(No Model.) 4 Sheets—Sheet 1.

H. L. HOWE.

TRIPLE VALVE FOR AIR BRAKES.

No. 507,132. Patented Oct. 24, 1893.

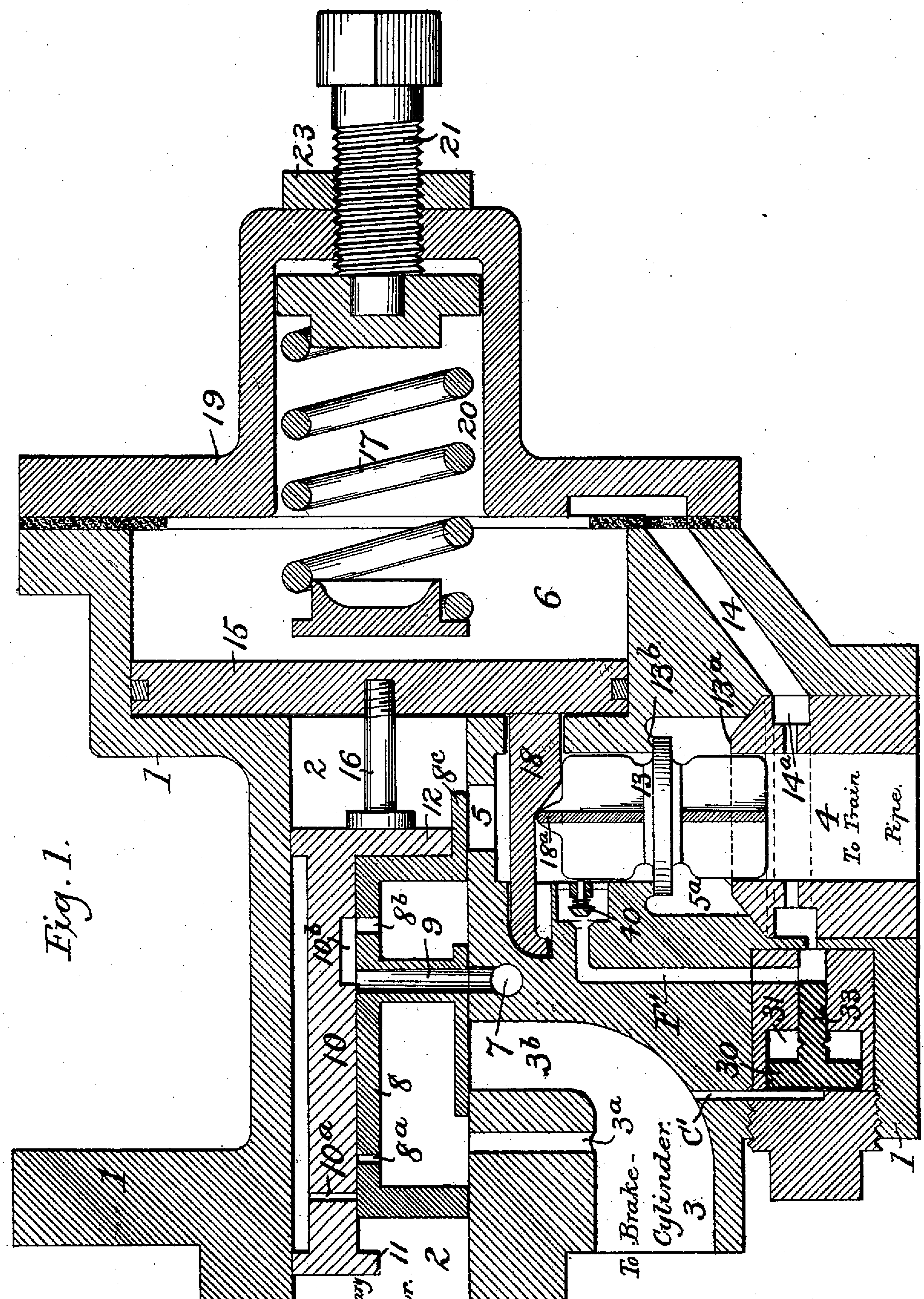

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

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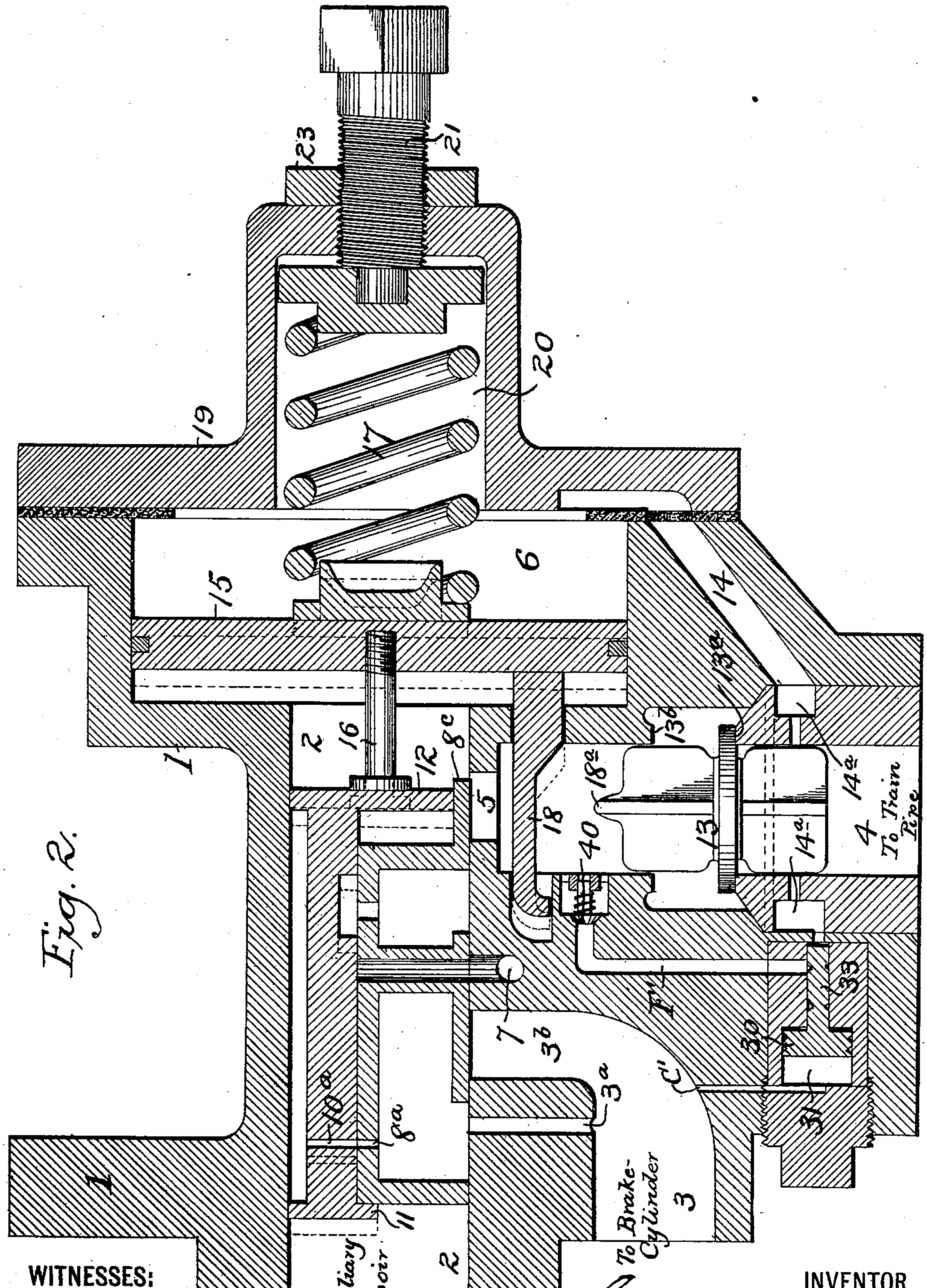

