May 5, 1936. C. W. FAILOR 2,039,639

SIGNALING SYSTEM

Original Filed April 23, 1932 6 Sheets-Sheet 1

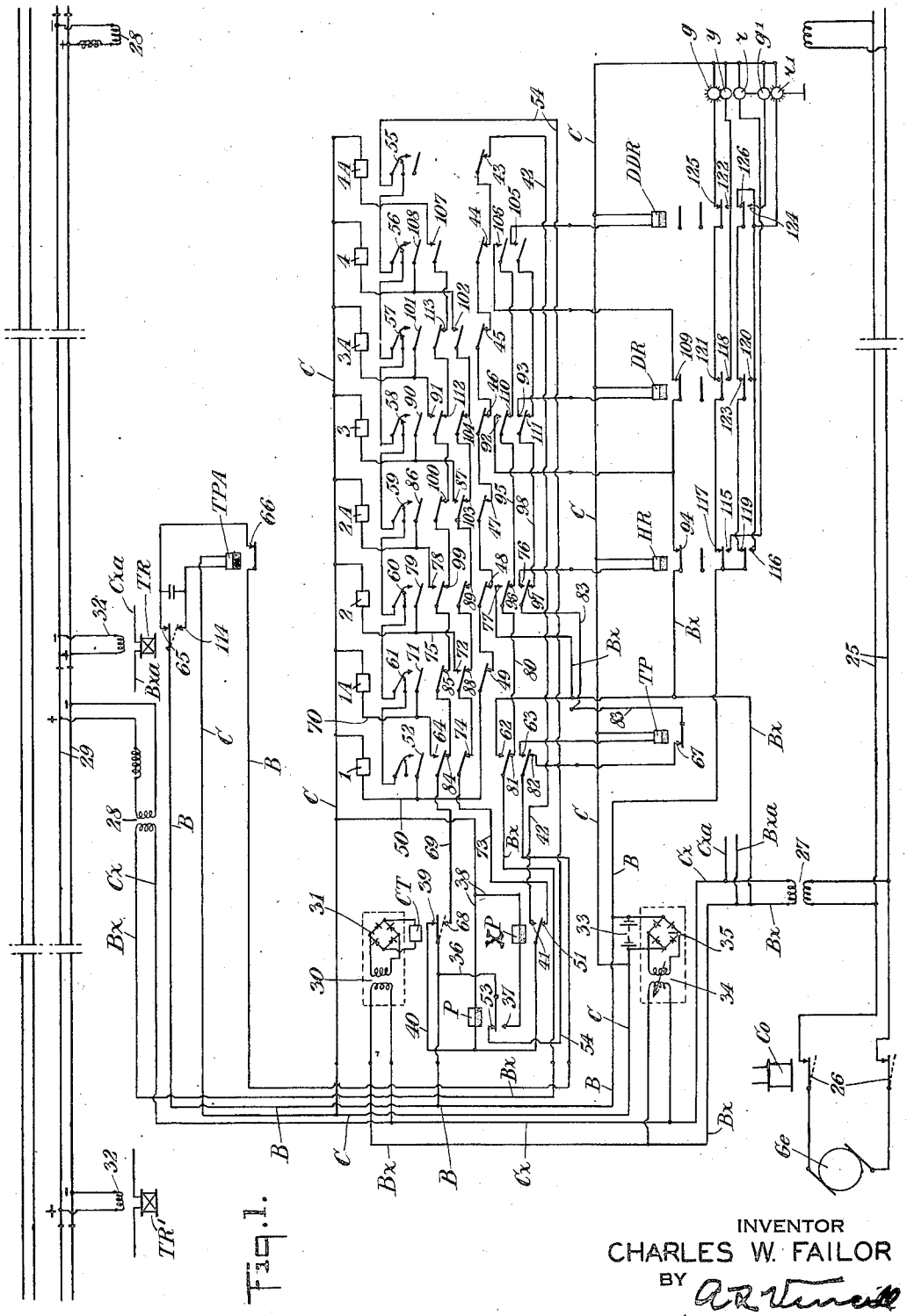


Fig. 1.

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SIGNALING SYSTEM

Original Filed April 23, 1932 6 Sheets-Sheet 2

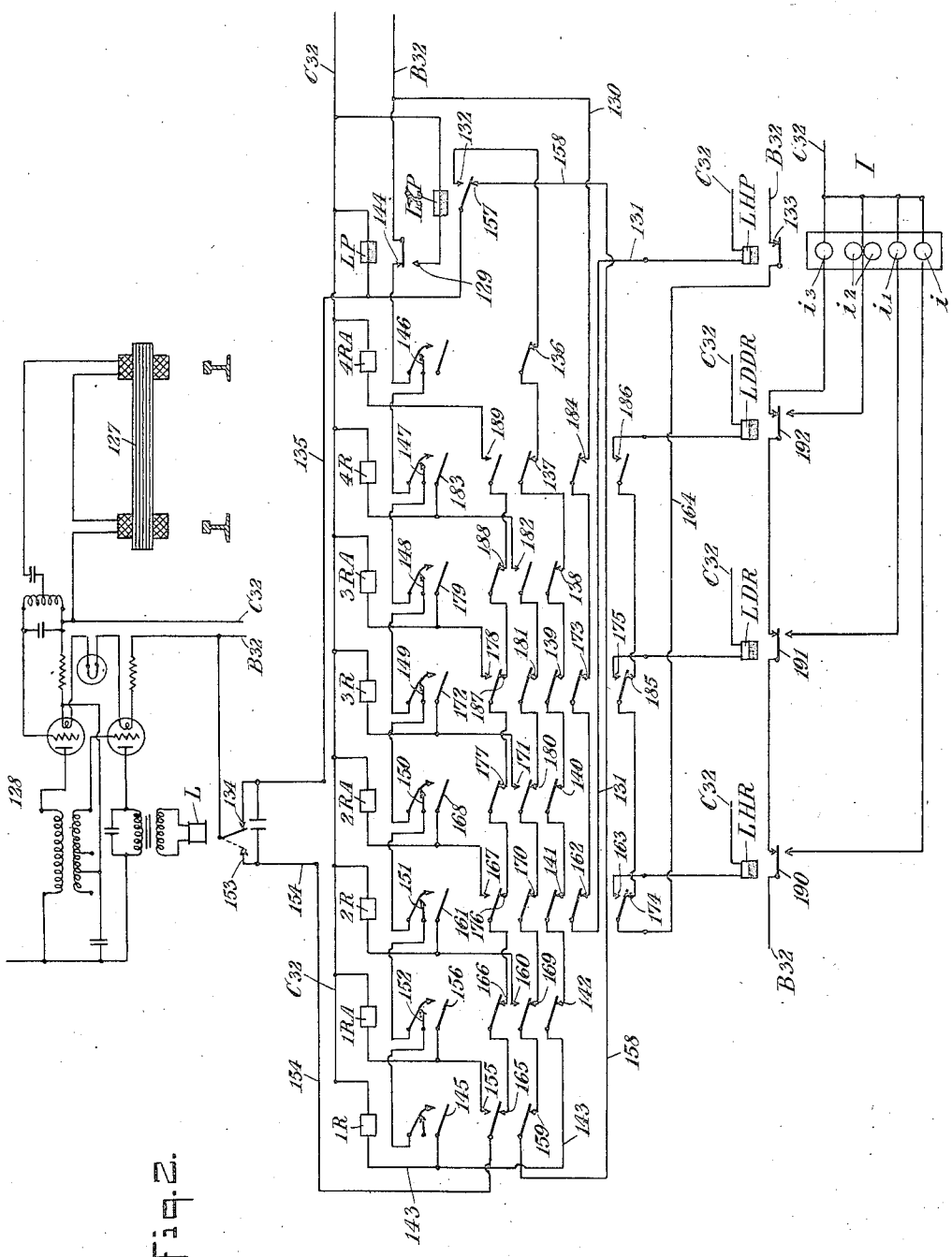


Fig. 2.

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May 5, 1936. C. W. FAILOR 2,039,639

SIGNALING SYSTEM

Original Filed April 23, 1932 6 Sheets-Sheet 3

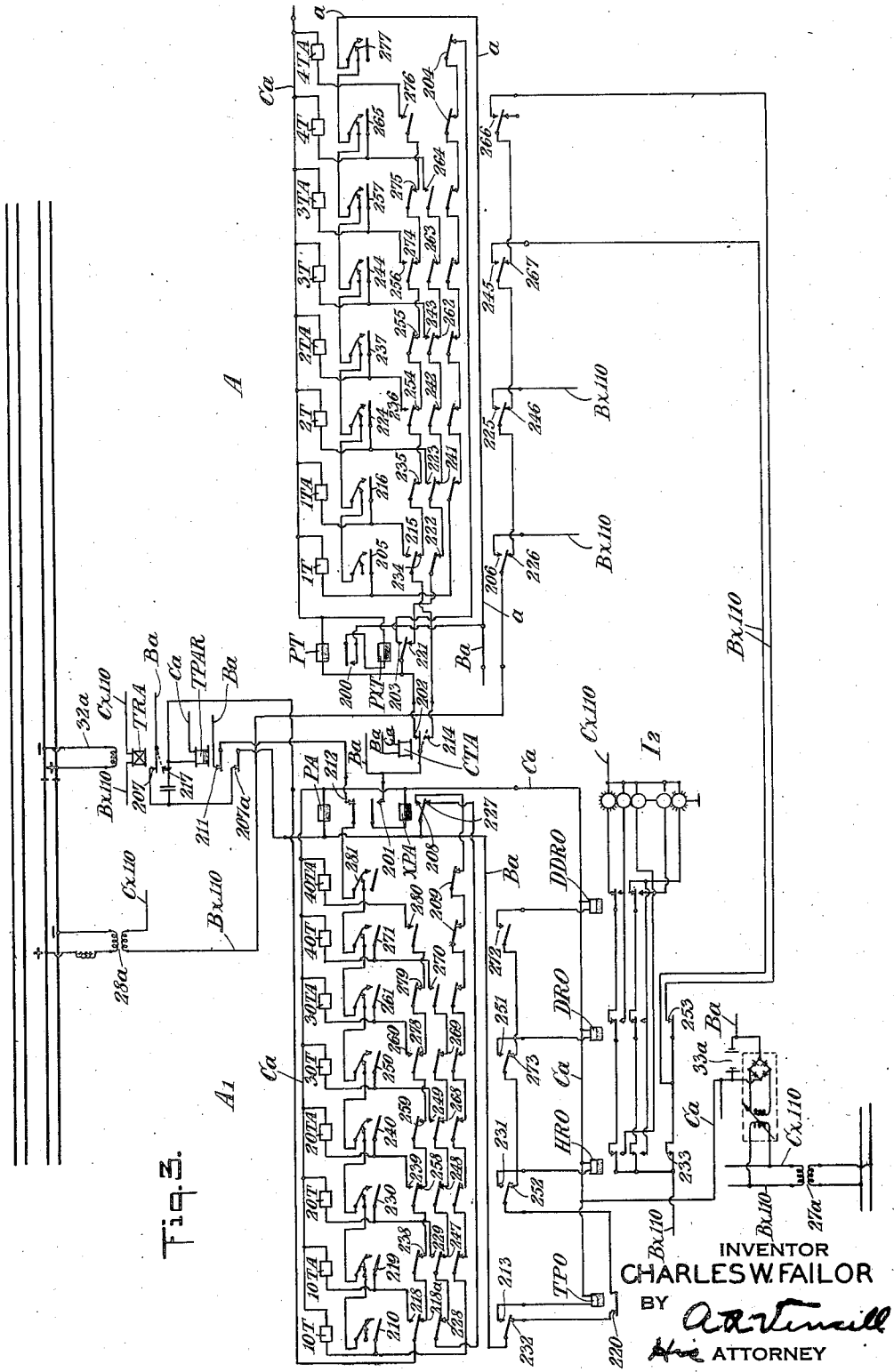


Fig. 3.

