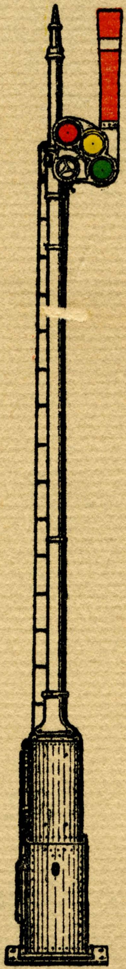
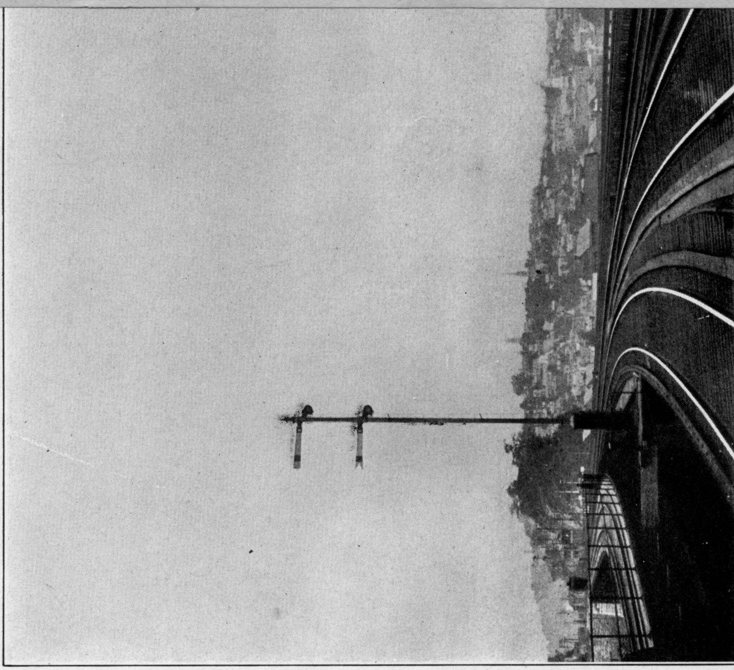
The HALL-ELECTRO-GAS AUTOMATIC-SEMAPHORE SIGNAL



OBF June -1917

Says there seems to be 2 different castings
19.133 - Rel to Rt & left hand clutch levers
should have upper lip taken off, this was
on dwg 1912 - pattern apparently not changed

405335



Hall "Normal Danger" Electro-gas Si

THE HALL ELECTRO-GAS AUTOMATIC SEMAPHORE SIGNAL

IN PRESENTING THIS ADDITION TO OUR CIRCULARS, WE WISH TO CALL YOUR SPECIAL ATTENTION TO OUR ELECTRO-GAS AUTOMATIC SEMAPHORE SIGNAL.

TIME AND USE HAVE ADDED TO ITS VALUE: USE HAS FULLY DEMONSTRATED THE UNDENIABLE FACT THAT THIS ELECTRO-GAS SIGNAL HAS MORE MERIT THAN ANY OTHER AUTOMATIC SEMAPHORE SIGNAL NOW KNOWN.

1907

THE HALL SIGNAL COMPANY

25 BROAD STREET, NEW YORK CITY

1423 MONADNOCK BUILDING, CHICAGO

U. S. A.

WORKS—GARWOOD, N. J.

Circular No. 10

THE HALL ELECTRO-GAS

AUTOMATIC SEMAPHORE SIGNAL

ON the fourth of February, 1902, the first electro-gas signal was placed in actual service on the Lehigh Valley Railroad near Buffalo. This signal, although somewhat crude as compared with later designs, was the result of years of work and experiments by the engineers of The Hall Signal Company.

Previous to this initial installation there were at least four types of automatic signals (all of which have merit), one of the first called the "Disc," the next the "Clock-work banjo," then "Electro-pneumatic" semaphore, then the "Electric motor" semaphore. Few of the "Clock-work banjo" are still in use. The "Electro-pneumatic," on account of its large initial cost, is confined to very few roads. The "Disc" is very largely used, and has been a most important factor in the art of signaling, having proved to be one of the most efficient, reliable and economical signals ever installed.

The "All-electric" motor semaphore signal is being used very largely throughout this country.