Fig. 2.

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(No Model.) 4 Sheets—Sheet 3.

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TRIPLE VALVE FOR AIR BRAKES.

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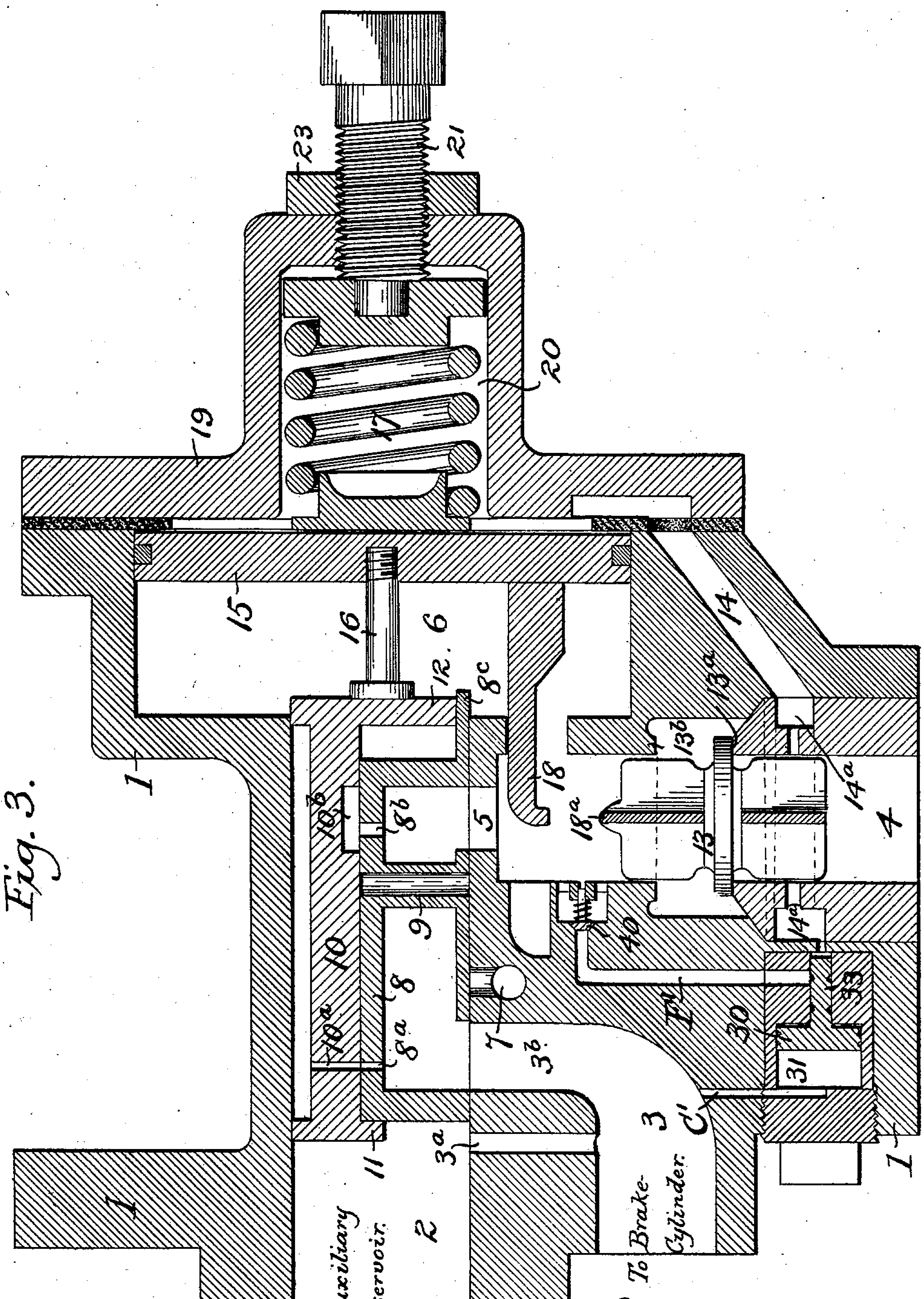
Fig. 3.



