J. REICHMANN.

ENGINEER'S VALVE.

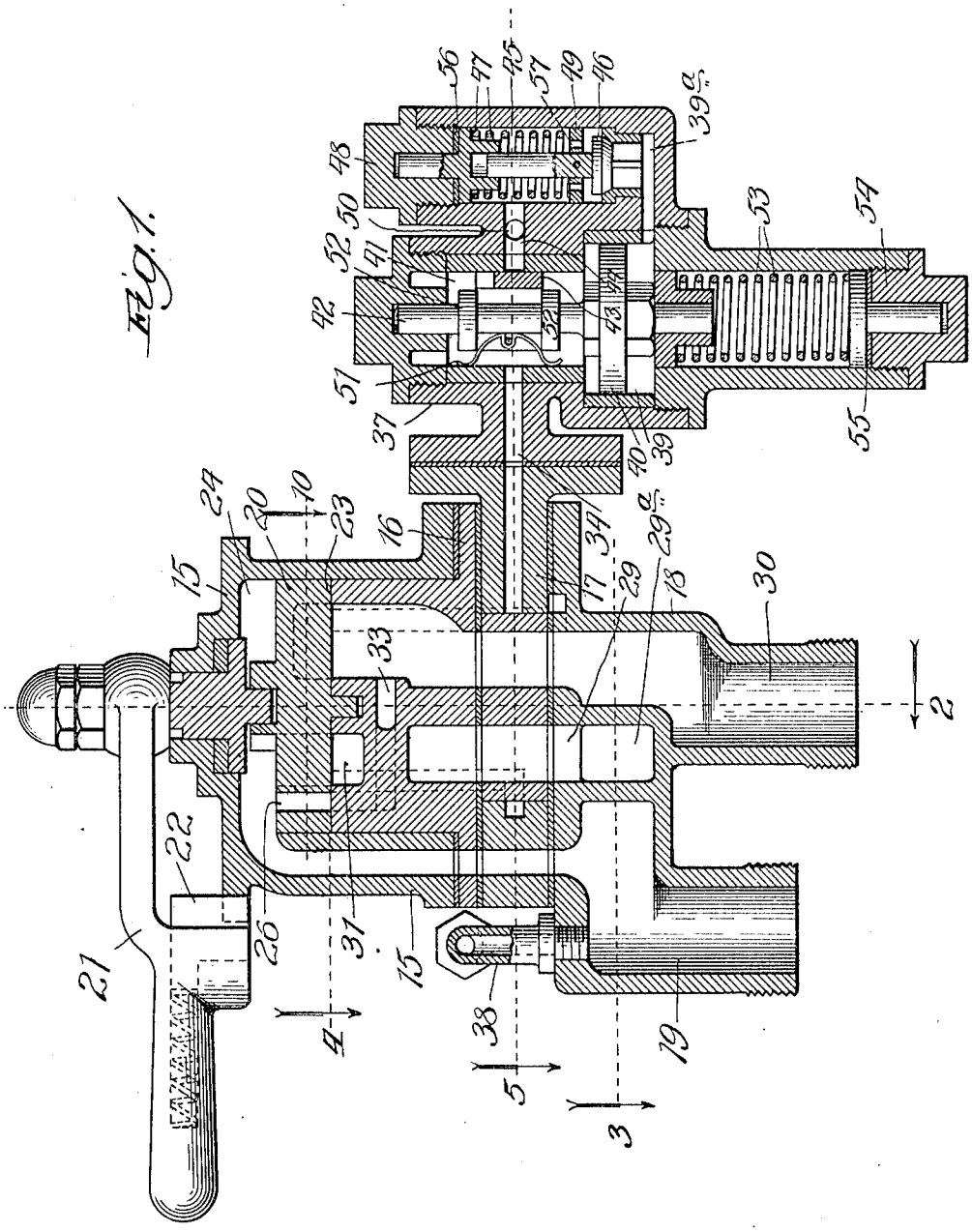
APPLICATION FILED FEB. 25, 1911.

1,001,552.

Patented Aug. 22, 1911.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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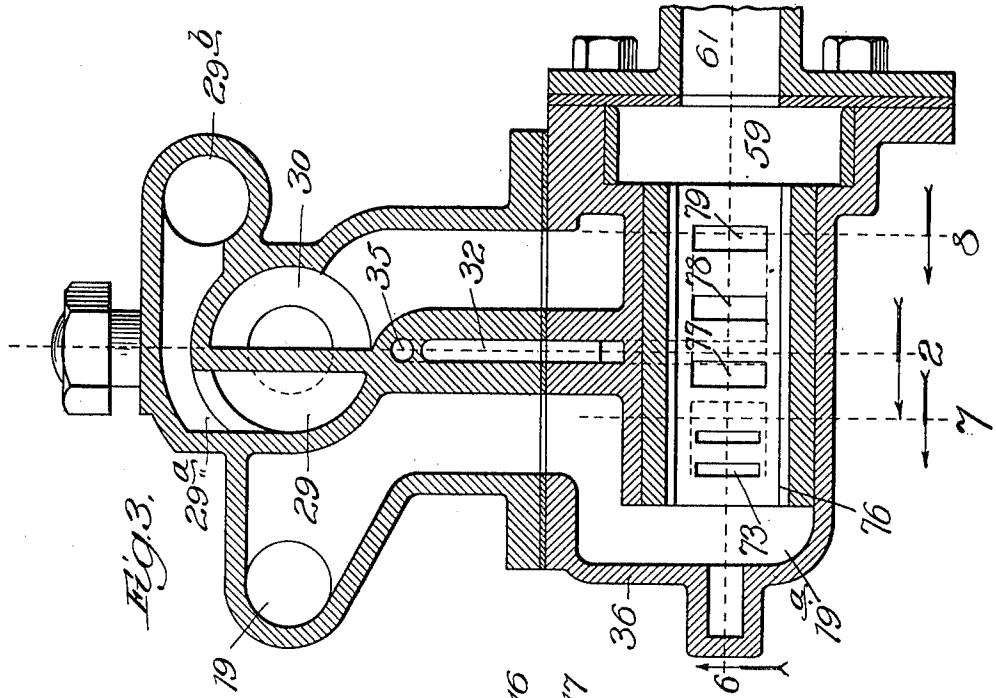

FIG. 3.

