No. 768,586. PATENTED AUG. 30, 1904.

N. A. CHRISTENSEN.

TRIPLE VALVE.

APPLICATION FILED AUG. 8, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

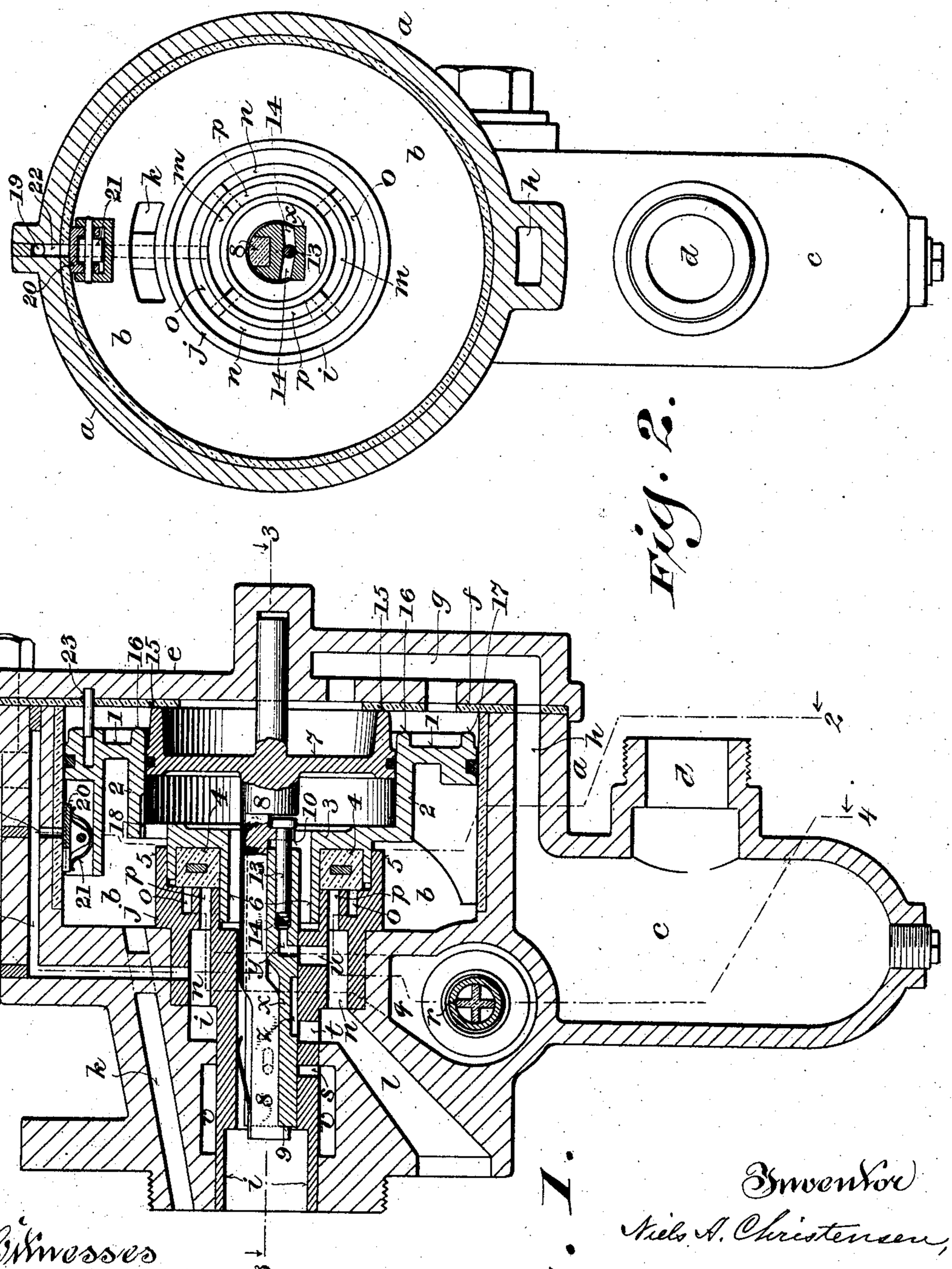


Fig. 2.

Fig. 1.

Witnesses
Geo. W. Young.
Chas. L. Goss.

Inventor
Niels A. Christensen,
By Winkler Flanders Smith Bottum & Vaas,
Attorneys.

No. 768,586. PATENTED AUG. 30, 1904.

N. A. CHRISTENSEN.

TRIPLE VALVE.

APPLICATION FILED AUG. 8, 1902.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 4.

