coded energy in track circuits provides, for all practical purposes, immunity to improper operation due to crosses, grounds or any other foreign influence such as capacity coupling, inductive interference or stray currents. It also provides higher shunting sensitivity, improved protection against intermittent loss of shunt, improved broken-rail detection and detection of defective insulated rail joints.

Where foreign current in an area is experienced, its effect may generally be surmounted or at least minimized by the use of coded track circuits, either d.c. or a.c. Foreign current may cause the coded track relay to be continuously energized or de-energized, resulting in no coding action which is equivalent to shunted track. This would cause a restrictive aspect to be displayed, the same as if a train were in the block.

In a steady energy track circuit, a train shunt must reduce the rail potential below the track relay's drop-away value in order to obtain track relay release. In a coded track circuit, however, the shunt need only reduce the rail potential below the track relay's pick-up value to stop the track relay from following code. As the latter value is considerably above the former, coded track circuits inherently have a shunting sensitivity which is higher than that of steady-energy track circuits under equivalent track circuit conditions.

Coded track circuits utilize higher initial rail voltage than do steady energy track circuits because energy is applied intermittently. Since with coded circuits energy is applied to the rails intermittently, less total power is used, even at the higher voltage. In addition to the economy so obtained, an improvement in shunting sensitivity is obtained by the use of higher interrail voltages which helps to break down the insulating films that form on the surfaces of the rails and wheels.

With coded track circuits, the code-following track relay works in conjunction with a code detector relay which checks that the track relay is following the code, thus, even though the track relay may be energized momentarily due to intermittent loss of shunt, quick shunting and slow reset can be readily provided in the code detector relay so that it will not respond to irregular or intermittent operation of the code-following track relay. Intermittent loss of shunt usually results in rapid variation in the track relay current, which causes irregular operation of the code-following track relay and de-energization of the code detector relay.

Coded track circuits provide better broken-rail detection than do steady energy circuits. As explained previously, an occupancy indication is obtained with a coded track circuit when the energy to the track relay is below pick-up. Hence, broken-rail detection is obtained when the leakage around a break in the rail is below the value of current required to pick up the code responsive track relay whereas this same detection is obtained on a steady energy circuit only when the leakage around the rail break is below the drop-away of the track relay. In addition, coded track circuits provide immunity to improper operation because of foreign current, since these currents either aid or oppose the regular code pulses and cause the relay to remain either fully energized or fully de-energized depending on the polarity of this foreign current. The absence of code results in the display of the most restrictive signal indication.

Protection against improper operation because of broken-down insulated joints is also obtained with coded track circuits. The track relay is a biased relay and will operate only with current of correct polarity. Hence by reversing the polarity of adjoining track circuits the relay will tend to be held de-energized by any energy which it receives from an adjoining track circuit through defective insulated joints.

In automatic signal territory, the controls for signals are accomplished by the use of various code rates in the coded track circuit. The three standard code rates are 75, 120 and 180 cycles per minute. The 75 code is used for the approach aspect. The 120 code is used for the approach medium aspect. The 180 code is used for the clear aspect. It is understood that the absence of code will result in a stop aspect. Approach lighting and approach locking can be accomplished by reverse code, details of which are explained later. Direct current code may be polarized to provide additional channels. It may be necessary to provide line wires for some auxiliary circuits, but generally the rails are used to control wayside signals by transmitting coded energy. It is possible to control wayside signals in automatic block signal system territory by coded track circuits with or without the use of line wires. The use of line wires may be desirable to by-pass locations where highway crossing protection installations are frequent enough to make coded track uneconomical. This use of line wires may apply also in traffic control system territory (commonly known as CTC or centralized traffic control). By eliminating most of the line wires, signal failures resulting from line faults or prostrations will be reduced to a minimum. The reduction or elimination of line wires would reduce the expense where new lines have to be built or where old lines have to be rebuilt.

The inherently greater operating margins of coded track circuits, which provide higher shunting sensitivity and greater broken-rail detection, permit the use of coded track circuits with lower ballast resistances and having greater lengths, thus reducing the number of cut-sections required.

A coded track circuit control system can be readily expanded to provide additional signal aspects. For instance, a three-indication system using 75 and 180 codes can be expanded to a four-indication system by the addition of 120 code equipment.

Coded track circuits may be used to perform a variety of functions as compared with the limited functional capacity of the steady energy track circuit. With the additional apparatus required, the basic form of the coded track circuit may be expanded to accomplish all elements of control required by certain signal systems. This flexibility is an important factor, not only in automatic block signaling, but also in connection with installation of traffic control, remote control, interlocking, and other systems of signaling.

Cab signaling with or without speed control can be added to or substituted for wayside signaling at relatively low additional cost for wayside apparatus where coded track circuits are in use.

Where coded track circuits are utilized in a traffic control system, it is possible to use coded energy on the rails to check the track occupancy between sidings and to provide an unlock for an electric switch lock to permit train movements from an auxiliary or spur track.

Mention of these uses is made here to emphasize how increased facilities can be realized and how coded track circuits can be adapted to practically any signaling requirements.

A simple form of d.c. coded track circuit is shown in Fig. 1. The track relay is connected to one end and a track battery with a current limiting resistor is connected to the other end of the track circuit. The arrangement looks very much the same as a steady energy track circuit. The difference is that in a coded track circuit the energy supplied to relay TR by the track battery is coded at regular intervals by the contacts of code transmitter CTR. The code transmitter produces alternate "on" and "off" periods of energy. Relay TR picks up during the "on" period and releases during the "off" period, thus following the code pattern. The track circuit is short circuited by the back contact of the code transmitter to dissipate any energy stored in the rail track circuit with resultant improvement in the code pattern.

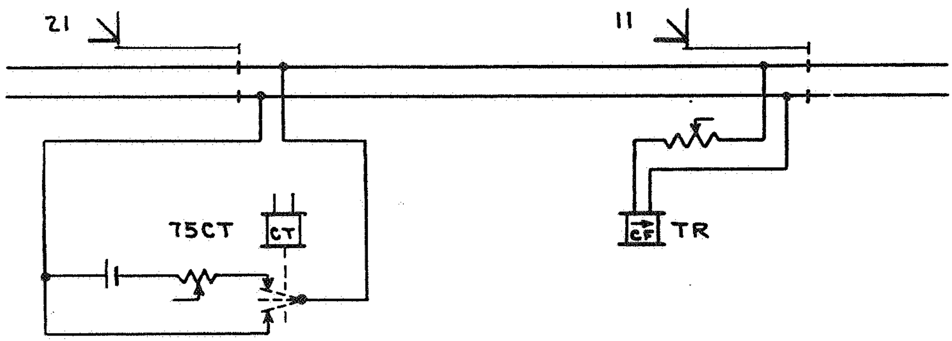


Fig. 1.

The track relay illustrated is a biased relay requiring that the energy applied to the track relay coil terminals be of proper polarity to energize the track relay and close its front contacts. Energy of improper polarity, such as results from a defective insulated joint, or absence of energy, results in the track relay being in the de-energized position and opening its front contacts. The track relay will pick up and drop away as the coded d.c. impulses are applied and removed from the rails. In other words, the track relay "follows the code" on the rails and is commonly called a code-following relay.