To simplify as well as to invent a thoroughly reliable signal mechanism combining all of the good features of other automatic signals, The Hall Signal Company concentrated its efforts and produced the "Electro-gas" signal, which has all of the advantages of the "electro-pneumatic" and electric motor semaphore signals, comprising the four main qualities in its mechanism, such as reliability, durability, simplicity and economy, as well as quickness in its movement. The very large number made and installed in the past few years has fully demonstrated the undeniable fact that no other automatic semaphore signal in operation has given such reliable service nor operated with as much economy.

THE ELECTRO-GAS SIGNAL

Liquified carbonic acid gas is the most available source of power for automatic signaling. It is made in hundreds of places in the United States for soda-water fountains and other uses, is inexpensive and is safe for transportation. It can be stored for long-time intervals in small bulk. Here we have the local power advantage. Its expansive power is enormous and easily regulated. Here we have the direct power advantage, and simplicity of mechanism is possible. During expansion it is dry and (for practical purposes) incapable of freezing. While exhausting from the cylinder after clearing the signal it rapidly absorbs whatever moisture there may be in the case, and thus tends to greatly decrease the likelihood of clogging by freezing, and the great bugbear of the electric motor signal is thus removed. Therefore, we see that in adapting liquid gas to signal use a basic principle of the ideal automatic signal was discovered. Is it surprising that in testifying before the Patent Commissioners disinterested experts have called it "a revolution in railroad signaling?"

The great problem that The Hall Signal Company encountered in developing the electro-gas signal was to find compositions of metals sufficiently compact to prevent leakage, to devise gas-tight unions and joints, and to invent simple, durable valves that would not leak. The first and second problems were not extremely difficult to solve, but the development of the valves for the gas flask and signal mechanism took years. It was not until the late Summer of 1902 that The Hall Company felt sure that a valve had been perfected which, when properly installed and cared for, would not leak. A section of the mechanism valve is shown in Fig. 4.

The electro-gas semaphore signal is the same in outward appearance as the electric motor signal. The spectacle casting, tubular iron post and sheet-steel mechanism and battery case are equally adapted to the all-electric or electro-gas motors. The base casting

Hall Standard Two-arm Mast

of the motor box is fastened by anchor bolts to the concrete base. Buried in the ground beside the base is an iron chute designed to hold two gas flasks. The flasks are 4 feet 4 inches high and 8½ inches in outside diameter. They weigh when empty about 96 pounds, and are charged with 50 pounds of liquified gas. On the top of the flask is a valve with a connection leading to the

