J. A. MILLER.

CONTROL CIRCUITS FOR OPERATING BLOCK SIGNALING DEVICES, AND THE LIKE UPON RAILWAYS.

APPLICATION FILED APR. 19, 1920.

1,379,592.

Patented May 24, 1921.

5 SHEETS—SHEET 1.

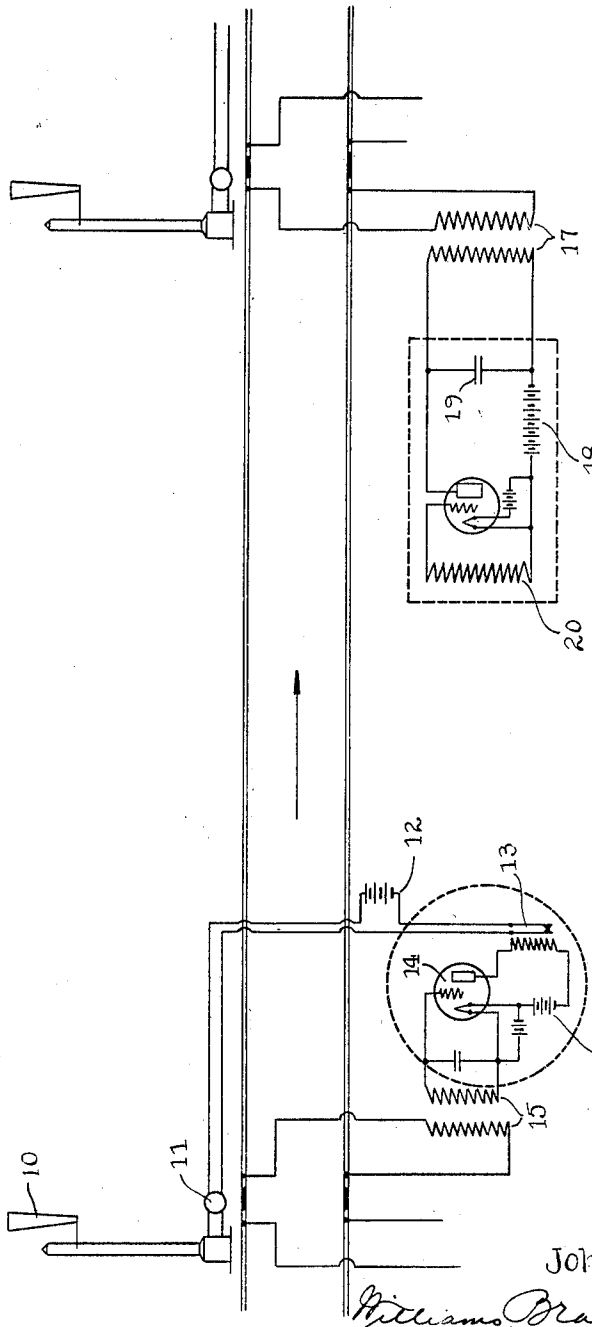


Fig. 1.

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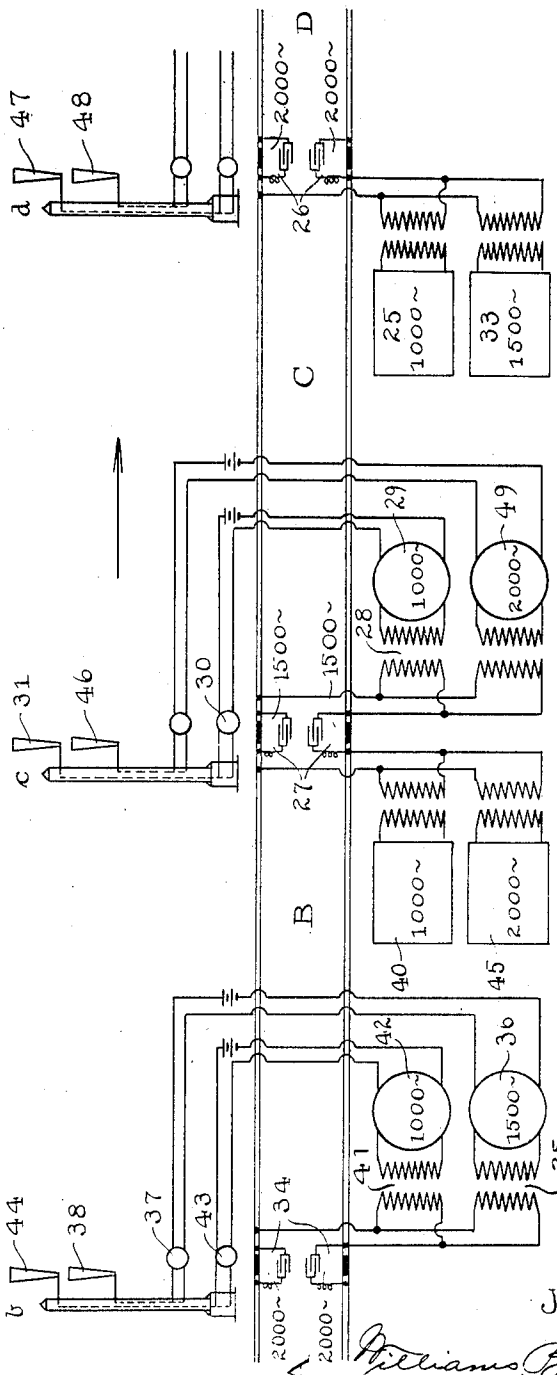


FIG. 2.

