

Filed July 2, 1946

2,555,013

4 Sheets-Sheet 1

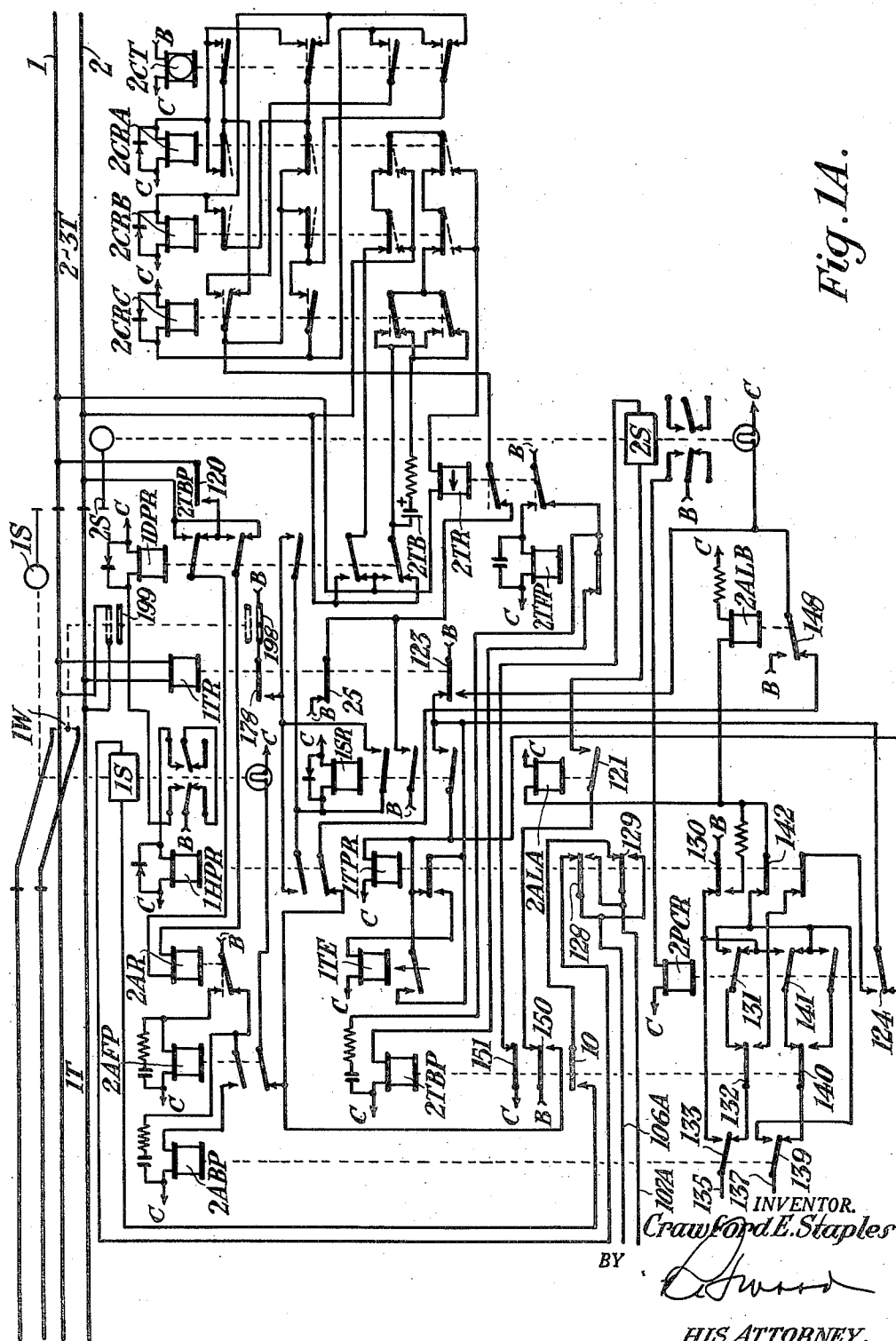


Fig. 1A.

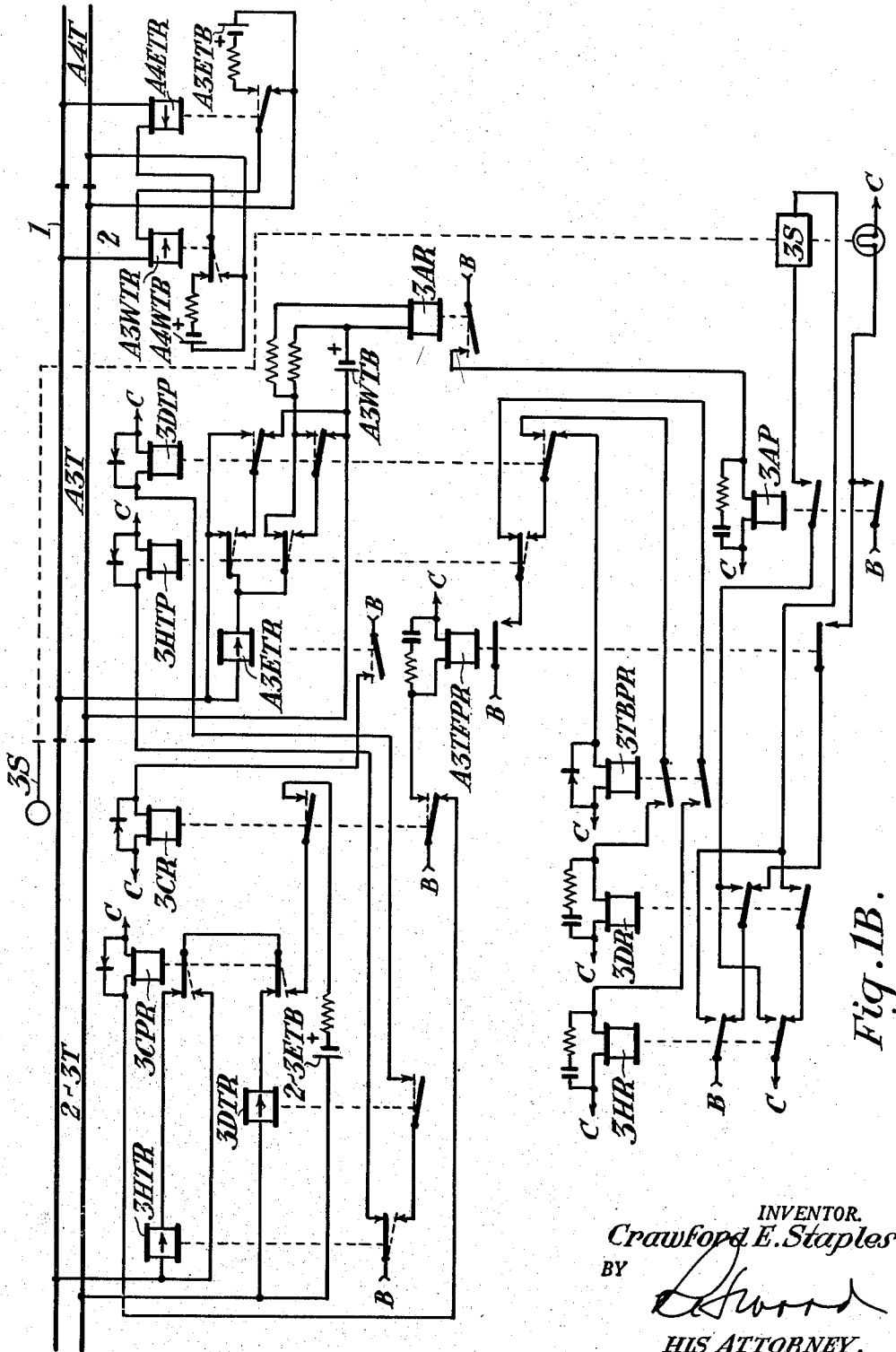
May 29, 1951

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APPROACH CONTROL APPARATUS FOR RAILROAD
BLOCK SIGNALING SYSTEMS

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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

