(No Model.)

C. C. WORTHINGTON.

DIRECT ACTING ENGINE.

No. 354,524. Patented Dec. 14, 1886.

Fig. 1.

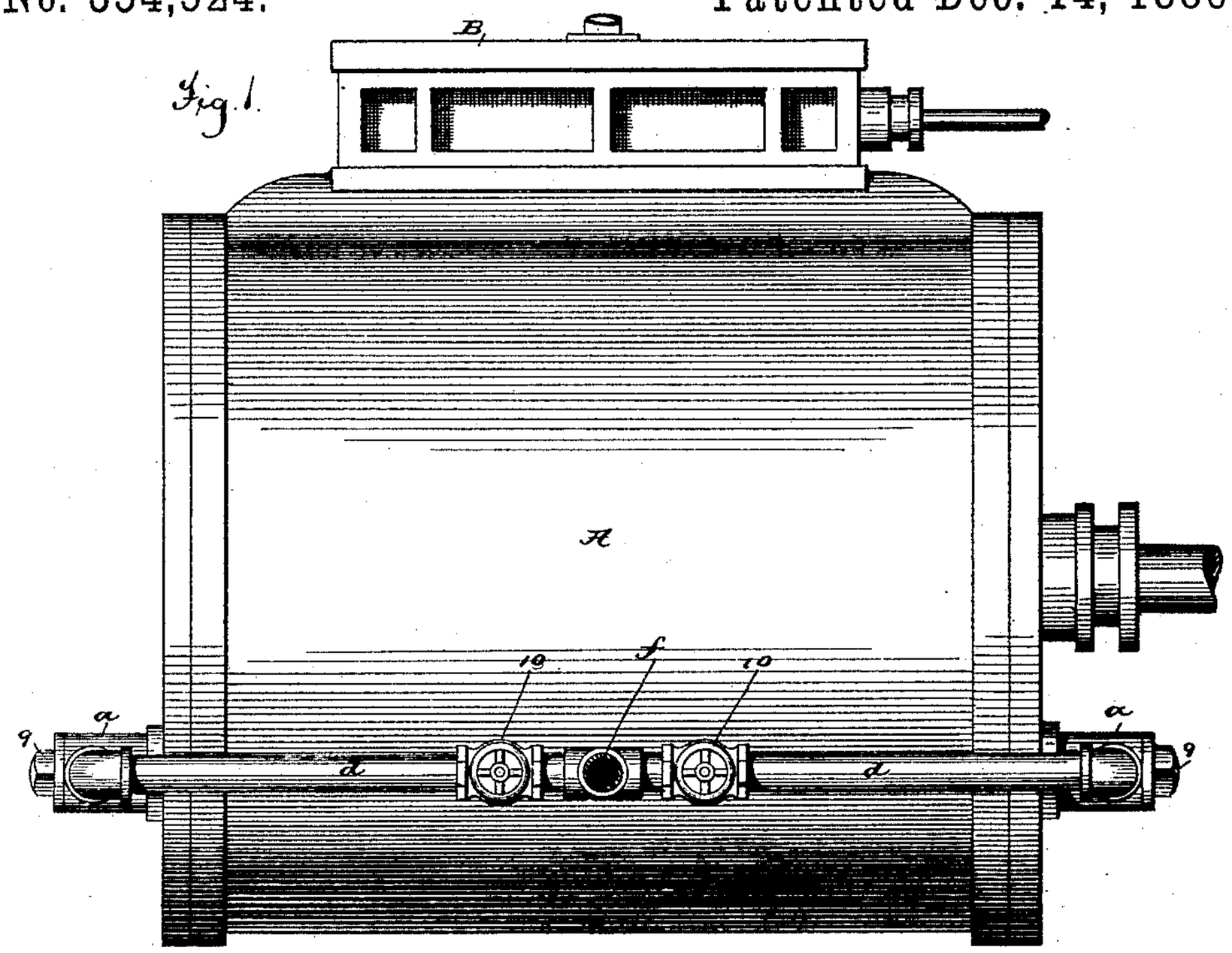


Fig. 2.

