

Sept. 16, 1958

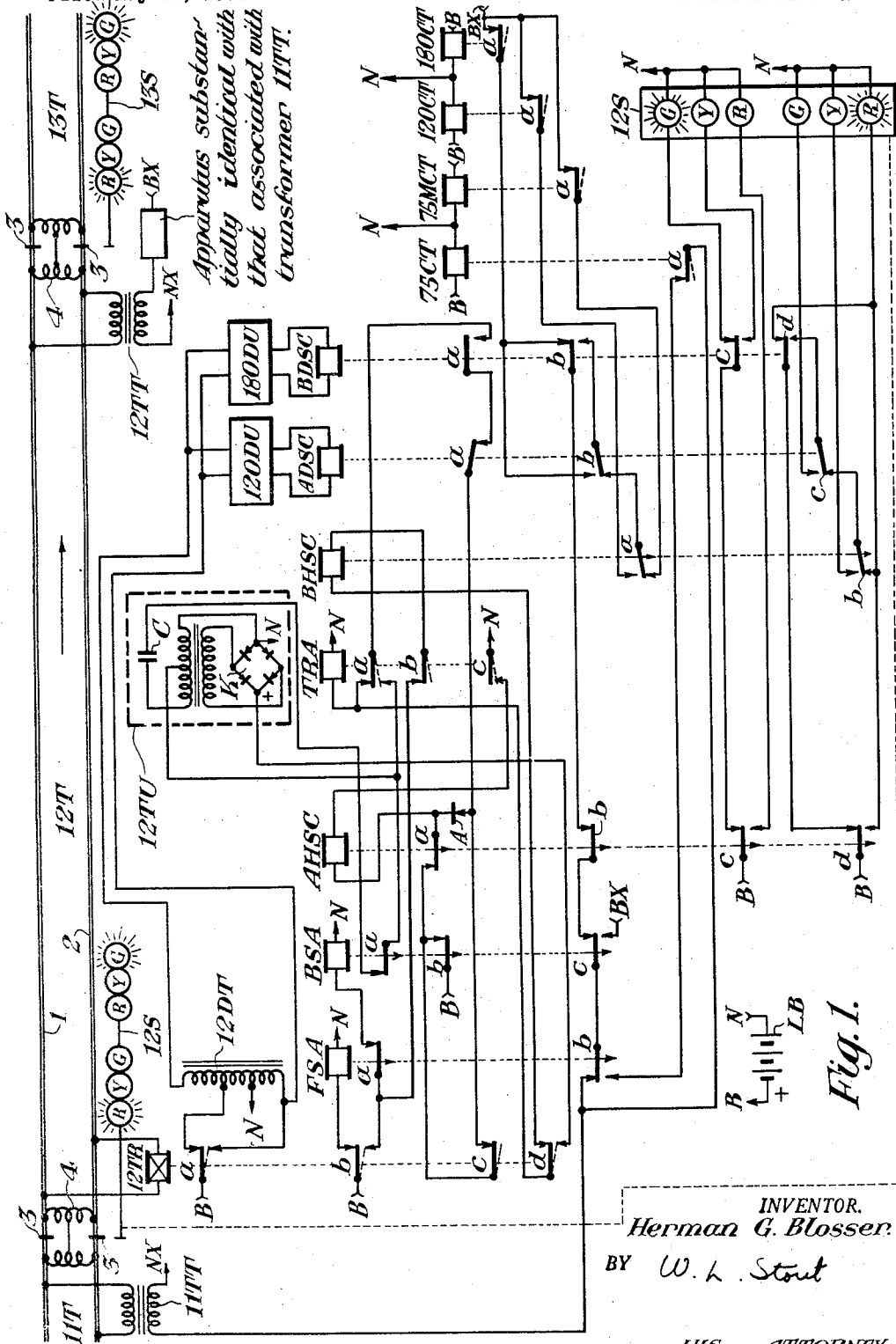
H. G. BLOSSER

2,852,664

RAILWAY SIGNALING SYSTEM

Filed May 18, 1953

2 Sheets-Sheet 1



Sept. 16, 1958

H. G. BLOSSER

2,852,664

RAILWAY SIGNALING SYSTEM

Filed May 18, 1953

2 Sheets-Sheet 2

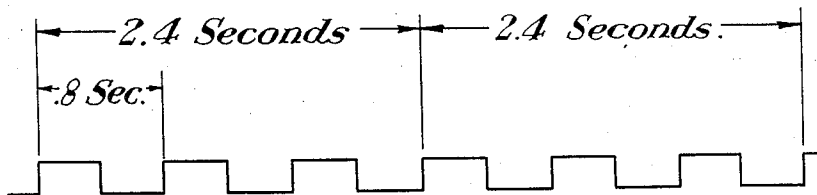


Fig. 2.

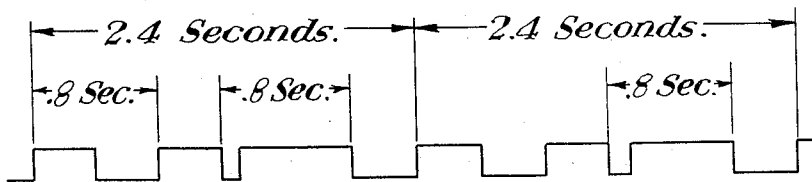


Fig. 3.

