2 Sheets—Sheet 1.

W. E. PRALL.

PNEUMATIC SIGNAL APPARATUS FOR RAILWAYS.

No. 172,487. Patented Jan. 18, 1876.

Fig: 4

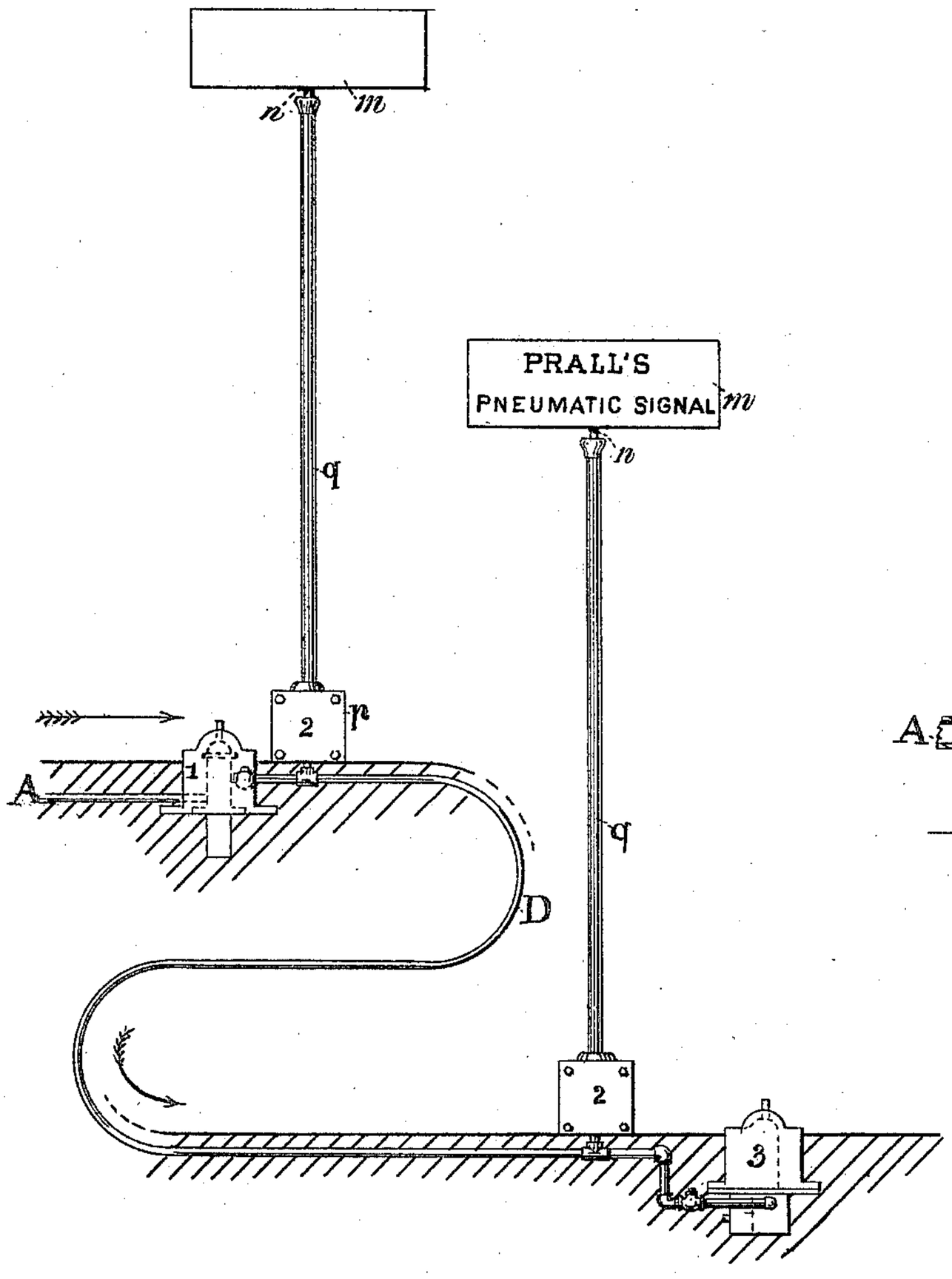
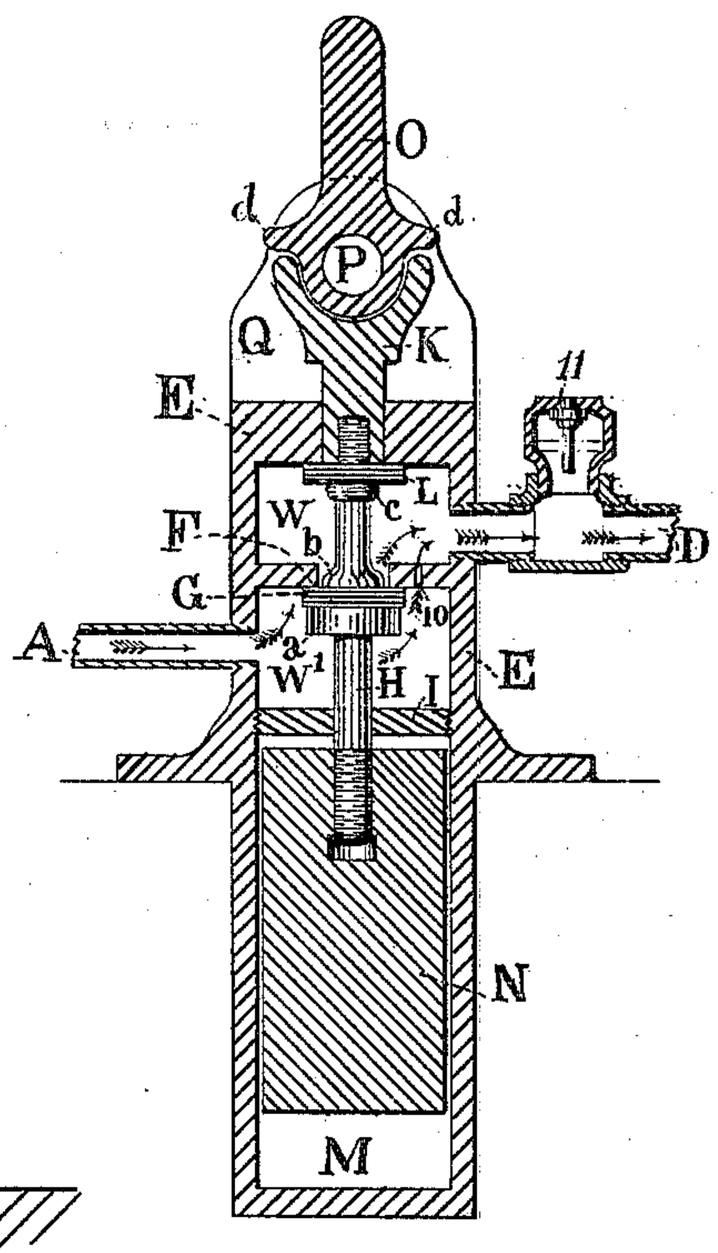