Since the code-following track relay is picking up and dropping away in unison with the impulses to the rails, an arrangement must be provided that will indicate that the track is unoccupied or that the d.c. impulses are continuously applied to the rails. This may be accomplished by means of a circuit consisting of two relays, as illustrated in Fig. 2.

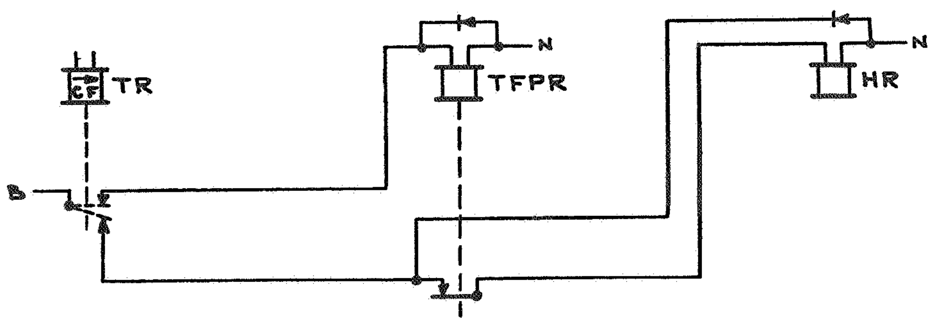


Fig. 2.

Relay TFPR repeats the front contact of the code-following track relay TR. It is made sufficiently slow drop-away by the rectifier to bridge a complete cycle of the lowest code transmitted; that is, it is slow enough in drop-away to bridge the period from the time the code-following relay picks up, releases and picks up again. A second relay, HR, known as the detector relay, picks up through a back contact of the code-following track relay TR and a front contact of the repeating relay TFPR.

This detector relay HR is also made slow drop-away to bridge a complete cycle of the lowest code transmitted to which the relay TR responds, as explained. So long as the code-following track relay is following the code, that is, picking up and releasing as the impulses are applied and removed from the rails, both TFPR and HR relays will be up. If, however, the code following track relay remains continuously energized, the detector relay HR will release as its control circuit is opened at the back contact in the code-following track relay TR. If the track current is shunted by a train occupying the track or is cut off by an open circuit due to broken rail or other causes, the code-following relay will release, causing relay TFPR to release. This in turn opens the control circuit of the detector relay HR where its control passes through the front contact of repeater relay TFPR. In other words, it is impossible for the detector relay HR to be up if there is steady energy on the code-following relay TR or if the TR relay is continuously de-energized.

You will note that the coils of the TFPR are shunted by a rectifier, or "snub," to make the relay slow drop-away. The rectifier in the control of the detector relay HR is so connected that it shunts the coils only while the TFPR relay is up. If, however, the relay TFPR is de-energized, the snub circuit is removed from the coils of the detector relay HR so that it will release quickly. A resistance or capacitance snub is used in some applications to accomplish the same purpose. Over-all timing characteristics will be different and should be considered.

The combination of repeater and detector relays provides a means of checking the code-following track relay. This check is a very important feature. It is used to provide the approach indication or to indicate a block is clear of trains and provides all the safety that a track relay provides.

Instead of using two relays it is possible to use only one relay in combination with a transformer to ascertain the condition of the track circuit. This is shown in Figs. 3, 4 and 5.

Figure 3 shows the condition that exists when the track relay is de-energized. Steady current flows in the lower half of the primary winding of the transformer so that after the flux builds up the flux remains constant, after which there is no inductive transfer of energy to the secondary of the transformer.

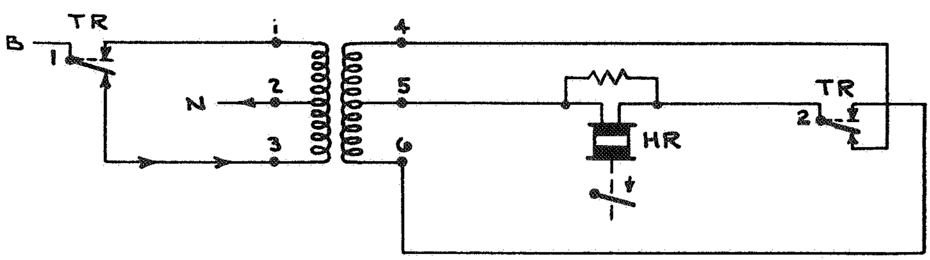


Fig. 3.
Track Relay De-energized—No Coding Action.

When the track relay starts following the coded impulses, the front contacts close as shown in Fig. 4. The current in the upper half of the primary winding reverses the polarity of the flux in the iron core of the transformer. As the magnetic flux reverses direction, it induces a current in the secondary winding of the transformer in a direction opposite to that in the primary. While the induced current is only momentary, it may be sufficient to pick up detector relay HR. However, the circuit is usually designed to require the second impulse of a standard code to pick up the relay to avoid single pulse pick-up. Only the lower half of the secondary winding is effective in energizing relay HR for the "on" impulse. As shown by the arrows, the current in the secondary winding passes from terminal 5, through coils of relay HR, front contact 2 of track relay TR, to terminal 6.

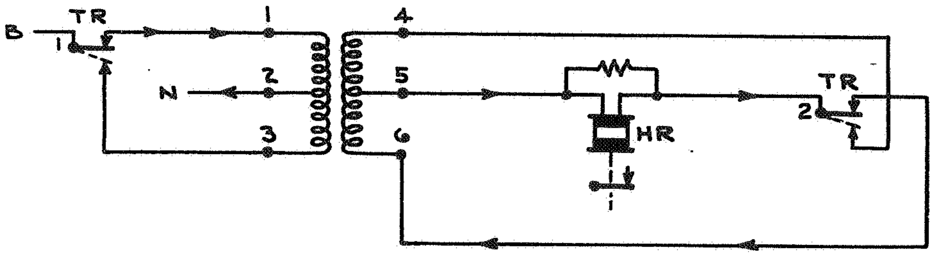


Fig. 4.
Track Relay Energized—Coding.

When the code-following track relay releases, the circuit is as shown in Fig.5. The current now flows through the lower portion of the primary winding, but in an opposite direction to that which prevailed when the code-following relay was energized. This results in the induced current in the secondary of the transformer flowing in such a manner as to be in the same direction when flowing through the coils of detector relay HR as indicated by the arrows: namely, from terminal 5, through coils of relay HR, back contact 2 of track relay TR, to terminal 4.

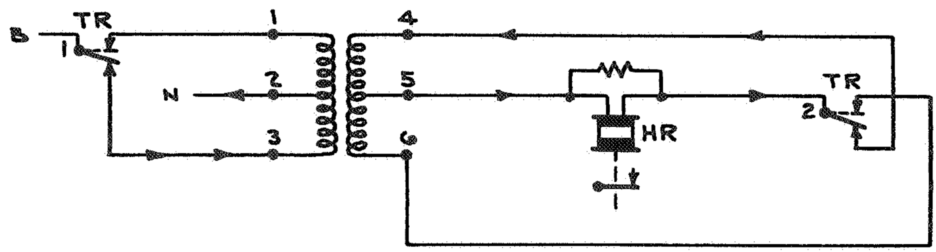


Fig. 5.
Track Relay De-energized—Coding.