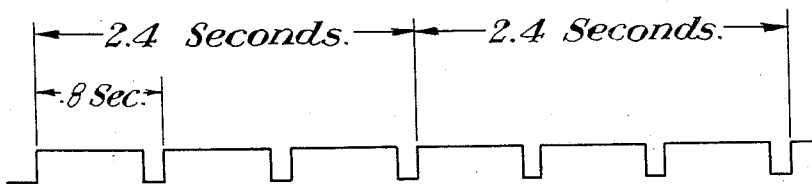


Fig. 4.

INVENTOR.
Herman G. Blosser.
BY *W. L. Stout*

HIS ATTORNEY

1

2,852,664

RAILWAY SIGNALING SYSTEM

Herman G. Blosser, Pittsburgh, Pa., assignor to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application May 18, 1953, Serial No. 355,666

5 Claims. (Cl. 246—38)

My invention relates to railway signaling systems of the type employing coded energy in the track circuits thereof, and particularly to an improvement in the system shown in United States Patent No. 2,331,134, granted to Frank H. Nicholson and Crawford E. Staples on October 5, 1943, for Railway Signaling Systems.

In signaling systems of the type employing coded energy in the track circuits thereof, it has been customary to employ energy coded at rates of 75 times per minute, 120 times per minute and 180 times per minute to provide three distinct proceed indications. These code rates are adequate for most situations, but in some cases it is desired to provide another or fourth proceed indication. The above mentioned Nicholson and Staples patent discloses a method for providing a fourth proceed indication by modifying the 75 code so that every third code cycle will have a very short off time followed by an extended on time. This modified 75 code, hereafter referred to as 75M code, is detected by means of a timing unit of the type shown and described in Letters Patent of the United States No. 2,391,369, granted to Carl Volz on December 18, 1945, for Code Detecting Means.

In such a system, if, due to the well known stored energy effect, the code following track relay has lagging front contacts, that is, the relay remains picked up for a time longer than the on period of the code, it is possible that when 75 code is being transmitted to the track relay, the track relay will operate in a manner similar to the manner the track relay normally operates during every third cycle of a 75M code. Accordingly, it is possible for the apparatus to give a false indication when 75 code is being transmitted. Such a condition is undesirable as the false indication would result in a less restrictive signal aspect, thereby permitting the train moving through the track stretch to move at a higher speed than is actually warranted for the traffic condition.

Accordingly, it is an object of my invention to provide a signaling system of the type described wherein means are provided for preventing a less restrictive signal aspect when 75 code is being transmitted to the track relay if the contacts of the track relay are lagging.

A further object of my invention is to provide means for opening the oscillating circuit in a timing unit of the type described in the above mentioned Volz patent when the contacts of the track relay are badly lagging on 75 code so that the associated signal governing train movements through the track stretch will not display a less restrictive aspect.

According to my invention, I provide a code following track relay and a first and a second auxiliary relay. The first auxiliary relay is energized over a back contact of the track relay. I further provide an oscillating circuit having a damped characteristic so that oscillations flowing in the oscillating circuit will be damped out in a time less than the normal off period of 75 code but longer than the shortened off period of 75M code. The oscillating circuit includes the primary winding of a

2

transformer, a capacitor and a front contact of the first auxiliary relay and is energized by a circuit including a front contact of the first auxiliary relay, a front contact of the track relay and a back contact of the second auxiliary relay. The second auxiliary relay is energized each time oscillations flow in the oscillating circuit by a circuit including the secondary winding of the transformer and a rectifier. Furthermore, a stick circuit for the second auxiliary relay is provided which is closed if both the track relay and the second auxiliary relay are picked up.

If the contacts of the track relay are badly lagging, then the back contact of the track relay will be opened for so long a time that the first auxiliary relay will release and, accordingly, the oscillating circuit will become open and the energy stored in the field of the transformer will be dissipated in a collapse of the field. Accordingly, when the oscillating circuit is closed, insufficient energy will be available for picking up the second auxiliary relay and it will be released. With the second auxiliary relay released, no false indication will result.

Other objects of my invention will become apparent hereinafter as the characteristic features of construction and mode of operation of my railway signaling system are described in detail.

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 accompanying drawings, Fig. 1 is a diagrammatic view of a five indication railway signaling system embodying my invention.

Fig. 2 is a diagram of 75 code used in this system.

Fig. 3 is a diagram of the 75M code used in this system.

Fig. 4 is a diagram of the action of the contacts of a track relay having badly lagging contacts when that relay is being supplied with energy at a 75 code rate.

Similar reference characters refer to similar parts in each of the several views.

Referring to Fig. 1 of the drawings, the reference characters 1 and 2 designate the track rails of a stretch of railway track over which traffic normally moves in the direction indicated by the arrow, that is, from left to right. These track rails are divided by insulated joints 3 into track sections 11T, 12T and 13T.

Electric current may be employed for propulsion purposes and where this is so, alternating current energy is employed in the track circuits and impedance bonds 4 of the customary form are provided to conduct the propulsion current around each pair of insulated rail joints 3. As the description proceeds, however, it will become apparent that the apparatus of this invention is equally well suited for use on a road where electrical propulsion current is not used, in which case either direct or alternating current may be employed in the track circuit, while the impedance bonds 4 may be omitted.

