No. 827,683. PATENTED JULY 31, 1906.

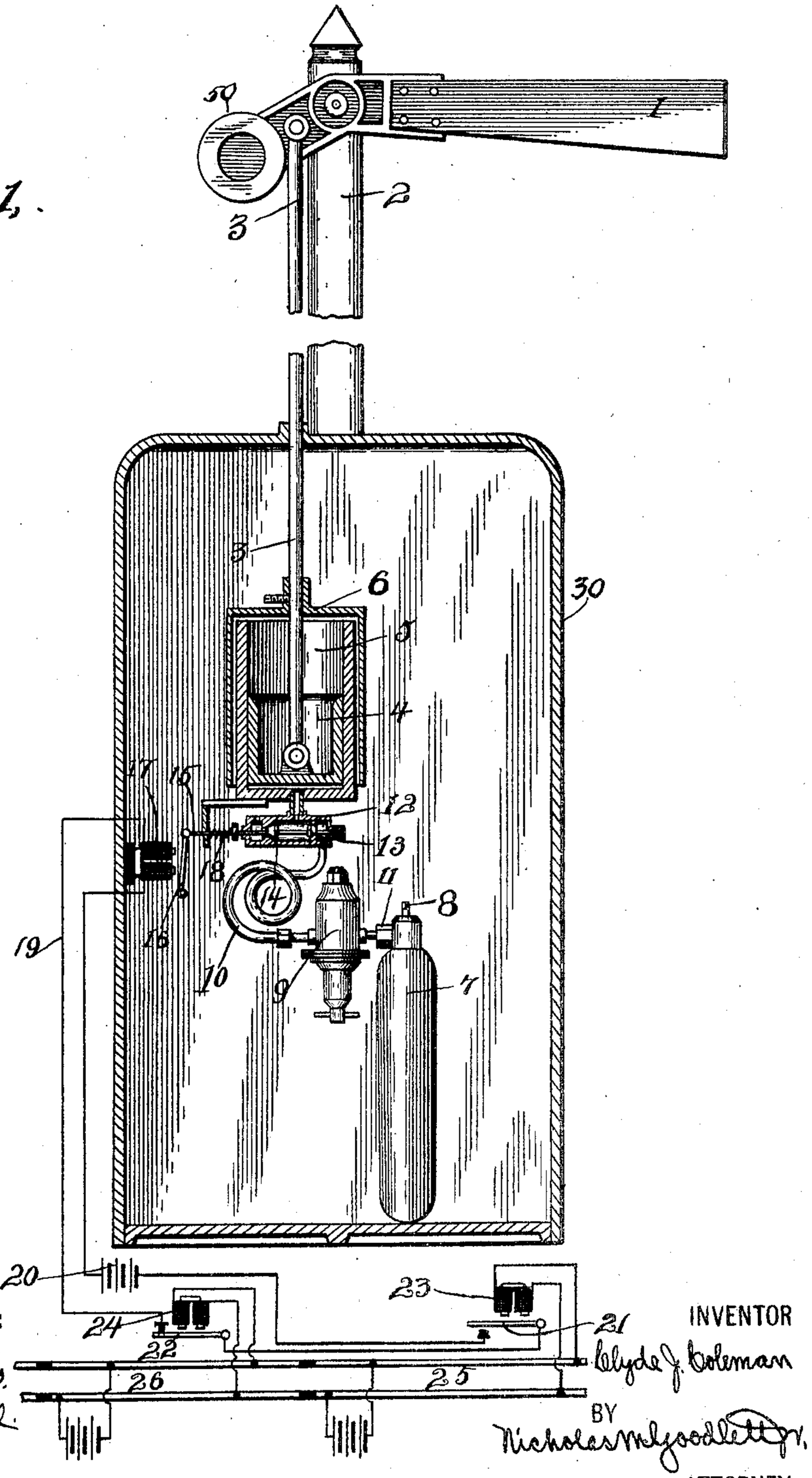
C. J. COLEMAN.

SIGNAL APPARATUS.

APPLICATION FILED MAY 7, 1902.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

Harry Goss.

Emma L. Carmichael.

INVENTOR

Clyde J. Coleman

BY

Nicholas M. Goodlett Jr.