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May 5, 1936. C. W. FAILOR 2,039,639

SIGNALING SYSTEM

Original Filed April 23, 1932 6 Sheets-Sheet 4

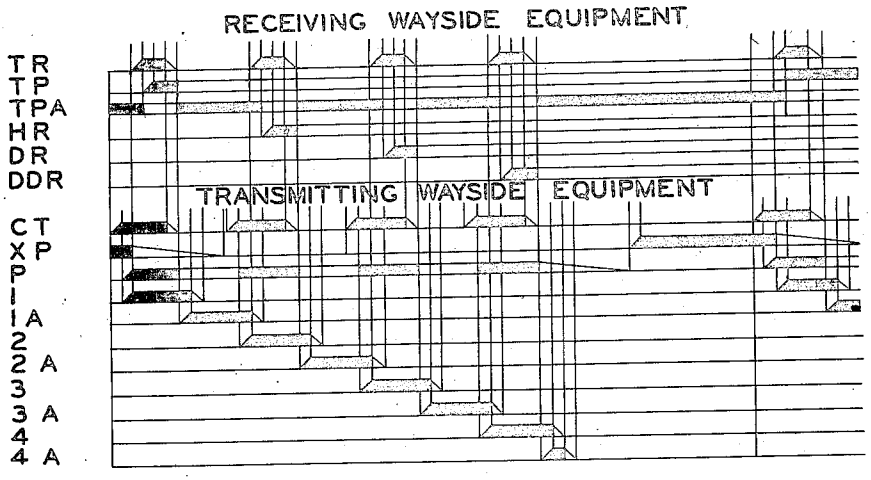


Fig. 4.

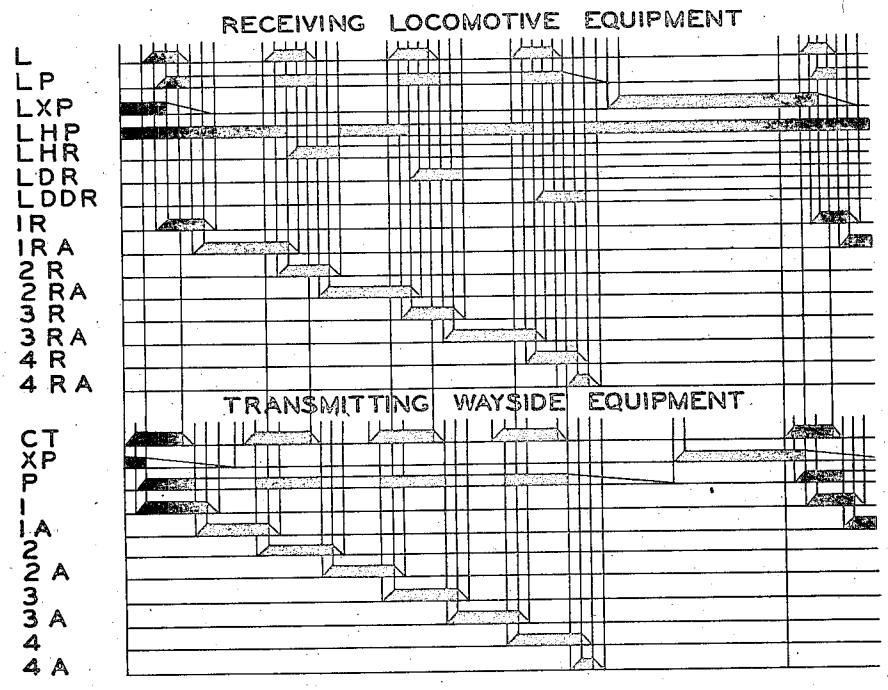


Fig. 5.

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SIGNALING SYSTEM

Original Filed April 23, 1932 6 Sheets-Sheet 5

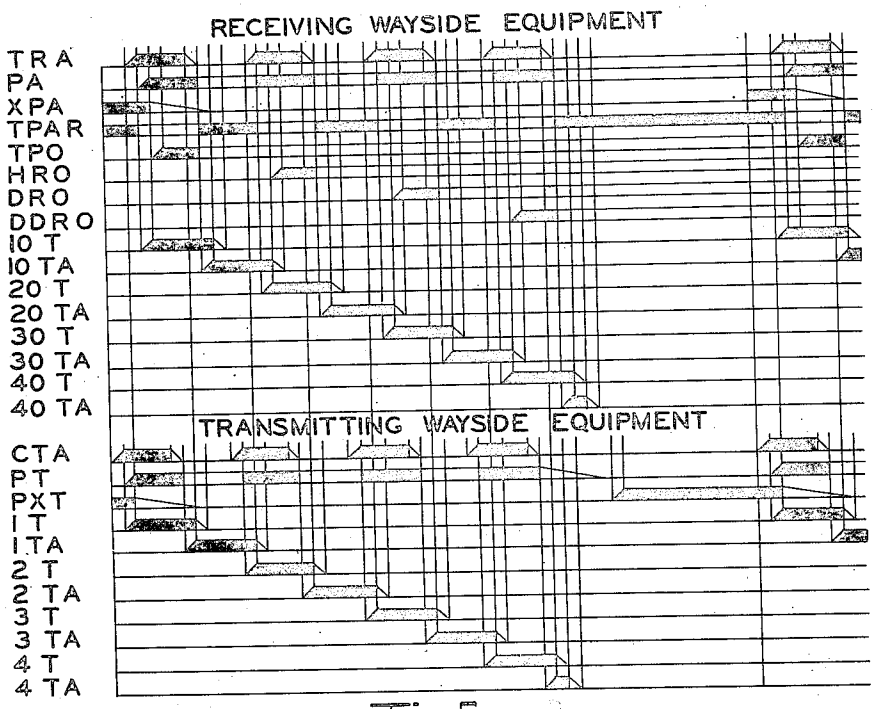


Fig. 6.

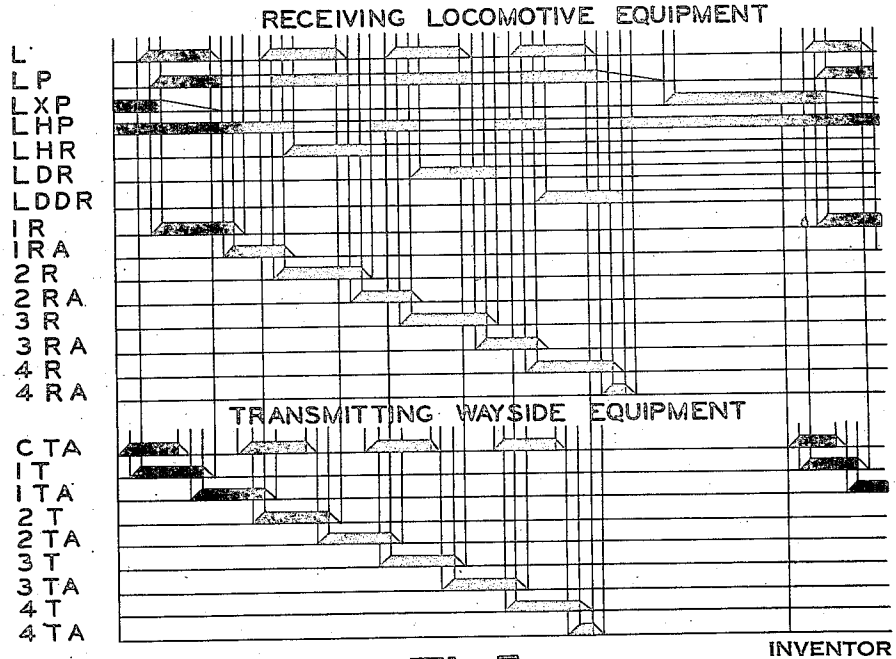


Fig. 2.

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May 5, 1936. C. W. FAILOR 2,039,639

SIGNALING SYSTEM

Original Filed April 23, 1932 6 Sheets-Sheet 6

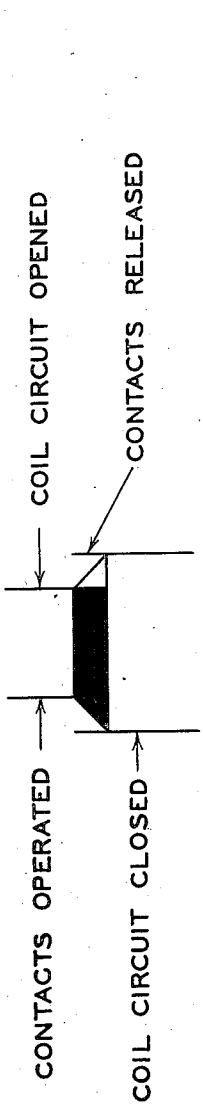


Fig. 8.

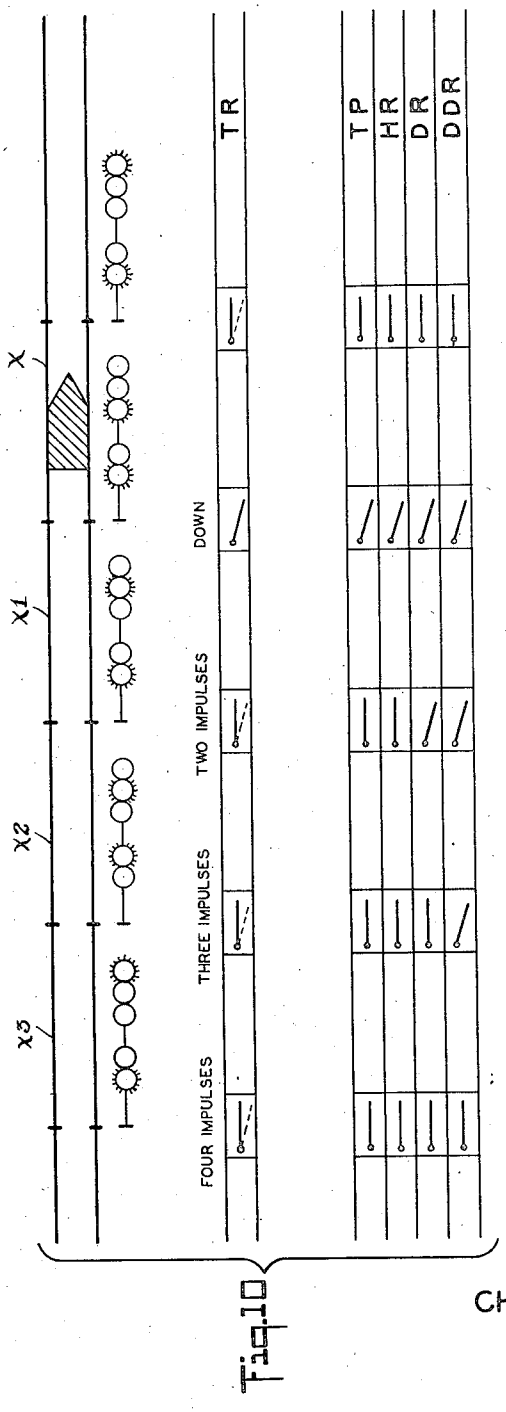


Fig. 10

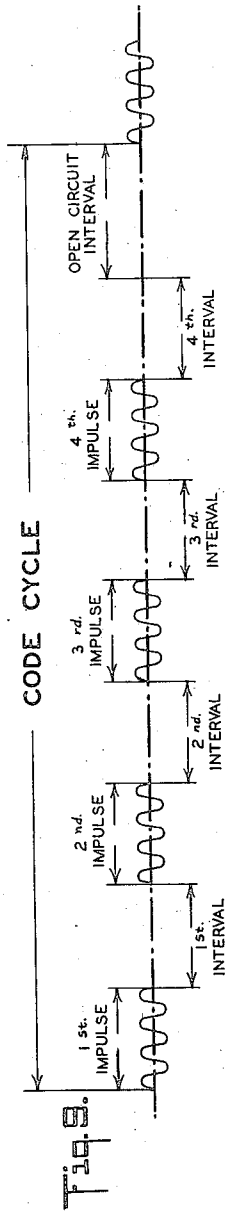


Fig. 9.

