No. 869,552. PATENTED OCT. 29, 1907.

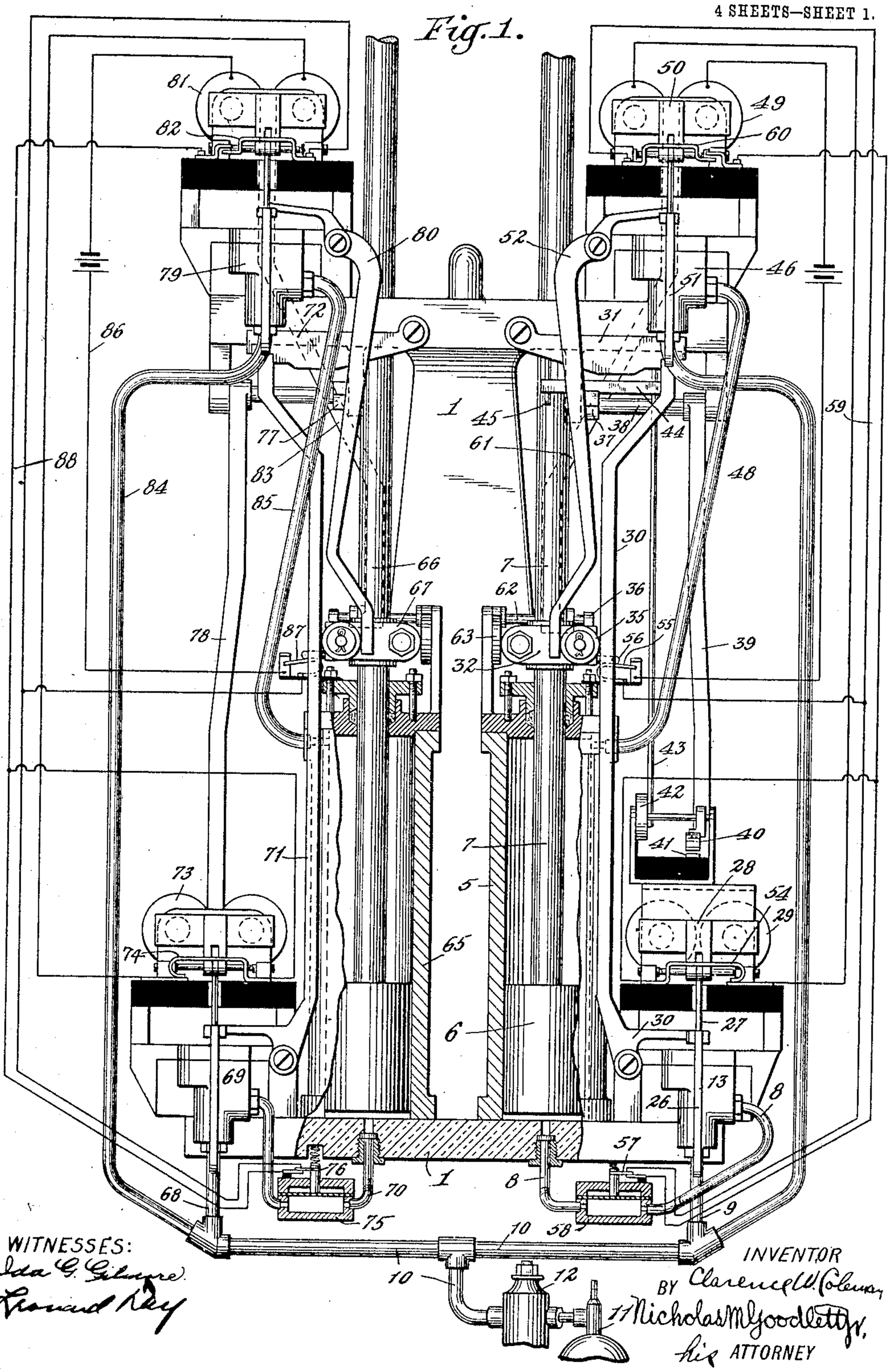
C. W. COLEMAN.

SIGNAL APPARATUS.

APPLICATION FILED FEB. 4, 1907.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 2.

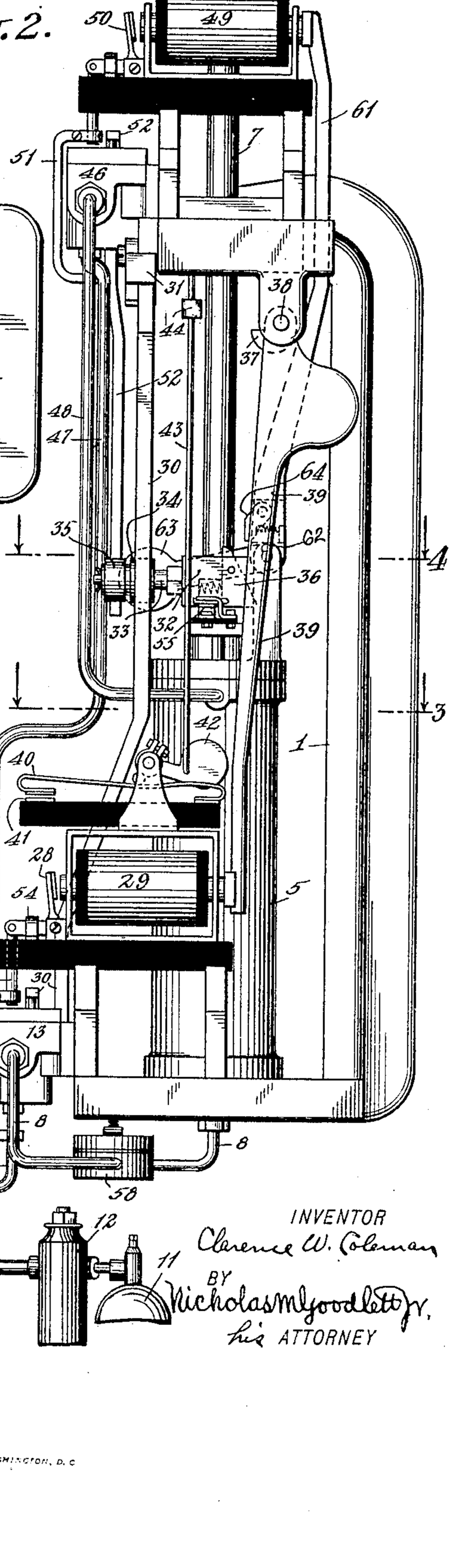


Fig. 4.