ATTORNEY

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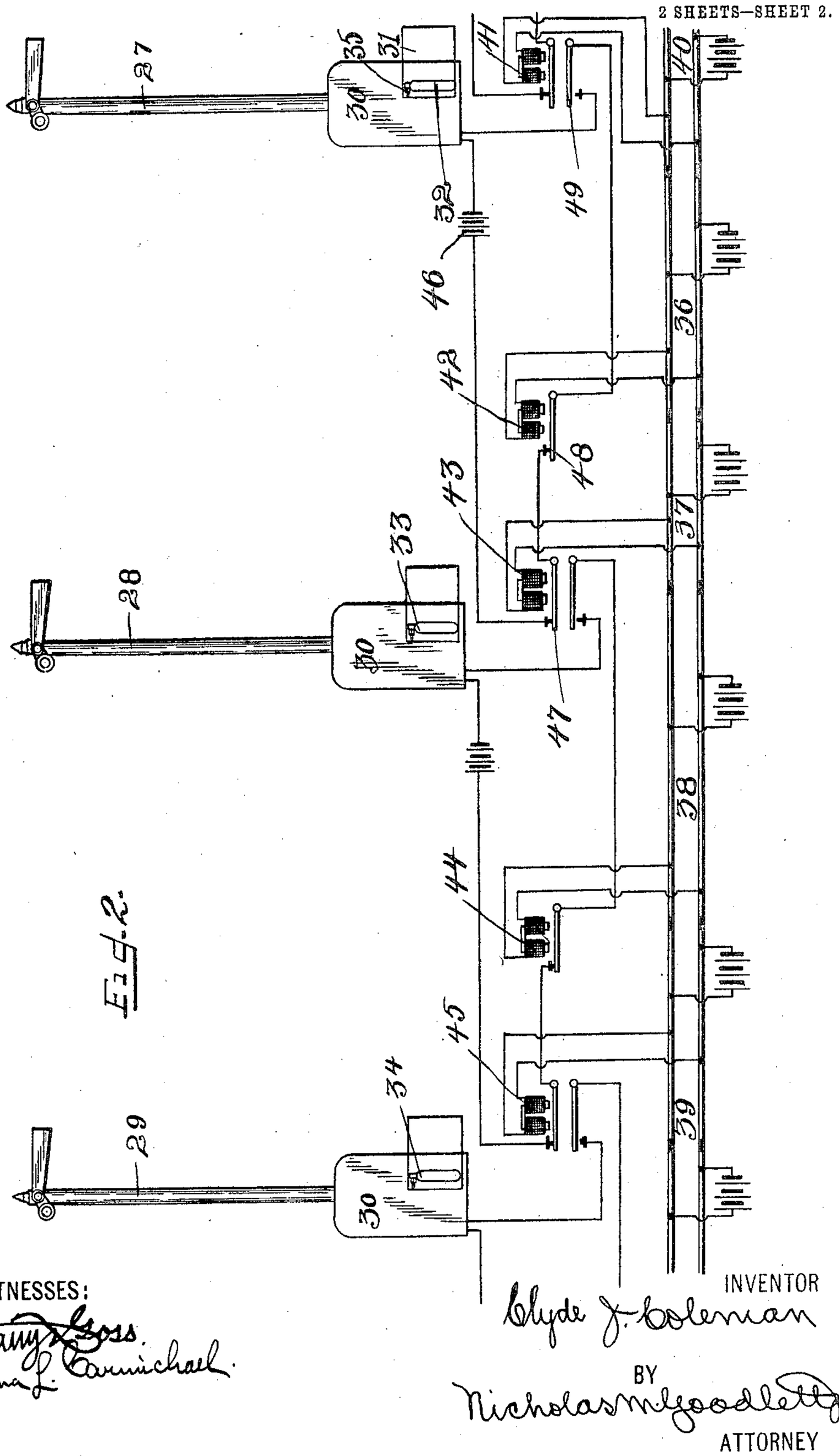

Fig. 2.

WITNESSES:

Harry L. Goss.

Emma L. Carmichael.

INVENTOR

Clyde J. Coleman

BY

Nicholas M. Goodlett Jr.

ATTORNEY

UNITED STATES PATENT OFFICE.

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

SIGNAL APPARATUS.

No. 827,683. Specification of Letters Patent. Patented July 31, 1906.

Original application filed July 8, 1901, Serial No. 67,530. Divided and this application filed May 7, 1902. Serial No. 106,245.

To all whom it may concern:

Be it known that I, CLYDE JAY 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 cause leakage at various points, which is 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 notwithstanding 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 infrequently 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 is 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 in a low-pressure chamber at the pressure required for an efficient and economical working of the signal. Thus the gas is initially applied at a low pressure to operate 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.

