No. 776,883. PATENTED DEC. 6, 1904.

W. J. BECKER.

VACUUM PNEUMATIC SIGNALING APPARATUS.

APPLICATION FILED MAR. 24, 1904.

NO MODEL. 3 SHEETS—SHEET 1.

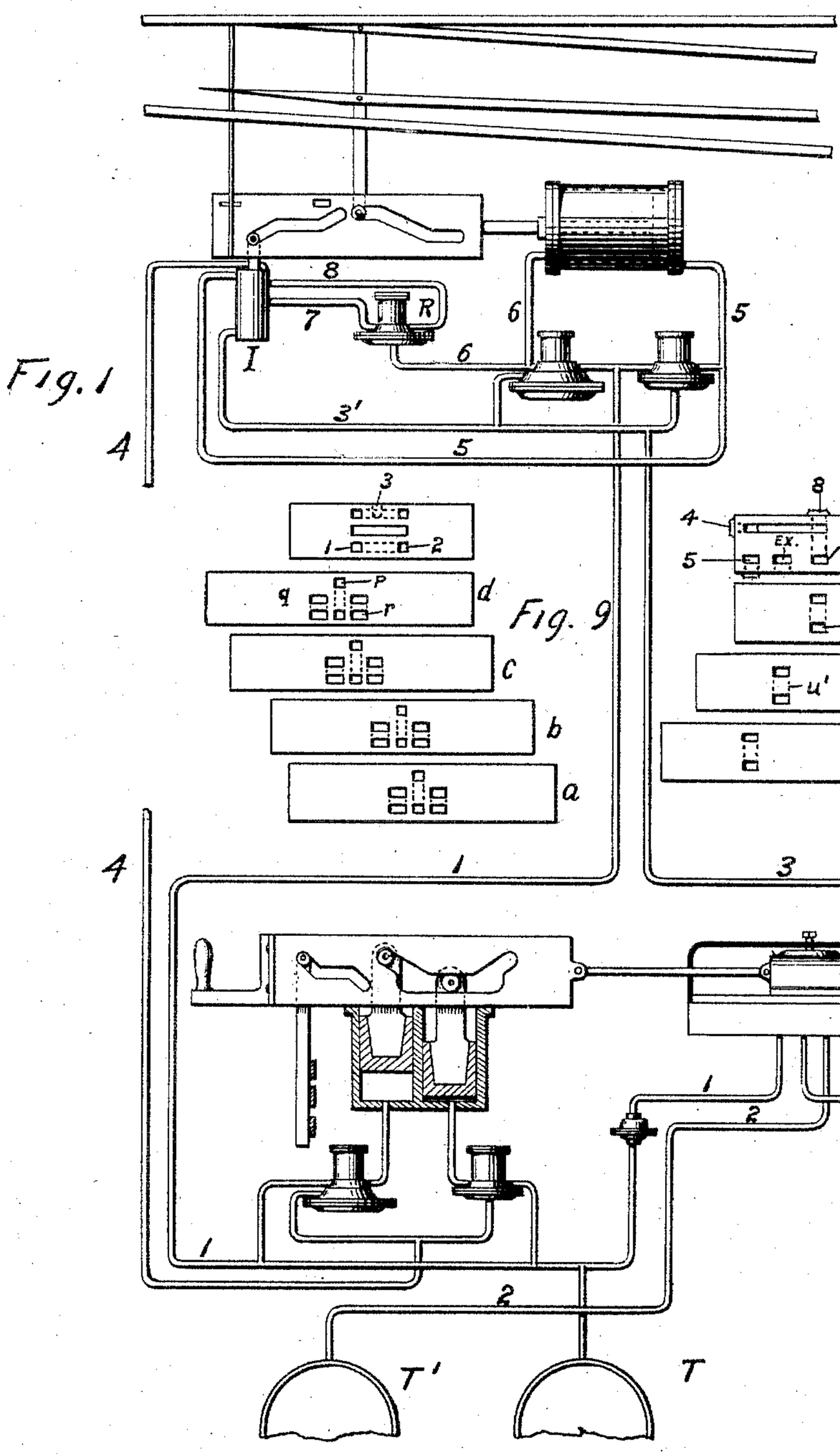

Fig. 1

Fig. 9

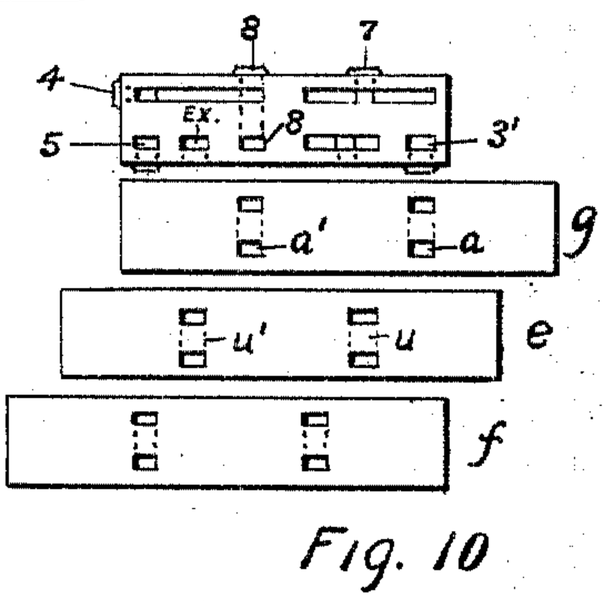

Fig. 10

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NO MODEL. 3 SHEETS—SHEET 2.