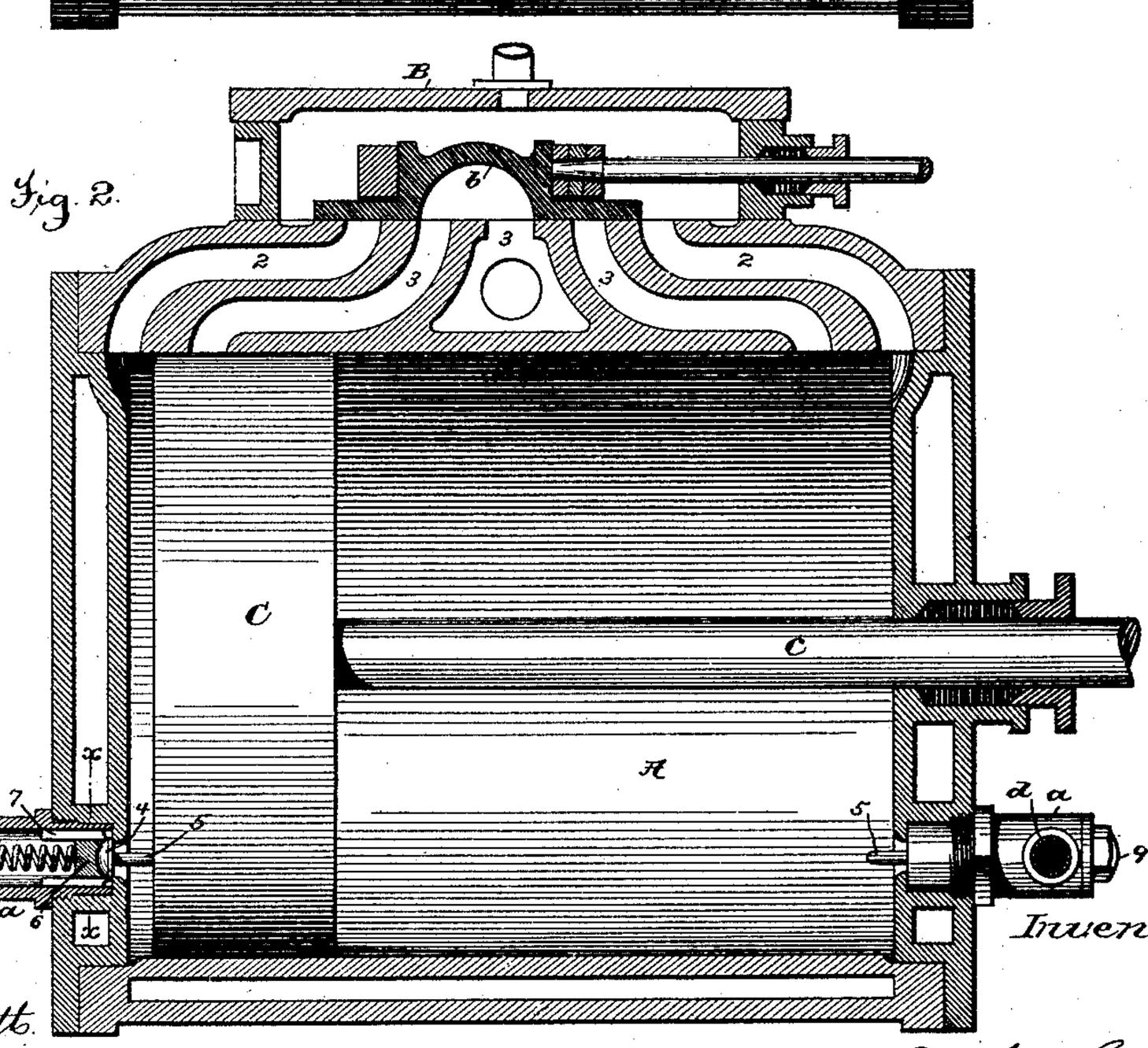
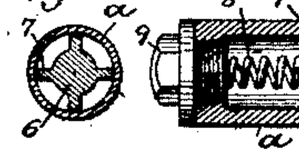


Fig. 3.