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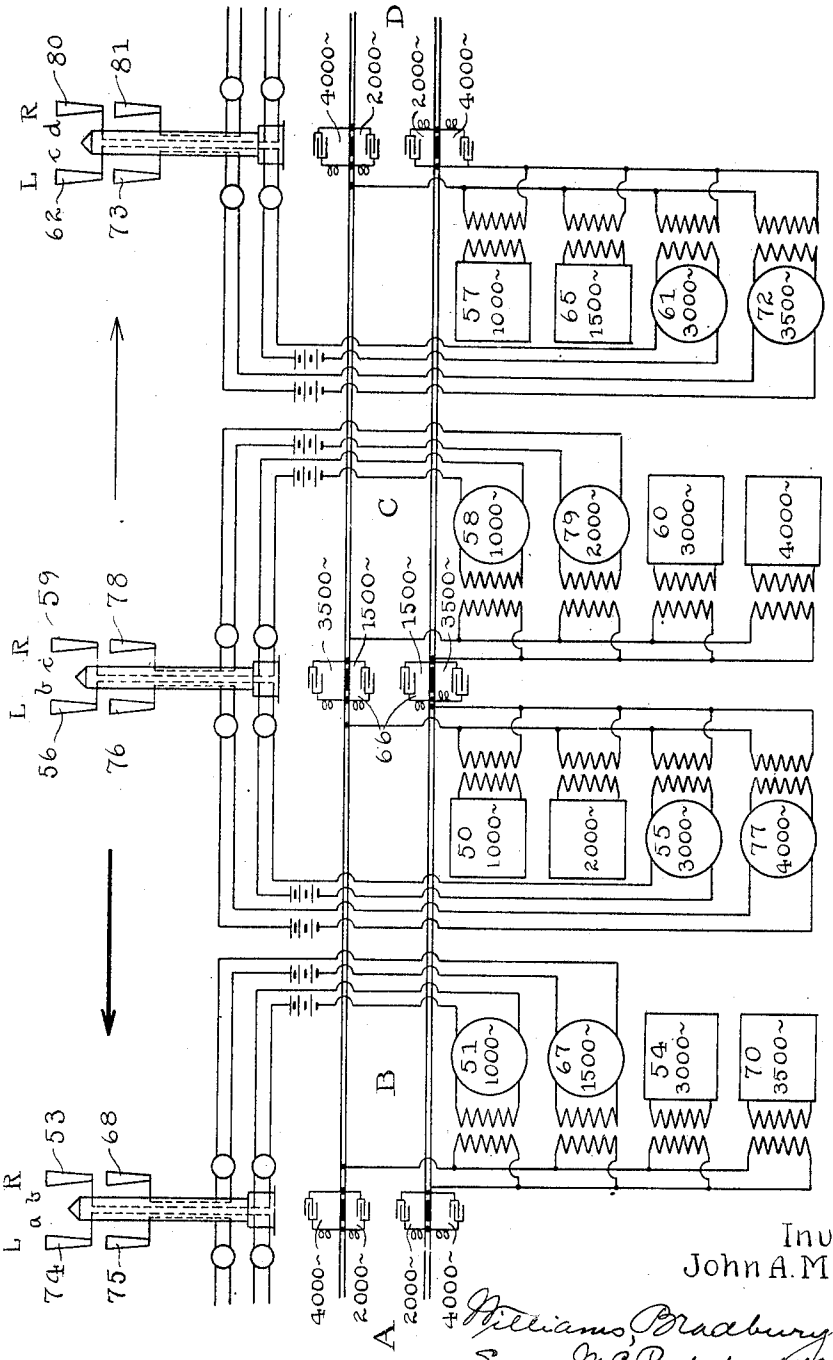


Fig. 3.

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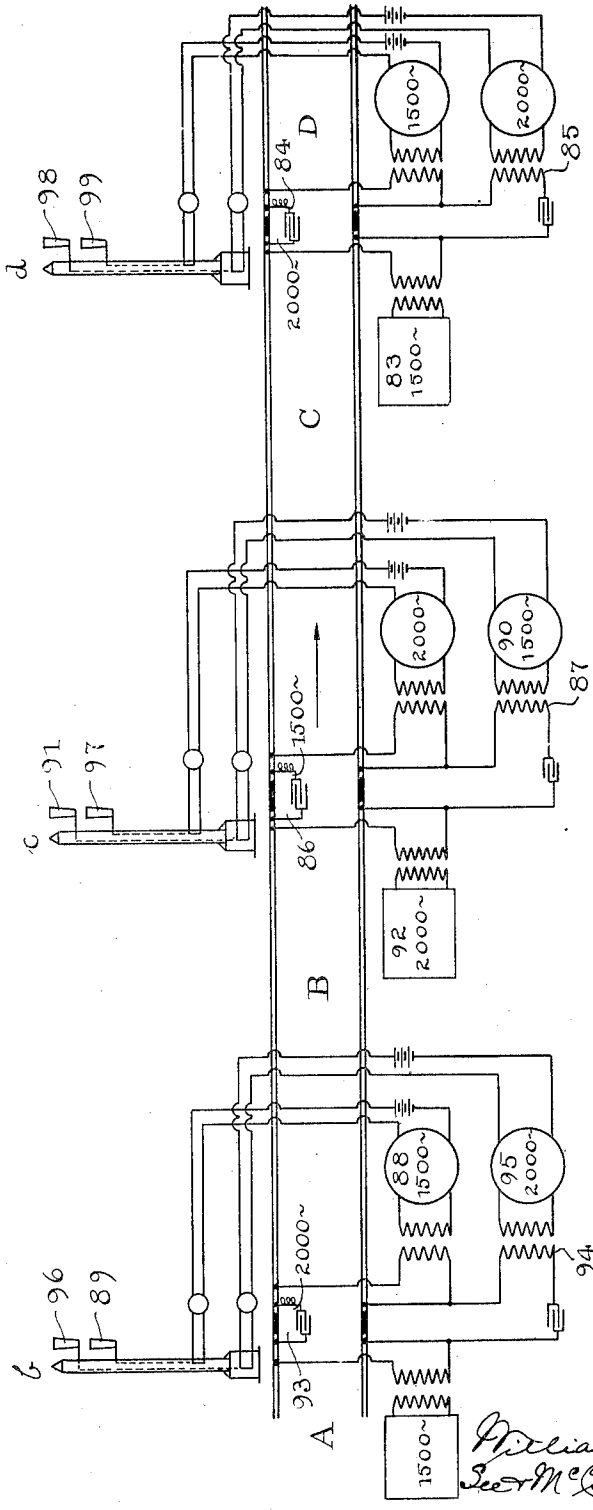