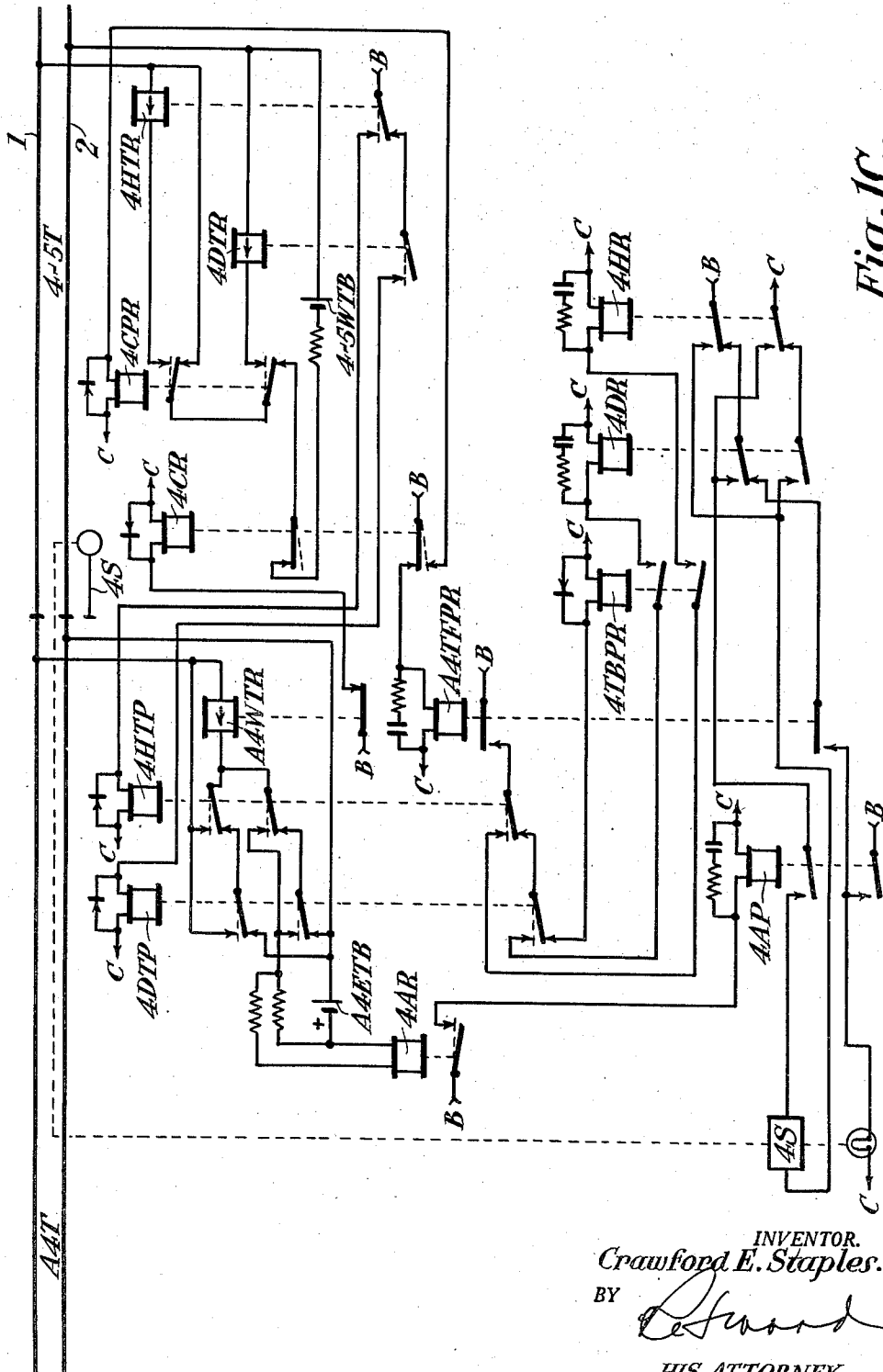


Fig. 1C.

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4 Sheets-Sheet 4

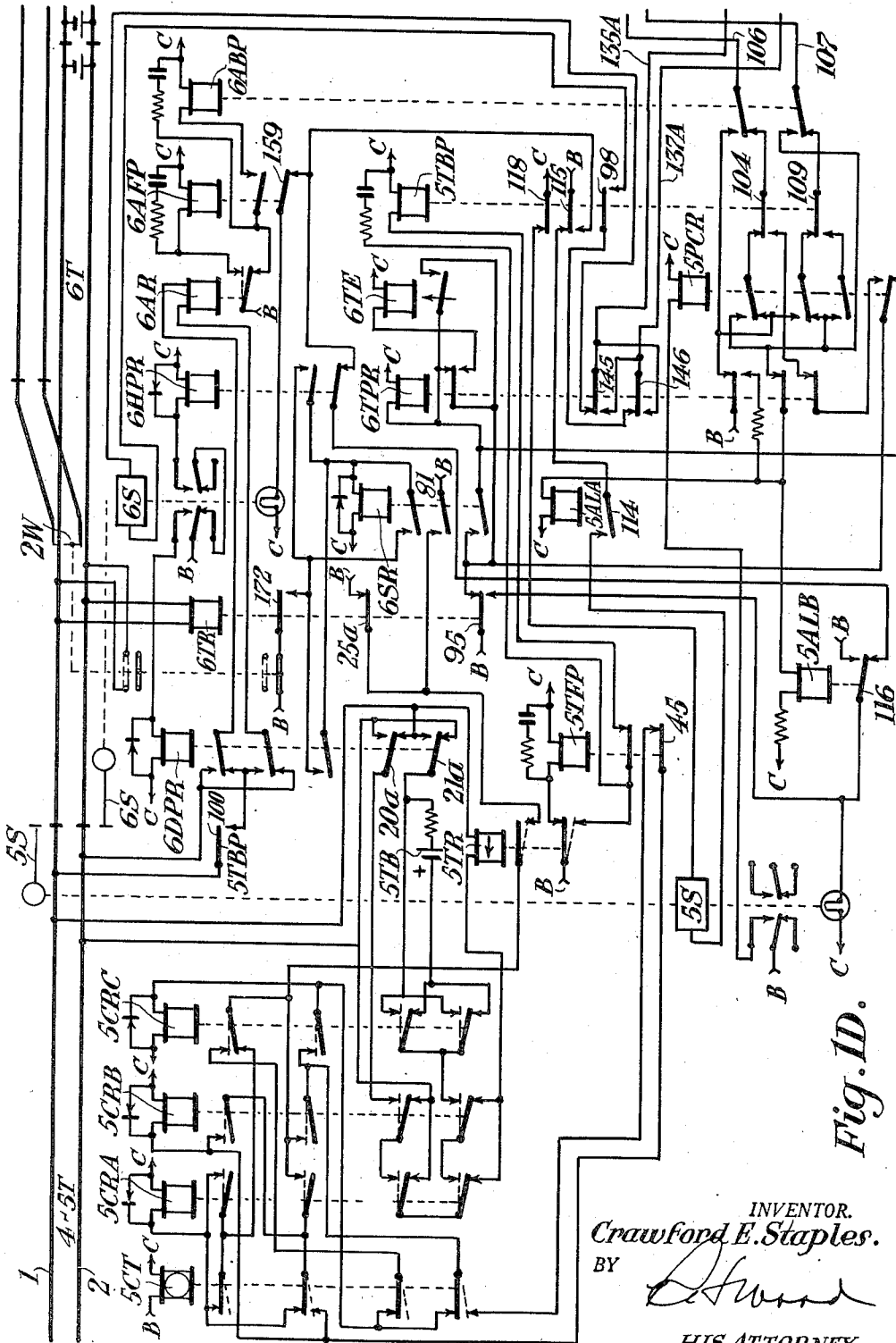


Fig. 1D.

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UNITED STATES PATENT OFFICE

2,555,013

APPROACH CONTROL APPARATUS FOR
RAILROAD BLOCK SIGNALING SYSTEMSCrawford E. Staples, Pittsburgh, Pa., assignor to
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Application July 2, 1946, Serial No. 680,885

15 Claims. (Cl. 246—39)

1

My invention relates to railway signaling systems and particularly to improved means for approach controlling selected portions of the apparatus in such a system.

In an application for Letters Patent of the United States, Serial No. 674,436 of Henry S. Young, filed June 5, 1946, there is shown a signaling system for use on single track railroads through which traffic may move in either direction. The system shown in that application is adapted for use on track stretches where trains are relatively infrequent, so there are long intervals between trains during which operation of substantial portions of the signaling apparatus is unnecessary. That system is arranged so that it may be operated by energy supplied from primary batteries, thereby making the system available for use on track stretches situated in regions in which there is no dependable local commercial source of electric power with which to charge storage batteries. Energy supplied from primary batteries is relatively expensive and where the system is operated from primary batteries it is highly desirable to eliminate unnecessary energy consumption.

An object of this invention is to provide means for use in a system of the type described to approach control portions of the system so that they are normally deenergized and are automatically energized on the approach of a train.

A further object of this invention is to provide improved approach control apparatus which is normally dormant and does not consume energy.

Another object of the invention is to provide improved approach control apparatus which is arranged to initiate operation of one portion of the equipment at a selected location on the approach of a train within one predetermined distance and to initiate operation of other portions of the equipment at this location on the approach of a train within a shorter distance.

A further object of the invention is to provide improved approach control apparatus for use in a signaling system for single track railroads through which traffic may move in either direction, the approach control apparatus for the signaling systems for the opposite directions of traffic being arranged so that they do not interfere with each other even though their control limits overlap for a portion of their length.

Another object of the invention is to provide approach control apparatus of the type described which is arranged so that no failure of the approach control equipment to function in the intended manner can create a hazardous condition.

A further object of the invention is to provide improved approach control apparatus which employs the equipment which is provided for the control of the wayside signals so that the ap-

2

proach control functions are performed with a minimum of additional apparatus.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings.

I shall describe one form of railway signaling system embodying my invention and shall then point out the novel features thereof in claims.

In the signaling system shown in the above-identified application of Henry S. Young, the track rails of a single track stretch between passing sidings are divided into a plurality of track sections each of which is provided with two sets of coded track circuit apparatus, one for each direction of traffic. The coded track circuit apparatus of the system shown in the application of Henry S. Young is arranged so that normally a transmitter relay at each end is operated between two positions in one of which it connects a track relay across the rails of the stretch and in the other of which it supplies an impulse of energy to the rails, which is repeated section by section to operate the track relay at the other end provided the stretch is vacant. Each transmitter relay is operated by impulse forming equipment so that as long as the associated track relay is responding to received impulses, impulses of energy are normally transmitted alternately in opposite directions from one end of a single track stretch to the other. Each equipment is also arranged that when active, if the associated track relay remains released, it continues to supply impulses at intervals which are substantially longer than the impulses. When the single track stretch is vacant, the received impulses of energy operate the track relays at the ends of the stretch periodically, to energize code detecting relays which prepare circuits for supplying energy to the windings of searchlight type head block signals for governing the entrance of traffic into the single track stretch, and the code detecting relays, when energized, interrupt the circuits of the windings of searchlight type entering signals which govern entrance of traffic into the main track portions of the passing tracks interposed between the single track stretches.

The impulse forming equipment at each end of a single track stretch is controlled by the track relay of the adjoining section of the main track portion in such manner that the supply of impulses is cut off when a train approaching the single track stretch enters this section, thereby releasing the code detecting relay at the remote end of the single track stretch in advance.

My invention relates more particularly to the control of traffic movements through this main track portion, which is usually divided into two track sections having steady energy track cir-

cuits, with the track relays located at the two ends of the passing track area.