It is to be observed that the pressure-storage tank for liquefied gas is independent of any outside power source. This involves a great advantage over the local tank or reser-

voir, which requires to be supplied from some outside power source upon which such power-tank is dependent.

In the embodiment of the invention as set out in the present application gas-pressure is utilized not only to move the signal against its normal bias from one position to another, but is also used to hold the signal in such position against its normal bias.

The present application is a division of the application filed by me on July 8, 1901, Serial No. 67,530.

In the accompanying drawings, forming part of this specification, I have shown one of the various embodiments of the invention.

Figure 1 is a side elevation, partly in section, of a railway-signal; and Fig. 2 is a diagram of a system employing signals such as that shown in Fig. 1.

Referring now more particularly to the specific apparatus shown in the drawings, 1 is a semaphore-signal pivoted on the post 2 and provided with the operating-rod 3. The piston 4 is secured to the rod 3 and works in the piston-chamber 5.

6 is a hood for the piston-chamber and secured to the rod 3. This piston-chamber, with its piston, constitutes the gas-pressure-applying device or chamber above referred to. It will be noted that the inlet end of the piston-chamber has no substantial clearance between the end wall and the piston.

The tank 7 contains a suitable liquefied gas under pressure and is provided with a valve 8, which is permanently opened after the tank is coupled with the reducing-valve 9 and pipe 10, leading to the piston-chamber.

11 is the coupling for the tank 7, by means of which the tank may be removed as required, so that when the tank has become exhausted another charged tank or the same tank when recharged may be readily substituted for the one removed.

That part of the pipe 10 between the inlet-valve 13 and the reducing-valve, together with a part of the reducing-valve, constitutes a low-pressure chamber wherein gas is maintained at the reduced working pressure and from which this low-pressure gas is initially supplied to operate the signal. In the form of the 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. 50 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."

Control of the gas supplied to the piston-chamber is provided by means of suitable valve devices, and in the arrangement shown in the drawings these valve devices are designed to be controlled from a distance and by means of electric circuits operated by a passing train.

12 is a valve-casing provided with seats for the inlet-valve 13 and for the exhaust-valve 14, carried on the valve-stem 15. This valve-stem is connected with an armature 16, operated by the magnet 17. When magnet 17 is energized, supply-valve 13 is opened and exhaust-valve 14 is closed.

18 is a spring operating to hold the exhaust-valve open and the supply-valve closed when the magnet 17 is deënergized.

The magnet 17 is included in the signal-circuit 19, which circuit includes the battery 20, the normally open circuit-controller 21, and the normally closed circuit-controller 22.

23 and 24 are magnets included, respectively, in the track-circuits of track-sections 25 and 26, respectively. The magnet 23 operates the circuit-controller 21, and the magnet 24 operates the circuit-controller 22. The track-section 25 is of course in advance of the signal, inasmuch as the signal stands normally at "danger."

The operation of the signal as thus described is as follows: A train entering track-section 25 closes at 21 the normally open signal-circuit 19, thereby energizing the magnet 17 and opening the supply-valve 13 and closing the exhaust-valve 14. Gas thereupon enters the piston-chamber, moving the piston upward and moving the signal 1 downward to safety position. The presence of the gas in the piston-chamber holds the signal in safety position against its normal bias. When the pressure of the gas in a piston-chamber has reached a predetermined pressure, the automatic reducing-valve 9 closes. If any of the gas, however, should unavoidably escape from the piston-chamber, this might permit the signal to start back to "danger" before such movement was desired if it were not for the automatic reducing-valve. The automatic reducing-valve, however, prevents this from occurring, because if any of the gas should leak out of the piston-chamber the pressure in the piston-chamber would be reduced, and this would permit the reducing-valve to automatically open and supply more gas to keep up the pressure, the

reducing-valve automatically closing as soon as the predetermined pressure is again restored in the piston-chamber. When the train enters the track-section 26, it opens the normally closed circuit-controller 22, thereby deënergizing magnet 17 and reversing the position of the valves, so that the gas in the piston-chamber may escape through the exhaust-valve 14 and permit the signal to go to "danger."

It will be observed that only one pressure-applying device or chamber is employed in effecting the changes in the conditions of indication of the signal.