In addition, as impedance bonds are employed in the signaling apparatus herein shown, means to check the insulated joints is provided. As here shown, this means is the non-cascading lockout circuit shown and described in Letters Patent of the United States No. 2,235,134, issued March 18, 1941, to Leslie R. Allison and Frank H. Nicholson. If my present invention is employed in a track stretch where impedance bonds are not required, the portion of the signaling apparatus relating to the lockout circuit may be omitted.

Similarly, the decoding means provided by this invention for detecting the modified 75 code is not limited to use in wayside apparatus but may be incorporated in cab signaling apparatus for use on locomotives.

Referring again to Fig. 1, the apparatus associated with

one complete section 12T is shown and parts of the apparatus associated with sections 11T and 13T are shown. Each of these sections has located at the entrance end thereof a signal S for governing traffic over the stretch. The signals illustrated are of the familiar color-light type and each signal has an upper and lower portion, each of which has a green, yellow and a red lamp. The invention, however, is not limited to the use of signals of this type and any appropriate form of signal may be used. Likewise, the invention is not limited to a system employing wayside signals, but is equally applicable to track stretches without wayside signals and having provision for cab signals only, or to stretches in which provision is made for both wayside and cab signals.

The rails of each track section form a part of a track circuit to which coded alternating current signal control energy is supplied at the exit or leaving end by the secondary of a track transformer TT. The alternating current supplied to the track circuits is derived from a suitable source and may be distributed throughout the track stretch by a transmission line, not shown, or by means individual to each track section. The terminals of the power supply source of the track circuit are designated by the reference characters BX and NX, and it will be assumed that the energy supplied from this source is alternating current of a frequency of 60 cycles per second. The energy supplied to the track circuit from the alternating current source BX-NX is coded by 4-code transmitters 75CT, 75MCT, 120CT, and 180CT, which are energized by obvious circuits and which code energy at code rates of 75, 75M, 120, and 180, respectively. As has already been stated, the 75 code pattern is shown in Fig. 2 and the 75M code pattern is shown in Fig. 3. The details of construction of the code transmitter 75MCT forms no part of my invention. However, this special coded energy may be generated by cam wheels of suitable design such as those shown in Letters Patent of the United States No. 1,861,488, granted on June 7, 1932, to Leslie R. Allison and Frank H. Nicholson.

Each track circuit includes a code following track relay TR provided with a prefix corresponding to the track section with which the relay is associated, connected across the track section rails at the entrance end of the section. As here shown, track relay 12TR is of the code following alternating current type of relay. However, relay 12TR may be of the direct current variety provided with a resonant rectifier unit for filtering the propulsion current passing through the winding of the track relay.

Track relay 12TR has associated therewith auxiliary relays FSA, BSA, AHSC, TRA, BHSC, ADSC and BDSC, a decoding transformer 12DT, and a timing unit 12TU of the type described in the aforementioned Volz patent. Associated with relay ADSC is a decoding unit 120DU of well known design which will permit sufficient energy to flow through the unit to the winding of relay ADSC when and only when that energy is coded at a 120 code rate. Associated with relay BDSC is a decoding unit 180DU, also of well known design, which will permit sufficient energy to flow to the winding of relay BDSC to cause that relay to pick up when and only when energy is supplied to the decoding unit at a 180 code rate. The energy for all the apparatus in the system other than the track circuit energy may be supplied by a suitable source of energy such as a battery LB having a positive terminal B and a negative terminal N.

The apparatus is shown in Fig. 1 in the condition it assumes in a stretch of railway track that is vacant. At such times, energy coded at a 180 code rate is supplied to the track transformer 12TT by the equipment associated with section 13T. The apparatus for section 13T operates in the same manner as the apparatus shown associated with section 12T. Coded energy is supplied to the track circuit by transformer 12TT and produces a

code following operation of track relay 12TR. As a result of this code following operation, energy is alternately supplied to two of the portions of transformer 12DT from battery LB. Accordingly, decoding units 120DU and 180DU are being supplied with energy coded at a 180 code rate. Therefore, sufficient energy will be supplied from decoding unit 180DU to cause relay BDSC to pick up, and insufficient energy will be supplied from decoding unit 120DU to cause relay ADSC to pick up. Therefore, relay ADSC will be released. Each time relay 12TR picks up an obvious circuit including front contact *b* of relay 12TR will be established for energizing relay FSA. Relay FSA is provided with a sufficiently slow release characteristic to remain picked up during the time front contact *b* of relay 12TR is open and, accordingly, relay FSA will remain picked up. With relay FSA picked up, each time relay 12TR is released, a circuit will be established for energizing relay BSA, which circuit may be traced from positive terminal B of battery LB, over back contact *b* of relay 12TR which is operating at a 180 code rate, front contact *a* of relay FSA, and the winding of relay BSA to negative terminal N of battery LB. Therefore, relay BSA will be energized at a code rate of 180 and relay BSA is also provided with a sufficiently slow release characteristic to remain picked up during the time back contact *b* of relay 12TR is open. Therefore, relay BSA will remain continuously picked up.

