No. 743,975. PATENTED NOV. 10, 1903.

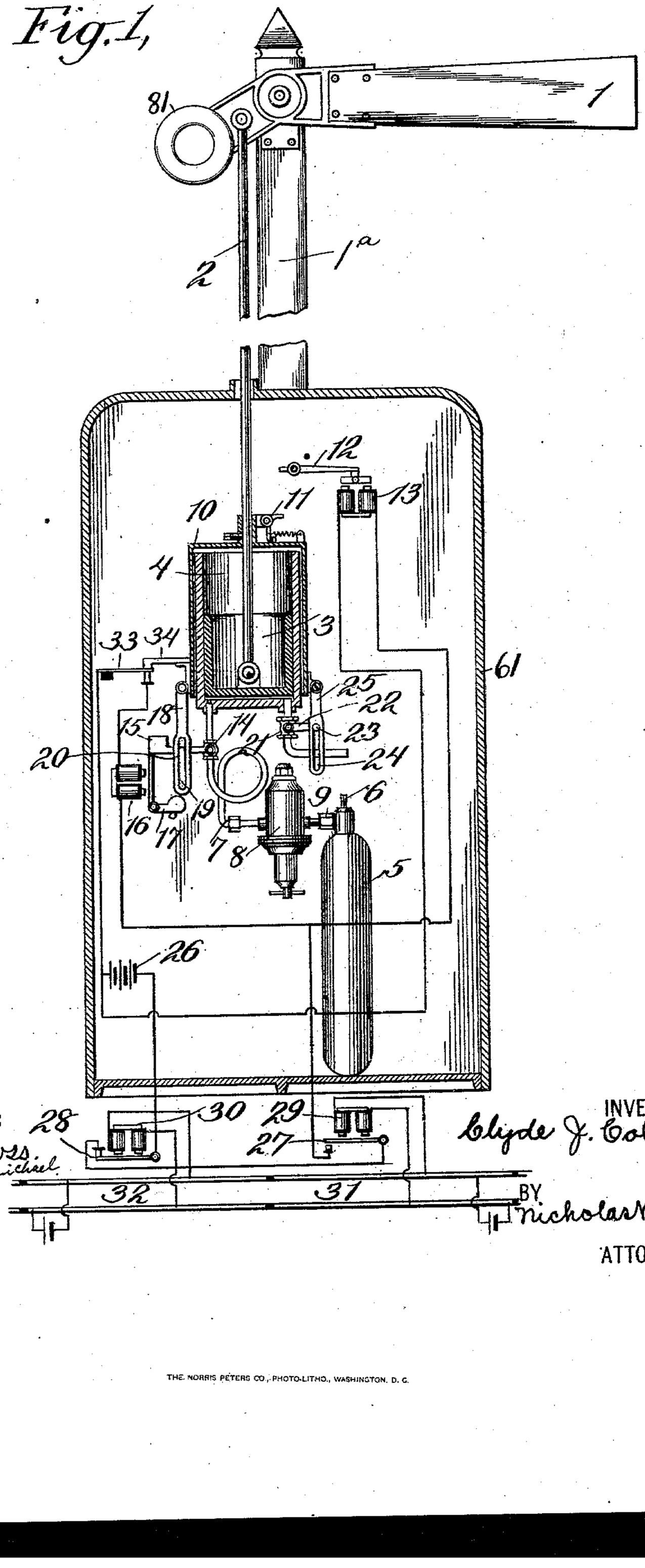
C. J. COLEMAN.

SIGNAL APPARATUS.

APPLICATION FILED JULY 8, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1,



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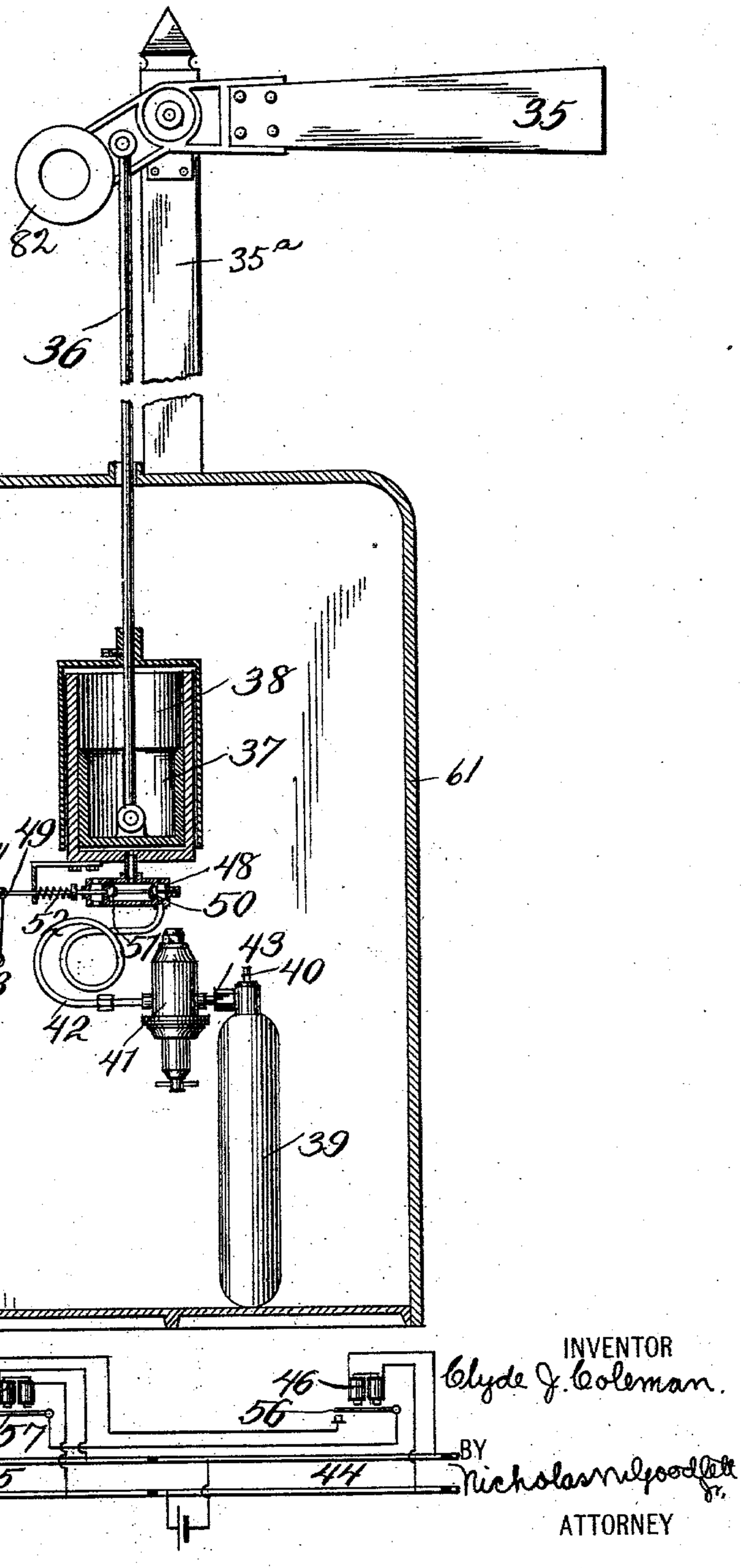
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2



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NO MODEL. 3 SHEETS—SHEET 3.