Fig: 1



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2 Sheets—Sheet 2.

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PNEUMATIC SIGNAL APPARATUS FOR RAILWAYS.

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Fig. 3

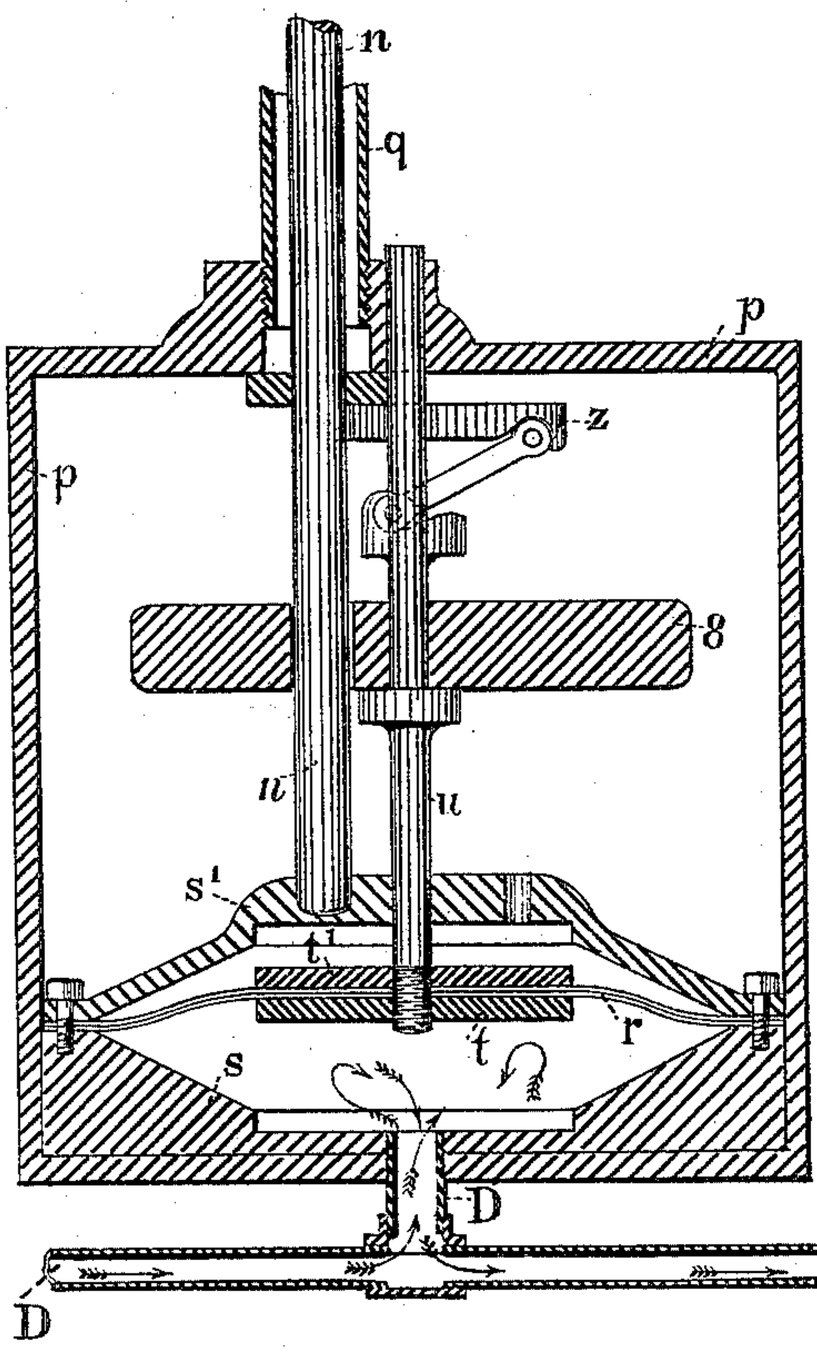
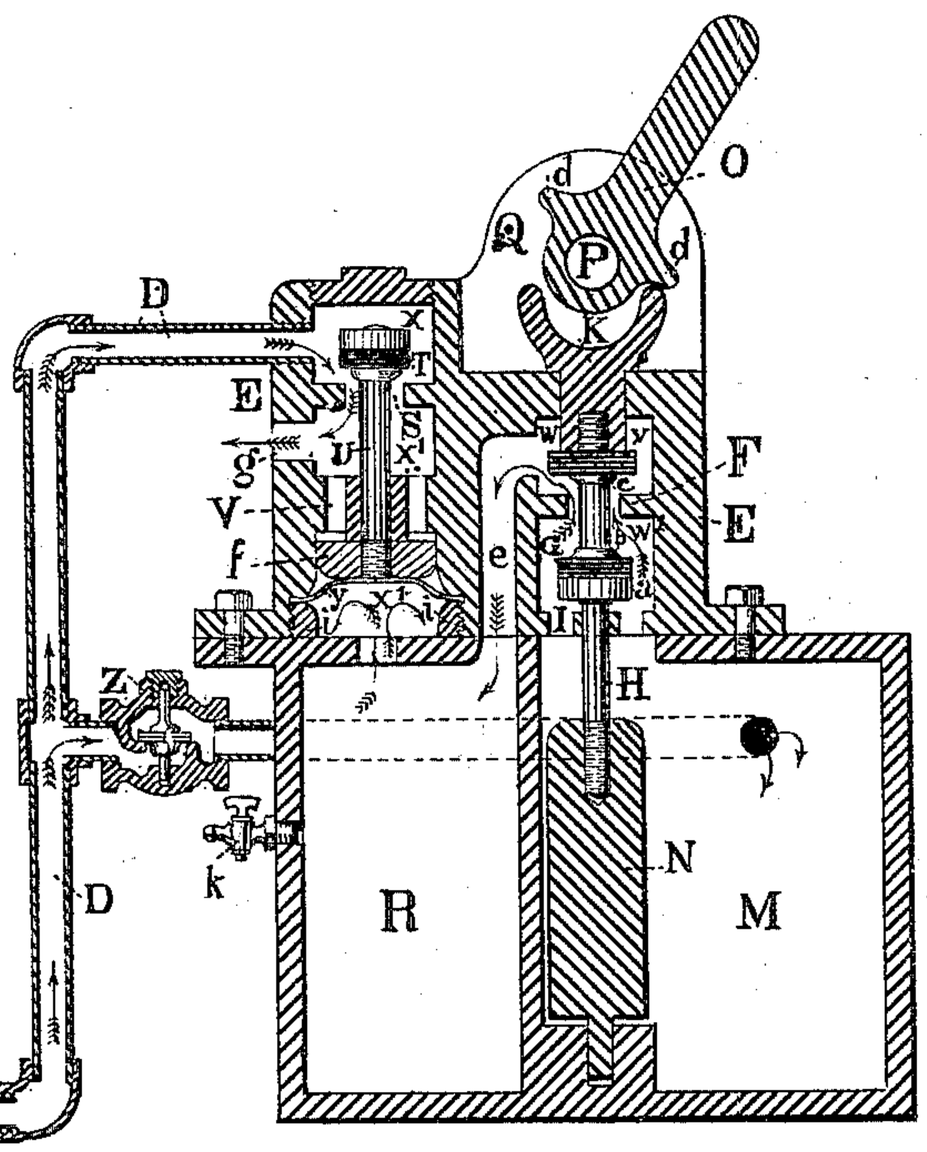