Detector relay HR is made sufficiently slow acting to bridge the cycle of the lowest code transmitted to which the relay responds. The resistor in multiple with the relay is used as an arc suppressor to protect contact 2 of track relay TR and to snub relay HR to increase its drop-away time.

The continuing action of the code-following track relay TR changes the direction of the current in the primary windings of the transformer at the coding rate. This, in turn, induces a current in the secondary winding to pick up the detector relay HR. The slow release of this relay bridges the coding action of the code-following track relay so that as long as there is transformer action to induce a current in the secondary, the detector relay HR will remain energized.

If there is a steady current or no current in the coils of the code-following track relay, the relay will remain in one position or the other. When it does remain steady in one position, the current in the primary windings of the transformer is steady and there is no current induced in the secondary to pick up the detector relay HR. This results in relay HR becoming de-energized.

More than one code is used in the coded track circuit to provide controls for three or four aspects. Two codes are necessary to control three aspects and three codes to control four aspects. A code of 180 cycles per minute usually controls the clear aspect, 75 code usually controls the approach aspect, and absence of code results in the most restrictive aspect. An additional aspect, the fourth, can be controlled by a code of 120 cycles per minute and usually is associated with the approach medium aspect.

When two or more codes are used, means must be provided to identify the code being received. Because the HR relay is non-selective, it responds to all codes. Decoding units which are responsive to higher than the 75 rate code are used to identify higher codes as required. Selection between two codes, between 75 and 120 or 180 for example, is illustrated by Fig. 6 which shows the decoding unit connections.

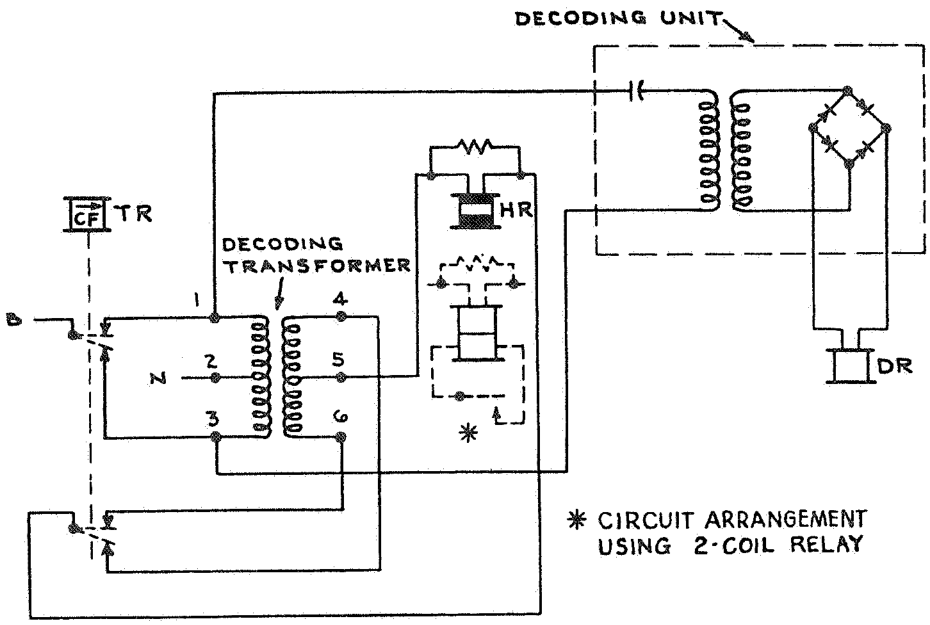


Fig. 6.

The decoding transformer supplies an a.c. output whose frequency corresponds with that of the code being transmitted. A decoding unit connected to the decoding transformer provides a means of identifying the code being transmitted, as the fundamental characteristic of a decoding unit is that it will pass energy to pick up the relay connected to it, only when the input energy is supplied at the code rate for which the decoding unit was designed and tuned, such as 120 or 180 cycles per minute.

The decoding unit contains a transformer, a capacitor and a rectifier as shown in Fig. 6. The capacitor is connected in series with the primary of the transformer in the decoding unit. The rectifier is connected across the secondary coil of the decoding transformer to convert the a.c. output to direct current to operate a d.c. relay, shown here as DR.

In order to understand why the 180 code will pick up its associated relay when it is supplied with a.c. energy by the decoding transformer at 180 cycles per minute and yet this relay will not pick up in response to 75 or 120 code, it is necessary to consider briefly how this is accomplished.

The primary winding of the transformer in the decoding unit provides inductance which, when connected in series with a capacitor, acts as an electrical filter. By using different values of inductance and capacitance, it is possible to provide an electrical circuit that will permit maximum flow of current at a certain frequency. In other words, the decoding unit is really a filter adjusted to permit the maximum flow of current only at the frequency for which it is set. At any other frequency, the filter will present considerable opposition to the flow of current.

If the frequency of the master decoding transformer output is below that for which the decoder circuit is tuned, the greatest opposition to the flow of current through the circuit is the capacitive reactance of the capacitor, since capacitive reactance increases as the frequency decreases. If the frequency of the master transformer output is too high, the current flow is restricted by the inductive reactance of the coil, since inductive reactance increases as the frequency increases.

The decoding unit for a 120 code has a filter that permits the maximum flow of current only at that code, while the filter for the 180 decoding unit permits the maximum flow for only the 180 code.

An arrangement using a two-coil relay for the HR relay is used extensively. This is shown in dashed lines in Fig. 6. One benefit obtained with this arrangement is an increased pick-up time obtained by shunting the second coil through the back contact of the relay.

Sufficient apparatus has now been described to illustrate basic circuit elements shown in Fig. 7. These circuits, omitting relays 21BDR, 120CT and 11BDR with circuits shown dashed, show the use of coded track circuits to provide the control for three-aspect automatic block signals.

With signal 21 clear, relay 21HR will be energized. Relay 21HR selects the code for 21CTPR which is a code-following relay. In this instance, 180 pulses per minute are being produced by the 180 code transmitter and fed over front contacts of 21HR to operate relay 21CTPR. This interrupts track circuit 11T since track energy is fed over a front contact of 21CTPR through a limiting resistor. The track circuit is shunted during the "off" period over the back contact of relay 21CTPR to improve the code pattern. The track current limiting resistance should not be included as part of the shunt circuit. To do so would decrease the effectiveness of the shunt on account of higher resistance.

When the 180 code is received at signal 11 by 11TR, coding action energizes relays 11HR and 11ADR, and signal 11 will display a clear aspect. If 21HR is de-energized, 75 code is transmitted over its back contact to 21CTPR and track circuit 11T will be interrupted at the rate of 75 times per minute. Relay 11TR will follow the code and energize 11HR. An approach aspect will be dis played by signal 11 as 11ADR is not energized by the 75 code.