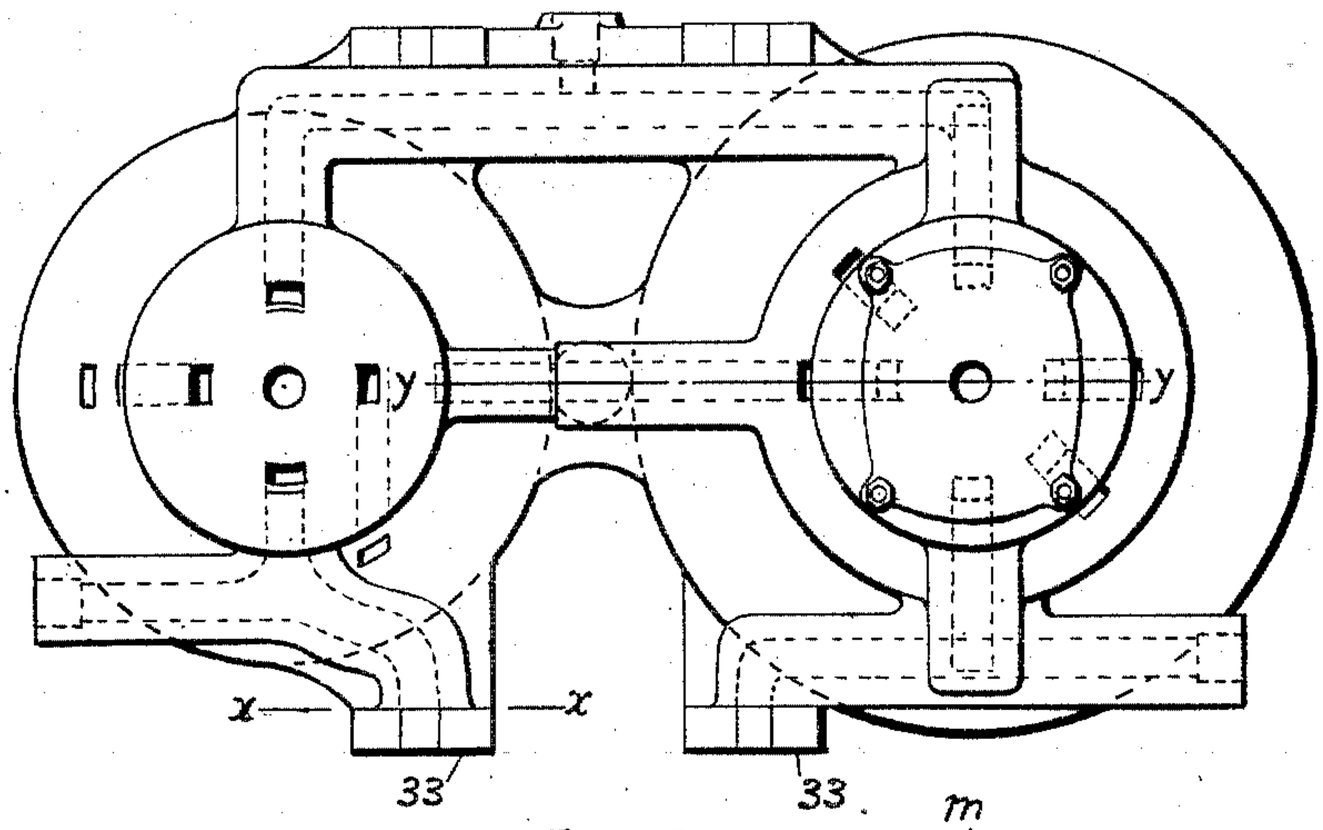

Fig. 2

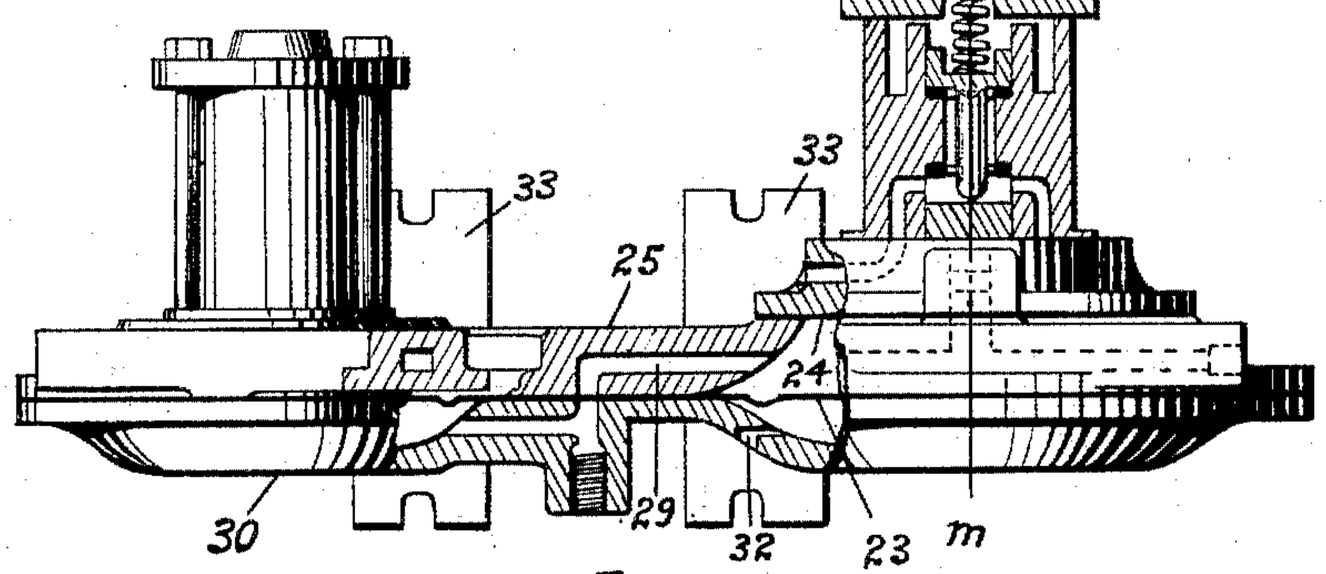

Fig. 3