Fig. 2



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IMPROVEMENT IN PNEUMATIC SIGNAL APPARATUS FOR RAILWAYS.

Specification forming part of Letters Patent No. **172,487**, dated January 18, 1876; application filed June 3, 1874.

CASE A.

To all whom it may concern:

Be it known that I, WILLIAM E. PRALL, of Washington, in the District of Columbia, have invented an improved apparatus for operating railroad-signals by means of compressed air, of which the following is a specification:

This invention relates to my pneumatic system for the management of railroads; and has for its object the improvement of the devices for admitting and shutting off the supply of compressed air from the signals on the road, and for actuating the latter.

In the accompanying drawings Figure 1 is a sectional view, illustrating a supply-commutator or valve arrangement for admitting compressed air from the reservoir and supply-pipe of the signal-system to the signal-pipe, to produce a display of the signals; Fig. 2, a similar view, illustrating an exhaust-commutator or valve arrangement for alllowing an exhaust of the compressed air from the signal-pipe to produce a reversal of the signals. Fig. 3, in like manner, illustrates a combination of diaphragm and rod movements for actuating a signal by means of an admission and exhaust of compressed air. Fig. 4 illustrates the combination of the apparatus with a railway.

A is an air main or pipe, kept constantly charged with compressed air supplied thereto by means of a suitable air-compressing pump or engine. D is a pipe extending to the signals, and which is alternately filled with compressed air to display the signals, and relieved thereof to reverse them. Figs. 1 and 2 illustrate the commutators E of the apparatus. Each commutator E is divided into an upper and a lower compartment, W W′, by means of a partition, F, through which a suitable valve-opening is formed. This opening between the compartments W W′ is governed by means of a valve, G, of india rubber, secured to a rod, H, which, projecting upward through the top of the casing, and downward through a cross-bar or plate, I, within the lower compartment, has free vertical movement in its bearings above and below. This valve G is secured by a nut, *a*, screwing upon the rod H against an offset, *b*, formed upon the rod. The upper end of the rod H terminates in a screw, which screws into the shank of a yoke or forked piece, K, and the joint of the bearing of the piece K through the top of the casing is packed by means of a flexible collar, L, which is confined upon the lower end of the piece K by means of an offset, *c*, whose diameter is less than that of the bearing, as shown in Fig. 1. The lower compartment W′ is extended by means of a receiver, M, which (after the rod H has been inserted and secured in place) is secured to the bottom of the casing E of the commutator with an air-tight joint. A weight, N, suspended upon the lower end of the rod H, hangs within the receiver M. In the signal-commutator, Fig. 1, the receiver M serves simply to inclose this weight N, but in the exhaust-commutator, Fig. 2, it is made of such capacity as to serve also as an air-chamber. The rod H, when elevated, is depressed and the valve G opened by means of cams *d d* upon the lower end of a lever, O, pivoted upon an axial rod, P, supported at right angles to the rod H, between the arms of its forked piece K.

In the use of the signal-commutator, Fig. 1) the air supply and pressure pipe A is connected to the lower compartment of the commutator, and the discharge or signal pipe D is connected to its upper compartment. The pressure of air admitted from the supply-pipe A, bearing against the valve G, will keep it closed, support the weight N, and elevate the forked piece K against the cams *d d*. If, now, the lever O be tripped in either direction, the corresponding cam *d*, bearing upon its counterpart-arm of the forked piece K, will force it and the rod H downward, so as to open the valve G and permit the compressed air to flow from the pipe A into the signal-pipe D. So soon, however, as the pressure in the pipe D and the upper compartment W of the commutator has attained such a degree as to bear outwardly upon the transverse area of the shank of the piece K with a force sufficient to more than counterbalance the weight N, it will elevate the rod H and close the valve G,

which will then remain tightly closed, because of the pressure of air against its under surface (especially after the pressure in the pipe D is removed) until it is again forced open by another movement of the lever and cams *d d*.

The pressure of air admitted to the pipe D is automatically determined with exactness in the operation of the commutator by the size of the weight N and the diameter of the shank of the piece K, for a supply of compressed air will continue to flow into the pipe D from the pressure-pipe A until the pressure in the former is sufficiently great to counterbalance the weight N and throw up and close the valve G.

In the construction of the exhaust-commutator, Fig. 2, in addition to the receiver M and compartments W W′, governed by a valve, G, as hereinbefore described, a second receiver, R, is placed by the side of the receiver M, and communication is established between said receiver R and the upper compartment W by means of a passage, *e*, as shown in Fig. 2. The casing E is also extended to embrace an upper and lower compartment, *x* and *x′*, separated by a centrally-perforated partition, S. The aperture in this partition is closed by a valve, T, placed in the upper compartment *x*, and secured to a rod, U, which extends down through an extended bearing, V, in the lower compartment *x′*, and terminates in a piston, *f*, playing freely in the lower end of said compartment *x′*. The rod and piston have sufficient longitudinal movement to admit of a wide opening of the valve T. The lower portion of the compartment *x′*, below the bearing V, communicates freely with the receiver R; but an elastic or flexible diaphragm, Y, is closely confined at its edges by means of a ring, *i*, which screws up against a shoulder, as shown in the drawing, Fig. 2. The center of the diaphragm Y is left sufficiently loose to bear up against the base of the piston *f* throughout its entire movement, and is thereby supported and protected from undue strain under the great pressure of air against it from below, while at the same time it constitutes a most effectual and complete packing for the piston, preventing all possibility of a leak of air around its circumference.

The signal-pipe D is connected with the upper compartment *x* of this commutator, and an exhaust-vent, *g*, is formed in the lower compartment *x′*, so that when the valve is opened a free exhaust-passage is opened from the pipe D out through said vent *g*.