At this time, timing unit 12TU will be deenergized due to the fact that its energizing circuit, which will be traced subsequently, is open at front contact *a* of relay BDSC. With the timing unit 12TU deenergized, relay TRA will be released for reasons which will be made clear presently. Therefore, relay AHSC will be energized by a stick circuit which may be traced from positive terminal B of battery LB, over front contact *b* of relay BSA, front contact *a* of relay AHSC, the winding of relay AHSC, and back contact *c* of relay TRA to negative terminal N of battery LB. Furthermore, with relay TRA released, the energizing circuit for relay BHSC, which circuit will be traced subsequently, will be open at front contact *b* of relay TRA and, accordingly, relay BHSC will be released.

With the auxiliary relays in the condition just described, an energizing circuit will be established for the upper green lamp G of signal 12S, which circuit may be traced from positive terminal B of battery LB, over front contact *c* of relay AHSC, front contact *c* of relay BDSC, and upper green lamp G of signal 12S to negative terminal N of battery LB. Furthermore, the lower red lamp R of signal 12S will be energized by a circuit which may be traced from positive terminal B of battery LB, over front contact *d* of relay AHSC, front contact *d* of relay BDSC, and the lower red lamp R of signal 12S to negative terminal N of battery LB. The signal aspect green over red is the least restrictive aspect of signal 12S and, accordingly, any train approaching signal 12S will be permitted to move at the maximum permissive speed through the stretch.

Furthermore, with the auxiliary relays in the above described condition, a circuit will be established for energizing track transformer 11TT at the 180 code rate, which circuit may be traced from terminal BX of the alternating current source, over front contact *a* of coder 180CT which is operating at the 180 code rate, front contact *b* of relay BDSC, front contact *b* of relay AHSC, front contact *c* of relay BSA, front contact *b* of relay FSA, and the primary winding of transformer 11TT to terminal NX of the alternating current source. Accordingly, energy will be supplied to section 11T at the 180 code rate and the apparatus associated with that section will operate in a manner identical to that described for the apparatus associated with section 12T.

When a train traveling in the normal direction over the stretch enters section 12T energy being supplied to that track section by track transformer 12TT will be

shunted by the wheels and axles of the train, and accordingly, track relay 12TR will release. With track relay 12TR released, no energy will be supplied from decoding transformer 12DT to the decoding units 120DU and 180DU, and, accordingly, relay BDSC will release and relay ADSC will remain released. Furthermore, no energy will be supplied to relay FSA and that relay will also release. With relay FSA released, the previously traced energizing circuit for relay BSA will become open and relay BSA will release. Upon relay BSA releasing, the previously traced stick circuit for relay AHSC will become open at front contact *b* of relay BSA and relay AHSC will also release. Timing unit 12TU will remain deenergized as will relay TRA for reasons which will become apparent when the energizing circuits for the timing unit and relay TRA are traced.

With the apparatus in the described condition, an energizing circuit for the upper red lamp R of signal 12S will become established, which circuit may be traced from positive terminal B of battery LB, over back contact *c* of relay AHSC, and the upper red lamp R of signal 12S to negative terminal N of battery LB. Furthermore, a second energizing circuit for the lower red lamp R of signal 12S will become established which circuit may be traced from positive terminal B of battery LB over back contact *d* of relay AHSC, and the lower red lamp R of signal 12S to negative terminal N of battery LB. The red over red aspect which signal 12S is now displaying is the stop aspect, and, accordingly, any train approaching signal 12S will stop.

Furthermore, with the apparatus in such condition, a circuit will be established for supplying energy at the 75 code rate to the primary winding of track transformer 11TT, which circuit may be traced from terminal BX of the alternating current source, over back contact *c* of relay BSA, back contact *b* of relay FSA, front contact *a* of coder 75CT which is operating at the 75 code rate, and the primary winding of transformer 11TT to terminal NX of the alternating current source. Accordingly, 75 code will be supplied to section 11T.

When the train enters section 13T, the apparatus associated with that section will operate in a manner identical with that described with respect to the apparatus associated with section 12T, and, accordingly, signal 13S will display its red over red or stop aspect. Therefore, 75 code will be supplied to track section 12T by transformer 12TT and upon the first pulse of 75 code being received by relay 12TR after the train vacates section 12T, relay 12TR will pick up and establish the previously traced energizing circuit for relay FSA. Upon relay FSA picking up, a circuit will be established for supplying steady uncoded energy to section 11T, which circuit may be traced from terminal BX of the alternating current source, over back contact *c* of relay BSA, front contact *b* of relay FSA, and the primary winding of transformer 11TT to terminal NX of the alternating current source.

As explained in the above mentioned Allison and Nicholson patent, if the insulated joints 3 separating sections 11T and 12T are defective, this steady energy will feed across the joints and prevent the release of track relay 12TR. If this occurs, no energy will be supplied to relay BSA and it will remain released, as will relay AHSC. Accordingly, signal 12S will continue to display its red over red aspect.

However, if the insulated joints are intact so that the steady energy does not reach track relay 12TR, relay 12TR will release at the end of the on period of the 75 code being supplied to it by transformer 12TT. However, due to its slow release characteristic, relay FSA will remain picked up. Upon relay 12TR releasing, relay BSA will become energized by its previously traced energizing circuit and will pick up; relay BSA will remain picked up during the time back contact *b* of relay 12TR is open due to its slow release characteristic.