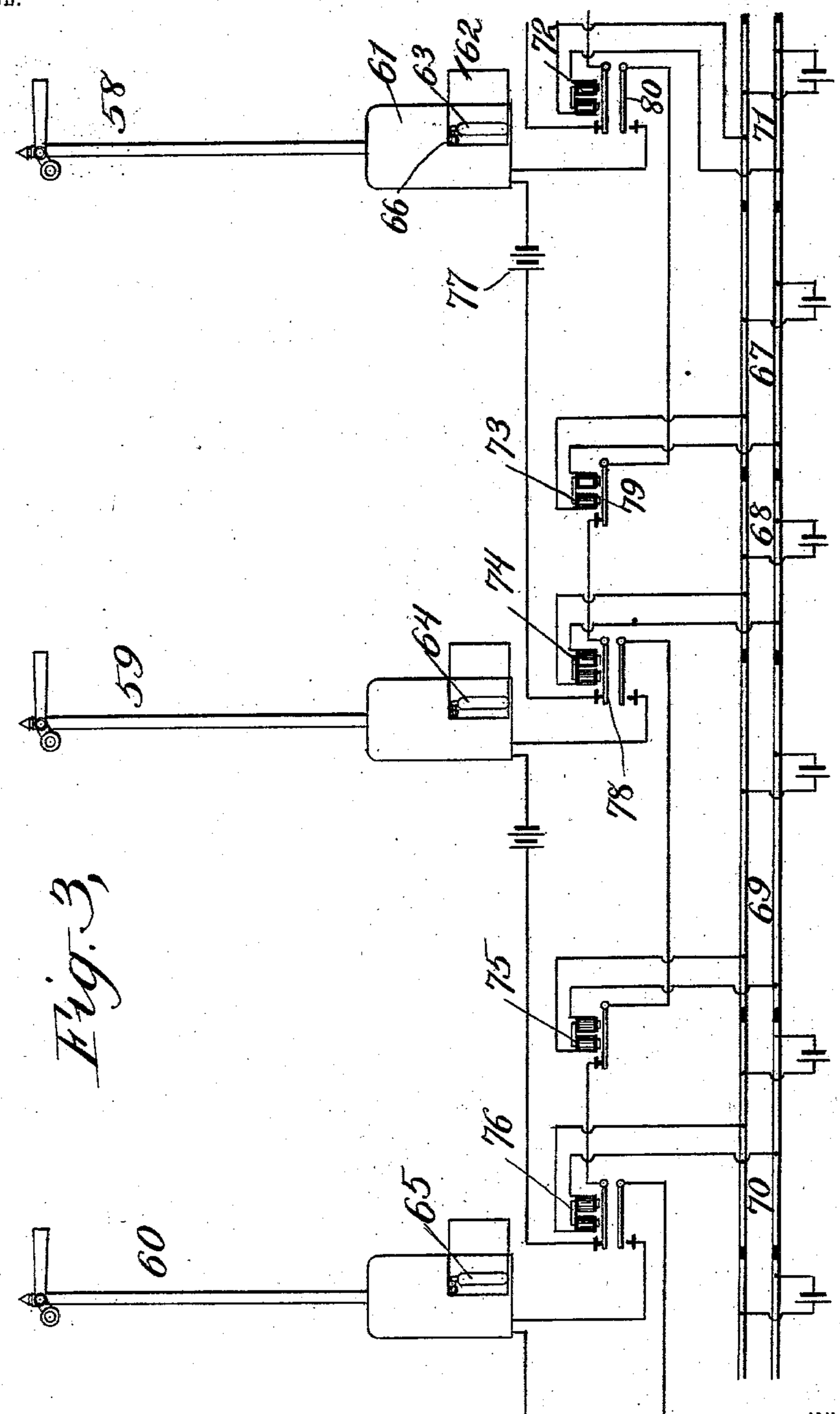

Fig. 3.

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No. 743,975. Patented November 10, 1903.

UNITED STATES PATENT OFFICE.

CLYDE J. COLEMAN, OF NEW YORK, N. Y., ASSIGNOR TO THE HALL SIGNAL COMPANY, A CORPORATION OF MAINE.

SIGNAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 743,975, dated November 10, 1903.

Application filed July 8, 1901. Serial No. 67,530. (No model.)

To all whom it may concern:

Be it known that I, CLYDE J. COLEMAN, a citizen of the United States, and a resident of New York city, in the county and State of New York, have invented certain new and useful Improvements in Signal Apparatus, of which the following is a specification.

This invention relates to signal apparatus and systems and also to such as are adapted for use in connection with railways.

The invention seeks to provide a signal apparatus capable of being operated automatically and one that shall particularly obviate the objections and limitations of the semaphore-signals heretofore in general use on railways. By reason of this invention exposed semaphore-signals requiring considerable energy for their actuation may be operated by means of apparatus of great simplicity in its construction, reliability in its operation, and of greatly-reduced cost.

Prior to my invention the only automatic semaphore-signals for railways that have gone into extended use belong to the class of pneumatic signals or to the class of electric-motor signals. These two classes prior to my invention have represented the highest development of automatic railway semaphore-signals, and they have both gone into wide general use on the railways of the country to the exclusion heretofore of all other forms of automatic semaphores. It is well recognized that both these classes of signals have their own peculiar serious limitations and objections which the persistent efforts of inventors and practical workers in the art have been unable to overcome.

In a pneumatic signaling system the signals are operated by compressed air carried by supply-pipes from a central power-station. At this power-station there is a furnace, a boiler, a steam air-compressor, and other expensive apparatus, all required to maintain the necessary air-pressure in the supply-pipes. This apparatus must be kept in efficient and constant operation day and night in order that the signals may operate when required. The supply-pipes in many cases extend some six or seven miles on each side of the power-station. It is evident that a pneumatic system is very expensive as regards installation, maintenance, operation, and inspection. This cost is so great that a pneumatic system is generally understood in the art to be impractical where the installation calls for less than one hundred signals. A pneumatic system, aside from its great cost, has other serious objections. The compression of the air generates moisture, which collects in the pipes and in winter-time freezes and clogs the pipes, thus often causing the signals to give false indications. Again, the expansion and contraction of these supply-pipes causes leakage at various points, which are frequently difficult to locate. Again, an accident at the power-station is likely to throw out of operation all the many signals which derive power from the station. Again, the percentage of failures to operate and of false operations is relatively high, owing to the system being essentially one in which the working apparatus is easily deranged. The great expense and other objections which inhere in a pneumatic system are due to the method and apparatus necessarily employed to supply and maintain the requisite energy for operating the signals.

Automatic electric semaphores require an expensive and complicated motor for each signal and a local battery to operate each motor. These batteries are subject to deterioration, battery-jars frequently break, battery connections corrode, and other battery troubles arise. Moreover, the contacts in the electric-power circuit are liable to fuse, the commutator is liable to become covered with frost or dirt, and so interfere with the proper operation of the signal. Again, in cold weather a great amount of frost frequently collects upon the gears and other working parts of the motor, sometimes to the depth of half an inch, and nothwithstanding the fact that the parts are entirely housed. This accumulation of frost is due to the fact that the chilled metal parts congeal moisture in the surrounding air. As a result this frost clogs the mechanism and frequently interferes with the proper working of the signal and causes it to give a safety indication when it should give a danger indication. Moreover, it not infre-

quently happens that the frost partly melts and then freezes hard, so that the signal cannot work at all and is liable to indicate "safety" when it should indicate "danger." These difficulties with electric-motor signals are well understood and many efforts have been made and various means employed to overcome them. For example, on one of the leading railroads of this country it is the practice to provide against the frost difficulty by resorting to a constantly-operating fan in proximity to the housed motor during cold weather.