For four-aspect signaling, the additional apparatus for 120 code and circuits shown dashed in Fig. 7 must be used and the B signal arm added. When signal 21 displays an approach aspect, relay 21HR will be energized and relay 21BDR will be de-energized. The 120 code will now be transmitted to signal 11. This will energize 11BDR and 11ADR will remain de-energized and signal 11 will display an approach medium aspect.

Approach lighting is obtained by use of relays AR and APR, as shown in Fig. 7. A code-following biased relay 21AR is connected by separate leads to the track to improve shunting characteristics. If track circuit 11T is not

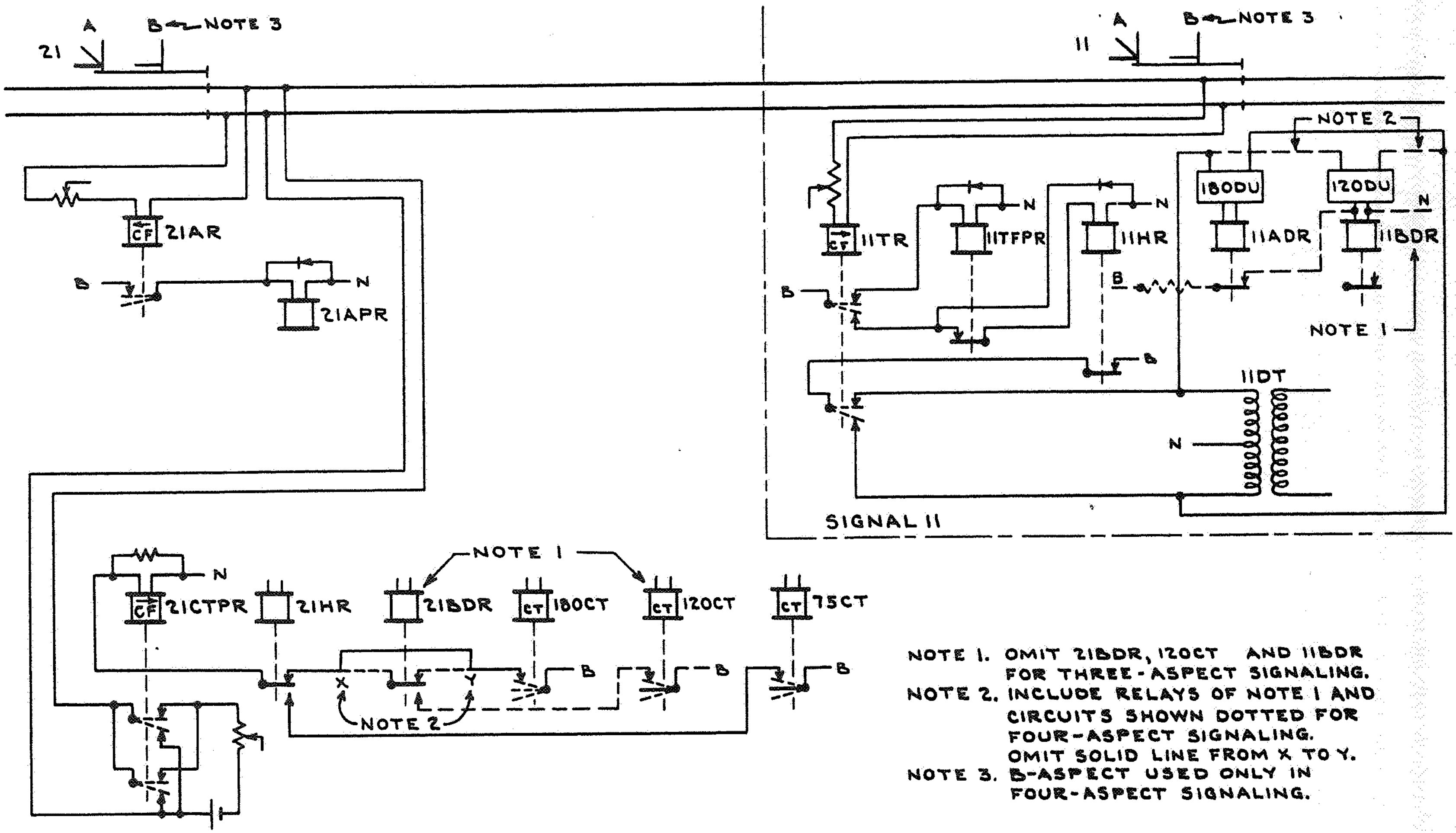

21
A
B ← NOTE 3
21AR
21APR
B
N
11
A
B ← NOTE 3
NOTE 2
180DU
120DU
11TR
11TFPR
11HR
11ADR
11BDR
N
B
NOTE 1
11DT
SIGNAL 11
NOTE 1
21CTPR
21HR
21BDR
180CT
120CT
75CT
X
Y
NOTE 2
NOTE 1. OMIT 21BDR, 120CT AND 11BDR FOR THREE-ASPECT SIGNALING.
NOTE 2. INCLUDE RELAYS OF NOTE 1 AND CIRCUITS SHOWN DOTTED FOR FOUR-ASPECT SIGNALING. OMIT SOLID LINE FROM X TO Y.
NOTE 3. B-ASPECT USED ONLY IN FOUR-ASPECT SIGNALING.

Fig. 7.

occupied, relay 21AR will follow the code produced by 21CTPR. When a train enters the track circuit at signal 11 and approaches signal 21, the effect of the train shunt reduces the voltage across the track leads of relay 21AR. This voltage is reduced to a level which prevents further operation of relay 21AR. By adjustment of the track circuit and of the resistance in series with 21AR, the signal will be lighted by the train shunt a sufficient distance in approach to the signal. These adjustments should be made in accordance with individual railroad's instructions.

The approach lighting of signal 21 is not controlled over the contacts of relay 21AR directly, but over the contacts of relay 21APR which is a front contact repeater relay. This method is known as multiple approach lighting and is used chiefly with storage battery installations.

Another method of approach lighting signal 21 is shown in Fig. 8, and is known as series approach lighting. As the train approaches signal 21 the energy is increased in 21AR and approach lights signal 21.

