No. 729,044. PATENTED MAY 26, 1903.

M. CORRINGTON.
ENGINEER'S BRAKE VALVE.

APPLICATION FILED JAN. 30, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.

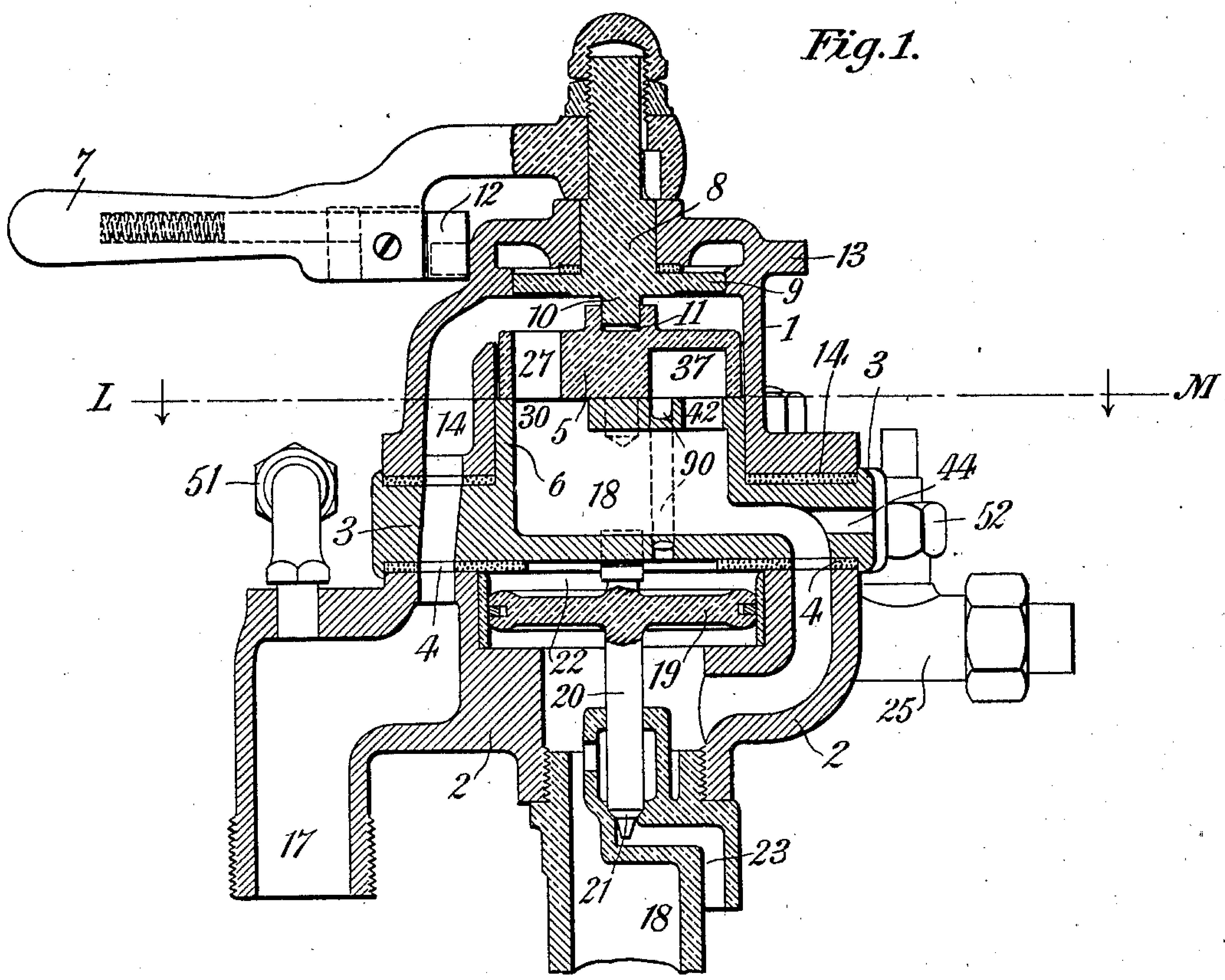
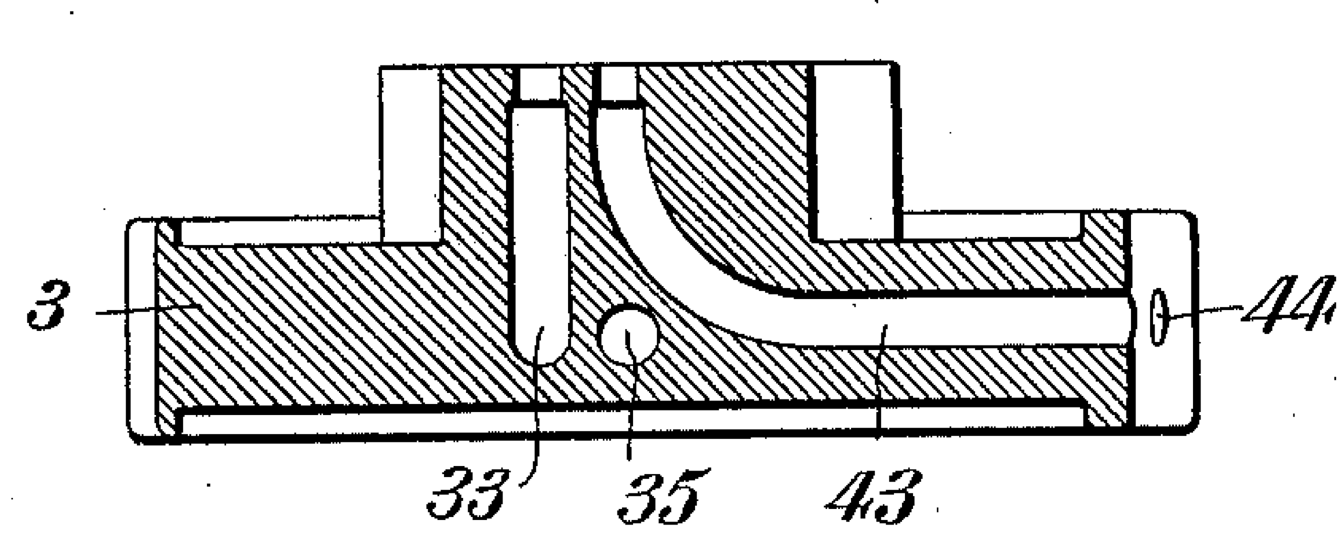


Fig. 2.



WITNESSES:

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John Ullrich

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Murray Corrington.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 3.