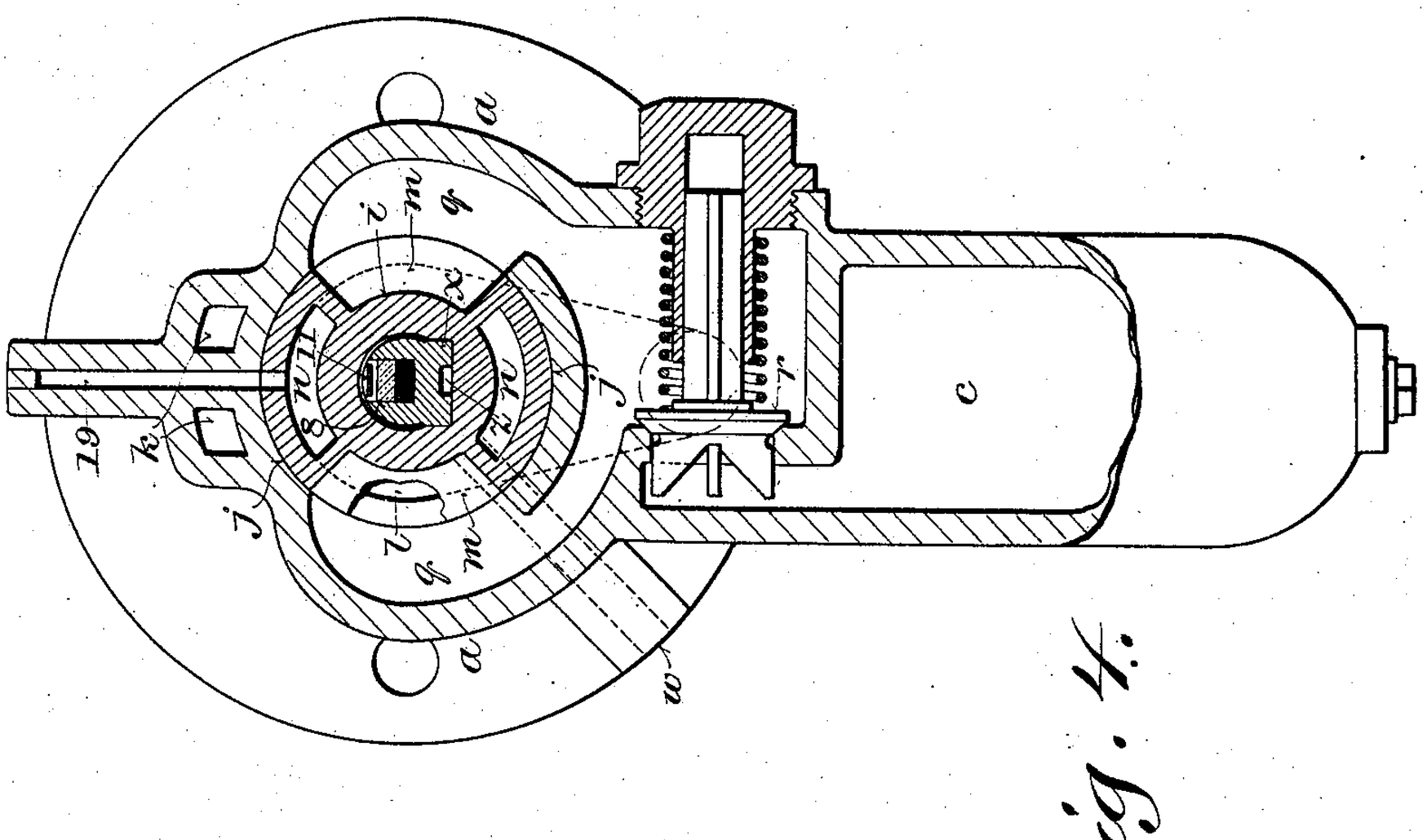
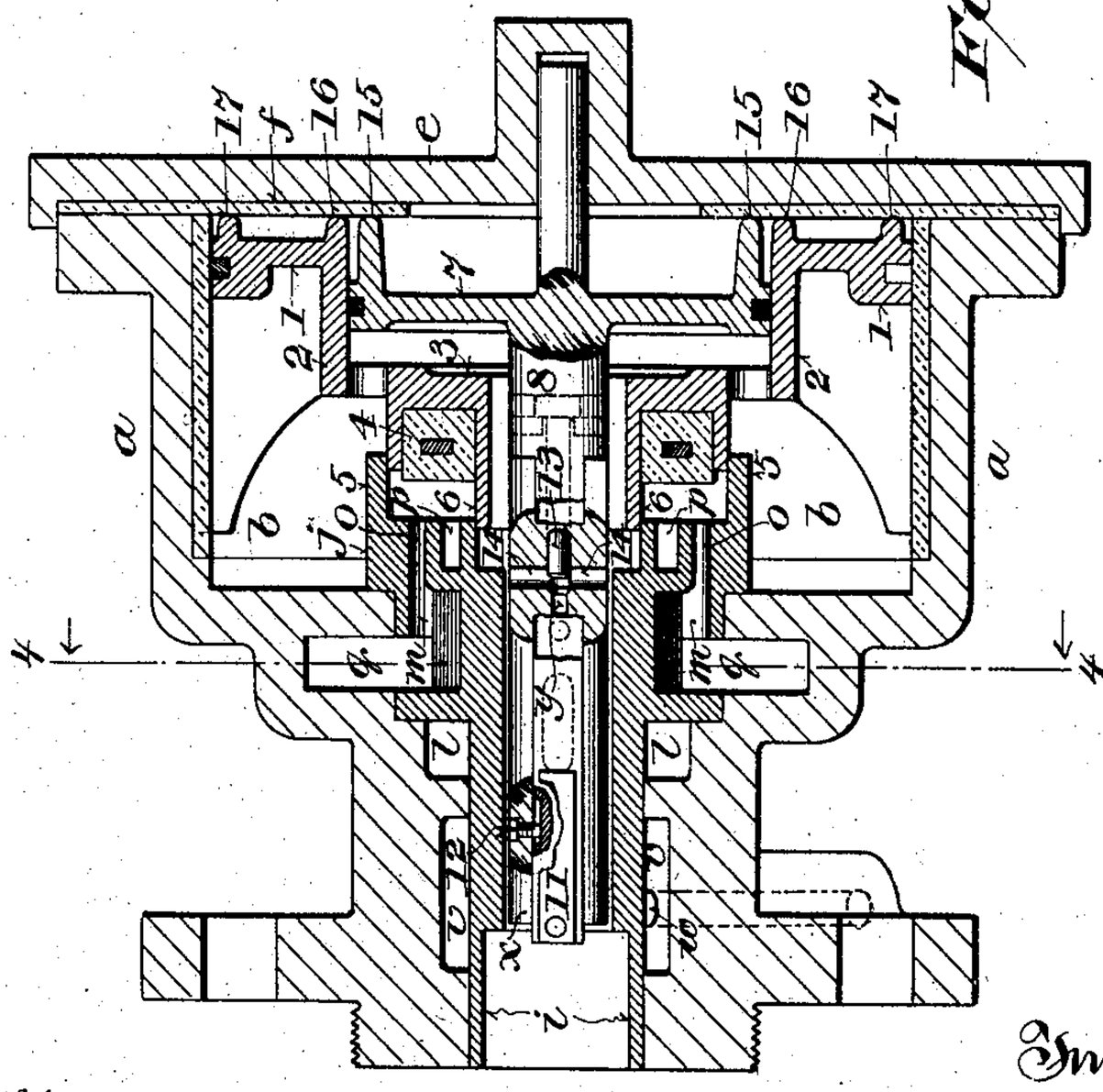