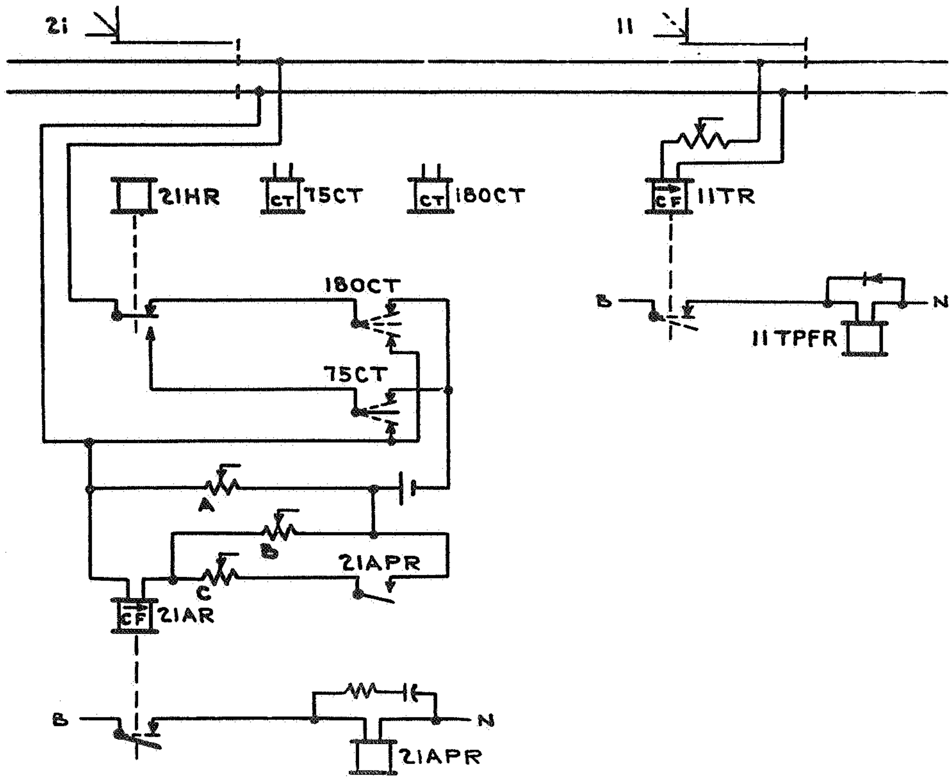


Fig. 8.

With track circuit 11T unoccupied, current from the positive side of the track battery flows over coding contacts 180CT or 75CT depending on the position of relay contact 21HR. Current returns to the negative side of battery through parallel branches. Resistors are so adjusted that most of the current flows through resistor A when track circuit 11T is unoccupied. The current flowing through 21AR and resistor B is not great enough to operate 21AR.

When a train enters track circuit 11T the low resistance of the train shunt permits an increased flow of current from the track battery. Sufficient current then flows through relay 21AR and resistor B to cause relay 21AR to follow the code. When relay 21AR picks up, it closes the control circuit of relay 21APR. When relay 21APR picks up, the greater portion of the current flows through resistor C and front contact of 21APR because a circuit with parallel resistance

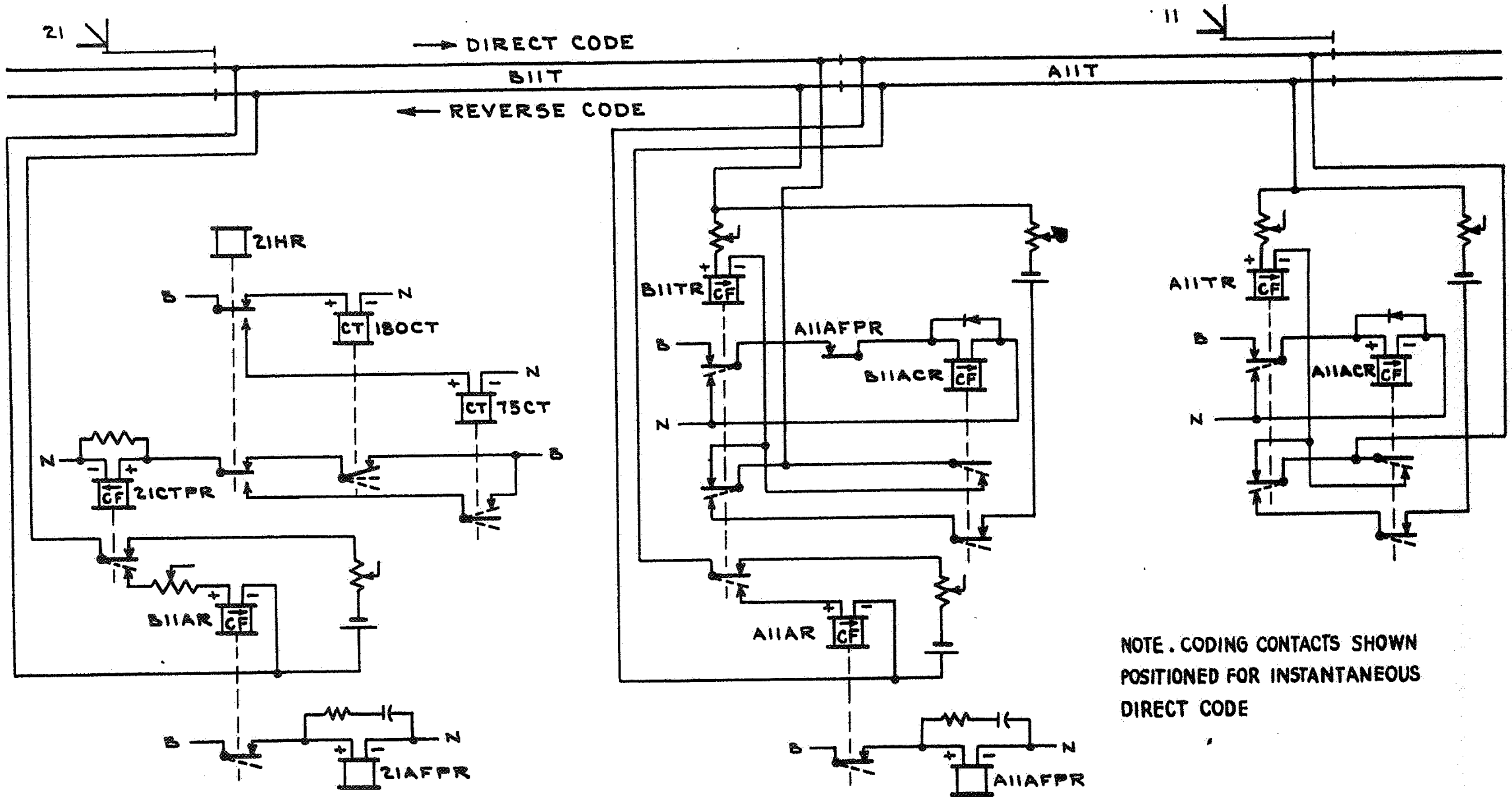

21
11
DIRECT CODE
REVERSE CODE
B11T
A11T
21HR
B
N
180CT
75CT
21CTPR
B11AR
21AFPR
B11TR
A11AFPR
B11ACR
A11AR
A11TR
A11ACR
NOTE. CODING CONTACTS SHOWN POSITIONED FOR INSTANTANEOUS DIRECT CODE

Fig. 9.

is formed and resistor C is of considerably less resistance than resistor B. You will note that the snub resistor bridging the coils of relay 21APR will cause this relay to be sufficiently slow acting to bridge the coding action of relay 21AR.

Series approach lighting is recommended and used quite generally. Since current consumption is low, it is particularly adaptable to primary battery installations.

It is well to keep in mind that relay 21AR follows the code only when track circuit 11T is occupied.