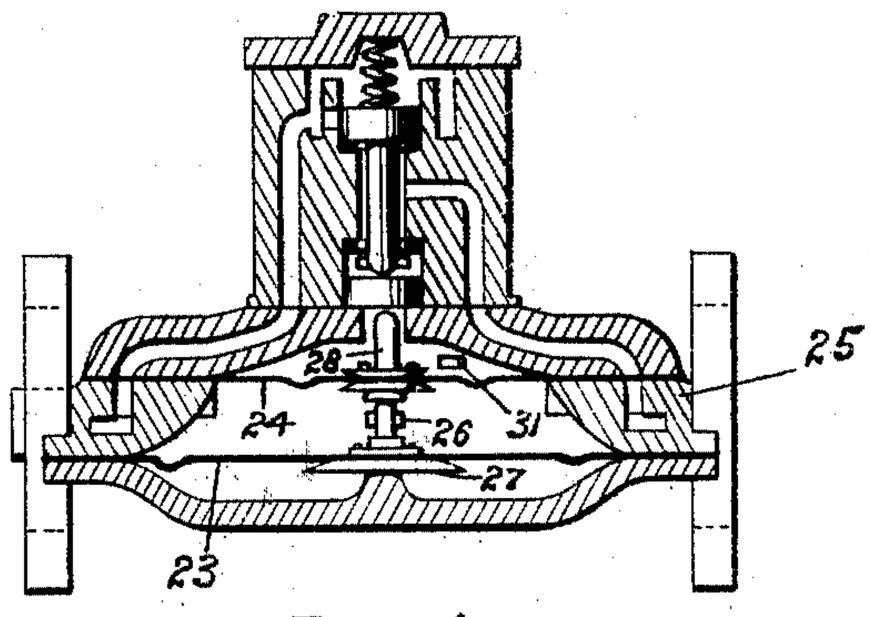

Fig. 4

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NO MODEL. 3 SHEETS—SHEET 3.