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(No Model.) 4 Sheets—Sheet 4.

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TRIPLE VALVE FOR AIR BRAKES.

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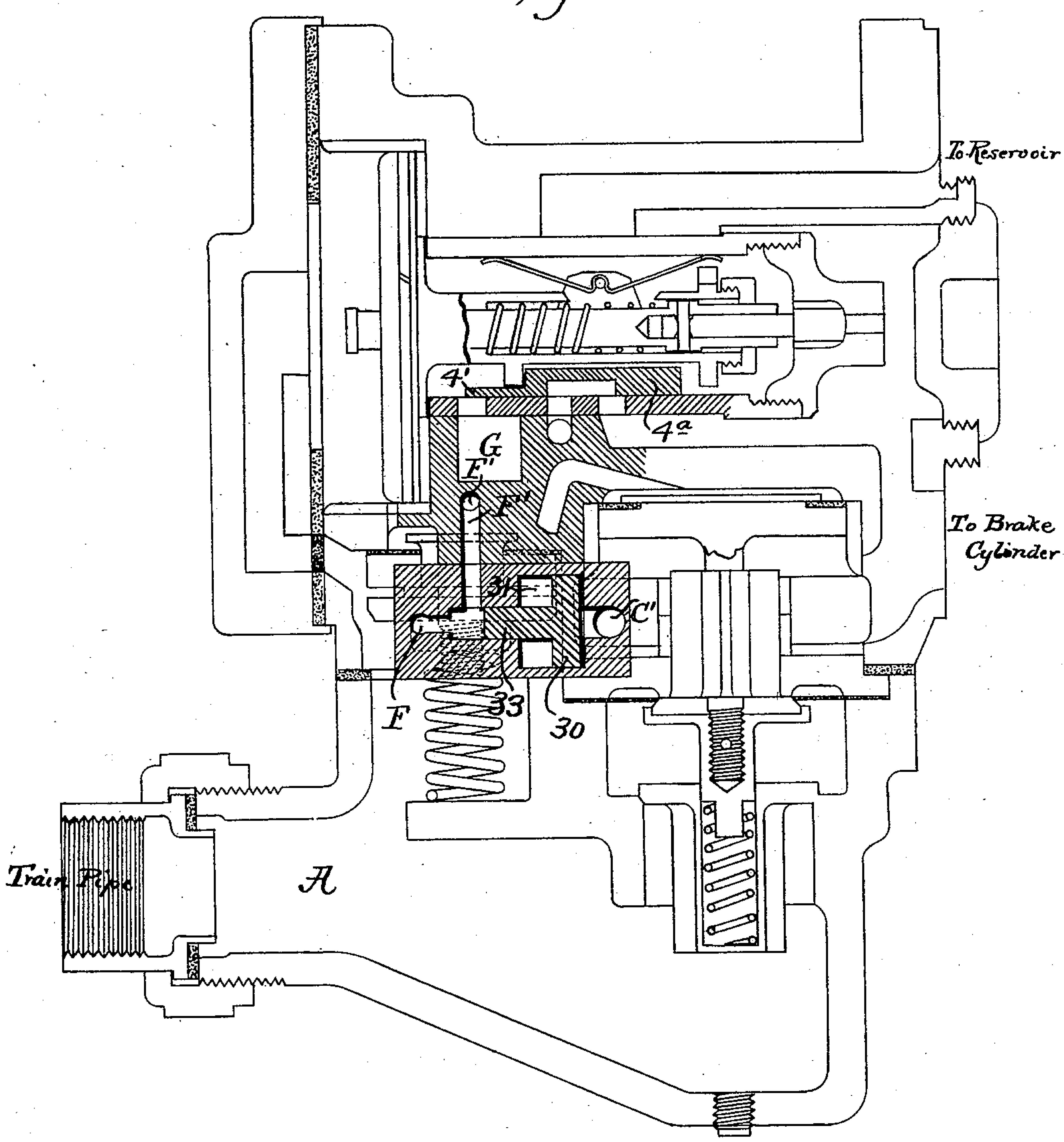
Fig. 4.