Fig. 4.

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5 SHEETS—SHEET 5.

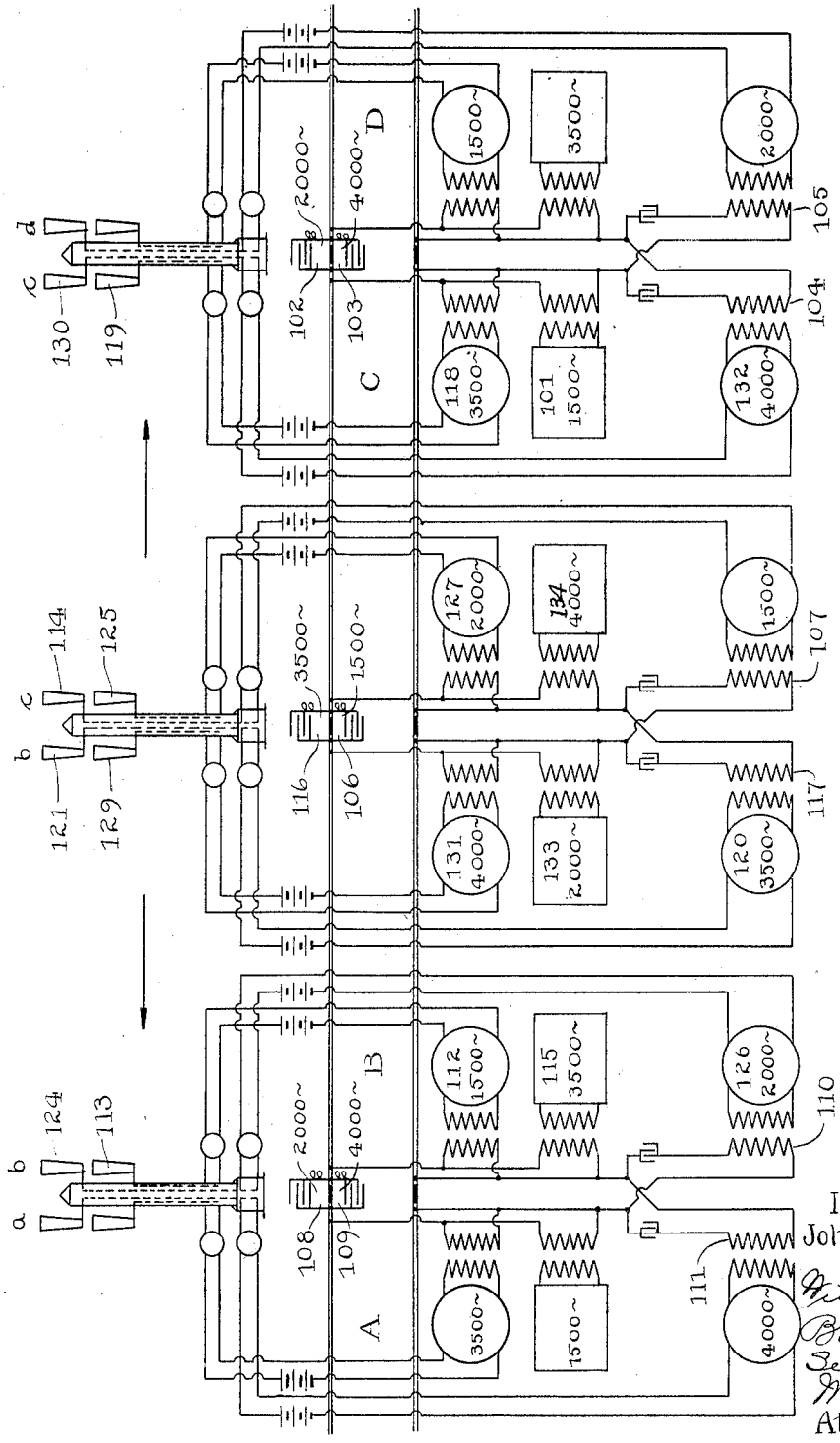


Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN A. MILLER, OF WAUKEGAN, ILLINOIS, ASSIGNOR TO LAURENCE R. WILDER, OF CHICAGO, ILLINOIS.

CONTROL-CIRCUITS FOR OPERATING BLOCK-SIGNALING DEVICES AND THE LIKE UPON RAILWAYS.

1,379,592. Specification of Letters Patent. Patented May 24, 1921.

Application filed April 19, 1920. Serial No. 374,793.