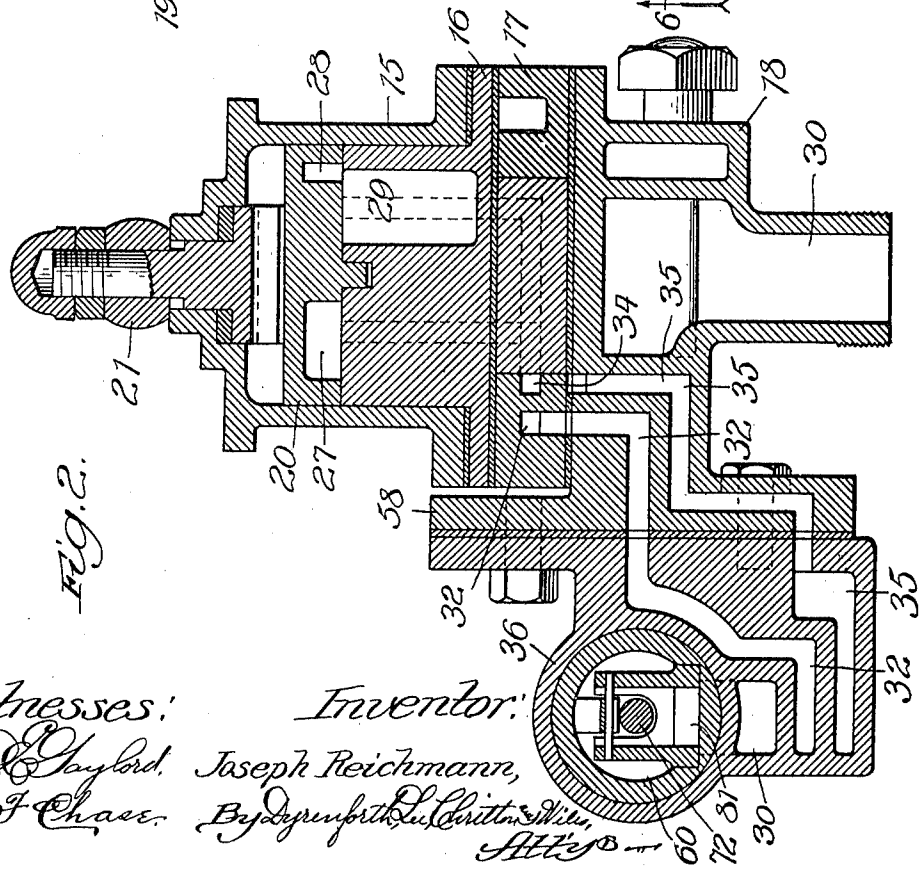

FIG. 2.

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5 SHEETS—SHEET 3.

Fig. 4.

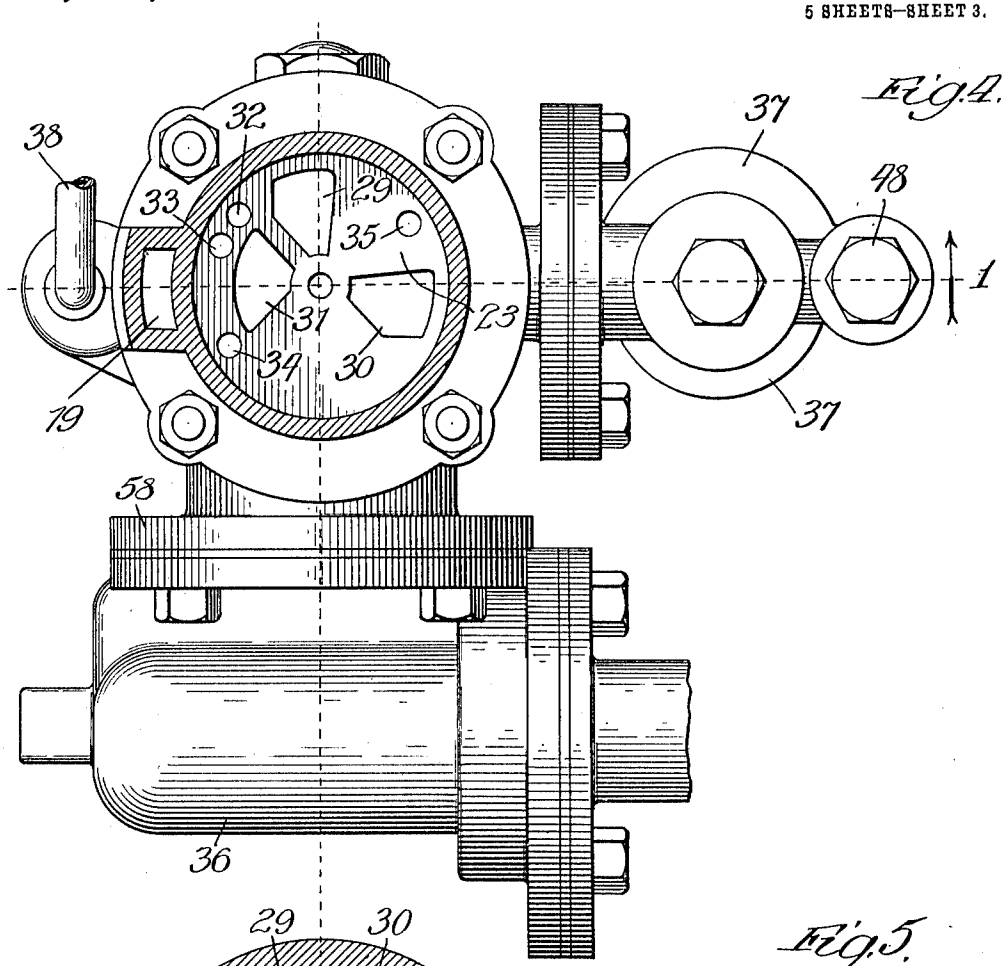
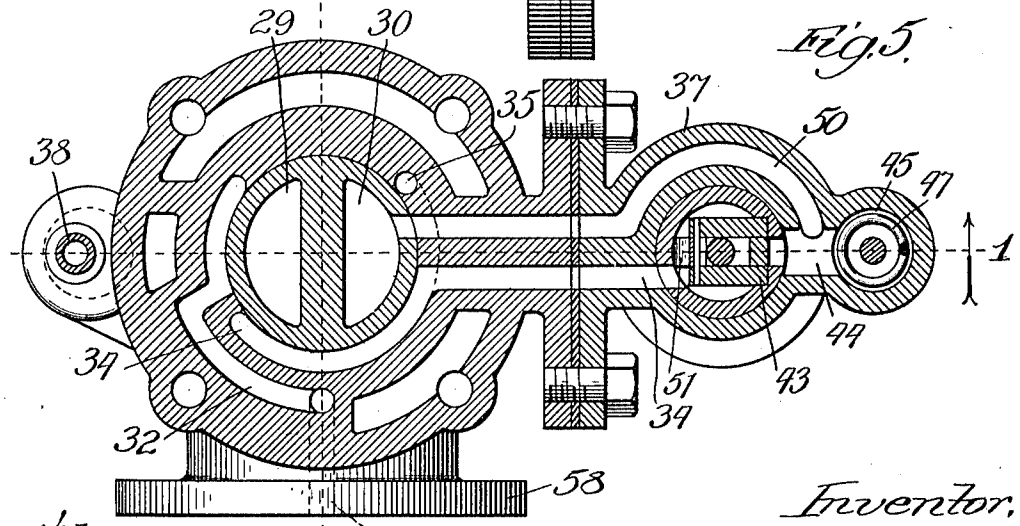