My invention, briefly described, is embodied in a line circuit for each direction, extending the length of the passing track area, which provides, first of all, an approach controlled energizing circuit for the entering signal for the corresponding direction, by including therein in addition to the signal winding, a back contact of the code detecting relay for the adjoining end of the single track stretch in the rear, and front contacts of the track relays for the two main track sections, the circuit being supplied with energy from a source at the advance end of the main track portion. A second feature is that this line circuit is arranged to provide approach control for the winding of a head block or leaving signal at the advance end of the main track portion, by including in the circuit the winding of an approach relay in series with the source of energy, the approach relay having a normally open front contact in the energizing circuit by which this head block signal is controlled in accordance with traffic conditions in the single track stretch in advance. A third feature resides in provisions by which the polarity of the energy supplied to a line circuit leading to an entering signal is governed by the head block signal at the exit end of the passing siding for the corresponding direction of traffic so that an entering signal may display its proceed indication only if the head block signal in advance is conditioned to display its proceed indication, and so that an entering signal may display only its caution indication if the head block signal in advance is conditioned to display its stop indication. A fourth feature is that the entering signals govern the polarity of the impulses of coded track circuit energy supplied to the single track stretch in the rear and thus control the indication which will be displayed to an approaching train by a distant signal located a suitable distance in the rear of the entering signal, in such a manner that the distant signal may be caused to display a proceed indication only when the entering signal and the head block signal in advance thereof are both conditioned to indicate proceed.

A fifth feature resides in the approach control of the lighting of the head block or leaving signal, with shorter control limits than are provided for the approach control of the head block signal winding. For this purpose I provide means controlled by the track relay for the first main track section in advance of the entering signal for short-circuiting the signal winding to cause a predetermined increase in the line circuit current when a train enters that section, and I provide a marginal approach relay which responds selectively to such increased current to energize the head block signal lamp. Additionally, this lamp and the associated approach relays are controlled by the track relay or a repeater relay for the second main track section as hereinafter explained in detail.

Considering these various features in more detail, it will be seen that the only time at which it is necessary for a head block or other wayside signal to display a permissive indication such as proceed or caution is when a train is approaching. The display of a permissive indication by a signal necessitates the supply of energy to the winding of the signal, so it is desirable to arrange the equipment as described above so that the signals will display permissive indications

only on the approach of a train to thereby reduce to a minimum the energy consumed by the system.

In view of the provisions by which a head block signal governs the polarity of the energy supplied to the line wires leading to the entering signal in the rear and thus governs the polarity of the coded track circuit energy which is supplied over the rails of the single track stretch in the rear of the entering signal to control the distant signal, in order that a distant signal will display the appropriate indication on the approach of a train, it is necessary to establish the circuit of the winding of a head block signal for a selected direction of traffic before a train approaches the distant signal for the entering signal in the rear of this head block signal, and this invention provides means for effecting this control of the circuits of the windings of the head block signals.

While the circuit of the winding of a head block signal must be established before an approaching train reaches the distant signal for the entering signal in the rear of this head block signal, the circuit of the lamp of the head block signal does not need to be established until a train passes the entering signal in the rear of the head block signal, and this invention provides means for distinctively approach controlling the circuits of the lamps of the head block signals.

In practicing my invention I arrange the equipment so that when a train cuts off the supply of coded energy over the rails of a single track stretch from one end and thereby releases the code detecting means at the other or exit end of the stretch, the winding of the entering signal at that location is connected to the associated line wires leading from the other end of the passing siding where these line wires are normally connected through the windings of two approach relays to the terminals of a source of energy. These approach relays are selected so that one of them will pick up in response to the supply over the line wires of energy of the value which is supplied when the line wires are connected to the winding of the entering signal. This one approach relay, when picked up, establishes the circuit for the winding of the head block signal at that location so that energy will be supplied to the signal winding to cause the signal to be prepared to display its clear indication if the associated code detecting means is energized. As long as the winding of the head block signal is deenergized, the energy supplied to the line wires is of reverse polarity and will prepare the entering signal to display its caution indication, but, if on picking up of the approach relay the head block signal clears, the energy supplied to the line wires is changed to normal polarity and will prepare the entering signal to display its proceed indication, and this signal will thereupon cause the coded energy supplied to the single track stretch to be of normal instead of reverse polarity so the distant signal will display its proceed indication instead of its caution indication to an approaching train.

During the supply of energy over the line wires through the winding of the entering signal, too little energy flows through the winding of the marginal approach relay to pick up its contacts and they remain released and do not establish the circuit of the lamp of the head block signal. When a train passes the entering signal and enters the main track portion, the supply of energy from the line wires to the winding of the entering

5

signal is cut off to put this signal to stop, and, since these line wires are connected together, the flow of energy over the line wires is increased to such an extent that the marginal approach relay picks up to establish the circuit of the lamp of the head block signal.

In the drawings, Figs. 1A, 1B, 1C and 1D, arranged side by side in the order named with Fig. 1A at the left, show the track plan and the circuits associated with a single track stretch. Fig. 1A shows the circuits at the right-hand or east end of a passing siding I and at the adjoining or left-hand end of the single track stretch, while Fig. 1D shows the circuits at the left-hand end of a passing siding II and at the adjoining or right-hand end of the single track stretch. Figs. 1B and 1C show the circuits at a distant signal for a passing siding, while Fig. 1B also shows the circuits which are employed at a cut-section. The circuits for a siding section are illustrated by placing Figs. 1A and 1D together with Fig. 1A at the right.

The system shown in the drawings of this application is substantially identical in construction and operation with that shown in the above-identified application of Henry S. Young and the same reference characters are employed to designate corresponding elements.

In order to simplify this disclosure the construction and operation of only as much of the entire system is described as is essential to an understanding of this invention, and it should be understood that the remainder of the system shown in the drawings is arranged and operates as described in the above-identified application of Henry S. Young.

In most instances in the drawings the relay contacts are shown directly under the relay winding, but in some cases, in order to simplify the drawings, relay contacts are separated from the relay winding. Where this is done, the relay with which the contacts are associated is indicated by appropriate reference characters placed above the contacts.

In this system, the single track stretch between passing sidings is divided by insulated joints in the track rails into a plurality of track sections, each of which is provided with two sets of coded track circuit equipment, one for each direction of traffic. At each end of the single track stretch there is an end track section extending from the end of the passing siding to the distant signal for this siding. These sections are designated 2—3T and 4—5T in the drawings. The portion of the single track stretch between the distant signals may form one or more track sections, the number depending on the length of this portion of the stretch. If more than one track section is required, the supply of coded energy in both directions is repeated between sections by front contact coding cut-section equipment. As shown, the single track portion between the distant signals 3S and 4S is divided into two sections which are designated A3T and A4T.

As shown, the main track portion of the tracks in the passing siding area is divided into two track sections each of which is provided with a track circuit employing steady energy. These passing siding track sections are designated 1T and 6T and extend beyond and include the hand-throw track switches which connect the single track stretch with the main track portions or with the passing sidings.

The entering signals 1S and 6S, which govern entrance of traffic from the single track stretch

6

into the main track portions, are governed over line circuits which extend the length of the passing siding and are controlled by the track relays of the track sections of the main track portions.

All of the signals are of the searchlight type shown in Letters Patent of the United States No. 1,864,224, issued June 21, 1932, to Wesley B. Wells for Light Signals, and each is provided with a spectacle arm biased to a position in which the signal, when lighted, displays a red or stop indication. On the supply of energy to the winding of a signal, the spectacle arm of the signal is moved to a position in which it causes the signal, when lighted, to display a yellow or a green indication depending on the polarity of the energy supplied to the signal winding.

Each of the signals also has contacts which are controlled in accordance with the indication displayed by the signal. On the entering and head block signals these contacts control relays which govern the polarity of the energy supplied to control the adjacent signal in the rear.

Each signal location in the track stretch is provided with a suitable source of direct current, such as a battery, not shown, the terminals of which are designated B and C in the drawings.

The supply of impulses of energy to the ends of each single track stretch and the connection of the track relays at the ends of the stretch with the track rails is governed by impulse generating equipment comprising a continuously operating code transmitter CT, and three transmitter relays CRA, CRB and CRC.

The impulse generating equipment is not a part of this invention, and this apparatus is shown and claimed in my application for Letters Patent of the United States, Serial No. 676,643, filed June 14, 1946, which has become Patent No. 2,496,607, dated February 7, 1950.

Similarly, the arrangement of the coded track circuit apparatus in the single track stretch is shown and claimed in the above-identified application of Henry S. Young.

A detailed consideration of the construction and operation of the impulse generating equipment is not necessary to an understanding of this invention, and it is sufficient to state that as long as energy is supplied to the control circuit for a group of transmitter relays, these relays are energized and deenergized sequentially in response to operation of the associated code transmitter. If the supply of energy to the control circuit is maintained, the transmitter relays are all energized and are all subsequently deenergized once every three cycles of operation of the code transmitter.

The control circuit for a group of transmitter relays includes a back contact of the associated track relay. Accordingly, when the track relay picks up, this control circuit is interrupted and the transmitter relays are released and they start a new cycle of operation on release of the track relay.

The circuits governed by the transmitter relays are arranged so that the associated track relay is connected across the track rails during most of the cycle of operation of these relays, and so that a track battery is connected across the track rails during one step in the cycle of operation of these relays, this step being near the beginning of the cycle so that an impulse of energy is supplied to the track rails promptly after release of the track relay.