With relay BSA picked up, upon relay 12TR picking

up a second time, an energizing circuit for relay AHSC will be established, which circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay BSA, front contact *c* of relay 12TR, rectifier A, the winding of relay AHSC, and back contact *c* of relay TRA to negative terminal N of battery LB. Upon relay AHSC picking up, its previously traced stick circuit will become established for continuing the supply of energy to that relay.

With track relay 12TR operating at the 75 code rate energy will be supplied to decoding units 120DU and 180DU at the 75 code rate and, therefore, insufficient energy will be supplied to relays ADSC and BDSC to pick up these relays. Accordingly, relays ADSC and BDSC will remain released. Furthermore, a circuit is now established for supplying energy to a portion of the primary winding of the transformer of timing unit 12TU. This circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay BSA, front contact *c* of relay 12TR which is operating at a 75 code rate, back contact *a* of relay ADSC, back contact *a* of relay BDSC, back contact *a* of relay TRA, and the right-hand portion of the primary winding of the transformer in timing unit 12TU to negative terminal N of battery LB. With the transformer of timing unit 12TU being energized each time relay 12TR picks up energy will be stored in the core of that transformer and upon the release of relay 12TR, oscillations with a highly damped wave form will flow in an oscillating circuit which may be traced from the right-hand terminal of capacitor C, over front contact *a* of relay BSA, the left-end portion of the transformer in the timing unit 12TU, and capacitor C to the right-hand terminal of capacitor C. The oscillations in the oscillating circuit will induce voltage in the secondary of the transformer in timing unit 12TU which voltage will be rectified by the rectifying unit K and will be supplied to the winding of relay TRA over a circuit which may be traced from the positive terminal of rectifier K, over back contact *d* of relay 12TR, and the winding of relay TRA to negative terminal N of battery LB which is also connected to the negative terminal of rectifier K. Accordingly, relay TRA will be energized but with the highly damped characteristic of the oscillating circuit, relay TRA will not remain picked up during the entire period while relay 12TR is released and therefore a stick circuit which will be traced subsequently will not be established for maintaining relay TRA picked up when relay 12TR picks up. Accordingly, it will be seen that while relay 12TR is responding to 75 code, relay TRA will pick up for a short time each time relay 12TR releases but will release prior to each time relay 12TR picks up. It will be seen that with relay TRA briefly picking up during each cycle of operation of relay 12TR, the previously traced energizing and stick circuits for relay AHSC will become open for that brief interval. But the slow release characteristic of relay AHSC is sufficient to keep relay AHSC picked up during the brief interval relay TRA is picked up and, therefore, relay AHSC will remain picked up.

At this time, for reasons which will become clear presently, relay BHSC will be released. With the auxiliary relay in the condition just described, a circuit for energizing the upper yellow lamp Y of signal 12S will be established which circuit may be traced from positive terminal B of battery LB, over front contact *c* of relay AHSC, back contact *c* of relay BDSC, and the upper yellow lamp Y of signal 12S to negative terminal N of battery LB. Furthermore, a third circuit for energizing the lower red lamp R of signal 12S will be established which circuit may be traced from positive terminal B of battery LB, over front contact *d* of relay AHSC, back contact *d* of relay BDSC, back contact *c* of relay ADSC, back contact *c* of relay BHSC, and the lower red lamp R of signal 12S to negative terminal N of battery LB,

Therefore, signal 12S will display a yellow over red aspect which aspect is the most restrictive proceed aspect of signal 12S.

Furthermore, at this time, a circuit will be established for supplying 75M code to the primary winding of track transformer 11TT which circuit may be traced from terminal BX of the alternating current source, over front contact *a* of coder 75MCT which is operating in the manner depicted by Fig. 3, back contact *a* of relay BHSC, back contact *b* of relay ADSC, back contact *b* of relay BDSC, front contact *b* of relay AHSC, front contact *c* of relay BSA, front contact *b* of relay FSA, and the primary winding of transformer 11TT to terminal NX of the alternating current source. Accordingly, energy will be supplied to section 11T at a 75M code rate.

When the train vacates section 13T and occupies the next section in advance, the apparatus associated with the advance section will operate in substantially the same manner as the apparatus associated with section 12T operated when the train occupied section 12T, and accordingly, the track circuit associated with section 13T will be supplied with 75 code. Therefore, the apparatus associated with section 13T will operate to supply 75M code to section 12T the pattern of which code is shown in Fig. 3. As can be seen from Fig. 3, 75M code is substantially the same as the 75 code shown in Fig. 2 but is provided with a very short off time every third cycle and a corresponding long on time following the short off time.

