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E. F. C. DAVIS.

VALVE DEVICE FOR COMPOUND ENGINES.

No. 564,050. Patented July 14, 1896.

Fig. 1

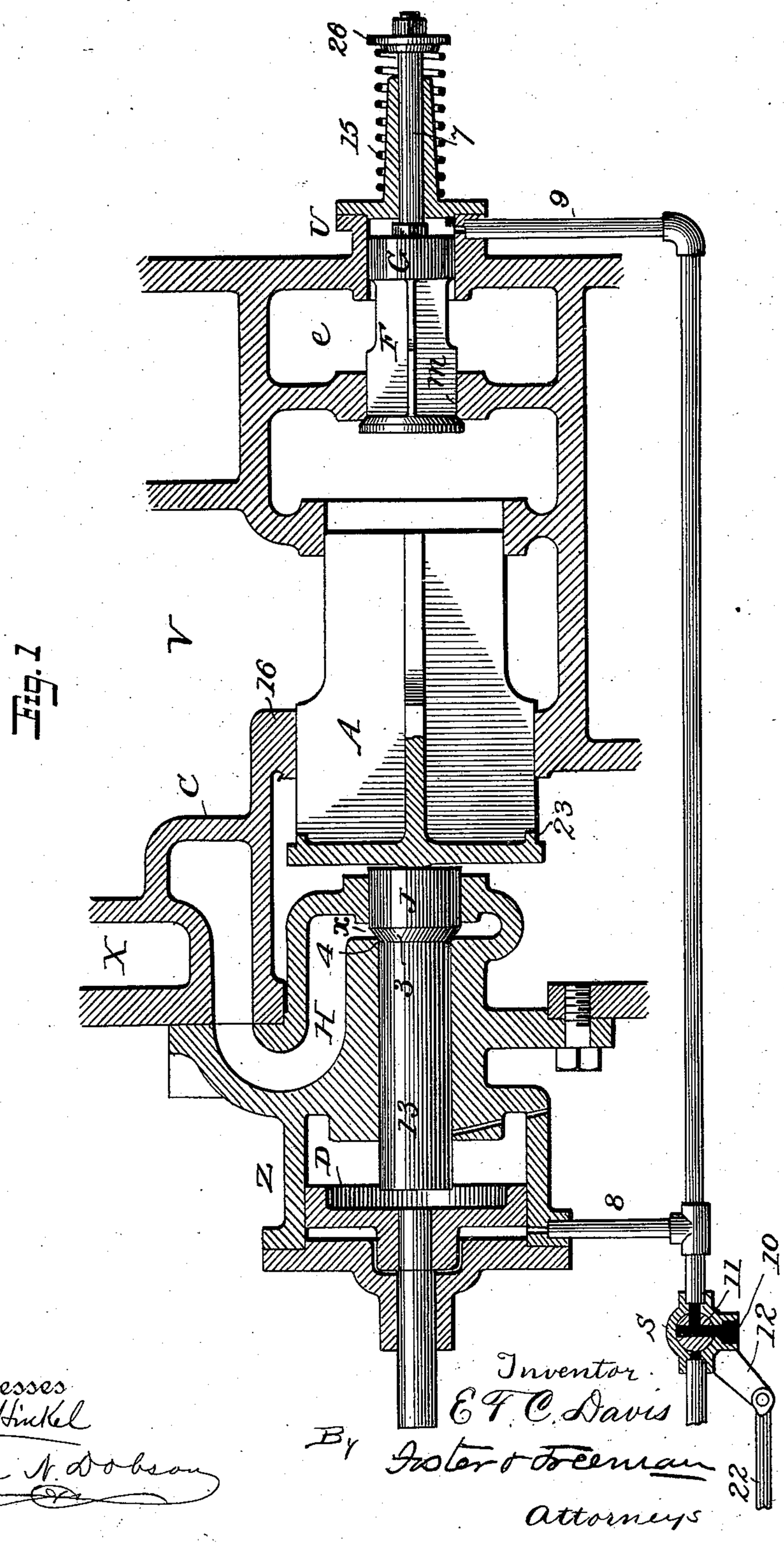