My invention overcomes the objections and limitations of both the pneumatic and electric-motor semaphores. It does away with the expensive power-station and long lines of piping and the troubles incident thereto which characterize the pneumatic signals. It does away with the batteries and complicated motors of the electric-motor signals and the troubles incident thereto. Moreover, it is not subject to interference from a collection of frost. It is far less expensive than either of the other forms of signals in installation, operation, and inspection, and is far more reliable in its operation than either of the other systems. Again, it is as commercially practicable where only one signal is required as where a thousand signals are required. These and other important advantages in favor of my signal arise from the peculiar method and apparatus which I employ.

By my invention the signal-operating energy is stored locally in separate storage units in the form of a fluid under high pressure and is stored in high-pressure portable storage-chambers.

By my invention also the energy for operating the signal is stored in the storage-chamber in the form of a liquid under high pressure, and when the energy is required it flows from the chamber in the form of a gas. This liquid may be called "liquefied gas," and the storage-chamber may be called a "pressure-storage chamber for liquefied gas." I apply the special and peculiarly-maintained power furnished by liquefied gas with its special advantages, and I apply it in a new and peculiar way. The gas flowing, as required, from the pressure-storage chamber through a pressure-reducing valve is conducted to a device whereat the expansive power of the gas is applied to operate the signal. This last-mentioned device may be called a "gas-pressure-applying device." A controlling valve or valves are provided for the control of this pressure-supply to this pressure-applying device. Any liquefied gas may be employed which is capable of supplying the requisite power in the form of gas-pressure when the pressure on the liquid is slightly reduced—such, for example, as liquefied carbonic-acid gas. The gas-pressure-applying device may be constructed in various forms. For example, it may be in the form of a piston-chamber or a turbine or in any other suitable form capable of receiving and applying the pressure of the expansive gas to operate the signal, although I prefer a piston and piston-chamber.

The pressure-storage tank in its best form is removable and replaceable, so that when it has become substantially exhausted it may be removed and another charged tank put in its place. Again, in the best arrangement there will be a separate storage-tank for each separate signal. The tank may thus be located in close proximity to its signal, thus avoiding leakage, loss of power, and other disadvantages incident to long pipes connected with a distant source of supply. Again, in the best arrangement the signal-operating parts are largely inclosed within a localized housing, including the gas-pressure-applying device, with its exhaust port or ports, wherefrom it results that the deposition of moisture and frost upon those operating parts is largely prevented. It will thus be seen that in my apparatus the signal and its connected parts may be entirely localized, compact, self-contained, and unitary and that its operation will be automatic and quite independent of any outside conditions. Moreover, the entire apparatus is of great simplicity, both in construction and mode of operation. By my system and apparatus a small portable pressure-storage chamber will supply a sufficient signal-operating pressure for many thousands of signal operations. Thus a tank containing fifty pounds avoirdupois of liquefied carbonic-acid gas is capable of operating an ordinary semaphore-signal upward of twelve thousand times. The great power-supply contained in the small portable pressure-storage tank is there maintained at an available pressure much in excess of that required for a practical working of the signal and by means of a reducing-valve is reliably reduced to and maintained at the pressure required for an efficient and economical working of the signal. The reducing valve or device is interposed between the pressure-storage tank and the valve or valves which control the admission of pressure to the pressure-applying device, as is shown in the drawings.

By my invention the operating of the signal makes only brief and intermittent and small demands upon the stored power, and by my invention also the changes of temperature incidental to the operation of the liquefied gas are prevented from deleteriously affecting the operation of the signal.

By my invention great economy of installation, of maintenance, and of operation are realized and obtained as contrasted with each of the two systems in practical use, and yet even greater certainty and reliability of operation are obtained than is possible with them.

After thorough and exhaustive tests and long-continued practical use my invention has gone into wide general use on most of the

leading railroads in the country and is now superseding all other forms of automatic semaphore-signals.

The accompanying drawings, Figures 1, 2, and 3, forming a part of this specification, show the apparatus embodying my invention in several different forms.

The same numerals of reference designate corresponding parts.

Fig. 1 is a representation, partly in vertical elevation, partly in vertical section, and partly in diagram, of a railway semaphore-signal apparatus embodying my invention in one of its forms. Fig. 2 is a similar view of a railway semaphore-signal apparatus embodying my invention in a modified form. Fig. 3 is a diagram of a railway signal system embodying my invention.

Referring now more particularly to the specific apparatus shown in Fig. 1 of the drawings, 1 is the signal pivoted on the post 1^a.

5 is a pressure-storage chamber containing a supply of suitable liquefied gas, such as liquefied carbonic-acid gas under pressure—say at from six hundred to nine hundred pounds to the square inch.

2, 3, and 4 are the gas-pressure-applying device, consisting in this case of an operating-rod 2, a piston 3, and a piston-chamber 4. It will be noted that the inlet end of the piston-chamber has no substantial clearance between the end wall and the piston.

The pressure-storage tank 5, containing liquefied gas, is provided with a valve 6, which is permanently opened after the tank is coupled up to the gas-pressure-applying device. The pressure-supply tank 5 has a coupling connection 9, by means of which the tank may be readily detached from and replaced in operative connection with the pressure-applying device. This coupling 9 permits of the ready removal of the tank, as when the supply of liquefied gas therein has become exhausted, and the convenient and ready replacing of another charged tank or the same tank recharged.

8 is an automatic pressure-reducing valve, which may be adjusted to automatically reduce the pressure of the pressure-supply tank 5 to the operating pressure desired in the pressure-applying device. A low-pressure chamber thus exists between the storage-flask 5 and the signal-operating means.

7 is a connecting-pipe connecting the reducing-valve 8 with the pressure-applying chamber 4. 14 is a valve in this connecting-pipe 7 for controlling the inlet of gas-pressure to the gas-pressure-applying chamber. This valve is operated and controlled in a way described below. In the form of signal shown in the drawings the signal is arranged to assume its different conditions of indication by change of its position with respect to the horizontal, the horizontal or upper position of the semaphore-arm indicating "danger" and the inclined or lowered position of the semaphore-arm indicating "safety." Thus this particular form of the signal is what is known as a "position-signal;" but in its broadest aspect the invention is not confined to this type of signal.

81 is the ordinary weighted spectacle and arranged to act as a counterweight for the semaphore-arm, so that the signal has a normal bias to "danger." Thus the signal is normally biased toward one condition of indication. Again, the signals, as shown in the drawings, are not inclosed in a casing and are exposed to view and in actual use have a landscape background. Moreover, as shown in the drawings, the signals are arranged to normally indicate "danger"—that is to say, when there is no train to receive an indication the signal shows "danger."

10 is a hood surrounding the piston-chamber and carried by the rod 2.

In the arrangement shown in Fig. 1 the signal is moved to its condition of safety indication by the gas-pressure in the pressure-applying device and is locked or held from returning to "danger" by a retaining device as contradistinguished from an arrangement in which the signal is held from returning to "danger" by the continued pressure of the gas in the pressure-applying device—such, for example, as is shown in Fig. 2.

In the arrangement shown in Fig. 2 the signal is not only moved to its condition of safety indication by the gas-pressure in the pressure-applying device, but it is held in that condition of safety indication by the gas-pressure in the pressure-applying device, the gas which has by its pressure raised the piston and so lowered the signal being prevented from escaping until it is desired that the signal shall go back to the condition of danger indication. Incidental to this difference between the arrangements shown in Figs. 1 and 2 there is also a difference in the arrangement of the valve devices and controlling-circuits, which will now be described.