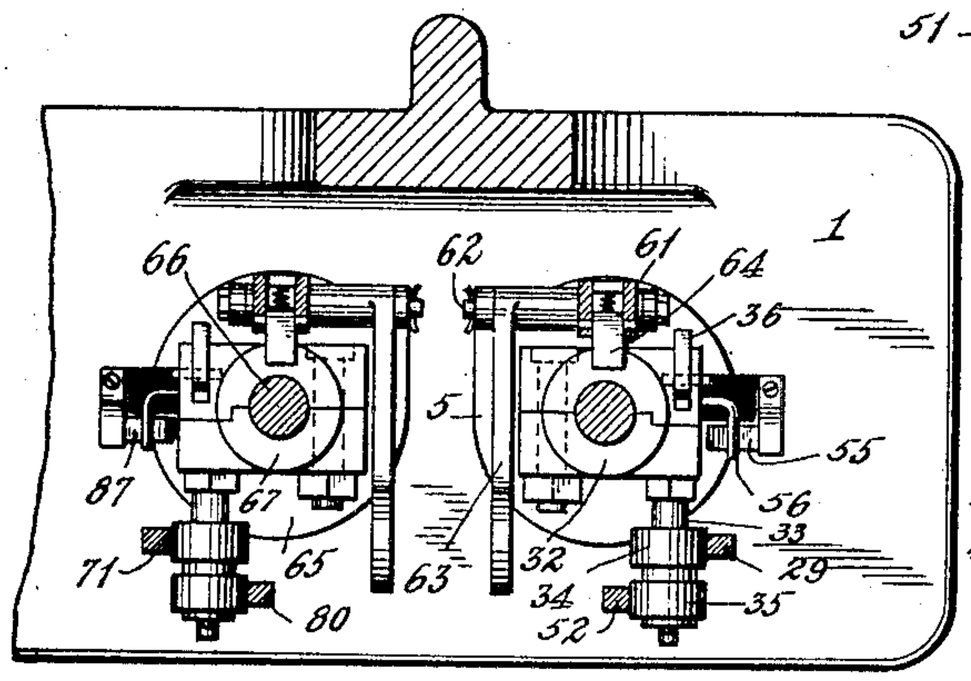
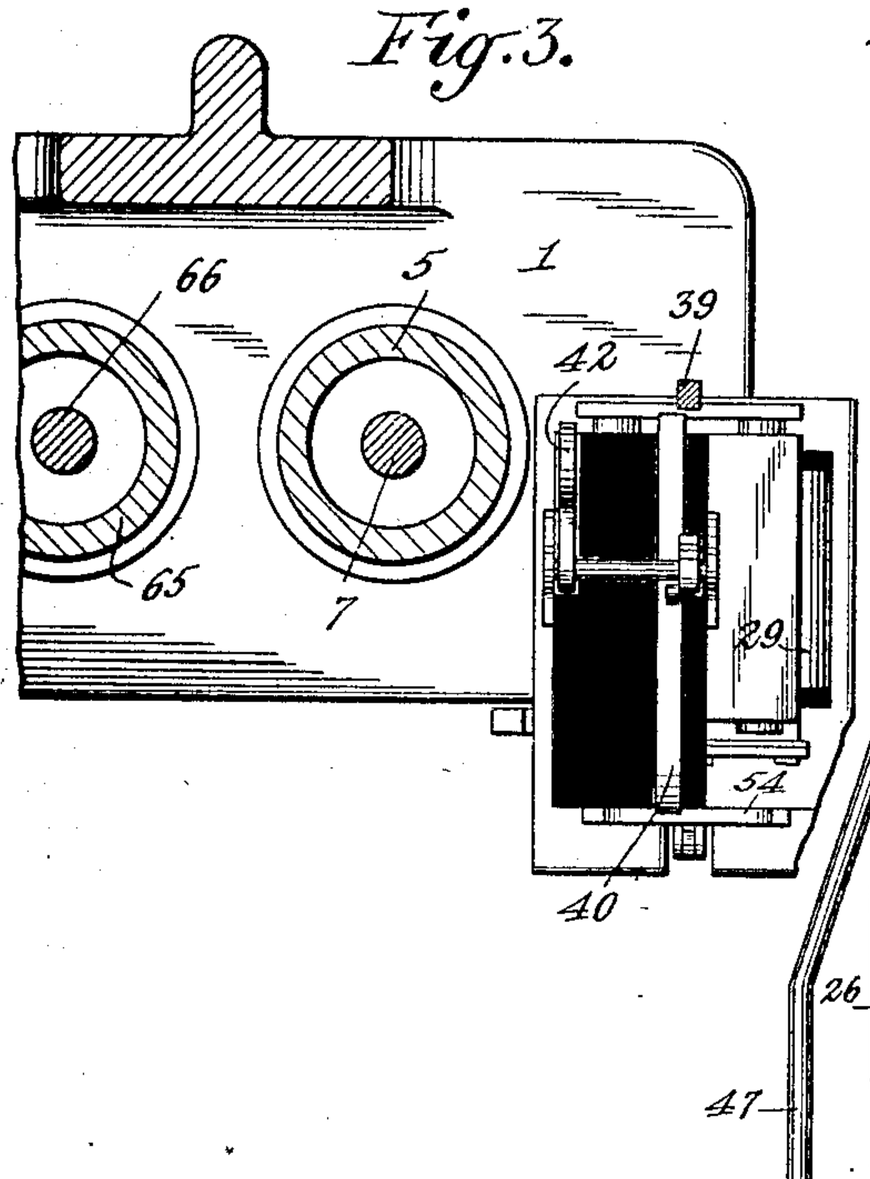


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 5.

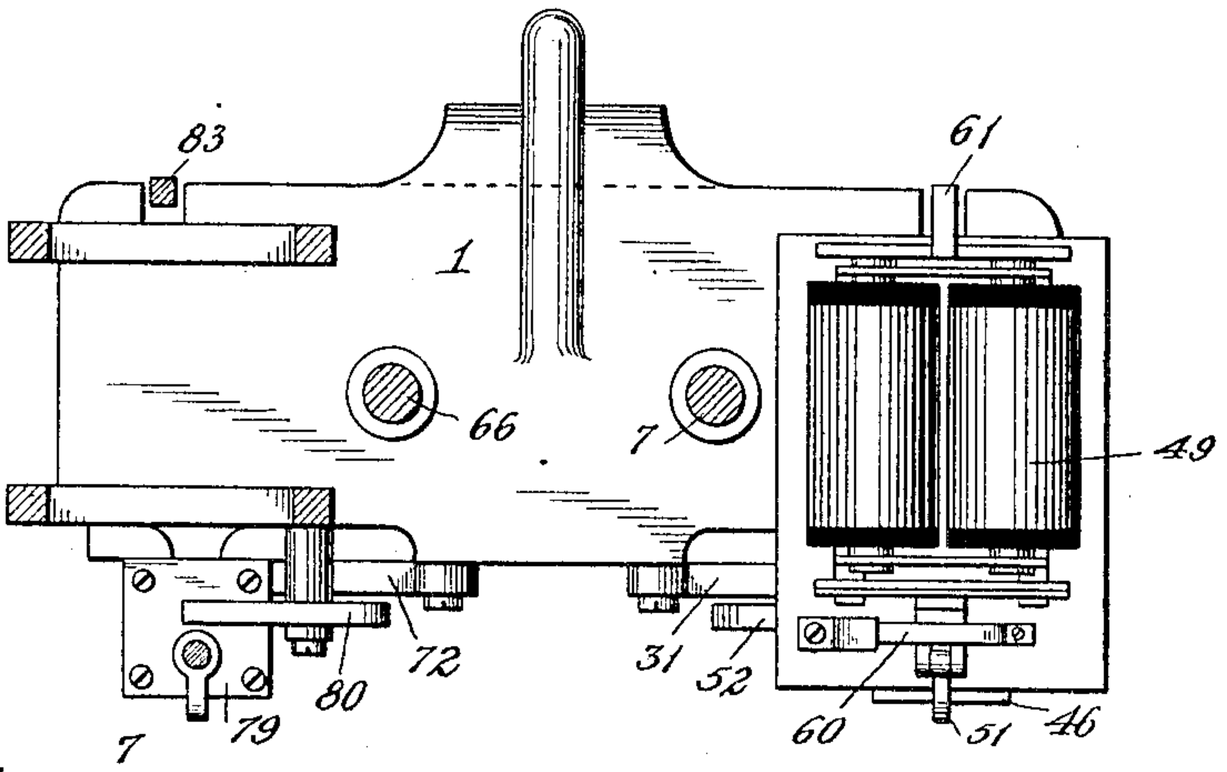


Fig. 6.