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UNITED STATES PATENT OFFICE.

HENRY L. HOWE, OF CANANDAIGUA, NEW YORK.

TRIPLE VALVE FOR AIR-BRAKES.

SPECIFICATION forming part of Letters Patent No. 507,132, dated October 24, 1893.

Application filed June 6, 1892. Serial No. 435,735. (No model.)

To all whom it may concern:

Be it known that I, HENRY L. HOWE, a citizen of the United States of America, residing at Canandaigua, in the county of Ontario and State of New York, have invented certain new and useful Improvements in Triple Valves for Air-Brakes, of which the following is a specification.

This invention relates generally to that class of valves now commonly known as triple-valves for air brakes, that is to say, a valve capable of controlling three different air passage connections, as for instance the connection between a supply or train-pipe and an auxiliary reservoir, between an auxiliary reservoir and an operating or brake-cylinder, and a direct connection between the supply or train-pipe and the operating or brake-cylinder.

In the triple valves now in common use there is provided a by pass or "charging slot" around the operating piston by which the fluid pressure may leak around or past said piston from the train pipe into the auxiliary reservoir after the train pipe pressure has been raised and is effecting the release of the brakes and also by which a leakage around or past said piston is had from the auxiliary reservoir into the train pipe when the train pipe pressure is first reduced to effect the application of the brakes. In one of these instances there is an unnecessary leakage of air from the auxiliary reservoir into the train-pipe and in the other from the train pipe into the auxiliary reservoir, which tends to interfere with the timely response of the operating parts to any change in pressure in the train pipe. In other words, the effectiveness of the change of pressure in the train pipe, either to apply the brakes or to let them off, is lessened in proportion to the quantity of air that leaks or is permitted to leak around the operating piston.

In the old forms of valves in bringing the parts to release position, the train pipe pressure has to feed as many auxiliary reservoirs as there are cars, and hence, where there are a number of cars the triple valves nearest the engine will operate earlier than those farther removed so that the engineer is required to keep supplying such pressure in the train pipe to overcome the leakages in the succeeding triple valves, as they operate successively and uncover the charging slots to charge the auxiliary reservoirs. The present invention primarily, is directed to wholly overcome this permissive leakage, so that immediately a change of pressure is made in the train pipe that change effects the desired result of itself, and the entire variation in train pipe pressure is utilized to accomplish the movement of the triple valve without such change in pressure being reduced in effectiveness by being augmented or lessened. To this end, also, only that variation of pressure in the train pipe need be made which is absolutely necessary to produce the desired movement of the parts, thereby lessening the extent of variation needed, and also making the parts respond immediately and without the delay which necessarily occurs when there is a leakage of the pressure from one part of the valve to another.

Having these objects in view my improvements consist essentially in a means by which the pressure is retained in the supply or train pipe until a certain reduction of pressure has been effected in the brake cylinder, or until the triple valve has been moved to its release position whereby such train pipe pressure thus prevented from leaking into the auxiliary reservoir, is brought to bear wholly upon the operating piston to cause its movement quickly and without any loss of air, or of pressure. These means also enable all the triple valves in a long train of cars to move to release position substantially simultaneously instead of successively because the effective pressure in the train pipe throughout the length of a train is operating without leakage upon the operating piston of each of the triple valves and such pressure is retained in the train pipe, can be quickly raised in pressure, and such pressure maintained, and confined to effect the movement of the operating piston without losing any of its effectiveness by reason of any portion of the quantity or pressure of the air expanding into the auxiliary reservoir. These means also operate to effect the proper and quick application of the brakes when the train pipe pressure is reduced and to lessen the amount of reduction needed by closing all communication between the auxiliary reservoir and the train pipe so that the auxiliary reservoir pressure is saved for use in putting on the brakes and is prevented from leaking into the train pipe to retard the reduction of pressure in the train pipe as well as to lessen the pressure in the auxiliary reservoir. The improved means, therefore, compels an immediate response on the part of the movable parts of the triple valve upon any change of pressure in the train pipe so that the brakes are quickly applied and quickly released, no matter what the length of the train of cars may be; by which much air is saved in producing the desired movements of the triple valve, and a less change in quantity of fluid supplied to or exhausted from the train pipe is needed to produce such movement.

In another application filed by me in the United States Patent Office, February 6, 1892, Serial No. 420,496, there is shown and set forth a novel construction and arrangement of coöperating slide-valves, and a piston, with proper ports and passages, by which the triple-valve action is effected by variation of the pressure in the train pipe, and the present improvements are for convenience shown and described herein in connection with such a form of triple valve as a practical exemplification of the same. The particular improvement, it is to be understood, is not intended thereby to be limited in its use to such a form of valve.