Fig. 5.



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5 SHEETS—SHEET 4.

Fig. 6.

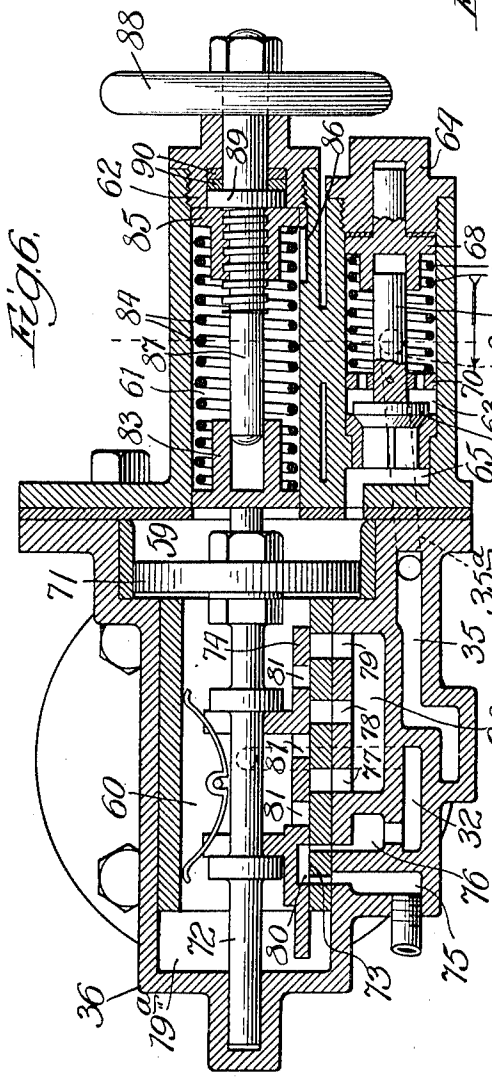


Fig. 9.

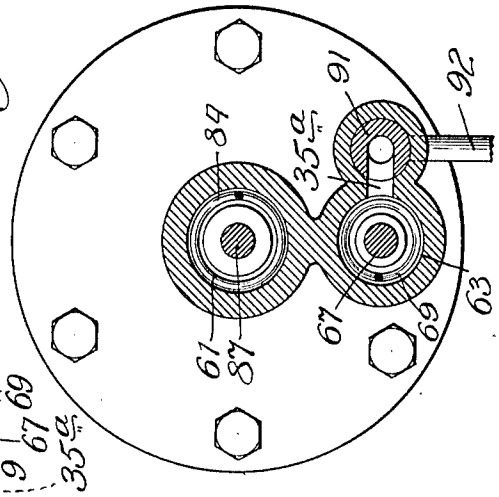


Fig. 8.

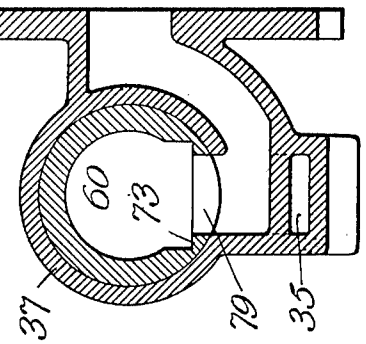
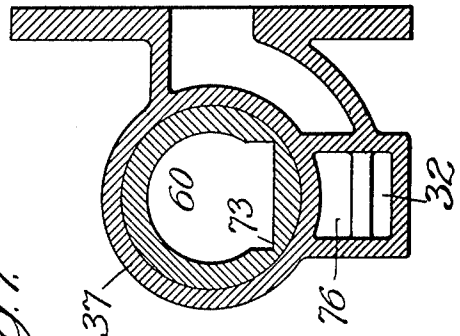


Fig. 7.



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5 SHEETS—SHEET 5.

FIG. 11.

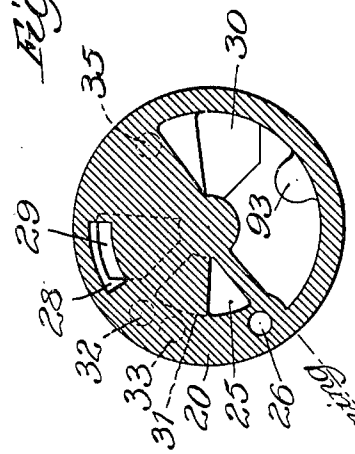


FIG. 14.