The track circuit apparatus at the intermediate points in a single track stretch is arranged

7

so that an impulse of energy supplied to an end of the single track stretch is repeated by front contact coding through the successive sections to the opposite end of the stretch. As the impulse generating means at each end of the stretch operates to supply an impulse of energy to the track rails promptly after release of the associated track relay, and as impulses of energy supplied to either end of the stretch are repeated through the stretch to the other end to pick up the track relay at that point, the equipment functions so that as long as the associated track relays continue to respond to impulses received over the track rails impulses of coded energy are transmitted alternately in opposite directions over the rails of the stretch. Each equipment functions in such manner that when the associated track relay remains released, impulses are supplied at intervals which are substantially longer than said impulses. Accordingly, the track relays at the opposite ends of a single track stretch are normally both operated by coded energy, and the code detecting relays which they control are energized.

In addition, the track relays at the intermediate locations in the single track stretch are operated by coded energy and the code detecting means governed by the track relays which are operated by energy supplied over the end track sections may be energized and may control the distant signals to cause them to display permissive indications.

In the system as shown in the above-identified application of Henry S. Young, the impulses of energy supplied to an end of the single track stretch may be of reverse or normal polarity and track relays selectively responsive to these different polarities of energy are provided for the end track sections and control the code detecting means so that the distant signals display caution or clear indications in accordance with the polarity of the coded track circuit energy.

In the system shown in the above-identified application of Henry S. Young, the control circuit for a group of transmitter relays at an end of single track stretch is also governed by traffic conditions in the adjoining main track portion so that when a train enters either of the two track sections in the main track portion from the other section or from the side track, the supply of energy to the transmitter relays at the adjoining end of the single track stretch in front of the train is cut off and they cease to operate and do not supply impulses of energy to the single track stretch. When the supply of coded energy to an end of the single track stretch is cut off, the supply of energy in the corresponding direction throughout the stretch is cut off and the track relays which were operated by this energy remain released.

The equipment is shown in the condition which it assumes when the single track stretch and the main track sections in the siding area are vacant, and when the hand-throw track switches 1W and 2W at the ends of the single track stretch are in their normal position as required for through traffic movements over the main track.

As the main track portions beside the passing sidings are assumed to be vacant, the track relays 1TR and 6TR for the main track sections are picked up and establish the control circuits for the transmitter relays at the opposite

8

ends of the single track stretch and these relays operate to supply impulses of energy to the rails of the stretch. Accordingly, the track relays 2TR and 5TR at the ends of the single track stretch are operated by coded energy and the code detecting relays 2TFP and 2TBP at the left-hand end of the stretch and the code detecting relays 5TFP and 5TBP at the right-hand end of the stretch are picked up. The condition of the equipment at this time is best understood by arranging the drawings in the order Figs. 1A, 1B, 1C and 1D, with Fig. 1A at the left.

As relay 5TBP, Fig. 1D, is picked up, its contact 98 interrupts the circuit of the winding of the entering signal 6S so that this signal, if lighted, would display its stop indication, and a single repeater relay 6DPR is released and causes the coded energy supplied to the rails of the single track stretch to be of reverse polarity.

As relay 5TBP is picked up, its front contacts 104 and 109 establish connections for supplying energy to line wires 106 and 107 leading to the entering signal at the other end of the passing siding. The connections over which energy is supplied to the line wires 106 and 107 include the approach relays 5ALA and 5ALB in series therewith. At this time, as the track stretch is assumed to be vacant, the circuit of the winding of the entering signal governed over the line wires 106 and 107 is interrupted and no energy flows in the circuit of these wires and of the windings of the approach relays 5ALA and 5ALB and the relays 5ALA and 5ALB are released. As relay 5ALA is released, its contact 114 interrupts the circuit of the winding of head block signal 5S and it is conditioned to display its stop indication and to open the circuit for a signal repeater relay 5PCR, and relay 5PCR is released so that the energy supplied to line wires 106 and 107 is now of reverse polarity. As relay 5ALB is released, its contact 116 interrupts the circuit which it controls for supplying energy to the lamp of signal 5S.

The complete circuit of the line wires 106 and 107 is illustrated by placing Fig. 1A at the right of Fig. 1D so that wires 106A and 107A leading to the entering signal 1S are extensions of the line wires 106 and 107. As shown, a stick repeater relay 1TPR of the track relay 1TR is picked up and its contacts 128 and 129 connect the line wires 106A and 107A to the wires leading to the winding of signal 1S, but the circuit of this winding is open at contact 10 of code detecting relay 2TBP.

Fig. 1A shows the equipment at the left-hand end of a single track stretch, and as code detecting relay 2TBP is picked up its contacts 150 and 151 over which energy may be supplied to the winding of signal 2S are closed, but at this time the series approach relay 2ALA is released and its contact 121 interrupts the circuit of the winding of head block signal 2S so this signal, if lighted, would display its stop indication. Accordingly, the repeater relay 2PCR for signal 2S is released and causes the connections to line wires 135 and 137 to be arranged so that energy of reverse polarity will be supplied to these wires.

The connections for supplying energy to line wires 135 and 137 include in series therewith the approach relays 2ALA and 2ALB, but at this time no energy is supplied over the circuit of the line wires 135 and 137 since the circuit of the winding of the entering signal at the other end of the siding is open. This will be apparent by placing Fig. 1D at the left of Fig. 1A and con-

sidering the wires 135A and 137A as extensions of the wires 135 and 137. At this time a stick repeater relay 6TPR of the track relay 6TR is picked up and its contacts 145 and 146 connect wires 135A and 137A to the wires leading to the winding of signal 6S, but the circuit of this winding is open at contact 98 of relay 5TBP so the signal 6S, if lighted, would display its stop indication.

Since energy is not supplied over the circuit of the line wires 135 and 137, the series approach relays 2ALA and 2ALB are released.

The stick repeater relays 1TPR (Fig. 1A) and 6TPR (Fig. 1B) of the track relays 1TR and 6TR at this time are energized by current supplied over their stick circuits.

At this time the lamps and the windings of the distant signals 3S and 4S are deenergized. This invention is not concerned with the means for controlling the circuits of the lamps and windings of the distant signals to normally prevent the supply of energy to these circuits, and to cause energy to be supplied to these circuits when required on the approach of a train. Accordingly, in order to simplify this disclosure, the construction and operation of these circuits will not be described in detail and it should be understood that these portions of the system are arranged as explained in the above-identified application of Henry S. Young.

From the foregoing it will be seen that when the track stretch is vacant, impulses of coded energy are transmitted alternately in opposite directions over the rails of a single track stretch to pick up the code detecting relays at both ends of the stretch. When the code detecting relay at an end of a single track stretch is picked up, it interrupts the circuit of the winding of the associated entering signal so that energy is not supplied over the line circuit leading to this signal. Accordingly, the series approach relays at the other end of the line circuit are released and interrupt the circuits of the winding and lamp of the associated head block signal. As the windings of the entering and head block signals are deenergized, these signals, if lighted, would display stop indications, and they cause the signals in the rear to be governed accordingly. However, when the track stretch is vacant, there is no need for any of the signals to display a permissive indication, and the arrangement of the apparatus so that the windings of the signals are normally deenergized eliminates unnecessary consumption of energy by these signals.

Operation of equipment on movement of an eastbound train through the stretch

For purposes of illustration it will be assumed that an eastbound train is present on the side track at passing siding I, and that it is to enter the single track stretch leading to passing siding II. The operation of the equipment at this time is best illustrated by arranging the drawings in the order Figs. 1A, 1B, 1C and 1D, with Fig. 1A at the left.

In order that the train may leave the siding, the switch 1W is reversed, thereby causing contact 199, which is governed in accordance with the position of the switch, to shunt the rails of the track section 1T so that track relay 1TR releases. When relay 1TR releases, its contact 123 interrupts the stick circuit of relay 1TPR so that it releases and its contacts 130 and 142 interrupt the connections for supplying energy to line wires 135 and 137 to hold the entering signal at the opposite end of the siding at stop.

On release of relay 1TPR its back contact 130 establishes a circuit for supplying energy to the series approach relays 2ALA and 2ALB and the contacts of both of these relays are picked up. As contact 121 of relay 2ALA is closed, energy is supplied to the winding of signal 2S, and as front contact 148 of relay 2ALB is closed, energy is supplied to the lamp of signal 2S and this signal displays its green or clear indication.

Contact 178 of relay 1TR controls pick-up and stick circuits for a directional stick relay 1SR, but in the case being described, on release of relay 1TR its contact 178 does not establish the circuit of relay 1SR since this circuit is interrupted by the switch operated contact 198 and relay 1SR therefore remains released.

When relay 1TR releases, its contact 25 interrupts the supply of energy to the control circuit for the transmitter relays 2CRA, 2CRB and 2CRC and they remain released and cease to supply impulses of energy to the track rails, while they connect the track relay 2TR across the track rails so that it responds to the impulses of energy which continue to be supplied over the rails of the single track stretch from right to left and consequently the code detecting relay 2TBP is energized to maintain its front contacts 150 and 151 closed in the circuit of the winding of the signal 2S.

When the transmitter relays 2CRA, 2CRB and 2CRC cease to supply impulses of energy to the left-hand end of the single track stretch, the track relays at the intermediate points in the track stretch cease to supply impulses of energy to the left-hand end of the successive sections in the stretch and the track relay 5TR at the right-hand end of the stretch remains released so the code detecting relays 5TFP and 5TBP release.

When relay 5TFP releases, its contact 45 interrupts one of the stick circuits for transmitter relay 5CRB so that the equipment at this point operates to supply an impulse of energy to the rails of section 4—5T once during every two cycles of operation of the code transmitter 5CT. The details of operation of the transmitter relays at this time is not a part of this invention, is not essential to an understanding of this invention, and is being omitted from this description in order to simplify this disclosure since the operation of these relays is fully explained in my application Serial No. 676,643, and also in the above-identified application of Henry S. Young.

On release of code detecting relay 5TBP, its contacts 115 and 118 interrupt the circuit over which energy may be supplied to the winding of signal 5S so that this signal is certain to remain at stop.