To all whom it may concern:

Be it known that I, JOHN A. MILLER, a citizen of the United States, residing at Waukegan, in the county of Lake and State of Illinois, have invented a certain new and useful Improvement in Control-Circuits for Operating Block-Signaling Devices and the like upon Railways, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to control circuits for operating block signaling devices and the like upon railways. The invention is carried out by the use of high frequency alternating current sending and receiving devices preferably conductively connected with the rails of the system so as to selectively control signals of different characters located in various positions.

In carrying out my invention, I make use of vacuum tube tuned generating and receiving devices of well known structure, the apparatus and circuits for which are only diagrammatically illustrated. My invention will be more readily understood by reference to the accompanying drawings in which—

Figure 1 represents the circuits of a pair of connected generating and receiving outfits connected so as to deliver to and receive current from the tracks of a railway system and in which the generator is shown inclosed within a rectangle while the receiver is shown inclosed within a circle.

Fig. 2 represents a block signal system arranged for traffic from west to east and in which danger and caution indications are provided. The rectangles of this figure are provided with circuits and apparatus such as shown in the rectangle of Fig. 1, while the circles of this figure are provided with apparatus and circuits such as shown in the circles of Fig. 1 with the exception of the difference in frequency tuning indicated by the frequencies marked in the various rectangles and circles.

Fig. 3 represents a block signal system arranged for giving danger and caution signals for traffic in both directions along a single track. In this figure, each generator is represented by a rectangle and each receiver is represented by a circle, the rectangles and circles corresponding in equipment with the rectangle and circle of Fig. 1.

Fig. 4 represents a block signal system arranged for traffic from west to east only and in which danger and caution indications are provided. In accordance with this system, certain rail joints are bridged by tuned circuits including a winding of a transformer.

Fig. 5 represents a single track system arranged for traffic in both directions and in which danger caution and safety signals are given and in which certain rail joints are bridged by tuned circuit which include windings of the current transformers.

Referring now to Fig. 1, it will be understood that the semaphore arm 10 is directly controlled by the motor mechanism 11 and has two positions, a vertical or safety position and a horizontal or danger position. It will also be understood that when the circuit of the motor mechanism 11 and the battery 12 is closed the arm 10 remains in its vertical or safety position while when the circuit of the motor mechanism 11 and battery 12 is opened, for example, at the contacts of relay 13, the arm 10 drops to its horizontal position indicating danger.

Within the circle is illustrated a vacuum tube 14 included in circuits in a manner well known in the art, such that when high frequency alternating current is induced in the secondary of the high frequency transformer 15, a current from battery 16 will find passage through the vacuum tube 14 to operate the relay 13 and maintain its contacts closed, whereupon the semaphore arm 10 will be caused to remain in its vertical position of safety.

Within the rectangle of Fig. 1 is shown an apparatus, well known in the art, and so arranged as to continuously impress upon the primary of the transformer 17 a definitely tuned high frequency of alternating current, the energy for which is supplied by the battery 18 and the frequency for which is governed by the relative adjustments of the condenser 19 and the inductance of coil 20 and the transformer primary.

By means of the system shown, a high frequency current is impressed by the generator within the rectangle onto the primary of the high frequency transformer 17 and by means of the secondary of that trans-

former and the conductors connected therewith, a current of similar frequencies is impressed upon the two rails of the single track system. These rails are connected in insulated blocks and the current thus conducted to them travels along the rails and is conducted to the primary of the high frequency transformer 15, the secondary of which is so connected with the vacuum tube 14 as to sustain its action and maintain the contacts of relay 13 normally closed.

When the wheels of a locomotive or car bridge the rails in the block shown, the car axles short circuit the high frequency current being sent from the generator in the rectangle and thus deprive the vacuum tube 14 of its sustaining current thus effectively opening the circuit of the coil of relay 13 and causing the semaphore arm 10 to drop to its horizontal or danger position. This position will be maintained until the wheels of the last car of the train pass out of the block, whereupon the high frequency from the generator in the rectangle will again sustain the operation of the vacuum tube 14 and cause the closure of the contacts of relay 13 again moving the arm 10 to its vertical position of safety.

As the train moves from block to block, it will be understood that the various semaphore arms associated with the various blocks, will drop to danger position and so remain until each successive block has been cleared by the last wheels of the train.

In the system of Fig. 2, generators and receivers similar to those illustrated in Fig. 1 are utilized for sending and receiving alternating currents of definite high frequencies, certain generators and receivers being tuned for like frequencies, the receivers being unresponsive to frequencies sent from certain other generators. The generators are illustrated as rectangles and the receivers as circles, each circle or rectangle being provided with apparatus similar to that of the circle and rectangle of Fig. 1 with the exception that the generators and receivers are differently tuned by the different adjustments of their associated condensers and inductances.

In this system and in all of the following systems herein described, the frequency produced by each generator is indicated within the rectangle representing that generator and the frequency to which each receiver is responsive is indicated by the frequency marked within the circle.

In this figure, two complete blocks and the end sections of two additional blocks are shown. Since this system is arranged for traffic only from left to right, these four blocks are indicated at A, B, C and D and the associated semaphores are indicated as *b*, *c* and *d*. If a train is moving through block C in the direction of the arrow, the pole *b* will have its top arm up and its lower arm horizontal, to give a caution indication to a train approaching block B from block A. At the same time, a pole *c* will have both its arms down to indicate danger to a train approaching block C from block B, while pole *d* will have both of its arms up to indicate safety to the train which was formerly assumed to be passing through the block C toward the block D.