It is of course obvious that many arrangements of valve devices may be employed to control the presence of gas in the piston-chamber or other gas-pressure-applying device. It is also obvious that various means may be employed for applying and for retaining gas supplied from the supply source to cause the signal to assume and be maintained by gas-pressure at a condition of indication. It is also obvious that the signal may be arranged to stand normally at "safety" and that the controlling-circuits may be variously modified.

In Fig. 2 the diagram shows three signals 27, 28, and 29 connected in a system. These signals stand normally at "danger" and are such as that shown in Fig. 1. The operating mechanism of each signal is inclosed in a casing 30, which is provided with a door 31. Pressure-storage tanks 32, 33, and 34 are provided, one for each signal, and for each tank there is a connection or coupling, such as the coupling 35, for detaching and replacing each tank. Signal 27 guards the block consisting of track-sections 36 and 37. Signal 28 guards the block consisting of the track-sections 38 and 39. Signal 29 guards the block consisting of the track-sections following. Track-section 40 is part of the block preceding signal 27. The rails of the several track-sections are connected in circuit with the magnets 41, 42, 43, 44, and 45. The signal-circuit of signal 27 includes battery 46, normally closed circuit-controllers 47 and 48, and normally open circuit-controller 49, operated, respectively, by magnets 43, 42, and 41. The signal-circuits of signals 28 and 29 are similarly arranged. In the operation of the system a train on track-section 40 closes at 49 the signal-circuit of signal 27 and puts the signal to "safety" in front of the train. When the train is on track-section 36, it breaks the signal-circuit at 48 and puts the signal to "danger" behind the train. When it enters track-section 37, it again breaks this signal-circuit at 47 and keeps the signal at "danger" and also closes the signal-circuit of signal 28 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 individual signals and each in close proximity to its signal.

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

1. In a railway signal apparatus the combination of a signal, means adapted to be controlled by gas-pressure to hold the signal at safety, a local storage-tank of liquefied gas, and means forming a communication between said controlling means and said tank and including an automatic pressure-reducing means, whereby the pressure in the controlling means is automatically maintained.

2. In a railway signal apparatus the combination of a signal normally biased to danger, means adapted to be controlled by gas-pressure to hold the signal at safety, a local storage-tank of liquefied gas and means forming a communication between said controlling means and said tank and including a pressure-reducing valve whereby the pressure in the controlling means is automatically maintained.

3. In a railway signal apparatus the combination of a semaphore-blade normally biased to danger, means adapted to be controlled by gas-pressure to hold the signal at safety, a local storage-tank of liquefied gas, an inlet-valve for controlling the admission of gas to said controlling means, means for operating said valve and means forming a communication between said controlling means and said tank, whereby the pressure of the gas in the controlling means is automatically maintained.

4. In a railway signal apparatus the combination of a semaphore-blade normally biased to danger, means adapted to be controlled by gas-pressure to hold the signal at safety, a local storage-tank of liquefied gas, an inlet-valve for controlling the admission of gas to said controlling means, means for operating said valve and means including a pressure-reducing valve forming a communication between said controlling means and said tank, whereby the pressure of the gas in the controlling means is automatically maintained.

5. In a railway signal apparatus the combination of a signal normally biased to danger, a local storage supply of liquefied gas, and means controlled by gas-pressure for maintaining the signal at a position of indication against its normal bias.

6. In a signal apparatus, the combination of a signal; storage means containing a supply of liquefied gas; means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in 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.

7. In a signal apparatus, the combination of a signal; storage means containing a sup-

ply of liquefied gas; means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication; train-controlled means for releasing said retained gas; and means other than said stored supply of liquefied gas to cause the signal to assume a condition of different indication.

8. In a signal apparatus, the combination of a signal; storage means containing a supply of liquefied gas; means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication; electric means for releasing said retained gas; and means other than said stored supply of liquefied gas to cause the signal to assume a condition of different indication.

9. In a signal apparatus, the combination of a signal; storage means containing a supply of liquefied gas; means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication; train-controlled electric means for releasing said retained gas; and means other than said stored supply of liquefied gas to cause the signal to assume a condition of different indication.

10. In a 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 and retaining said gas at the reduced pressure to cause the signal to assume and be maintained by gas-pressure in a condition of indication.

11. In a signal apparatus, the combination of a signal; storage means containing a supply of liquefied gas; a reducing-valve; and means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication.

12. In a signal apparatus, the combination of a signal; storage means containing a supply of liquefied gas; an automatic reducing-valve; and means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication.