In addition, on release of relay 5TBP, its back contact 98 in the circuit of the winding of the entering signal 6S is closed so that energy will be supplied to this winding from the line wires 135A and 137A. The operation of the equipment after closing of back contact 98 of relay 5TBP is best understood by placing Fig. 1A at the right of Fig. 1D and considering the line wires 135 and 137 as extensions of the line wires 135A and 137A. With the drawings arranged in this manner it will be seen that line wire 135 is connected over back contact 133 of relay 2ABP, front contact 132 of relay 2TBP, back contact 131 of relay 2PCR, and front contact 130 of relay 1TPR to terminal B of the source, while line wire 137 is connected over back contact 139 of a code detecting relay 2ABP, controlled by a multiple approach relay

2AR, a front contact 140 of relay 2TBP, back contact 141 of relay 2PCR, front contact 142 of relay 1TPR, and windings of series approach relays 2ALA and 2ALB in multiple to terminal C of the source.

It will be seen, therefore, that when contact 98 of relay 5TBP establishes the circuit of the winding of entering signal 6S energy is supplied to this winding in series with the series approach relays at the opposite end of the passing siding. The series approach relays ALA and ALB are selected so that contacts of relay ALA will pick up in response to the supply over the line wires of energy of the value which will be supplied through the winding of signal 6S, but so that the contacts of relay ALB will not pick up in response to the supply of energy of this value. Accordingly, when the circuit of the winding of entering signal 6S is established, the series approach relay ALA at the opposite end of the passing siding is picked up but the series approach relay ALB remains released.

Referring to Fig. 1A, it will be seen that when relay 2ALA picks up its contact 121 in the circuit of the winding of signal 2S is closed. If the single track stretch in advance of signal 2S is unoccupied so that coded energy is supplied over the rails of the stretch to operate track relay 2TR and keep the relay 2TBP picked up, energy will be supplied to the winding of signal 2S on picking up of relay 2ALA and this signal will be conditioned to display its green or clear indication, if lighted.

If conditions are such that energy is supplied to the winding of signal 2S, a contact of the signal mechanism will establish the circuit of the relay 2PCR and its contacts will be picked up to cause the energy supplied to line wires 135 and 137 to be of normal instead of reverse polarity. After relay 2PCR picks up, line wire 135 is connected over back contact 133 of relay 2ABP, front contact 132 of relay 2TBP, front contact 131 of relay 2PCR, front contact 142 of relay 1TPR, and windings of relays 2ALA and 2ALB to terminal C, while line wire 137 is connected over back contact 139 of relay 2ABP, front contact 140 of relay 2TBP, front contact 141 of relay 2PCR, and front contact 130 of relay 1TPR to terminal B.

On this change in the polarity of the energy supplied to the line wires 135 and 137 the flow of energy through the windings of the series approach relays 2ALA and 2ALB is maintained so that contact 121 of relay 2ALA remains picked up and maintains the circuit of the winding of signal 2S.

If the energy supplied to the line wires 135 and 137 leading to signal 6S is changed to normal polarity, the signal 6S will be prepared, when lighted, to display its green or clear indication while a contact of the signal mechanism will establish the circuit of the relay 6DPR. When relay 6DPR picks up, its contacts 20a and 21a change the connections over which energy is supplied from battery 5TB to the rails of section 4—5T so that energy of normal instead of reverse polarity is supplied to the rails of this section. The track relays 4HTR and 4DTR for section 4—5T are of the biased polar type selectively responsive to the polarity of the current supplied thereto as indicated by the arrows on the representation of their windings, and on this change in the polarity of the energy supplied to the rails of section 4—5T the track relay 4DTR instead of the track relay 4HTR operates and on the ap-

proach of a train the code detecting equipment at this location will cause the signal 4S to display its green or clear indication.

On the other hand, if at the time back contact 98 of relay 5TBP in the circuit of the winding of signal 6S is closed, traffic conditions are such that the head block signal in advance does not clear, the energy supplied to the line wires 135 and 137 continues to be of reverse polarity and when supplied to the winding of signal 6S will prepare this signal to display its yellow or caution indication.

Similarly, if at the time back contact 98 of relay 5TBP in the circuit of the winding of signal 6S is closed, traffic conditions are such that energy is not supplied to the line wires leading to signal 6S, this signal will remain at stop.

When the signal 6S is at stop or is prepared to display its caution indication, the circuit of relay 6DPR is not established and this relay remains released so the energy supplied from battery 5TB to the rails of section 4—5T continues to be of reverse polarity. This energy operates track relay 4HTR so that the code detecting equipment at this location will cause the signal 4S to display its yellow or caution indication.

When the supply of coded energy from left to right over the rails of the single track stretch is discontinued and relay 5TBP releases, its back contact 115 in the circuit for supplying energy to the lamp of signal 6S is closed. When relay 5TBP releases, its contact 100 in the circuit of the multiple approach relay 6AR is closed and this relay is operated periodically by coded energy supplied from battery 5TB to the rails of section 4—5T. Accordingly, the contact of relay 6AR establishes the circuits of two code detecting relays 6AFP and 6ABP which it controls and contact 159 of relay 6AFP interrupts the circuit of the lamp of signal 6S and this signal remains dark, which is proper as there is no need for the signal lamp to be lighted until a train approaches the signal.

The operation of the equipment when the train leaves the passing siding I is best understood by again arranging the drawings in the order Figs. 1A, 1B, 1C and 1D with Fig. 1A at the left.

When the eastbound train under consideration leaves passing siding I and enters the single track stretch, the supply of coded energy over the rails of the stretch to track relay 2TR is cut off and relay 2TR remains released so that the code detecting relays 2TFP and 2TBP release. On release of relay 2TBP, its contacts 150 and 151 interrupt the circuit of the winding of signal 2S and this signal is then conditioned to display its stop indication.

When the train vacates the siding section 1T and the switch 1W is restored to its normal position, the track relay 1TR picks up so that its contact 123 establishes the pick-up circuit for relay 1TPR and it picks up to establish its own stick circuit. The pick-up circuit for relay 1TPR includes back contact 124 of relay 2PCR. When relay 1TPR picks up, the opening of its back contact 130 interrupts the circuit over which energy had been supplied to relays 2ALA and 2ALB, and these relays release so that the circuit governed by front contact 148 of relay 2ALB for supplying energy to the lamp of signal 2S is interrupted.

In addition, when track relay 1TR picks up, its contact 123 interrupts the circuit which it controls for supplying energy to the lamp of signal 2S, while contact 25 of relay 1TR establishes the control circuit for the transmitter relays 2CRA, 2CRB and 2CRC, and these relays now operate

13

to cause impulses of energy to be supplied to the rails of the single track stretch. However, because of occupancy of the single track stretch, the impulses of energy supplied to the left-hand end of the stretch do not reach the right-hand end of the stretch and the track relay 5TR remains released and the relays 5TFP and 5TBP also remain released.

When the train advances to within a predetermined distance of the distant signal 4S, the series approach relay 4AR is operated by the coded energy supplied to the rails of section A4T and its slow release repeating relay 4AP picks up to establish the circuit of the winding of signal 4S and to also establish the circuit of the lamp of this signal. When relay 4AP establishes the circuit of the winding of signal 4S, this signal is caused to display its clear or its caution indication depending upon whether a code detecting relay 4DR or a code detecting relay 4HR is picked up. As explained in the above-identified application of Henry S. Young, the relays 4DR and 4HR are governed by two code following repeater relays 4HTP and 4DTP of the track relays 4DTR and 4HTR and by a slow release back contact repeater relay 4TBPR, so that relay 4DR is picked up when relay 4DTR is operating and so that relay 4HR is picked up when relay 4HTR is operating. As explained above, the track relays 4DTR and 4HTR are governed by the polarity of the energy supplied over the track rails, and this is determined by the indication displayed by the entering signal 6S, which in turn is determined by the indication displayed by the head block signal in advance.

When the train advances into section 4—5T, the track relays 4DTR and 4HTR both remain released so the relays 4DR and 4HR are both released and the winding of signal 4S is deenergized so that this signal will display its red or stop indication.

When the train advances to within a predetermined distance of the signal 6S, the energy supplied from the track rails to relay 6AR is reduced below the operating value of the relay so it ceases to operate and relays 6AFP and 6ABP release. On release of relay 6AFP, its contact 159 completes the circuit of the lamp of signal 6S so that this signal is lighted and displays an appropriate indication to the approaching train.

When the train passes signal 6S and enters section 6T, the track relay 6TR releases and its contact 95 interrupts the circuit of relay 6TPR and it releases with the result that its contacts 145 and 146 interrupt the connections from line wires 135A and 137A to the winding of signal 6S and connect these line wires together.

When the line wires 135A and 137A are connected directly together instead of being connected together through the winding of signal 6S, there is a substantial increase in the value of the energy flowing in the circuit of these line wires because of the removal from the circuit of the line wires of the resistance represented by the signal winding.

The energy supplied over the line wires after they are short-circuited is of such value that the contacts of both of the approach relays which are energized in series with these line wires are picked up. The operation of the equipment at this time is best understood by placing Fig. 1A at the right of Fig. 1D and considering the line wires 135 and 137 as extensions of the line wires 135A and 137A. With the drawings arranged in this manner it will be seen that when relay 6TPR

14

releases and connects the line wires 135A and 137A together, the series approach relay 2ALA remains picked up and the relay 2ALB becomes picked up in response to the increased flow of energy in the circuit of the line wires 135 and 137. When relay 2ALB picks up, its contact 148 establishes a circuit for supplying energy to the lamp of signal 2S and this signal is lighted to indicate to the approaching train the nature of traffic conditions in advance.