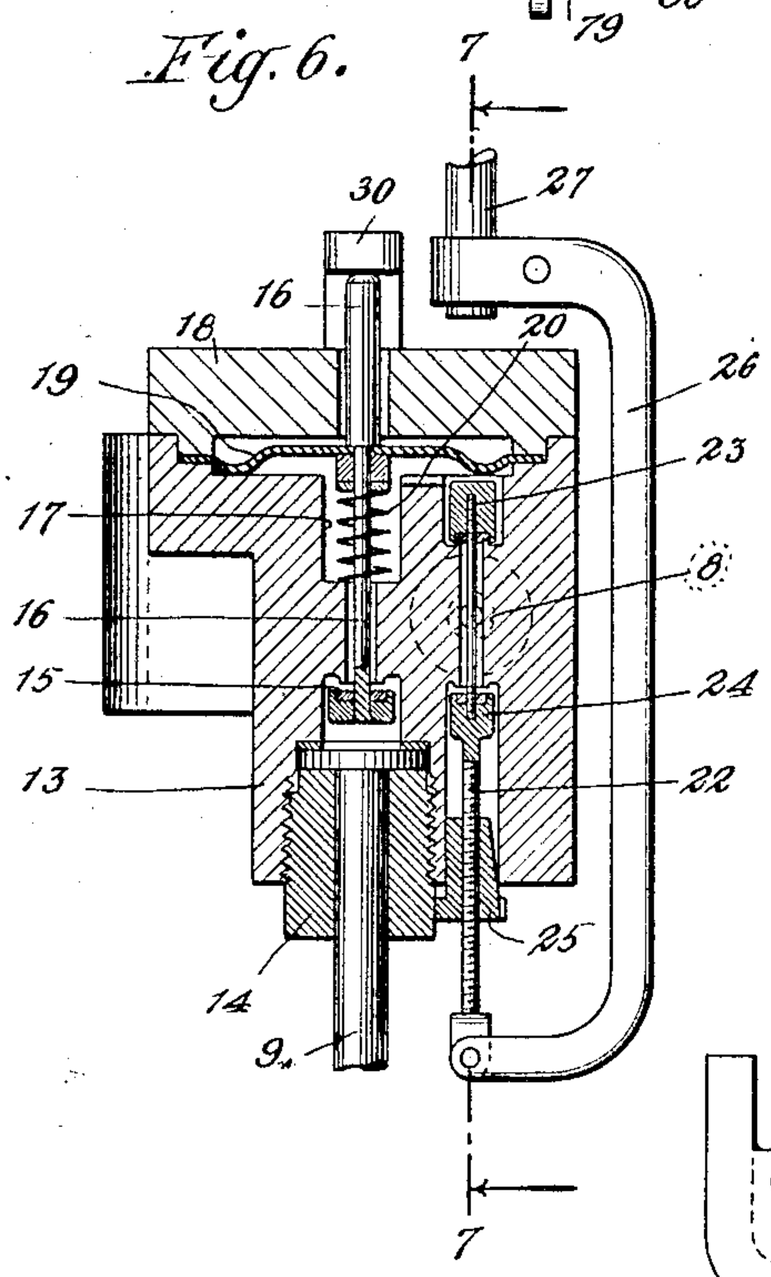


Fig. 7

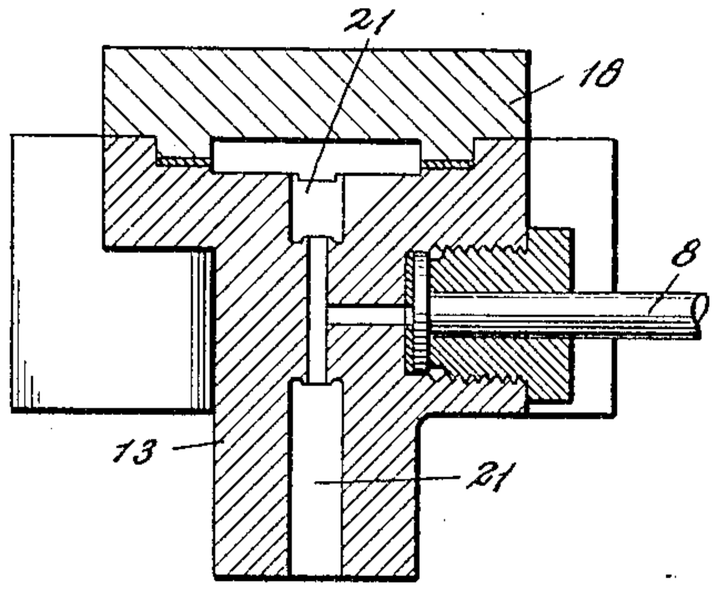
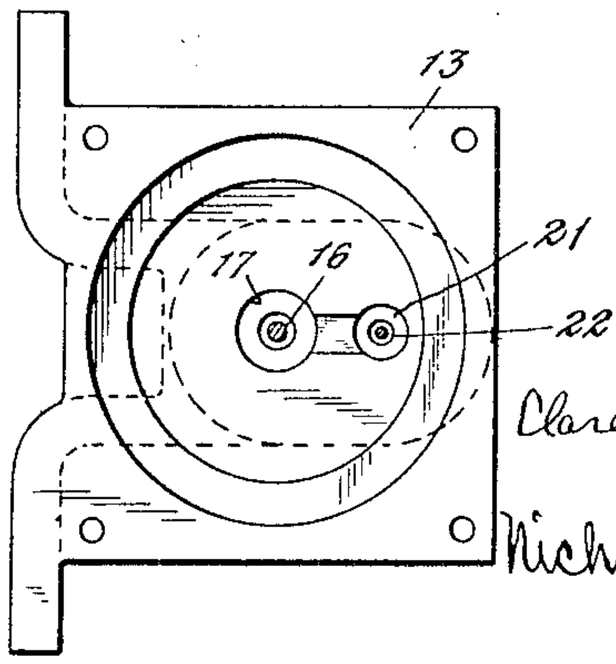


Fig. 8.



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4 SHEETS—SHEET 4.