The receiver M is placed in connection, either directly with a pressure-pipe, A, or, as shown in Fig. 2, with the signal-pipe D. Where it is connected with the signal-pipe D a check-valve, Z, opening toward the receiver, is so placed in the branch pipe employed to form said connection as to prevent a return of air from the receiver to the pipe D.

With the exhaust-commutator thus constructed and arranged the weight of the piston *f* and valve T will suffice to keep it closed, and thus close the exhaust-vent *g*. If the valve G between the compartments W W′ be closed, and compressed air be admitted to the signal-pipe D, it will flow through the branch pipe and check-valve Z into the receiver M, and fill the same until the pressure therein is equal to that in pipe D. If, now, the lever O be tripped in either direction the pressure of the cam-lug *d* upon the forked piece K will operate to force open the valve G, and the air confined in the receiver M, rushing into the receiver R, and bearing against the flexible diaphragm Y, will force up the piston *f* and valve-rod U, and thus open the exhaust-valve T, whereupon the charge of air in the signal-pipe D will be allowed to escape through the exhaust-vent *g*. So soon as the pressure of air in the receiver R upon the transverse area of the shank of the forked piece K becomes great enough to overcome the gravity of the rod H and its weight N, the rod will be carried upward, and thus close the valve G, which, when thus closed, will be kept closed after the pressure of air in the receiver R is diminished by the excess of pressure of the air confined in the receiver M. The exhaust-valve T will remain open so long as the pressure of the air confined in the receiver R is sufficient to bear up the valve-rod U and its piston *f*. This pressure is, however, reduced, and the valve automatically closed, by permitting the air confined in the receiver R to escape gradually through a small cock, *k*, the interval during which the valve shall remain open being determined at pleasure by opening said cock more or less.

The signals in my improved system consist of suitable vanes, (see Fig. 4,) each secured to a metallic rod, so supported and left free to turn in proper bearings as that it may be revolved with its vane a quarter-turn.

m m, Fig. 4, are the signal-vanes to be operated by the compressed air admitted and released through the commutators E E. Each vane *m* is attached to the upper end of a rod, *n*, which is stepped and supported in a suitable bearing within a box, *p*. (See Fig. 3.) This rod is inclosed and protected above the box by a pipe, *q*, which screws into the top of the box. *r* is a diaphragm, of rubber or other flexible material, closely confined and secured at its edges between two concaved plates, *s s′*, which limits its movement. The signal-pipe D is connected to and opens through that plate *s* of the diaphragm opposite the rod *u*, so that when air is admitted from said pipe the diaphragm will be forced away therefrom. *t t′* are metallic plates, placed upon opposite sides of the diaphragm, and bolted or riveted together thereon, to receive and secure the end of a rod, *u*, which projects thence through bearing in the plate *s′* and box *p*, and has free longitudinal play in said bearings.

When the rod *u* is arranged vertically, as shown in Fig. 3, its reciprocating movement may be made to impart a rotary movement to the signal-rod *n* by means of a link pivoted with a free joint at one end in a suitable offset upon the rod *u*, and at its other to the end of an arm projecting at right angles from the signal-rod *n*, and rigidly secured thereto; or the reciprocating movement of said rod *u* may be converted into a rotary movement of the rod *n* by means of cog-gearing or other customary mechanical devices, and it may be employed to actuate other well-known signal devices, instead of simple vanes, as described.

8 is a weight placed upon the diaphragm-rod *u*. This weight is of sufficient gravity to bear down the diaphragm, and automatically turn the signal-rod when the air admitted beneath the diaphragm to force it up is allowed to escape.

In the use of my apparatus the commutators may be placed either near the level of the track, as shown in Fig. 4, or elevated upon standards above it. In either case their operative levers are arranged to be struck and tripped by a finger projecting from the locomotive, or from the rear car of a train.