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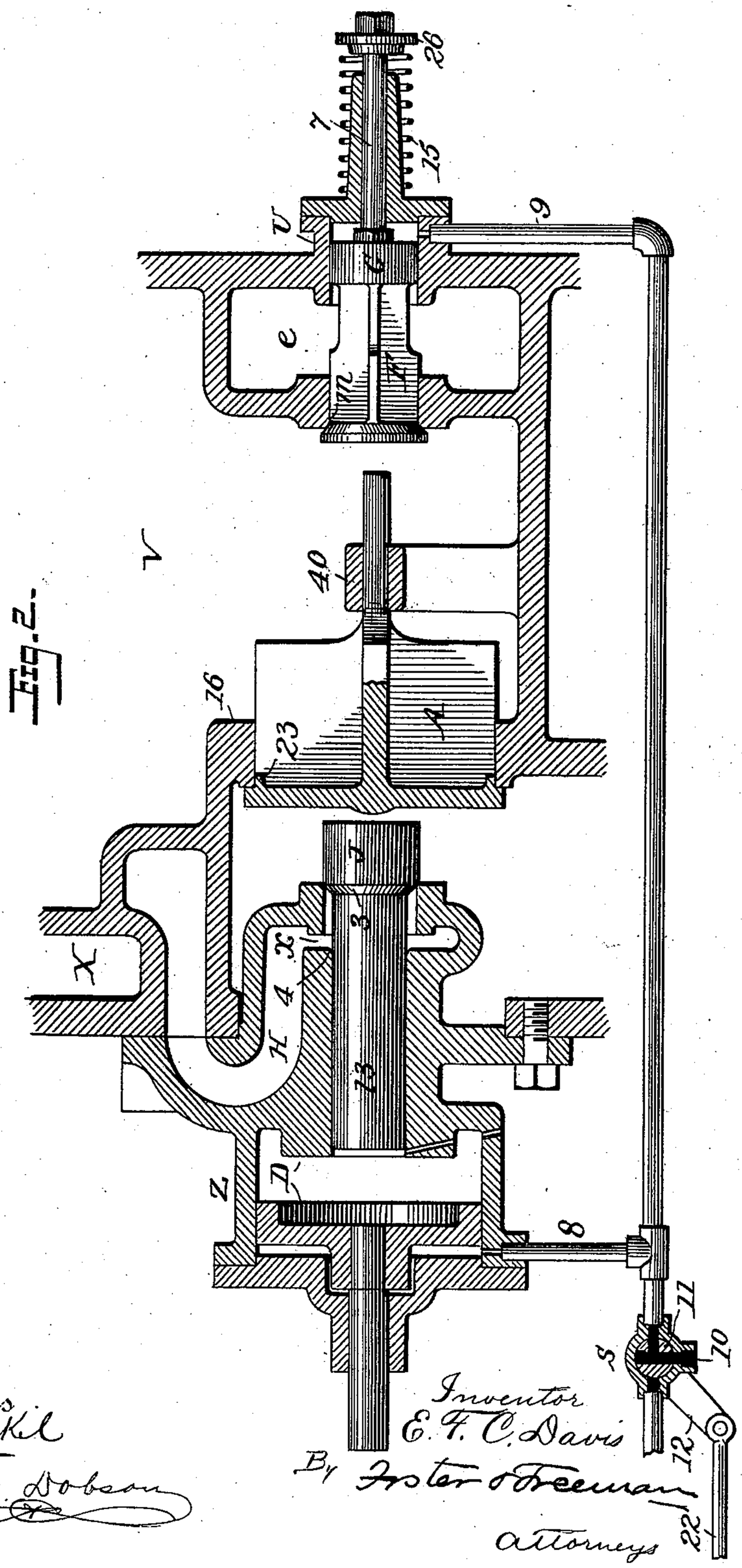
Fig. 2.



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VALVE DEVICE FOR COMPOUND ENGINES.