Briefly stated, the improvements consist in a valve, piston or the like adapted to automatically control a passage or by-pass between the supply or train pipe and an auxiliary reservoir, said valve being controlled in its position by a certain difference in pressure between that in said supply or train pipe and that in the operating or brake cylinder, whereby, first, upon a reduction in pressure in the train pipe and an accumulation of pressure in the brake cylinder, the communication through the aforesaid passage between the train pipe and auxiliary reservoir is cut off; second, the pressure in the brake cylinder may be reduced before this communication between the train pipe and auxiliary reservoir is opened to recharge said reservoir; and third, the train pipe pressure is retained until the triple valve is brought to a release position or to a position to relieve or exhaust the pressure in the brake-cylinder, thereby preventing all loss of pressure in the train pipe through premature leakage therefrom into the charging ports of the triple valve or connected devices, and holding the pressure on the fluid in the train pipe until the pressure in the brake cylinder has been reduced by exhausting it down to a low degree, and thereby effecting a positive release of the brakes.

The accompanying drawings illustrate a practical embodiment of the invention in one form of triple valve for air brakes.

In said drawings: Figure 1, is a vertical sectional elevation of a triple valve provided with the improvement, the parts being shown in the exhaust or running position. Fig. 2, is a similar view, showing the parts in "service-stop" position; and Fig. 3, is a like view with the parts in "emergency-stop" position. Fig. 4, is a sectional elevation of another form of valve with the present improvements added.

As the general construction and arrangement of the triple valve are the same as that set forth in my said application, corresponding parts will be lettered and numbered and called alike.

The valve shell 1, is provided with a valve chamber 2, having an opening for communication with an auxiliary reservoir; ducts 3^a, 3^b, communicating with a brake cylinder opening 3; a passage 5 leading to the train-pipe-opening 4, being also open to the piston-cylinder 6 through passage 14; and having a passage in communication with the exhaust port 7. In the valve chamber 2 are arranged a pair of slide valves 8 and 10; the valve 8 is a recessed valve and controls the ducts 3^a, 3^b, the passage to the exhaust port 7, and the passage 5 to the train pipe, and has an independent exhaust duct 9 extending across its recess which at the proper time coincides with the passage to the exhaust port 7; and it also has an opening 8^b through its top wall. The valve 8 is also provided with a flange 8^c, that is adapted to overlie and partially close the train pipe passage 5 so that the passage from the train pipe passage into the valve chamber 2 is somewhat restricted during the ordinary operation of the triple valve, but in emergency stop position, when the valve 8 has been moved as hereinafter set forth, the passage 5 is completely opened to the recess of the valve 8. The other valve 10 partially contains or overlies the valve 8 and moves the latter through its projections 11, 12, a sufficient space being provided between said projections and the valve 8 to permit a limited movement of the valve 10 relative to the other valve. The valve 10 has an inner recess 10^b adapted to open communication between the chamber of the valve 8 and the exhaust port 7 through opening 8^b and duct 9; and also a port 10^a that coincides with a port 8^a in the valve 8 at the proper time.

The pair of valves 8, 10, are moved by connection with an operating piston 15, arranged in the cylinder 6 through a stem 16 leading from the valve 10. The movement of the piston 15 and pair of valves in one direction is yieldingly opposed by a suitable spring 17, arranged in a recess 20 in the head 19 of the valve shell 1, its pressure being regulated and held by an adjusting screw 21 and lock nut 23. The spring, however, is of such length as to allow the piston 15 and its immediately connected valve 10 to move a short distance from their limit of movement in one direction unopposed by said spring, as will be observed by referring to Fig. 1.

The passage 5 to the train pipe is provided with a double seated check valve 13 working in an enlargement 5^a between upper and lower valve seats 13^b and 13^a, the wings of the valve fitting and being guided by the walls of the passage 5. The passage 5 is constantly in communication by an annular channel 14^a and piston duct 14, with the piston cylinder 6 in rear of the operating piston 15, the piston not acting to restrict or cut off such communication.

The piston 15 is provided with an arm 18, extending forward across the passage 5, and over the double check valve 13, adapted to engage with a projection 18^a on the end of the check valve when the piston is at the limit of its rearward or emergency stroke to hold said check valve from seating against its upper seat 13^b when the parts are in "emergency" position, as in Fig. 3, so that the brake cylinder may receive the fluid direct from the train pipe in addition to that from the auxiliary reservoir, and when said arm 18 is moved slightly from this stopping position permitting said valve to close against its upper seat 13^b immediately the train pipe pressure is raised to cause the piston and valves to move toward the release position as in Fig. 1. This closing of the double check-valve 13 against its upper seat 13^b and shutting off the further passage of fluid to brake cylinder the instant it is desired to release the brakes in a long train of cars, is obviously of great importance, as thereby the letting off of the brakes is not retarded by the passing of the fluid from the train pipe to the auxiliary reservoir or to the brake cylinder, and hence very little fluid is wasted from the train pipe in effecting the release of the brakes, which fluid may, therefore, be stored up and maintained in the train pipe until such time as the by passage hereinafter described will have opened communication between the train pipe passage and the auxiliary reservoir when the fluid can then be let into said reservoir.