With relay 12TR following 75M code, relay FSA will be energized as previously described. Relay BSA will be energized as previously described during the two normal cycles of 75M code but will tend to release during the long on time of the 75M code. However, relay BSA will not release during the long on time of the 75M code for a reason which will be made clear presently. Furthermore, each time relay 12TR releases timing unit 12TU operates for a brief interval and thereby energizes relay TRA which picks up. As was previously stated, relay TRA will pick up for a brief interval each time it is supplied with energy from timing unit 12TU but this interval is sufficiently long for relay TRA to remain picked up for a time longer than the short off time of the 75M code. Accordingly, every third cycle of operation of relay 12TR, relay TRA will still be picked up when relay 12TR picks up since it will not release during the brief time it takes the armature of relay 12TR to move from its released position to its picked up position. With relays 12TR and TRA both picked up, a circuit for energizing relays BHSC and BSA in series will become established. This circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay BSA, front contact *c* of relay 12TR, back contact *a* of relay ADSC, back contact *a* of relay BDSC, front contact *a* of relay TRA, front contact *d* of relay 12TR, the winding of relay BHSC, front contact *b* of relay TRA, front contact *a* of relay FSA, and the winding of relay BSA to negative terminal N of battery LB. It is this circuit which prevents relay BSA from releasing during the long on time of the 75M code. When relay TRA is picked up along with relay 12TR being picked up, the previously referred to stick circuit for relay TRA becomes established which circuit may be traced from positive terminal B of battery LB, over front contact *b* of relay BSA, front contact *c* of relay 12TR, back contact *a* of relay ADSC, back contact *a* of relay BDSC, front contact *a* of relay TRA, and the winding of relay TRA to negative terminal N of battery LB. Therefore, relay TRA will remain picked up during the long on time of relay 12TR and relay BHSC will remain energized as just described. Upon relay 12TR releasing after the long on time, relay TRA will release and will not pick up until relay 12TR releases again at which time oscillations will once more flow in the oscillating circuit. However, relay BHSC

is provided with a sufficiently slow release characteristic to remain picked up during the long periods that relay TRA is released and, accordingly, relay BHSC will remain picked up at this time. Furthermore, relay AHSC will remain picked up as was described during the description of the apparatus operating at a 75 code being supplied to the track relay and with the auxiliary relays so disposed, the previously traced circuit for energizing the upper yellow lamp Y of signal 12S will remain established. Furthermore, a circuit will be established for energizing the lower yellow lamp Y of signal 12S which circuit may be traced from positive terminal B of battery LB, over front contact *d* of relay AHSC, back contact *d* of relay BDSC, back contact *c* of relay ADSC, front contact *b* of relay BHSC, and the lower yellow lamp Y of signal 12S to negative terminal N of battery LB. Accordingly, signal 12S will display a yellow over yellow proceed aspect which is the next to most restrictive proceed aspect of signal 12S.

With the apparatus in the condition just described a circuit will be established for supplying track transformer 11TT with 120 coded energy which circuit may be traced from terminal BX of the alternating current source, over front contact *a* of coder 120CT, front contact *a* of relay BHSC, back contact *b* of relay ADSC, back contact *b* of relay BDSC, front contact *b* of relay AHSC, front contact *c* of relay BSA, front contact *b* of relay FSA, and the primary winding of transformer 11TT to terminal NX of the alternating current source. With the primary winding of transformer 11TT so energized, energy will be supplied to section 11T at the 120 code rate.

When the train vacates the section next in advance of section 13T and occupies the section two sections in advance of section 13T, the apparatus of the several sections in advance of section 12T will operate in a manner substantially similar to that already described in section 12T and, accordingly, track transformer 12TT will now be energized with energy coded at the 120 code rate. Accordingly, relay 12TR will commence operating at the 120 code rate to supply energy to decoding units 120DU and 180DU at that code rate. Therefore, relay ADSC will pick up and relay BDSC will remain released. Furthermore, relays FSA, BSA and AHSC will all pick up in a manner substantially the same as that already described, and timing unit 12TU will now be deenergized due to the fact that its previously traced energizing circuit is now open at back contact *a* of relay ADSC. With the timing unit deenergized, relay TRA will release and stay released and, accordingly, relay BHSC will release. With the apparatus associated with section 12T in such a condition, the circuit will remain established for energizing the upper yellow lamp Y of signal 12S, which circuit has already been traced. Furthermore, a circuit will be established for energizing the lower green lamp G of signal 12S which circuit may be traced from the positive terminal B of battery LB, over front contact *d* of relay AHSC, back contact *d* of relay BDSC, front contact *c* of relay ADSC, and the lower green lamp G of signal 12S to negative terminal N of battery LB. Therefore, signal 12S will display a yellow over green aspect which is the next to least restrictive proceed aspect that signal 12S can display.

At this time, a second circuit will be established for supplying 180 code to track transformer 11TT which circuit may be traced from the terminal BX of the alternating current source, over front contact *a* of coder 180CT, front contact *b* of relay ADSC, back contact *b* of relay BDSC, front contact *b* of relay AHSC, front contact *c* of relay BSA, front contact *b* of relay FSA, and the primary winding of transformer 11TT to the terminal NX of the alternating current source. With the primary winding of transformer 11TT so energized, transformer 11TT will supply 180 code to section 11T.

When the train enters the third section in advance of

section 13T and vacates the second section in advance of section 13T, the apparatus of the several sections in advance of section 12T will operate so that transformer 12TT is supplied with 180 code energy and, accordingly, track relay 12TR will commence operating at a 180 code rate. Therefore, relay BDSC will pick up and relay ADSC will release. Furthermore, relays FSA, BSA and AHSC will remain picked up and relays TRA and BHSC will remain deenergized. In this manner the apparatus will be restored to its normal condition as was described at the beginning of the detailed description.