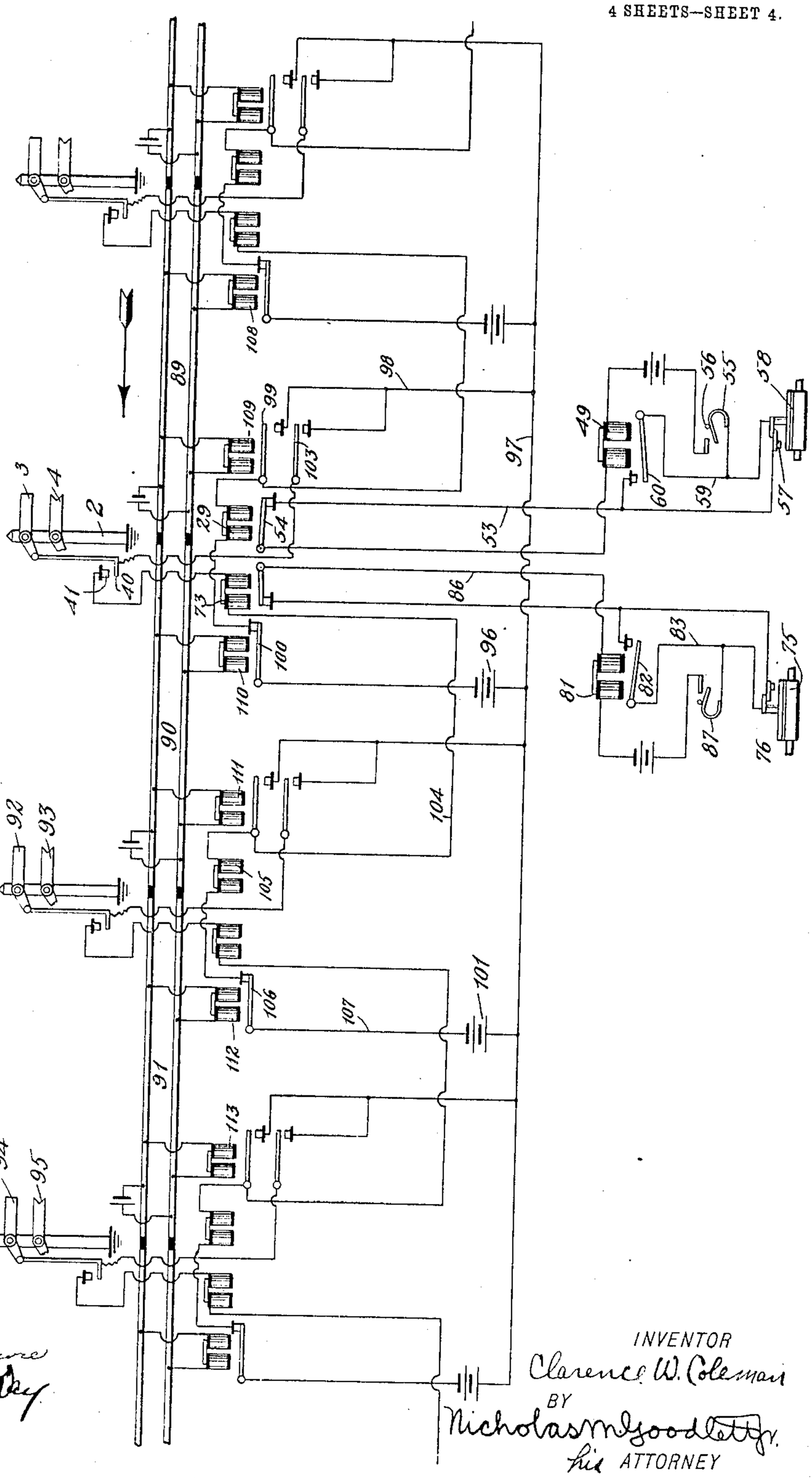

Fig. 9.

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UNITED STATES PATENT OFFICE.

CLARENCE W. COLEMAN, OF WESTFIELD, NEW JERSEY, ASSIGNOR TO THE HALL SIGNAL COMPANY, A CORPORATION OF MAINE.

SIGNAL APPARATUS.

No. 869,552. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed February 4, 1907. Serial No. 355,772.

To all whom it may concern:

Be it known that I, CLARENCE W. COLEMAN, a citizen of the United States, and a resident of Westfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Signal Apparatus and Systems, of which the following is a specification.

This invention relates to railway signal apparatus and systems.

The invention proposes to utilize fluid-pressure for operating the signal, and in the best form of the apparatus it is proposed to utilize liquefied gas stored in a local reservoir in proximity to the signal which liquefied gas, when released, assumes the gaseous form for performing the required work. Examples of such liquefied gas are liquefied carbonic-acid gas and liquefied ammonia gas. The invention, moreover, proposes to utilize fluid-pressure for moving the signal to both danger and safety positions.

In the preferred embodiment of the invention, and as hereinafter set forth, the signals are arranged to stand normally at danger, home and distant signals being carried on the same post, and the signals having a normal bias to danger position. Fluid-pressure is employed to move the signal from danger to safety position, and under ordinary circumstances the normal bias of a signal moves it back to danger position. If, however, anything intervenes to prevent the signal from thus returning to danger position, such for example as accumulations of snow, or ice, on the signal blade, then the fluid-pressure acts to move the signal by positive pressure to danger. The signal is provided with a retaining device which operates to hold the signal in safety position until the signal is released. The signal is also provided with a retaining device to hold the signal in danger position. In the present embodiment of the invention, this last mentioned retaining device only comes into effective use in case the signal has a casual bias to safety position, such as might occur from accumulations of snow and ice on the signal blade of such weight as would over-balance the normal bias of the signal to danger.

Certain features of the invention may be embodied in an apparatus wherein the signal does not have a normal bias to danger. And in some cases, fluid-pressure or gas-pressure may be employed to regularly move the signal to both safety and danger positions.

Furthermore, certain features of this invention are applicable to any train controlling device such as a switch as well as a signal etc.

The invention consists of the various features and combinations of features hereinafter set forth and pointed out in the claims.

In the accompanying drawings forming part of this specification, and in which like numerals designate corresponding parts, Figure 1 is a front elevation partly in section of signal apparatus embodying the invention in its preferred form; Fig. 2 is a side elevation of the same; Figs. 3 and 4 are sectional plan views taken on the lines 3—3 and 4—4, respectively, of Fig. 2; Fig. 5 is a sectional plan view on the lines 5—5 of Fig. 2, with one of the retaining-device magnets and other parts omitted; Fig. 6 is a vertical sectional elevation of one of the valve systems employed to control the flow of fluid; Fig. 7 is a sectional elevation on the lines 7—7 of Fig. 6, the supply and exhaust valves being removed; Fig. 8 is a top plan view of Fig. 6 with top plate and other parts removed; and Fig. 9 is a diagram of a system employing the signals shown in Figs. 1 to 8, inclusive.

Referring now in detail to the particular embodiment of the invention shown in the drawings, 1 is a frame substantially U-shaped, and secured to a signal post 2, and to which are connected the operating parts of the fluid-pressure motors for the home and distant signals 3 and 4.

In the accompanying drawings, duplicate motors are shown having the same construction and arrangement, one being employed for the home signal and one for the distant signal. In each of these motors a fluid-pressure applying chamber is employed which, as shown in the drawings, may be in the form of a piston chamber and piston.

5 is a piston chamber for the home signal 3 within which works the piston 6 carrying the piston rod 7. The piston chamber is supplied with gas through pipes 8, 9 and 10, leading from the tank 11 for liquefied gas. 12 is an automatic reducing valve associated with this tank.

13 is a valve chamber connected with pipes 8 and 9, and containing the valves which control the supply and exhaust of gas or other fluid to the piston chamber. This valve chamber and its valves are more particularly shown in Figs. 6, 7 and 8. The pipe 9 is connected with the valve chamber by a screw plug 14.

15 is a cut-off valve carried on a stem 16 which works in the passage 17 and projects upward through the cap 18 of the valve chamber. The valve stem 16 carries a diaphragm 19 to prevent the escape of gas. This diaphragm is held in place at its outer margin by the cap 18. The valve stem 16 is provided with a spring 20 which operates to close the cut-off valve 15 when the normal pressure on this spring is released. Connecting with the passage 17 and beneath the diaphragm 19 is a passage 21 in which works a stem 22 carrying a supply valve 23 and an exhaust valve 24. The valve stem 22 also carries an adjustable plug 25 provided with an inclined channel whereby the exhaust opening may be regulated. The pipe 8 is secured to the valve chamber 13 and so as to communicate with the passage 21

between the valves 23 and 24. A yoke 26 is secured at one end to the valve stem 22 and at its other end is secured to a rod 27 connected to a bell crank lever 28 carrying an armature operated by the magnet 29.