When the entering signal 6S displays a permissive indication one or the other of two signal repeater relays 6DPR or 6HPR is picked up and prepares a pick-up circuit for a directional stick relay 6SR so that when the train enters sections 6T and relay 6TR releases, its contact 172 establishes a pick-up circuit for relay 6SR and its contacts pick up to establish a stock circuit for itself so the relay remains energized after relays 6DPR and 6HPR are both released, as they will be after the supply of energy to the winding of signal 6S is cut off and this signal goes to stop.

When relay 6SR is picked up, its contact 81 causes energy to be supplied to the control circuit for the transmitter relays 5CRA, 5CRB and 5CRC after opening of contact 25a of relay 6TR. Accordingly, these transmitter relays continue to operate and cause impulses of energy to be supplied to the rails of the single track stretch. As the relay 6DPR is released, the energy supplied to the rails of section 4—5T from battery 5TB is of reverse polarity, and when section 4—5T is vacated and this energy is supplied over the rails of the section, the code detecting means associated with the distant signal 4S will prepare that signal to display its yellow or caution indication.

When the train vacates the single track stretch, impulses of coded energy supplied from left to right over the rails of the single track stretch behind the train feed to track relay 5TR and operate it to pick up relays 5TFP and 5TBP. When relay 5TFP picks up, its front contact 45 in the stick circuit for relay 5CRB is closed and the operation of the transmitter relays 5CRA, 5CRB and 5CRC is modified by picking up of track relay 5TR so that these relays now operate to cause an impulse of energy to be supplied to the track stretch following release of the track relay 5TR, as explained in my copending application identified above.

When relay 5TBP picks up, its back contact 115 interrupts the circuit for supplying energy to the lamp of signal 6S, while its front contacts 115 and 118 establish the circuit for supplying energy to the winding of signal 5S and this signal may display its clear indication to show that the single track stretch between sidings I and II is unoccupied.

When the eastbound train under consideration advances from section 6T into section 1T, the track relay 1TR releases and its contact 123 interrupts the circuit of relay 1TPR and it releases so that its contacts 130 and 142 interrupt the supply of energy to line wires 135 and 137, but at this time back contact 130 of relay 1TPR establishes a circuit for supplying energy to relays 2ALA and 2ALB and both of these relays remain picked up. Accordingly, contact 121 of relay 2ALA maintains the circuit of the winding of head block signal 2S, and contact 148 of relay 2ALB maintains a circuit for supplying energy to the lamp of signal 2S. In addition, as back contact 148 of relay 2ALB is open, energy supplied over back contact 123 of relay 1TR to the

lamp of signal 2S cannot feed to the lamp of signal 1S and cause unnecessary lighting of this signal.

At this time signal 1S is at stop so the signal repeating relays 1DPR and 1HPR are both released, and on release of track relay 1TR the relay 1SR does not pick up. Accordingly, on release of relay 1TR its contact 25 cuts off the supply of energy to the control circuit for the transmitter relays 2CRA, 2CRB and 2CRC and they remain released and cease to cause energy to be supplied to the single track stretch. The relay 2TR continues to be operated periodically by energy impulses supplied over the single track stretch from right to left and keeps relays 2TFP and 2TBP energized so that contacts 150 and 151 of relay 2TBP maintain the circuit for supplying energy to the winding of signal 2S.

When the supply of coded energy from left to right over the rails of the single track stretch is cut off, the equipment at the right-hand of the single track stretch operates as described above.

In the foregoing description only the construction and operation of the approach control equipment employed in the control of the signals governing movement of eastbound traffic has been considered. However, the apparatus is arranged symmetrically and corresponding equipment is provided for westbound traffic. Since the equipment for westbound traffic is the same in construction and operation as the equipment for eastbound traffic, a detailed description of the apparatus for westbound traffic is unnecessary and is being omitted in order to simplify this disclosure.

The approach control apparatus for both directions of traffic is governed by occupancy of the track stretch by a train and is independent of the direction of movement of the train, except as the directional stick relays SR at the ends of a single track stretch control the supply of coded energy to the rails of the track stretch. Accordingly, occupancy of a portion of the stretch by a train results in operation of the approach control apparatus behind the train as well as in advance of the train.

For example, when a train is present in the single track stretch between passing sidings I and II, the code detecting relays at both ends of the stretch are released. As explained above, on release of relay 5TBP, Fig. 1D, its contact 98 establishes the circuit of the winding of entering signal 6S and energy supplied over the line wires leading to this signal picks up one of the series approach relays at the other end of the passing siding II to establish the circuit of the winding of the head block signal at that end of this siding. Similarly, as the code detecting relay 2TBP, Fig. 1A, is released, its contact 10 establishes the circuit of the winding of entering signal 1S, and the energy supplied over the line circuit leading to this signal picks up one of the series relays at the other end of the passing siding I to establish the circuit of the winding of the head block signal at that end of this siding.

The operation of the approach control apparatus in the portion of the stretch behind the train is unnecessary, and the consequent energization of the windings of the signals behind the train results in unnecessary current consumption, but it does not in any way interfere with movement of traffic in either direction behind the train. Furthermore, this unnecessary energy consumption continues only as long as a predetermined portion of the stretch is occupied and is auto-

matically cut off when this portion of the stretch is vacated. As train movements are relatively infrequent the total unnecessary energy consumption resulting from this operation of the approach control apparatus behind a train is not large and the saving which would result from its elimination does not justify the addition of means responsive to the direction of movement of traffic to prevent operation of the approach control apparatus behind a train.

From the foregoing it will be seen that the circuits of the windings of the entering and head block signals are normally interrupted so that these signals do not consume energy during the periods in which traffic conditions do not require these signals to be prepared to display permissive indications.

In addition, it will be seen that the circuits of the windings of the entering and head block signals are controlled so that these circuits are automatically established on the approach of a train. The circuit of the winding of an entering signal at one end of a passing siding is established when the supply of coded energy over the rails of the single track stretch leading to this signal is cut off, while establishment of the circuit of the winding of an entering signal with resultant flow of energy therethrough over the associated line circuit picks up one of the two series approach relays at the opposite end of the siding and thus establishes the circuit of the winding of the head block signal at that point. This head block signal checks traffic conditions in the single track stretch leading to the next passing siding and governs the polarity of the energy supplied to the line circuit for controlling the adjacent entering signal in the rear, and thus causes the entering signal to govern the polarity of the coded energy supplied to the single track stretch so that the distant signal in the rear of the entering signal will be prepared to display an indication determined by traffic conditions in advance.

Although the circuit of the winding of a head block signal governing entrance of traffic into one single track stretch is established when the supply of coded energy over the rails of the single track stretch in the rear is cut off, the circuit of the lamp of the head block signal is not established until a train passes the entering signal in the rear. Thus the circuit of the signal winding is established far enough in advance of an approaching train to cause the signal to determine traffic conditions in advance and provide appropriate control for the entering and distant signals in the rear before the train reaches these signals.

On the other hand it is unnecessary for the lamp of a head block signal to be lighted until a train advances a substantial distance beyond the point at which the circuit of the winding of the signal must be established, and this system is arranged so that the circuit of the lamp of a head block signal is interrupted until a train passes the entering signal in the rear of the head block signal.

It will be seen that the approach control of the winding and of the lamp of a head block signal is effected by series approach relays ALA and ALB which are controlled through the coded track circuit apparatus provided for a single track stretch and are energized by current supplied over the line wires which are provided for the control of the entering signal so that no equipment other than the relays ALA and ALB themselves is required to carry out the approach control functions.

17

Furthermore, the equipment is arranged so that the series approach relays ALA and ALB are normally deenergized and therefore do not consume energy. These relays are energized on the approach of a train and are automatically deenergized when the train passes. In the track stretches where this system is intended to be employed, trains are relatively infrequent so the periods during which the approach relays ALA and ALB are energized are infrequent and the energy consumed by these relays is relatively small. Hence the energy required to operate the relays ALA and ALB does not materially reduce the energy saved by deenergization of the head block signal windings and lamps.

The equipment is arranged so that failure of the approach control relays to function as intended cannot create a hazardous condition. If relay 2ALA fails to pick up, the circuit of the winding of the head block signal 2S will not be established and this signal will remain at stop even though traffic conditions in advance are such that the signal should display its green or clear indication. As the head block signal 2S remains at stop, the energy supplied to the line wires leading to the entering signal in the rear continues to be of reverse polarity and will prepare that signal to display its caution indication, while this signal causes the coded energy supplied to the single track stretch in the rear to be of reverse polarity so the distant signal governed thereby will display its caution indication. The display of a stop indication by the head block signal 2S, and the display of caution indications by the entering and distant signals in the rear at a time when all of these signals should display clear indications will delay traffic but cannot create a hazardous situation.

If for any reason the relay 2ALB fails to pick up, the lamp of signal 2S will not be lighted until section 1T is occupied and there will be a short period after a train passes the entering signal in the rear during which the signal 2S will not provide an indication. However, the engineer of the train will have received indications of traffic conditions in advance from the distant and entering signals, while the lamp of signal 2S is certain to be lighted to cause the signal to display an indication before the train reaches the signal so the delay in the lighting of this signal is not serious.

The series approach relays ALA and ALB associated with a head block signal for one direction of traffic in no way govern the signals for the opposite direction of traffic. Accordingly, failure of the series approach relays to operate as intended cannot cause the display of an improper indication by the signals for the opposite direction of traffic.

Although I have herein illustrated and described only one form of railway signaling system embodying my invention it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a railroad track layout including a first track stretch, a main track portion and a second track stretch through which traffic moves in the order named, a first and a second signal governing entrance of traffic into said main track portion and a second track stretch respectively, each having a winding for

18

causing the signal to display a permissive or stop indication depending on whether its winding is energized or not, said first signal displaying a caution or proceed indication when its winding is energized depending upon whether the energy supplied thereto is of reverse or normal polarity, a pair of line wires governed by traffic conditions in said main track portion, an approach relay, pole changer contacts governed by said second signal for connecting said line wires through the winding of said approach relay to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as said second signal is prepared to display a stop or a permissive indication, means for interrupting the circuit of said line wires or for connecting said line wires to the winding of said first signal according as said first track stretch is vacant or is occupied, and means governed by said approach relay and by traffic conditions in said second track stretch for supplying energy to the winding of said second signal.