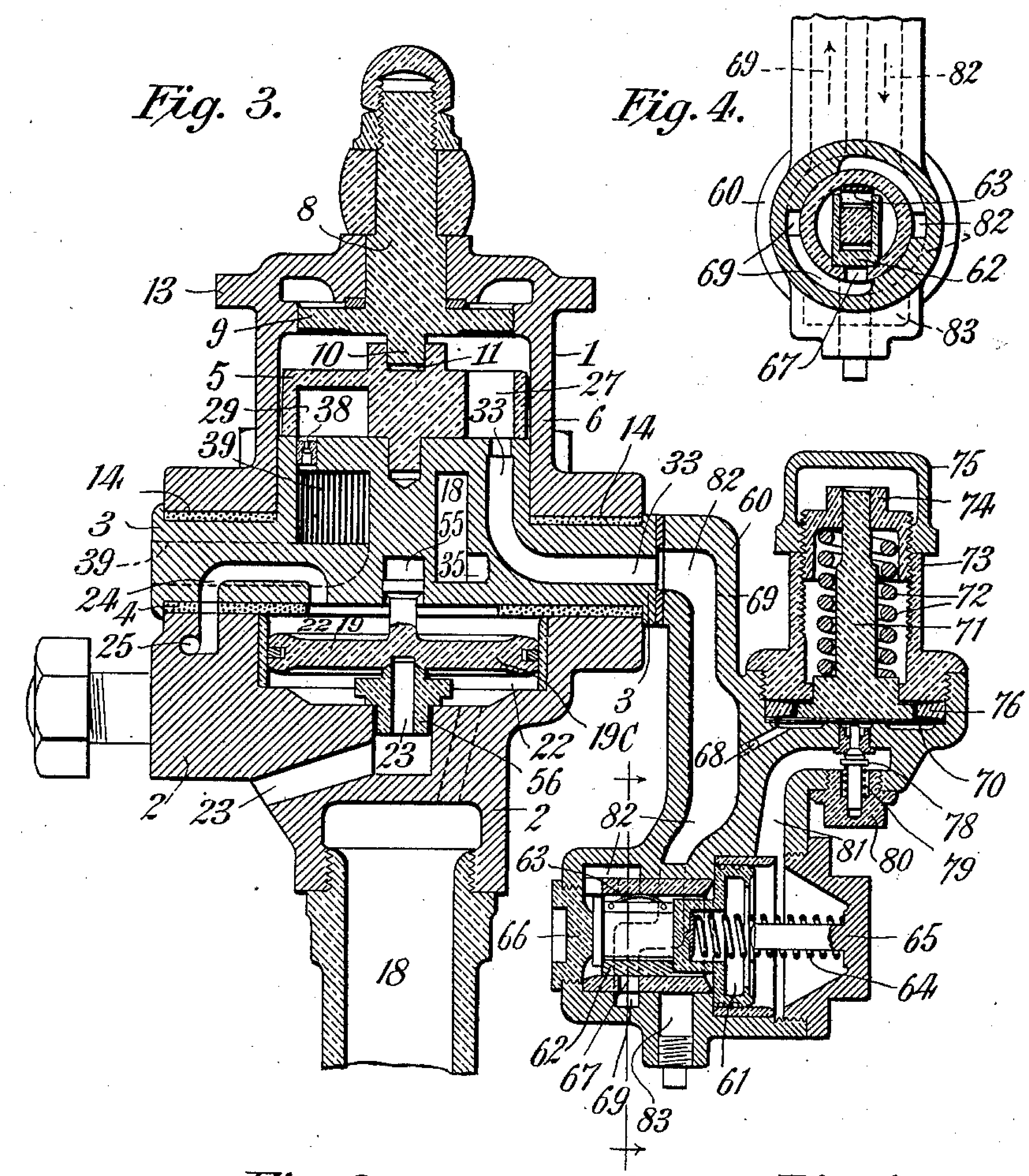


Fig. 4.

Fig. 8.

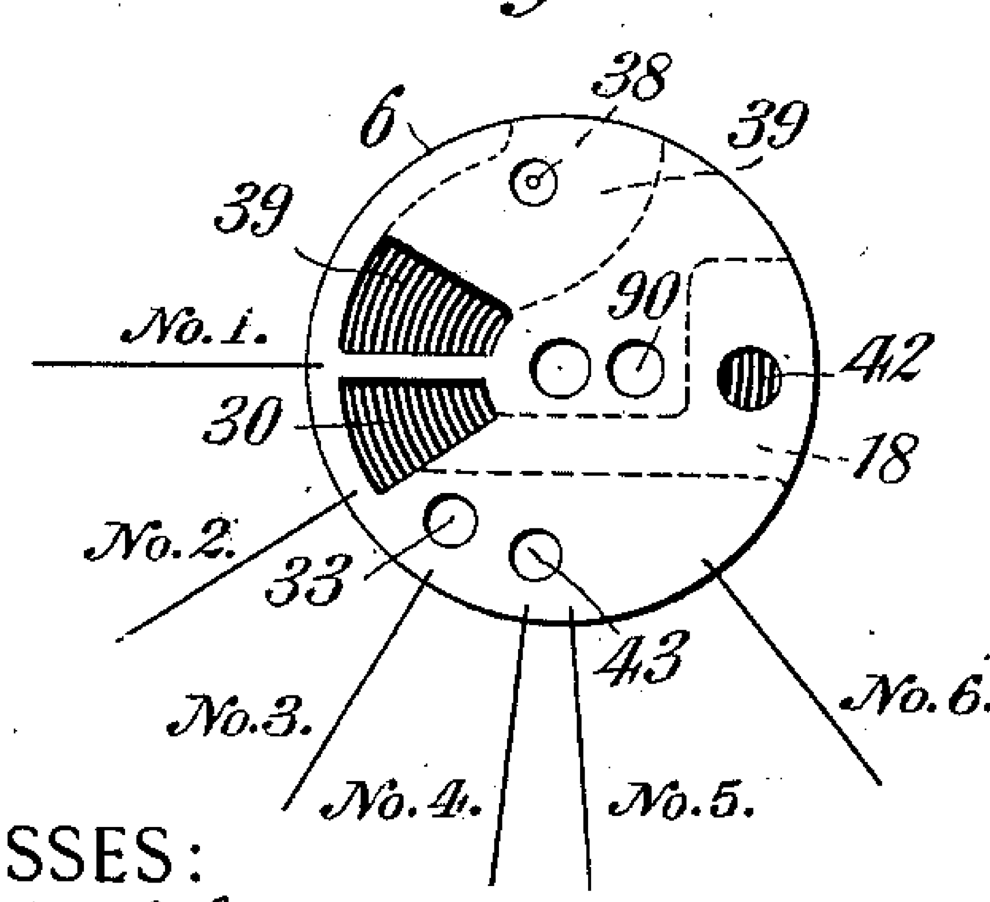
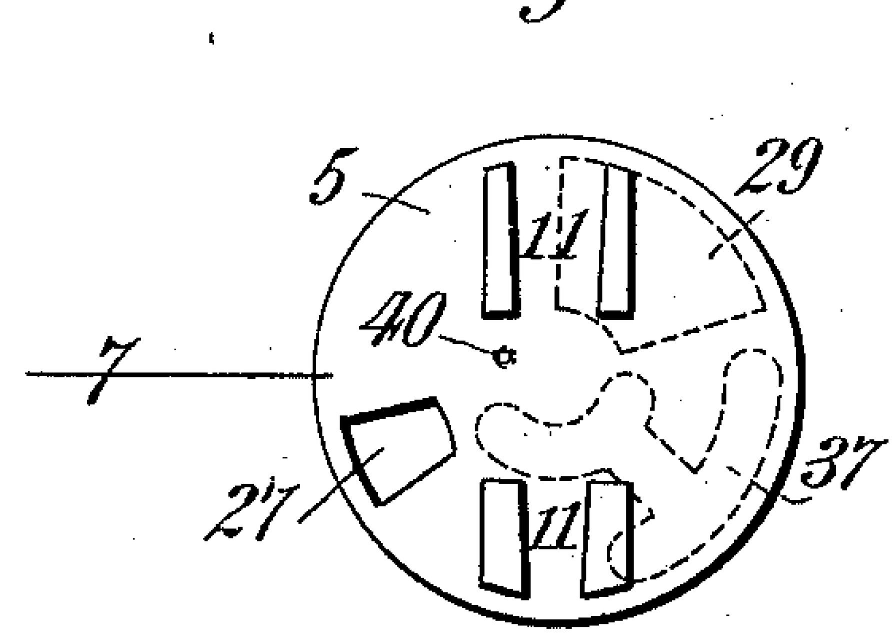


Fig. 9.



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 5.