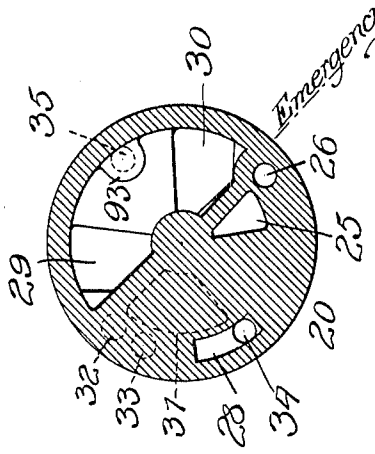


FIG. 13.

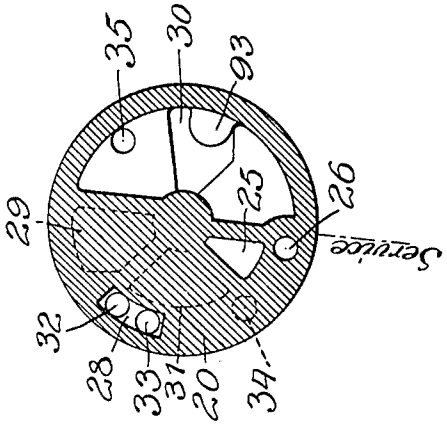


FIG. 10.

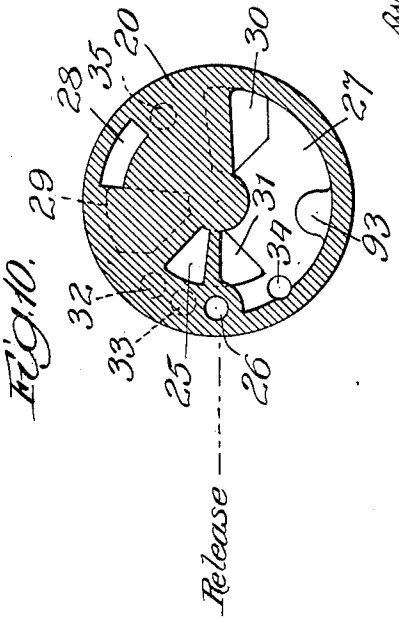
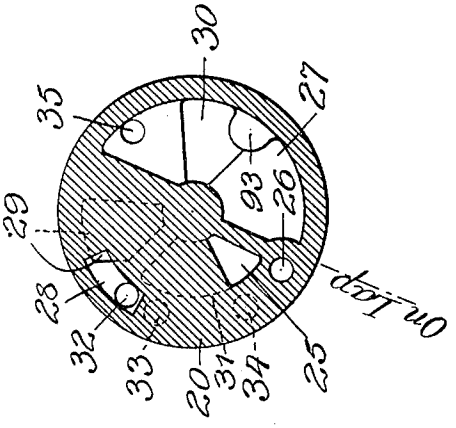


FIG. 12.



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UNITED STATES PATENT OFFICE.

JOSEPH REICHMANN, OF CHICAGO, ILLINOIS.

ENGINEER'S VALVE.

1,001,552. Specification of Letters Patent. Patented Aug. 22, 1911.

Application filed February 25, 1911. Serial No. 610,696.

To all whom it may concern:

Be it known that I, JOSEPH REICHMANN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Engineers' Valves, of which the following is a specification.

My object is to provide an engineer's brake-valve of improved construction adapting it for use in connection with automatic air-brake triple-valves either of the well-known type which cause the brakes to be applied for "service" stops by auxiliary reservoir pressure alone, or of the type which cause the brakes to be applied for "service" stops by auxiliary reservoir pressure supplemented by train-pipe pressure. A triple-valve of the latter type is shown, described and claimed in Letters Patent No. 991,801, granted to me May 9, 1911, "Fluid-pressure brake apparatus".

My present engineer's brake-valve has been devised by me not only to render such combination automatic and straight-air valves under ready control of the engineer, but also to fulfil all the more advanced requirements of engineers' brake-valves designed for use where all the triple valves of the train are of the purely automatic type.

In the accompanying drawings, which show my improvements as I prefer to provide them—Figure 1 is a vertical section of my engineer's valve taken on line 1 in Figs. 4 and 5; Fig. 2, a vertical section taken on line 2 in Figs. 1, 3, 4 and 5; Fig. 3, a broken plan-section taken on line 3 in Fig. 1; Fig. 4, a partly sectional plan-view, the section being taken on line 4 in Fig. 1; Fig. 5, a plan section taken on line 5 in Fig. 1; Fig. 6, a vertical section taken on line 6 in Fig. 3; Figs. 7 and 8 detail sections taken on lines 7 and 8, respectively, in Fig. 3; Fig. 9, a vertical section taken on line 9 in Fig. 6; and Figs. 10, 11, 12, 13 and 14, plan sections taken on line 10 in Fig. 1, and indicating the different positions of the main valve with relation to its seat when turned, respectively, to "release", "running", "on-lap", "service" and "emergency", to bring about all those operations.