13. In a signal apparatus, the combination of an exposed signal having a landscape background; said signal being normally biased toward one position of indication; storage means containing a supply of liquefied gas; and means for applying and retaining gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication.

14. In a signal apparatus, the combination of an exposed signal having a landscape background; storage means containing a supply of liquefied gas; and means for applying and retaining at a reduced pressure gas supplied from said storage means to cause the signal to assume and be maintained by gas-pressure in a condition of indication.

15. 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 and retaining gas supplied from said storage means to move the signal to and maintain it by gas at a position of indication.

16. In a 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 signal to and maintain it by gas-pressure at a position of indication.

17. In a 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; storage means containing liquefied gas; an automatic reducing-valve; means for applying and retaining gas supplied from said storage means at reduced pressure to move the signal to and maintain it by gas-pressure at safety; and train-controlled means for releasing the retained gas whereby the signal may go to danger.

18. In a 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 indication by changes in its position; storage means containing liquefied gas; in automatic reducing-valve; means for applying and retaining gas supplied from said storage means at reduced pressure to move the signal to and maintain it by gas-pressure at safety, said means including supply and exhaust valves operating simultaneously; and a train-controlled magnet for operating said valves, whereby when the supply-valve is opened and the exhaust-valve is closed the signal is moved to safety, and is maintained at safety by gas-pressure retained for maintaining the signal at safety, and whereby when the exhaust-valve is opened and the supply-valve is closed the retained gas is released to permit the signal to go to danger.

19. In a signal apparatus, the combination of a signal; a stored supply of liquefied gas; means for applying and retaining gas taken from said stored supply to cause the signal to assume and be maintained by gas-pressure at a condition of indication, and a low-pressure chamber between the gas-supply and the signal.

20. In a signal apparatus, the combination

of a signal; a stored supply of liquefied gas; means for applying and retaining gas taken from said stored supply to cause the signal to assume and be maintained by gas-pressure at a condition of indication, said means including supply and exhaust valves; and an automatic reducing-valve.

21. In a railway-signal apparatus, the combination of a pivoted semaphore-blade having a weight to give it a normal bias to danger position; a tank containing liquefied gas; means for applying and retaining gas supplied from said tank to move the blade to and maintain it at safety by gas-pressure, said means including a piston-chamber in operative connection with the blade and in communication with said tank, and said means also including supply and exhaust valves, said supply-valve operating when opened to supply the gas which moves the blade to safety and which maintains the blade at safety, and said exhaust-valve operating when opened to release the gas which is retained to maintain the blade at safety; an automatic reducing-valve; and train-controlled magnetic means for operating the supply and exhaust valves, said magnetic means being energized to open the supply-valve and close the exhaust-valve.

22. In a signal apparatus, the combination of a signal normally biased to one condition of indication; a tank containing liquefied gas; and means for applying and retaining gas supplied from said tank to cause the signal to assume and be maintained by gas-pressure at a condition of indication against its normal bias, said means including a gas-pressure-applying device to move the signal and an exhaust-valve to release the retained gas and thereby permit the signal to assume another condition of indication.

23. In a signal apparatus, the combination of a signal normally biased to one condition of indication; a tank containing liquefied gas; and means for applying and retaining gas supplied from said tank to cause the signal to assume and be maintained by gas-pressure at a condition of indication against its normal bias, said means including a piston and piston-chamber to move the signal and an exhaust-valve to release the retained gas and thereby permit the signal to assume another condition of indication.

24. In a signal apparatus, the combination of a signal normally biased to one condition of indication; a tank containing liquefied gas, a reducing-valve, and means for applying and retaining gas supplied from said tank to cause the signal to assume and be maintained by gas-pressure at a condition of indication against its normal bias, said means including a gas-pressure-applying device to move the signal and an exhaust-valve to release the retained gas and thereby permit the signal to assume another condition of indication.

25. In a signal apparatus, the combination of a signal normally biased to one condition of indication; a tank containing liquefied gas; a reducing-valve; and means for applying and retaining gas supplied from said tank to cause the signal to assume and be maintained by gas-pressure at a condition of indication against its normal bias, said means including a piston and piston-chamber to move the signal and an exhaust-valve to release the retained gas and thereby permit the signal to assume another condition of indication.