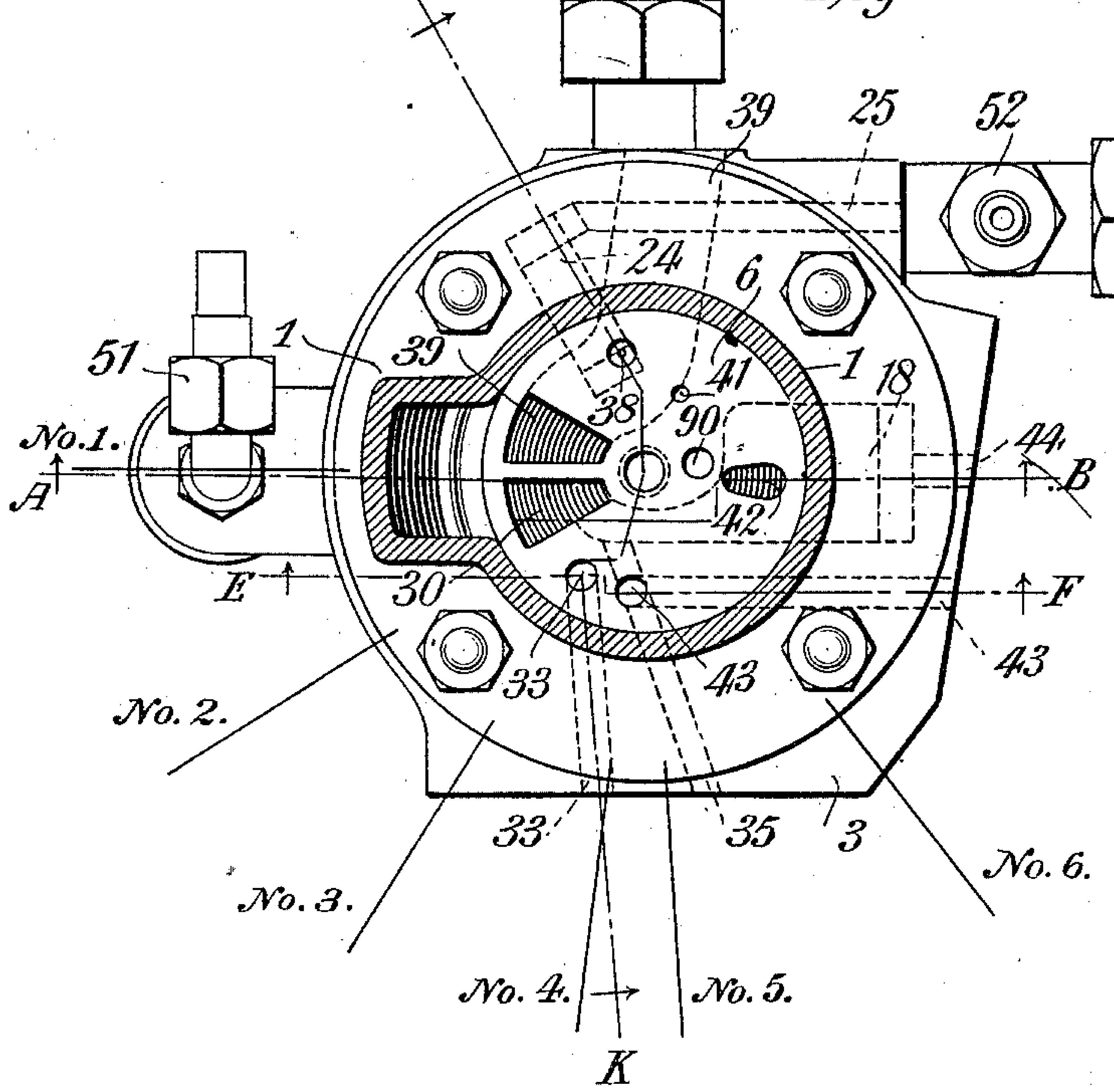


Fig. 6.

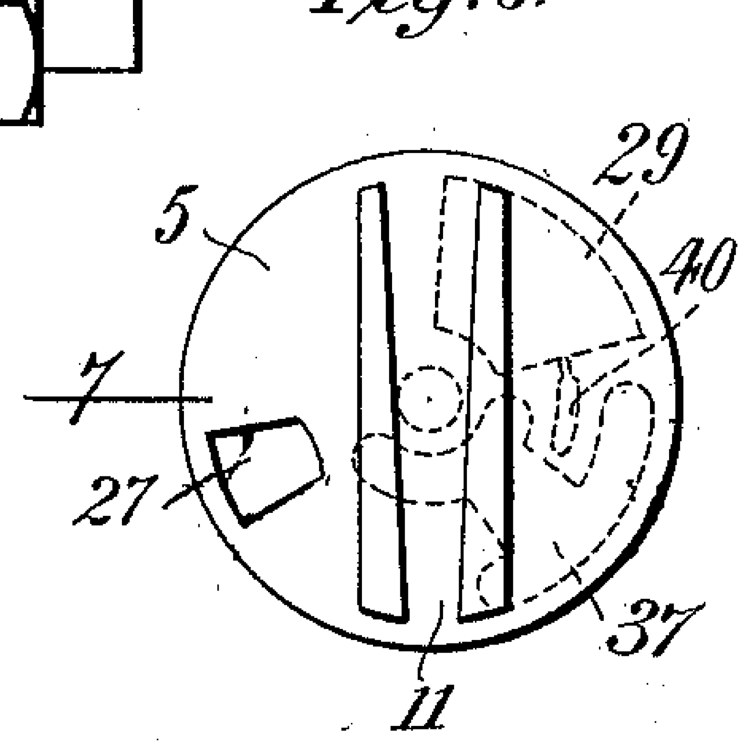
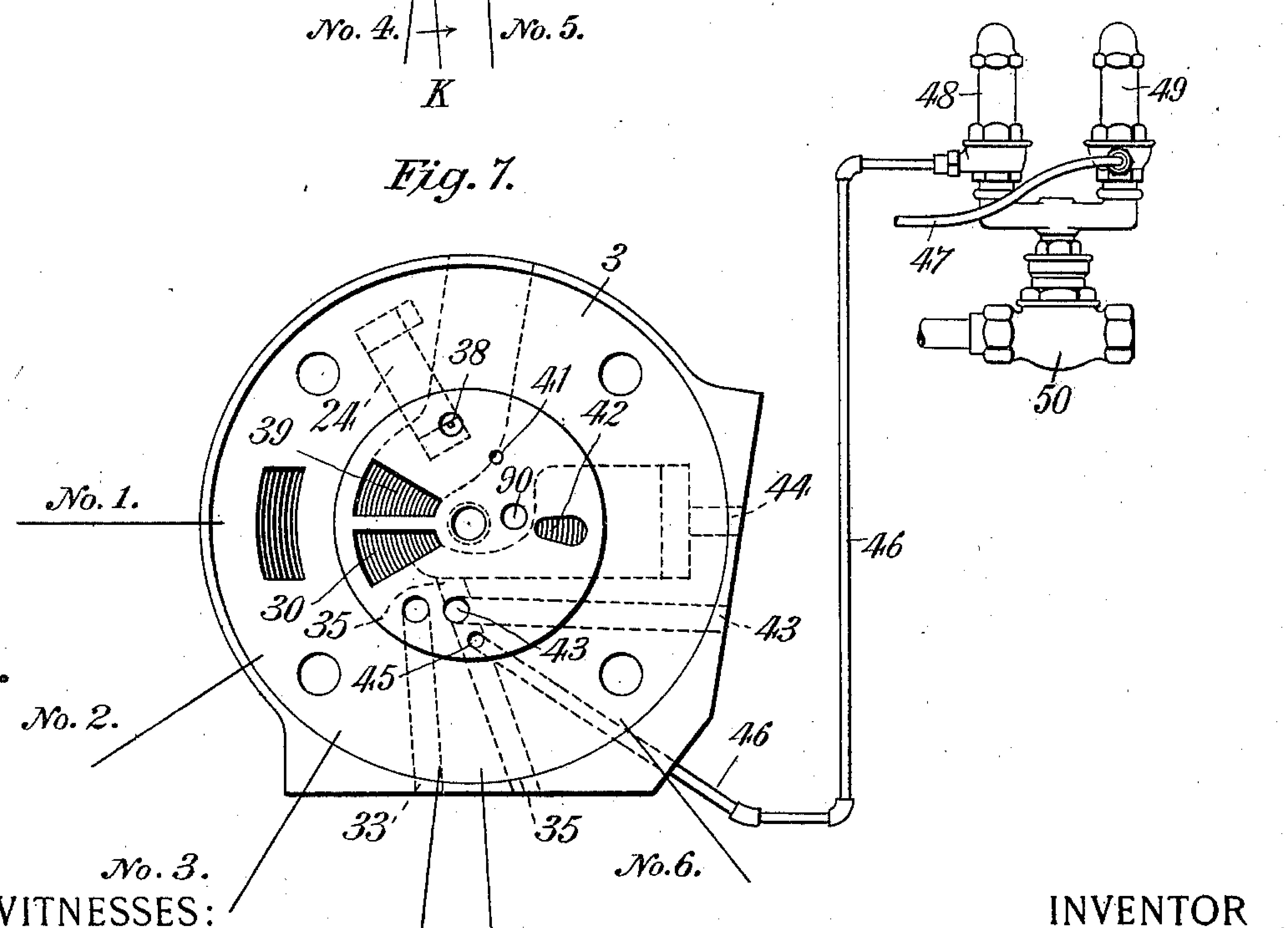


Fig. 7.