30 is a bell crank lever pivoted on a suitable support and having a short arm designed to bear against the valve stem 16 to open the cut-off valve 15. The cut-off valve is normally held open by the lever 30, this lever being held in position to open the valve 15 by a pivoted dog 31 which engages the upper end of the lever. When the lever 30 is released its weight and the spring 20 swing the upper end of the lever to one side thus freeing the cut-off valve.

Secured to the piston rod 7 is an adjustable block 32 having a stud 33 which carries rollers 34 and 35. The block 32 carries a spring dog 36 which, when the piston rises to put the signal to safety against its normal bias, is arranged to engage a retaining device to hold the signal against return movement. In the present embodiment this retaining device is shown in the form of a latch 37 carried on the rockshaft 38 to which is also fixed a controlling arm 39 provided with an armature controlled by the magnet 29, the arrangement being such that when the magnet is energized the arm 39 will be held firmly to the magnet so that the latch 37 may be held in position to engage the spring dog 36 and thereby hold the signal against return movement. When the piston rod rises the block 32 lifts the dog 31 from engagement with the lever 30 which, being thereby released, permits the cut-off valve 15 to close. The lever 30 is formed with an offset at its upper end to permit proper movement of the lever when released. When the piston rod descends the roller 34 works against the lever 30 so that it may again open the cut-off valve 15 and be engaged by the dog 31. The arm 39 is so balanced as to hold its armature against the magnet 29.

From the above description it will be seen that when the magnet 29 is energized the supply valve is opened and the exhaust valve is closed, whereupon the piston rod 7 rises to put the signal to safety. When the piston rod has about reached the limit of its upward movement the block 32 lifts the dog 31 out of engagement with the lever 30 which thereupon permits the cut-off valve 15 to close. At the same time, the spring dog 36 snaps into engagement with the latch 37. The latch 37 holds the piston rod in elevated position with the signal at safety because, when the magnet 29 was energized, the arm 39 was held fast against the magnet. When magnet 29 is deënergized the pressure of spring-dog 36 upon latch 37 moves the latch back out of the way so that the piston may descend, arm 39 swinging back on its pivot 38.

40 is a circuit closer working against a contact 41 and operated by a weighted lever 42 which is controlled by a rod 43. This rod is secured to a bar 44 adapted to work up and down on a pin 45 projecting from the upper part of the frame 1. When the block 32 rises it lifts the bar 44 thereby closing the contacts 40 and 41. These contacts control the movement of the distant signal to safety and by means of these contacts the movement of the distant signal to safety is prevented until after the home signal has gone to safety. This will more fully appear in connection with the circuits hereinafter described.

In the best embodiment of the invention, and as herein shown, the signals are arranged so as to have a normal bias to danger position so that when a signal is released it will of itself return to danger unless already in such position. It may happen, however, for various reasons that this normal bias to danger will be overcome on certain occasions by some extraneous cause so that the signal may fail to return to danger when released. For example, snow and ice accumulating on an exposed signal blade may overcome the normal bias of the signal to danger, and may thus give the signal a casual bias to safety. Under such circumstances, a signal would remain at safety when it should go to danger.

The present invention proposes to prevent errors of this kind by providing for the application of power to move the signal to danger when its normal bias fails to accomplish this result. The features whereby this is accomplished are of course applicable to signals which do not have a normal bias to danger.

In the present embodiment of the invention the power applying devices which are employed to move the signal to danger are quite similar to those employed to move the signal to safety.

46 is a valve chamber containing valves for controlling the flow of gas to the piston chamber 5 to move the signal to danger. Gas or other fluid-pressure enters the valve chamber 46 through a pipe 47 which communicates with the pipe 10. The pipe 48 conducts the gas from the valve chamber 46 to the piston chamber 5 on the upper side of the piston. The valve chamber 46 is in all respects similar to the valve chamber 13 shown in Figs. 6, 7 and 8, and contains a cut-off valve, a supply valve, and an exhaust valve, of the same construction and arrangement as the valves in the valve chamber 13. The cut-off valve in valve chamber 46, however, is normally closed instead of being normally open.

49 is a magnet whose armature is carried on a bell crank lever 50 which is connected with and operates the yoke 51 to actuate the supply and exhaust valves in valve chamber 46. The cut-off valve in valve chamber 46 is operated by a bell crank lever 52 provided with an offset at its lower end and similar to lever 30. When the signal is at danger, with the motor, parts in corresponding position, as shown in Fig. 1, the lower end of lever 52 is in its extreme position to the right, thus causing the cut-off valve to be closed. The magnet 49 is in a local circuit 53, and is thereby so controlled as to be energized to admit gas to the piston chamber only when the signal fails to return to danger by reason of its normal bias to that position and is prevented from being energized provided the signal properly returns to danger, thus preventing a needless expenditure of power. The circuit 53 contains a normally closed circuit controller 54 operated by the magnet 29. This circuit 53 also contains a circuit controller 55 arranged to be held in normally open position by an arm 56 carried by the block 32. When the piston 7 rises to put the signal to safety the block 32 carries with it the arm 56 thereby permitting the circuit controller 55 to close. When the piston descends to put the signal fully to danger the arm 56 opens the circuit controller 55. The circuit 53 also contains a circuit controller 57 operated by a diaphragm in a chamber 58 connected in the pipe 8. When gas is admitted to the piston chamber 5 it passes

through the chamber 58 and lifts the diaphragm therein so as to open the circuit controller 57. When the gas escapes from the piston chamber 5 through the pipe 8 and exhaust valve 24, or when the pressure of the gas has been sufficiently reduced, the circuit controller 57 closes. Thus when the signal at safety is released it will tend to go to danger quite rapidly by the action of its counterweight provided, of course, that the apparatus is operating normally. The piston 6 during this normal movement falls rapidly in the chamber 5 against the air or gas beneath the piston which it must expel through the exhaust vent. While thus expelling this gas or air back pressure is necessarily produced. This back pressure continues until the piston comes to rest and by operating the diaphragm of chamber 58 keeps circuit 53 open at controller 57. Of course, if the signal does not properly return to danger the piston does not fall, there is no back pressure and the controller 57 remains closed completing circuit 53 and energizing magnet 49. Bridged across the circuit 53 is a wire 59 which includes a normally open circuit controller 60 operated by the magnet 49. 61 is a retaining device lever whose purpose is to retain the signal in danger position against a casual bias of the signal to safety. This lever which corresponds in general purposes to the lever 39 is pivoted on a rock-shaft 62 and counter-weighted by an arm 63 so that its armature carried on its upper end rests against the magnet 49. The lever 61 carries a spring dog 64 designed to stand in the path of the block 32 so that when this block has passed beneath the dog 64 to put the signal to danger this dog will prevent the piston from rising, and thereby hold the signal in danger position when the magnet 49 is energized to lock the lever 61. When the piston rod 7 rises to put the signal to safety, magnet 49 being at this time deënergized, block 32 strikes against spring-dog 64 and pushes it back out of the way, lever 61 swinging back on its pivot 62. When the magnet 29 is energized to admit gas to the piston chamber 5 to put the signal to safety, it opens the circuit controller 54. At the same time the circuit controller 57 is opened by gas-pressure in the chamber 58, and the circuit controller 55 is closed by the upward movement of the piston as heretofore explained. As the piston rises, the roller 35 moves along the lever 52, pushing it to the left, and thereby opening the cut-off valve in the valve chamber 46. If, after the signal has been in safety position, it refuses to return to danger position when released, gas is admitted to the piston chamber above the piston to force the signal to danger according to the following operation. In releasing the signal, the magnet 29 is deënergized, thereby closing the circuit controller 54 and also permitting gas to escape from the piston chamber through the exhaust valve 24. When the pressure of the gas has been sufficiently reduced in the chamber 58 by this outflow of gas and is not maintained by the falling of the piston 6 the circuit controller 57 closes, thereby closing the circuit 53 because the circuit controller 55 is at this time closed. This circuit may be traced as follows:—from battery through magnet 49, circuit controller 54, circuit controller 57, circuit controller 55, back to battery. The magnet 49 is thus energized whereupon the supply valve in the valve chamber 46 is opened and the exhaust valve therein is closed. Gas then flows through the pipe 48 to the upper end of the valve chamber and forces the piston down so as to bring the signal to danger. As the block 32 descends it permits the lever 52 to move to the right and the cut-off valve in valve chamber 46 closes. This takes place just before the block 32 reaches its lowest position, and therefore just before the circuit controller 55 is opened. When the magnet 49 was energized it locked the lever 61 against it, so that the block 32 in descending pushed back the dog 64 until the block had passed the dog. When the magnet 49 was energized it also closed the circuit controller 60 in the bridge wire 59.