Under normal conditions, the 1000 frequency current from generator 25 is conducted to the rails of section C, this current is blocked from passage into section D by the bypasses 26 tuned to pass frequencies of 2000 cycles only. The current, therefore, passes along the rails of section C and is prevented from passing into section B by bypasses 27 tuned to pass frequencies of 1500 cycles only. This current, however, passes through transformer 28 and by means of receiver 29 maintains closed the circuit of motor mechanism 30 which maintains semaphore arm 31 in its vertical position. The current from 1500 cycle generator 33 passes into the rails of section C, is blocked from section D by 2000 frequency bypasses 26, travels along the rails of section C and passes into the rails of section B through 1500 frequency bypasses 27; then passes along section B to its left hand end, where it is blocked by 2000 frequency bypasses 34. This current then passes through the transformer 35 into 1500 cycle receiver 36 maintaining closed the circuit of motor mechanism 37 controlling semaphore arm 38 which is thus maintained in its vertical position. The current from 1000 cycle generator 40 passes onto the rails of section B, is blocked from flowing into the rails of section C by 1500 cycle bypasses 27, flows then to the left hand end of section B where it is blocked from flowing into the rails of section A by 2000 frequency bypasses 34. The current then flows through transformer 41 into 1000 cycle receiver 42, maintaining the circuit closed for motor mechanism 43 and thus maintaining the arm 44 in its vertical position.

By a continuation of analogous circuits, it will be seen that 2000 cycle generator 45 controls the operation of the lower arm of the pole (not shown) for section A, that the semaphore arm 46 of pole *c* is controlled from a 2000 cycle generator (not shown) connected with the rails of section D, that the semaphore arm 47 is controlled by a 1000 cycle generator (not shown) connected with the rails of section D and that the semaphore arm 48 is controlled by a 1500 cycle generator (not shown) connected with the rails of the next section to the right of section D.

In the operation of the system of Fig. 2, assume a train to be approaching section B

from section A. The semaphore arms 44 and 38 will both be in vertical position indicating safety. When the wheels have rolled into section B, short circuiting the rails of section B, both receivers 36 and 42 are deprived of current and semaphore arms 38 and 44 are thus caused to move to their horizontal positions indicating danger to any train which may be approaching from section A. When the train has passed out of section B into section C, the semaphore arms 31 and 46 move to their horizontal positions indicating danger because of the short circuiting of currents for the receivers 29 and 49. At the same time, by reason of the removal of the short circuit between the rails of section B, the semaphore arm 44 returns to its vertical position, because there is now nothing to interfere with the passage of currents from generator 40 to receiver 42 which controls the arm 44. The arm 38, however, still remains in its horizontal position because at this time, the 1500 cycle current from generator 33 is short circuited between the rails of section C and prevented from passing through the 1500 cycle bypasses 27 into section B.

When the train rolls into section D and removes the short circuit from section C, the current from 1500 cycle generator 33 again passes through the rails of section C, through the 1500 cycle bypasses 27 into the rails of section B and again operates 1500 cycle receiver 36 causing semaphore 38 to assume its vertical position indicating safety for other trains desiring to enter section B.

Fig. 3 shows a single track system arranged for traffic in two directions and arranged with semaphore arms to give the indications of safety, danger and caution in each direction. The right-hand semaphore arms afford indications of safety, danger or caution to trains traveling to the right, while the left-hand semaphore arms afford the same indications to trains traveling to the left. When both arms are up, the indication is safety; when both arms are horizontal, the indication is danger; and when the upper arm is up and the lower arm horizontal, the indication is caution.

In this figure, two complete sections B and C with their associated apparatus are shown, while the ends of adjacent sections A and D are also illustrated. The pole *ab* carries the arms indicating the condition of section A to travel to the left, and section B to travel to the right. The pole *bc* carries the arms for indication of the condition of section B to travel to the left, and section C to travel to the right, and the pole *cd* carries the arms indicating the condition of section C to travel to the left, and of section D to travel to the right.

Each section has associated with it and individual to it a pair of generators and a pair of receivers connected as in Fig. 2 for controlling the danger signals for the section. For this purpose the 1000 cycle generator 50 normally sends current through the rails of section B into the 1000 cycle receiver 51, thus as in Fig. 2 sustaining the vertical position of semaphore arm 53. Also the 3000 cycle generator 54 normally supplies current to the 3000 cycle receiver 55 for sustaining the vertical position of the semaphore arm 56, it being understood that the semaphore arm 53, when in horizontal position, affords a danger signal to traffic to the right about to enter section B, while the semaphore arm 56, when in horizontal position, affords a danger signal to traffic to the left when about to enter section B. In this same manner 1000 cycle generator 57, through 1000-cycle receiver 58, controls right traffic semaphore arm 59, and 3000 cycle generator 60, through 3000 cycle receiver 61, controls left traffic semaphore arm 62. The insulated rail joints between sections are bridged by bypasses which are tuned not to pass either 1000 cycle or 3000 cycle currents, so that as before described, the currents from the generators individual to sections do not penetrate into adjacent sections.

1500 cycle generator 65 sends current onto the rails of section C, which current is blocked from section D by the tuned bypasses of 2000 and 4000 cycles. The current from this generator, therefore, passes along the rails of section C and into the rails of section B, through the bypasses 66 which are tuned to pass currents of 1500 cycles. The current then proceeds along the rails of section B to the 1500 cycle receiver 67, it having encountered bypasses between sections A and B, which it could not penetrate. Receiver 67 being thus energized, sustains the vertical position of semaphore arm 68 in the manner heretofore described.