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Patented May 5, 1936 2,039,639

UNITED STATES PATENT OFFICE

2,039,639

SIGNALING SYSTEM

Charles W. Failor, Forest Hills, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application April 23, 1932, Serial No. 607,103
Renewed August 26, 1933
60 Claims. (Cl. 246—63)

This invention relates to a signaling system of the type known as a "count-code" system, and has for its main object and feature the production of a system in which current of a single frequency may be employed, and in which a code cycle of a given number of impulses constantly recurs, under all traffic conditions, the various indications being obtained by utilizing a variable number of the impulses of the recurring cycles.

In the accompanying drawings the invention is disclosed in several preferred and concrete, though somewhat diagrammatic, forms in which:

Fig. 1 is a diagrammatic view of the wayside equipment of one form of the invention;

Fig. 2 is a diagrammatic view of the cab or locomotive equipment designed to be utilized in connection with the wayside equipments of Figs. 1 or 3;

Fig. 3 is a diagrammatic view of a modified form of wayside equipment;

Fig. 4 is a diagrammatic time-table of the sequence of operations of the relays of the wayside equipment of Fig. 1;

Fig. 5 is a similar time-table for the relays of the transmitting wayside equipment of Fig. 1 and the relays of the locomotive or cab receiving equipment of Fig. 2;

Fig. 6 is a similar time-table for the relays of the wayside equipment of Fig. 3;

Fig. 7 is a similar time-table for the relays of the transmitting wayside equipment of Fig. 3 and the relays of the locomotive or cab receiving equipment of Fig. 2;

Fig. 8 is a diagrammatic key to the symbols of Figs. 4 to 7 inclusive;

Fig. 9 is a diagrammatic representation of a characteristic code cycle, such as is contemplated in this system; and

Fig. 10 is a diagrammatic representation of the effect of the presence of a train in a block upon the track relay and traffic controlling relays of a number of blocks.

This invention has at its basis the production, under all traffic conditions, of the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series, and the utilization of a variable number of impulses of the series of impulses of the constant code cycles to indicate different traffic conditions. In Fig. 9 is depicted graphically a constant code cycle such as it is contemplated to employ, and in this case it consists of four "on" periods, four "off" periods and what may be called an open circuit interval. The "on" and "off" periods are of approximately equal length, and the current here used being an alternating one, (of, say, sixty cycles), each impulse consists of a number of waves. The indications thus obtained may be used for wayside signaling and/or cab signaling and/or brake control purposes as will be understood. The principal advantage of the invention lies in the fact that, the code cycle being constant for all blocks under all traffic conditions, a line circuit may be employed to supply coded current from a single coder unit to a number of blocks, and even if it is desired to use a coder unit for each block, such coder unit can supply current to a number of tracks that are simultaneously subject to different traffic conditions. Although the invention, as above explained, has for its basis the employment of the same constantly recurring code cycle, it will be understood that there are, nevertheless, inventive features present that are capable of use independently of the system herein disclosed.

In the form of the invention disclosed in Fig. 1, an alternating current is supplied by generator *Ge* to line wires **25**, and the current so supplied is coded in the manner previously described by means of coder *Co* that controls armatures **26**. **27** indicates a line transformer that supplies coded current from the line wires to bus wires *Bx* and *Cx* which form part of a transmission circuit, controlled by relays in a manner to be presently described, which circuit feeds track transformer **28**, the secondary of which latter is connected to traffic rails **29** at the outgoing end of a block. CT is a direct current code following relay that receives the unvarying cycle of code impulses by means of a transformer **30** and rectifier **31**, said transformer **30** being connected to leads *Bx* and *Cx*. TR is an alternating current track relay at the ingoing end of a block, said relay being here of the two energizing circuit type with stationary windings, one winding **32** being connected to the traffic rails so as to be energized and deenergized in accordance with the impulses in the traffic rails supplied by the track transformer at the other end of the block, and the other winding being connected by leads *Bxa* and *Cxa* to the corresponding leads of *Bxa* and *Cxa* adjacent line transformer **27** of the signal location shown. The track relay therefore, unlike code following relay CT which receives the unvarying cycle of code impulses, is effectively energized only by such code impulses as are transmitted to the traffic

rails and that reach winding 32. The code impulses of the unvarying cycle of impulses received by code following relay CT are constantly registered or counted by a chain of relays consisting of two groups, one group marked 1 to 4 counting the "on" periods, and another group marked 1A to 4A counting the "off" periods of the code cycle. The relays of the two groups alternate in the arrangement shown, and each relay controls the energization of the succeeding one and the deenergization of the preceding one. The function of code following relay CT is to energize the chain of counting relays in sequence during each code cycle, and it is to be borne in mind that the counting relays are energized and deenergized during each code cycle regardless of traffic conditions. TP, HR, DR and DDR are four slow release relays, here referred to as traffic controlling relays, each having a slow release period equal to one code cycle, so that if each of these relays is energized at the appropriate time—once to each code cycle—its armatures will stay up and its front contact or contacts will remain closed. The counting relays and the traffic controlling relays are supplied with current from a suitable source such as battery 33 over bus wires B and C arranged to establish different circuits; among others, an energizing circuit for the counting relays, a holding circuit also for the counting relays, and a receiving or decoding circuit for the traffic controlling relays, which receiving circuit is controlled by the track relay and also by the counting relays, and said counting relays and traffic controlling relays controlling the transmission circuit from line transformer 27 to track transformer 28. The number of counting relays and traffic controlling relays used will depend upon the number of indications desired and the number of impulses in the code cycle. Battery 33 is conveniently trickle-charged by means of transformer 34, connected to B*x* and C*x*, and by rectifier 35. Relays P, XP and TPA may be disregarded for the time being, except to say that during normal operation of the system relay XP is deenergized most of the time throughout each code cycle and becomes energized only toward the end of the interval that follows the series of impulses of a code cycle; and that relays P and TPA hold their front contacts closed except toward the end of the interval that follows the series of impulses of a code cycle.

At the end of the prolonged interval that follows a series of impulses of the code cycle, relay XP is energized by current flowing from one of the leads of bus wire B, over wire 36, back contact 37 of relay P, coil of relay XP and wire 38, to common return C.

When code following relay CT receives the first impulse of a series of impluses of a code cycle, it closes its front contact and current now flows from one of the leads of bus wire B to front contact 39 of relay CT, then by wire 40, over front contact 41 of relay XP, wire 42, back contacts 43 to 49 inclusive of relays 4A to 1A inclusive, wire 50, coil of relay 1 and thence to common return C thereby energizing relay 1. The closing of front contact 39 of relay CT also established a circuit through relay P by way of said front contact 39, wire 40, coil of relay P, and wire 38 to common return C. The energization of relay P breaks at 37 the previously traced circuit through relay XP, and XP opens its front contact 41 and closes back contact 51. Relay XP being of the slow release type will hold its front contact 41, and thereby the energizing circuit previously described for relay 1, closed until relay 1 has picked up its armatures. As soon as relay 1 has picked up its armatures, it is no longer dependent for its energization upon front contact 41 of relay XP, because contact 52 of relay 1 now being closed and front contact 53 of relay P now also being closed, a holding circuit for relay 1 is established as follows: from one of the leads of bus wire B, over wire 36, front contact 53 of relay P, wire 54, back contacts 55 to 61 inclusive of relays 4A to 1A, contact 52 of relay 1, wire 50, coil of relay 1 and common return C. When relay 1 picked up its armatures it closed front contacts 62, 63 and 64. By closing front contact 62 a path for the impulse in the transmission circuit from line transformer 27 to track transformer 28 is established as follows: from line transformer 27 over bus wire B*x*, front contact 62, over wire B*x* continued to track transformer 28 and thence by common return C*x* back to line transformer 27. This impresses the first impulse of the code cycle on the traffic rails and energizes coil 32 of track relay TR[1] of the block whose rails are energized. Track relay TR, which is energized by the equipment at the next block station, closes its front contact 65, and by the closing of this front contact and front contact 63 of relay 1 a receiving or decoding circuit is established as follows: from bus wire B, over front contact 65 of relay TR, front contact 66 of relay TPA, continuation of wire B, front contact 63 of relay 1, coil of traffic-controlling relay TP and back to common return C, thereby causing relay TP to close front contact 67.

During the interval that follows the first impulse of the series of impulses of the code cycle, coil 32 of track relay TR is deenergized and code repeater relay CT is likewise deenergized. The deenergization of relay CT opens its front contact 39 and closes its back contact 68. Current therefore flows from one of the leads of bus wire B, over back contact 68 of relay CT, over wire 69, over front contact 64 and wire 70 to coil of relay 1A, and thence to common return C, thereby energizing relay 1A. As soon as relay 1A is energized it picks up its armatures and in so doing closes contact 71 and thereafter opens contact 61. In closing contact 71, the holding or stick circuit by way of contact 53 of relay P, wire 54 and back contacts 55 to 60 inclusive is transferred to relay 1A, and in opening contact 61, the holding circuit to relay 1 is ruptured. Relay 1 is therefore deenergized and drops its armatures thereby rupturing the transmission circuit between line transformer 27 and track transformer 28, and also the receiving or decoding circuit leading to relay TP. Relay TP, however, remains energized on account of its slow release feature. When relay 1A was energized it closed front contact 72.

Upon receipt by code following relay CT of the second impulse of the series of impulses of the code cycle, said relay CT is energized and in closing its front contact 39 it establishes the following circuit: from a lead of bus wire B, over contact 39 of relay CT, wire 40, back contact 51 of relay XP, wire 73, back contact 74 of relay 1, front contact 72 of relay 1A, wire 75, coil of relay 2 and thence to common return C. This energizes relay 2 and causes it to pick up its armatures and to close contacts 76, 77, 78 and 79. In closing contact 79 it transfers the holding circuit through back contacts 55 to 59 inclusive to its own coil by way of wire 75, and subsequently by opening

contact 60 it breaks the holding circuit to relay 1A thereby deenergizing the latter. In closing front contact 77, the transmission circuit between line transformer 27 and track transformer 28 is closed over the following path: line transformer 27, bus wire Bx, contact 77 of relay 2, wire 80, back contact 81 of relay 1, continuation of Bx, track transformer 28, and bus wire Cx back to line transformer 27. This impresses the second impulse of the code cycle on the traffic rails and energizes coil 32 of track relay TR1 of the block whose rails are being energized. Track relay TR as before closes its front contact 65, and by the closing of this front contact and front contact 76 of relay 2, a receiving or decoding circuit is closed over the following path: from bus wire B, over contact 65 of track relay TR, contact 66 of relay TPA, continuation of wire B, back contact 82 of relay 1, contact 67 of relay TP, wire 83, front contact 76 of relay 2, coil of relay HR and back to common return C. This energizes relay HR and causes it to pick up its armatures.

During the interval that follows the second impulse of the series of impulses of the code cycle, coil 32 of track relay TR is deenergized and code repeater relay CT is likewise deenergized. The deenergization of relay CT opens its front contact 39 and closes its back contact 68. Current therefore flows from one of the leads of bus wire B over back contact 68 of relay CT, over wire 69, back contacts 84 and 85 of relays 1 and 1A, front contact 78 of relay 2, coil of relay 2A, and thence to common return C. As soon as relay 2A is energized, it picks up its armatures and in so doing closes contact 86 and thereafter opens contact 59. In closing contact 86, the holding circuit by way of back contacts 55 to 58 inclusive is transferred to relay 2A, and in opening contact 59 the holding circuit to relay 2 is ruptured. Relay 2 is therefore deenergized and drops its armatures, thereby rupturing the transmission circuit between line transformer 27 and track transformer 28, and also the receiving or decoding circuit leading to relay HR. Relay HR, however, remains energized on account of its slow release feature. When relay 2A was energized it closed front contact 87.