The engineer's valve in its entirety involves in its structure a main valve and two supplemental valve-devices connected thereto and coöperating therewith in bringing about the accomplishing of the duties for which the engineer's valve is designed. The casing or stationary part of the main valve is formed of four sections, 15, 16, 17 and 18, bolted together and separated by gaskets, as indicated. The section 15 contains a chamber 24, which is in open communication with the main reservoir (not shown) through a passage 19. The said chamber incloses the main valve 20 which is controlled in the usual way by a handle 21. On the rim of the section 15 are the usual notches defining the positions to which the valve-operating handle 21 should be turned for bringing about the different operations, the handle carrying the usual spring-stop 22 to engage the notches. The valve 20 turns on the usual valve-seat 23, which forms the base of the chamber 24. Extending through the valve 20 in the positions indicated are the ports 25 and 26, and in the under face of the valve are the cavities 27, 28. In the valve-seat, in the positions shown, are the large direct exhaust port 29, the large port 30, a cavity 31 and the small ports of passages 32, 33, 34, and 35. The port 29 extends directly downward from the seat, as indicated in Figs. 1, 3 and 5, and communicates at its lower end, as indicated in Fig. 3, with a passage 29^a extending to the outlet connection 29^b for a pipe (not shown), which would extend to the outside of the cab. The port or passage 30 leads directly to the train-pipe; the cavity 31, when the valve is in the "release" position shown in Fig. 10, opens communication from the port 25 through the cavities 31, 27 to the direct train-pipe port 30; the port of passage 32 extends through a circuitous course to the atmosphere; the passage 33 extends, as indicated in Fig. 1, to the train-pipe passage 30, being simply a branch thereof; and the passages 34 and 35 extend to the supplemental valve-devices 37 and 36. The ports 33, 32 are supplemental exhaust ports which when in communication through the cavity 28 establish a supplemental exhaust-passage from the train-pipe passage 30 through the supplemental valve-device 36; and the port 34 is a feed-port for air from the main-reservoir to the train-pipe when the main-valve 20 is turned to "running" position (Fig. 11).

Extending from the main-reservoir passage 19 is a pressure-gage pipe 38 carrying the usual main-reservoir pressure-gage (not

shown), and the train-pipe, in practice, also carries the usual train-pipe pressure-gage (not shown).

The supplemental valve-device, or feed-valve, 37 is interposed between the feed-port and passage 34 and the train-pipe, as indicated most plainly in Fig. 5. It contains a piston-chamber 39 (Fig. 1) provided with a piston 40. In open communication with the piston-chamber 39 is a slide-valve chamber 41 to which the passage 34 leads, as shown. The stem 42 of the piston extends through the chamber 41 and carries a slide-valve 43 governing a port 44 which leads to a second chamber 45. In the lower end-portion of the chamber 45 is a valve 46 normally closing a passage 39^a extending from the chamber 39 beneath the piston 40 to the chamber 45. The valve 46 is held normally to its seat by a spring 47 confined between a screw-plug 48 and perforated sleeve 49 fastened to and movable with the stem of the valve 46. A passage 50 extends from the passage 44 to the train-pipe passage 30, as indicated in Fig. 5. The slide-valve 43 is held to its seat in the usual way by a spring 51 and is confined between collars 52 on the stem 42. The piston 40 is held normally in the raised position shown in Fig. 1, by a spring 53 bearing at its lower end against the screw-cap 54.

When the main-valve 20 is in "release" position, as indicated in Fig. 10, the pressure flows from the main reservoir to the train-pipe and also flows through the feed-port and passage 34 into the slide-valve chamber 41. When the valve 20 is in "running" position, as indicated in Fig. 11, air from the main-reservoir passes through the port 26 and passage 34 to the slide-valve chamber 41. In other positions of the main valve 20 the port of the feed-passage 34 is closed. It will be seen from the construction, as illustrated in Fig. 1, that the piston 40 is a loosely fitted or free-moving piston and that pressure escaping past the same to its under side can escape through the passage 39^a by opening the valve 46. There is thus formed, in effect, a by-passage for air, around the slide-valve 43, from the passage 34 to the passage 50, which by-passage is normally closed by the valve 46. The tension of the spring 53 may be regulated by means of washers 55 inserted above the screw-plug 54 and the tension of the spring 47 may be regulated by means of washers 56 inserted beneath the screw-plug 48. The sleeve or collar 49 which is fastened to the stem of the valve 46 has openings 57 for the free passage of air through it.

The supplemental valve-device 36 is bolted to the flange 58 of the main valve-member 18 and contains portions of the aforesaid passages 30, 32 and 35. In the said valve-device is a piston-chamber 59 and a slide-valve chamber 60 in open communication with a branch 19^a of the main-reservoir passage 19. Extending from the chamber 59 in line with the chamber 60 is a chamber or housing 61 closed at its outer end by a screw-plug 62. Beneath the chamber or housing 61 is a chamber 63 closed by a screw-plug 64 and in open communication with the chamber 59 through a passage 65, which passage, however, is normally closed by a valve 66 having a stem 67. The stem is guided at its end in a plug 68 and is surrounded by a spring 69 confined between a perforated collar 70 on the stem and the plug 68. The spring 69 may be tensioned by the insertion of washers between the plugs 68, 64. In the chamber 59 is a loosely fitted or free-moving piston 71 on a stem 72. In the base of the chamber 60 is a valve-seat 73 having a slide-valve 74 movable with the stem 72. In the seat 73, in the position shown, is the port of an exhaust-passage 75, the outlet of which may be piped to the outside of the cab. Also in the valve-seat 73 is a port 76, communicating with the passage 32, and ports 77, 78, 79, communicating with a branch of the train-pipe passage 30. In the slide-valve is a cavity 80, and openings 81, forming ports adapted to register with the port formed by the series of openings 77, 78, 79 to afford communication between the passages 19^a and 30, and thus establish what is, in effect, a train-pipe re-charging by-passage. Communicating with the chamber 63 is a port 35^a extending to the passage 35 and forming therewith an equalizing passage, to equalize the pressure in the chamber 63 with the train-pipe pressure when the main-valve 20 is in service position or "on-lap." In the housing 61 is a buffer 83 which is in the path of the end of the piston stem 72 and held normally in the position shown in Fig. 6 by a graduating spring 84. The spring 84 is confined between the buffer 83 and the tensioning nut 85, which latter is splined into a key-way 86 to prevent its rotation and is interiorly threaded to receive a threaded adjusting stem 87 which extends through the plug 62 and carries a hand-wheel 88. By turning the wheel 88 and consequently the stem 87 the nut 85 may be caused to travel along the stem and thus tension the spring 84. On the stem 87 is a collar 89 and the normal position of the stem with reference to the adjacent parts may be regulated by washers 90 inserted between the stem and the plug 62. Interposed in the passage 35^a between the chamber 63 and the passage 35 is a rotary plug-valve 91 having a handle 92 and which may be turned to open or close the said passage.