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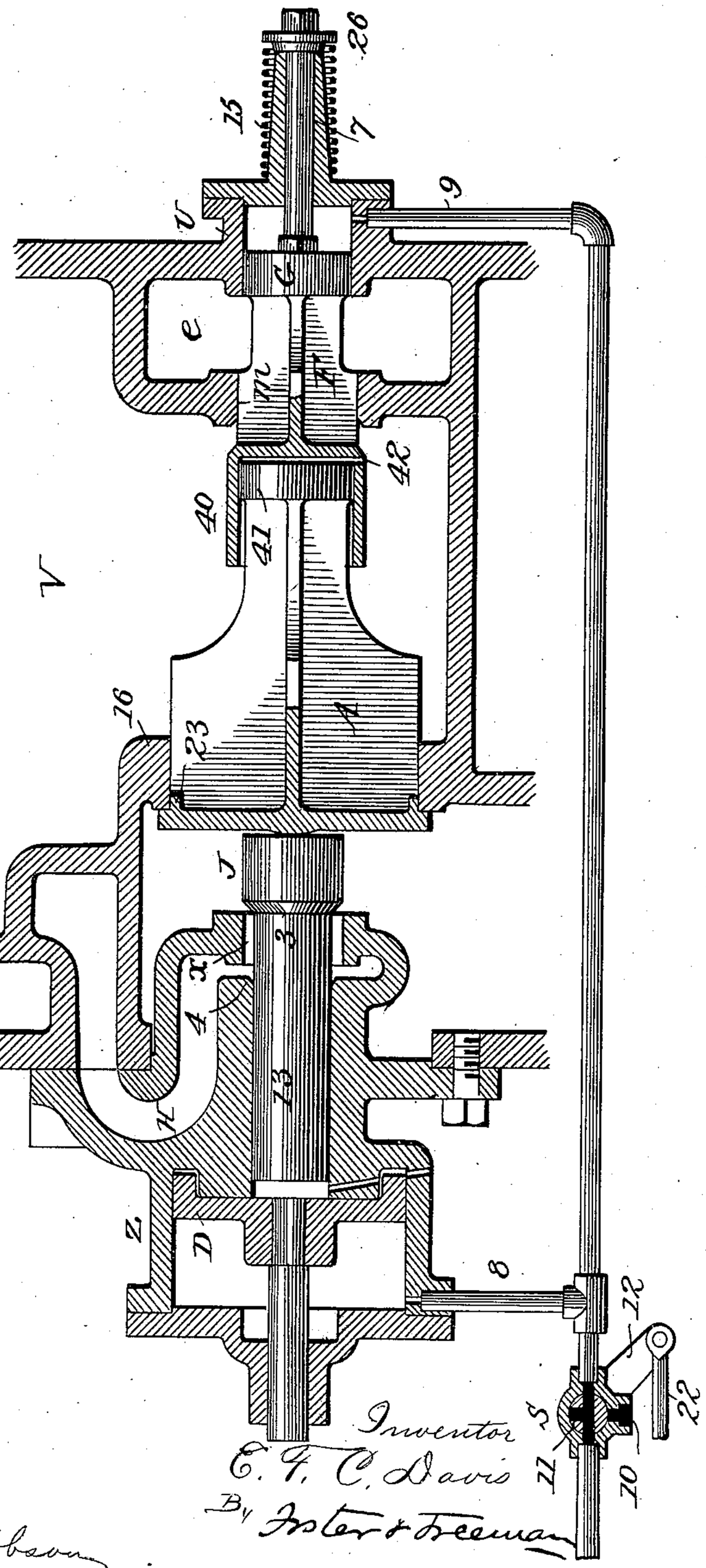
Fig. 3.



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UNITED STATES PATENT OFFICE.

EZEKIEL F. C. DAVIS, OF RICHMOND, VIRGINIA, ASSIGNOR TO THE RICHMOND LOCOMOTIVE AND MACHINE WORKS, OF SAME PLACE.

VALVE DEVICE FOR COMPOUND ENGINES.

SPECIFICATION forming part of Letters Patent No. 564,050, dated July 14, 1896.

Application filed April 3, 1894. Serial No. 506,176. (No model.)