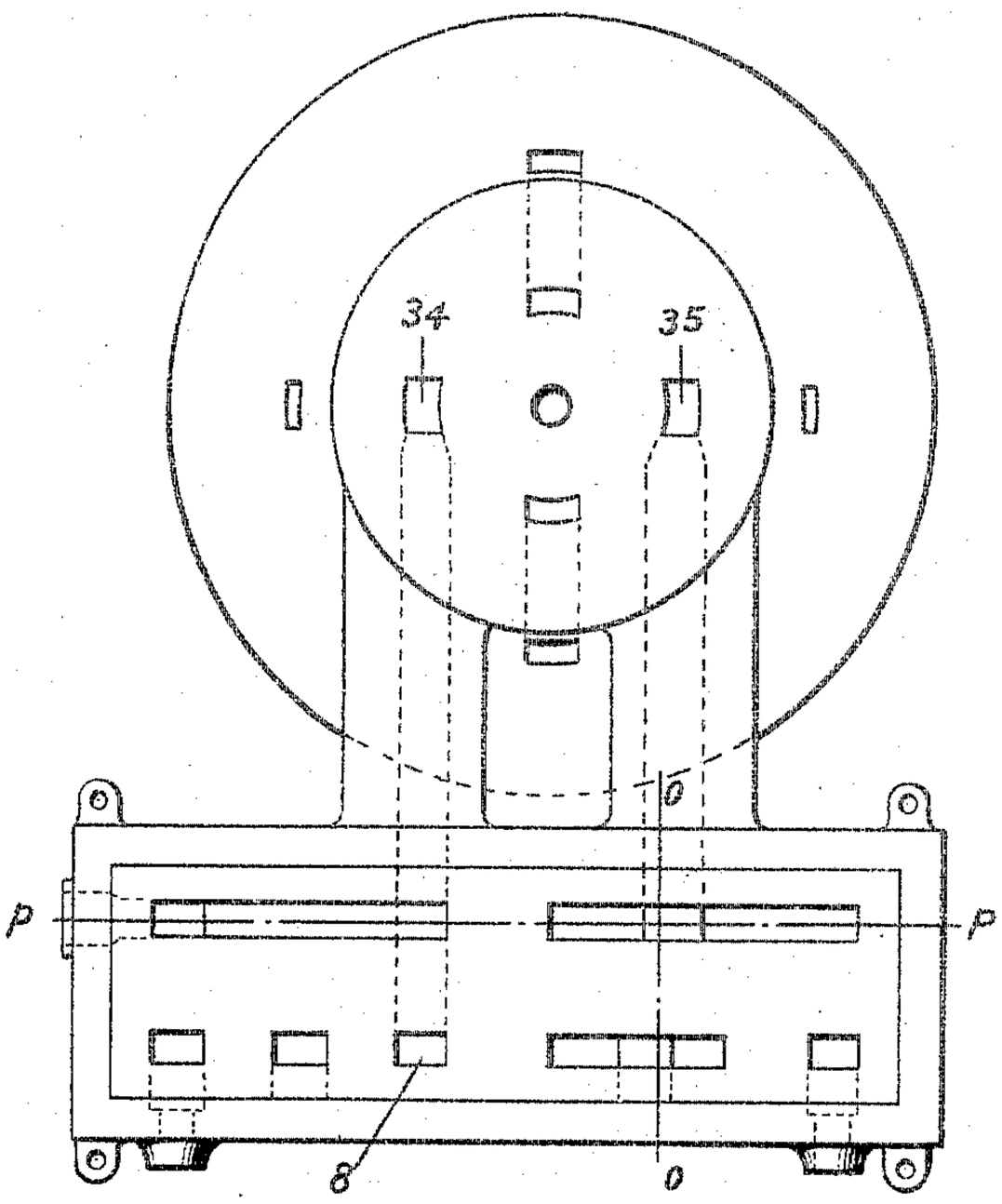

Fig. 5

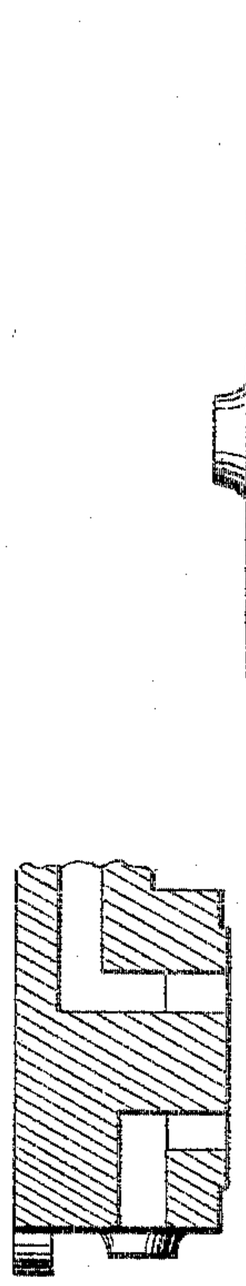

Fig. 6

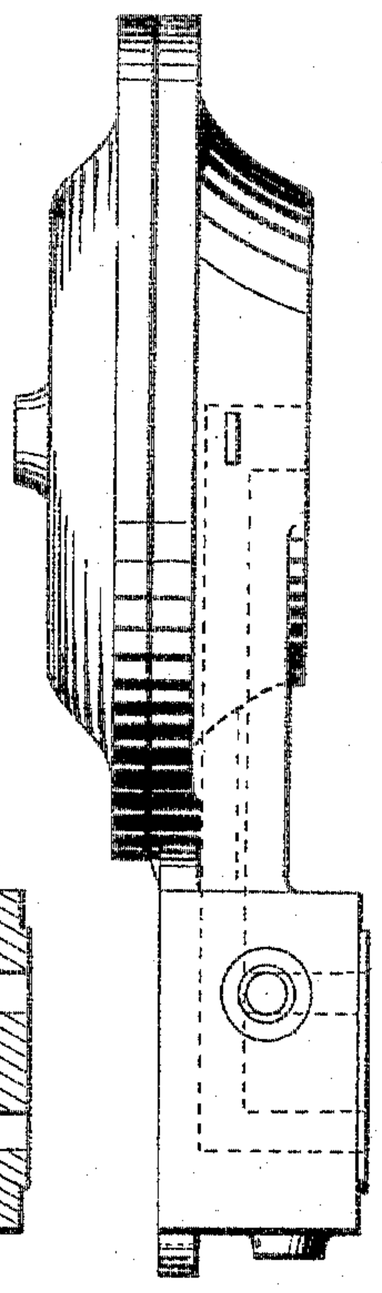

Fig. 7

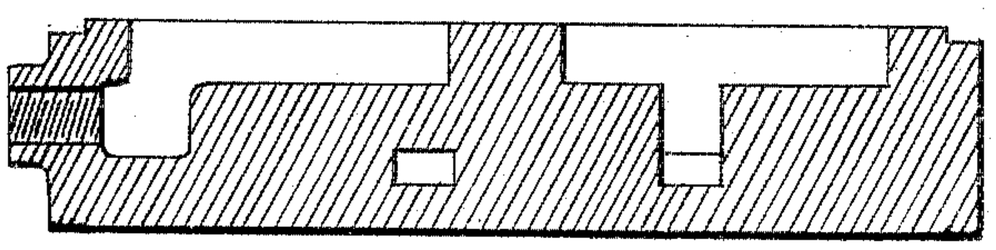

Fig. 8

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No. 776,883. Patented December 6, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM J. BECKER, OF MILWAUKEE, WISCONSIN.

VACUUM PNEUMATIC SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 776,883, dated December 6, 1904.

Application filed March 24, 1904. Serial No. 199,754. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM J. BECKER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Vacuum Pneumatic Signaling Apparatus, of which the following is a specification.

My invention relates to vacuum pneumatic signaling apparatus; and its object is to provide a simplified and improved construction based upon the broad principle of alternate pressure and vacuum operation described and claimed in my patent for pneumatic switch and signal apparatus, No. 756,929, dated April 12, 1904. In the construction shown in this application it was necessary to carry the vacuum-line to the switch in order to give the vacuum indication, thus adding a second supply-pipe to the pressure-pipe necessary for operation. By my present construction I do away with this vacuum-supply pipe by indicating directly from the operating-pipe through the indicating-pipe in the corresponding position of the switch, the vacuum being transmitted in this manner from the tower, through the operating-pipe, to the indicating-pipe, back to the tower. By this means a vacuum-supply at the tower only is necessary. I likewise provide an improved form of vacuum-operated diaphragm which can be employed in various other pneumatic apparatus.

The invention will be more specifically described in connection with the accompanying drawings, in which—

Figure 1 shows a diagrammatic view of the switch movement and its connections; Fig. 2, a plan view; and Fig. 3, a partly-sectional elevation on the lines *x x*, *y y*, of the combined pressure and vacuum relay-valves supplying both ends of the cylinder. Fig. 4 is a section on the line *m m*, showing the construction of the improved vacuum-relay. Fig. 5 is a plan view of the combined switch indication-valve, and diaphragm-casing for the indication transfer-relay, the valve itself being omitted. Fig. 6 is an end view; Fig. 7, a section on the line *o o*, and Fig. 8 a section on the line *p p*. Fig. 9 is a diagram of the ports of the controlling slide-valve and its seat, the slide being shown in its four positions relative to the seat. Fig. 10 is a similar diagram of the indication-valve.