Currents from 3500 cycle generator 70 pass onto the rails of section B, are blocked from section A by bypasses tuned to 2000 and 4000 cycles, then pass along the rails of section B, through the 3500 cycle bypasses, and proceed along the rails of section C to 3500 cycle receiver 72, this current being effectively blocked from section D by tuned bypasses of 2000 and 4000 cycles. This current, in the manner before described, controls the operation of left traffic semaphore arm 73.

The same system of circuits will be found to control the other semaphore arms of Fig. 3, the left traffic arm 74 being controlled by apparatus (not shown) individual to section A; the left traffic arm 75 by apparatus (not shown) individual to the section to the left of section A. The left traffic arm 76 is controlled by 4000 cycle receiver 77, which receives its current from a 4000 cycle gen-

erator (not shown) connected with section A. The right traffic semaphore arm 78 is controlled by 2000 cycle receiver 79, which receives its current from a generator (not shown) associated with section D. The right traffic semaphore arm 80 is controlled by apparatus individual to section D, while the right traffic semaphore arm 81 is controlled by apparatus individual to the next section to the right of section D.

A train approaching section B from section A will find the right traffic semaphore arms 53 and 68 in vertical position indicating safety. Upon passing into section B, the arms 53 and 68 will both move to their horizontal positions because their sustaining currents will now be short-circuited by the axles extending between the wheels on the rails of section B. This short-circuit between the rails of section B also deprives left traffic semaphore arms 56 and 76 of their sustaining currents, so that they likewise now stand in horizontal position, indicating danger to traffic approaching section B in the left bound direction. The short circuit between the rails of section B still further cuts off the current of 3500 cycle generator 70 and prevents it from sustaining the operation of the left traffic semaphore arm 73, which drops to its horizontal position indicating caution to a train entering section C from section D in the left bound direction. As the train moves through section B and enters section C, the right traffic arms 59 and 78 drop to their horizontal positions. The arms 56, 76 and 53 return to their vertical positions, while the arm 68 remains in its horizontal position because its sustaining current of 1500 cycles is derived from 1500 cycle generator 65, which is connected with the rails of section C, upon which there is now a short circuit. In this manner, as the train passes to the right, it causes the operation of a caution signal at the right end of the block next ahead of that through which the train is passing, and also causes the operation of a caution signal at the left end of the block next behind that through which the train is passing, and also causes a danger signal at both entrances to the block through which the train is passing.

Since the circuits of Fig. 3 are symmetrical, it is deemed unnecessary to trace the operation as the train passes from right to left, the operation in that respect being the same in all respects as just described, excepting for the reversal of directions.

In Fig. 4 is illustrated a modification which accomplishes the same class of signaling as that accomplished by the system of Fig. 2. The system illustrated in this figure is arranged for traffic in one direction, that is, from left to right, the difference between this system and that illustrated in Fig. 2 lying principally in the fact that the primary coil of a receiver transformer, together with a condenser is bridged around a rail joint to provide the tuned bypasses for currents, which in thus flowing between sections, cause the operation of a danger signal for that section. In accordance with this figure, two complete sections B and C are illustrated, together with a partial section A at the left of section B and a partial section D at the right of section C. The semaphore pole *b* carries the arms for affording indications of safety, danger and caution for section B. The semaphore pole *c* carries the arms for affording similar indications at the entrance of section C, and the semaphore pole *d* carries arms for a similar indication at the entrance of section D.

The 1500 cycle generator 83 sends its current onto the rails of section C where it is blocked from section D by the 2000 cycle tuned bypass 84 and the 2000 cycle tuned transformer primary 85. The currents then traverse and pass into section B, through the 1500 cycle bypass 86 and the 1500 cycle transformer primary 87 along the rails of section B to the 1500 cycle receiver 88 controlling caution semaphore arm 89 on pole *b*. This current having passed through the primary 87 of 1500 cycle receiver 90, also maintains the vertical position of danger semaphore arm 91 on pole *c*.

Current from 2000 cycle generator 92 passes onto the rails of section B, is blocked from the rails of section C by the tuned current paths including bypass 86 and transformer primary 87, passes along the rails of section B, through the tuned bypass 93 between sections A and B, and through the tuned transformer primary 94, into the rails of section A, at the left end of which this current passes through a receiver tuned to 2000 cycles. The current in this path operates 2000 cycle receiver 95 and maintains the vertical position of danger semaphore 96 on pole *b*.

By analogous circuits, caution semaphore arm 97 is normally maintained in its vertical position by means of a 2000 cycle generator (not shown) located at the right end of section D. Danger semaphore arm 98 is normally maintained in vertical position by a 1500 cycle generator located at the right end of the section next to the right of section D, while caution semaphore arm 99 is normally maintained in its vertical position by a 2000 cycle generator (not shown) located at the right end of section D, this being the same generator as that which normally maintains the vertical position of semaphore arm 97.

In the operation of the system shown in Fig. 4, a train approaching section B from section A will find the arms 96 and 89 in vertical position indicating safety. Upon rolling into section B and short-circuiting

the rails of that section, the arms 96 and 89 will drop to their horizontal positions because the sustaining currents will have been short-circuited away from receivers 88 and 95. The current through receiver 90, however, although somewhat increased in strength by the short-circuiting of receiver 88, will nevertheless continue to sustain the vertical position of the danger signal 91 at the entrance of section C. When the train passes out of section B into section C, danger semaphore arm 96 of pole *b* will return to its vertical position, because the 2000 cycle currents from generator 92 are no longer short-circuited and can now pass through the transformer coil 94 to sustain the operation of the signal arm 96. Upon the passage of the train into section C, its arms 91 and 97 will immediately drop to their horizontal positions for the same reasons as heretofore described in connection with section B. As the train passes on to the right, analogous circuits will be successively short-circuited so that danger and caution signals will be successively given as the train passes from one section to another.