Upon receipt of code following relay CT by the third impulse of the series of impulses of the code cycle, said relay CT is energized and in closing its front contact 39 it establishes the following circuit: from a lead of bus wire B, over contact 39, wire 40, back contact 51 of relay XP, wire 73, back contact 74 of relay 1, back contact 88 of relay 1A, back contact 89 of relay 2, front contact 87, coil of relay 3, and thence to common return C. This energizes relay 3 and causes it to pick up its armatures and to close contacts 90, 91, 92 and 93. In closing contact 90 it transfers the holding circuit through back contacts 55 to 57 inclusive to its own coil, and subsequently by opening contact 58 it breaks the holding circuit to relay 2A thereby deenergizing the latter. In closing contact 92 the transmission circuit between line transformer 27 and track transformer 28 is closed over the following path: from line transformer 27, bus wire Bx, front contact 94 of relay HR, front contact 92 of relay 3, wire 95, back contact 96 of relay 2, wire 80, back contact 81 of relay 1, continuation of wire Bx, track transformer 28, and bus wire Cx back to line transformer 27. This impresses the third impulse of the code cycle on the traffic rails and energizes coil 32 of track relay TR1 of the block whose rails are being energized. Track relay TR as before closes its front contact 65, and by the closing of this front contact and front contact 93 of relay 3, a receiving or decoding circuit is closed over the following path: from bus wire B, over contact 65 of track relay TR, contact 66 of relay TPA, continuation of wire B, back contact 82 of relay 1, contact 67 of relay TP, wire 83, back contact 97 of relay 2, wire 98, front contact 93 of relay 3, coil of relay DR and common return C. This energizes relay DR and causes it to pick up its armatures.

During the interval that follows the third impulse of the series of impulses of the crude cycle, coil 32 of track relay TR is deenergized and code following relay CT is likewise deenergized. The deenergization of relay CT opens its front contact 39 and closes its back contact 68. Current therefore flows from one of the leads of bus wire B, over back contact 68 of relay CT, wire 69, back contacts 84, 85, 99 and 100 of relay 1, 1A, 2 and 2A, front contact 91 of relay 3, coil of relay 3A and thence to common return C. As soon as relay 3A is energized, it picks up its armatures and in so doing closes contact 101 and thereafter opens contact 57. In closing contact 101, the holding circuit by way of back contacts 55 and 56 is transferred to relay 3A, and in opening contact 57 the holding circuit of relay 3 is ruptured. Relay 3 is therefore deenergized and drops its armatures thereby rupturing the transmission circuit between line transformer 27 and track transformer 28, and also the receiving or decoding circuit leading to relay DR. Relay DR, however, remains energized on account of its slow release feature. When relay 3A was energized it closed front contact 102.

Upon receipt by code following relay CT of the fourth impulse of the series of impulses of the code cycle, said relay CT is energized and in closing its front contact 39 it establishes the following circuit: From a lead of bus wire B, over contact 39 of relay CT, wire 40, back contact 51 of relay XP, wire 73, back contacts 74, 88, 89, 103 and 104 of relays 1, 1A, 2, 2A and 3, front contact 102 of relay 3A, coil of relay 4, and thence to common return C. This energizes relay 4 and causes it to pick up its armatures and to close contacts 105, 106, 107 and 108. In closing contact 108 it transfers the holding circuit through back contact 55 to its own coil, and subsequently by opening contact 56 it breaks the holding circuit to relay 3A thereby deenergizing the latter. In closing front contact 106, the transmission circuit between line transformer 27 and track transformer 28 is closed over the following path: line transformer 27, bus wire Bx, front contact 94 of relay HR, front contact 109 of relay DR, front contact 106 of relay 4, back contacts 110, 96 and 81 of relays 3, 2 and 1, continuation of wire Bx, track transformer 28, bus wire Cx and back to line transformer 27. This impresses the fourth impulse of the code cycle on the traffic rails and energizes coil 32 of track relay TR1 of the block whose rails are being energized. Track relay TR as before closes its front contact 65, and by the closing of this front contact and front contact 105 of relay 4, a receiving or decoding circuit is closed over the following path: from bus wire B, over contact 65 of relay TR, contact 66 of relay TPA, continuation of wire B, back contact 82 of relay 1, contact 67 of relay TP, wire 83, back contact 97 of relay 2, back contact 111 of relay 3, front contact 105 of relay 4, coil of relay DDR and back to common return C. This energizes relay DDR and causes it to pick up its armatures.

During the interval that follows the fourth

impulse of the code cycle, coil 32 of track relay TR is deenergized and code repeater relay CT is likewise deenergized. The deenergization of relay CT opens its front contact 39 and closes its back contact 68. Current therefore flows from one of the leads of bus wire B, over back contact 68 of relay CT, wire 69, back contacts 84, 85, 99, 100, 112 and 113 of relays 1 to 3A inclusive, front contact 107 of relay 4, coil of relay 4A and back to common return C. The energization of relay 4A causes it to pick up its armatures thereby opening contact 95 and rupturing the holding circuit of relay 4. Relay 4 is therefore deenergized and drops its armatures, thereby rupturing the transmission circuit between line transformer 27 and track transformer 28, and also the receiving or decoding circuit leading to relay DDR. Relay DDR, however, continues to hold up its armatures on account of its slow release feature. The deenergization of relay 4 also causes the circuit to relay 4A to be ruptured at contact 107, thus deenergizing relay 4A and causing it to drop its armatures.

We now come to the prolonged or open circuit interval that follows the series of impulses at the end of the code cycle. During this prolonged interval, relay P will drop its armature and close contact 37 thereby energizing relay XP and causing it to close front contact 41, and the system is now ready for the next code cycle of impulses, when the devices will again function in the manner set forth in detail in the preceding description of operation.

Adverting now for a moment to relay TPA, it will be understood that it is a slow release relay and that it is energized each time track relay TR closes back contact 114, that is to say, during the intervals between impulses of a series of impulses and also at the end of a series of impulses, current passing from a lead of bus wire B, over back contact 114, coil of TPA and back to common return C. If track relay TR fails to follow the code impulses and remains energized, relay TPA will open its front contact 66, thus rupturing the receiving or decoding circuit, thereby checking the operation of track relay TR.

The function of relay XP is to check the relays of the counting chain, and to insure that the open circuit interval at the end of a series of impulses is registered by said counting chain. This will be understood when it is remembered that relay XP is deenergized during the major part of the code cycle and becomes energized toward the end of the open circuit interval that follows a series of impulses and holds front contact 41 closed only long enough to permit relay 1 to become energized. That is to say, front contact 41 must be closed to start the counting chain, but after relay 1 is energized the counting chain is controlled by front and back contacts 39 and 68 of code following relay CT. Slow release relay P is utilized to control relay XP. Relay P has a slow release period sufficient to enable it to bridge the interval between two impulses of a series of impulses, but insufficient to bridge the open circuit interval at the end of a series of impulses. It will therefore be seen that relay P is energized each time front contact 39 of relay CT is closed and that it holds relay XP deenergized except toward the end of the open circuit interval at the end of a series of impulses. It will also be seen that relay P controls through its front contact 53 and wire 54 the stick circuit or holding circuit for the chain of counting relays that becomes effective after the initial energization of relay 1 by the energizing circuit controlled by front contact 41 of relay XP.

As a convenient reference, a time-table of the energization of all the relays is shown in Fig. 4 and the key to the symbols of this time-table is shown in Fig. 8 from which two figures it can readily be ascertained when the coil circuit of any particular relay is closed, when the relay picks up its front contact, when its coil circuit is opened and when its front contact is released.

In Fig. 10 is shown a diagram of a number of blocks X, X1, X2 and X3 and the effect of a train in block X upon relays TP, HR, DR and DDR of the various blocks. It will be seen that the presence of the train indicated in block X will prevent the current impulses from reaching coil 32 of track relay TR located at the entrance end of block X. Consequently, relays TP, HR, DR and DDR of that block station will not be energized by the receiving or decoding circuit controlled by relay TR of that station. The result is that the rails of block X1 will receive only the first two impulses of the series of impulses. This will be understood when it is remembered that the transmission circuit that energizes track transformer 28 is completed, during the first two impulses of a series of impulses, independently of relays TP, HR, DR and DDR, the transmission circuit for the first impulse being completed from Bx over front contact 62 of relay 1, and the transmission circuit for the second impulse being completed from Bx over front contact 77 of relay 2, as previously described. The transmission circuit for the third and fourth impulses being completed, in part, over front contact 94 of HR and front contact 109 of DR, and relays HR and DR (associated with relay TR of block X) being deenergized and their armatures down, said third and fourth impulses cannot be transmitted to the rails of block X1, and consequently track relay TR at the entrance of block X1 will pick up only on the first and second impulses of the series of impulses. When track relay TR at the entrance of block X1 picks up on the first and second impulses it will energize relays TP and HR (associated with relay TR of block X1), relay TP being energized over front contact 63 of relay 1 and relay HR being energized over front contact 67 of TP and front contact 76 of relay 2. The result is that three impulses will be transmitted to the rails of block X2, the first two as previously described in connection with the rails of block X1, and the third from wire Bx, front contact 94 of HR and front contact 92 of relay 3. Track relay TR at the entrance of block X2 will therefore pick up on the first, second and third impulses. This will energize relays TP, HR and DR (associated with relay TR of block X2), relays TP and HR being energized as previously described in connection with block X1, and relay DR receiving the third impulse over front contact 67 of relay TP, back contact 97 of relay 2 and front contact 93 of relay 3. In consequence of this, all four impulses will be transmitted to the rails of block X3, the first three as previously described in connection with the rails of block X2, and the fourth from wire Bx over front contact 94 of HR, front contact 109 of DR and front contact 106 of relay 4. The result is that track relay TR at the entrance of block X3 picks up on all four impulses, and this will energize relays TP, HR, DR and DDR (associated with relay TR of block X3), relays TP, HR and DR being energized as previously described in connection with block X2, and relay DDR receiv-

ing the fourth impulse over front contact 67 of TP, back contacts 97 and 111 of relays 2 and 3, and front contact 105 of relay 4.

In the present description of the operation of the system it has been brought out that the track section immediately in rear of an occupied section receives the first two impulses. This, of course, is not essential but it is essential that at least the first impulse be impressed on the rails of such section.

It will further be understood that, while one chain of counting relays can control a number of tracks that are subject to different traffic conditions, there must be a separate set of traffic controlling relays for each track.

It will now be understood that the code system thus described can be utilized in many different ways for the purpose of giving signals or indications. For instance, if it is desired to use wayside signals, relays HR, DR and DDR can be provided with additional contacts to control a group of lights *g*, *y*, *r*, *g*1 and *r*1. Thus when all relays TP, HR, DR and DDR are deenergized and their armatures are down, current will flow from bus wire B over back contact 115 of HR to light *r* and back over C, and also over back contact 116 of HR to light *r*1 and thence to C thereby displaying two red lights indicating stop. If relays TP and HR are energized, current will flow from wire B over front contact 117 of HR, back contact 118 of DR to light *y* and thence to common return, and also over front contact 119 of HR, back contact 120 of DR and thence to lamp *r*1 and common return, thereby displaying a yellow light and a red light indicating approach. If relays TP, HR and DR are all energized and their armatures up, then current will flow from B over front contact 117 of HR, front contact 121 of DR, back contact 122 of DDR, light *y* and to common return, and also over front contact 119 of HR, front contact 123 of DR, back contact 124 of DDR to light *g*1, thereby displaying a yellow light and a green light indicating approach restricting. If all relays TP, HR, DR and DDR are energized and their armatures are up, current will flow from B, over front contact 117 of HR, front contact 121 of DR, front contact 125 of DDR, light *g* and common return, and also over front contact 119 of HR, 123 of DR, front contact 126 of DDR, light *r*1 and common return, thereby displaying a green light and a red light indicating clear. If no wayside signals are used, relay DDR can be omitted.