To all whom it may concern:

Be it known that I, EZEKIEL F. C. DAVIS, a citizen of the United States, residing at Richmond, in the county of Henrico and State of Virginia, have invented certain new and useful Improvements in Valve Devices for Compound Engines, of which the following is a specification.

My invention relates to that class of valve devices which is used in connection with compound engines for the purpose of securing the automatic shifting of an intercepting valve controlling the port between the high and low pressure engines; and my invention consists of means for securing positive actions of the parts, facilitating and simplifying the construction, and increasing the efficiency of the apparatus, as fully set forth hereinafter and as illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal section of a compound-engine valve device, showing the parts in position before starting and also when working as a compound engine; Fig. 2, the same, illustrating the position of the parts, showing the intercepting valve closed after starting and prior to the accumulation of pressure at the high-pressure side of the receiver; Fig. 3, the same, illustrating the position when working as a simple or non-compound engine.

The different figures show different arrangements of guides, and Fig. 3 shows in addition a dash-pot between the intercepting and emergency valves.

The casing X of the valve device is constructed in any suitable manner to contain the parts hereinafter described, and in the case of the application of the device to a locomotive engine it is preferably a part of the saddle of the cylinders. In said casing there is the usual partition C, having the intercepting port, which is closed by an intercepting valve A, which, in the construction shown in Fig. 1, is provided with wings that extend into a guide 16, that serves to guide the valve longitudinally. In Fig. 2 the guide is a standard 40, and in Fig. 3 it is a dash-pot.

An admission-port x, which affords a communication between a live-steam passage H and that portion of the receiver between the partition C and the low-pressure engine, is closed by a piston-valve J, so constructed as to constitute also the motor for closing the intercepting valve. Thus the piston-valve J has a beveled face 3, which meets a seat 4 upon the casing, the said seat being narrower than the face 3, so that a portion of the said face is always exposed to the steam from the passage H, and the reduced stem 13 of the valve J extends through an opening in the casing into a cylinder Z in position to be struck by an independent piston D, sliding in said cylinder.

The piston J, with its beveled face and stem, constitutes, further, a reducing-valve, being so proportioned that while it will be moved to the right, so as to open the port x under the live-steam pressure, the pressure upon the larger area of its end will serve to counterbalance that of the live-steam pressure, partially throttling or closing the port x, according as the relative pressures vary, said reducing-valve operating in the ordinary manner.

Assuming the parts above described to be in the position indicated in Fig. 1 prior to starting, the opening of the throttle and the admission of steam to the passage H will bring a pressure upon the face of the piston-valve J, and the latter will be thrown to the right, carrying with it the intercepting valve A to a closed position, while the live steam from the passage H will pass through the port x to the low-pressure steam-chest, the parts then being in the position illustrated in Fig. 2. The parts will continue in this position until the pressure on the high-pressure side of the intercepting valve A is sufficient to open that valve, when the increased pressure in the receiver v will close the valve J, if the latter is proportioned to secure this result. It may be desired, however, to facilitate the closing of the valve J by the action of the intercepting valve A, in which case the intercepting valve may be caused to be brought against the end of the piston-valve J and aid in bringing it to a closed position with its face 3 against the seat 4; but, as before described, by properly proportioning this valve the closing action of the valve J may be effected en-

tirely by the increased pressure in the receiver after the intercepting valve has been opened, as described.

When the intercepting valve A is closed, during the operation of the engine, as set forth hereinafter, the admission-valve J will be opened to again permit the live steam to pass to the low-pressure cylinder and the said valve will act as a reducing-valve during this operation. It will therefore be seen that the piston-valve J constitutes practically three different things: first, it is a piston acting to carry the intercepting valve A to its seat; secondly, it is an admission-valve acting to open and close the port *x;* thirdly, it is a reducing-valve acting to limit the pressure in the receiver communicating with the low-pressure steam-chest.

It will be seen that the piston-valve J is entirely independent of the intercepting valve A, that is, it is not directly connected with it in any way; that it does not depend upon any motion of the intercepting valve of necessity either to open or close it, and therefore it is not necessary that it should be strictly in line with it or move exactly in parallel lines, and the necessity of that nice fitting which is required when these two parts are connected inseparably together is avoided. It will also be evident that as the piston-valve J constitutes thus practically three things the advantages of the different features are attained by the single fitting of the valve J to its seat and port.