It will be noted that as the piston 6 descends it might accumulate sufficient pressure of air, or other fluid, beneath it to open the circuit controller 57, and thus break the circuit 53, even when the piston had refused to move down until forced by fluid pressure. It is the purpose of the bridge 59 and circuit controller 60 to keep the circuit 53 closed during the descent of the piston after said circuit 53 has actually been caused to close due to the sticking of the signal, even though the circuit controller 57 might be opened by the descent of the piston as stated. Under some conditions the bridge 59 may be omitted. If omitted, fluid pressure would be applied above the piston when the signal refused to move in response to its counterweight, but not continuously throughout its movement to danger after the signal had once been started by the fluid pressure.

It will be noted that the offset at the lower end of the lever 52 is so arranged with respect to the circuit controller 55 that the lever 52 moves to its extreme right position to close the cut-off valve in the valve chamber 46 when the arm 56 is still a short distance above the circuit controller 55. By this arrangement, if the casual bias of a signal to safety prevents the piston from fully completing its movement after the lever 52 has permitted its cut-off valve to close, then the circuit controller 55 will still remain closed and keep the circuit 53 closed. This of course would keep the magnet 49 energized so that the dog 64 would hold the signal at danger against this casual bias to safety. If, however, the signal did not have this casual bias to safety but was simply unable to respond to its normal bias to danger so as to require to be positively moved by power to danger, then the expansion of gas for the movement of the signal blade would be sufficient to complete the movement of the signal to danger even after the cut-off valve in valve chamber 46 is closed. In this case, the block 32 would descend far enough to open the circuit controller 55, thereby restoring the circuit 53 to normal condition.

In case the descent of the piston rod carries the block 32 below the dog 64 but leaves the circuit controller 55 closed, so that gas is still confined above the piston 6, then when the magnet 29 is energized to put the signal to safety the circuit 53 will at once be opened at circuit controller 54 thereby deënergizing the magnet 49, releasing the block 32 from the dog 64 and opening the exhaust valve in the valve chamber 46.

Inasmuch as the apparatus for the distant signal is a duplicate of that already described for the home signal, it will not be necessary to describe it further than to point out its various parts.

65 is a piston chamber for the distant signal 4 and 66 is the piston rod which carries a block 67 similar in construction and operation to block 32.

68 is a supply pipe leading from the pipe 10 te tho valve chamber 69 which is similar to and contains the same arrangement of valves as the valve chamber 13. It is connected with the piston chamber 65 by the pipe 70.

71 is a lever similar to the lever 30 and which controls the cut-off valve in the valve chamber 69, and which is itself controlled by the dog 72.

73 is a magnet similar in operation and arrangement to the magnet 29 and which operates the supply and exhaust valves in valve chamber 69 and also operates the circuit controller 74 similar to the circuit controller 54.

75 is a diaphragm-chamber which operates the circuit controller 76 similar to the chamber 58 and circuit controller 57.

77 is a latch similar to the latch 37 and is controlled by the arm 78 in conjunction with magnet 73.

79 is a valve chamber similar in construction and arrangement to valve chamber 46, and 80 is the lever which operates the cut-off valve of the valve chamber 79.

81 is the magnet corresponding to the magnet 49 and which operates the supply and cut-off valves of the valve chamber 79, and also the circuit controller 82 similar to the circuit controller 60.

83 is a lever similar to the lever 61 and operates in conjunction with the magnet 81 to hold the signal at danger when required.

84 is a pipe leading from the supply pipe 10 to the valve chamber 79. 85 is a pipe leading from this valve chamber to the upper end of the piston chamber 71.

86 is a circuit similar to the circuit 53 and including the magnet 81, circuit controller 74, circuit controller 76 and also the circuit controller 87, which is similar to the circuit controller 55.

88 is a bridge wire across the circuit 86 and including the circuit controller 82.

If desired, each of the signals may have a separate storage tank for liquefied gas, and a separate reducing valve associated with each tank.

The system shown in Fig. 9 contemplates an arrangement of home and distant signals in blocks, the signals being equipped with an apparatus, such as that shown in Figs. 1 to 8, inclusive. In Fig. 9 the track is shown divided into blocks 89, 90, 91, etc. The home and distant signals 3 and 4 are located at the entrance of the block 90. The home and distant signals 92 and 93 are located at the entrance of the block 91. The home and distant signals 94 and 95 are located at the entrance of the block which follows block 91. The signal circuit for home signal 3 may be traced as follows;—from battery 96 through common return wire 97, wire 98, normally open circuit controller 99, home signal magnet 29 (shown also in Figs. 1 and 2) and normally closed circuit controller 100, back to battery. The signal circuit for the distant signal 4 may be traced from battery 101, wire 97, wire 98, normally open circuit controller 103, circuit controller 40, (shown also in Fig. 1), distant signal magnet 73, wire 104, magnet 105, for the home signal 92, circuit controller 106, and wire 107, back to battery. The track circuit of block 89 includes the track magnets 108 and 109. The track circuit for the block 90 includes the magnets 110 and 111, and the track circuit for the block 91 includes the magnets 112 and 113.