If it is desired to give a traffic indication on the train, such as by means of signals or brake control or both, the arrangement shown in Fig. 2 may be employed. As there shown, the train carries a coil 127 that is in an inductive relation with the rails to thereby pick up the impulses transmitted to the traffic rail. L indicates a code-following relay on the train to be energized by each impulse of the series of impulses and to be deenergized in the intervals between impulses of the same series as well during the interval that follows after a series of impulses. This relay is of the polarized type, and is so designed that it operates its armature to the right-hand position (wherein contact 134 is closed) at the beginning of an energizing impulse, and to the left-hand position (wherein contact 153 is closed) as such impulse ceases. Circuit and amplifying means, generally indicated by 128 and the details of which do not concern us here, are interposed between coil 127 and relay L in such manner that said relay follows the code. Carried by the train are three traffic-controlling relays LHR, LDR and LDDR which correspond to the three wayside traffic-controlling relays HR, DR and DDR. Also a chain of counting relays is carried by the train, the relays of which chain are arranged in two groups marked respectively 1R to 4R inclusive and 1RA to 4RA inclusive, the relays of the two groups alternating in the chain and controlling each other in the same manner as the counting relays of the wayside. It is to be noted, however, that the counting relays on the train do not operate regardless of traffic conditions, but count only the impulses received by relay L. The train also carries two relays LP and LXP that correspond to wayside relays P and XP. The current is supplied from various leads of wire B32 and returns over the various leads of wire C32. LHP indicates a relay that controls the supply of current to relays LHR, LDR and LDDR.

During the interval that follows at the end of a series of impulses, relay LXP is energized by a circuit that can be traced from one of the leads of wire B32, back contact 129 of relay LP, coil of relay LXP and back to common return C32. Front contact 132 of relay LXP is therefore closed. Also at this time relay LHP is energized by a current that flows from the same lead of B32, over wire 130, back contacts 184, 173 and 162 of relays 4R, 3R and 2R, wire 131, coil of relay LHP and common return C32. Front contact 133 of relay LHP therefore closes.

When relay L receives the first impulse, of the series of impulses, its right-hand contact 134 is closed and current now flows from a lead of wire B32, over contact 134 of relay L, along wire 135, over front contact 132 of relay LXP, over back contacts 136 to 142 inclusive of relays 4RA to 1RA inclusive, wire 143, coil of relay 1R and thence to common return C32, thereby energizing relay 1R. Current also flows from wire 135 to coil of relay LP and thence to common return C32, thereby energizing relay LP and breaking the circuit through relay LXP by opening back contact 129 and closing front contact 144. When relay LXP opens its front contact 132 it ruptures the energizing circuit to relay 1R, but as relay LXP is of the slow release type it holds front contact 132 closed until relay 1R has become energized as previously described. Relay 1R having thus become energized closes its contact 145 and this establishes a holding circuit or a stick circuit for said relay 1R that can be traced from one of the leads of B32, over front contact 144 of relay LP, over back contacts 146 to 152 inclusive of relays 4RA to 1RA, contact 145 of relay 1R, wire 143, coil of relay 1R and thence to common return C32.

During the interval that follows the first impulse of the series of impulses, relay L becomes deenergized and closes its left-hand contact 153, and current now flows from one of the leads of wire B32, over contact 153 of relay L, wire 154, front contact 155 of relay 1R, coil of relay 1RA and so to common return C32. Although relay LP becomes deenergized when relay L opens its contact 134, yet, on account of its slow release feature, said relay LP retains its front contact 144 closed. Relay 1RA having become energized, it closes contact 156 and thus transfers the stick circuit to its own coil and by subsequently opening contact 152 it ruptures the stick circuit to relay 1R and the latter becomes deenergized.

When relay L receives the second impulse of the series of impulses, it closes its right-hand contact 134, reenergizing relay LP, and current

now flows from one of the leads of wire B32, over contact 134, wire 135, back contact 157 of relay LXP, wire 158, back contact 159 of relay 1R, front contact 160 of relay 1RA, coil of relay 2R and thence to common return C32. As soon as relay 2R becomes energized it closes contact 161 and thus transfers the stick circuit to its own coil and subsequently by opening contact 151 it ruptures the stick circuit to the coil of relay 1RA. The energization of relay 2R also opens back contact 162 thereby rupturing the circuit to relay LHP but the latter relay being of the slow release type holds front contact 133 closed, so that current can now flow from one of the leads of wire B32, over front contact 133 of relay LHP, over wire 164, over front contact 163 of relay 2R, coil of relay LHR, and to common return C32.

During the interval that follows the second impulse of the series of impulses, relay L becomes deenergized, thereby deenergizing relay LP as before, and when it closes its left-hand contact 153, current flows from B32, over contact 153 of relay L, wire 154, back contacts 165 and 166 of relays 1R and 1RA, front contact 167 of relay 2R, coil of relay 2RA, and to common return C32. The energization of relay 2RA closes contact 168 thereby transferring the stick circuit to its own coil, and later by opening contact 150 ruptures the stick circuit to relay 2R thereby deenergizing the latter. When relay 2R becomes deenergized it closes contact 162 thereby reenergizing relay LHP, and it also opens contact 163 thereby deenergizing relay LHR. This relay LHR is of the slow release type and bridges one complete code cycle.

When relay L receives the third impulse of the series of impulses, it closes its right-hand contact 134, reenergizes relay LP, and current now flows from one of the leads of wire B32, over contact 134, wire 135, back contact 157 of relay LXP, wire 158, back contacts 159, 169 and 170 of relays 1R, 1RA and 2R, front contact 171 of relay 2RA, coil of 3R, and common return C32. As soon as relay 3R becomes energized it closes contact 172 and thus transfers the stick circuit to its own coil, and subsequently by opening contact 149 it ruptures the stick circuit to the coil of relay 2RA. The energization of relay 3R also opens back contact 173 thereby rupturing the circuit to relay LHP, but the latter relay being of the slow release type holds front contact 133 closed, so that current can now flow from one of the leads of B32, over front contact 133 of relay LHP, wire 164, back contact 174 of relay 2R, front contact 175 of relay 3R, coil of relay LDR, and so to common return C32.

During the interval that follows the third impulse of the series of impulses, relay L becomes deenergized, thereby deenergizing relay LP as before, and when it closes its left-hand contact 153 current flows from B32, over contact 153 of relay L, wire 154, back contacts 165, 166, 176 and 177 of relays 1R, 1RA, 2R and 2RA, over front contact 178 of relay 3R, coil of relay 3RA, and to common return C32. The energization of relay 3RA closes contact 179 thereby transferring the stick circuit to its own coil, and later by opening contact 148 ruptures the stick circuit to relay 3R thereby deenergizing the latter. When relay 3R becomes deenergized it closes contact 173 thereby reenergizing relay LHP, and it also opens contact 175 thereby deenergizing relay LDR. This relay LDR is of the slow release type and bridges one complete code cycle.

When relay L receives the fourth impulse of the series of impulses, it closes its right-hand contact 134, reenergizes relay LP, and current now flows from one of the leads of wire B32, over contact 134, wire 135, back contact 157 of relay LXP, wire 158, back contacts 159, 169, 170, 180 and 181 of relays 1R, 1RA, 2R, 2RA and 3R and front contact 182 of relay 3RA, coil of 4R, and thence to common return C32. As soon as relay 4R becomes energized it closes contact 183 and thus transfers the stick circuit to its own coil and subsequently by opening contact 147 it ruptures the stick circuit to the coil of 3RA. The energization of relay 4R also opens back contact 184 thereby rupturing the circuit to relay LHP, but the latter being of the slow release type holds front contact 133 closed, so that current can now flow from one of the leads of B32, over front contact 133, wire 164, back contacts 174 and 185 of relays 2R and 3R, front contact 186 of relay 4R, coil of relay LDDR, and common return C32.

During the interval that follows the fourth impulse of the series of impulses, relay L becomes deenergized, thereby deenergizing relay LP as before, and when it closes its left-hand contact 153 current flows from B32, over contact 153 of relay L, wire 154, back contacts 165, 166, 176, 177, 187 and 188 of relays 1R, 1RA, 2R, 2RA, 3R and 3RA, over front contact 189, coil of relay 4RA, and common return C32. The energization of relay 4RA eventually opens contact 146 and thus ruptures the stick circuit to relay 4R, but note that the stick circuit is not transferred to the coil of 4RA. Relay 4R therefore becomes deenergized and opens contact 189 thereby also deenergizing relay 4RA. When relay 4R becomes deenergized, it closes contact 184 thereby reenergizing relay LHP, and it also opens contact 186 thereby deenergizing relay LDDR. This relay LDDR is of the slow release type and bridges one complete code cycle.

During the open circuit interval that follows the series of impulses, relay LP opens contact 144 and closes contact 129 thereby energizing relay LXP which opens contact 157 and closes contact 132.

As we have seen, relay LHP is energized during the open circuit interval because back contacts 162, 173 and 184 of relays 2R, 3R and 4R are all closed. Relays LHR, LDR and LDDR keep their front contacts closed because of their slow release characteristics, so long as all four impulses of each recurrent code cycle are received by the train-carried equipment. It will now be evident that if the traffic rails of a block receive no impulses (or only one impulse) then all the relays LHR, LDR and LDDR will drop their armatures; that if only two impulses of the recurrent code cycle are received then relay LHR will keep its armature up whereas relays LDR and LDDR will drop their armatures; that if only three impulses of the recurrent code cycle are received then relay LDR, as well as relay LHR, will keep its armature up whereas the armature of relay LDDR will be down; and finally if all four impulses of the recurrent code cycle are received then relay LDDR, as well as relays LHR and LDR, will keep its armature up.

There are, of course, many ways in which the different conditions of these traffic-controlling relays LHR, LDR and LDDR can be utilized but the simple diagram in Fig. 2 showing armatures 190, 191 and 192 together with an indicator I and appropriate wiring will serve as an illustration. As there shown, when relay L receives no impulses, or but a single impulse, then armatures

190, 191 and 192 will be down and the circuit to lamp *i* will be closed; if L receives two impulses, then armature 190 will be up and armatures 191 and 192 will be down and hence the circuit to lamp *i1* will be closed; if L receives three impulses, then armatures 190 and 191 will be up and armature 192 will be down and hence the circuit to lamp *i2* will be closed; and finally if four impulses are received by L then all armatures 190, 191 and 192 will be up and the circuit to lamp *i3* will be closed. The time-table of the various relays is shown in Fig. 5, and it remains only to be stated that the function of relay LHP, which is energized during the "off" periods and during the open circuit interval at the end of a series of impulses, and deenergized during the "on" periods of the code cycles, is to check that only coded impulses will keep relays LHR, LDR and LDDR energized. This will be understood when it is remembered that said relay will bridge the "on" periods of the code cycle, and if the "on" period is prolonged, relay LHP will become deenergized and thereby rupture the circuit that supplies current to said relays LHR, LDR and LDDR. Relay LHP therefore corresponds in a measure to relay TPA of the wayside equipment.