Fig. 3.



Witnesses
Geo. W. Young.
Chas. L. Goss.

Inventor:
Niels A. Christensen,
By Wm. Keller Flanders Smith Bottum & Keller,
Attorneys.

No. 768,586. PATENTED AUG. 30, 1904.

N. A. CHRISTENSEN.

TRIPLE VALVE.

APPLICATION FILED AUG. 8, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

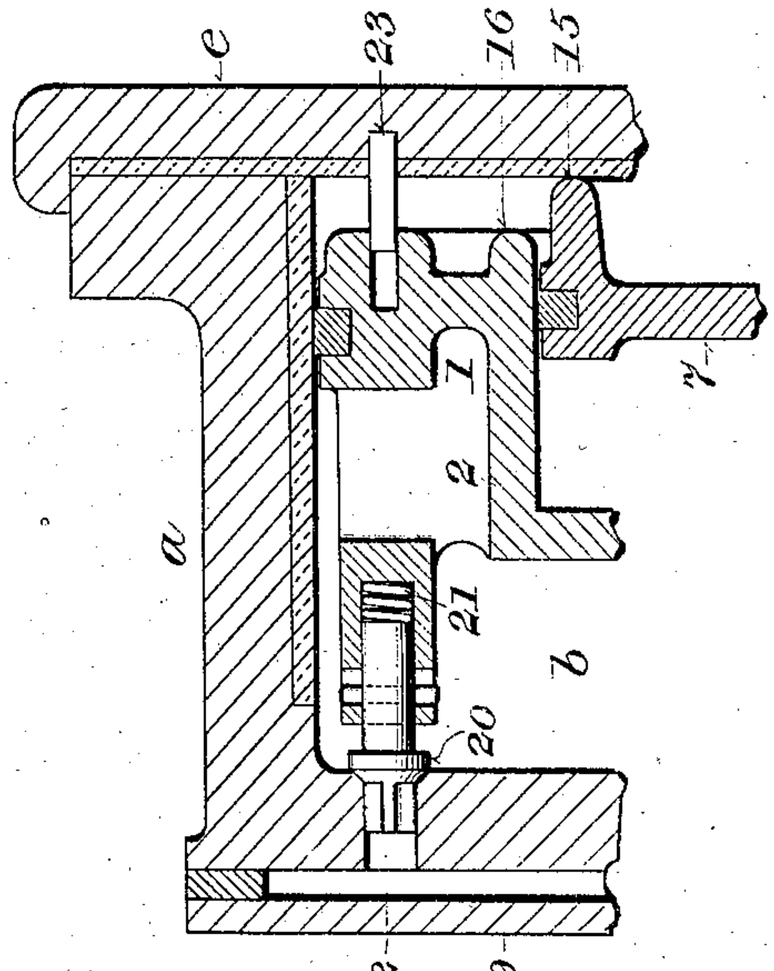


Fig. 1.