In Fig. 5 is illustrated a modification of the system illustrated in Fig. 3, but so arranged as to accomplish the same kind of signaling as is accomplished in Fig. 3. The system of Fig. 5 is arranged for traffic in two directions with means for giving safety, danger and caution signals to trains traveling in each direction. In this figure, block sections B and C are illustrated in full, while partial block section A is shown at the left of section B, and partial block section D is shown at the right of section C. Between sections A and B is the semaphore pole *ab* having four semaphore arms, the two on the left serving as signals for traffic to the left, and the two on the right serving as signals for traffic to the right. Pole *bc* is generally equipped with semaphore arms for indicating the conditions of sections B and C, while the pole *cd* is generally equipped for indicating the conditions of sections C and D. In the system of this figure, the 1500 cycle generator 101 sends current onto the rails of section C, which currents are blocked from section D by bypasses 102 and 103 tuned to 2000 and 4000 cycles, respectively, and by transformer primary circuits 104 and 105 tuned to 4000 cycles and 2000 cycles, respectively. These currents then pass along the rails of section C, through the 1500 cycle bypass 106 and through the tuned transformer primary 107 to the rails of section B, thence along the rails of section B until they are stopped by the 2000 and 4000 cycle bypasses 108 and 109, and by the 2000 and 4000 cycle tuned transformer primaries 110 and 111, which prevent the 1500 cycle currents from passing into rail section A. These currents, however, pass into the transformer of 1500 cycle receiver 112, thus normally sustaining the vertical position of right traffic caution semaphore arm 113. The currents, as just described, pass through the winding of tuned 1500 cycle transformer 107 and thus sustain the operation of right traffic danger semaphore arm 114. In a similar manner, the current from 3500 cycle generator 115 passes onto the rails of section B, is blocked from section A by the 2000 and 4000 cycle bypasses 108 and 109 and transformer primaries 110 and 111, passes into rail section C, through the 3500 cycle bypasses 116, and the 3500 cycle transformer primary 117, then passes along the rails of section C, sustaining the operation of 3500 cycle receiver 118, which controls left traffic caution semaphore arm 119, these currents of 3500 frequency being blocked away from section D by the tuned bypasses 102 and 103 of 2000 and 4000 frequencies, respectively, and by the tuned transformer primaries 104 and 105 of 4000 and 2000 frequencies, respectively. The path of the currents just described, having included the circuit of 3500 cycle tuned transformer 117, sustains the operation of receiver 120 and maintains the left traffic danger semaphore arm 121 in its vertical position. By analogous circuits the right traffic semaphore arm 124 is controlled by the 2000 cycle receiver 126 and by 2000 cycle generator 133. Semaphore arm 125 is controlled by 2000 cycle receiver 127 and by a 2000 cycle generator (not shown) located at the right hand end of block D. Left traffic semaphore arm 129 is controlled by 4000 cycle receiver 131 and by a 4000 cycle generator (not shown) located at the left end of block A. Semaphore arm 130 is controlled by 4000 cycle receiver 132 and by a 4000 cycle generator 134 located at the left end of block C.

It is believed to be unnecessary to further trace the circuits of generators and receivers illustrated on this drawing, since they are all analogous to circuits heretofore traced and described.

In the operation of the system illustrated in Fig. 5, a train approaching section B from section A finds right traffic semaphore arms 113 and 124 in vertical position, indicating safety. Upon passing into section B a short circuit is created between the rails of this section, thus depriving 1500 cycle receiver 112 of sustaining current and causing semaphore arm 113 to move to its horizontal position. At the same time, 2000 cycle generator 133 is short circuited, thus depriving 2000 cycle receiver 126 of sustaining current and causing semaphore arm 124 to move to its horizontal position. Likewise the short circuit between the rails of section B causes left traffic semaphore arms 121 and 129 to assume horizontal positions because 3500

cycle generator 115 is now short-circuited and cannot, therefore, furnish current to sustain the operation of 3500 cycle receiver 120 and the arm 129 because 4000 cycle receiver 131 is now short circuited. The short circuiting of the rails of section B also deprives the 3500 cycle receiver 118 of its sustaining currents and, therefore, causes the left traffic caution semaphore arm 119 to assume its horizontal position. As the train passes out of section B into section C, semaphore arms 114 and 125 assume their horizontal positions for the same reasons as previously described with respect to the arms 124 and 113. When the short circuit is removed from the rails of section B, however, the arm 124 resumes its vertical position because 2000 cycle generator 133 is no longer short-circuited and its currents are again free to pass through the 2000 cycle receiver 126 for sustaining the operation of this arm. The right traffic caution arm 113, however, remains in its horizontal position because the circuit of 1500 cycle generator 101, which creates the current for the operation of 1500 cycle receiver 112, is now short circuited by the wheels which rest in section C. As the train passes onto the right from one section to another, the rails of various sections are successively short circuited, so that successive signals similar to those just decribed are given at the entrance of various blocks. It is believed to be unnecessary to describe the operation of the signals for traffic in the direction from right to left, since that will merely be the reverse of those heretofore described in connection with traffic from left to right.