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APPLICATION FILED JAN. 30, 1903.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 10.

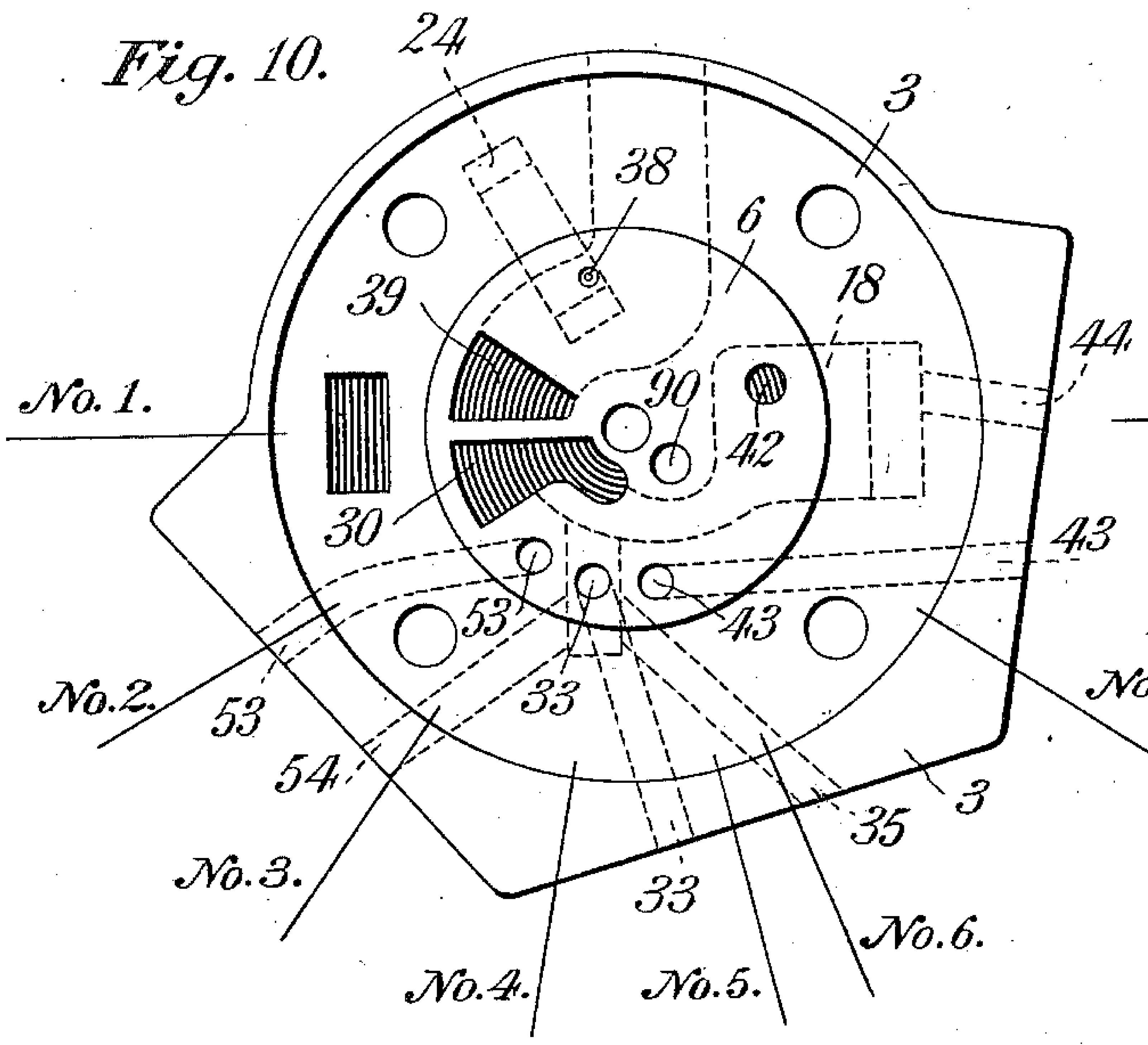


Fig. 11.

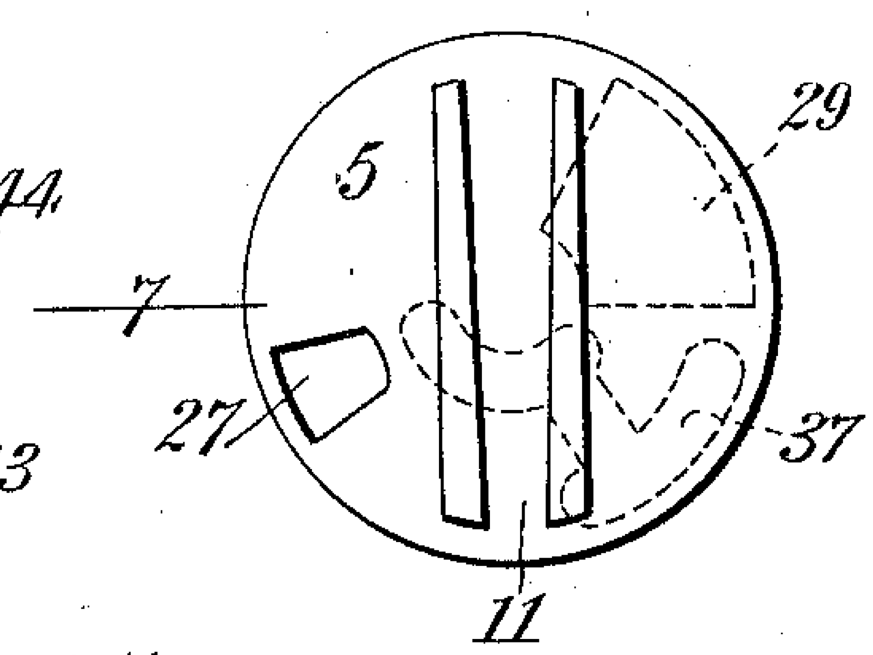


Fig. 12.