In Fig. 1 a spring-catch 11, carried by the boss of the hood 10, is arranged to snap past the projecting end of the armature 12 of the magnet 13, when the piston and rod are driven upward to lower the signal to the position of safety indication. The catch 11 then settles upon and is supported by the armature 12 to hold the signal to its position of safety indication, the magnet 13 being at this time and for this purpose energized, as will presently be shown. This constitutes a retaining device to hold the signal in a position of definite indication against its normal bias. The gas in the piston-chamber 4, which operated to drive the piston and rod upward, escapes after the catch 11 passes the armature 12, as hereinafter shown.

In Fig. 1 the inlet-valve 14 in the pipe 7 is operated by the weighted arm 15, which is normally held in horizontal position, as shown, by the weighted armature 17 of the magnet 16 to hold the valve closed. When the magnet 16 is energized, the armature is attracted

and permits the arm 15 to drop, and thereby to open the inlet-valve 14.

18 is a pivoted arm carried by the hood 10 and having a slot 19, into which projects a pin 20, carried by the arm 15. When the piston 3, rod 2, and hood 10 rise, the arm 18 lifts the fallen arm 15 above the end of the armature 17, and thereby closes the inlet-valve 14. The armature 17 when released from the magnet 16 by the deënergization of the latter falls back under and again supports the arm 15 and holds the inlet-valve 14 closed.

21 is an exhaust or outlet valve operated by an arm 22, having a pin 23, which enters the slot 24 of the arm 25 and pivoted to and carried by the hood 10. This valve 21 is normally closed and is opened just after the catch 11 passes the armature 12, this being accomplished by the slotted arm 25. When the piston 3 returns to its lowest position, the arm 15 is not affected; but the arm 25 lowers the valve-arm 22, and so closes the outlet-valve. The magnets 13 and 16 are arranged in multiple in a signal-circuit which includes the battery 26 and circuit-controllers or circuit-breakers 27 and 28, operated, respectively, by the track-magnets 29 and 30. The magnets 29 and 30 are connected, respectively, in the rail-circuits of track-sections 31 and 32. In the branch with the magnet 16 is a circuit-controller or circuit-breaker 33, mechanically closed when the piston is in its lowest position and so the signal is at "danger" by an arm 34, carried on the hood 10. When the piston 3 and hood 10 have accomplished a small portion of the upward stroke, the circuit through the magnet 16 is broken at 33. This effects a saving of battery-power.

The operation is as follows: A train on track-section 31 closes at 27 the signal-circuit of battery 26, energizing magnets 13 and 16, the latter of which trips the arm 15, which thereupon opens the valve 14, allowing gas to enter the piston-chamber 4 and lower the signal to "safety." As the rod 2 rises the branch circuit through magnet 16 is broken and armature 17 is released. As the rod continues to rise the arm 15 is lifted, so that it again closes the inlet-valve 14 and comes to rest upon the armature 17. The catch 11 also snaps past the armature 12, and immediately thereafter the outlet-valve 21 is opened, allowing the rod to settle back slightly, so that the catch 11 rests upon the armature 12, which being held by its magnet supports the signal at "safety." When the train enters track-section 32, the signal-circuit of battery 26 is broken at 28, thereby deënergizing magnet 13, releasing catch 11, and permitting the signal to rise to "danger" behind the train. Sufficient gas remains within the piston-chamber to form a cushion for the return stroke of the piston. When the train passes beyond track-section 32, the signal-circuit will be restored to normal.

From the above statement of operation it will be seen that the supply of gas for causing the signal to indicate "safety" is automatically cut off when the signal has completed a predetermined movement under gas-pressure. It will also be seen that only one pressure-applying chamber or device is needed in effecting the changes in the conditions of indications.

In Fig. 2 the signal 35, pivoted on the post 35ª, counterweighted by spectacle 82, signal-rod 36, piston 37, piston-chamber 38, storage-tank 39, having valve 40, reducing-valve 41, pipe 42, having coupling 43, track-sections 44 and 45, with track-magnets 46 and 47, are the same as the corresponding parts in Fig. 1 and need not be again described. The pipe 42 opens into a valve-chamber 48, having a valve-rod 49, carrying two valves 50 and 51. The valve 50 opens and closes an inlet-port for admission of gas to the piston-chamber 38 from the pipe 42, and the valve 51 opens and closes an outlet-port for the escape of gas from the piston-chamber 38. A spring 52 on the valve-rod 49 serves to hold the rod 49 inward, so that the inlet-port is normally closed and the outlet-port is normally open, the signal being normally at "danger." When the rod 49 is retracted, the outlet-port is closed and the inlet-port is opened. The rod 49 is operatively connected with the armature 53 of magnet 54 in the signal-circuit of battery 55, this circuit including the normally open circuit-controller 56 and the normally closed circuit-controller 57. These circuit-controllers are operated, respectively, by the magnets 46 and 47 in the rail-circuits of track-sections 44 and 45.

The operation is as follows: A train on track-section 44 closes at 56 the signal-circuit of battery 55, energizes magnet 54, and opens inlet-port and closes outlet-port in valve-chamber 48. The inlet of gas to the piston-chamber 38 puts the signal to "safety," and the gas-pressure from the tank 39 holds the signal at "safety" until the train enters track-section 45, whereupon the signal-circuit is broken at 57, thereby deënergizing magnet 54 and opening the gas-outlet port and closing the gas-inlet port. The signal thus returns to "danger" behind the train.

61 in the arrangements of both Fig. 1 and Fig. 2 indicates the casing or housing for the signal-operating parts.

In Fig. 3 the diagram shows three signals 58, 59, and 60 connected in a system. These signals may be of either of the types shown in Figs. 1 and 2. The operating mechanism of each signal is shown inclosed within a casing, such as 61, which is provided with a door 62. Pressure-storage tanks 63, 64, and 65 are provided, one for each signal, and for each tank there is a connection, such as that shown at 66, for detaching and replacing each tank. Signal 58 guards the block consisting of track-sections 67 and 68. Signal 59 guards the block consisting of the track-sections 69 and 70. Signal 60 guards the block consisting of the track-sections following. Track-section 71

is part of the block preceding signal 58. The rails of the several track-sections are connected in circuit with the magnets 72, 73, 74, 75, and 76. The signal-circuit of signal 58 includes battery 77, normally closed circuit-controllers 78 and 79, and normally open circuit-controller 80, operated, respectively, by magnets 74, 73, and 72. The signal-circuits of signals 59 and 60 are similarly arranged.

In the operation of the system a train on track-section 71 closes at 80 the signal-circuit of signal 58 and puts the signal to "safety." When the train is on track-section 67, it breaks the signal-circuit at 79 and puts the signal to "danger." When it enters track-section 68, it again breaks this signal-circuit at 78 and keeps the signal at "danger" and also closes the signal-circuit of signal 59 and puts it to "safety." This operation is repeated as the train proceeds. This diagram of a system is shown herein more particularly to illustrate the individual pressure-storage tanks for the individual signals and each in close proximity to its signal.

It is to be understood that the invention in its broader aspect is not limited to the employment of any particular mechanism for operatively connecting a signal with a pressure-storage tank for liquefied gas. Various changes could readily be made in such mechanism and in the apparatus for controlling the operation of the signal without departing from the scope of the invention.

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

1. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume a condition of indication, and means other than said stored supply of liquefied gas to cause the signal to assume a condition of different indication, substantially as described.

2. In a railway signal apparatus the combination of a signal, storage means containing a supply of carbonic-acid gas, means for applying said gas to cause the signal to assume a condition of indication, and means other than said storage-supply of gas to cause the signal to assume a condition of different indication, substantially as described.

3. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume a condition of indication, means other than the said stored supply of liquefied gas to maintain the signal in said condition of indication, and means other than the said stored supply of liquefied gas to cause the signal to assume a condition of different indication, substantially as described.

4. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume a condition of indication, and means other than a stored supply of liquefied gas to cause the signal to assume a condition of different indication, substantially as described.

5. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume a condition of indication, and means other than the said stored supply of liquefied gas to maintain the signal in said condition of indication, substantially as described.

6. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to operate the signal, and a retaining device for said signal, substantially as described.

7. In a railway signal apparatus the combination of a signal, storage means containing a supply of carbonic-acid gas, means for applying said gas to operate the signal and a retaining device for said signal, substantially as described.

8. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to operate the signal, a retaining device for said signal, and means for releasing the signal, substantially as described.

9. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, train-controlled means for applying said gas to operate the signal, and a retaining device for said signal, substantially as described.

10. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to operate the signal, a retaining device for said signal, and train-controlled means for releasing the signal, substantially as described.

11. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying the gas to cause the signal to assume one condition of indication, and a detent for maintaining the signal in said condition of indication, substantially as described.

12. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying the gas to cause the signal to assume one condition of indication, a detent for maintaining the signal in said condition of indication, and train-controlled means for releasing said detent, substantially as described.

13. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for producing and maintaining a reduction in the pressure of said gas, and means for applying the gas at the reduced pressure to operate the signal, substantially as described.

14. In a railway signal apparatus, the combination of a signal, storage means contain-

ing a supply of liquefied gas, a reducing-valve, and means for applying the gas to operate the signal, substantially as described.

15. In a railway signal apparatus the combination of a signal, storage means containing a supply of carbonic-acid gas, a reducing-valve and means for applying the gas to operate the signal, substantially as described.

16. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, an automatic reducing-valve, and means for applying the gas to operate the signal, substantially as described.

17. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, and means for initially supplying said gas at a reduced pressure to operate the signal, substantially as described.

18. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, a pressure-applying device to operate the signal and in communication with said storage means, means for controlling the supply of gas to said pressure-applying device, and a reducing-valve interposed between said storage means and said controlling means, substantially as described.

19. In a railway signal apparatus, the combination of a signal normally biased toward one condition of indication, storage means containing a supply of liquefied gas, and means for applying said gas to cause the signal to assume a condition of different indication against its normal bias, substantially as described.

20. In a railway signal apparatus the combination of a signal normally biased toward one condition of indication, storage means containing a supply of carbonic-acid gas, and means for applying said gas to cause the signal to assume a position of different indication against its normal bias, substantially as described.

21. In a railway signal apparatus, the combination of a signal normally biased toward one condition of indication, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume a condition of different indication against its normal bias, and means other than the said stored supply of liquefied gas to maintain the signal in said condition of indication, substantially as described.

22. In a railway signaling system, the combination of a series of signals normally biased toward one condition of indication, a series of independent storage means containing supplies of liquefied gas, and a series of means for applying the gas from each stored supply to cause the signals to assume a condition of different indication against their normal bias, substantially as described.

23. In a railway signal apparatus, the combination of a signal, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume one condition of indication, and a casing or housing for said gas-applying means, said gas-applying means and the exhaust from same being within the same part of the casing, substantially as described.

24. In a railway signal apparatus, the combination of a signal normally biased toward one condition of indication, storage means containing a supply of liquefied gas, means for applying said gas to cause the signal to assume a condition of different indication against its normal bias, and a casing or housing for said gas-applying means, substantially as described.

25. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, and a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, substantially as described.

26. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, and a retaining device to hold the signal against return movement, substantially as described.

27. In a signal apparatus the combination of a signal having a normal bias to one position of indication, a storage-tank containing liquefied carbonic-acid gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, and a retaining device to hold the signal against return movement, substantially as described.

28. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, and a retaining device under electric control to hold the signal against return movement, substantially as described.

29. In a signal apparatus, the combination

of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, means for admitting gas to the gas-pressure-applying chamber, a track-circuit for controlling said means to move the signal against its normal bias, and a retaining device to hold the signal against its return movement, substantially as described.

30. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, means for admitting gas to the gas-pressure-applying chamber, electric devices for controlling said means to move the signal against its normal bias, and a retaining device under electric control to hold the signal against return movement, substantially as described.

31. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, and a reducing-valve for said tank whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, substantially as described.

32. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, and a retaining device to hold the signal against return movement, substantially as said described.

33. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, and a retaining device under electric control to hold the signal against return movement, substantially as described.

34. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, means for admitting gas to the gas-pressure-applying chamber, a track-circuit for controlling said means to move the signal against its normal bias, and a retaining device to hold the signal against return movement, substantially as described.

35. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, means for admitting gas to the gas-pressure-applying chamber, electric devices for controlling said means to move the signal against its normal bias, and a retaining device under electric control to hold the signal against return movement, substantially as described.

36. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position, a pressure-storage tank containing liquefied gas, and a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, substantially as described.

37. In a railway signal apparatus the combination of a signal normally at danger and having a normal bias to danger position, a pressure-storage tank containing carbonic-acid gas, and a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, substantially as described.

38. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in

controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, train-actuated means in advance of the signal operating to supply gas to the gas-pressure-applying chamber to move the signal to safety, and train-actuated means in the rear of the signal operating to allow the signal to return to danger, substantially as described.

39. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, train-actuated means in advance of the signal operating to supply gas to the gas-pressure-applying chamber to move the signal to safety, and train-actuated means in the rear of the signal operating to cause the signal to return to danger, substantially as described.

40. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, a retaining device to hold the signal against return movement, train-actuated means in advance of the signal operating to supply gas to the gas-pressure-applying chamber to move the signal to safety, and train-actuated means in the rear of the signal operating to release said retaining device to permit the signal to return to danger, substantially as described.

41. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, a retaining device to hold the signal against return movement, train-actuated means in advance of the signal operating to supply gas to the gas-pressure-applying chamber to move the signal to safety, and train-actuated means in the rear of the signal operating to release said retaining device and permit the signal to return to danger, substantially as described.

42. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, a supply-port for the gas-pressure-applying chamber, whereby gas may be supplied to said chamber from the storage-tank to move the signal against its normal bias to another position of indication, a retaining device to hold the signal against return movement, and a track-circuit operating to open said supply-port and to set said retaining device, substantially as described.

43. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a detachable and replaceable pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, an automatic reducing-valve for said tank, a supply-port for the gas-pressure-applying chamber, whereby gas may be supplied from the storage-tank to said chamber to move the signal against its normal bias to another position of indication, a retaining device to hold the signal against return movement, and a track-circuit operating to open said supply-port and to set said retaining device, substantially as described.

44. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position, a detachable and replaceable pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, an automatic reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal to safety, a retaining device to hold the signal against return movement, a track-circuit in advance of the signal operating to supply gas to the gas-pressure-applying chamber to move the signal to safety, and a track-circuit in the rear of the signal operating to release said retaining device and permit the signal to return to danger, substantially as described.

45. In a railway signal apparatus, the combination of a series of signals each having a normal bias to danger position, a series of detachable and replaceable storage-tanks containing liquefied gas, one for each signal, a series of gas-pressure-applying chambers, one for each storage-tank in operative connection with a signal and in controllable communication with its associated storage-tank, a reducing-valve for each tank, whereby gas may be supplied from each storage-tank to its gas-pressure-applying chamber to move the associated signal to safety, and train-operated devices for controlling the gas-supply for operating said signals, substantially as described.

46. In a railway signal apparatus, the combination of a series of signals each having a normal bias to danger position, a series of detachable and replaceable storage-tanks containing liquefied gas, one for each signal, a series of gas-pressure-applying chambers one for each storage-tank, in operative connection with a signal and in controllable communication with its associated storage-tank, a reducing-valve for each tank, whereby gas may be supplied from each storage-tank to its gas-pressure-applying chamber to move the associated signal to safety, a supply-port for each gas-pressure-applying chamber, a retaining device for each signal to hold it against return movement, and a track-circuit for each signal operating to open the supply-port and to set the retaining device for said signal, substantially as described.