Other approach controls for full block can be obtained by using reverse code. Figure 9 illustrates the fundamental circuits using reverse code for full block approach controls. For descriptive purposes, the code transmitters and code-following relays are shown in their relative positions at the instant direct code is applied.

Direct code energy is fed from track battery at signal 21 over a front contact of 21CTPR energizing track relay B11TR which in turn energizes track relay A11TR.

The reverse code energy is applied to the track circuit the instant that track relays A11TR and B11TR close their back contacts and remains applied for a period of time equal to the release of track repeater relays A11ACR and B11ACR. Relay B11AR at signal 21 will follow the reverse code as its circuit is completed over a back contact of 21CTPR, which relay is de-energized during the "off" period of the normal code.

The preceding text describes the use of reverse code for full block approach controls only and does not include circuits for safety or vital functions.

A system that is controlled by d.c. coded track circuits may be expanded to include cab signals by applying a.c. energy at the leaving end of each track circuit. Such a system may be used to control wayside and cab signals or cab signals without wayside signals. One form of track circuit is shown in Fig. 10.

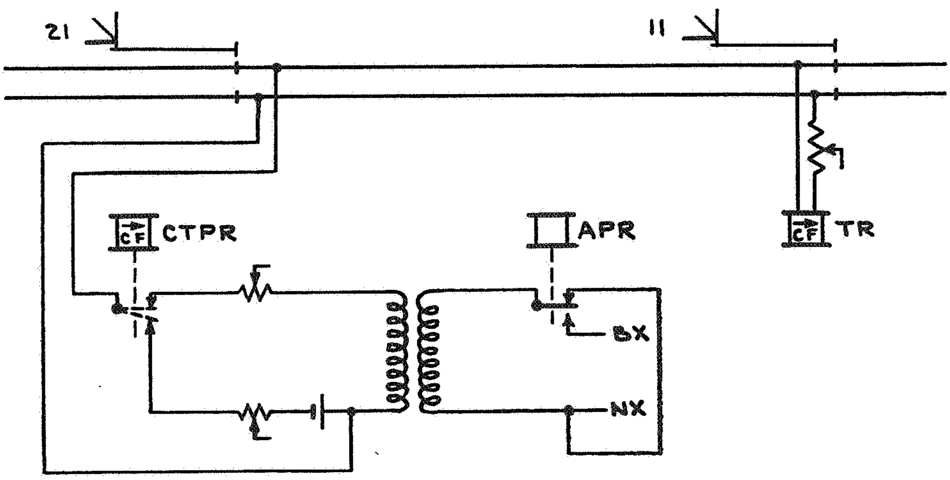


Fig. 10.

In this arrangement, the d.c. energy is fed over the back contact of the code transmitter repeater CTPR, while the a.c. energy is fed over the front contact.

The d.c. energy is necessary for track detection and other controls but a.c. energy for cab signals need not be applied until a train occupies the track circuit.

This is accomplished by means of approach relay APR which is controlled over line from signal 11 and is de-energized when TR releases as train passes signal 11. Approach relay APR reduces consumption of a.c. energy.

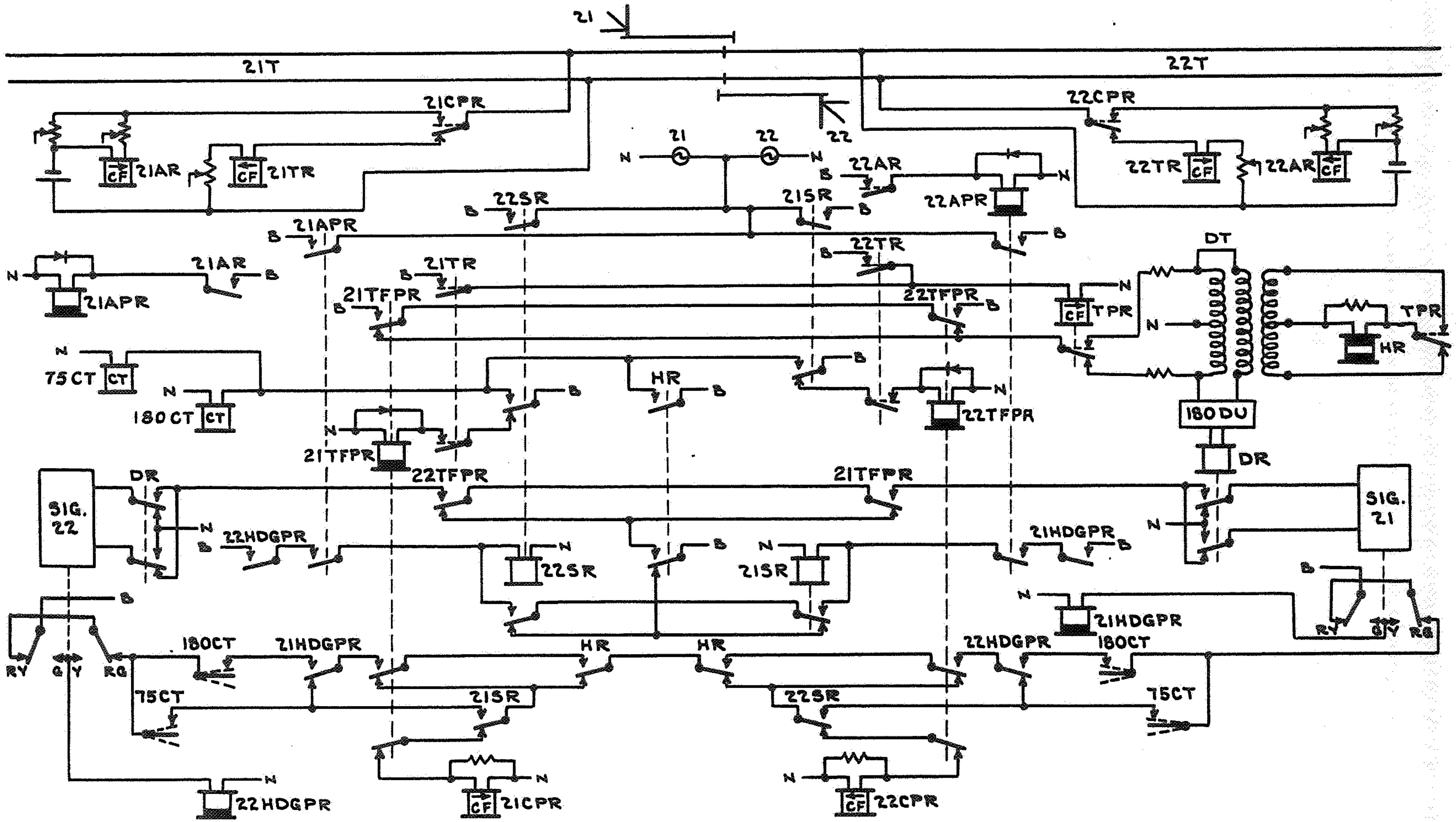

21T
22T
21
22
21CPR
22CPR
21AR
21TR
22TR
22AR
22SR
21SR
21APR
22APR
DT
TPR
HR
21TFPR
22TFPR
75CT
180CT
180DU
DR
SIG. 22
SIG. 21
22HDGPR
21HDGPR
RY
G
Y
RG
N
B
CF
CT

Fig. 11.