2. In combination, a railroad track layout including a first track stretch, a main track portion and a second track stretch through which traffic moves in the order named, a first and a second signal governing entrance of traffic into said main track portion and second track stretch respectively, each having a winding and lamp which when lighted causes the signal to display a permissive or stop indication depending upon whether the winding is energized or not, said first signal displaying a caution or proceed indication when its winding is energized depending upon whether the energy supplied thereto is of reverse or normal polarity, a pair of line wires governed by traffic conditions in said first track stretch and in said main track portion so that the circuit of said line wires is interrupted when said first track stretch is vacant, and so that said line wires are connected together through the winding of said first signal when said first track stretch is occupied and said main track portion is vacant, and also so that said line wires are connected together independently of the winding of said first signal when a train enters said main track portion, a first and a second approach relay, means governed by said second signal for connecting said line wires through the windings of said first and second approach relay in multiple to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as said second signal is prepared to display a stop or a permissive indication, said approach relays being selected and arranged so that the energy supplied through the relay windings when the line wires are connected together through the winding of said first signal will pick up the contacts of the first approach relay only and so that the energy supplied through the relay windings when said line wires are connected together independently of the winding of said first signal will pick up the contacts of both of said approach relays, a circuit governed by traffic conditions in said second track stretch for supplying energy to the winding of said second signal provided the contacts of said first approach relay are picked up, and a circuit for supplying energy to the lamp of said second signal provided the contacts of said second approach relay are picked up.

3. In combination, a railroad track layout including a first track stretch, a main track portion and a second track stretch through which traffic moves in the order named, a first and a

second signal governing entrance of traffic into said main track portion and second track stretch respectively, each having a winding for causing the signal to display a permissive or stop indication depending on whether its winding is energized or not, said first signal displaying a caution or proceed indication when its winding is energized depending upon whether the energy supplied thereto is of reverse or normal polarity, a pair of line wires governed by traffic conditions in said first track stretch and in said main track portion so that the circuit of said line wires is interrupted when said first track stretch is vacant, and so that said line wires are connected together through the winding of said first signal when said first track stretch is occupied and said main track portion is vacant, and also so that said line wires are connected together independently of the winding of said first signal when a train enters said main track portion, an approach relay, means governed by said second signal for connecting said line wires through the winding of said approach relay to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as said second signal is prepared to display a stop or a permissive indication, and a circuit governed by traffic conditions in said second track stretch for supplying energy to the winding of said second signal provided the contacts of said approach relay are picked up.

4. In combination, a railroad track layout including a first track stretch, a main track portion and a second track stretch through which traffic moves in the order named, a distant signal and a first and a second block signal governing entrance of traffic into said first track stretch, said main track portion and said second track stretch respectively, each having a winding for causing the signal to display a permissive or stop indication depending on whether its winding is energized or not, said first signal displaying a caution or proceed indication when its winding is energized depending upon whether the energy supplied thereto is of reverse or normal polarity, means governed by traffic conditions in said first track stretch and by the indication which said first block signal is prepared to display for controlling said distant signal, a pair of line wires governed by traffic conditions in said first track stretch and in said main track portion so that the circuit of said line wires is interrupted when said first track stretch is vacant, and so that said line wires are connected together through the winding of said first signal when said first track stretch is occupied and said main track portion is vacant, and also so that said line wires are connected together independently of the winding of said first signal when a train enters said main track portion, an approach relay, means governed by said second block signal for connecting said line wires through the winding of said approach relay to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as said second signal is prepared to display a stop or a permissive indication, and a circuit governed by traffic conditions in said second track stretch for supplying energy to the winding of said second signal provided the contacts of said approach relay are picked up.

5. In combination, a railroad track layout including a first track stretch, a main track portion and a second track stretch through which traffic moves in the order named, a distant sig-

nal and a first and a second block signal governing entrance of traffic into said first track stretch, said main track portion and said second track stretch respectively, each having a winding and lamp which when lighted causes the signal to display a permissive or stop indication depending upon whether the winding is energized or not, said first signal displaying a caution or proceed indication when its winding is energized depending upon whether the energy supplied thereto is of reverse or normal polarity, means governed by traffic conditions in said first track stretch and by the indication which said first block signal is prepared to display for controlling said distant signal, a pair of line wires governed by traffic conditions in said first track stretch and in said main track portion so that the circuit of said line wires is interrupted when said first track stretch is vacant, and so that said line wires are connected together through the winding of said first signal when said first track stretch is occupied and said main track portion is vacant, and also so that said line wires are connected together independently of the winding of said first signal when a train enters said main track portion, a first and second approach relay, means governed by said second block signal for connecting said line wires through the windings of said first and second approach relay in multiple to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as the winding of said second signal is deenergized or is energized, said approach relays being selected and arranged so that the energy supplied through the relay windings when the line wires are connected together through the winding of said first signal will pick up the contacts of said first approach relay only and so that the energy supplied through the relay windings when said line wires are connected together independently of the winding of said first signal will pick up the contacts of both of said approach relays, a circuit governed by traffic conditions in said second track stretch for supplying energy to the winding of said second signal provided the contacts of said first approach relay are picked up, and a circuit for supplying energy to the lamp of said second signal provided the contacts of said second approach relay are picked up.

6. In combination, a railroad track layout having a first and a second single track stretch connected by a main track portion, each of said single track stretches having at each end a code following track relay operated by coded energy supplied over the rails of the stretch, code transmitting means at each end of each single track stretch normally connecting the associated track relay across the track rails and operable at times to connect a source of energy across the track rails, a code detecting relay associated with each track relay and governed thereby so as to be energized when and only when the track relay is being operated by coded energy, a head block signal at each end of each single track stretch for governing entrance of traffic into the stretch, an entering signal at each end of said main track portion for governing entrance of traffic into the main track portion, each signal having a winding for causing the signal to display a permissive or stop indication depending on whether its winding is energized or not, each entering signal displaying a caution or proceed indication when its winding is energized,

depending upon whether the energy supplied thereto is of reverse or normal polarity, a pair of line wires for each of said entering signals extending the length of said main track portion and governed by traffic conditions therein, an approach relay at each end of the main track portion, means for each pair of line wires for connecting the ends of said line wires remote from the signal with which the line wires are associated through the winding of the adjacent approach relay to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as the winding of the head block signal at that end of said line wires is deenergized or is energized, means for each entering signal effective only when the code detecting relay adjacent the same end of said main track portion is deenergized for connecting the associated line wires to the winding of said signal, and a circuit for each head block signal for supplying energy to the signal winding provided the associated approach and code detecting relays are energized.

7. In combination, a railroad track layout having a first and a second single track stretch connected by a main track portion, each of said single track stretches being divided into a plurality of track sections including an end section adjoining the main track portion, each of said single track stretches having at each end a code following track relay which is operated by coded energy supplied over the rails of the single track stretch provided the entire single track stretch is unoccupied, a code detecting relay associated with each track relay and governed thereby so as to be energized when and only when the track relay is being operated by coded energy, a head block signal at each end of each single track stretch for governing the entrance of traffic into the stretch, an entering signal at each end of said main track portion for governing entrance of traffic into the main track portion, a distant signal for each entering signal for governing the entrance of traffic into the end section of the single track stretch in the rear of such entering signal, each signal having a winding for causing the signal to display a permissive or stop indication depending on whether its winding is energized or not, each entering signal and each distant signal displaying a caution or proceed indication when its winding is energized, depending upon whether the energy supplied thereto is of reverse or normal polarity, a pair of line wires for each of said entering signals extending the length of said main track portion and governed by traffic conditions therein, an approach relay at each end of the main track portion, means for each pair of line wires for connecting the ends of said line wires remote from the signal with which the line wires are associated through the winding of the adjacent approach relay to the terminals of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as the winding of the head block signal at that end of said line wires is deenergized or is energized, means for each entering signal effective only when the code detecting relay at the same end of said main track portion is deenergized for connecting the associated line wires to the winding of said signal, a circuit for each head block signal for supplying energy to the signal winding provided the associated approach and code detecting relays are energized, and control means for each of said distant signals governed by traffic conditions in the

associated end section for supplying energy of reverse or normal polarity to its winding when the associated end section is unoccupied, each such means supplying energy of normal polarity only when the winding of the entering signal in advance is energized by energy of normal polarity.

8. In combination, a railroad track layout having a first and a second single track stretch connected by a main track portion, the rails of said first single track stretch being divided into a plurality of track sections including an end track section adjoining said second main track portion, the main track portion being divided into a first track section adjacent said first single track stretch and a second track section adjacent said second single track stretch, each of said track sections being provided with a track circuit including a track relay, a pair of line wires extending the length of said main track portion, a head block signal governing entrance of traffic into the second single track stretch from the main track portion, an entering signal governing entrance of traffic from said first single track stretch into the main track portion each signal having a winding for causing the signal to display a permissive or a stop indication depending upon whether its winding is energized or not, each entering signal displaying a caution or proceed indication when its winding is energized, depending upon whether the energy supplied thereto is of reverse or normal polarity, an approach relay at the location of said head block signal, means responsive to occupancy of said first single track stretch for connecting said line wires together through the winding of said entering signal, means effective during occupancy of said first track section for connecting said line wires together independently of the winding of said entering signal, means effective only when said second track section is unoccupied for connecting said line wires through the winding of said approach relay to the terminals of the winding of a source of energy so that energy of reverse or normal polarity is supplied to said line wires according as the winding of said head block signal is deenergized or is energized, a circuit governed by traffic conditions in said second single track stretch and effective when the contacts of said approach relay are picked up for supplying energy to the winding of said head block signal, a distant signal governing entrance into said end track section of traffic approaching said entering signal, and means governed by traffic conditions in said end track section and by the polarity of the energy supplied to the winding of said entering signal for controlling said distant signal.