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UNITED STATES PATENT OFFICE.

CHARLES C. WORTHINGTON, OF IRVINGTON, NEW YORK.

DIRECT-ACTING ENGINE.

SPECIFICATION forming part of Letters Patent No. 354,524, dated December 14, 1886.

Application filed September 11, 1886. Serial No. 213,291. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, residing at Irvington, county of Westchester, and State of New York, have invented certain new and useful Improvements in Direct-Acting Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to a means for cushioning the steam-piston of a direct-acting engine at the end of its stroke to prevent the same from coming into violent contact with the ends of the cylinder. In direct-acting engines, where the stroke of the piston is not limited in length by the use of a crank, it has been found necessary in practice to provide some means to overcome the momentum of the piston and the parts connected thereto at the end of the stroke, so as to prevent the piston from coming into violent contact with the cylinder-heads, which would be liable to occasion damage. In order to effect this it has been common to provide this class of engines with separate induction and exhaust ports, the exhaust-ports being arranged so as to be covered by the piston as it approached the end of its stroke, thus entrapping a small portion of steam in the end of the cylinder against which the piston cushioned, and was arrested as it arrived at the end of its stroke. Where the engine is run at considerable speed this arrangement has not always been found sufficient for the purpose, and this has been particularly the case where the engine exhausted into a condenser, as in such case, if the condenser were a good one, so nearly a vacuum was formed in the cylinder that very little steam would be entrapped in the end of the cylinder for the piston to cushion against. In order to overcome this provision has sometimes been made for the admission of a small amount of live steam to the cylinder in front of the advancing piston just at the end of the stroke, so as to resist the advance of the piston and bring it to rest before it could come into contact with the cylinder-head.

The present invention relates to an apparatus for accomplishing the result just stated, the apparatus being so organized as to be operated by the piston as it approaches the end of its stroke in either direction to admit a quantity of steam in front of it to resist its progress and bring it to rest.

The invention consists in a particular organization of the apparatus by which the quantity of steam admitted in front of the piston can be easily and quickly regulated to suit the different running conditions of the engine, and by which the steam can be entirely cut off when the engine is running under such conditions as to make the admission of steam in front of the piston unnecessary.

As an understanding of the invention can be best given by reference to an engine embodying the same, all further preliminary description of the invention will be omitted and a full description given, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of the steam-cylinder of an ordinary direct-acting engine provided with the apparatus embodying the present invention. Fig. 2 is a central vertical section of the same, the apparatus for admitting steam to one end of the cylinder being shown in elevation; and Fig. 3 is a sectional detail taken upon the line *x x* of Fig. 2.

Referring to said figures, it is to be understood that A represents the steam-cylinder of an ordinary direct-acting engine, and B the steam-chest thereof. The steam is admitted to and exhausted from the cylinder by means of the usual induction-ports, 2, and exhaust-ports 3, and these ports are controlled by an ordinary slide-valve, *b*, which is of the D form. The piston C and the piston-rod *c* of the cylinder are arranged in the usual manner. The cylinder A is provided at each end with an opening, which communicates with a small valve-chamber, *a*, in which is arranged a reciprocating valve, 4, which closes the opening into the cylinder. The valves 4 are provided with stems 5, which extend into the cylinder a short distance, so as to come in contact with the piston C as the latter approaches the end of its stroke in each direction and with followers 6, having ribs or projections 7, by which they are guided in the chambers *a*. The valves are held to their seats so as to close the openings to the cylinder by means of springs 8, which are arranged between the followers 6 and the ends of the chambers *a*. It is also to be remarked that the ends of the chambers *a* are provided with screw-plugs 9, by which ac-

cess can be had to their interiors to remove or repair the springs 8. The chambers *a* are connected by a pipe, *d*, having a branch, *f*, which is supplied with live steam from any suitable source. The pipe *d* is provided on each side of the branch *f* with a valve, 10, by which the supply of steam admitted to either one of the chambers *a* can be regulated or entirely cut off.