It should be noted that the track circuit is shunted over the front contact of CTPR through the low resistance of the transformer secondary and the low series limiting resistor, when the circuit is not occupied and APR is energized, to absorb any stored energy. The primary of the transformer is shorted by the front contact of APR to eliminate the inductive effect of the transformer secondary in the circuit.

The remaining portion of this chapter is devoted to some of the applications of coded track circuits used in various signal system functions. The descriptions and illustrations apply to the use of coded track circuits only and do not necessarily include controls for vital circuits or meet certain requirements peculiar to a system.

A traffic control system identified as normally de-energized reversible coded track circuits without line wires is described in Figs. 11, 12 and 13.

The intermediate signal location shown in Fig. 11 reveals that all circuits are de-energized. Let it be assumed that traffic direction is such that coded energy is received by 22TR. Coding action energizes TFPR, 22TFPR, HR and DR. Signal 22 will then be cleared. It should be observed that when the relays necessary to clear signal 22 are energized, certain control relays for signal 21 are de-energized and checked in that position.

The control of an electric switch lock is shown in Fig. 12. Both 11TR and 22TR code-following track relays are de-energized. Before a train moves from the siding to the main track it is necessary to check that no train is approaching the switch from either direction. This is accomplished by transmitting coded energy from control stations on either side of the switch and if no train is present between these stations, coded energy will be received by 11TR and 22TR. The coding action of these relays and battery over an energized contact of WTR will energize 11TFPR and 22TFPR. Battery over front contacts of 11TFPR, 22TFPR and the removal of the padlock on the switch lock, will energize WL and light the indication light. The switch lock will then be released and permit movement of train from siding to main track.

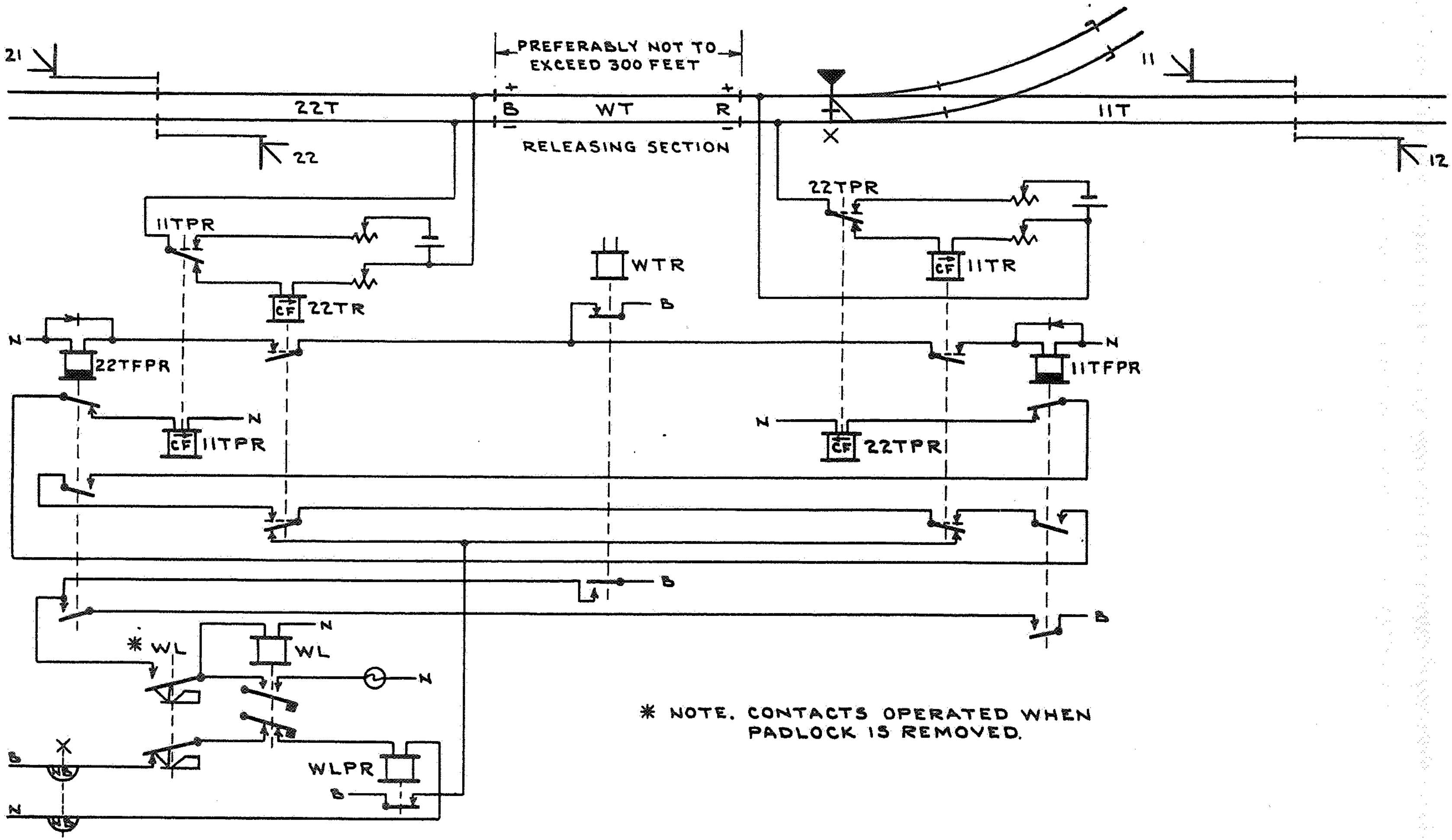
If movement of a train is to be made from the main track to siding, no coding action is necessary. After removal of the padlock on the switch lock, a direct release is accomplished by the presence of a train on the releasing section. Relay WTR will be de-energized and supply battery to energize WL and light the indication light.

Figure 13 illustrates the application of coded energy in the proper direction between control stations A and B after the direction of traffic has been established. End of siding station A is shown in detail. Station B is shown for reference only.

Track circuit 3T is the steady energy type, while track circuits 4RT and 4LT are coded.