47. In a railway signal apparatus, the combination of a series of signals each having a normal bias to danger position, a series of detachable and replaceable storage-tanks containing liquefied gas, one for each signal, a series of gas-pressure-applying chambers, one for each storage-tank, in operative connection with a signal and in controllable communication with its associated storage-tank, a reducing-valve for each tank, whereby gas may be supplied from each storage-tank to its gas-pressure-applying chamber to move the associated signal to safety, a supply-port for each gas-pressure-applying chamber, a retaining device for each signal to hold it against return movement, a track-circuit in advance of each signal to control said supply-port to put the signal to safety, and a track-circuit in the rear of each signal to release said retaining device to put the signal to danger, substantially as described.

48. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, means for admitting a supply of gas to and exhausting it from the gas-pressure-applying chamber, means for automatically cutting off the supply of gas to said chamber when the signal has completed a predetermined movement under gas-pressure, and a retaining device to hold the signal against return movement, substantially as described.

49. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a pressure-storage tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, means for admitting a supply of gas to and exhausting it from the gas-pressure-applying chamber, means for automatically cutting off the supply of gas to said chamber when the signal has completed a predetermined movement under gas-pressure, and a retaining device under electric control to hold the signal against return movement, substantially as described.

50. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a detachable and replaceable pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank; an automatic reducing-valve for said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against the normal bias to another position of indication; means for admitting a supply of gas to and exhausting it from the gas-pressure-applying chamber; means for automatically cutting off the supply of gas to said chamber when the signal has completed a predetermined movement under gas-pressure; and a retaining device under electric control to hold the signal against return movement, substantially as described.

51. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; means for admitting a supply of gas to and exhausting it from the gas-pressure-applying chamber; means for automatically cutting off the supply of gas to said chamber when the signal has completed a predetermined movement under gas-pressure; a retaining device to hold the signal against return movement; and train-actuated means in the rear of said signal for releasing said retaining device, substantially as described.

52. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; means for admitting a supply of gas to and exhausting it from said chamber; means for cutting off the supply of gas to said chamber when the signal has com-

pleted a predetermined movement under gas-pressure; a retaining device to hold the signal against return movement; and a signal-circuit operating when closed to actuate the means for supplying gas to the gas-pressure-applying chamber, and operating when opened to release said retaining device, substantially as described.

53. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for the gas-pressure-applying chamber; a retaining device to hold the signal against return movement; and a signal-circuit operating when closed to open said supply-port, and operating when opened to release the retaining device, substantially as described.

54. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for the gas-pressure-applying chamber; a retaining device to hold the signal against return movement; a signal-circuit operating when closed to open said supply-port, and operating when opened to release said retaining device; and means for automatically cutting off the supply of gas to the gas-pressure-applying chamber upon a predetermined movement of the signal under gas-pressure, substantially as described.

55. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a detachable and replaceable pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank; an automatic reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for the gas-pressure-applying chamber; a retaining device to hold the signal against return movement; and a signal-circuit operating when closed to open said supply-port, and operating when opened to release the retaining device, substantially as described.

56. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a detachable and replaceable pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for the gas-pressure-applying chamber; a retaining device to hold the signal against return movement; a signal-circuit operating when closed to open said supply-port, and operating when opened to release said retaining device; and means for automatically cutting off the supply of gas to the gas-pressure-applying chamber upon a predetermined movement of the signal under gas-pressure, substantially as described.

57. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a storage-supply of carbonic-acid gas, a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication, supply and exhaust ports for the gas-pressure-applying chamber, a retaining device to hold the signal against return movement, and means controlled by the train for opening said supply-port and setting said retaining device, substantially as described.

58. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for the gas-pressure-applying chamber; a retaining device to hold the signal against return movement; and a signal-circuit operating when closed to open said supply-port and to set the retaining device, and operating when opened to release the retaining device, substantially as described.

59. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for said gas-pressure-applying chamber; a retaining device to hold the signal against re-

turn movement; and a signal-circuit operating when closed to open said supply-port and to set the retaining device, and operating when opened to release the retaining device; and means for automatically cutting off the supply of gas to said gas-pressure-applying chamber upon a predetermined movement of the signal, substantially as described.

60. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for said gas-pressure-applying chamber; a retaining device to hold the signal against return movement; a track-circuit operating to open said supply-port; and another track-circuit operating to release said retaining device, substantially as described.

61. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for said gas-pressure-applying chamber; a retaining device to hold the signal against return movement; a track-circuit operating to open said supply-port; and another track-circuit operating to release said retaining device, substantially as described.

62. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for said gas-pressure-applying chamber; a retaining device to hold the signal against return movement; a track-circuit operating to open said supply-port, and another track-circuit operating to release the retaining device; and means for automatically cutting off the supply of gas to said gas-pressure-applying chamber upon a predetermined movement of the signal, substantially as described.

63. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said storage-tank; an automatic reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for said gas-pressure-applying chamber; a retaining device to hold the signal against return movement; a track-circuit operating to open said supply-port; and another track-circuit operating to release said retaining device; and means for automatically cutting off the supply of gas to said gas-pressure-applying chamber upon a predetermined movement of the signal, substantially as described.

64. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position; a pressure-storage tank containing liquefied gas; a gas-pressure-applying device in operative connection with said signal and in controllable communication with said storage-tank; whereby gas may be supplied from said storage-tank to said gas-pressure-applying device to move the signal to safety; a normally open signal-circuit operating when closed to supply gas to the gas-pressure-applying device to move the signal to safety, and operating when opened to cause the signal to move to danger; train-actuated means in advance of the signal operating to close the signal-circuit; and train-actuated means in the rear of the signal operating to open the signal-circuit, substantially as described.

65. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position; a pressure-storage tank containing liquefied gas; a gas-pressure-applying device in operative connection with said signal and in controllable communication with said storage-tank; a reducing-valve for said tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying device to move the signal to safety; a retaining device to hold the signal against return movement; a normally open signal-circuit operating when closed to supply gas to the gas-pressure-applying device to move the signal to safety, and operating when opened to release said retaining device to permit the signal to return to danger; train-actuated means in advance of the signal operating to close said signal-circuit; and train-actuated means in the rear of the signal operating to open said signal-circuit, substantially as described.

66. In an automatic block-signaling system, the combination of a series of blocks; a signal normally biased to danger for each block; a pressure-storage tank containing liquefied gas for each block; a gas-pressure-applying device for each block in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a sup-

ply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; and a retaining device for each signal to hold the signal against return movement, substantially as described.

67. In an automatic block-signaling system, the combination of a series of blocks; a signal normally biased to danger for each block; a detachable and replaceable pressure-storage tank containing liquefied gas for each block; an automatic reducing-valve for each of said tanks; a gas-pressure-applying device for each block in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; a retaining device for each signal to hold the signal against return movement; and train-actuated means in the rear of each signal for releasing its retaining device, substantially as described.

68. In an automatic block-signaling system, the combination of a series of blocks; a signal normally biased to danger for each block; a pressure-storage tank containing liquefied gas for each block; a gas-pressure-applying device for each block in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; a retaining device for each signal to hold the signal against return movement; and a signal-circuit for each signal operating when closed to actuate the means for supplying gas to the gas-pressure-applying device for said signal and operating when opened to release the retaining device for said signal, substantially as described.