In the operation of the system, a train on block 89 shunts magnet 109, thereby closing the signal circuit for the home signal 3 at the normally open contacts 99. The magnet 29 is thereupon energized and this magnet then opens the supply valve 23 and closes the exhaust valve 24, (see Figs. 2 and 6). The gas, or other fluid-pressure, then enters the piston chamber and puts the signal to safety as heretofore described. The various details of operation consequent upon the movement of the signal to safety have already been described. The upward movement of the piston rod lifts the bar 44 and closes the circuit controller 40. As soon as this occurs, the circuit of the distant signal 4 is completed through the signal magnet 73, the normally open circuit controller 103 having been already closed simultaneously with the closing of contacts 99. The distant signal 4 thereupon goes to safety and also the home signal 92, whose signal magnet 105 is in the same circuit with magnet 73. The apparatus for moving these signals operates in the way already described. When a train enters block 90 it shunts the magnet 110 thereby opening at contacts 100 the signal circuit of home signal 3. The magnet 29 thereupon releases the valves 24 and 25 so that the former is closed and the latter opened, permitting the home signal 2 to return to danger. As the piston rod 7 descends to effect this result the contacts 40 and 41 are opened thereby breaking the circuit through distant signal magnet 73 and permitting the signal 4 to go to danger. The presence of the train in block 90 also deënergizes magnet 111 and operates the circuits in the way already described to put the signals 92 and 93 to safety in advance of the train. As long as the train is in block 90 the circuit controller 100 is open, and as long as the train is in block 91 the circuit controller 106 is open, so that a train approaching signals 3 and 4 cannot put the home signal 2 to safety while a train is in block 90, nor can it put the distant signal 4 to safety while a train is in blocks 90 and 91.

The operation of the circuits 53 and 86 controlled, respectively, by the magnets 29 and 73, has already been described.

While the various features of the invention are shown in what is believed to be the best form and arrangement, it is to be understood that many of the advantages of the invention may be obtained by various changes in the details of structure and arrangement of such features without departing from the scope of the invention. For example, various forms of pressure applying chambers, other than a piston chamber, may be used. Again, if desired, the fluid within the pressure applying chamber may be exhausted or allowed to escape therefrom immediately after the signal has been brought to a position where its return movement is prevented by the retaining device. Furthermore, some features of the invention may be used in connection with a fluid-pressure signal wherein the source of fluid-pressure supply is other than liquefied gas. In such cases, the gas-pressure applying chamber would still be utilized. Again, some features of the inven-

tion may be used to advantage in connection with signals other than those operated by fluid-pressure.

What I claim and desire to secure by Letters Patent is;—

1. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position and normally operating to go to danger by reason of said bias; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; supply and exhaust valves for said chamber; and means for operating said valves whereby fluid-pressure may be supplied to said chamber with approximately equal effective force to move the signal to both safety and danger positions.

2. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply force; supply and exhaust valves for said chamber; means for operating said valves whereby fluid-pressure may be supplied to said chamber to move the signal to both safety and danger positions; and a retaining device to hold the signal at safety.

3. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to safety position; and means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

4. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to safety position; means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at safety.

5. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to safety position; and electrically controlled means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

6. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; train controlled means for supplying fluid-pressure to move the signal to safety position; and means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

7. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; train controlled means for supplying fluid-pressure to move the signal to safety position; electrically controlled means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at safety.

8. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to safety position; a signal circuit for controlling said means; and means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

9. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to safety position; a signal circuit for controlling said means; means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at safety and controlled by said signal circuit.

10. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to safety position; a signal circuit for controlling said means; means for applying fluid-pressure to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at safety and controlled by said signal circuit.

11. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure supply source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves for said chamber; means for operating said valves whereby fluid-pressure may be supplied to said chamber to move the signal to safety; a retaining device to hold the signal at safety; and means for applying fluid-pressure to move the signal to danger, said means being dependent for its operation upon a failure of the signal to return to danger when released.

12. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure supply source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said chamber; supply and exhaust valves for said chamber; means for opening said supply valve whereby fluid-pressure may be supplied to said chamber to move the signal to safety; a retaining device to hold the signal at safety; means for releasing said retaining device and opening said exhaust valve to permit the signal to go to danger; and means for applying fluid-pressure to move the signal to danger, said means being dependent for its operation upon a failure of the signal to return to danger when released.

13. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure supply source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves for said chamber; means for operating said valves whereby fluid-pressure may be supplied to said chamber to move the signal to safety; a retaining device to hold the signal at safety; a signal circuit for operating said valve operating means and said retaining device; and means for applying fluid-pressure to move the signal to danger, said means being dependent for its operation upon a failure of the signal to return to danger when released.

14. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves for said chamber; means for operating said valves whereby fluid-pressure may be supplied to said chamber to move the signal to safety; a retaining device to hold the signal at safety; a track circuit for controlling said valve operating means and said retaining device; and means for applying fluid-pressure to move the signal to danger, said means

being dependent for its operation upon a failure of the signal to return to danger when released.

15. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position and normally operating to go to danger by reason of said bias; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; and means for supplying fluid-pressure to said piston chamber on both sides of said piston whereby the signal may be moved with approximately equal effective force by fluid-pressure to both safety and danger positions.

16. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to said chamber on one side of said piston to move the signal to safety; and means for supplying fluid-pressure to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

17. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to said chamber on one side of said piston to move the signal to safety; means for supplying fluid-pressure to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at safety.

18. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves to control the supply of fluid-pressure to said chamber on one side of said piston to move the signal to safety; supply and exhaust valves to control the supply of fluid-pressure to said chamber on one side of said piston to move the signal to danger; a retaining device to hold the signal at safety; and means for controlling said valves and retaining device.

19. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves to control the supply of fluid-pressure to said chamber on one side of said piston to move the signal to safety; supply and exhaust valves to control the supply of fluid-pressure to said chamber on the other side of said piston to move the signal to danger; a retaining device to hold the signal at safety; means for simultaneously locking the retaining device and opening the supply valve to move the signal to safety; means for simultaneously releasing said retaining device and opening the exhaust valve to permit the signal to return to danger; and means for opening the supply valve to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

20. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves to control the supply of fluid-pressure to said chamber on one side of said piston to move the signal to safety; supply and exhaust valves to control the supply of fluid-pressure to said chamber on the other side of said piston to move the signal to danger; a retaining device to hold the signal at safety; and train controlled means for controlling said valves and retaining device.

21. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves to control the supply of fluid-pressure to said chamber on one side of said piston to move the signal to safety; supply and exhaust valves to control the supply of fluid-pressure to said chamber on the other side of said piston to move the signal to danger; a retaining device to hold the signal at safety; train controlled means for simultaneously locking the retaining device and opening the supply valve to move the signal to safety; means for simultaneously releasing said retaining device and opening the exhaust valve to permit the signal to return to danger; and means for opening the supply valve to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

22. In a fluid-pressure signal apparatus, the combination of a signal; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to both danger and safety positions; and retaining devices to hold the signal in both positions.

23. In a fluid-pressure signal apparatus, the combination of a signal; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with and positively to move said signal and in communication with said supply source; means for applying fluid-pressure to operate the signal; and a retaining device to hold the signal at danger position.

24. In a fluid-pressure signal apparatus, the combination of a signal; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to operate the signal; and a retaining device to hold the signal at danger position, said device being dependent for its operation upon a casual bias of the signal to safety position.

25. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to operate the signal; and a retaining device to hold the signal at danger position, said device being dependent for its operation upon a casual bias of the signal to safety.

26. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure supply source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; supply and exhaust valves for said chamber; means for operating said valves whereby fluid-pressure may be supplied to said chamber to move the signal to safety; a retaining device to hold the signal at safety; means for applying fluid-pressure to move the signal to danger, said means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at danger, said device being dependent for its operation upon a casual bias of the signal to safety.

27. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a gas-pressure applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves for said chamber; and means for operating said valves whereby gas may be supplied to said chamber to move the signal to both safety and danger positions.

28. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a piston and piston chamber in operative connection with said signal and in communication with said tank; and means for supplying gas to said chamber on both sides of said piston whereby the signal may be moved to both danger and safety positions by gas-pressure.

29. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a piston and piston chamber in operative connection with said signal and in communication with said tank; means for supplying gas to said chamber on one side of the piston to move the signal to safety; and means for supplying gas to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released.

30. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a piston and piston chamber in operative connection with said signal and in communication with said tank; means for supplying gas to said chamber on one side of the piston to move the signal to safety; means for supplying gas to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and a retaining device to hold the signal at safety.

31. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a piston and piston chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves to control the supply of gas on one side of said piston to move the signal to safety; supply and exhaust valves to control the supply of gas to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; a retaining device to hold the signal at safety; and means for simultaneously locking said retaining device and opening said supply valve to move the signal to safety.

32. In a gas-pressure signal apparatus, the combination of a signal; a tank for liquefied gas; a gas-pressure applying chamber in operative connection with said signal and in communication with said tank; means for supplying gas to move the signal to both safety and danger positions; and retaining devices to hold the signal in both positions.

33. In a gas-pressure signal apparatus, the combination of a signal; a tank for liquefied gas; a gas-pressure applying chamber in operative connection with said signal and in communication with said tank; means for supplying gas to operate the signal; and a retaining device to hold the signal at danger.

34. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; a gas-pressure applying chamber in operative connection with said signal and in communication with said tank; means for supplying gas to operate the signal; and a retaining device to hold the signal at danger, said device being dependent for its operation upon a casual bias of the signal to safety.

35. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; a piston and piston chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves on one side of said piston to move the signal to safety; supply and exhaust valves on the other side of said piston to move the signal to danger; a retaining device to hold the signal in safety position; means for simultaneously locking said retaining device and opening said supply valve to move the signal to safety; a retaining device to hold the signal at danger; means for simultaneously locking said last mentioned retaining device and opening said supply valve to move the signal to danger, said means being dependent for its operation upon a casual bias of the signal to safety.

36. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; supply and exhaust valves for said chamber; means for operating said valves whereby fluid-pressure may be supplied to said chamber to move the signal to both safety and danger positions; and means for cutting off the fluid-pressure supply upon a predetermined movement of the signal.

37. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with the signal and in communication with said supply source; supply and exhaust valves for said chamber; means for operating said valve whereby fluid-pressure may be supplied to said chamber to move the signal to both safety and danger positions; means for cutting off the fluid-pressure supply upon a predetermined movement of the signal; and a retaining device to hold the signal at safety.

38. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to said piston chamber on both sides of said piston whereby the signal may be moved by fluid-pressure to both safety and danger positions; and means for cutting off the fluid-pressure supply upon a predetermined movement of the signal.

39. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to said chamber on one side of said piston to move the signal to safety; means for supplying fluid-pressure to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; and means for cutting off the fluid-pressure supply upon a predetermined movement of the signal.

40. In a fluid-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a fluid-pressure source; a piston and piston chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to said chamber on one side of said piston to move the signal to safety; means for supplying fluid-pressure to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the signal to return to danger when released; means for cutting off the fluid-pressure supply upon a predetermined movement of the signal; and a retaining device to hold the signal at safety.

41. In a fluid-pressure signal apparatus, the combination of a signal; a fluid-pressure source; a fluid-pressure applying chamber in operative connection with said signal and in communication with said supply source; means for supplying fluid-pressure to move the signal to both danger and safety positions; means for cutting off the fluid-pressure supply upon a predetermined movement of the signal; and retaining devices to hold the signal in both positions.

42. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a gas-pressure applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves for said chamber; means for operating said valves whereby gas may be supplied to said chamber to move the signal to both safety and danger positions; and means for cutting off the fluid-pressure supply upon a predetermined movement of the signal.

43. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; an automatic reducing valve for said tank; a piston and piston chamber in operative connection with said signal and in communication with said tank; means for supplying gas to said chamber on one side of the piston to move the signal to safety; means for supplying gas to said chamber on the other side of said piston to move the signal to danger, said last mentioned means being dependent for its operation upon a failure of the

signal to return to danger when released; and means for cutting off the fluid-pressure supply upon a predetermined movement of the signal.

44. In a gas-pressure signal apparatus, the combination of a signal; a tank for liquefied gas; a gas-pressure applying chamber in operative connection with said signal and in communication with said tank; means for supplying gas to move the signal to both safety and danger positions; means for cutting off the fluid-pressure supply upon a predetermined movement of the signal; and retaining devices to hold the signal in both positions.

45. In a gas-pressure signal apparatus, the combination of a signal having a normal bias to danger position; a tank for liquefied gas; a piston and piston chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves on one side of said piston to move the signal to safety; supply and exhaust valves on the other side of said piston to move the signal to danger; a retaining device to hold the signal in safety position; means for simultaneously locking said retaining device and opening said supply valve to move the signal to safety; a retaining device to hold the signal at danger; means for simultaneously locking said last mentioned retaining device and opening said supply valve to move the signal to danger, said means being dependent for its operation upon a casual bias of the signal to safety; and means for cutting off the fluid-pressure supply upon a predetermined movement of the signal.

46. In combination, a train controlling device capable of assuming a plurality of controlling positions, having a normal bias to a predetermined position and normally operating to go to said predetermined position by reason of said bias; and a fluid-pressure piston motor for said train controlling device operable to force said device to said predetermined position upon the failure of said device normally to operate as described.

47. In a signal apparatus, the combination of a signal capable of assuming a plurality of signaling positions, having a normal bias to a predetermined position and normally operating to go to said predetermined position by reason of said bias; and a fluid-pressure piston motor for said signal operable to force said signal to said predetermined position upon the failure of said signal normally to operate as described.

48. In a signal apparatus, the combination of a signal having a normal bias to danger position and normally operating to go to said danger position by reason of said bias; and a gas-pressure motor for said signal operable to force said signal to danger position upon the failure of said signal normally to operate as described.

49. In combination, a train controlling device capable of assuming a plurality of controlling positions, having a normal bias to a predetermined position and normally operating to go to said predetermined position by reason of said bias; a gas-pressure motor for said train controlling device operable to force said device to said predetermined position upon the failure of said device normally to operate as described; and means for preventing said motor from forcing said device to said predetermined position when said device goes to said position in response to its bias, as described.

50. In a signal apparatus, the combination of a signal capable of assuming a plurality of signaling positions, having a normal bias to a predetermined position and normally operating to go to said predetermined position by reason of said bias; a gas-pressure motor for said signal operable to force said signal to said predetermined position upon the failure of said signal normally to operate as described; and means for preventing said motor from forcing said signal to said predetermined position when said signal goes to said position in response to its bias, as described.

51. In a signal apparatus, the combination of a signal having a normal bias to danger position and normally operating to go to said danger position in response to said bias; and a fluid-pressure piston motor for moving said signal to safety position, said motor also being operable to force said signal to danger position upon the failure of said signal normally to operate, as described.

52. In a signal apparatus, the combination of a signal having a normal bias to danger position and normally operating to go to said danger position in response to said bias; a gas-pressure piston motor for moving said signal to safety position, said motor also being operable to force said signal to danger position upon the failure of said signal normally to operate, as described; and means for preventing said motor from forcing said signal to danger position when said signal goes to said position in response to its bias, as described.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

CLARENCE W. COLEMAN.

Witnesses:
E. G. WHITAKER,
NICHOLAS M. GOODLETT, Jr.