26. In a signal apparatus, the combination of a signal normally biased to one condition of indication; a tank containing liquefied gas; a reducing-valve; and means for applying and retaining gas supplied from said tank to cause the signal to assume and be maintained by gas-pressure at a condition of indication against its normal bias, said means including a gas-pressure-applying device to move the signal, an exhaust-valve to release the retained gas and thereby permit the signal to assume another condition of indication and a magnet to operate said exhaust-valve.

27. In a signal apparatus, the combination of a signal normally biased to one condition of indication; a tank containing liquefied gas; a reducing-valve; means for applying and retaining gas supplied from said tank to cause the signal to assume and be maintained by gas-pressure at a condition of indication against its normal bias, said means including a piston and piston-chamber to move the signal, an exhaust-valve to release the retained gas and thereby permit the signal to assume another condition of indication and a magnet to operate said exhaust-valve.

28. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of tanks containing liquefied gas, one for each signal; a series of devices, one for each signal, for applying and retaining gas supplied from said tanks to move the signals to and maintain them at safety by gas-pressure, each of said devices including supply and exhaust valves, said exhaust-valve operating when opened to release the gas which is retained to maintain the signal at safety; an automatic reducing-valve for each signal; and train-operated means for controlling the signals.

29. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of tanks containing liquefied gas, one for each signal; a series of devices, one for each signal, for applying and retaining gas supplied from said tanks to move the signals to and

maintain them at safety by gas-pressure each of said devices including supply and exhaust valves, said exhaust-valve operating when opened to release the gas which is retained to maintain the signal at safety; an automatic reducing-valve for each signal; and train-operated magnetic means for each signal operating when energized to open the supply-valve and close the exhaust-valve and when deënergized to close the supply-valve and open the exhaust-valve.

30. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of tanks containing liquefied gas, one for each signal; a series of devices, one for each signal, for applying and retaining gas supplied from said tanks to move the signals to and maintain them at safety by gas-pressure, each of said devices including a piston and piston-chamber and supply and exhaust valves, said exhaust-valve operating when opened to release the gas which is retained to maintain the signal at safety; an automatic reducing-valve for each signal; and train-operated means for controlling the signal.

31. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of tanks containing liquefied gas, one for each signal; a series of devices, one for each signal for applying and retaining gas supplied from said tanks to move the signals to and maintain them at safety by gas-pressure, each of said devices including a piston and piston-chamber and supply and exhaust valves, said exhaust-valve operating when opened to release the gas which is retained to maintain the signal at safety; an automatic reducing-valve for each signal; and train-operated magnetic means for each signal operating when energized to open the supply-valve and close the exhaust-valve and when deënergized to close the supply-valve and open the exhaust-valve.

32. In a 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; storage means containing liquefied gas; an automatic reducing-valve; means for applying and retaining gas supplied from said storage means at reduced pressure to move the signal to and maintain it by gas-pressure at safety, said means including supply and exhaust valves mounted on the same stem and operating simultaneously; and a train-controlled magnet for operating said valves, said magnet being energized to open the supply-valve and close the exhaust-valve and being deënergized to close the supply-valve and open the exhaust-valve, whereby when the supply-valve is opened and the exhaust-valve is closed the signal is moved to safety, and is maintained at safety by gas-pressure retained for maintaining the signal at safety, and whereby when the exhaust-valve is opened and the supply-valve is closed the retained gas is released to permit the signal to go to danger.

33. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; and means for operating said supply-valve whereby gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure.

34. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; and electrically-controlled means for operating said supply-valve whereby gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure.

35. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; and means for simultaneously opening the supply-valve and closing the exhaust-valve and holding said valves in said positions whereby gas may be supplied to said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure.

36. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; means for opening the supply-valve and closing the exhaust-valve and holding said valves in said positions whereby gas may be supplied to said gas-pressure-applying chamber to move

the signal against its normal bias to and hold it at another position of indication by gas-pressure; an automatic reducing-valve in the connection between said supply-valve and said tank whereby when the supply-valve is open a predetermined gas-pressure may be automatically maintained in said chamber to hold the signal against its normal bias.

37. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber designed and arranged to operate simultaneously in reverse; and electrically-controlled means for moving said valves from one position to another and there maintaining them, whereby when the supply-valve is opened and the exhaust-valve is closed gas may be supplied to said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure, and whereby when said valves are reversed the signal may return to and remain in the position of its normal bias.

38. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; an automatic reducing-valve for said tank; and means for operating said supply-valve whereby gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure.

39. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber designed and arranged to operate simultaneously in reverse; an automatic reducing-valve for said chamber; and electrically-controlled means for operating said supply and exhaust valves in both directions, whereby when the supply-valve is opened and the exhaust-valve is closed gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure, and whereby when said supply and exhaust valves are reversed the signal may return to and remain in the position of its normal bias.

40. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; and means for operating said supply-valve whereby gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to hold it at another position of indication by gas-pressure.

41. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; means for opening the supply-valve and closing the exhaust-valve and holding said valves in said positions whereby gas may be supplied to said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure; an automatic reducing-valve in the connection between said supply-valve and said tank whereby when the supply-valve is open a predetermined gas-pressure may be automatically maintained in said chamber to hold the signal against its normal bias.

42. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; an automatic reducing-valve for said tank; and means for operating said supply-valve whereby gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure.

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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply

and exhaust valves for said gas-pressure-applying chamber designed and arranged to operate simultaneously in reverse; an automatic reducing-valve for said chamber; and electrically-controlled means for operating said supply and exhaust valves in both directions, whereby when the supply-valve is opened and the exhaust-valve is closed gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure, and whereby when said supply and exhaust valves are reversed the signal may return to and remain in the position of its normal bias.

44. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; a signal-circuit for operating said supply-valve whereby gas may be supplied to and maintained in said chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure; and train-actuated means for operating said signal-circuit.

45. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; supply and exhaust valves for said gas-pressure-applying chamber; means for operating said supply-valve whereby gas may be supplied to and maintained in said gas-pressure-applying chamber to move the signal against its normal bias and to hold it at another position of indication by gas-pressure; and a track-circuit for controlling said valve-operating means.

46. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in controllable communication with said tank; an automatic reducing-valve for said tank; supply and exhaust valves for said gas-pressure-applying chamber; a signal-circuit for operating said supply-valve whereby gas may be supplied to and maintained in said chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure; and train-actuated means for operating said signal-circuit.

47. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves controlling the admission to and presence of gas in said chamber; and means operating to open said supply-valve whereby gas may be admitted to and maintained in said chamber to move the signal to and hold it at safety by gas-pressure.

48. 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 for liquefied gas independent of any outside power source; 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 controlling the admission to and presence of gas in said chamber; and means operating to open said supply-valve whereby gas may be admitted to and maintained in said chamber to move the signal to and hold it at safety by said gas-pressure.

49. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves controlling the admission to and presence of gas in said chamber; train-actuated means in advance of said signal operating to open said supply-valve whereby gas may be admitted to and maintained in said chamber to move the signal to and hold it at safety by gas-pressure; and train-actuated means in the rear of said signal for opening said exhaust-valve to cause the signal to go to danger.

50. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves controlling the admission to and presence of gas in said chamber; a track-circuit in advance of said signal operating to open said supply-valve whereby gas may be admitted to and maintained in said chamber to move the signal to and hold it at safety by gas-pressure; and a track-circuit in the rear of said signal for opening said exhaust-valve to cause the signal to go to danger.

51. 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 for liquefied gas independent of any outside power source; 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 controlling the admission to and presence of gas in said chamber; a track-circuit in advance of said signal operating to open said supply-valve whereby gas may be admitted to and maintained in said chamber to move the signal to and hold it at safety by gas-pressure; and a track-circuit in the rear of said signal for opening said exhaust-valve to cause the signal to go to danger.

52. In a signal apparatus, the combination of a signal having a normal bias to one position of indication; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves for said chamber whereby gas may be supplied to and maintained in said chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure; a signal-circuit for operating said valves; and one or more track-circuits for controlling said signal-circuit.

53. 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves for said chamber whereby gas may be supplied to and maintained in said chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure; a signal-circuit for operating said valves; and one or more track-circuits for controlling said signal-circuit.

54. 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 for liquefied gas independent of any outside power source; 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 whereby gas may be supplied to and maintained in said chamber to move the signal against its normal bias to and hold it at another position of indication by gas-pressure; a signal-circuit for operating said valves; and one or more track-circuits for controlling said signal-circuit.

55. In a signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position; a pressure-storage tank for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves for said chamber whereby gas may be supplied to and maintained in said chamber to move the signal to and hold it at safety; a normally open signal-circuit operating when closed to put the signal to safety; a track-circuit in advance of the signal adapted to be operated by a train to close the signal-circuit; and a track-circuit in the rear of the signal adapted to be operated by a train to open the signal-circuit.