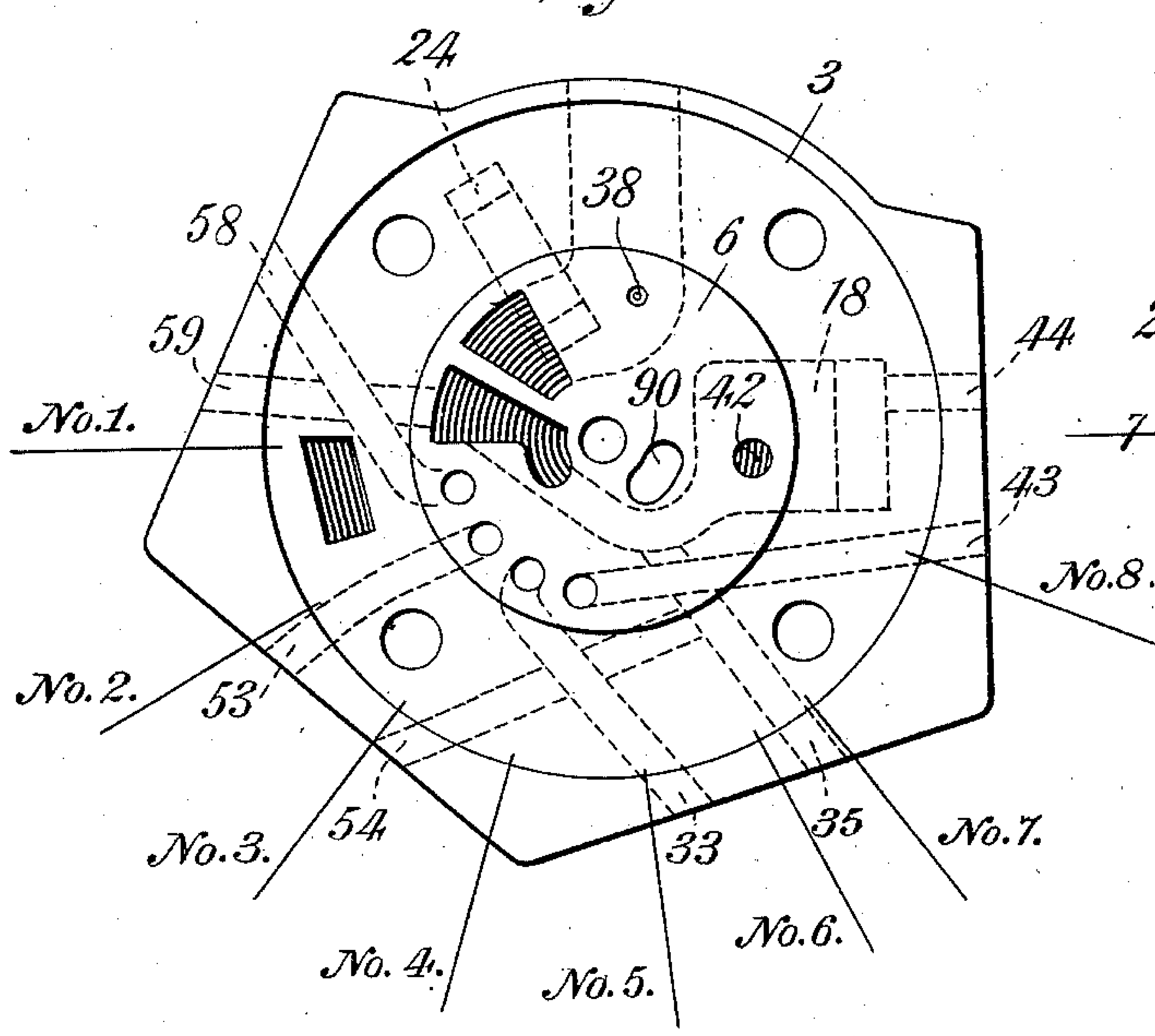
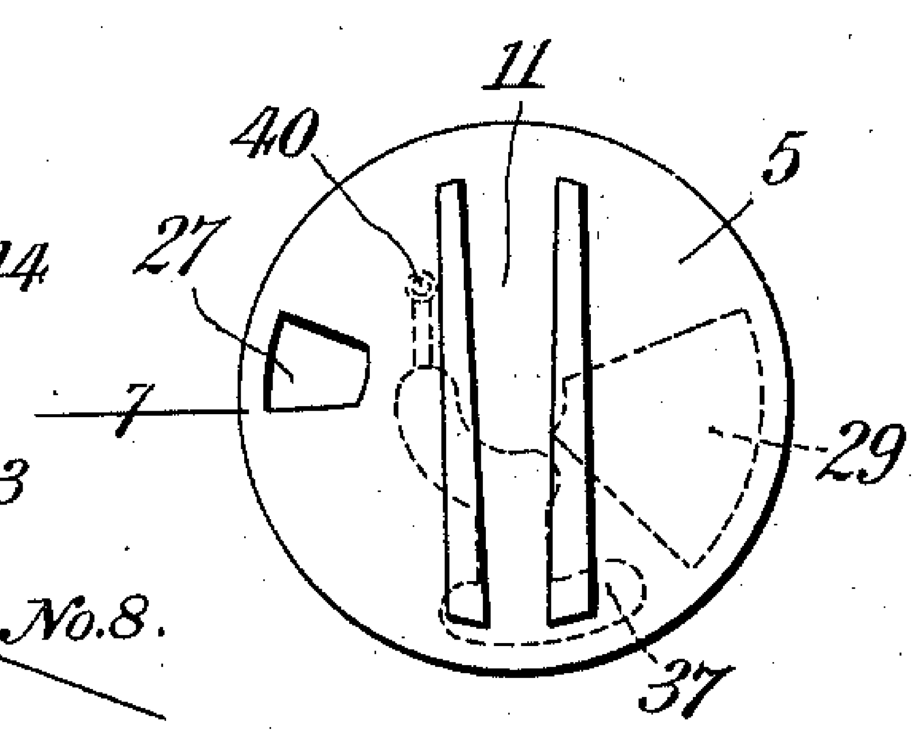


Fig. 13.



WITNESSES:

C. E. Ashley

John Ullrich

INVENTOR

Murray Corrington.

No. 729,044. Patented May 26, 1903.

UNITED STATES PATENT OFFICE.

MURRAY CORRINGTON, OF NEW YORK, N. Y.

ENGINEER'S BRAKE-VALVE.

SPECIFICATION forming part of Letters Patent No. 729,044, dated May 26, 1903.

Application filed January 30, 1903. Serial No. 141,092. (No model.)

To all whom it may concern:

Be it known that I, MURRAY CORRINGTON, a citizen of the United States, residing at New York city, in the county and State of New York, have invented certain new and useful Improvements in Engineers' Brake-Valves, of which the following is a specification.

My invention relates to improvements in that part of an automatic fluid-pressure air-brake system which is adapted, through manipulations by the engineer or locomotive-driver, to control the admission of compressed air into and its exhaust from the train-pipe for the setting and release of the brakes. The mechanism is placed in the cab of the locomotive and is usually designated as the "engineer's brake-valve," or simply as the "brake-valve."

Referring to the drawings, Figure 1 is a vertical section through an engineer's brake-valve and its casings on the line A B, including also the ends of port 90 of Fig. 5. Fig. 2 is a vertical section of the valve-seat portion of the casing, essentially on the line E F of Fig. 5. Fig. 3 is a vertical section of the brake-valve and its casings, essentially on the line J K of Fig. 5 looking toward the right with modifications of the equalizing-piston, including also a vertical section of a pressure-reducing valve device attached to one of the sections of the brake-valve proper, which will be fully described hereinbelow. Fig. 4 is a section of part of the reducing or "feed" valve on the line C D of Fig. 3 looking toward the right. Fig. 5 is a plan of the brake-valve mechanism on the line L M of Fig. 1, showing a top view of the seat on which the main valve operates. Fig. 6 is a top view of the main operative or rotary valve. Fig. 7 is a top or plan view of the valve-seat section, showing a modification and including also a diagrammatic representation of a duplex pump-governor for controlling the air-pump of the brake system. Figs. 8 and 9 are a plan of the rotary valve-seat and valve, showing modifications of Figs. 5 and 6. Figs. 10 and 11 are also modifications for allowing seven instead of six positions for the operator's valve. Figs. 12 and 13 are further modifications allowing eight positions for said valve.