As the double check valve 13 will seat itself against its upper seat 13^b when free from the arm 18, immediately the train pipe pressure is raised, means must be provided to open communication between the train pipe and the auxiliary reservoir, around, or past, as it were, said check valve; and these means should be subject to the control of the fluid pressure or the difference in pressures in the apparatus so as to act automatically, that is to say, should close communication between the train pipe and the auxiliary reservoir, and then open communication with said reservoir only after the triple valve has moved to release position. This automatic control is effected in the present instance by providing a differential piston controlling said communication and exposed at one side or area to the fluid pressure in the brake cylinder and upon the opposite side or other area to that in the train pipe. To this end the valve shell 1 is formed with a passage or by-pass F′, opening at one end into the train pipe passage 5, above the double check valve 13, and at its other end communicating with said passage 5 below the check valve. The opening and closing of this passage F′ is controlled by the smaller end 33, of a differential piston that is mounted to reciprocate in a chamber 31, which is in communication with the brake cylinder passage 3, through a duct C′. The large area 30, of the differential piston is thus exposed to the pressure from the brake cylinder, while its smaller area 33 is exposed to that from the train pipe.

When the parts are in the position shown in Fig. 1, the triple valve is in its exhaust or charging position, the brake cylinder being open to the atmosphere through the ports and passages connecting it with the exhaust port 7, and the pressure in the train pipe having caused the check valve 13 to be seated against its upper seat 13^b thereby cutting off the train pipe passage from the auxiliary reservoir, so that said pressure is retained in the train pipe; but such pressure at the same time has acted upon the small area 33 of the differential piston against but little pressure on the large area, and has moved said piston to open the passage F′ so that the fluid may pass from the train pipe through said passage into the valve chamber 2 and thence to the auxiliary reservoir to charge the same.

Should the pressure in the train pipe be reduced for a stop—"service" or "emergency"—the triple valve will have been so moved, as in Fig. 2, or as in Fig. 3, that the fluid pressure let into the brake cylinder, either from the auxiliary reservoir or from the train pipe direct, will act upon the large area 30 of the differential piston and move the same to close the passage F′ and prevent the fluid from passing around or past the check valve 13 through said passage; and this closing movement of the differential piston owing to the difference in the areas of its opposite ends will be proportionately quickly effected.

In service stops after the first reduction of pressure in the train pipe to effect the movement of the triple valve, as in Fig. 2, no air can leak from the valve chamber 2 or from the auxiliary reservoir into the train pipe because of the closing of the passage 5 by the seating of the double check valve 13 upon its lower seat 13^a and by the closing of the passage F′ by the seating of a small check valve 40, so that whether or not the pressure in the brake cylinder has been raised enough to move the differential piston to close the passage F′ is immaterial, but in the construction shown, owing to the large difference in the two areas of the differential piston, it will be necessarily moved to close the passage F′ when the total pressure on the large area exceeds that on the small area.

In bringing the parts of the triple valve to the emergency stop position, as shown in Fig. 3, the train pipe pressure is reduced to a larger extent than that needed to effect a service stop, and this results in causing the double check valve 13 to seat upon its lower seat 13^a; and about simultaneously therewith the operating piston 15 (under the pressure in the valve chamber 2 and because of the reduced pressure in rear of said piston), moves backward to the limit of its stroke, compressing the spring 17, thereby bringing the underlying valve 8 in position to connect by its recess the train pipe passage 5 with the brake cylinder passage 3^b, and also bringing the end of the finger 18 immediately above the end 18^a of the double check valve. Immediately the train pipe passage is open to the brake cylinder passage, the pressure above the double check valve expands through the recess of the valve 8, into the brake cylinder, thereby permitting the train pipe pressure below the double check valve overcoming its weight to raise said valve against the end of the finger 18, which prevents it from seating against its upper seat 13^b and holds the train pipe open so that the pressure from the train pipe may expand directly into the brake cylinder. As soon as the pressure in the train pipe and in the brake cylinder is equalized the double check valve falls to its lower seat 13^b by gravity, and the pressure in the auxiliary reservoir having also been gradually passing into the brake cylinder by the coincidence of the ports 10^a and 8^a and it may be by the passage 3^a, whereby the pressure tending to hold the operating piston 15 at the limit of its outward movement has been reduced, the spring 17 commences to slowly move said operating piston forward toward its normal position so that the end of the finger 18 is removed from position to obstruct the seating of the double check valve upon its upper seat. As soon as the parts have moved to the emergency position and the pressure in the brake cylinder acting upon the larger area 30 of the differential piston is enough to exceed the train pipe pressure acting upon its smaller area 33, said differential piston closes the by-passage F′ so that no pressure can pass in either direction through said by-passage. When the small check valve 40 is used it moves to close the by-passage F′ immediately the train pipe pressure is reduced to effect the emergency stop as before explained, and remains seated until the pressure in the brake cylinder has been sufficiently reduced, by exhausting to the atmosphere as hereinafter explained, that the pressure in the train pipe acting upon the smaller area 33 of the differential piston is sufficient to overcome the pressure in the brake cylinder that may be acting upon the large area 30 of said piston and to cause said piston to be moved to open the by passage F′. After the parts have moved to emergency position and the pressure has become equalized both above and below the valves 10 and 8, the tension of the spring 17 is sufficiently strong to start the piston toward its normal position and thus remove the finger 18 from above the end of the double check valve 13, so that when the train pipe pressure is raised to cause the parts to return to release position the double check valve is free to seat against its upper seat 13^b to confine the pressure to the rear side of the operating piston and thus effect its movement.