9. In combination, a railroad track layout having a first and a second single track stretch connected by a main track portion, impulse forming equipment at each end of each single track stretch for supplying coded energy to the rails of the stretch, each of said single track stretches having a code following track relay at each end which is operated by coded energy supplied over the rails of the stretch as a result of operation of the impulse forming equipment at the opposite end of the stretch, each impulse forming equipment being governed by the associated track relay and operating in such manner that as long as the track relay is responding to received impulses an impulse of energy is supplied to the track rails following each release of the track relay to thereby cause impulses of energy to be normally supplied alternately in opposite directions

over the rails of the stretch by the operation of the equipments at the two ends, a code detecting relay associated with each track relay and governed thereby so as to be energized when and only when the track relay is being operated periodically by coded energy, an entering signal at each end of said main track portion for governing entrance of traffic into the main track portion, a line circuit for each of said entering signals extending the length of said main track portion and governed by traffic conditions therein, an approach relay for each line circuit connected in series therewith at the end thereof remote from the associated signal, a winding for each entering signal selectively responsive to the polarity of the energy supplied thereto for causing the signal to indicate caution or proceed depending upon whether the winding is supplied with energy of reverse or normal polarity, means for supplying energy to each such winding from the line circuit for the associated signal only when the code detecting relay at the same end of the second passing siding is deenergized, head block signals at the ends of said single track portions adjacent said second passing siding, each having a winding for causing the signal to display a proceed or stop indication depending upon whether or not its winding is energized, a control circuit for each of said head block signals over which energy may be supplied to the winding of the signal provided the associated code detecting and series approach relays are both energized, and means for supplying to each line circuit at the end thereof remote from the signal with which the line circuit is associated energy of normal or of reverse polarity according as the winding of the head block signal at the supply end of the line circuit is energized or is deenergized.

10. In combination, a stretch of railroad track having a first signal governing movement of traffic in one direction in said stretch, a second signal in the rear of said first signal and governing traffic approaching said first signal, said first signal being effective to display its stop or a permissive indication according as the signal winding is deenergized or is energized, said second signal being effective when its winding is deenergized to display its stop indication and being effective to display one or the other of its permissive indications according as energy of normal or reverse polarity is supplied to the signal winding, a line circuit over which energy may be supplied to the winding of said second signal, means effective according as the winding of said first signal is energized or is deenergized for supplying energy of normal or of reverse polarity to said line circuit in series with an approach relay, means responsive to traffic conditions in advance of said first signal for supplying energy to the winding of said first signal provided said approach relay is energized, means responsive to the presence of a train approaching said second signal for supplying energy from said line circuit to the winding of said second signal, and means responsive to occupancy of the portion of the track stretch between said second and first signals for interrupting said line circuit and for also energizing said approach relay.

11. In combination, a stretch of railroad track having a first signal governing movement of traffic in one direction in said stretch, a second signal in the rear of said first signal and governing traffic approaching said first signal, said first signal being effective to display its stop or a permissive indication according as the signal

winding is deenergized or is energized, said second signal being effective when its winding is deenergized to display its stop indication and being effective to display one or the other of its permissive indications according as energy of normal or reverse polarity is supplied to the signal winding, a line circuit over which energy may be supplied to the winding of said second signal, means effective according as the winding of said first signal is energized or is deenergized for supplying energy to said line circuit through the windings of a first and a second approach relay in multiple, the contacts of said first approach relay being picked up on the supply of energy over said line circuit to the winding of said second signal and the contacts of said second approach relay being picked up only on the supply of energy over said line wires of a value greater than is supplied through the winding of said second signal, means responsive to traffic conditions in advance of said first signal for supplying energy to the winding of said first signal provided the contacts of said first approach relay are picked up, a circuit for supplying energy to the lamp of said first signal when the contacts of said second approach relay are picked up, means responsive to the presence of a train approaching said second signal for supplying energy from said line circuit to the winding of said second signal, and means responsive to occupancy of the portion of said track stretch between said second and first signals for interrupting the supply of energy from said line circuit to the winding of said second signal and for connecting the wires of said line circuit together through connections having substantially lower resistance than the winding of said second signal.

12. In combination, a stretch of railroad track having a first signal governing movement of traffic in one direction in said stretch, a second signal in the rear of said first signal and governing traffic approaching said first signal, said first signal being effective to display its stop or a permissive indication according as the signal winding is deenergized or is energized, said second signal being effective when its winding is deenergized to display its stop indication and being effective to display one or the other of its permissive indications according as energy of normal or reverse polarity is supplied to the signal winding, a line circuit over which energy may be supplied to the winding of said second signal, means effective according as the winding of said first signal is energized or is deenergized for supplying energy of normal or of reverse polarity to said line circuit in series with an approach relay, means responsive to traffic conditions in advance of said first signal for supplying energy to the winding of said first signal provided said approach relay is energized, means responsive to the presence of a train approaching said second signal for supplying energy from said line circuit to the winding of said second signal, the track stretch between said first and second signals being divided into a first section adjacent said first signal and a second section adjacent said second signal, means responsive to occupancy of said second section for interrupting the supply of energy from said line circuit to the winding of said second signal and for connecting the wires of said line circuit together independently of the winding of said second signal, and means responsive to occupancy of said first section for interrupt-

ing said line circuit and for energizing said approach relay independently of said line circuit.

13. In combination, a stretch of railroad track having a first signal governing movement of traffic in one direction in said stretch, a second signal in the rear of said first signal and governing traffic approaching said first signal, said first signal being effective to display its stop or a permissive indication according as the signal winding is deenergized or is energized, said second signal being effective when its winding is deenergized to display its stop indication and being effective to display one or the other of its permissive indications according as energy of normal or reverse polarity is supplied to the signal winding, a line circuit over which energy may be supplied to the winding of said second signal, means effective according as the winding of said first signal is energized or is deenergized for supplying energy of normal or of reverse polarity to said line circuit in series with an approach relay, means responsive to the presence of a train approaching said second signal for supplying energy from said line circuit to the winding of said second signal, the track stretch between said first and second signals being divided into a first section adjacent said first signal and a second section adjacent said second signal, means responsive to occupancy of said second section for interrupting the supply of energy from said line circuit to the winding of said second signal and for connecting the wires of said line circuit together independently of the winding of said second signal, means responsive to occupancy of said first section for interrupting said line circuit, a control circuit governed by traffic conditions in advance of said first signal, and means governed by said approach relay and by occupancy of said first section for supplying energy from said control circuit to the winding of said first signal.

14. In combination, a stretch of railroad track having a first signal governing movement of traffic in one direction in said stretch, a second signal in the rear of said first signal and governing traffic approaching said first signal, said first signal being effective to display its stop or a permissive indication according as the signal winding is deenergized or is energized, said second signal being effective when its winding is deenergized to display its stop indication and being effective to display one or the other of its permissive indications according as energy of normal or reverse polarity is supplied to the signal winding, a line circuit over which energy may be supplied to the winding of said second signal, means effective according as the winding of said first signal is energized or is deenergized for supply energy to said line circuit through the windings of a first and a second approach relay in multiple, the contacts of said first approach relay being picked up on the supply of energy over said line circuit to the winding of said second signal and the contacts of said second approach relay being picked up only on the supply of energy over said line wires of a value greater than is supplied through the winding of said second signal, the track stretch between said second and said first signal being divided into a first section adjacent said first signal and a second section adjacent said second signal, means responsive to the presence of a train approaching said second signal for supplying energy from said line circuit to the winding of said second signal, means responsive to occupancy of said second section for interrupt-

ing the supply of energy from said line circuit to the winding of said second signal and for connecting the wires of said line circuit together through connections having substantially lower resistance than the winding of said second signal, means responsive to occupancy of said first section for interrupting said line circuit and for energizing said first and second approach relays independently of said line circuit, means responsive to traffic conditions in advance of said first signal for supplying energy to the winding of said first signal provided the first approach relay is energized, and a circuit for supplying energy to the lamp of said first signal when the contacts of said second approach relay are picked up.

15. In combination, a stretch of railroad track having a first signal governing movement of traffic in one direction in said stretch, a second signal in the rear of said first signal and governing traffic approaching said first signal, said first signal being effective to display its stop or a permissive indication according as the signal winding is deenergized or is energized, said second signal being effective when its winding is deenergized to display its stop indication and being effective to display one or the other of its permissive indications according as energy of normal or reverse polarity is supplied to the signal winding, a line circuit over which energy may be supplied to the winding of said second signal, means effective according as the winding of said first signal is energized or is deenergized for supplying energy to said line circuit through the windings of a first and a second approach relay in multiple, the contacts of said first approach relay being picked up on the supply of energy over said line circuit to the winding of said second signal and the contacts of said second approach relay being picked up only on the supply of energy over said line wires of a value greater than is supplied through the winding of said second signal, the track stretch between said second and said first signal being divided into a first section adjacent said first signal and a second section adjacent said second signal, means responsive to the presence of a train approaching said second signal for supplying energy from said line circuit to the winding of said second signal, means responsive to occupancy of said second section for interrupting the supply of energy from said line circuit to the winding of said second signal and for connecting the wires of said line circuit together through connections having substantially lower resistance than the winding of said second signal, means responsive to occupancy of said first section for interrupting said line circuit, a control circuit governed by traffic conditions in advance of said first signal, means governed by said first approach relay and by occupancy of said first section for supplying energy from said control circuit to the winding of said first signal, and means governed by said second approach relay and by occupancy of said first section for supplying energy to the lamp of said first signal.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,057,581	McCann	Oct. 13, 1936