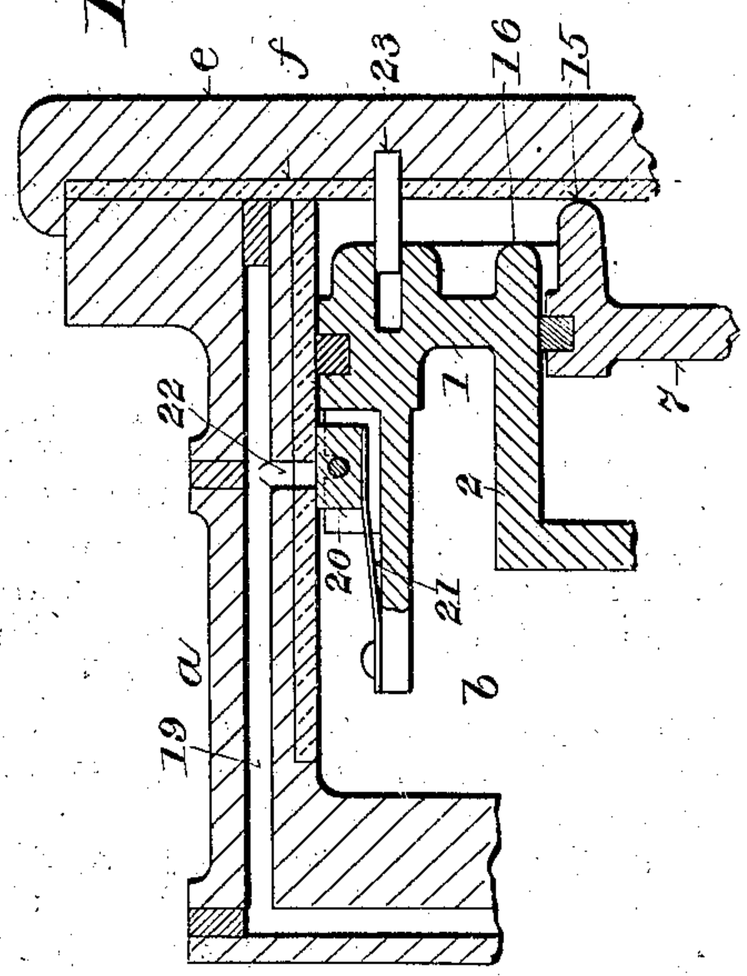


Fig. 5.

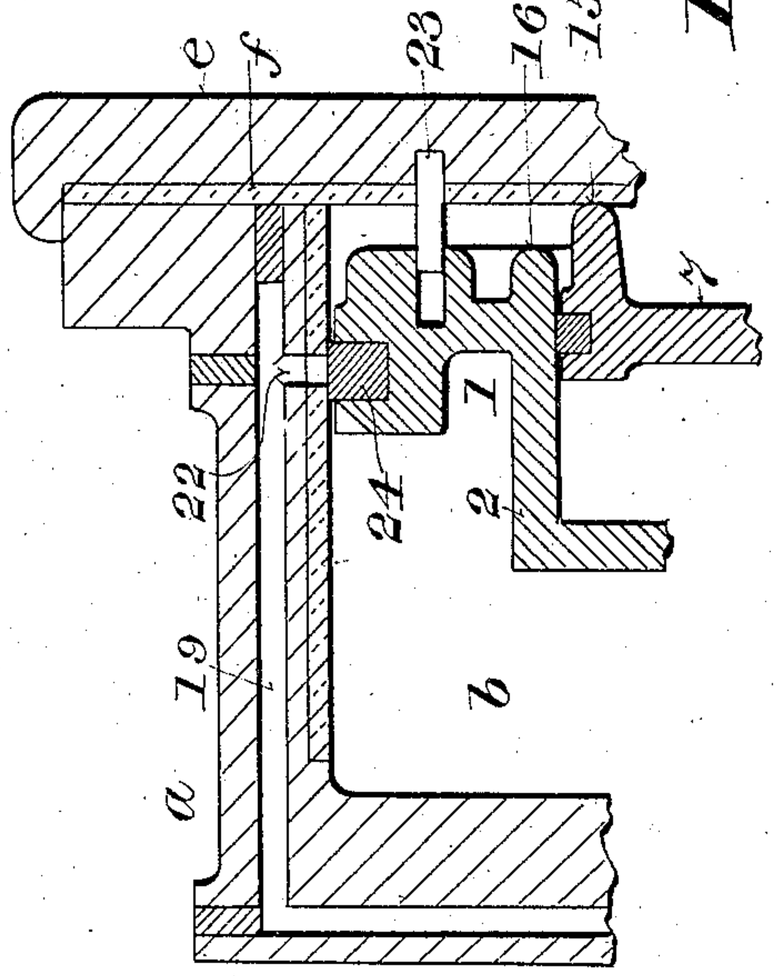


Fig. 6.