The operation of the apparatus thus constructed is as follows: As the piston C arrives near the end of its stroke in either direction it will cover the exhaust-port 3 at that end of the cylinder, thereby entrapping a quantity of steam in the end of the cylinder, against which steam the piston will cushion, and the steam thus entrapped will offer resistance to the piston and tend to bring it to rest. If, however, the momentum of the moving piston and parts attached thereto is so great that the steam thus entrapped is not sufficient to bring the piston to rest, the piston will, as it arrives near the head of the cylinder, come into contact with the stem 5 of the valve 4 at that end of the cylinder, and thus open the valve and admit a quantity of live steam into the cylinder in front of the piston, and thus sufficient resistance will be offered to the piston to prevent it from coming into contact with the cylinder-head. As soon as the piston starts upon its return-stroke and moves a short distance away from the cylinder-head the valve 4 will be closed by the spring 8.

The valves 10 can be operated from time to time, so as to regulate the amount of steam which will be allowed to pass through the pipe *d* into the chambers *a*, and thus the amount of resistance which shall be offered to the piston C by the live steam admitted in front of it can be regulated to any degree of nicety. If at any time the running condition of the engine is such, owing to the load which is upon it, or for any other reason, that it is not necessary to admit steam in front of the piston to bring it to rest, the valves 10 can be entirely closed, so as to shut off the steam from the pipe *d* and the chambers *a*.

In the organizations of this class heretofore in use the quantity of steam admitted in front of the advancing piston has been regulated by the position of the stems of the valves 4, the stems being made adjustable, so as to extend a greater or less distance into the cylinder A, and thus cause the valves 4 to be opened to a greater or less extent. To provide for the adjustment of the valve-stems 5, they were made to screw into the valves, and were operated by means of rods which extended through the ends of the chambers *a*. When it was not necessary or desirable to admit any steam, the valve stems were adjusted so that they would not come into contact with the piston. It was found in practice that it was impossible to keep the valves 4 steam-tight, as foreign matter would lodge under them to such an extent as to cause steam to constantly leak past them, and the leak thus occasioned could not be prevented. In the present organization, however, the valves 4 are always in operation, and by this means are kept in good order, while the admission of the steam is controlled by separate valves, which are of such form as to prevent leakage past them. In the former organization the engineer was obliged to adjust or regulate one valve at a time, whereas in practice it is frequently desirable to regulate both together, and to do this very quickly. In the present organization this can readily be done by operating the valves 10.

What I claim is—

1. The combination, with the cylinder A and its piston C, of the valves 4, operated by the piston to admit steam to each end of the cylinder, and the valves 10, for controlling the admission of steam to the valves 4, substantially as described.

2. The combination, with the cylinder A and its piston C, of the pipe *d*, communicating with each end of the cylinder, the valves 4, arranged to be opened by the piston as it approaches the end of its stroke in either direction, the pipe *f*, for supplying the pipe *d* with steam, and the valves 10, for regulating the amount of steam admitted to each end of the cylinder, substantially as described.

3. The combination, with the cylinder A and its piston C, of the chambers *a* at each end of the cylinder, provided with the valves 4, having the stems 5, extending into the cylinder, the pipe *d*, communicating with both of said chambers, the pipe *f*, for supplying the pipe *d* with steam, and the valves 10, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES C. WORTHINGTON.

Witnesses:

W. A. P. BICKNELL,

JAS. J. KENNEDY.