Going first to Fig. 1, the mechanism is composed of an upper casing-section 1, a lower casing-section 2, and a middle or valve-seat section 3, a gasket 4 being inserted between sections 2 and 3 and a gasket 14 between sections 1 and 3. A rotary valve 5 operates upon a valve-seat 6, forming a part of section 3, said valve having a central pin that projects into the casing, as illustrated, to hold it concentric with its seat. An operator's handle 7 is attached to the upper end of a shaft 8, which projects through the casing 1 and whose lower end carries a disk 9 and a tapered key or tenon 10, that fits into a correspondingly-shaped mortise or slot 11 on the upper side of the valve 5. The shape of this slot or mortise is illustrated in Fig. 6 and is made wider at one end than the other, so that the correspondingly-shaped key 10 can only be inserted into the slot when the valve occupies the proper position. A spring-stop 12, attached to the handle 7, bears against a flange 13 on the casing 1, which flange has various projections for enabling the operator to move the handle 7 to the various positions it is intended to occupy during the operations of the device, but which are not illustrated, since they are well known in this art. A suitable nozzle 17 serves for a connection directly to the main reservoir or air-pump, and a similar nozzle or opening 18 serves for connection directly to the train-pipe. For convenience the reference-numeral 18 is applied to those chambers and cavities in the casing which are normally open to the train-pipe. Gages may be connected to pipes or nozzles 51 and 52. A piston 19, known in the air-brake art as an "equalizing-piston," having a stem 20 and connected valve 21, operates in a suitable chamber 22 and controls a port or opening 23, leading to the atmosphere. The chamber 22 on the upper side of the piston is connected by a passage 24 (see Fig. 3) with a second passage or pipe 25, which leads to a small reservoir, well known in the air-brake art as an "equalizing-reservoir" and not shown herein and whose purpose is merely to increase the capacity of the chamber 22 on the upper side of the equalizing-piston.

Going now to Figs. 5 and 6, the rotary valve 5 has a port 27 through it, (shown in full lines,) and cavities 29, 37, and 40 on its under face or bearing-surface. (Shown in dotted lines.)

The cavity 40 is really a part of the cavity 29, but is made separate and connected with the latter by a small pin-hole, as shown in Fig. 6, for purposes of convenience, as will presently be explained. Fig. 5 shows the valve-seat 6, on which the valve 5 operates. It has a large port 30 leading directly to the train-pipe. A port or passage 33 leads downward and out of the casing. Another passage 35 leads from the same side of the casing into the train-pipe passage or chamber 18. A similar port or passage 43 leads from the valve-seat to the outside of the casing at the right, and another passage 44 leads from the same side of the casing back to the train-pipe connection or cavity, these passages being shown in dotted lines. A port 42 connects the valve-seat with the train-pipe cavity 18. Another port 90 leads from the valve-seat directly to the upper end of the equalizing-piston chamber 22. A large exhaust-port 39 leads from the valve-seat downward and thence through the casing to the atmosphere, as illustrated in dotted lines. A small port 38, which we may term the "preliminary" exhaust-port, and a second port 41 lead from the valve-seat into exhaust-passage 39.

Referring to Fig. 3, there is seen attached to the casing-section a pressure-reducing valve device. This consists of a casing 60, inclosing in a suitable chamber a piston 61, a slide-valve 62, with its spring 63, the piston and valve being held in the position illustrated by a spring 64 and the two ends of the chamber being closed by the caps 65 and 66. The valve 62 controls a port 67, by which air admitted to the mechanism through passages 33 and 82 may be vented through the passage 69 and upward, as shown in dotted lines, and thence by passage 35 into train-pipe 18. The passage 68 admits pressure from 69 against a diaphragm 70, that is backed up by a piston or disk 71, which in turn carries a load, such as a spring 72, inclosed in a box or case 73. The spring 72 may be adjusted to any desired tension by the nut 74, and this in turn may be covered and locked by the cap-nut 75. The edges of the diaphragm 70 may be secured by a ring 76, held in place by the case 73. The movement of the diaphragm 70 and disk 71 operates a valve 78, which controls communication between the passage 68, already described, and a passage 81, leading from said valve to the right-hand side of the piston 61. It will be understood that this pressure-reducing valve, including the casing 60 and its inclosed parts or any similar device, may be operated in connection with my improved brake-valve proper for the purpose of automatically controlling the flow of air from the main reservoir or air-pump to the train-pipe and keeping the train-pipe pressure automatically regulated at a definite or normal pressure when the handle of the brake-valve is placed in the proper position. I shall describe its operation here, therefore, before describing the operation of my improved brake-valve; but it must be understood that any other suitable pressure-reducing valve that will admit fluid under pressure from one vessel into another and keep the pressure in the second vessel at a definite normal amount irrespective of variations of pressure in the first vessel will answer the purposes equally well with the reducing-valve herein illustrated.

Whenever compressed air is admitted through passage 33 into the passage 82 of the casing 60, it flows downward and toward the observer and then toward the left, then upward, Fig. 4, and to the left and into the chamber at the left of piston 61, moves the piston, with the valve 62, to the right, uncovering port 67 and admitting the pressure into both passages 69 and 68. A branch of passage 82 extends downward into a pocket 83 for catching all dirt, grease, or water blown through the brake-valve. The passage 69 in the casing 60 meets the passage 35 leading to the train-pipe just as passages 82 and 33 meet. The air going through passage 68 tends to move the diaphragm 70 and disk 71 upward against the spring 72 and also flows past the valve 78 and through the passage 81 to the right-hand side of piston 61. This flow of the air will continue until the pressure in passages 68 and 69 and the train-pipe connecting with the latter is sufficient to move the parts 70 and 71 against the spring 72 and permit the spring 79 to close the valve 78. The piston 61 is made preferably without packing-rings, but, rather, having little grooves turned in its surface, so that all the while there is a tendency for the fluid to leak past said piston from left to right.

Let us suppose that the spring 72 is adjusted to balance a pressure of seventy pounds per square inch against the diaphragm 70. Then as quickly as the pressure in passages 68 and 69 and the train-pipe reaches seventy pounds the parts 70 and 71 will move upward and the valve 78 will close. This permits the spring 64 to move the piston 61 and valve 62 to the left and close the port 67, the leakage of air past the piston 61 from left to right being sufficient for this purpose. If now we assume that there is admitted to the port 82 a pressure of, say, ninety pounds, then with the system fully charged we shall have ninety pounds pressure in the passages 82 and 81 and in the chamber on both sides of the piston 61 and seventy pounds in the passages 68 and 69, in the train-pipe, and against diaphragm 70. If for any reason, through leakage or otherwise, the pressure in passage 69 and the train-pipe drops below seventy pounds, the spring 72 moves the disk 71 downward, opens the valve 78, and vents the pressure from 81 and the right-hand side of piston 61 into the passages 68 and 69, thus unbalancing the piston 61 and permitting the higher pressure of ninety pounds at its left side to move it to the right, open valve 62, and admit enough more pressure from the passage 82 against the diaphragm 70 to move it upward and permit the valve 78 to close, when the parts will again resume their normal positions, with seventy pounds in passages 68 and 69 and ninety pounds in passages 81 and 82 and the parts connected therewith.