Witnesses:
Geo. W. Young.
Chas. R. Goss.

Inventor:
Niels A. Christensen,
By Winkler Flanders Smith Bottum & Vilas,
Attorneys.

No. 768,586. Patented August 30, 1904.

UNITED STATES PATENT OFFICE.

NIELS ANTON CHRISTENSEN, OF MILWAUKEE, WISCONSIN.

TRIPLE VALVE.

SPECIFICATION forming part of Letters Patent No. 768,586, dated August 30, 1904.

Application filed August 8, 1902. Serial No. 118,873. (No model.)

To all whom it may concern:

Be it known that I, NIELS ANTON CHRISTENSEN, a subject of the King of Denmark, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Triple Valves, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to triple valves of the class shown and described in United States Letters Patent No. 580,846, issued to me April 20, 1897, and in my application for United States Letters Patent Serial No. 55,842, filed April 15, 1901.

The main objects of the present invention are to provide for a more certain and accurate control of the admission of air from the auxiliary reservoir into the brake-cylinder in order to permit of the admission in advance into the brake-cylinder of train-pipe air under lower pressure, whereby the brakes on all the cars of a train may be promptly and simultaneously applied in emergencies with the greatest available pressure and to accomplish the foregoing ends with as few and simple working parts as practicable.

It consists, essentially, in an auxiliary valve which is operated independently of the main valve to admit air from the auxiliary reservoir to the brake-cylinder independently of the emergency-valve, which admits a large volume of air in advance under lower pressure from the train-pipe to the brake-cylinder in making emergency applications of the brakes, and in certain novel features in the construction, arrangement, and combinations of parts hereinafter particularly described, and pointed out in the claims.

In the accompanying drawings like characters designate the same parts in the several figures.

Figure 1 is a vertical longitudinal section of a triple valve embodying the invention. Fig. 2 is a vertical cross-section thereof on the line 2 2, Fig. 1. Fig. 3 is a horizontal longitudinal section on the line 3 3, Fig. 1. Fig. 4 is a vertical cross-section on the line 4 4, Figs. 1 and 3; and Figs. 5, 6, and 7 are sectional views similar to Fig. 1 of modifications of the auxiliary valve.

a is the valve-case, formed in its larger end with a cylindrical piston-chamber *b* and below said chamber with a drip-chamber *c*, having a neck *d* on one side for the attachment of the train-pipe. A detachable cover *e* is bolted with a gasket *f* to the larger end of said case and affords access to the piston-chamber. It is formed with a passage *g*, which opens into the piston-chamber *b* and communicates through a passage *h* in the valve-case with the drip-chamber *c*. A bushing composed of inner and outer parts or cylinders *i* and *j* is fitted into a longitudinal opening in the valve-case and extends from the smaller end of said case, which is attached to the auxiliary reservoir and brake-cylinder in the usual way, into the piston-chamber *b*. Passages *k* and *l* lead through the smaller end of the valve-case, the first from the piston-chamber *b* to the auxiliary reservoir and the second from the opening in which the cylinder *i* is fitted to the brake-cylinder. Between the inner and outer parts *i* and *j* of said bushing are formed longitudinal passages *m m* and *n n*, which terminate at their ends toward the piston-chamber *b* in concentric annular ports *o* and *p*. The passages *m m* open laterally at their opposite ends into passages *q q*, formed in the valve-case *a*, as shown in Figs. 3 and 4. The passages *q q* communicate through a port controlled by a check-valve *r*, as shown in Figs. 1 and 4, with the drip-chamber *c*, to which the train-pipe is attached. The passages *n n* communicate, as shown in Fig. 1, at their ends opposite the port *p* with an annular enlargement of the passage *l*, leading to the brake-cylinder. As shown in Fig. 1, the inner part *i* of the bushing is formed in the under side with ports *s*, *t*, and *u*. The port *s* opens into an annular recess *v*, which is formed in the valve-case *a* around the smaller part *i* of the bushing and communicates, as shown in Figs. 3 and 4, through a lateral passage *w* with the atmosphere.

x is the main valve, which controls communication between the brake-cylinder and the atmosphere and between the auxiliary reservoir and the brake-cylinder for releasing and

applying the brakes in ordinary service applications. It is approximately D-shaped in cross-section, as shown in Figs. 2 and 4, and is loosely fitted in the inner part *i* of the bushing, the bore of which is correspondingly shaped. A longitudinal passage *y*, opening at one end through the inner end of said valve, opens at its opposite end through the face of the valve, so as to register with the port *u* when said valve is moved to the extreme right, as shown in Fig. 1, for making a service application of the brakes. A cavity *z* is also formed in the face of said valve and arranged to connect the ports *s* and *t* when the valve is moved to the extreme left for releasing the brakes.