Referring to Fig. 1, the general arrangement of switch movement and controlling and indicating mechanism is the same as that fully shown and described in my patent referred to and need not be further described. The arrangement of piping which is peculiar to this modification is as follows: From the pressure-supply reservoir T the main supply-pipe 1 and its branches lead to the controlling-valve, the indication-relays, and the switch-operating relays, as shown. The vacuum-supply pipe 2, from the vacuum-supply reservoir T′, leads to the controlling-valve only. The single operating-pipe 3 leads to both operating-relays and has a branch 3′, leading to the indication-valve I. The single indication-pipe 4 leads from the indication-valve to the indication-relays. The pipe 5 leads from the back of the switch-cylinder or from the outlet-passage of the pressure-operated switch-relay to the indication-valve. Another pipe, 6, leads from the front end of the cylinder or the outlet-passage of the vacuum switch-relay to the diaphragm of an ordinary pressure-relay R, located between the indication-valve and the operating-relay. The inlet-passage of this valve is connected to the indication-valve by connection 7 and the outlet-passage by connection 8.

In the controlling-valve seat, Fig. 9, the pressure-supply pipes 1 and 2 are connected to their respective ports, as shown. Two corresponding ports on the other side unite into a port to which the controlling-pipe 3 is connected. In the center is an exhaust-port *e x*. The slide has a central bridge-port *p*, connecting the two opposite sides, and two bridge-ports *q* and *r*, adapted to connect the exhaust with the controlling-pipe.

The indication-valve (shown in Fig. 10) has a port connecting with the indication-pipe 4, two ports on opposite sides connecting with the pipes 7 and 8, respectively, through the body of the seat, ports connecting with the pipes 5 and 3′, and two exhaust-ports, as shown. The slide is provided with two bridge-ports *u u′*, connecting one side with the other. In

the diagrams the slides are shown in their consecutive positions with relation to their seats. They are supposed to be turned over from their proper positions on the seats in order to show the ports, so that the upper lines of the slides in the diagrams correspond to the lower lines of the seats when the parts are in place.

The cycle of operation is described in connection with Figs. 9 and 10, and is as follows: We will assume that in the position shown in Fig. 1 all the pipes, with the exception of the main supply-pipe, are open to exhaust. If it is desired to operate the switch, the operating-lever is pulled to the left until the roller on the indication-piston abuts against the shoulder of the slot, as described in the above-mentioned patent. The controlling-valve is thereby brought from the position *a*, Fig. 9, passing the position *b*, to the position *c*. In this position it will be seen from Fig. 9 that pressure-supply pipe 1 is connected, through the bridge-port *p*, with the controlling-pipe 3 and the vacuum-supply is shut off from the controlling-pipe. Pressure can therefore pass into the controlling-pipe, operating the right-hand pressure-relay at the switch without affecting the vacuum-relay, as described in my former patent, and allowing pressure from the supply to enter the rear of the cylinder, operating the switch and indication-valve through the motion-plate and its slots. The indication-valve is in the position *g*, and 3′ is cut off through A and R, Fig. 10. While the switch-rod roller passes through the straight part of its slot without affecting the switch, the indication-valve is moved through half its stroke by the incline of its slot from *g* into the central position *e*. In this position it will be seen that the pipe 7 and the indication-pipe 4 are connected with the exhaust, thus avoiding all danger of pressure entering the indication-pipe. After the switch movement has been completed and the roller is in the corresponding straight part of the slot the indication-valve is moved to the end of its stroke into the position *f*, Fig. 10. In this position it will be seen that the pipe 7 is still connected with the exhaust. The pipe 8 is shut off, but is connected to the exhaust of the valve R, the latter being closed, and the indication-pipe 4 is connected to the pipe 5. Pressure from the outlet of the operating-relay or the cylinder can therefore enter at the indication-pipe 4, returning to the tower and giving the indication in the well-known manner through the pressure-relay and completing the stroke, so that the controlling-valve now reaches the position *d*, Fig. 9. In this position the operating-pipe is open to exhaust through the bridge-port *r*. The operating-relay will therefore close and open the cylinder to exhaust, and the indication-pipe being connected to the pipe 5 will likewise exhaust, closing the indicating-relay and opening the indication-cylinder to exhaust. All the parts will again be normal. To reverse the switch, the controlling-valve is moved from the end position *d*, passing over the position *c* to the position *b*. In this position the vacuum-supply pipe 2 is connected to the operating-pipe 3 through *p*, the pressure-supply being cut off. Vacuum will therefore enter the operating-pipe, operating vacuum-relay on the left-hand side of the cylinder and allowing the pressure from the supply-pipe to enter the cylinder and likewise to operate the relay R through the pipe 6, and thus connecting pipes 7 and 8 through the relay R. At the beginning of the movement the indication-valve is in the position *f*, in which it connects 4 with 5 and with the atmosphere through the pressure-relay. 7 is connected with 8 through R. 3′, and therefore the controlling-pipe, is cut off. While the switch-rod roller is in the straight part of the slot the indication-valve is moved into the central position, connecting 4 with the exhaust, while 7 remains at exhaust. After the switch has completed its movement 7 is connected to 3′ by *u*, as shown at *g*, and 4 is connected to 8. The vacuum in the operating-pipe will therefore pass from 3′ to 7 and (R being open) to 8, to 4, back to the tower to give the indication through vacuum. The lever is pushed to its end position A shown in the drawings, and 3 is connected to exhaust through 9. As there is still pressure in the cylinder holding the relay R open, the pipe 4 will therefore begin to exhaust simultaneously with 3 through the controlling-valve. As soon, however, as the vacuum in 3 has decreased sufficiently to open the cylinder through the cylinder-relay to exhaust the valve R will close, opening 8, still connected to 4 through the indication-valve, to exhaust, so that the indication-pipe will complete its exhaust through R, completing the indication. All the pipes will thus be connected to exhaust with the exception of the supply-pipes.