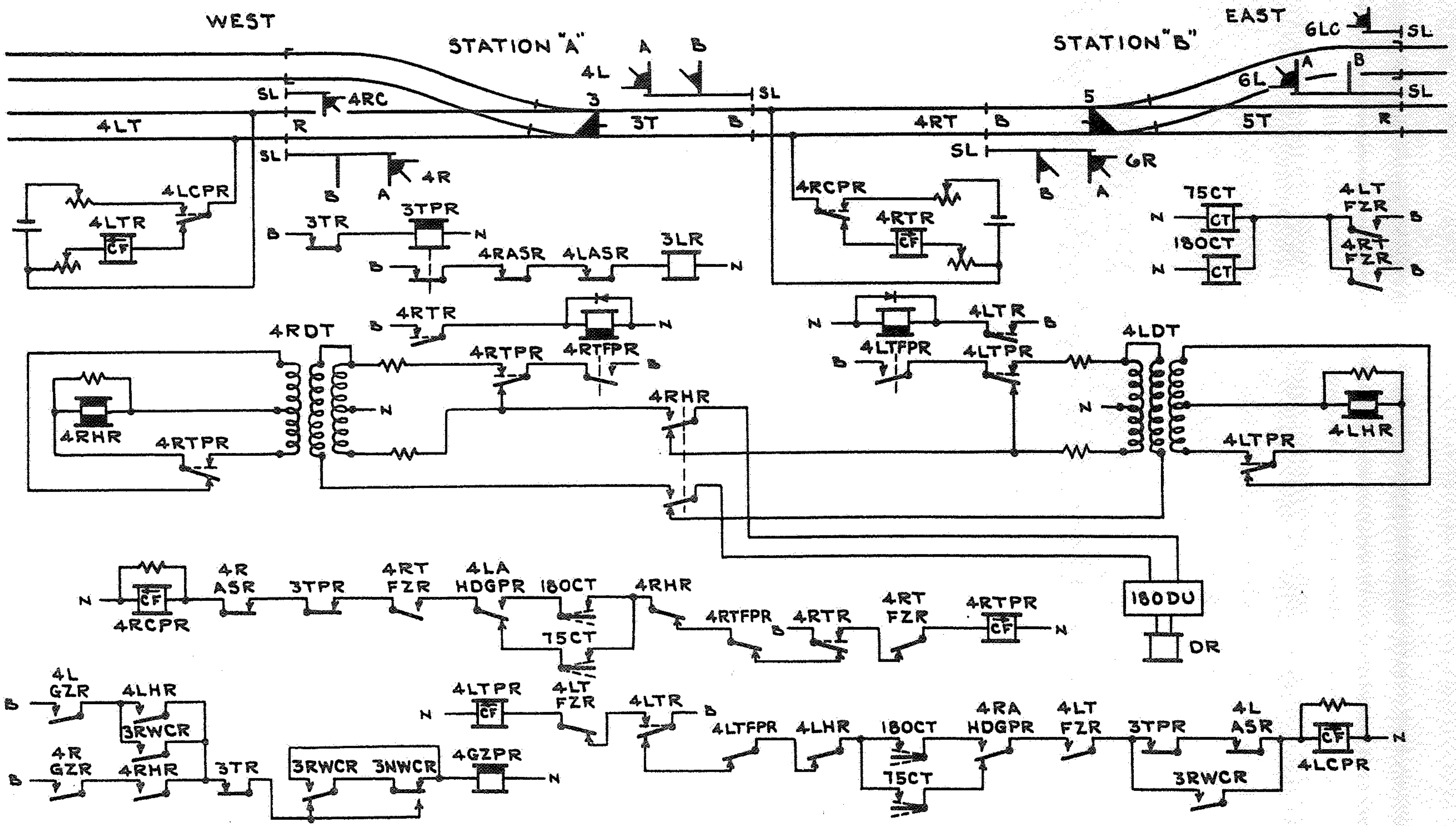
In order to clear signal 4R for an eastward movement, it is necessary to establish the direction of traffic between stations A and B. This is accomplished by function control relay circuits of the traffic control system at each station. After the direction of traffic has been established, coded energy will be applied to the rails at station B. Relay 4RTR will follow this code, relay 4RTFPR will be energized and relay 4RTPR will follow 4RTR. This action will energize 4RHR and check that the track is clear between stations A and B. If 180 code is being received, relay DR will be energized. Signal 4R will clear and permit a train movement by signal indication from station A to station B.

It is suggested that reference be made to AAR Signal Section Typical Circuits Representing Current Practice for Railway Signaling, which circuits will provide a better understanding of various control circuits and their relation to the coded track circuits described in this chapter.



PREFERABLY NOT TO EXCEED 300 FEET
21
22T
22
B
WT
R
RELEASING SECTION
11
11T
12
22TPR
11TPR
22TR
WTR
B
11TR
N
22TFPR
11TFPR
11TPR
22TPR
B
B
* WL
WL
N
WLPR
* NOTE. CONTACTS OPERATED WHEN PADLOCK IS REMOVED.

Fig. 12.



WEST
STATION "A"
STATION "B"
EAST
4L
A
B
SL
4RC
3
3T
4LT
R
4R
4RT
5
5T
6LC
6L
6R
4LCPR
4LTR
CF
3TR
3TPR
4RASR
4LASR
3LR
4RCPR
4RTR
75CT
180CT
CT
4LT FZR
4RT FZR
4RDT
4RTR
4RTPR
4RTFPR
4RHR
4LTR
4LTFPR
4LTPR
4LDT
4LHR
N
180DU
DR
4R ASR
3TPR
4RT FZR
4LA HDGPR
180CT
75CT
4RTFPR
4RCPR
4L GZR
4LHR
3RWCR
4R GZR
4RHR
3TR
3NWCR
4GZPR
4LTPR
4LT FZR
4LTR
4LTFPR
4RA HDGPR
4L ASR
4LCPR

Fig. 19

American Railway Signaling Principles and Practices

QUESTIONS ON

CHAPTER XXV

Coded Track Circuits

QUESTIONS ON CHAPTER XXV

CODED TRACK CIRCUITS

1. Describe a basic coded track circuit.

2. How does a coded track circuit provide more protection than the steady energy type?

3. Give the three Standard Code frequencies commonly used.

4. How can a basic coded track circuit control system be expanded?

5. Why are snubs used across the coils of relays TFPR and HR in Fig. 2?

6. How many codes are necessary to control three signal aspects?

7. When three codes are necessary, what is required to distinguish each of them?

8. What signal aspects are usually associated with the three codes?

9. Name several controlled functions that may be obtained by using coded track circuits.

10. How may a d.c. coded track circuit be expanded to include cab signals?

11. What is the function of the HR relay in the decoding circuit?

12. What is the function of a decoding transformer?

AMERICAN RAILWAY SIGNALING PRINCIPLES AND PRACTICES

Following are the titles comprising this series of educational chapters:

I—History and Development of Railway Signaling
II—Symbols, Aspects and Indications
III—Principles and Economics of Signaling
IV—Centralized Traffic Control, Part 1 (Series line systems)
IV—Centralized Traffic Control, Part 2 (Multiple line systems including carrier control operation)
V—Batteries
VI—Direct Current Relays
VII—Non-Coded Direct Current Track Circuits
VIII—Transformers
IX—Rectifiers and Battery Chargers
X—Alternating Current Relays
XI—Non-Coded Alternating Current Track Circuits
XII—Semaphore Signals
XIII—Light Signals and Light Signal Lamps
XIV—Definitions
XV—Block Signal Systems
XVI—Interlocking
XVII—Mechanical and Electro-Mechanical Interlocking
XVIII—Electro-Pneumatic Interlocking
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XXIV—Signal Power Transmission and Lightning Protection
XXV—Coded Track Circuits
XXVI—Relay Interlocking*

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* Under preparation.