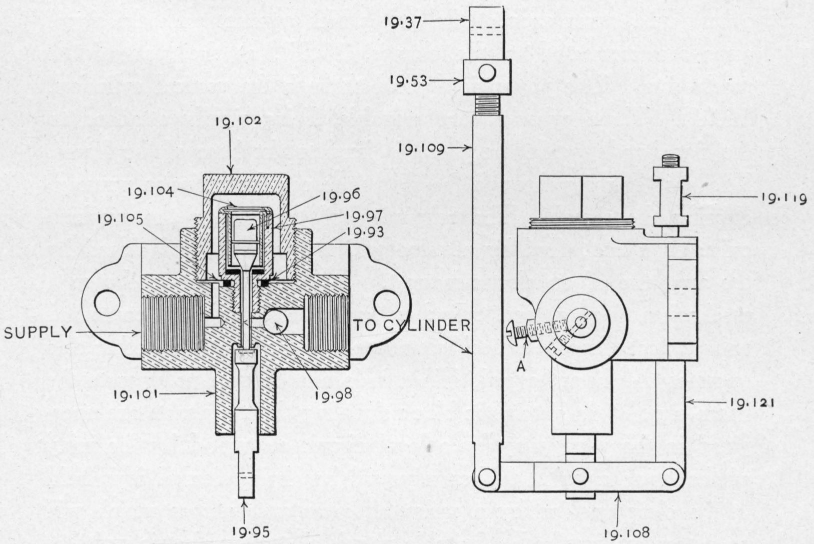


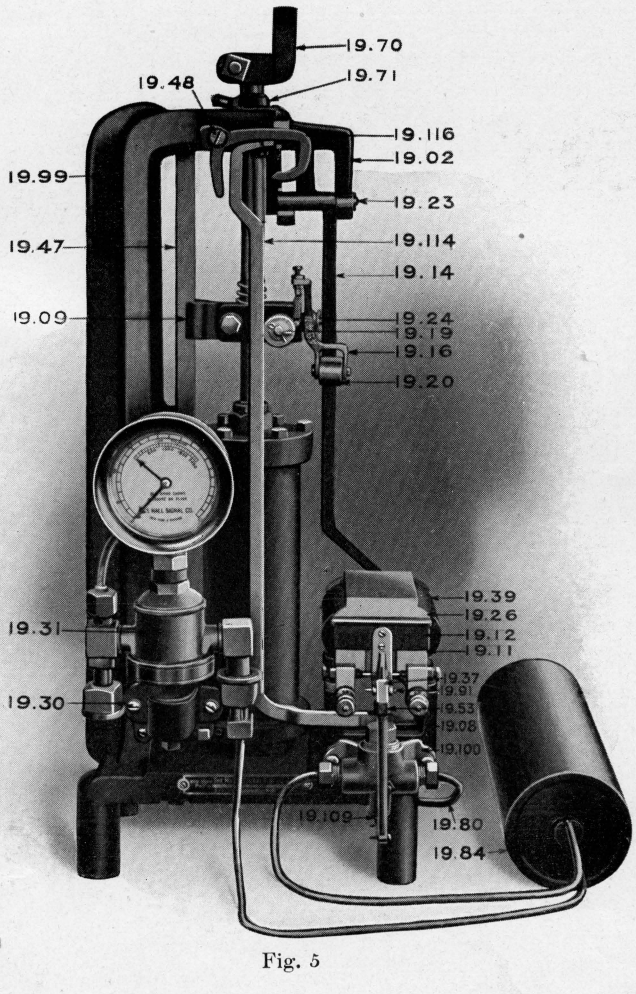
Fig. 4

reducing valve in the motor box. The pressure in the newly-charged flask is about 600 pounds per square inch, varying somewhat with the temperature, and this is reduced to about 40 pounds for working pressure at the signal. These flasks are tested to 3700 pounds to avoid the possibility of explosion if left lying in the hot sun or roughly handled during transportation. They also have a safety valve which will blow off at 2400 pounds pressure. These safeguards are used because the pressure increases with rising temperature. If the tanks were left lying in an intensely hot sun a sufficient length of time the pressure might increase to the blowing-off point.

The apparatus for working the signal is shown in detail in Figs. 4, 5 and 6. Fig. 6 is a view of the double gas mechanism for working a home and distant signal on the same post. The lower ends of the rods which connect with the signal arms are connected to the clamps, 19.70, at the tops of the mechanism. The power is applied through the vertical cylinders, 19.00. These cylinders are movable, being rigidly attached to the signal rods, while the piston is fixed to the base of the frame. The gas, entering through the piston, forces the cylinder upward, clearing the signal. The admission of the gas to the working cylinders is controlled by a valve which is opened and closed by the armature of an electro-magnet. In the engraving is shown a mechanism having two cylinders and two electrically controlled valves: one side of the mechanism operates the home, the other side operates the distant signal. Either side can be used to operate the home signal. In automatic block signaling these magnets are energized in the usual way by a local circuit controlled by the relay of the track circuit. When a signal has been cleared it is held in the clear position by a series of levers and latches which will be presently described. Suitable circuit closers or electric switches are provided to insure the operation of the two signals in proper sequence, the distant to be cleared after the home signal has been cleared.

The construction of the mechanism is shown in Fig. 5. In referring to this drawing, the general number (19) will be omitted, 19.00 being referred to as 00. In Figs. 4, 5 and 6, 01 is the frame, 00 the cylinder and piston complete.

Pipe 79 leads from the reducing valve 31 to the expansion



19.70
19.71
19.48
19.116
19.02
19.99
19.23
19.114
19.47
19.14
19.09
19.24
19.19
19.16
19.20
19.39
19.26
19.31
19.12
19.11
19.37
19.91
19.30
19.53
19.08
19.100
19.109
19.80
19.84

Fig. 5

chamber, and from there to the electrically-controlled valves 100. Pipe 82 connects the supply tank to the reducing valve. The armatures 12 operate the valves 100 by means of 109 and the other connections shown in Fig. 4. Clutch levers 14 and 15 hold the signal clear.