The form of the invention shown in Fig. 1 is what may be called a synchronous system in that one coder unit can supply coded current to line wires that feed a number of signal or block stations, and it is characterized by the fact that a single chain of counting relays is used, which chain controls both the circuit that transmits impulses to the track transformer, and also the receiving or decoding circuit that receives impulses through the influence of the track relay to energize the traffic-controlling relays.

In Fig. 3 is shown a modified form of the invention which may be called non-synchronous and which employs a separate coder unit for each signal location and two chains of counting relays one to control the transmission circuit to one block and the other to control the receiving or decoding circuit of the block in advance. The counting chain that controls the transmission circuit operates constantly regardless of traffic conditions, but the counting chain that controls the receiving circuit counts only the impulses received by the track relay.

In the form of the invention shown in Fig. 3, the transmitting counting chain is indicated by A and consists of a series of relays marked 1T to 4TA inclusive and associated with this chain are slow release relays PT and PXT that correspond to relays P and XP of Fig. 1. The receiving counting chain is indicated at A1 and consists of a series of relays 10T to 40TA inclusive and associated with this chain are slow release relays PA and XPA that likewise correspond to relays P and XP of Fig. 1. Also, associated with the two counting chains are traffic-controlling relays TPO, HRO, DRO and DDRO that correspond to traffic-controlling relays TP, HR, DR and DDR of Fig. 1. Code following relay CTA is a locally operated coder unit, say of the D. C. oscillating pendulum type, which is supplied with energy by bus wires B*a* and C*a* and corresponds to relay CT of Fig. 1. TRA indicates the track relay and TPAR corresponds to relay TPA of Fig. 1. The current for the transmitting circuit that energizes the rails is conducted by bus wires B*x*110 and C*x*110, and the current that actuates the various relays (except the track relay) is supplied by bus wires B*a* and C*a*. The main transformer is indicated by 27*a* and the track transformer by 28*a*. The battery is indicated by 33*a* and is arranged as before, and 32*a* indicates the coil which is connected to the track rails and which controls the track relay. The code cycle is, in this instance, the same as that previously described. The same transmitting counting chain can be used to control a number of tracks, but there must be a separate receiving counting chain and a separate series of traffic controlling relays for each track.

During the open circuit interval that follows the series of impulses, relays PT and PA drop their armatures and close back contacts 200 and 201 thereby energizing relays PXT and XPA, the first of these receiving current from one of the leads of B*a*, over contact 200, coil of PXT and common return C*a*, and the second of these receiving current from another lead of B*a* over contact 201, coil of XPA and common return C*a*.

When the first impulse of the series of impulses is received by relay CTA it closes front contact 202 and current now flows from a lead of B*a*, over contact 202, to coil of PT and thence to common return C*a*. Current also flows from contact 202 over front contact 203 of PXT, over back contacts 204 of 4TA to 1TA inclusive, coil of 1T, and common return C*a*. Although PXT was deenergized when PT became energized, it does not release until 1T has become energized. As soon as 1T is energized it closes contact 205 and thereby closes stick circuit *a* through its own coil so that when PXT opens contact 203, relay 1T remains energized. When 1T became energized it also closed contact 206 and current therefore flows from one of the leads of B*x*110 to track transformer 28*a* and thence to C*x*110. Upon receipt of the first impulse by track relay TRA it closes front contact 207 and current now flows from one of the leads of B*a*, over contact 207, contact 207*a* of TPAR, coil of PA, and thence to common return C*a*. Current also flows from contact 207, over contact 207*a* of TPAR, to front contact 208 of XPA, over back contacts 209 of relays 40TA to 10TA, coil of relay 10T, and common return C*a*. Although XPA was deenergized when PA became energized it does not release until 10T has become energized. As soon as 10T is energized it closes contact 210 and thereby closes the stick circuit through its own coil. This stick circuit is here shown as coming from one of the leads of B*a*, over contact 211 of TPAR, over contact 212 of PA and the back contacts of 40TA to 10TA. When 10T became energized it closed contact 213 and current now flows from one of the leads of B*a*, over contact 207 of TRA, contact 207*a* of TPAR, contact 213 of 10T, coil of TPO and thence to common return C*a*.

Upon deenergization of CTA during the interval that follows the first impulse, it closes back contact 214 and current now flows over said back contact and over front contact 215 of 1T to coil of relay 1TA and thence to common return. As soon as 1TA is energized it closes contact 216, transfers the stick circuit to its own coil and ruptures the stick circuit to 1T so that the latter becomes deenergized. This ruptures the transmission circuit, at 206, to the traffic rails. During the interval following the first impulse, track relay TRA becomes deenergized and ruptures the decoding or receiving circuit leading to TPO at 207, but in closing its back contact 217 a circuit will be established from that point to contact 218 of 10T, and thence to coil of 10TA and common

return Ca. As soon as relay 10TA becomes energized it closes contact 219, transfers the stick circuit to its own coil, and ruptures the stick circuit to 10T thereby deenergizing the latter and opening contact 213. Relay TPO needs to be energized only once to each complete code cycle and so holds its front contact 220 closed.

Upon receipt of the second impulse of the series of impulses by CTA, front contact 202 is closed and current now flows from that point, over back contacts 221 of PXT and 222 of 1T, over front contact 223 of 1TA, coil of 2T, and thence to common return Ca. As soon as 2T is energized it closes contact 224, transfers the stick circuit to its own coil and ruptures the stick circuit to 1TA thereby deenergizing the latter. When 2T becomes energized it closes contact 225 and thereby establishes a transmission circuit from one of the leads of Bx110, over contact 225, back contact 226 of 1T, track transformer 28a and Cx110. Upon track relay TRA receiving the second impulse of the series of impulses, it closes contact 207 and current now flows from that point, over contact 207a of TPAR, back contact 227 of XPA, back contact 228 of 10T, front contact 229 of 10TA, coil of 20T and common return Ca. As soon as 20T is energized it closes contact 230, transfers the stick circuit to its own coil, and ruptures the stick circuit to 10TA thereby deenergizing the latter. When 20T is energized it closes contact 231, thereby establishing a receiving or decoding circuit from contact 207 of TRA, contact 207a of TPAR, back contact 232 of 10T, front contact 220 of TPO, front contact 231 of 20T, coil of HRO, and common return Ca. Relay HRO is thereby energized and closes contact 233 controlling the transmission circuit.

Upon deenergization of CTA during the interval that follows the second impulse of the series of impulses, it closes its back contact 214 and current now flows over said back contact and over back contacts 234 and 235 of 1T and 1TA, over front contact 236 of 2T, coil of 2TA, and to common return Ca. As soon as 2TA is energized it closes contact 237, transfers the stick circuit to its own coil and ruptures the stick circuit to 2T thereby deenergizing the latter. This ruptures the transmission circuit, at 225, to the traffic rails. During the interval following the second impulse, track relay TRA becomes deenergized and ruptures the decoding or receiving circuit leading to HRO at 207, but in closing its back contact 217 a circuit will be established from that point to back contact 218a of 10T, back contact 238 of 10TA, front contact 239 of 20T, coil of 20TA, and common return Ca. As soon as 20TA becomes energized it closes contact 240, transfers the stick circuit to its own coil and ruptures the stick circuit to 20T thereby deenergizing the latter and opening contact 231. Relay HRO needs to be energized only once to each complete code cycle and so holds its front contact 233 closed.

Upon receipt of the third impulse of the series of impulses by CTA, front contact 202 is closed, and current now flows from that point over back contacts 221 of PXT, 222 of 1T, 241 of 1TA, 242 of 2T, front contact 243 of 2TA, coil of relay 3T, and common return Ca. As soon as 3T is energized it closes contact 244, transfers the stick circuit to its own coil and ruptures the stick circuit to 2TA thereby deenergizing the latter. When 3T becomes energized it closes contact 245 and thereby establishes a transmission circuit from one of the leads of Bx110, over contact 233 of HRO, contact 245 of 3T, back contacts 246 and 226 of 2T and 1T, track transformer 28a and Cx110. Upon track relay TRA receiving the third impulse of the series of impulses it closes contact 207 and current now flows from that point, over contact 207a of TPAR, back contact 227 of XPA, back contacts 228, 247 and 248 of 10T, 10TA and 20T, front contact 249 of 20TA, coil of 30T, and common return Ca. As soon as 30T is energized it closes contact 250, transfers the stick circuit to its own coil and ruptures the stick circuit to 20TA thereby deenergizing the latter. When 30T becomes energized it closes contact 251 thereby establishing a receiving or decoding circuit from contact 207 of TRA, contact 207a of TPAR, back contact 232 of 10T, front contact 220 of TPO, back contact 252 of 20T, front contact 251 of 30T, coil of DRO, and common return Ca. Relay DRO is thereby energized and closes contact 253 controlling the transmission circuit.

Upon deenergization of CTA during the interval that follows the third impulse of the series of impulses, it closes its back contact 214 and current now flows over said back contact, over back contacts 234, 235, 254, 255 of 1T, 1TA, 2T and 2TA, over front contact 256 of 3T, coil of 3TA, and common return Ca. As soon as 3TA is energized it closes contact 257, transfers the stick circuit to its own coil and ruptures the stick circuit to 3T thereby deenergizing the latter. This ruptures the transmission circuit, at 245, to the traffic rails. During the interval following the third impulse, track relay TRA becomes deenergized and ruptures the decoding or receiving circuit leading to DRO at 207, but in closing its back contact 217 a circuit is established from that point to back contacts 218a, 238, 258, 259 of 10T, 10TA, 20T and 20TA, front contact 260 of 30T, coil of 30TA, and common return Ca. As soon as 30TA becomes energized it closes contact 261, transfers the stick circuit to its own coil and ruptures the stick circuit to 30T thereby deenergizing the latter and opening contact 251. Relay DRO needs to be energized only once to each complete code cycle and so holds its front contact 253 closed.

Upon receipt of the fourth impulse of the series of impulses by CTA, front contact 202 is closed, and current now flows from that point over back contacts 221 of PXT, 222 of 1T, 241 of 1TA, 242 of 2T, 262 of 2TA, 263 of 3T, front contact 264 of 3TA, coil of 4T and common return Ca. As soon as 4T is energized it closes contact 265, transfers the stick circuit to its own coil and ruptures the stick circuit to 3TA. When 4T becomes energized it closes contact 266 and thereby establishes a transmission circuit from one of the leads Bx110, over contact 233 of HRO, contact 253 of DRO, contact 266 of 4T, contacts 267 of 3T, 246 of 2T, 226 of 1T, track transformer 28a and Cx110. Upon track relay TRA receiving the fourth impulse of the series of impulses, it closes contact 207 and current now flows from that point, over contact 207a of TPAR, back contact 227 of XPA, back contacts 228 of 10T, 247 of 10TA, 248 of 20T, 268 of 20TA, 269 of 30T, front contact 270 of 30TA, coil of 40T, and common return Ca. As soon as 40T is energized it closes contact 271, transfers the stick circuit to its own coil and ruptures the stick circuit to 30TA thereby deenergizing the latter. When 40T becomes energized it closes contact 272 thereby establishing a receiving or decoding circuit from contact 207

of TRA, contact 207a of TPAR, back contact 232 of 10T, front contact 220 of TPO, back contact 252 of 20T, back contact 213 of 30T, front contact 272 of 40T, coil of DDRO, and common return Ca. Relay DDRO is thereby energized.