A signal-commutator, 1, Fig. 4, is placed at one end of the section of road along which it is desired that the train shall be signaled, and is there connected with the air-pressure pipe or main A. An exhaust-commutator, 3, is likewise placed at the other end of the section, and a signal-pipe, D, is laid to connect the two commutators. Signals 2 2 are located and connected with the signal-pipe D, as required, and the signal-pipe may, for this purpose, be extended, if desired, beyond the commutators in either direction.

Where the air-main A extends as far as the exhaust-commutator 3 a connection is made therefrom to the receiver M; otherwise, this receiver may be connected with the supply-pipe D, as hereinbefore described. (See Figs. 2 and 4.)

The signals *m* are so arranged as that when the signal-pipe D is not charged with air each vane will be in a right line with the road, so that its edge shall be presented to the engineer of an approaching train; but so soon as air is admitted to said pipe the vanes will be thrown at right angles to the road, and thus present their face to the engineer; or, in like manner, a flag attached to a staff or pole secured to extend horizontally from the end of the rod *n* may be swung around at right angles to the road, to indicate danger.

With the apparatus thus arranged, a train approaching the signals in the direction indicated by the arrow, Fig. 4, will trip the lever of the signal-commutator, and, thereby opening its valve, will allow a supply of air under compression to fill the signal-pipe D. The air thus admitted to the pipe D, bearing upon the diaphragm *r* (see Fig. 2) of each signal 2 2 connected with said pipe, will instantly operate, as hereinbefore described, to turn and display the signals.

So long as the valves in the exhaust-commutator remain closed the air confined in the signal-pipe D will keep the signals displayed; and to avoid the possibility of a premature reversal of the signals, because of a slight and unobserved leak in the signal-pipe, a very small aperture, 11, Fig. 1, may be left open through the signal-commutator, to allow a small yet constant supply of air to pass into the pipe D from the air-main A after the valve of the signal-commutator is closed, and thus maintain the pressure in said pipe D, notwithstanding there should happen to be slight escape of the air therefrom.

When the train reaches the end of the signal-section it will trip the lever of the exhaust-commutator 3, Fig. 4, and thereby opening its valve G (see Fig. 2) will allow a supply of air under compression to pass under its diaphragm and piston *y* and *f*, and thus force open the exhaust-valve T, so as to permit the air confined in the pipe D to escape. The pressure against the diaphragm of each signal being removed by the escape of air, each signal will be at once reversed by the operation of the weight 8 combined therewith, or by the action of springs substituted for the weight. So soon as the air is exhausted from the pipe D the exhaust-valve T will close automatically, as hereinbefore described.

In order to prevent an accumulation of pressure in the pipe D after its exhaust-valve has closed, because of the inflow of air through the small aperture 10 in the signal-commutator, (Fig. 1,) a check-valve, 11, is so adjusted and placed in the signal-pipe as that it will open automatically simply by its own weight, but will close under the influence of a high pressure in the pipe. Hence, when the pipe D is emptied of air, the valve 11 will open and allow the slight amount of air entering through the opening 10 to escape; but so soon as a full volume of air is admitted into the pipe under compression its pressure will instantly operate to close the valve, and will keep it closed until the pressure is removed by the opening of the exhaust.

I claim as my invention—

1. In combination with each other, and with a pipe conveying compressed air to one or more pneumatic signals, a valve, closing an exhaust-opening in or for said pipe, a pressure-chamber provided with a simple outward vent, and made to communicate with a diaphragm or piston, to operate the aforesaid valve, an air-supply pipe or reservoir, and a pressure-valve controlling the communication between said supply pipe or reservoir, and the pressure-chamber, substantially as and for the purpose herein set forth.

2. A weight, combined with a valve, G, valve-chamber W, outwardly-projecting rod H, supply-pipe A, and delivery-pipe D, sub-

stantially as and for the purpose herein set forth.

3. In combination with a yielding valve, G, a flexible packing-collar, L, confined upon the rod of the valve, to pack the outer bearing of said rod when the valve is thrown open, substantially as herein set forth.

4. In combination with each other, a rotative signal-rod, *n*, weighted reciprocating rod *u*, diaphragm *r*, and pressure-supply pipe D, arranged to operate substantially as and for the purpose herein set forth.

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