When it is desired to release the brakes while the parts are in emergency stop position the pressure in the train pipe is raised, causing the double check valve 13 to be lifted against its upper seat 13^b, to close the train pipe the finger 18 having moved to permit this seating of the check valve so that no pressure may leak therefrom into the cylinder 6 or into the brake cylinder, and such pressure passes by the passage 14 to the rear of the operating piston 15 so that aided by the spring 17 it causes the piston 15 to move toward its normal position, first moving the slide valve 10 and thereafter also moving the slide valve 8 so as to bring the parts back to the normal position shown in Fig. 1. When this position is reached the brake cylinder is open to the atmosphere through the passage 3^a, the recess of the valve 8, port 8^b, recess 10^b, duct 9, and exhaust port 7, thereby permitting the pressure in the brake cylinder to expand to the atmosphere and thus release in the brakes. As soon as this occurs, or as soon as the pressure in the brake cylinder acting upon the large area 30 of the differential piston is less than the pressure in the train pipe acting upon the small area 33 of said piston, such differential piston will be moved by the train pipe pressure from the position shown in Fig. 3 to the position shown in Fig. 1, so that if it be now desired to charge the auxiliary reservoir, the train pipe pressure may pass around the double check valve 13 by the by passage F′ and thence by passage 5 and valve chamber 2 into the auxiliary reservoir. From the foregoing it will be noticed that in thus returning the parts of the triple valve to the release position shown in Fig. 1, and opening the brake cylinder to the atmosphere so that the brakes are released, the only expansion that has taken place of the train pipe pressure has been that caused by the return movement of the operating piston 15 and in effecting this return movement of the piston positively. It will also be noticed that as said by passage F′ remains closed until the brake cylinder is substantially exhausted, no pressure has passed from the train pipe into the valve chamber or into the auxiliary reservoir, or, in fact, into any part of the triple valve in front of the piston 15, so that not only has the train pipe pressure been saved and confined to one side of the operating piston, but it has been prevented from passing to the opposite side of the operating piston to retard its quick return movement, and it is only when and after the parts of the triple valve have assumed the release position shown in Fig. 1, and the pressure in the brake cylinder has been exhausted or nearly exhausted, that the by passage F′ is opened to permit the auxiliary reservoir to be recharged; so that when this is done such passage of the pressure to the auxiliary reservoir by the by passage F′ occurs only after the train pipe pressure has effected the absolute return of the operating piston and its connected valves to said release position. If now it be desired to apply the brakes, as for instance for a service stop, the train pipe pressure is reduced sufficient to have relieved the pressure by the passage 14 upon the rear of the operating piston 15 that the auxiliary reservoir pressure acting against its opposite side moves said operating piston and valve 10 into the position shown in Fig. 2, so that the recess 10^b is moved to close the duct 9 and the port 10^a of said valve 10 is moved into coincidence with the port 8^a in the valve 8 permitting the auxiliary reservoir pressure to pass into the brake cylinder until such time that such pressure and the pressure in the train pipe is equalized, whereupon the spring 17, which had been slightly compressed by the rearward movement of the piston 15, will now move said piston and the valve 10 into the position shown by dotted lines in Fig. 2, thereby removing the port 10^a from coincidence with the port 8^a cutting off the auxiliary reservoir pressure from the brake cylinder. As soon as the train pipe pressure is reduced to cause the parts to move to this service stop position as in Fig. 2, the pressure through the by passage F′ is also consequently reduced so that the small check valve 40 moves to its seat, closes such passage F′ and thus prevents any pressure from the auxiliary reservoir or the valve chamber 2 or in the train pipe passage 5 above the double check valve 13 to leak into the train pipe. As soon as the pressure in the brake cylinder acting upon the large area 30 of the differential piston is enough to overcome the reduced pressure in the train pipe acting upon the small area 33 of said piston the differential piston will move from the position shown in Fig. 1 to the position shown in Fig. 2, closing the by passage F′ so that whenever the train pipe pressure is raised to return the parts to the released position again, such pressure in the train pipe is prevented from leaking into the valve chamber 2 to retard the quick return of the operating piston 15.

If it be desired to recharge the auxiliary reservoir while the brakes are on and the parts are in the position shown in Fig. 2 as modified by the position indicated by the dotted lines, the train pipe pressure is slightly raised (not sufficient to hold the double check valve 13 to its upper seat), so that such pressure flows past said double check valve into the valve chamber 2 and thence into the auxiliary reservoir. This recharging is effected without disturbing the position of the differential piston shown in Fig. 2, closing the by passage F′.

From the foregoing it will be understood that a very efficient means is provided for insuring a positive release of the brakes and effecting an important saving of the fluid pressure, as well as enabling the maintaining of pressure in the long length of train pipe incident to a long train of cars, while the pressure is being simultaneously relieved from all of the brake cylinders in the train.