Now let it be assumed that due to the well known stored energy affect in the track circuit associated with section 12T, the on period of the coded energy is extended and the off period is shortened so that with 75 code being supplied, the code pattern will be similar to the sketch shown in Fig. 4. When a code following track relay follows such a code, it is said to have badly lagging front contacts. Let it further be assumed that a train is occupying section 12T so that any energy being supplied to that section is being shunted by the wheels and axles of the train and accordingly all the relays in the apparatus associated with section 12T will be deenergized except for the coders which continuously operate. Upon the train vacating section 12T and occupying only section 13T, transformer 12TT will be supplied with 75 code and upon relay 12TR picking up the first time relay FSA will become energized and will pick up and, as previously described, will remain picked up due to its slow release characteristic. With the relay 12TR picked up no energy will be supplied to the primary winding of the transformer in timing unit 12TU over its previously traced energizing circuit because relay BSA is still released. Upon the first releasing of relay 12TR, energy will be supplied to relay BSA over back contact *b* of relay 12TR and front contact *a* of relay FSA, and relay BSA will pick up. With relay BSA picked up, energy still will not be supplied to timing unit 12TU because the previously traced energizing circuit will now be open at front contact *c* of relay 12TR. Upon relay 12TR again picking up, energy will be supplied to timing unit 12TU, but with relay 12TR remaining picked up for an extended period of time, relay BSA will release because its slow release characteristic is insufficient to keep it picked up for the extended time that back contact *b* of relay 12TR is open. Upon relay BSA releasing, the energizing circuit for timing unit 12TU will become open at front contact *b* of relay BSA, and the oscillating circuit will become open at front contact *a* of relay BSA. Accordingly, the energy stored in the core of the transformer in the timing unit cannot be dissipated in a series of oscillations flowing in the oscillating circuit so the energy will be dissipated in a collapse of the magnetic field surrounding the transformer core. To further aid in the dissipation of the energy stored by the transformer of timing unit 12TU, with relay TRA released a circuit will be established for current to flow from the center tap of the primary winding of the timing unit transformer, over back contact *a* of relay TRA, back contact *a* of relay BDSC, back contact *a* of relay ADSC, rectifier A, the winding of relay AHSC, and back contact *c* of relay TRA to negative terminal N of battery LB which is also connected to the right-hand terminal of the primary winding of the timing unit transformer.

Upon relay 12TR again releasing, relay BSA will become energized and will pick up, thereby closing the oscillating circuit. However, there will now be insufficient energy stored in the timing unit transformer to pick up relay TRA so relay TRA will remain released. The above described cycle of operations will continue to be repeated and relay TRA will continue to remain released. With relay TRA released, relay BHSC will remain released. Relay AHSC, however, will be energized by its previously traced energizing circuit and by the circuit for dissipating energy stored in the timing unit transformer. Accordingly relay AHSC will be picked up.

With the auxiliary relays in the condition just described, it will be seen that they are in the same condition as when ordinary 75 code is being transmitted to section 12T. Therefore, for reasons made clear when the operation of the apparatus was described in connection with 75 code, signal 12S will display its yellow over red aspect and transformer 11TT will be energized at a 75M code rate. Accordingly, no false indication will result when section 12T is being energized at a 75 code rate and the track relay 12TR has badly lagging front contacts.

Although I have herein shown 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 a coded railway signaling system of the type wherein a first code of a given code rate and having substantially equal on and off periods is supplied to produce a first signal aspect and a second code of said given code rate but periodically having its off period shortened and the following on period correspondingly lengthened to produce a second signal aspect, a code following track relay, a first slow release auxiliary relay, means for energizing said first auxiliary relay including said track relay, an oscillating circuit having sufficient damping to damp oscillations to below a predetermined amplitude in a time less than the normal off period of said second code but longer than said shortened off period of said second code, means for energizing said oscillating circuit controlled by said track relay and said first auxiliary relay, a second auxiliary relay, means for energizing said second auxiliary relay when oscillations having amplitudes greater than said predetermined amplitude are flowing in said oscillating circuit, stick circuit means for said second auxiliary relay controlled by said track relay, signal control means controlled by said second auxiliary relay, and means for interrupting said oscillating circuit controlled by said first auxiliary relay whereby false operation of said signal control means is prevented when said first code becomes distorted so that it has a shortened off period and a prolonged on period.

2. In a coded railway signaling system of the type wherein two distinct signal aspects are achieved by using codes of the same code rates but periodically prolonging the on period of the code and correspondingly shortening the preceding off period of the code for one signal aspect and supplying code having substantially equal on and off periods for the other signal aspect, a code following track relay, a first auxiliary relay having a slow release characteristic and energized when said track relay is deenergized, an oscillating circuit having sufficient damping to damp oscillations to below a given amplitude in a time less than the normal off period of said codes but longer than said shortened off period and including a contact closed when said first auxiliary relay is picked up, circuit means for supplying energy to said oscillating circuit when said track relay is energized and said first auxiliary relay is picked up, a second auxiliary relay, circuit means for picking up said second auxiliary relay when oscillations having amplitudes greater than said given amplitude flow in said oscillating circuit, a stick circuit means for said second auxiliary relay closed when said track relay is energized and said first auxiliary relay is picked up, and signal control means controlled by said second auxiliary relay.