Upon deenergization of CTA during the interval that follows the fourth impulse of the series of impulses, it closes its back contact 214 and current now flows over said back contact, over back contacts 234 of 1T, 235 of 1TA, 254 of 2T, 255 of 2TA, 274 of 3T, 275 of 3TA, front contact 276 of 4T, coil of 4TA, and common return Ca. As soon as 4TA is energized it opens contact 277 thereby rupturing the stick circuit to 4T so that the latter becomes deenergized, and this in turn opens contact 276 so that 4TA likewise becomes deenergized. Also the transmission circuit is ruptured at 266, to the rails. During the interval following the fourth impulse of the series of impulses, track relay TRA becomes deenergized and ruptures the decoding or receiving circuit leading to DDRO at 207, but in closing its back contact 217 a circuit is established from that point to back contact 218a of 10T, 238 of 10TA, 258 of 20T, 259 of 20TA, 278 of 30T, 279 of 30TA, front contact 280 of 40T, coil of 40TA, and common return Ca. As soon as 40TA becomes energized it opens contact 281 thereby rupturing the stick circuit to 40T thereby deenergizing the latter and so opening contact 280 and deenergizing 40TA. The deenergization of 40T opens contact 272.

During the open circuit interval that follows the series of impulses, PT releases and closes contact 200 thereby reenergizing PXT so that contact 203 closes. Also during this open-circuit interval PA releases thereby opening contact 212 and closing contact 201, this latter closing the circuit through XPA and so closing contact 208. The system is now ready for the next code cycle.

In the preceding description of the operation of the system shown in Fig. 3 reference to the repetitive deenergization and reenergization of PT, PA and TPAR has been omitted as what occurs is clear from the description given elsewhere herein.

The distinction between the system shown in Fig. 1 and that of Fig. 3 lies principally in the employment in the one case of a single counting chain of relays and in the other in the use of two chains of counting relays one for transmitting the impulses to the rails, and the other for receiving the impulses from the rails. Also in Fig. 1, a single coder circuit is used for a number of block stations, whereas in Fig. 3 a local coder unit is used at each block station. It will therefore be understood that when a train occupies a block it will shunt the track relay of that block and therefore the receiving counting chain of that block station will receive no impulses from the rails and the receiving counting chain will not be operated. The transmitting counting chain will nevertheless go through its cycle of operations and will deliver the first and second impulses of the series of impulses to the rails of the next block in rear. The first one of these two impulses will be transmitted over contact 206 of 1T and the second over contact 225 of 2T and contact 226 of 1T. The third and fourth impulses cannot be transmitted to the rails because contacts 233 and 253 of HRO and DRO are open, and the closing of contacts 245 and 266 of 3T and 4T is therefore ineffective. The track relay of said next block in rear will therefore receive two impulses, and this will energize relays TPO and HRO of the block station associated with that track relay. Hence the rails of the second block in rear of the occupied one will receive not only the two impulses previously referred to, but will also receive the third impulse because contact 233 of HRO is closed as well as contact 245 of 3T. The track relay of said second block in rear of the occupied one will therefore receive three impulses thereby energizing TPO, HRO and DRO of the block station associated therewith. As a result of this, the rails of the third block in rear of the occupied one will receive not only the three impulses previously referred to, but will also receive the fourth impulse over contact 253 of DRO and 266 of 4T. The track relay of said third block in rear of the occupied one will therefore receive all four impulses, and all of the relays TPO, HRO, DRO and DDRO will become energized. It will now be understood that the system of Fig. 3 can be utilized both for wayside and/or cab signaling in the same manner as that of Fig. 1. Lamps I2 are shown associated with relays HRO, DRO and DDRO, the operation of which will be obvious. If desired the system of Fig. 3 can be utilized in connection with that of Fig. 2, in which event relay DDRO can be omitted, provided no wayside signaling means are employed. It is believed to be unnecessary to trace the circuits that are established in Fig. 2 when the system of the latter is used in connection with that of Fig. 3, since they would be the same as those that are established when the system of Fig. 1 is used with that of Fig. 2. For the sake of completeness, however, there is shown in Fig. 6 a time-table of the operation of the transmitting and receiving counting chains of the wayside equipment, and in Fig. 7 a time-table of the wayside transmitting and the locomotive receiving relays.

It will be noted that the system provides automatic detection of insulation break-down in the traffic rails because the alternating current supplied to the rails of adjacent blocks is of opposite instantaneous polarity, and therefore, in case of a break in the insulation, the track relay would become deenergized.

I claim:

1. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic rails to receive the impulses; means to impress on the rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; and wayside traffic-controlling means variably responsive to the variable number of impulses of the series of impulses of the constant code cycles impressed on the rails.

2. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic rails to receive the impulses; means to impress on the rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; a car traveling on the rails; and car-carried as well as wayside traffic-controlling means both of which are variably responsive to the variable number of

impulses of the series of impulses of the constant code cycles impressed on the rails.

3. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic-controlling means; and traffic-controlled means to variably influence the traffic-controlling means by rendering all or less than all of said impulses of the series of impulses of the constant code cycles effective with respect to the traffic-controlling means.

4. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic rails arranged in blocks; traffic-controlling means associated with one block; and traffic-controlled means responsive to traffic conditions of another block to variably influence the traffic-controlling means of the first-mentioned block by rendering all or less than all of said impulses of the series of impulses of the constant code cycles effective with respect to said traffic-controlling means.

5. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic rails, to receive the impulses, arranged in blocks; traffic-controlling means to control the transmission of a variable number of impulses of the series of impulses of the constant code cycles to the rails of one block; and traffic-controlled means responsive to traffic conditions of another block and variably influenced by the variable number of impulses of the series of impulses of the constant code cycles received by the rails of said other block to thereby variably influence the traffic-controlling means of the first-mentioned block and the number of impulses of the series of impulses of the constant code cycles to be received by the rails of said first-mentioned block.

6. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic-controlling means; and a track relay to variably influence the traffic-controlling means by rendering all or less than all of said impulses of the series of impulses of the constant code cycle effective with respect to the traffic-controlling means.

7. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic rails arranged in blocks; traffic-controlling means associated with one block; and a track relay responsive to traffic conditions of another block to variably influence the traffic-controlling means of the first-mentioned block by rendering all or less than all of said impulses of the series of impulses of the constant code cycle effective with respect to said traffic-controlling means.

8. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; traffic rails, to receive the impulses, arranged in blocks; traffic-controlling means to control the transmission of a variable number of impulses of the series of impulses of the constant code cycles to the rails of one block; and a track relay responsive to traffic conditions of another block and variably influenced by the variable number of impulses of the series of impulses of the constant code cycles received by the rails of said other block to thereby variably influence the traffic-controlling means of the first-mentioned block and the number of impulses of the series of impulses of the constant code cycles to be received by the rails of said first-mentioned block.

9. In a signaling system: means to generate the same constantly recurring series of impulses; a traffic track to receive impulses; a chain of counting relays to register all of the impulses of each series; a transmission circuit, to transmit a variable number of the impulses to the track, controlled by the chain of relays; and a receiving circuit, to receive a variable number of impulses depending upon the number of impulses received by the track, also controlled by the chain of relays.

10. In a signaling system: means to generate the same constantly recurring series of impulses; a traffic track to receive impulses; a chain of counting relays to register all of the impulses of each series; a transmission circuit, to transmit a variable number of the impulses to the track, controlled by the chain of relays; a receiving circuit to receive a variable number of impulses depending upon the number of impulses received by the track; and a second chain of counting relays to register the impulses of the receiving circuit.

11. In a signaling system: means to generate the same constantly recurring series of impulses; a traffic track, arranged in blocks, to receive impulses; a chain of counting relays to register all of the impulses of each series; a transmission circuit, to transmit a variable number of impulses to the rails of a block, controlled by the chain of relays; a receiving circuit to receive a variable number of impulses depending upon the number of impulses received by the rails of a block; and a second chain of counting relays to register the impulses of the receiving circuit.

12. In a count-code railway signaling system employing recurring series of impulses: a plurality of counting relays to register in sequential order the impulses of each series, the same relay always registering the same sequential impulse of a series; a plurality of other relays sequentially controlled by the counting relays in accordance with traffic conditions; and a circuit, to transmit recurring series of impulses to the track rails, controlled by the counting relays and by the other relays.

13. In a count-code railway signaling system employing recurring series of impulses: a plurality of counting relays to register in sequen-

tial order the impulses of each series, the same relay always registering the same sequential impulse of a series; a plurality of other relays sequentially controlled by the counting relays; traffic rails; and a circuit, to transmit recurring series of impulses to the traffic rails, controlled by the counting relays and by the other relays.

14. In a signaling system: a traffic track arranged in blocks, each block adapted to receive recurring series of impulses; means to generate said recurring series of impulses; a receiving circuit associated with the rails of one block and adapted to energize traffic-controlling means; an impulse transmitting circuit associated with the rails of the adjacent block and with the impulse generating means; a plurality of relays to register each impulse of each series of impulses and to control said transmission circuit and said receiving circuit; and traffic-controlling means to be energized by said receiving circuit and to control said transmission circuit.

15. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; a chain of relays, to be energized and deenergized in sequence, consisting of two groups the relays of which groups are arranged in alternation, the relays of one group registering the number of impulses of the series of impulses, and the relays of the other group registering the number of intervals occurring during a series of impulses; a code following relay having a front contact and a back contact; and circuit means to control the energization of one group of relays through the front contact of the code following relay and the other group of relays through the back contact of the code following relay.

16. In a signaling system: means to produce a constantly recurring series of impulses; a chain of counting relays to be sequentially energized and deenergized in response to the influence of the impulses of the same series; traffic rails arranged in blocks; circuit means, controlled by part of said chain of relays, to impress less than all impulses of a series of impulses on the traffic rails of one block; a control relay controlled by traffic conditions of the rails of another block; and other circuit means controlled by the remainder of said chain of relays and by the control relay to impress another impulse of the series of impulses on the traffic rails of the first-mentioned block.

17. In a signaling system: traffic rails; means to impress on the rails a variable number of impulses of a code cycle in accordance with different traffic conditions; and a code-following track relay located in the wayside to close its front contact during each impulse and to open its front contact during the intervals between impulses.

18. In a signaling system: traffic rails; means to impress on the rails a variable number of impulses of a code cycle in accordance with different traffic conditions; a code-following track relay located in the wayside to close its front contact during each impulse and to open its front contact during the intervals between impulses; and a decoding circuit controlled by the front contact of the code-following track relay.

19. In a signaling system: traffic rails; means to impress on the rails a variable number of impulses of a code cycle in accordance with different traffic conditions; a code-following track relay to close its front contact during each impulse and to open its front contact during the intervals between impulses; a decoding circuit controlled by the front contact of the code-following track relay; and a slow release relay, to be energized when the code-following track relay is deenergized, and acting to rupture the decoding circuit if the track relay remains energized and fails to follow the code impulses.

20. In a signaling system: traffic rails; means to produce under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; means to impress on the traffic rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; and a code-following track relay to close its front contact during each impulse of a series of impulses and to open its front contact during the interval between impulses of the same series as well as during the interval following after each series of impulses.

21. In a signaling system: traffic rails; means to produce under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; means to impress on the traffic rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; a code-following track relay to close its front contact during each impulse of a series of impulses and to open its front contact during the interval between impulses of the same series as well as during the interval following after each series of impulses; and a decoding circuit controlled by the front contact of the code-following relay.

22. In a signaling system: traffic rails; means to produce under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; means to impress on the traffic rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; a code-following track relay having a front and a back contact, the front contact being closed during each impulse of a series of impulses and the back contact being closed during the interval between impulses of the same series as well as during the interval following after each series of impulses; a decoding circuit controlled by the front contact of the code-following track relay; and a slow release relay, to be energized through the back contact of the code-following track relay, having a slow release period capable of bridging a complete code cycle of impulses, and acting to rupture the decoding circuit of the track relay remains energized and fails to follow the code impulses.

23. In a signaling system: traffic rails; means to impress code impulses on the traffic rails; a code-following track relay having a front and a

back contact, the front contact being closed during each impulse of the code and the back contact being closed during each interval between impulses; a circuit controlled by the front contact of the code-following track relay; and a slow release relay, to be energized through the back contact of the track relay, and acting to rupture the circuit if the track relay remains energized and fails to follow the impulses.