An annular winged piston 1, fitted to work in the chamber *b*, is formed around its inner margin with a cylinder 2 and at the inner end of said cylinder with a grooved annular valve base or body 3, in which is fitted and held the emergency-valve 4, consisting of a ring of hard rubber or other suitable material. The valve base or body 3 fits closely on its outer side into a rim 5 on the outer part *j* of the bushing, and an annular ring 6 on the inner margin of said valve-base fits closely into a corresponding recess in the inner part *i* of said bushing, so as to prevent the passage of auxiliary-reservoir air from the piston-chamber *b* into the port *p* and thence to the brake-cylinder when the emergency-valve 4 is opened.

A piston 7, fitted to work in the cylinder 2, is provided with a stem 8, which is loosely fitted and movable a limited distance in a longitudinal channel in the back or upper side of the main valve *x* without effect upon said valve. The stem 8 is formed with shoulders 9 and 10, adapted to engage with the ends of the valve *x* and to move said valve after taking up the play between its ends and said shoulders into release and service positions. A spring 11, attached to the upper side of said stem and bearing against the opposing face of the inner part *i* of the bushing, holds the working face of the valve *x* snugly against its seat. The main valve is loosely connected with and held upon said stem by a screw or pin 12, passing through one side of the valve into a slot in one side of the stem, as shown in Fig. 3.

A graduating-valve 13, loosely fitted in the passage *y* of the main valve *x* and having a seat at one end therein, is provided at the other end with a head which is engaged by a forked lug on the under side of the stem 8, as shown in Fig. 1. Adjacent to the seat of the valve 13 the valve *x* is formed, as shown in Figs. 2 and 3, with lateral passages 14, opening into the passage *y*, for admitting auxiliary-reservoir air through said passages, the port *u*, and the passages *n* and *l* to the brake-cylinder, when the main valve *x* and the graduating-valve 13 are moved to the right, as shown in Fig. 1.

The main piston 7 is preferably formed with an annular rim 15, which prevents its outward movement by the emergency-piston 1 beyond service position, and the emergency-piston 1 is formed near its inner and outer margins with annular ribs 16 and 17, which, with the rim 15 on the main piston and gasket *f*, serve when both pistons are moved to the extreme right, as shown in Fig. 3, for emergency applications of the brakes to prevent the leakage of air from the auxiliary reservoir into the train-pipe in case the packing of either piston is defective.

The inner part *i* of the bushing is in open communication at both ends at all times with the auxiliary reservoir, so that the main valve is subjected at both ends to the same pressure and is consequently balanced.

The usual leak-groove or restricted passage 18 for charging the auxiliary reservoir with compressed air from the train-pipe is formed, as shown in Fig. 1, in the cylinder 2, in which the main piston 7 is contained.

The construction and arrangements of the parts of the valve hereinbefore described are substantially the same as in the valves shown and described in my former patent and application hereinbefore referred to, except that a working fit is made between the rim 5 on the outer part *j* of the bushing and the valve-base 3 and between the rim 6 on the said valve-base and the inner part *i* of said bushing to prevent the admission of auxiliary-reservoir air from the piston-chamber *b* through port *p* to the brake-cylinder when the emergency-valve is opened.

In order to control the admission of auxiliary-reservoir air to the brake-cylinder independently of the emergency-valve 4, which controls the admission of train-pipe air to the brake-cylinder in making emergency applications of the brakes, a passage 19, leading from the piston-chamber *b* into the passage *l* or one of the passages *n*, communicating therewith, is formed, as shown in Fig. 1, in the valve-case *a*, and the emergency-piston 1 is provided with an auxiliary valve 20, which controls the admission of auxiliary-reservoir air into said passage 19. The valve 20 may be loosely pivoted in an extension of the emergency-piston, as shown in Figs. 1 and 2, and yieldingly held against the seat in the bushing of the piston-chamber by a spring 21.

To insure the assemblage of parts and to hold them in such relation that the valve 20 will close the port 22, opening from the chamber *b* into the passage 19, the cover *e* is provided with a guide-pin 23, which fits loosely into a corresponding socket in the emergency-piston 1 and prevents said piston from turning, but allows it to move endwise.