In order that the valve A may be closed to run the engine simple in case of an emergency, as, for instance, when it is necessary to ascend a steep incline, I make use of an emergency or exhaust valve, which, as shown, consists of a winged valve F, closing a port *m*, constituting a direct communication between the receiver and the passage *e*, extending to the exhaust.

The emergency-valve F may be shifted positively by means of any suitable devices, as levers or rods extending to the engine; but I prefer to make use of a motor (shown in the form of the piston G) fitting a cylinder U, which may be a part of or attached to the casing X, and from the piston G extends a rod 7, having a collar 26, between which and the casing intervenes a spring 15. To positively actuate the valve A, I make use of a piston D, fitting a cylinder Z, and which may be brought against the end of the reduced stem 13 of the piston-valve J to carry the latter to the right, moving the valve A to a closed position.

A motor fluid, as steam, air, or water under pressure, may be admitted to the cylinders U Z in any suitable manner. As shown, there are two pipes 8 9, communicating with their respective cylinders and leading to valve-casing S, provided with a three-way valve 11, which may be turned by means of a rod 22 and arm 12, and which, as shown, communicates with a steam-pipe leading to the boiler and has an air-escape port 10, but of course any suitable character of valve device may be used for controlling the flow of motor fluid to and from the respective cylinders. The arrangement is such, however, that the motor fluid is admitted to and discharged from the cylinders simultaneously, so that there is a positively-operated piston in each, one of which acts to open the emergency-valve F, while the other is brought against the stem 13 of the valve J and opens it, with a positive movement imparted to each, these movements being simultaneous in reverse directions, and the movements imparted to the piston D being transferred to the intercepting valve and closing it positively and quickly upon its seat the instant that the emergency-valve is carried from its seat. By this means the engine is converted from a compound to a simple or non-compound engine without any reduction of pressure in the receiver on the side where it communicates with the low-pressure engine, or loss of power which would otherwise occur is prevented. When the engine is again to be run compound, the valve 11 is adjusted so as to cut off the pressure from the cylinders Z U and open communication with the air-port 10, when the pressure from the piston G, added to the pressure of the spring, or even without the latter, will be sufficient to close the emergency-valve, when the consequent accumulation of pressure on the high-pressure side of the receiver will force open the intercepting valve and bring a pressure upon the end of the valve J, or bring the intercepting valve against the end of that valve and close it.

By the use of the two positively-operating pistons D G, actuated by a motor fluid controlled by a valve device S, as above described, I am enabled to impart direct and positive movements to the parts which have to be adjusted, and to impart these movements simultaneously, so as to maintain the pressure, as before described, while the movement, imparted to the intercepting valve to close the same is through the medium of the piston-valve J and its rod without the necessity of employing any additional device for this purpose.

It will be seen that although the piston-valve J is moved by the piston D and is the means of closing the intercepting valve A it is absolutely independent of the intercepting valve and of the piston D, so that it can act with the greatest delicacy as a reducing-valve, and when so acting is not obstructed in any way in its movement by its absolute connection with or bearing upon any other moving part of the device. It is necessary to close the port of the intercepting valve before the piston reaches the full limit of its travel, that is, before the admission-valve is open. For this reason I provide the intercepting valve with a flange 23, which as the valve is closed is brought into the port in the partition G and practically closes that port before the

valve A fully reaches its seat, and just as the outer shoulder of the face 3 begins to pass from the port *x*, so that the live steam from the admission-port cannot pass through the intercepting-valve port. After this the pressure of the high-pressure steam, which then passes into the receiver on the low-pressure side of the same, presses upon the end of the intercepting valve and will close the latter fully to its seat, leaving a space between the head of the intercepting valve and the piston-valve J that will permit the latter to play as it should while acting as a reducing-valve, the parts then being in the position shown in Fig. 2. It will be evident that if the pressure is such that the piston-valve J will not move materially beyond the piston shown in Fig. 2, yet the intercepting valve will be carried fully to its seat after the port in the partition C is closed by the pressure upon the head of the intercepting valve from the live steam admitted through the port *x*.