24. In a count-code signaling system employing recurring series of impulses: a plurality of traffic-controlling relays to be energized in sequential order by the impulses of each series, the same relay to receive the same sequential impulse of each series of impulses; a track relay to receive in accordance with traffic conditions a variable number of impulses of the recurring series of impulses; and a circuit controlled by the track relay to energize a variable number of said relays.

25. In a count-code signaling system employing recurring series of impulses: a plurality of counting relays to register in sequential order the impulses of each series, the same relay always registering the same sequential impulse; a plurality of traffic-controlling relays to be energized in sequential order by the impulses of each series of impulses, the same traffic-controlling relay to receive the same sequential impulse of each series of impulses; a track relay to receive in accordance with traffic conditions a variable number of impulses; and a receiving circuit controlled by the track relay and by the counting relays to energize a variable number of said traffic-controlled relays.

26. A method of signaling for a stretch of railway track divided into track sections which consists in: producing, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of energy impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; supplying said series of energy impulses to the track sections of said stretch; varying the number of impulses of said recurring series which are supplied to a given track section in accordance with traffic conditions in advance of said given section; and in utilizing a variable number of impulses of the series of impulses of the constant code cycles supplied to said given section to indicate different traffic conditions in accordance with the number of such impulses supplied to said section.

27. A method of signaling for a stretch of railway track divided into track sections which consists in: producing, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of energy impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; supplying all or less than all of the energy impulses of said series to the individual track sections of said stretch according as a track section in advance of the respective section is unoccupied or occupied respectively; and in utilizing the impulses of the series of impulses of the constant code cycles supplied to said track sections to indicate traffic conditions in the advance sections.

28. In a code signaling system: a traffic track arranged in a plurality of blocks; coding means to generate, under all traffic conditions, the same coded current; means associated with a block section to supply part or all of said coded current to the traffic track to thereby indicate different traffic conditions; a car traveling on the track; and car-carried as well as wayside traffic-controlling means both of which are variably responsive to part or all of said coded current supplied to the traffic track.

29. In a code signaling system for a stretch of railway track: coding means to generate, under all traffic conditions, the same coded current; traffic-controlling means associated with a first section of said stretch and selectively responsive to said coded current according as a part or all of said current is effective in said first section; and traffic-controlled means associated with a second section of said stretch and effective to variably influence said traffic-controlling means by rendering part or all of said coded current effective in said first section according as said second section is occupied or unoccupied respectively.

30. In a code signaling system: coding means to generate, under all traffic conditions, the same coded current; traffic rails arranged in blocks; traffic-controlling means associated with one block; and traffic-controlled means responsive to traffic conditions of another block to variably influence the traffic-controlling means of the first-mentioned block by rendering part or all of said coded current effective with respect to said traffic-controlling means.

31. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses; a traffic track to receive the impulses; circuit means to impress the impulses on the track; and means to prevent, under certain traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track.

32. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses; a traffic track to receive the impulses; circuit means to impress the impulses on the track; and means to prevent, under adverse traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track.

33. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses comprising a given impulse which is repeated to form the series; a traffic track to receive the impulses; circuit means to impress the impulses on the track; means to prevent, under certain traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; and traffic-controlling means variably responsive to the different number of impulses of the recurring series impressed on the track.

34. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses comprising a given impulse which is repeated to form the series; a traffic track to receive the impulses; circuit means to impress the impulses on the track; means to prevent, under certain traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; and wayside traffic-controlling means variably responsive to the different number of impulses of the recurring series impressed on the track.

35. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses; a traffic track to re-

ceive the impulses; circuit means to impress the impulses on the track; means to prevent, under certain traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; a car traveling on the track; and car-carried as well as wayside traffic-controlling means both of which are variably responsive to the different number of impulses of the recurring series impressed on the track.

36. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses comprising a given impulse which is repeated to form the series; a traffic track to receive the impulses; circuit means to impress the impulses on the track; means to prevent, under adverse traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; and traffic-controlling means variably responsive to the different number of impulses of the recurring series impressed on the track.

37. In a signaling system: means to generate under all traffic conditions, the same constantly recurring series of impulses; a traffic track to receive the impulses; circuit means to impress the impulses on the track; means to prevent, under adverse traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; and wayside traffic-controlling means variably responsive to the different number of impulses of the recurring series impressed on the track.

38. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses comprising a given impulse which is repeated to form the series; a traffic track to receive the impulses; circuit means to impress the impulses on the track; means to prevent, under adverse traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; a car traveling on the track; and car-carried traffic-controlling means variably responsive to the different number of impulses of the recurring series impressed on the track.

39. In a signaling system: means to generate, under all traffic conditions, the same constantly recurring series of impulses; a traffic track to receive the impulses; circuit means to impress the impulses on the track; means to prevent, under adverse traffic conditions, one or more of the impulses of the recurring series of impulses from being impressed on the track; a car traveling on the track; and car-carried as well as wayside traffic-controlling means both of which are variably responsive to the different number of impulses of the recurring series impressed on the track.

40. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of energy impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; traffic rails to receive the impulses; and means to impress on the rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles.

41. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of energy impulses and an interval between impulses, together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; traffic rails to receive the impulses; means to impress on the rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; and traffic-controlling means variably responsive to the variable number of impulses of the series of impulses of the constant code cycles impressed on the rails.

42. A signaling system including: means to produce, under all traffic conditions, the same constantly recurring code cycles, each cycle consisting of a series of energy impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; traffic rails to receive the impulses; means to impress on the rails, in accordance with traffic conditions, a variable number of impulses of the series of impulses of the constant code cycles; a car traveling on the rails; and car-carried traffic-controlling means variably responsive to the variable number of impulses of the series of impulses of the constant code cycles impressed on the rails.

43. In a signaling system: a traffic track to receive impulses; means to produce recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; means to register each impulse and each interval of each series and also to control the sending of impulses to the traffic track; and means to register the interval of greater duration that follows each series of impulses.

44. In a signaling system: a traffic track to receive impulses; means to produce recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; a pluraliay of relays to register each impulse and each interval of each series, the same relay always registering the same sequential impulse or interval, and to control the sending of impulses to the track by said plurality of relays; and means to register the interval of greater duration that follows each series of impulses.

45. In a signaling system: a traffic track to receive impulses; means to produce recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; a plurality of relays to register each impulse and each interval of each series, the same relay always registering the same sequential impulse or interval, and to control the sending of impulses to the track by said plurality of relays; and a relay to register the interval of greater duration that follows each series of impulses.

46. In a signaling system: a traffic track arranged in blocks, each block adapted to receive recurring series of impulses; means to generate said recurring series of impulses; a receiving circuit associated with the rails of one block and adapted to energize traffic-controlling means; an impulse transmitting circuit associated with the

rails of the adjacent block and with the impulse generating means; and a plurality of counting relays to register each impulse of each series of impulses and to control said transmission circuit and said receiving circuit.

47. In a signaling system, means to produce recurring code cycles, each cycle consisting of a series of energy impulses and intervals between impulses together with an interval after each series of impulses of greater duration than any one interval between impulses of the same series; and a plurality of relays to be sequentially energized in response to successive impulses of the same series, the same relay to receive the same sequential impulse of each series of impulses, and each relay having a slow release period sufficient to span the time between successive energizations during recurrent cycles.

48. A signaling system including: a traffic track; a car traveling on the track; wayside means to produce under all traffic conditions the same recurring series of impulses; a wayside counting chain of relays to register, under all traffic conditions, all the impulses of each series; traffic-controlled means to impress a variable number of the impulses of a series on the traffic track; means on the car in an inductive relation with the traffic track; and a counting chain of relays on the train to register the number of impulses of a series impressed on the traffic track.

49. A signaling system including: a traffic track; a car traveling on the track; wayside means to produce under all traffic conditions the same recurring series of impulses; a wayside counting chain of relays to register, under all traffic conditions, all the impulses of each series; traffic-controlled means to impress a variable number of the impulses of a series on the traffic track; means on the car in an inductive relation with the traffic track; a counting chain of relays on the train to register the number of impulses of a series impressed on the traffic track; and traffic-controlling means on the car responsive to the variable number of impulses registered by the car-carried counting chain.

50. In a signaling system: means constantly active to produce the same recurring series of impulses under all traffic conditions; and a chain of counting relays to register both the on and off periods of each series of impulses, each relay controlling the energization of the succeeding one and the deenergization of the preceding one.

51. In a count-code railway signaling system employing the same recurring series of impulses under all traffic conditions; a plurality of counting relays to register in sequential order the impulses of each series, the same relay always registering the same sequential impulse of a series; and a circuit, to transmit recurring series of impulses to the track rails, controlled by the counting relays.

52. In a code signaling system: means to produce the same recurring series of impulses under all traffic conditions; a code relay responsive to the impulses of each series and having a front contact which is closed during each impulse of a series, and a back contact which is closed during the interval between impulses of the same series; a plurality of relays to be sequentially energized by the alternate closing of the front and back contacts of the code relay; and circuits controlled by the contacts of the code relay and controlling the plurality of relays.

53. In a count-code signaling system employing the same recurring series of impulses under all traffic conditions: a plurality of traffic-controlling relays to be energized in sequential order by the impulses of each series, the same relay to receive the same sequential impulse of each series of impulses; and a traffic-controlled circuit to receive, in accordance with traffic conditions, a variable number of impulses of the recurring series of impulses and to thereby energize a variable number of said relays.

54. In a signaling system: means constantly active to produce the same recurring series of impulses under all traffic conditions; means to register each impulse of each series; means to register the completion of each series of impulses; and means to prevent the registering of a succeeding series of impulses if the completion of a preceding series has not been registered.

55. In a signaling system: means to produce recurring series of impulses; a plurality of relays to register each impulse of each series, the same relay always registering the same sequential impulse; means to register the completion of each series of impulses; and a checking relay to prevent the registering of a succeeding series of impulses if the completion of a preceding series has not been registered.

56. In a signaling system: means to produce recurring series of impulses; a plurality of relays to register each impulse of each series, the same relay always registering the same sequential impulse, means to register the completion of each series of impulses; a normally deenergized checking relay which becomes energized each time that the completion of a series of impulses has been registered; and a circuit to initiate registering of a series of impulses, including a front contact of said checking relay.

57. In a signaling system: means to produce recurring series of impulses; a plurality of relays to register each impulse of each series, the same relay always registering the same sequential impulse, means to register the completion of each series of impulses; a normally deenergized checking relay which becomes energized each time that the completion of a series of impulses has been registered; and a circuit to initiate registering of a series of impulses, including a front contact of said checking relay and a back contact of each relay of said plurality of relays.

58. In a signaling system: means to produce recurring code cycles, each cycle consisting of a series of impulses and an interval between impulses together with an interval after each series of impulses of greater duration than an interval between impulses of the same series; a code-following relay; a slow-acting relay controlled by said code-following relay in such manner as to remain energized when the code-following relay is following the impulses of a code cycle but to become deenergized during said interval of greater duration following each series of impulses; a plurality of relays to register each impulse of each series; a checking relay controlled over a back contact of said slow-acting relay; and a starting circuit controlled by said checking relay for initiating the registering of impulses by said plurality of relays.

59. In a railway signaling system, a transmission circuit for delivering different series of impulses to the track rails of a block section and a receiving circuit for controlling means selectively responsive to said impulses both in the wayside, and a chain of counting relays to register the

received impulses and to control both the transmission and receiving circuits.

60. In a railway signaling system, a transmission circuit for delivering different series of impulses to the track rails of a block section and a receiving circuit for controlling means selectively responsive to said impulses both in the wayside, a chain of counting relays to register said impulses and to control the transmission circuit, and a second chain of counting relays also to register said impulses and to control the receiving circuit.

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