The proportion of the areas, 30, 33, of the differential piston will be governed by the pressures under which the triple-valve operates, but assuming it capable of operating upon a reduction of twenty pounds pressure in the train pipe from a normal pressure of seventy pounds, the large area of the differential piston is preferably six times greater than the small area; in which case the said piston will continue to close the passage F′ upon the release of the brakes until the pressure in the brake cylinder has been lowered to a little more than one-sixth of that in the train pipe when the much greater pressure acting upon the small area will cause the piston to move to open said passage.

To prevent any escape of the pressure in the reverse direction through the passage F′, such passage is provided with the small check valve 40 adapted to close said passage the moment the pressure shall drop in the train pipe, as before explained.

It is to be understood that the use of the passage or by-pass and differential piston and the check valve 40 is not confined to the particular form of so-called triple-valve shown and set forth herein, but that it may be used in other forms of triple valves; and that instead of using a differential piston for controlling the admission of the fluid pressure to the auxiliary reservoir when releasing the brakes, it may be employed to open and close communication between the train pipe and brake cylinder in another form of triple valve, arranging and proportioning the piston so that a reduction of pressure in the train pipe as for instance for an "emergency stop" of twenty pounds will cause it to move to open the train pipe into communication with the brake cylinder. Thus in applying the improvement to the form of triple valve represented in Fig. 4, substantially the same construction may be employed, the only changes that are necessary being the addition of a flange 4′ on the end of the exhaust valve 4^a, to close communication between the train pipe and the auxiliary reservoir except when said valve is in exhaust position; and the closing of the direct charging port F^2.

The by-pass F′ opens into the passage G that is in communication with the auxiliary reservoir and into the train pipe passage A, through the opening F; the smaller area 33 of the differential piston controlling the communication of the train pipe passage with the auxiliary reservoir by closing the pass F′, while the larger area 30 of the differential piston is open by the passage C′ to the brake cylinder. The action of this differential piston is the same as before described and need not be repeated here.

What is claimed is—

1. In a fluid pressure brake, the combina-

tion of a valve controlling the exhaust from the brake cylinder, a fluid pressure supply passage communicating with a reservoir, and a second valve controlling said passage the movement of which is effected by the variations of pressure in the brake cylinder, substantially as described.

2. In an air brake apparatus, the combination with the triple valve, of another valve exposed to the brake cylinder pressure and closing communication between the train pipe and auxiliary reservoir while the brakes are on, substantially as described.

3. The combination with the triple valve of an air brake apparatus controlling the passage of pressure to the brake cylinder of another valve controlling communication between the train pipe and auxiliary reservoir and exposed to the brake cylinder pressure, and a check valve in the train pipe to hold the pressure in auxiliary reservoir, substantially as described.

4. The combination with a brake cylinder, reservoir, triple valve and train pipe, of a passage connected with the train pipe and leading to a reservoir forming a portion of the air brake apparatus, and a differential pistion or valve controlling said passage exposed to the change in pressures in the train pipe and brake cylinder to open or close said passage after the movement of the triple valve, substantially as described.

5. The combination with a brake cylinder, reservoir, triple valve and train pipe, of a passage leading from the train pipe and communicating with the auxiliary reservoir, and a differential piston or valve controlling said passage, the differential areas of which are exposed both to the brake cylinder and to the train pipe pressures to open and close said passage after the triple valve has moved, substantially as described.

6. The combination with a brake cylinder, reservoir, valve, train pipe and a check valve in said train pipe, of a by passage extending from the train pipe to the upper side of said check valve, and a piston or valve automatically controlling said by passage, substantially as described.

7. The combination with a brake cylinder, reservoir, triple valve, train pipe and a double seated check valve in said train pipe, of a by passage opening into the train pipe upon opposite sides of said double check valve and a piston or valve controlling said by passage exposed to the train pipe and to the brake cylinder pressures, substantially as described.

8. The combination with a brake cylinder, reservoir, triple valve and train pipe, of a by passage leading from the train pipe and communicating with the reservoir, a check valve closing one end of said by passage and a piston or valve controlling the other end and exposed to the brake cylinder and train pipe pressures, substantially as described.

9. The combination with a brake cylinder, reservoir, and valve for controlling the admission and exhaust of fluid to and from the brake cylinder, of a supply passage communicating with the auxiliary reservoir and a piston or valve controlling said passage and an air passage connection between the said piston or valve and the brake cylinder whereby the piston or valve is operated by an increase and decrease in pressure in the brake cylinder, substantially as described.

10. The combination in an air brake apparatus, of a train pipe passage to the auxiliary reservoir, a by pass from the train pipe passage communicating with the auxiliary reservoir having a valve exposed to and moved to open said by pass by the train pipe pressure when the brake is released, substantially as described.

11. The combination, in an air brake apparatus, of a check valve in the train pipe passage adapted to close the same on an increase of pressure in the train pipe, and a by pass around or past said check-valve having a valve moved to open said by pass by the train pipe pressure when the brake is released, substantially as described.

12. The combination, in an air brake apparatus, of a check valve in the train pipe passage, a connection with the triple valve adapted in one position to hold the check valve from its seat, a by pass around or past said check valve and a piston or valve controlling said by pass moved to open the by pass after the triple valve is in release position, substantially as described.

In testimony whereof I have hereunto set my hand, this 4th day of May, A. D. 1892, in presence of two witnesses.

HENRY L. HOWE.

Witnesses:
MAX C. BEARD,
HENRY STEWART.