In the construction shown in Fig. 3 the guide for the intercepting valve is also part of a dash-pot, there being a cup 40 open at one end and connected at the other to the valve F and a piston 41 fitting said cup and secured to or forming part of the valve A, or the piston may be on the valve F and the cup in the valve A. In either case a small vent 42 throttles the passage of steam from the cup 40, so that the movement of either valve inward is retained and a buffer or dash-pot action secured while the vent permits the passage of steam to the cup to put the parts in equilibrium and in closing the valve F or opening the valve A. With the dash-pot thus arranged the abrupt movements of the parts are prevented, while the steam can pass directly to the exhaust from the receiver without passing through the dash-pot.

I do not claim as my invention the construction and arrangement whereby reduction of pressure on the low-pressure side of the receiver is prevented when the exhaust is opened.

The claims in this case are distinguished from those in my other pending case, Serial No. 506,338, which are based on an independent reducing-valve. They are also distinguished from my pending case, Serial No. 509,997, by the independent relations of the admission-valve and intercepting valve, which are described in this case, and they are also distinguished from those in my pending case, Serial No. 507,578, which are based on an independent reducing-valve.

Without limiting myself to the precise construction and arrangement of parts shown and described, I claim as my invention—

1. In a compound-engine valve device, an intercepting valve, a live-steam passage communicating with the receiver through a port *x*, a piston-valve supported independently of the intercepting valve and adapted to move in the port *x* to the intercepting valve to close the same and from said valve to close the port *x*, substantially as described.

2. In a valve device for compound engines, an intercepting partition having a port, a valve for closing the same, an admission-port opposite the intercepting valve, and a piston-valve movable in said port toward and away from the intercepting valve to close the same, substantially as described.

3. The combination with the intercepting valve and with an independent actuating-piston D, of an intermediate independent admission-valve movable toward and from the intercepting valve and adapted to close the same, substantially as described.

4. The combination of the intercepting valve, actuating-piston D, means for directing a motor fluid to and from the latter and a loose piston intermediate of the piston D and intercepting valve adapted to engage and close the latter, substantially as described.

5. The combination of the intercepting valve piston J having a central bearing thereon and independently movable to and from the same, and a live-steam admission-port controlled by said piston-valve, substantially as described.

6. The combination of the piston-valve J controlling the live-steam port and an independent intercepting valve supported wholly in bearings beyond the valve J in position to be engaged by said valve substantially as described.

7. The combination of the admission-valve, emergency-valve and the intermediate intercepting valve, in alinement with each other, and the intercepting valve supported independently in bearings between the admission and emergency valves, substantially as described.

8. In a compound-engine valve device, the combination of an admission-valve, a live-steam port controlled thereby, a piston adapted to operate on said valve to open the same, an emergency-valve controlling a port between the receiver and exhaust-passage, said valve being provided with a piston, an independent intercepting valve intermediate of the admission and emergency valves, adapted to be closed by the latter, and means for admitting a motor fluid to the pistons of the admission and emergency valves to operate the same, substantially as described.

9. The combination with an intercepting valve of an independent piston supported in bearings beyond the intercepting valve and constituting both an admission and reducing valve, said piston being adapted to engage and move the intercepting valves substantially as described.

10. The combination with the valves A and F of a cup closed except a vent, on one part and a piston on the other, the cup arranged to permit the steam to pass directly from the receiver to the exhaust, substantially as described.

11. In a valve device for compound engines, the combination of a piston-valve, a live-steam port controlled by said valve, a piston adjacent to and disconnected from said valve adapted to engage and move the same, means for directing a motor fluid to the piston, and an intercepting valve disconnected from but designed to be engaged and moved by the piston-valve, substantially as described.

12. In a valve device for compound engines, the combination of a piston D, means for directing a motor fluid thereto, an admission-valve adapted to be opened by said piston, and means for opening said valve independently of said piston, a live-steam port controlled by the admission-valve, and an intercepting valve, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

E. F. C. DAVIS.

Witnesses:

CHARLES E. FOSTER,

CHARLES E. GRAVES.