The operation of the engineer's valve is as follows: Compressed air from the main reservoir enters through the passage 19 and its

branch 19ª, shown in Fig. 3, to the slide-valve chamber 60, and also into the chamber 24 above the main-valve 20. When the handle 21 is turned to "release" position (Fig. 10) air from the main reservoir passes through the port 25, cavity 31 and cavity 27 to the port and passage 30 to the train-pipe. When the handle 21 is turned to "on-lap" position (Fig. 12), all of the air-pressure controlling ports are closed. By moving the handle 21 to "service" application position (Fig. 13), communication between the ports 32 and 33 is opened through the cavity 28, whereby air from the train-pipe will exhaust through the passage 30, the passage 33, cavity 28 and passage 32 to the supplemental valve-device 36; and, while the parts are in the position shown in Fig. 6, will exhaust from the passage 32 through the port 76, slide-valve cavity 80 and port 75 to the atmosphere, thereby reducing the air-pressure in the train-pipe, as desired. During "service" application the piston 71 and valve 74 remain stationary in the position shown in Fig. 6. When the reduction of air-pressure in the train-pipe is sufficient to cause the triple valves of the train to apply the brakes for a "service" stop, the handle 21 of the valve 20 may be turned to "on lap" position, indicated in Fig. 12, thereby closing all the pressure-controlling ports. By moving the handle to "emergency" position (Fig. 14), communication between the port 30 and exhaust-port 29 is fully opened, causing the exhaust of air from the train-pipe to the full capacity of the valve.

In the "running" position of the valve 20 (Fig. 11), communication between the port 25 and train-pipe passage 30 is closed and communication between the main-reservoir passage 19 and the feed-port 34 is opened through the port 26 in the valve 20, whereby the main-reservoir air passes through the passage 34 into the pressure-reducing valve-device 37. This pressure entering the slide-valve chamber 41 and bearing against the piston 40 moves the latter and slide-valve 43 downward, whereby the pressure will pass through the port 44 and passage 50 to the train-pipe. This passage from the port 34 through the reducing-valve 37 to the train-pipe is, in effect, a feed-passage through which pressure passes from the main-reservoir through a reducing-valve to the train-pipe to maintain the latter at normal. The tension of the spring 53 is adjusted to control the movement and position of the piston 40 and slide-valve 43 in conjunction with a predetermined air-pressure below the piston in the chamber 39. Main-reservoir air from the chamber 41 will escape past the piston 40, and the valve 46 in the chamber 45 being closed a pressure is produced in the chamber 39 below the piston which will coöperate with the spring 53 to move the piston and lift the slide-valve to a position with reference to the port 44, as may be required for continuously supplying the desired quantity of main reservoir air to the train-pipe through the passages 44, 50. The air escaping past the piston 40 to the under side of the latter passes through the passage 39ª, chamber 45 and passage 50 into the train-pipe. For operations involving only a slight reduction of the train-pipe pressure, the valve 46 would perform no particular function. Under these circumstances, owing to the slight difference of air-pressure on opposite sides of the piston 40, the leakage of air past the piston is very slight and the pressure in the chamber 39 operates, in conjunction with the spring 53, to maintain the slide-valve 43 normally closed. When the train-pipe pressure is reduced sufficiently below the pressure in the chamber 41 to cause the latter to overcome the resistance of the spring 53, the piston would yield and cause the opening of the port 44 to admit main-reservoir pressure to the train-pipe. By employing the valve 46 and attendant parts shown in Fig. 1 and above described a greater back pressure may be maintained under the piston 40, this increased back pressure being commensurate with the resistance of the spring 47 as adjusted. Thus, when the valve 20 is in "running" position, a predetermined pressure may be maintained in the train-pipe with reference to the main reservoir pressure, and in the case of leakage from the train-pipe the same will be supplied and the train-pipe pressure maintained at its standard. The pressure-reducing valve-mechanism, described, in the casing 37 will automatically adjust itself to conditions, whereby the port 44 will be maintained open more or less constantly to the extent required to supply the train-pipe and maintain the pressure in the latter at standard. In practice, the tensions of the springs 53 and 47 should be so adjusted as to maintain the proper difference between main-reservoir pressure and train-pipe pressure.

When the valve 20 is turned to "on lap" position (Fig. 12), communication is established between the main exhaust port 29 and supplemental exhaust port 32, but this performs no function. When the valve 20 is turned to "service" position, Fig. 13, the port 34 is closed and consequently the reducing valve-device 37 is thrown out of action.

Train-pipe air passes through the passage and port 33 and cavity 28 to the passage 32. As before stated, the chamber 63 is in open communication through the port 35ª with the passage 35, so that when the valve 20 is either in "on lap" or "service" position, the ports 30 and 35 being in communication through the cavity 27 of the valve 20, the pressure in the chamber 63 will be the same

as that in the train-pipe. The piston 71 in the supplemental valve-device 36 is loosely fitted or free-moving, so that there will be more or less leakage of pressure from the main-reservoir passage 19ª through the chamber 60 and past the said piston to the chamber 59 in front of the piston 71. This pressure in the chamber 59 will be maintained at a predetermined degree over the train-pipe pressure by the resistance of the spring 69. When the valve 20 is first turned to "service" position, the parts of the valve-device 36 will be in the positions indicated in Fig. 6, so that air passing from the train-pipe into the passage 32 will exhaust through the port 76, cavity 80 and port 75 to the atmosphere. When pressure in the train-pipe is reduced to a predetermined extent, as would be the case after the triple valves of the train have been moved to "service" application position, the pressure from the main-reservoir through the passage 19ª exerted against the piston 71 will move it to compress the regulating spring 84. In the movement of the slide valve 74 thus brought about the exhaust-port 75 is closed, thereby stopping further reduction of the pressure from the train-pipe. In the further movement of the piston and slide-valve 74 which would occur following abnormal reduction of train-pipe pressure, the ports 77, 78, 79 of the passage 30 will be opened to admit main reservoir pressure quickly and in comparatively large volume from the main-reservoir branch passage 19ª to the train-pipe passage 30.