Details are shown in Figs. 2 to 8. Figs. 2 and 3 show the construction whereby both of the switch-operating valves are mounted on a common base and connected by passages in such a manner as to avoid all unnecessary piping. Figs. 3 and 4 show sections through my vacuum-operated valve. The construction of the valve proper is apparent from the figures and is described in my above-mentioned patent. The vacuum-operating device is constructed as follows: Two diaphragms of different areas, 23 and 24, are arranged one above the other with the separating-piece 25 between them, this separating-piece forming a part of the common base in the double valve shown. The centers of these diaphragms are connected by a distance-piece 26, having a rounded mushroom-shaped top, as shown. The lower and larger one is held between this piece and the mushroom-shaped washer 27. The upper diaphragm is fastened between the distance-piece and the operating-pin 28, which is also pro-

vided with a mushroom-shaped base. The distance-piece 25 is provided with a passage 29, communicating with the space between the two diaphragms. This passage in the double valve shown also leads through the distance-piece and into the base-plate 30, having lower diaphragm-chambers for both valves and provided with proper means for attaching the controlling-pipe. It will thus be seen that either pressure or vacuum transmitted through the controlling-pipe can enter under the diaphragm of the pressure-valve and also between the diaphragms of the vacuum-valve. When pressure is introduced, it will be exerted upon both diaphragms, tending to move them apart, as they are held together by the distance-piece 26. However, as the area of the lower diaphragm is larger than that of the upper the diaphragms will bulge out between their fixed points and no upward movement can take place, and, in fact, a downward pressure is exerted on the cover of the diaphragm-chamber. The pressure-diaphragm, however, will be operated, opening its valve. If, on the contrary, vacuum is introduced in the passage 29, the diaphragms will tend to approach each other as their outer chambers communicate with the atmosphere through the ports 31 and 32, respectively. The upward pressure on the diaphragm 23 being on account of its larger area greater than the downward pressure on the diaphragm 24, the diaphragm 23, with the distance-piece, the upper diaphragm, and the operating-stem will be forced upwardly, opening the valve. The other valve will not be affected, however, as its diaphragm will simply be pushed down, and the operating-stem is not connected with the valve. Proper passages for supply, outlet, and exhaust and pipes to the indication-valve are provided, as shown in Fig. 2. Faced lugs 33 33, having proper ports and upper and lower notches, are adapted to fit against proper surfaces on the cylinder, being held rigidly thereto by studs passing through notches in these lugs and in outer lugs on the supply-passage, as shown. Ports in the lugs register with the ports in the cylinder. Exhaust-passages may be arranged as shown. It will thus be seen that a compact structure is provided in which only the pipe-passages necessary for communication with distant parts are necessary.