69. In an automatic block-signaling system, the combination of a series of blocks; a signal normally biased to danger for each block; a detachable and replaceable pressure-storage tank containing liquefied gas for each block; an automatic reducing-valve for each of said tanks; a gas-pressure-applying device for each block in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predeter-mined movement under gas-pressure; a retaining device for each signal to hold the signal against return movement; a signal-circuit for each signal operating when closed to actuate the means for supplying gas to the gas-pressure-applying device for said signal and operating when opened to release the retaining device for said signal; and track-circuits for operating said signal-circuits, substantially as described.

70. In an automatic block-signaling system, the combination of a series of blocks; a signal normally at danger and normally biased to danger for each block; a pressure-storage tank containing liquefied gas for each block; a gas-pressure-applying device for each block in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; and a retaining device for each signal to hold the signal against return movement, substantially as described.

71. In an automatic block-signaling system, the combination of a series of blocks; a signal normally at danger and normally biased to danger for each block; a pressure-storage tank containing liquefied gas for each block; a gas-pressure-applying device for each block in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; a retaining device for each signal to hold the signal against return movement; and a normally open signal-circuit for each signal operating when closed to actuate the means for supplying gas to the gas-pressure-applying device for said signal and operating when opened to release the retaining device for said signal, substantially as described.

72. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; and a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said piston-chamber to move the signal against its normal bias to another position of indication, substantially as described.

73. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a storage-supply of carbonic-acid gas, and a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-supply, whereby gas may be supplied

from said storage-supply to said piston-chamber to move the signal against its normal bias to another position of indication, substantially as described.

74. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-tank; and a reducing-valve for said tank whereby gas may be supplied from said storage-tank to said piston-chamber to move the signal against its normal bias to another position of indication, substantially as described.

75. In a signal apparatus, the combination of a signal having a normal bias to one position of indication, a storage-supply of carbonic-acid gas, a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-supply, and a reducing-valve for said supply whereby gas may be supplied from said storage-supply to said piston-chamber to move the signal against its normal bias to another position of indication, substantially as described.

76. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a detachable and replaceable pressure-storage tank containing liquefied gas; a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-tank; an automatic reducing-valve for said tank, a supply-port for the piston-chamber, whereby gas may be supplied to said chamber from the storage-tank to move the signal against its normal bias to another position of indication; a retaining device to hold the signal against return movement; and a track-circuit operating to open said supply-port and to set said retaining device, substantially as described.

77. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a detachable and replaceable pressure-storage tank containing liquefied gas; a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-tank; an automatic reducing-valve for said storage-tank, whereby gas may be supplied from said storage-tank to said piston-chamber to move the signal against its normal bias to another position of indication; means for admitting a supply of gas to and exhausting it from the piston-chamber; means for automatically cutting off the supply of gas to said chamber when the signal has completed a predetermined movement under gas-pressure; and a retaining device under electric control to hold the signal against return movement, substantially as described.

78. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank containing liquefied gas; a piston and piston-chamber in operative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said piston-chamber to move the signal against its normal bias to another position of indication; supply and exhaust ports for the piston-chamber; a retaining device to hold the signal against return movement; a signal-circuit operating when closed to open said supply-port, and operating when opened to release said retaining device; and means for automatically cutting off the supply of gas to the piston-chamber upon a predetermined movement of the signal under gas-pressure, substantially as described.

79. In an automatic block-signaling system, the combination of a series of blocks; a signal normally biased to danger for each block; a pressure-storage tank containing liquefied gas for each block; a gas-pressure-applying device for each block in operative connection with a signal, and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; a retaining device for each signal to hold the signal against return movement; a series of reducing-valves, one for each tank; a retaining device for each signal to hold it against return movement; and a signal-circuit for controlling each signal, substantially as described.

80. In an automatic block-signaling system, the combination of a series of blocks; a signal normally biased to danger for each block; a detachable and replaceable pressure-storage tank containing liquefied gas for each block; an automatic reducing-valve for each of said tanks; a gas-pressure-applying device in operative connection with a signal and in controllable communication with a storage-tank; means for each of said devices for admitting a supply of gas to and exhausting it from said device; means for each of said devices for automatically cutting off the supply of gas to said device when its associated signal has completed a predetermined movement under gas-pressure; a retaining device for each signal to hold the signal against return movement; and a signal-circuit for each signal operating when closed to actuate the means for supplying gas to the gas-pressure-applying device for said signal and operating when opened to release the retaining device for said signal, substantially as described.

81. In a railway signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position; a pressure-storage tank containing liquefied gas; a gas-pressure-applying device in oper-

ative connection with said signal and in controllable communication with said storage-tank, whereby gas may be supplied from said storage-tank to said gas-pressure-applying device to move the signal to safety; a normally open signal-circuit operating when closed to permit the supply of gas to the gas-pressure-applying device to move the signal to safety, and operating when opened to cause the signal to move to danger; train-actuated means in advance of the signal operating to close the signal-circuit; train-actuated means in the rear of the signal operating to open the signal-circuit; a series of reducing-valves, one for each tank; and a retaining device for each signal to hold it against return movement, substantially as described.

82. In a railway signal apparatus, the combination of an exposed signal having a landscape background and having a normal bias to one condition of indication, storage means containing a supply of liquefied gas, and means for applying the gas to operate the signal, substantially as described.

83. In a railway signal apparatus, the combination of an exposed signal having a landscape background, storage means containing a supply of liquefied gas, and means for applying the gas at a reduced pressure to operate the signal, substantially as described.

84. In a railway signal apparatus, the combination of an exposed signal having a landscape background, storage means containing a supply of liquefied gas, means for applying the gas at a reduced pressure to operate the signal, and a retaining device to hold the signal against movement when the signal is in one position, substantially as described.

85. In a signal apparatus, the combination of a pivoted signal whose various indications are given by changes in its position, said signal being normally biased toward one position of indication, storage means containing a supply of liquefied gas, and means for applying the gas to operate the signal, substantially as described.

86. In a signal apparatus, the combination of a pivoted signal whose various indications are given by changes in its position, said signal being normally biased toward one position, storage means containing a supply of carbonic-acid gas, and means for applying the gas to operate the signal, substantially as described.

87. In a signal apparatus, the combination of a pivoted signal whose various indications are given by changes in its position, storage means containing a supply of liquefied gas, means for applying the gas at a reduced pressure, to operate the signal, and a retaining device to hold the signal in one of its positions, substantially as described.

88. In a railway signal apparatus, the combination of an exposed pivoted signal having a landscape background and whose various indications are given by changes in its position, said signal being normally biased toward one position of indication, storage means containing a supply of liquefied gas, and means for applying the gas to operate the signal, substantially as described.

89. In a railway signal apparatus, the combination of an exposed pivoted signal having a landscape background and whose various indications are given by changes in its position, storage means containing a supply of liquefied gas, means for applying the gas at a reduced pressure to operate the signal, and a retaining device to hold the signal in one of its positions, substantially as described.

90. In a railway signal apparatus, the combination of an exposed pivoted signal having a landscape background and having a normal bias to danger, said signal giving its various indications by a change in its position, a tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank, train-controlled valve devices whereby gas may be admitted to and exhausted from said gas-pressure-applying chamber, and a reducing-valve, substantially as described.

91. In a railway signal apparatus, the combination of an exposed pivoted signal having a landscape background and having a normal bias to danger, said signal giving its various indications by a change in its position, a tank containing liquefied gas, a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank, train-controlled valve devices whereby gas may be admitted to and exhausted from said gas-pressure-applying chamber, a reducing-valve, and a retaining device to hold the signal at safety, substantially as described.