The function of the buffer-spring 84 is to permit opening of the ports 77, 78, 79 only when train-pipe pressure drops abnormally; that is to say, when it drops below the limit which it is desirable to retain in the train-pipe when brakes have been applied for a "service" stop. When the ports 77, 78, 79 are open the pressure passing the loosely-fitted piston 71 to the forward side thereof in the chamber 59, coupled with the rise of pressure in the train-pipe, and, consequently, in the passages 35, 35ª and chamber 63 against the valve 66, very soon causes said piston to return far enough, in the direction to the left in Fig. 6, to close the ports 77, 78, 79 without necessarily moving far enough to open the exhaust-port 75. This return of the piston would, in practice, occur before the passage of main-reservoir pressure through the ports 77, 78, 79 could influence the triple-valves to return to "release" position.

Where the triple valves of the train are of the combination automatic and straight air type, described in my aforesaid Patent No. 991,801, a "service" reduction of train-pipe pressure through the engineer's valve is followed by a further reduction thereof through a direct passage into the brake-cylinder, with the probable result of causing the piston 71 to move in opposition to the buffer-spring 84. The air thus admitted to the train-pipe direct from the main-reservoir through the ports 77, 78, 79 will tend to overcome any undue reduction of train-pipe pressure produced by the passage of the latter direct to the brake-cylinders. In the movement of the piston 71 toward normal position, the ports 77, 78 and 79 close in advance of the opening of the port 75, as before stated, and for a time at least the passage of main reservoir pressure to the train-pipe through the ports 77, 78, 79 may be shut off and the exhaust-port 75 also closed. During this time the engineer may turn the valve 20 back to "on lap" position.

The permissible reduction of train-pipe pressure for "service" application of brakes is governed by the adjustment of the graduating spring 84 in the manner set forth, and the difference of pressure between what it is desired to maintain in the chamber 59 and the train-pipe pressure at the time is governed by the tension of the spring 69.

When the main-valve 20 is turned to "emergency" application position (Fig. 14), the large train-pipe port 30 in the valve-seat 23 is thrown into wide communication with the large exhaust-port 29, with the result of releasing all pressure from the train-pipe. Naturally, during "emergency" application of brakes, the pressure in the chamber 63 should not be reduced to an extent which would permit the main reservoir pressure to move the supplemental slide-valve 74 to open the ports 77, 78, 79 which would admit main-reservoir pressure to the train-pipe. Therefore, to lock the pressure in the chamber 63 when the valve is moved to "emergency" position, I provide on the valve 20 a port-closing lip or lug 93, which, in the emergency position of the valve 20, effectually closes the port 35. In case of a rupture of the train-pipe, the handle 21 may be moved to "on lap" position, and the passage 35ª closed by turning the plug 91 to retain the air-pressure in the main reservoir.

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

1. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection, a valve-seat provided with a direct train-pipe port and a direct exhaust-port and a main-valve on the valve-seat, of supplemental train-pipe exhaust-ports in the valve-seat established by the main-valve when turned to "service" position to open a "service-stop" exhaust-passage, a feed-port in the valve-seat leading indirectly to the train-pipe and opened into communication with the main-reservoir by the main-valve when turned to "running" position, supplemental valve-mechanism interposed in said "service-stop"

passage and governing the exhaust of pressure therethrough, supplemental valve-mechanism interposed in said feed-passage and governing the passage of pressure therethrough, means for adjusting the resistance against closing of the first named supplemental valve-mechanism, and means independent of said adjusting means for adjusting the resistance against opening of the second supplemental valve-mechanism.

2. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a supplemental exhaust-passage from the train-pipe to the atmosphere, a main-valve on the valve-seat controlling the said ports and establishing said passage when turned to "service" position, a supplemental valve-device through which said passage extends, a piston-chamber in said valve-device communicating at one side with the main-reservoir and at its opposite side with the train-pipe, a loosely fitted piston in said chamber, a valve operatively connected with the piston and controlling said passage, and a spring-seated valve between said chamber and train-pipe resisting the passage of pressure from the chamber to the train-pipe.

3. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a supplemental exhaust-passage from the train-pipe to the atmosphere, a main-valve on the valve-seat controlling the said ports and establishing said passage when turned to "service" position, a by-passage for pressure from the main-reservoir to the train-pipe, a supplemental valve-device, a piston in said valve-device exposed at one side to main-reservoir pressure and subject on its opposite side to the resistance of back-pressure from the train-pipe, and valve-mechanism governing both of said passages and operatively connected with said piston, said valve-mechanism normally opening said established supplemental exhaust-passage and closing said by-passage and operating under the initial movement of the piston from normal position to close said established supplemental exhaust-passage, and operating under further travel of the piston to open said by-passage, for the purpose set forth.

4. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a supplemental exhaust-passage from the train-pipe to the atmosphere, a main-valve on the valve-seat controlling the said ports and establishing said passage when turned to "service" position, a by-passage for pressure from the main-reservoir to the train-pipe, a supplemental valve-device, a piston in said valve-device exposed at one side to main-reservoir pressure and subject on its opposite side to the resistance of back-pressure from the train-pipe, valve-mechanism governing both of said passages and operatively connected with said piston, said valve-mechanism normally opening said established supplemental exhaust-passage and closing said by-passage and operating under the initial movement of the piston to close said established supplemental exhaust-passage, and operating under further travel of the piston to open said by-passage, a graduating-spring resisting movement of the piston from normal position, for the purpose set forth.

5. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a supplemental exhaust-passage from the train-pipe to the atmosphere, a main-valve on the valve-seat controlling the said ports and establishing said passage when turned to "service" position, a by-passage for pressure from the main-reservoir to the train-pipe, a supplemental valve-device, a piston in said valve-device exposed at one side to main-reservoir pressure and subject on its opposite side to the resistance of back-pressure from the train-pipe, valve-mechanism governing both of said passages and operatively connected with said piston, said valve-mechanism normally opening said established supplemental exhaust-passage and closing said by-passage and operating under the initial movement of the piston to close said established supplemental exhaust-passage, and operating under further travel of the piston to open said by-passage, a graduating spring resisting movement of the piston from normal position, and means for adjusting the tension of the graduating spring from outside the valve-casing.

6. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection, a valve-seat provided with a direct train-pipe port and a direct exhaust-port, and a main valve on the valve-seat controlling said ports, of a supplemental exhaust-passage from the train-pipe to the atmosphere established by movement of said main-valve to "service" position, a recharging by-passage extending from the main-reservoir to the train-pipe, a slide-valve chamber in open communication with the main reservoir having a slide-valve seat provided with a series of ports interposed in said by-passage and ports interposed in said established supplemental

exhaust-passage, a slide-valve on said slide-valve seat governing the ports therein, and the passage of main-reservoir pressure through the said by-passage ports, a piston-chamber in open communication with the slide-valve chamber at one side and communicating at its opposite side with the train-pipe, a piston in said chamber exposed on one side to main-reservoir pressure and subject on its opposite side to the train-pipe pressure, said piston being operatively connected with the slide-valve and causing the same normally to open the supplemental exhaust-passage ports and close the said by-passage ports, and operating, in its initial movement from normal position, to close said supplemental exhaust-passage ports and operating, in its further travel, to open said series of by-passage ports simultaneously for the passage of main-reservoir pressure direct to the train-pipe, for the purpose set forth.

7. In an engineer's brake-valve, the combination with a valve-casing having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a piston-chamber and a slide-valve chamber communicating with the main-reservoir, a loosely fitted piston and a slide-valve operating in said chambers, a graduating spring-chamber communicating with the piston-chamber at the side thereof opposite the main-reservoir connection, a graduating-spring in the said graduating-spring chamber coöperating with the pressure in the piston-chamber, at the side of the piston opposite the main-reservoir connection, produced by air from the main-reservoir escaping past the piston, an equalizing passage communicating with the piston-chamber, at the side thereof opposite the main-reservoir connection, and leading to a port in the main valve-seat, and a main-valve on the main valve-seat controlling the main valve-seat ports and operating to open communication between said equalizing passage-port and the direct train-pipe port when moved to "service" position.

8. In an engineer's brake-valve, the combination with a valve-casing having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a piston-chamber and a slide-valve chamber communicating with the main-reservoir, a loosely fitted piston and a slide-valve operating in said chambers, a graduating spring-chamber communicating with the piston-chamber at the side thereof opposite the main-reservoir connection, a graduating-spring in the said graduating-spring chamber coöperating with the back-pressure in the piston-chamber produced by air from the main reservoir escaping past the piston to the side thereof opposite the main-reservoir connection, an equalizing passage communicating with the piston-chamber at the side of the piston opposite the main-reservoir connection and leading to a port in the main-valve seat, a main-valve on the main valve-seat controlling the main-valve-seat ports and operating to open communication between said equalizing passage-port and the direct train-pipe port when moved to "service" position, and a spring-closed valve in said equalizing passage operating to check the flow of air past the piston through said equalizing passage.

9. In an engineer's brake-valve, the combination with a valve-casing having a main-reservoir connection and a valve-seat provided with a direct train-pipe port and a direct exhaust-port, of a piston-chamber and a slide-valve chamber communicating with the main-reservoir, a loosely fitted piston and a slide-valve operating in said chambers, a graduating spring-chamber communicating with the piston-chamber at the side thereof opposite the main-reservoir connection, a graduating spring in the said graduating-spring chamber coöperating with the back-pressure in the piston-chamber produced by air from the main-reservoir escaping past the piston to the side thereof opposite the main-reservoir connection, an equalizing passage communicating with the piston-chamber at the side of the piston opposite the main-reservoir connection and leading to a port in the main-valve seat, a main valve on the main valve-seat controlling the main valve-seat ports and operating to open communication between said equalizing passage-port and the direct train-pipe port when moved to "service" position, and a stop-cock in said equalizing passage with means for opening and closing it from outside the casing.

10. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection, a valve-seat provided with a direct train-pipe port, a direct exhaust-port and a train-pipe feed-port, and a main valve on the valve-seat controlling all the said ports and movable to open the feed-port to the main-reservoir pressure, of a feed-passage extending from the feed-port to the train-pipe and established by the main-valve when turned to "running" position, and a supplemental pressure-reducing feed-valve device, interposed in said feed-passage, having a piston-chamber communicating with a slide-valve chamber, a piston and slide-valve operating in said chambers, the piston being exposed at one side to pressure from said feed-port, and the slide-valve normally closing the feed of air through said passage, a by-passage extending from said chamber, at the side of the piston opposite the feed-port connection

of the chamber, to the train-pipe, and a spring operating to resist movement of the piston and slide-valve from normal position.

11. In an engineer's brake-valve, the combination with a valve-casing or chamber having a main-reservoir connection, a valve-seat provided with a direct train-pipe port, a direct exhaust-port and a train-pipe feed-port, and a main-valve on the valve-seat controlling all the said ports and movable to open the feed-port to the main-reservoir pressure, of a feed-passage extending from the feed-port to the train-pipe and established by the main-valve when turned to "running" position, and a supplemental pressure-reducing feed-valve device interposed in said feed-passage, having a piston-chamber communicating with a slide-valve chamber, a loosely fitted piston and slide-valve operating in said chambers, the piston being exposed at one side to pressure from said feed-port and the slide-valve normally closing the feed of air through said passage, a by-passage extending from said chamber, at the side of the piston opposite the feed-port connection of the chamber, to the train-pipe, a spring coöperating with back-pressure in the piston chamber, produced by air from the feed-port escaping past the piston to the side thereof opposite the feed-port connection, to resist movement of the piston and slide-valve from normal position, and a spring-closed valve in said by-passage operating to check the flow of air past the piston through said by-passage, to render said back-pressure higher than the pressure in the train-pipe.

JOSEPH REICHMANN.

In presence of—
R. A. RAYMOND,
J. G. ANDERSON.