It is to be understood that the various bypasses may be tuned in a manner well known in the art, and that the high frequency transformer primary circuits, which have been referred to as being tuned, are variously tuned by variously adjusting the relative capacities and inductances of the condensers and primary coils of the transformers, though these latter circuits may be further adjusted by the inclusion in circuit with them of one or more additional impendances, which may, if desired, be separate from the transformer primary coils, all of which is well known in the art.

Although I have described my invention in connection with the operation of railway signals, certain novel features of the invention are applicable to other classes of signaling to which the invention may be applied without departing from the spirit and scope thereof, and it is to be understood that such further application of the invention is within my contemplation and that, therefore, I do not wish to be unduly limited to the specific uses herein described in detail.

What I claim is:

1. A system of the class described comprising a track divided into blocks, tuned bypasses connecting the rails of one block with the rails of a contiguous block, means for impressing a high frequency current upon the rails of one block which can not traverse the bypasses at the end of the block, signal devices comprising a receiver connected with the rails of said block and responsive to the high frequency current aforesaid, said signal devices indicating safety when said responsive means is detecting said high frequency current, and indicating danger when said high frequency current is short-circuited through the wheels of a car in said block, means for impressing a high frequency current capable of traversing the bypasses aforesaid upon the rails of the contiguous block, and signal devices comprising a receiver connected with the rails of the first block and responsive to high frequency current impressed upon the rails of the contiguous block, said last-mentioned signal devices indicating safety when said last-mentioned receiver is detecting the high frequency current impressed upon the rails of said contiguous block, and indicating caution when said last-mentioned receiver is not detecting such high frequency current.

2. A system of the class described comprising a track divided into blocks, tuned bypasses connecting the rails of contiguous blocks, means for impressing a high frequency current capable of traversing said bypasses upon the rails of one block, and signal devices comprising a high frequency current receiver connected with the rails of the adjacent block, said signal devices indicating caution when said receiver is not detecting said high frequency current, and indicating safety when said receiver is detecting such high frequency current.

3. A system of the class described comprising a track divided into blocks, tuned bypasses connecting the rails of contiguous blocks, means for impressing a high frequency current capable of traversing said bypasses upon the rails of one block, and signal devices comprising a high frequency current receiver connected with the rails of the adjacent block, said signal devices indicating caution when said receiver is not detecting said high frequency current, and indicating safety when said receiver is detecting such high frequency current, means for impressing upon each block a high frequency current which can not traverse the bypasses aforesaid, and signal devices each comprising a receiver connected with the rails of one of said blocks and responsive to the high frequency currents which are not capable of traversing said bypasses.

4. A system of the class described comprising a track divided into blocks, bypasses connecting the rails of contiguous blocks, each of said bypasses being tuned to permit

the passage of a current of a definite frequency, and to prevent the passage of currents of different frequencies, means for impressing upon the rails of each block a high frequency current which is incapable of traversing the bypasses at the block ends, together with two sets of signaling devices at the entrance to each block, one set of signaling devices comprising a tuned receiver connected with the rails of said block and responsive to the high frequency current impressed upon the rails of said block, the other set of signaling devices comprising a tuned receiver connected with the rails of said block and responsive to the high frequency current impressed upon the block in advance of its associated block.

5. A system of the class described comprising a track divided into blocks, bypasses connecting the rails of contiguous blocks, said bypasses tuned to permit the passage of currents of certain frequencies and to prevent the passage of currents of different frequencies, means for impressing upon the rails of each block two high frequency currents of different frequency, neither of which is capable of traversing the bypasses at the block ends, means for impressing upon each block high frequency currents of different frequency which are capable of traversing the bypasses at the block ends, together with signal devices at the block ends comprising tuned receivers, each responsive to a high frequency current of definite frequency.

6. In a system of railway signaling, a track divided into blocks, a danger signal and a caution signal at the entrance into each block, each signal controlled by a receiver tuned to respond to a high frequency current of a certain frequency, bypasses connecting the rails of contiguous blocks, each bypass tuned to permit a current of a certain frequency to traverse the same, means for impressing upon each block a high frequency current capable of being detected by the receiver associated with the danger signal at the entrance to said block, and means for impressing upon the rails of each block a high frequency current capable of being detected by the receiver associated with the caution signal at the entrance to an adjacent block.

7. In combination with two adjacent blocks of a railway, a danger signal and a caution signal at the entrance to one of said blocks, tuned bypasses connecting the rails of said blocks, tuned receivers controlling said signals, each receiver connected with the rails of the block with which the signals are associated, means for impressing upon the rails of the block with which said signals are associated a high frequency current incapable of traversing said bypasses, but capable of detection by the receiver controlling the danger signal, and means for impressing upon the rails of the other block a high frequency current capable of traversing said bypasses and capable of being detected by the receiver controlling the caution signal.

8. In combination with two adjacent blocks of a railway, a danger signal and a caution signal at the entrance to one of said blocks, tuned bypasses connecting the rails of said blocks, tuned receivers controlling said signals, each receiver connected with the rails of the block with which the signals are associated, means for impressing upon the rails of the block with which said signals are associated a high frequency current incapable of traversing said bypasses, but capable of detection by the receiver controlling the danger signal, and means for impressing upon the rails of the other block a high frequency current capable of traversing said bypasses and capable of being detected by the receiver controlling the caution signal, said receivers being adapted to cause their respective signals to indicate safety when the receivers are detecting the high frequency currents which they are tuned to detect, and to indicate danger or caution, as the case may be, when the detectors fail to detect the currents which they are tuned to detect.

In witness whereof I hereunto subscribe my name this 1st day of April, 1920.

JOHN A. MILLER.

Witnesses:

EDNA V. GUSTAFSON,

JULIA V. IVES.