3. In a coded railway signaling system of the type wherein code of a given code rate and having substantially equal on and off periods is supplied to produce a first signal aspect and code of the same code rate but periodically having its off period shortened and the following on period correspondingly lengthened supplied to produce a second signal aspect, a code following track relay, a first auxiliary relay provided with a slow release

characteristic which will maintain the relay picked up during a time corresponding to an on period of said given code rate but will be unable to maintain the relay picked up for a time corresponding to a lengthened on period, an energizing circuit means for said first auxiliary relay closed when said track relay is released; a device including an inductance, a capacitance and a contact closed when said first auxiliary relay is picked up to form an oscillating circuit having sufficient damping to damp oscillations flowing in said oscillating circuit to below a given amplitude in a time less than the normal off period of the given code rate but greater than the shortened off period; a second auxiliary relay, an energizing circuit means for supplying energy to said second auxiliary relay when oscillations above said given amplitude are flowing in said oscillating circuit, a stick circuit means for said second auxiliary relay closed when said track relay and said first auxiliary relay are picked up, a stick circuit means for said first auxiliary relay closed when said track relay and said second auxiliary relay are picked up, and signal control means controlled by said second auxiliary relay.

4. In a coded railway signaling system of the type wherein a first code of a given code rate and having substantially equal on and off periods is supplied to produce a first signal aspect and a second code of the same code rate but periodically having a shortened off period and a correspondingly prolonged on period is supplied to produce a second signal aspect, a code following track relay, a first auxiliary relay provided with a slow release characteristic for maintaining the relay picked up for a period of time corresponding to an on period of said given code rate but insufficient for maintaining the relay picked up for a period of time corresponding to a prolonged on period, an energizing circuit for said first auxiliary relay including a back contact of said track relay, a transformer, a capacitor; an oscillating circuit having a damping characteristic sufficient to damp oscillations flowing therein to below a given value in a time less than the normal off period of said second code but greater than the shortened off period of said second code including the primary winding of said transformer, said capacitor, and a front contact of said first auxiliary relay; a second auxiliary relay, a third auxiliary relay having a slow release characteristic; an energizing circuit for said third auxiliary relay including a front contact of said first auxiliary relay, a front contact of said track relay and a back contact of said second auxiliary relay; a stick circuit for said third auxiliary relay including a front contact of said first auxiliary relay and a back contact of said second auxiliary relay, circuit means for dissipating energy stored in the core of said transformer by supplying it to said third auxiliary relay effective when said first and second auxiliary relays are released; an energizing circuit for said oscillating circuit including a front contact of said first auxiliary relay, a front contact of said track relay and a back contact of said second auxiliary relay; an asymmetric unit, a circuit for picking up said second auxiliary relay when oscillations above said given value are flowing in said oscillating circuit including the secondary winding of said transformer and said asymmetric unit, a stick circuit for said second

auxiliary relay including a front contact of said first auxiliary relay and a front contact of said track relay, a fourth auxiliary relay provided with a slow release characteristic, an energizing circuit for said first and fourth auxiliary relays including a front contact of said track relay and each of said first and second auxiliary relays, and signaling means controlled by said third and fourth auxiliary relays.

5. In combination, a first code transmitting means for transmitting energy coded at a given code rate and having substantially equal on and off periods, a second code transmitting means for transmitting energy at said given code rate but periodically modifying said code to have a shortened off period and following correspondingly long on period, a code following track relay for responding to said first and second codes, a first relay provided with a slow release characteristic, an energizing circuit for said first relay including a front contact of said track relay, a second relay provided with a slow release characteristic for maintaining said second relay picked up for longer than a time corresponding to a normal on period but not as long as a time corresponding to said long on period, a first energizing circuit for said second relay including a back contact of said track relay and a front contact of said first relay, a third relay provided with a slow release characteristic, a fourth relay; an energizing circuit for said third relay including a front contact of said second relay, a front contact of said track relay, and a back contact of said fourth relay; a stick circuit for said third relay including a front contact of said second relay and a back contact of said fourth relay, a transformer provided with a primary and a secondary winding, a capacitor; an oscillating circuit having a damped characteristic so that a series of oscillations will flow in said oscillating circuit for a time less than the normal off period of said modified code but longer than the shortened off period of said modified code and including said primary winding of said transformer, said capacitor, and a front contact of said second relay; an energizing circuit for said oscillating circuit including a front contact of said second relay, a front contact of said track relay, and a back contact of said fourth relay; a circuit for dissipating energy stored by said transformer by supplying it to said third relay including a back contact of said fourth relay and effective when and only when said second relay is released, an asymmetric unit; an energizing circuit for said fourth relay including said secondary winding of said transformer, said asymmetric unit and a back contact of said track relay; a fifth relay provided with a slow release characteristic, a circuit for energizing said fifth and second relays in series including a front contact of said second relay, a front contact of said track relay, a front contact of said fourth relay, and a front contact of said first relay; a signal, and circuit means for controlling said signal including said third and fifth relays.

References Cited in the file of this patent

UNITED STATES PATENTS

2,331,134	Nicholson et al. -----	Oct. 5, 1943
2,348,525	Cravath -----	May 9, 1944