The operation of the brake-valve will now be readily understood by reference more particularly to Figs. 5 and 6. For operation the valve 5 of Fig. 6 is to be moved to the left and set in place upon the valve-seat 6 of Fig. 5 so that the line 7 of the valve, which corresponds to the valve-handle 7 of Fig. 1, shall fall directly above the line marked No. 1 of Fig. 5. It is to be understood that, as illustrated in Fig. 1, main-reservoir pressure or pressure directly from the air-pump is always present on the upper side of the valve 5, and therefore in the port 27. The various lines (marked from No. 1 to No. 6, inclusive) of Fig. 5 represent the six positions to which the line 7 of Fig. 6 or the valve-handle is to be moved in the operation of the brake-valve. With the valve 5 in position upon the valve-seat 6 and the line 7 in position No. 1 the port 27 stands directly over the port 30, so that air is admitted directly and in large volume from the main reservoir or pump through port 30 and cavity or passages 18 to the train-pipe and thence to the under side of piston 19, this being the normal position for release of brakes. In this position of the valve 5 the outward arc or curved portion of the cavity 37 stands over the port 42, while the inner arc or curved portion of said cavity is above the port 90, (see Fig. 1,) so that while pressure is admitted through 30 to the train-pipe passage 18 it is likewise admitted from the latter through ports and cavity 42, 37, and 90 to the equalizing-piston chamber 22 and its connected reservoir on the upper side of the piston 19, thereby preserving equilibrium of pressure on the two sides of said piston and keeping it in normal position. At the same time the small cavity 40 rests over the port 42, so that air escapes through the small pin-hole from cavity 40 into 29 and thence by port 41 and exhaust 39, thus giving a certain blow or "warning" to the engineer that the valve is in release position and that if he leaves it there too long full main-reservoir pressure will be communicated to train-pipe. If we move the valve so that the line 7 shall occupy position No. 2, the port 27 will go to the right of port 30 and rest over port 33, thus admitting pressure only through the passage 33. The air will flow through passages 33 and 82 and thence through the reducing-valve and by the passages 69 and 35 into the train-pipe connection 18, as seen in Figs. 3, 4, and 5. We shall therefore admit and maintain a pressure in the train-pipe from the main reservoir whose amount will depend upon the adjustment of the pressure-reducing valve. The cavity 37 still connects ports 42 and 90, thus preserving equilibrium of pressure above and below piston 19. If now we move the valve 5 so that the line 7 shall occupy position No. 3, the port 27 will move farther to the right and rest over the passage 43, thus admitting air through that passage only. It is intended that a second pressure-reducing valve, such as shown in Figs. 3 and 4, or other suitable device of similar character shall be attached at the right-hand side of Fig. 5, so that the passages 82 and 69 of the pressure-reducing valve shall meet the passages 43 and 44, respectively, exactly as they meet passages 33 and 35 in Fig. 3, thus admitting the main-reservoir pressure through passage 43 and the pressure-reducing valve and thence by passage 44 into the train-pipe connection 18. The flow of air from the main reservoir to the train-pipe will be controlled in the same manner, therefore, whether the brake-valve is in position No. 2 or No. 3. In position No. 3 of the brake-valve the cavity 37 still connects the ports 42 and 90, as already described with regard to positions Nos. 1 and 2 of the valve, so that air is admitted to the upper side of the equalizing-piston chamber 22 at the same rate at which it is admitted to the under side of said piston-chamber, thus keeping said piston balanced and the vent-passage 23 closed. If the valve 5 is turned further around, so that the line 7 falls over the line No. 4, the port 27 will stand at the right of port 43 and the outer arc of cavity 37 will stand between ports 42 and 38, while the inner arc of cavity 37 still remains above port 90. No two operative ports will, therefore, be in communication. This is known in the art as "lap" position of the brake-valve in which all ports are closed and no operation is effected, no air being admitted into or exhausted from the train-pipe. If we turn the valve still further around, so that the line 7 falls over the line indicating position No. 5, the outer portion of cavity 37 will reach the preliminary exhaust-port 38, while the inner portion of said cavity still rests over port 90. This causes a gradual exhaust of air from the equalizing-piston chamber and its connected reservoir through the ports and cavities 90, 37, and 38 and 39, permitting the piston 19 to rise and open the passage 23, when air flows from the train-pipe until the pressure on the under side of the piston falls slightly below that on its upper side, whereupon the piston moves downward and closes said passage. Ordinarily the engineer leaves the valve in position No. 5 until the pressure above the piston is reduced from six to eight pounds and then shifts it back to position No. 4 and leaves it there until the equalizing-piston opens the train-pipe vent and moves back to normal position as the train-pipe pressure falls to the proper degree. The operation of the valve between positions Nos. 4 and 5 permits the setting of the brakes in the service application to the desired degree, depending upon the amount of reduction of train-pipe pressure.

For the emergency application the valve is moved so that the line or handle 7 falls over position No. 6. In this position the large cavity 29 of the valve connects the two large ports 30 and 39, which vents the air from the train-pipe directly and through large ports to the atmosphere and quickly and suddenly reduces the train-pipe pressure, causing the actuation of the quick-acting or emergency mechanism on the cars in the well-known manner familiar to those skilled in the air-brake art. To assist in the quick venting of the train-pipe while the valve is in position No. 6, if desired, the inner arc of cavity 37 may be made as long as indicated in Fig. 6, in which case it still remains over the port 90, while the other parts of said cavity stand over both ports 38 and 41, thus venting the air from the upper part of the equalizing-piston chamber and permitting piston 19 to rise and open the vent-passage 23.

Going now to Fig. 7, a slight modification is observed, which will be readily understood from the above description. It is common in air-brake practice on certain trains when running at high speed on level roads or while descending heavy grades to operate with about one hundred pounds pressure in the train-pipe and auxiliary reservoirs instead of the seventy pounds ordinarily employed and with about one hundred and twenty pounds pressure in the main reservoir. In order that the brake apparatus on the locomotive may be adapted for operation with either the ordinary pressure or with this extraordinary pressure used in high speed or on mountain grades, a duplex governor is placed on the locomotive for controlling the air-pump and so arranged that it will operate to stop the pump either when ninety pounds is obtained in the main reservoir for ordinary practice or will operate only when the higher pressure of one hundred and twenty pounds is desired in extraordinary practice. Such duplex governor is seen in outline at the right of Fig. 7, in which 50 is the main or steam body of the device, 48 and 49 are the respective low-pressure and high-pressure governors, and 46 and 47 are the respective pipes for admitting air into the governors to operate them. It is usual to connect these pipes 46 and 47 with some part of the brake system, preferably the main reservor, and to control the pipe 46 with a small cut-out cock. When it is desired to operate the brake system with ninety pounds pressure in the main reservoir, the cut-out cock in the pipe leading to the low-pressure governor 48 is opened, and consequently when the pressure reaches the desired amount the low-pressure governor 48 operates to stop the pump. When it is desired to carry the higher pressure of one hundred and twenty pounds in the main reservoir, the cut-out cock in the pipe leading to the low-pressure governor is closed and that governor is cut out, and therefore the pump will not stop until the pressure rises to one hundred and twenty pounds and is communicated through the pipe 47 to the high-pressure governor 49. In Fig. 7 all of the ports and cavities in the valve-seat 6 are the same as in Fig. 5 already explained, excepting that the port 43 is moved inwardly toward the center and an extra port or passage 45 is made in the valve-seat, whence it leads to the outside of the casing and communicates with the pipe 46, leading to the low-pressure governor 48. The same valve 5 (seen in Fig. 6) is to operate upon the valve-seat of Fig. 7 in the same manner as already described with reference to Fig. 5, and its mode of operation and the effects produced are exactly the same, with the additional result that when the valve is turned to position No. 3 the port 27 stands over both ports 43 and 45, thus admitting air from the main reservoir through passages 45 and 46 to operate the low-pressure governor 48 and stop the pump and avoiding wholly the necessity of a cut-out cock in the pipe 46.

It has become necessary in the brake system most commonly employed to have two pressure-reducing valves, by means of which either of two definite pressures can be carried in the train-pipe and reservoirs, depending on whether the system is being operated at the ordinary pressure of about seventy pounds or at the higher pressure of about one hundred pounds in high speed or on mountain grades. With the system in general use, having only five positions for the brake-valve, it is possible to have independently of the port for admitting full main-reservoir pressure to train-pipe but a single pressure-reducing valve attached to the engineer's brake-valve for automatically controlling the train-pipe pressure. When it is desired to have the second pressure-reducing valve in operation, pipes are employed to carry the air from the brake-valve proper to a supplemental brake-valve or reversing-cock to which the reducing-valves are attached and which must be operated to one of two positions to determine which of the two pressure-reducing valves shall be put in operation to limit the train-pipe pressure to the lower or the higher desired point. With my improvements illustrated herein I dispense wholly with this supplemental brake-valve or reversing-cock by providing an extra position for the brake-valve proper and attach the two pressure-reducing valves directly to the brake-valve casing. Whether the higher or the lower pressure reducing valve shall control the flow of air to the train-pipe depends solely on whether the brake-valve proper is turned to position No. 2 or position No. 3. It is scarcely necessary to say that these two reducing-valves may be adjusted to give any other desired pressures in the train-pipe instead of seventy and one hundred pounds, respectively, and also that their adjustments may be such that the reducing-valve connected with ports 43 and 44 may control the admission of the higher pressure, while that connected with the ports

33 and 35 may control the admission of the lower pressure into the train-pipe.