92. In a railway signal apparatus, the combination of an exposed pivoted signal having a landscape background and having a normal bias to danger, said signal giving its various indications by changes in its position, a tank containing liquefied gas, a piston-chamber in operative connection with said signal and in communication with said tank, train-controlled valve devices whereby gas may be admitted to and exhausted from said piston-chamber, a reducing-valve, and a train-controlled retaining device to hold the signal at safety, substantially as described.

93. In a railway signal apparatus, the combination of a semaphore-blade a weight for moving it in one direction, a storage-supply of liquefied gas and means for applying the gas to move the blade in the opposite direction, substantially as described.

94. In a railway signal apparatus, the combination of a semaphore-blade, a weight for moving it in one direction, a storage-supply of carbonic-acid gas, and means for applying the gas to move the blade in the opposite direction against the action of the weight, substantially as described.

95. In a railway signaling apparatus, the combination of a signal, a storage-supply of liquefied gas, and a low-pressure chamber

between the gas-supply and the signal, substantially as described.

96. In a railway signaling apparatus, the combination of a signal, a signal-operating means, a storage-supply of liquefied gas, and a low-pressure chamber between the gas-supply and the signal-operating means, substantially as described.

97. In a railway signaling apparatus, the combination of a signal, a storage-supply of liquefied gas, and a piston-chamber and piston, for operating said signal, there being no substantial clearance-space between the inlet end of the piston-chamber and the piston, substantially as described.

98. In a railway signaling apparatus, the combination of a pivoted semaphore-signal, a storage-supply of liquefied gas, a piston-chamber and piston for operating said signal in one direction, there being no substantial clearance-space between the inlet end of the piston-chamber and the piston, substantially as described.

99. In a railway-signal, the combination of a signal device, a fluid-pressure mechanism for moving the signal device from one position of indication to another position of indication, a locking means comprising an electromagnet, and a circuit and source of current for the electromagnet for locking the signal device in the position to which it has been moved, said locking means being effective only when the circuit of the electromagnet is closed, an electrically-operated valve device for controlling the supply of fluid-pressure to the fluid-pressure mechanism, a circuit and source of current for said electrically-operated valve device, a circuit-breaker, common to the circuit of the electromagnet and electrically-operated valve device and a second circuit-breaker in the circuit of the electrically-operated valve device, which second circuit-breaker is operated from a moving part comprised in the railway-signal, substantially as described.

100. In a railway-signal, the combination of a signal device, a fluid-pressure mechanism for moving the signal device from one position of indication to another, a locking means, comprising an electromagnet and a circuit and a source of current for the electromagnet, for locking the signal device in the position to which it has been moved, said locking means being effective only when the circuit of the electromagnet is closed, an electrically-operated valve device for controlling the supply of fluid-pressure to the fluid-pressure mechanism, a storage-tank containing a liquefied gas from which tank the supply of fluid-pressure is obtained, a circuit and source of current for said electrically-operated valve device, a circuit-breaker common to the circuits of the electromagnet and electrically-operated valve device and a second circuit-breaker in the circuit of the electrically-operated valve device, which second circuit is operated by a moving part comprised in the railway-signal, substantially as described.

101. The combination of a signal normally biased to one position of indication, a gas-pressure-applying device adapted to be actuated by carbonic-acid gas for moving the signal in a direction against its normal bias, and means for supplying carbonic-acid gas in small quantities to actuate the gas-pressure-applying device, substantially as described.

102. The combination of a semaphore-signal, said signal being normally biased toward the danger position, a gas-pressure-applying device adapted to be actuated by carbonic-acid gas, and means for supplying said gas in small quantities to said gas-pressure-applying device to actuate it, substantially as described.

103. The combination of a semaphore-signal, a weight which exerts a normal bias to urge the signal toward the danger position, said weight serving to return the signal, a gas-pressure-applying device for moving the signal to another position of indication against the action of the weight, admission-valves and reducing-valves controlling the supply of carbonic-acid gas to said gas-pressure-applying device and means for actuating said valves so as to supply small quantities of carbonic-acid gas to said gas-pressure-applying device to move the signal, substantially as described.

104. The combination of a signal normally biased to one position of indication, a gas-pressure-applying device to be actuated by carbonic-acid gas for moving the signal in one direction, admission and exhaust valves for said gas-pressure-applying device, and means controlled by the movement of the gas-pressure-applying device for closing and opening the exhaust-valve at suitable intervals, substantially as described.

105. The combination of a semaphore-signal normally biased to one position of indication, a gas-pressure-applying device for moving it in a direction opposite to its normal bias, said gas-pressure-applying device including a reciprocating member adapted to be actuated by the pressure of carbonic-acid gas, a connecting-rod connecting said signal with said member, admission and exhaust valves for said gas-pressure-applying device and means operated by the moving member of the gas-pressure-applying device for controlling the closing and opening of the exhaust-valve at suitable intervals, substantially as described.

106. The combination of a signal normally biased to one position of indication, a gas-pressure-applying device to be actuated by carbonic-acid gas for moving the signal in one direction, admission and exhaust valves for said gas-pressure-applying device, a retaining device for said signal, and means controlled by the movement of the gas-pressure-applying

device for closing and opening the exhaust-valve at suitable intervals, substantially as described.

107. The combination of a signal normally biased to one position of indication, a gas-pressure-applying device to be actuated by carbonic-acid gas for moving the signal in one direction, an admission and an exhaust valve for said gas-pressure-applying device, a retaining device for said signal, and means controlled by the movement of a part of the gas-pressure-applying device for closing and opening the exhaust-valve at suitable intervals, the parts being so arranged and so operated as to move the signal in one direction and allow the signal after the exhaust-valve has been opened to be held by said retaining device, substantially as described.

108. In a fluid-pressure railway signaling system, the combination of a signal adapted to be actuated by fluid-pressure, a self-contained, storage-supply of highly-compressed fluid stored in a reservoir of small volume, for operating said signal in one direction, and means other than said storage-supply of fluid for returning said signal, substantially as described.

109. In a gas-pressure railway signaling system, the combination with a signal-blade, a portable storage-tank containing a supply of high-pressure fluid located adjacent to said signal, a gas-pressure-applying chamber, means for admitting gas from said storage-tank to said gas-pressure-applying chamber to move the signal in one direction and a weight acting to move said signal-blade in the opposite direction, substantially as described.

110. In a gas-pressure railway signaling system, the combination of a signal-blade, a portable storage-chamber for high-pressure gas located adjacent to the signal, a gas-pressure-applying chamber located between the signal and the storage-chamber, an admission-valve and a reducing-valve for controlling the supply of gas to said gas-pressure-applying chamber, the action of the gas being to move the signal in one direction, and a weight acting to normally bias the signal and return it in the opposite direction, substantially as described.

111. In a gas-pressure railway signaling system, the combination with a signal-blade, a gas-pressure-applying chamber, a local portable storage-chamber containing a supply of high-pressure gas, an admission-valve and a reducing-valve for supplying gas from said storage-chamber to said gas-pressure-applying chamber to move the signal in one direction, a retaining device for holding said signal after it has been moved by the gas, and a weight acting to give the signal-blade a normal bias and to move it in the opposite direction, substantially as described.

112. In a gas-pressure railway signaling system, the combination of a series of signals, a gas-pressure-applying chamber for each signal, a portable storage-chamber adjacent to each signal each containing a supply of high-pressure fluid, an admission-valve and a reducing-valve for each signal so as to move each signal in one direction and means other than said storage-supply of high-pressure gas for returning each of said signals, substantially as described.

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

CLYDE J. COLEMAN.

Witnesses:
NICHOLAS M. GOODLETT, Jr.,
ELMER E. COOLEY.