The improved valve mechanism hereinbefore described operates as follows: For making a service application of the brakes the usual reduction of pressure—say from five to

six pounds—is made in the train-pipe. When this occurs, the main piston 7 is shifted to the right, as shown in Fig. 1, by the greater pressure in the auxiliary reservoir. The initial movement of the piston 7 to the right unseats the graduating-valve 13 and cuts off communication between the auxiliary reservoir and train-pipe through the groove 18. The further movement of said piston in this direction causes the shoulder 9 to engage with the main valve *x* and shift it into the position in which it is shown in Fig. 1. Communication between the brake-cylinder and the atmosphere through the passage *l*, port *t*, cavity *z*, port *s*, recess *v*, and passage *w* is thus cut off and the inner end of the passage *y*, controlled by the graduating-valve, is brought into register with the port *u*. Air is thereupon admitted from the auxiliary reservoir to the brake-cylinder through the passages 14 and *y*, port *u*, and passages *n* and *l*. As soon as the pressure in the auxiliary reservoir is lowered slightly below the reduced train-pipe pressure the main piston 7 will be moved back to the left sufficiently to close the graduating-valve 13, which is very sensitive in operation, and then stop, leaving the main valve *x* in position to cut off communication between the auxiliary reservoir and train-pipe through the groove 18, as well as between the brake-cylinder and the atmosphere through the cavity *z*. The pressure thus admitted to the brake-cylinder will be considerably below that in the auxiliary reservoir and the brakes will be held applied with a force corresponding to the force in the brake-cylinder, while the conditions last mention remain unchanged.

To apply the brakes with greater force, a further reduction—say from two to three pounds—is made in the train-pipe pressure, and the operations above explained will be repeated. Thus the brakes may be applied with a gradually-augmented force until the pressures in the brake-cylinder and auxiliary reservoir are equalized.

To release the brakes, the train-pipe pressure is restored and acting in opposition to the reduced auxiliary-reservoir pressure shifts the main piston 7 back to the left. The shoulder 10, engaging with the valve *x*, carries the passage *y* out of register with the port *u* and the cavity *z* over the ports *s* and *t*, through which air thereupon escapes from the brake-cylinder to the atmosphere. At the same time communication is established through the groove 18 between the train-pipe and the auxiliary reservoir, and the latter is gradually recharged with compressed air until the pressure therein is equal to that in the train-pipe.

To make an emergency application of the brakes, a reduction—say from ten to twelve pounds—is made in the train-pipe pressure. When this takes place, the unbalanced auxiliary-reservoir pressure shifts both the emergency and main pistons 1 and 7 to the extreme right, as shown in Fig. 3. This cuts off communication between the brake-cylinder and the atmosphere through the cavity *z* and the ports *s* and *t* and also between the auxiliary reservoir and the train-pipe through the groove 18 and at the same time unseats the emergency-valve 4 and uncovers the annular ports *o* and *p*. The unbalanced pressure in the train-pipe will thereupon open the check-valve *r*, and air will rush freely from the train-pipe through the passages *q* and *m*, ports *o* and *p*, and passages *n* and *l* into the brake-cylinder, thereby instantly reducing the pressure still more in the train-pipe and charging the brake-cylinder with air at the reduced pressure. Immediately following the admission of air under the reduced pressure from the train-pipe into the brake-cylinder the auxiliary valve 20 uncovers the port 22 and admits air under higher pressure from the auxiliary reservoir in the brake-cylinder. As soon as the pressure in the brake-cylinder nearly equals that in the train-pipe the check-valve *r* will close and prevent the passage of air under higher pressure from the auxiliary reservoir or brake-cylinder into the train-pipe. The venting of the train-pipe, as above explained, into the brake-cylinder not only assists in applying the brakes, but also causes all the triple valves connected by the same train-pipe to operate simultaneously or in quick succession by reason of the simultaneous reduction in pressure at the several points in the train-pipe where said valves are located. After the pressure in the brake-cylinder equals the reduced train-pipe pressure and the check-valve *r* is closed air under higher pressure will continue to flow through the passage 19 from the auxiliary reservoir into the brake-cylinder until the pressures therein are equalized. Thus the most powerful application of the brakes possible is made simultaneously or in quick succession on all the cars of a long train. By restoring the normal pressure in the train-pipe the moving parts of the valve mechanism will be returned to their original positions, the brakes will be released, and the auxiliary reservoir recharged. By the provision of a separate passage controlled by a special valve operating independently of the main valve for admitting auxiliary-reservoir air into the brake-cylinder in emergency applications of the brakes the admission of air from the auxiliary reservoir to the brake-cylinder may be restricted and timed with greater accuracy and certainty, so as to coöperate to the best advantage with the air admitted in advance under lower pressure from the train-pipe. To accomplish this, the valve 20 may be adjusted with relation to the emergency-piston 1 to open the port sooner or later, as may be desired, with reference to the opening of the emergency-valve 4, and the area of the port

or passage controlled by said valve 20 may be restricted more or less, so as to exactly predetermine the rate of flow of the air through said port or passage. The construction and adaptation of the auxiliary valve 20 so that it is operated by the same piston which operates the valve 4 avoids unnecessarily increasing the number of parts and complicating the device.