Figs. 5, 6, 7, and 8 show the indication-valve and pressure-relay R in one structure. The ports in the slide are connected with those in the valve in the manner shown, and the connections are made as indicated. The passage from the outlet-port 34 of the valve to the corresponding port in the indication-valve corresponds to the pipe 8 in the diagram. The passage from the inlet-port 35 corresponds to the pipe 7. Otherwise the figures are self-explanatory.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a pneumatic signaling apparatus, a switch-operating mechanism, a controlling and an indicating pipe therefor, and means for connecting the pipes at the limit of the movement of the switch.

2. In a pneumatic signaling apparatus, a switch mechanism, a controlling mechanism, a controlling-pipe, an indicating-pipe, and means for connecting and disconnecting the pipes at the limit of the movement of the switch and controlling mechanism respectively.

3. In a pneumatic signaling apparatus, a switch mechanism, a controlling mechanism, a single controlling-pipe and a single indicating-pipe, respectively controlling both movements and both indications of the switch, a single vacuum-supply for both controlling and operating, and a compressed-air supply at the switch and controlling mechanism, means for operating and indicating by pressure and vacuum alternately from the controlling mechanism and switch mechanism, respectively, through the pipes.

4. In a pneumatic signaling apparatus, a switch mechanism, a controlling mechanism, a controlling-pipe, an indicating-pipe, a fluid-pressure supply at the switch and controlling mechanism, a single vacuum-supply for both controlling and operating, means for operating and means for indicating the switch alternately by pressure and vacuum through the pipes.

5. In a pneumatic signaling apparatus, a switch mechanism, a controlling mechanism, a controlling-pipe, an indicating-pipe, a fluid-pressure supply at the switch and controlling mechanism, a vacuum-supply at the controlling mechanism only, means for operating the switch through the controlling-pipe by pressure and vacuum alternately, and means for connecting and disconnecting the controlling-pipe and indicating-pipe at the limit of movement of the switch when operated by vacuum only, and at the corresponding limit of movement of the controlling mechanism, respectively.

6. In a pneumatic signaling apparatus, a switch mechanism, a controlling mechanism, a single controlling-pipe and a single indicating-pipe, respectively controlling both movements and both indications of the switch, a single vacuum-supply for both controlling and indicating, a means for operating the switch through the controlling mechanism by vacuum in one direction only, a pneumatic valve at the switch open for passage from one side to the other only when the controlling-pipe is under vacuum, a valve whose position is dependent upon the position of the switch, this valve connecting the outlet of the pneumatic valve with the indication-pipe at the

limit of the movement of the switch when actuated by vacuum.

7. In pneumatic apparatus, a pressure-operated switch mechanism and controlling mechanism, an indicating mechanism, a controlling-pipe, an indicating-pipe, a vacuum-supply at the controlling mechanism and a pressure-supply at the switch, a valve operated by vacuum through the controlling-pipe for admitting the pressure to the switch mechanism for moving the switch in one direction only, a pressure-operated valve at the switch, a connection from the outlet side of the vacuum-valve to the pressure-valve for operating the same, a valve operating with the switch and dependent upon its position and provided with passages connecting the indicating-pipe with the outlet side, and the controlling-pipe with the inlet side of the pressure-valve only when the switch has reached the limit of its movement in the stated direction.

8. In pneumatic apparatus, means for operating the valves or other parts by vacuum, comprising two differential flexible diaphragms inclosing a chamber between them, the chamber being adapted for communication with the vacuum, and the outer surfaces of the diaphragms being in communication with the atmosphere.

9. In pneumatic apparatus, a means for operating valves and other parts by vacuum or suction, comprising a spacing-ring having a passage for connection with vacuum, a diaphragm confined at its edges on one side of the ring, a diaphragm of different area confined at its edges on the other side of the ring, and means on the outside of the smaller diaphragm for operating the valve or other part.

10. In pneumatic apparatus, a means for operating valves and other parts by vacuum or suction, comprising a spacing-ring and two disks dished to different diameters on either side of the ring, two flexible diaphragms held between the disks and ring, and suitable means for operating connected to the smaller diaphragm.

11. In pneumatic apparatus, a means for operating valves and other parts by vacuum or suction, comprising a spacing-ring and two disks dished to different diameters on either side of the ring, two flexible diaphragms held between the disks and ring, and a spacing-piece between the centers of the diaphragms and connected thereto.

12. In pneumatic apparatus, a means for operating valves and other parts by vacuum or suction, comprising a spacing-ring and two disks dished to different diameters on either side of the ring, two flexible diaphragms held between the disks and ring, a spacing-piece between the centers of the diaphragms and connected thereto, and a stem in line with the spacing-piece connected to the smaller diaphragm and passing through the disk.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM J. BECKER.

Witnesses:
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FRED SUTER.