In Fig. 3 instead of the piston 19 operating a connected valve to control the passage 23 one side of said piston bears upon a valve 56, fixed to the casing 2, through which the passage 23 extends. The means for operating said piston to move from and return to the valve 56 are the same as in the other figures.

Figs. 8 and 9 are modifications of the valve-seat and rotary valve. The ports in the valve-seat are essentially the same and similarly located, as in Fig. 5, except that port 39 has a little different shape and the port 41 is abandoned. Instead of the small cavity 40 in the face of the valve, a small pin-hole 40 extends through the valve in Fig. 9, so that with the valve in position No. 1 there is a limited blow of air or "warning" through the exhaust directly from the main reservoir, and when the valve is turned to position No. 6 the inner arc of cavity 37 connects port 90 with exhaust-port 39.

Figs. 10 and 11 show a modification in which the operative valve may have seven instead of six positions. All the ports are essentially the same as in the figures described, but there is an added passage 53, leading from the valve-seat 6 to the outer casing at the left, and a second passage 54 leading back to the train-pipe connection 18. The passages 33 35 and the passages 43 44 serve the same purposes as in the figures already described. The inner portion of train-pipe port 30 is curved to the right, as illustrated, with the result that when the operator's valve is in position No. 1 the inner arc of cavity 37 connects ports 30 and 90, while port 27 in the valve likewise stands over the outer end of port 30. In positions No. 2, No. 3, and No. 4 the cavity 37 connects ports 42 and 90, thus keeping train-pipe air in the upper end of the equalizing-piston chamber. In position No. 2 the port 27 stands over the passage 53, thus admitting pressure from main reservoir or pump through the passage 53 and thence through the passage 54 into train-pipe connection 18 after it passes through the pressure-reducing valve which is to be attached to the casing to control these passages just as the other pressure-reducing valve controls the passages 33 and 35, as already explained. With this arrangement we may have any one of three automatically-controlled train-pipe pressures besides the full main-reservoir pressure admitted to the train-pipe.

Figs. 12 and 13 show still further modifications by means of which we may attach four pressure-reducing valves to the casing to control the admission of air from main reservoir or pump to train-pipe. When the valve, Fig. 13, is in position No. 1, the port 27 stands over the port 30. In position No. 2 port 27 stands over port 58, admitting air through passage 58, the appropriate reducing-valve, and passage 59 into train-pipe connections 30 and 18. In position No. 3 the port 27 stands over passage 53, whence the air flows through passage 53, the appropriate reducing-valve, and the passages 54 and 35 to train-pipe connection 18. In positions No. 4 and No. 5 the port 27 stands, respectively, over the ports 33 and 43, admitting the air to train-pipe, as already described. If it is desired with Figs. 12 and 13, the port 90, leading to the upper end of the equalizing-piston chamber, may have an oblong shape, as illustrated, so that with the valve in position No. 1 train-pipe air may be admitted through said port to said chamber both from the port 30 through the cavity 37 and also from port 42 through the cavity 29. The arrangement of ports allows the valve to be placed in any one of eight positions and permits four feed-valves to be attached directly to the casing, thus giving any one of four automatically-controlled pressures in train-pipe, besides the full main-reservoir pressure.

In all the figures described ports 30 and 42, which latter is in reality a branch of port 30, are always open to the train-pipe and are therefore always filled with train-pipe pressure. It will be noted that no matter what position the operator's valve occupies for admitting air from the main reservoir or pump to the train-pipe the train-pipe always remains in communication with the upper end of the equalizing-piston chamber 22.

By the employment of my entirely novel arrangement of apparatus and of ports and cavities in the operative valve and valve-seat I am permitted to have either six, seven, or eight positions for the brake-valve, thus enabling me to attach two, three, or four pressure-reducing or feed valves having different adjustment directly to the casing of the brake-valve, admit either one of two or more definite and automatically-controlled pressures to the train-pipe by placing the brake-valve in the appropriate position, and so wholly avoid the necessity for a second or supplemental engineer's valve. I therefore claim, broadly, an arrangement of mechanism by means of which besides the full main-reservoir pressure either of two or more automatically-controlled pressures may be carried in the train-pipe by merely placing the brake-valve in the proper position to admit pressure to the train-pipe through either of two or more pressure-reducing valves, while at the same time keeping the pressures so far equalized on both sides of the equalizing-piston as to prevent any venting of air from the train-pipe.

I claim—

1. In an engineer's brake-valve, the combination of an operator's valve, an equalizing-piston chamber and piston therein, a series of at least three independent passages controlled by as many positions of the operator's valve for supplying substantially the same pressure to the train-pipe and to both ends of said piston-chamber, and pressure-

reducing devices controlling at least two of said supply-passages.

2. In an engineer's brake-valve, the combination, with an operator's valve arranged to occupy any one of at least six positions, of an equalizing-piston chamber and piston therein, a series of ports and cavities controlled by said valve so arranged that in three of its positions supply-passages are controlled for supplying substantially the same pressure to the train-pipe and to both ends of said piston-chamber, in a fourth position all operative ports are closed, in a fifth position a port is opened from one end of said chamber to the atmosphere and in a sixth position a port is opened directly from train-pipe to the atmosphere, and pressure-reducing-valve devices controlling at least two of said supply-passages.

3. In an engineer's brake-valve, the combination of an equalizing-piston chamber, a piston in said chamber whose operation controls a vent-passage from the train-pipe, an operator's valve and valve-seat, three ports leading from said valve-seat, first, to the piston-chamber, second, to the train-pipe, and, third, to exhaust, and a cavity in said valve for alternately connecting the first of said ports with the second to keep the pressures on said piston equal and the vent-passage closed, and with the third to vent the pressure from one of its sides and open said passage.

4. In an engineer's brake-valve, the combination with an equalizing-piston chamber and piston whose operation controls a vent-passage from the train-pipe, an operator's valve moving upon a valve-seat, a series of at least two independent ports in the valve-seat for admitting pressure into the train-pipe, an exhaust-port in said valve-seat and a single port leading from the seat to one side of the said piston for admitting pressure against one side of the piston at all times of admitting pressure into the train-pipe and for venting pressure from the same side of said piston to move the same from its normal position.

5. In an engineer's brake-valve, the combination of an equalizing-piston chamber, a controlling-valve and a valve-seat on which the same operates, three ports in the valve-seat for admitting air into the train-pipe, while the controlling-valve occupies three several positions, two ports from the valve-seat leading to the piston-chamber and to the brake-pipe, respectively, and a cavity in said valve for connecting said last-mentioned ports so long as said valve occupies any one of its three positions for admitting air into the brake-pipe.

6. In an engineer's brake-valve, the combination of an operator's valve, a series of at least three independent passages controlled by as many positions of said operator's valve, for admitting pressure into the train-pipe, a series of reducing valve devices controlling two of said passages, an equalizing-piston chamber normally open at one end to the train-pipe, and a passage controlled by said operator's valve for connecting the train-pipe with the opposite end of said chamber at all times of admitting pressure into the train-pipe, whereby either of two or more automatically-controlled pressures, independently of the full main-reservoir pressure, may be carried in the train-pipe while keeping an equalized pressure in both ends of said piston-chamber.

7. In an engineer's brake-valve, the combination of a piston operating in a chamber, a stationary valve having a port from train-pipe to atmosphere on which said piston normally rests and means for alternately establishing equilibrium of train-pipe pressure on both sides and for venting pressure from one side of said piston to operate the same.

MURRAY CORRINGTON.

Witnesses:
BURTON E. EMORY,
JOHN E. SMITH.