Various changes in the details of construction and arrangement of the several parts of the valve may be made without departing from the principle and intended scope of my invention. For example, the auxiliary valve may be constructed and arranged as shown in Fig. 5 or Fig. 7, or the packing-ring 24 of the emergency-piston may be made to perform the function and serve the purpose of said valve, as shown in Fig. 6. With the form of valve shown in Fig. 7 the passage 19 may be considerably shortened. The stem of this form of valve having a limited amount of longitudinal play in the piston 1, the valve is held against its seat by the spiral spring 21 during the initial movement of said piston, thus causing the emergency-valve 4 to be opened first and allowing train-pipe air to enter the brake-cylinder in advance of auxiliary-reservoir air.

I claim—

1. In a triple valve the combination with the valve-case having separate passages to conduct air to the brake-cylinder from the train-pipe and from the auxiliary reservoir for emergency application of the brakes, and a main valve controlling communication between the brake-cylinder and atmosphere and between the auxiliary reservoir and brake-cylinder for release and service application of the brakes, of valves normally closing said passages which unite after passing said valves toward the brake-cylinder, and a movable part adapted to open said valves independently of the main valve upon a certain reduction of pressure being made in the train-pipe, substantially as described.

2. In a triple valve the combination with a main valve controlling communication between the brake-cylinder and atmosphere and between the auxiliary reservoir and brake-cylinder for the release and service application of the brakes, of an emergency-valve controlling the admission of air to the brake-cylinder directly from the train-pipe, and an auxiliary valve controlling the admission of air to the brake-cylinder from the auxiliary reservoir, for emergency application of the brakes, said emergency and auxiliary valves controlling passages which are separate from and independent of the passages controlled by the main valve and unite after passing the emergency-valve toward the brake-cylinder, substantially as described.

3. In a triple valve the combination with a main valve controlling communication between the brake-cylinder and atmosphere and between the auxiliary reservoir and brake-cylinder, of emergency and auxiliary valves controlling separate passages which unite after passing the emergency-valve for the admission of air to the brake-cylinder from the train-pipe and from the auxiliary reservoir and movable parts exposed on one side to auxiliary-reservoir pressure and on the other to train-pipe pressure, one of said parts being arranged to operate the main valve for the release and service application of the brakes, while the other part is adapted to operate the emergency and auxiliary valves for emergency application of the brakes, substantially as described.

4. In a triple valve the combination with the valve-case having a piston-chamber and passages for connecting said chamber with the train-pipe and auxiliary reservoir, pistons fitted one within the other in said chamber, a main valve operated by one of said pistons and controlling communication between the brake-cylinder and the atmosphere and between the auxiliary reservoir and the brake-cylinder, and an emergency-valve operated by the other piston controlling direct communication between the brake-cylinder and train-pipe, of an auxiliary valve also operated by the emergency-piston and controlling communication through a separate passage around and independent of the emergency-valve between the brake-cylinder and auxiliary reservoir, substantially as described.

5. In a triple valve the combination with the main valve controlling communication between the brake-cylinder and atmosphere and between the auxiliary reservoir and brake-cylinder for release and service application of the brakes, of an emergency-valve controlling direct communication between the brake-cylinder and train-pipe, an auxiliary valve controlling communication through a separate passage around and independent of the emergency-valve between the brake-cylinder and auxiliary reservoir, and a movable part exposed on one side to train-pipe pressure and on the other to auxiliary-reservoir pressure and adapted, when a certain reduction is made in train-pipe pressure, to first open the emergency-valve and then open the auxiliary valve, substantially as described.

6. In a triple valve the combination with the valve-case having a piston-chamber and passages for connecting said chamber with a train-pipe and an auxiliary reservoir, a main valve controlling communication between the brake-cylinder and atmosphere and between the auxiliary reservoir and brake-cylinder for release and service application of the brakes, an emergency-valve controlling direct communication between the brake-cylinder and train-pipe, and a piston fitted to work in said chamber and adapted to open said valve when the train-pipe pressure is reduced to a certain degree, of an auxiliary valve operated by said

piston and controlling a passage leading from said chamber to the brake-cylinder connection, and means for holding said piston from turning in said chamber, substantially as described.

7. In a triple valve the combination with a valve-case having a chamber and passages for connecting said chamber with the train-pipe and auxiliary reservoir, of an emergency-valve controlling ports in a passage which leads from the train-pipe to the brake-cylinder and adapted when opened to prevent communication between said ports and said chamber, an auxiliary valve controlling a separate passage leading from said chamber to the brake-cylinder connection, and a movable part arranged in said chamber between its train-pipe and auxiliary-reservoir connections and adapted, when the train-pipe pressure is reduced to a certain degree, to open both of said valves, substantially as described.

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

NIELS ANTON CHRISTENSEN.

Witnesses:

CHAS. L. GOSS,

ALICE E. GOSS.