56. In a 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 for liquefied gas independent of any outside power source; a gas-pressure-applying chamber in operative connection with said signal and in communication with said tank; supply and exhaust valves for said chamber whereby gas may be supplied to and maintained in said chamber to move the signal to and hold it at safety; a normally open signal-circuit operating when closed to put the signal to safety; a track-circuit in advance of the signal adapted to be operated by a train to close the signal-circuit; and a track-circuit in the rear of the signal adapted to be operated by a train to open the signal-circuit.

57. In a signal apparatus, the combination of a signal normally at danger and having a normal bias to danger position; a pressure-storage tank for liquefied gas independent of any outside power source; 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 whereby gas may be supplied to and maintained in said chamber to move the signal to and hold it at safety; a normally open signal-circuit operating when closed to put the signal to safety; a track-circuit in advance of the signal adapted to be operated by a train to close the signal-circuit; and a track-circuit in the rear of the signal adapted to be operated by a train to open the signal-circuit.

58. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of detachable and replaceable pressure-storage tanks for liquefied gas, one for each signal and independent of any outside power source; a series of gas-pressure-applying chambers, one for each tank, in operative connection with a signal and in controllable communication with its associated tank; supply and exhaust valves for each of said chambers; and train-operated means for operating said supply-valves whereby gas may

be supplied to and maintained in said chambers to move the signals to and hold them at safety position.

59. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of detachable and replaceable pressure-storage tanks for liquefied gas, one for each signal and independent of any outside power source; an automatic reducing-valve for each tank; a series of gas-pressure-applying chambers, one for each tank, in operative connection with a signal and in controllable communication with its associated tank; supply and exhaust valves for each of said chambers; and train-operated means for operating said supply-valves whereby gas may be supplied to and maintained in said chambers to move the signals to and hold them at safety position.

60. In a railway signaling system, the combination of a series of signals each having a normal bias to danger position; a series of detachable and replaceable pressure-storage tanks for liquefied gas, one for each signal and independent of any outside power source; a series of gas-pressure-applying chambers, one for each tank, in operative connection with a signal and in controllable communication with its associated tank; supply and exhaust valves for each of said chambers whereby gas may be supplied to and maintained in said chambers to move the signals to and hold them at safety by gas-pressure; and train-operated electric circuits for operating said valves.

61. In a railway signaling system, the combination of a series of signals normally at danger each having a normal bias to danger position; a series of detachable and replaceable pressure-storage tanks for liquefied gas, one for each signal and independent of any outside power source; a series of gas-pressure-applying chambers, one for each tank, in operative connection with a signal and in controllable communication with its associated tank; supply and exhaust valves for each of said chambers whereby gas may be supplied to and maintained in said chambers to move the signals to and hold them at safety by gas-pressure; a normally open signal-circuit for each signal; a track-circuit in advance of each signal operating to close a signal-circuit to put its signal to safety; and a track-circuit in the rear of each signal operating to open a signal-circuit to put its signal to danger.

62. In a railway signaling system, the combination of a series of signals normally at danger each having a normal bias to danger position; a series of detachable and replaceable pressure-storage tanks for liquefied gas, one for each signal and independent of any outside power source; an automatic reducing-valve for each tank; a series of gas-pressure-applying chambers, one for each tank, in operative connection with a signal and in controllable communication with its associated tank; supply and exhaust valves for each of said chambers whereby gas may be supplied to and maintained in said chambers to move the signals to and hold them at safety by gas-pressure; a normally open signal-circuit for each signal; a track-circuit in advance of each signal operating to close a signal-circuit to put its signal to safety; and a track-circuit in the rear of each signal operating to open a signal-circuit to put its signal to danger.

63. The combination of a semaphore-blade, a weight for moving the blade toward the danger position, a piston and piston-cylinder, a connecting-rod between said piston and said semaphore-blade, a hood secured to said rod to cover said cylinder and means for admitting gas to said cylinder to move the signal to safety.

64. The combination of a semaphore-blade normally biased to danger, a weight for moving the blade toward the danger position, a piston and piston-cylinder, a connecting-rod between said piston and said semaphore-blade, covering means for said cylinder secured to and moving with said rod, and means for admitting gas to said cylinder to move the signal to safety.

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

CLYDE J. COLEMAN.

Witnesses:
E. F. PORTER,
NICHOLAS M. GOODLETT, Jr.