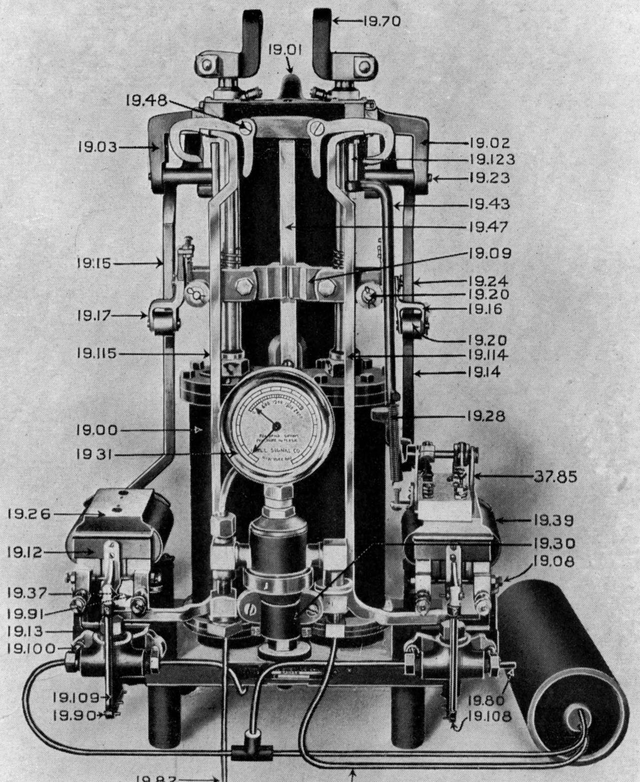
Nos. 16 and 17 are buffer levers to prevent the clutch lever from striking the ends of the magnets when the signal goes to danger. They also hold the clutch armature a short distance from the poles of the magnets while the signal is at danger to prevent them from freezing fast in case moisture condenses on them in freezing weather.

Cut-off levers 114 and 115 are to cut off the supply of gas from the working cylinder and allow it to escape when the signal has reached the clear position. These levers are controlled by pawls 116. The clutch casting 09 is clamped on the cylinder rod, and is guided by the guide rod 47. The clutch casting can be placed higher or lower on the cylinder rod so as to change the stroke of the cylinder. It also carries the roller 20, which engages the pawl 116 at the end of the upward stroke and cuts off the gas, the signal then reaches the position for which it is adjusted.

The magnets 39 have front armatures to operate the gas valve and rear armatures to hold the signal in the clear position. No. 85 on top of the right-hand magnet is an electric switch operated by rod 43 when it is engaged by the stud 19.

The gauge on the reducing valve 31 has two pointers, and shows both the pressure in the supply tank and the working pressure.

In clearing the signal the magnets 39 are energized and the armatures 07 and 12 are attracted, and the valve is opened by means of its connections, 37, 109 and 108. The exhaust valve 95 is forced against its seat and supply valve 96 is opened, allowing gas to enter the working cylinder through the pipe 80. This



19.70
19.01
19.48
19.03
19.02
19.123
19.23
19.43
19.47
19.09
19.15
19.24
19.20
19.16
19.17
19.20
19.115
19.114
19.14
19.28
19.00
19 31
37.85
19.26
19.39
19.12
19.30
19.08
19.37
19.91
19.13
19.100
19.109
19.90
19.80
19.108
19.82
19.79

Fig. 6

forces the cylinder up and puts the signal in the clear position. As soon as the latch in 09 has passed the toe of clutch lever 24, the roller 20 raises the pawl 116 and allows the cut-off lever 114 to move downward. This being engaged with the nut 119 forces the links 121 and 108 down, opening the exhaust valve 95 and closing the supply valve 96. The entire weight of the signal now rests upon the latch, where it is engaged with the clutch lever, and is held in the all-clear position on account of the magnets being energized and holding the armature in the rear of the magnets.

The electric switch 85, used to change the current in the magnets after the signal is cleared, is operated by means of the stud 19 raising the rod 43 and rotating the shaft of the switch which makes the contacts.

When the magnets are de-energized, as by the entrance of a train to the section, the rear armature is released, and the clutch lever 24 swings backward and allows the latch to pass the toe of this lever. The signal then assumes the danger or stop position by gravity. The cylinder acts as a dash pot for the signal when going to the danger position.

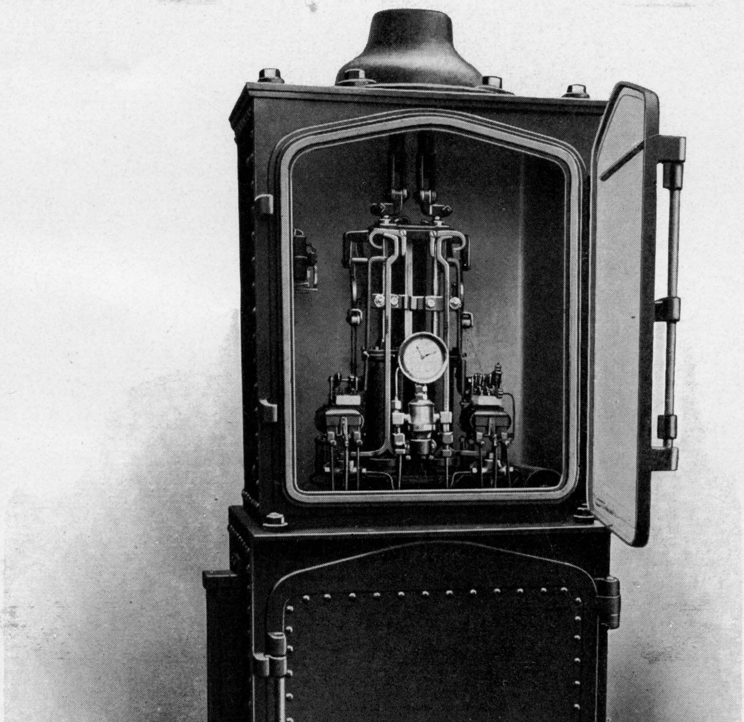
The expansion chamber, which is connected between the reducing valve and the electrically controlled valve, serves as an auxiliary low pressure storage chamber. On account of the reserve supply of low pressure gas obtained in this way, the reducing valve is not required to operate as rapidly as would be necessary if no expansion chamber was used, and on account of the relatively great cubic capacity of the expansion chamber it prevents undue pressure on evaporation of the carbonic acid snow, which is deposited during the operation of the reducing valve when the gas becomes liquified in the pipes leading to it.

If no expansion chamber was used a small amount of snow evaporating in the low pressure chamber of the reducing valve, because of its small cubic capacity, would create an excessive pressure. The gas becomes intensely cold during expansion from a high pressure or liquified state to a low pressure, and the expansion chamber, on account of its relatively great capacity, permits the gas to absorb heat until it becomes as warm as the surrounding atmosphere and to increase in volume before entering the operating cylinder. On account of the increase in volume more operations are obtained per pound of gas.

The cylinders and pistons are made of phosphor-bronze and ground to fit; no packing rings are used and very little lubrication is required. The area of the piston is 5 square inches. By using 40-pound pressure, which makes a force of 200 pounds, there will be at least a margin of 50 pounds over the weight of the ordinary blade grip. This margin can be increased to anything desired, by increasing the gas pressure. With this pressure and a 60-degree movement of the arm, 250 signal movements are possible per pound of gas, or 12,500 from each 50-pound tank of gas.

One end of the magnets is utilized to hold the signal clear and the other to operate the valve. The amount of energy required to operate the valve is .1 watt, and to hold the signal clear is .045 watt. By means of two windings on the magnets the energy is reduced, after the valve is operated and the signal is cleared. The two windings are used in multiple to operate the valve; then the low winding is disconnected and the signal is held clear with the other; or, in case of slow releasing clutches, the one winding is disconnected from the battery and closed upon itself to prevent the cores becoming immediately demagnetized. A current of 4 volts is used on these slow releasing clutch magnets and .0113 ampere. With this energy the signal is held clear 2½ seconds after the circuit is opened. This slow releasing clutch was devised to use with a polarized relay circuit to avoid the signal mechanism starting to drop to the stop position at the change of polarity.

The electro-gas signal adapted to a three-position movement



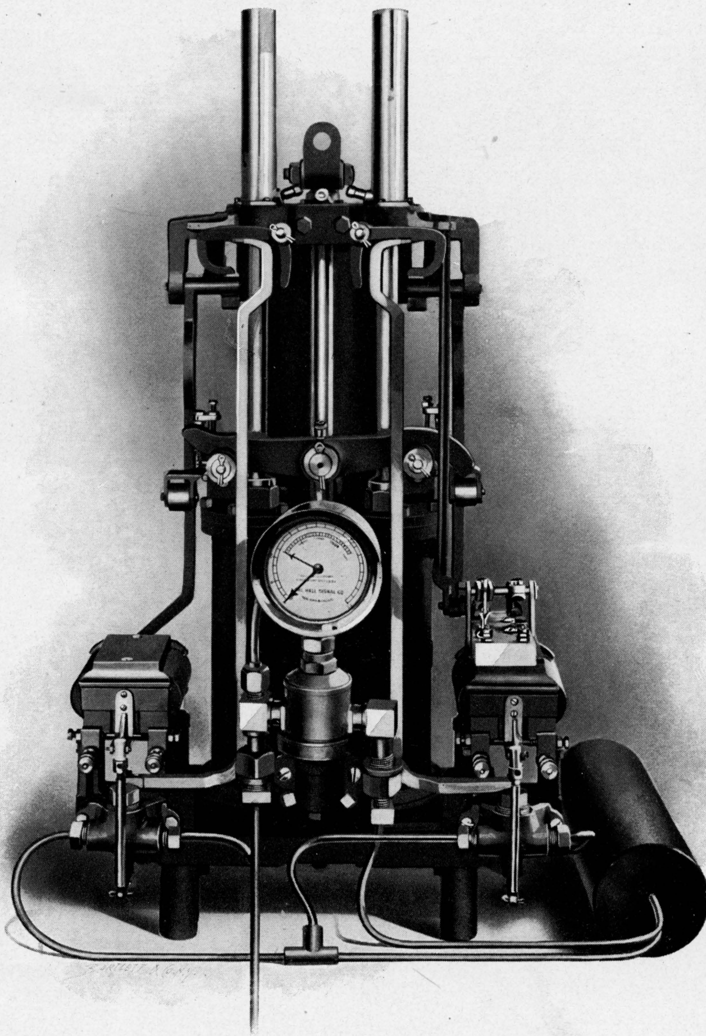
Hall Battery and Mechanism Case

of one blade, instead of using a home and a distant blade, is shown in accompanying illustration. The introduction of a walking beam and the use of one signal rod in place of two, changes the double--signal mechanism into a three-position signal. When one of the cylinders is moved to the clear position the blade assumes an angle of 45 degrees and shows one block ahead clear. When the other cylinder moves to clear, the walking beam carries the signal rod the remainder of the distance and the blade drops to 90 degrees, indicating two blocks in advance clear.

The number of cells of battery necessary to operate the clutch magnets, and the amount of electrical energy consumed, are obviously dependent on the spacing of the signals and the frequency of trains. From four to six cells of Edison or Gordon battery are used on wire circuits of average length, and as only 18 milamperes are required to hold the signal in the clear position, the battery consumption is relatively slight. Assuming the price of liquified gas as 4½ cents per pound, and estimating 250 signal movements per pound of gas, the cost of operating the signal 1000 times is 18 cents plus the cost of battery consumed. These figures are based on the assumption of perfect maintenance and have often been equaled in actual service. The economy of the electro-gas over any other type of automatic semaphore signal is easily seen.

An attractive feature of this signal is the steadiness and rapidity of the movement to the clear position. It clears in from one to two seconds, according to the valve adjustment, and this movement is distinctly pleasant when contrasted with the tedious and uncertain action of the electric motor signal.

The Hall Signal Company finally perfected the electro-gas signal and began commercially introducing it in the late Summer of 1902. In the first year in which it was on the market this company had installed or had on order 1400 signals of this type. When the natural reluctance of railroads to experiment with un-



"Three-position" Electro-gas Signal

tried devices is considered, the revolutionary nature of this invention is well brought out by these figures. If more proof were needed of the immense superiority of the electro-gas signals over all other automatic semaphores, it is given by the action of other signal companies. Soon after this Hall signal appeared other electro-gas signals were devised and their sale attempted without success.

The upper quadrant signal (as represented herein), with the spectacle casting pivotally connected to the support on the blade side of said support, insures first a much lighter spectacle casting or plate, and next under all conditions a bias to the horizontal or danger position.

The "electro-gas" signal mechanism is adapted to any class of semaphore signal, or any system of circuits.

As all railroads in this country will desire to provide signal protection very soon, we take pleasure in sending you this brief circular calling your attention to the "Electro-Gas" signal, and respectfully beg you to investigate fully its uses and merits before adopting any other style, believing you will find just what you want, viz: A reliable, as well as an economical signal, economical not only in the initial cost of installation but in maintenance.