

(No Model.)

2 Sheets—Sheet 1.

F. W. JOHNSTONE.  
VALVE FOR COMPOUND ENGINES.

No. 464,175.

Patented Dec. 1, 1891.

FIG. 1.

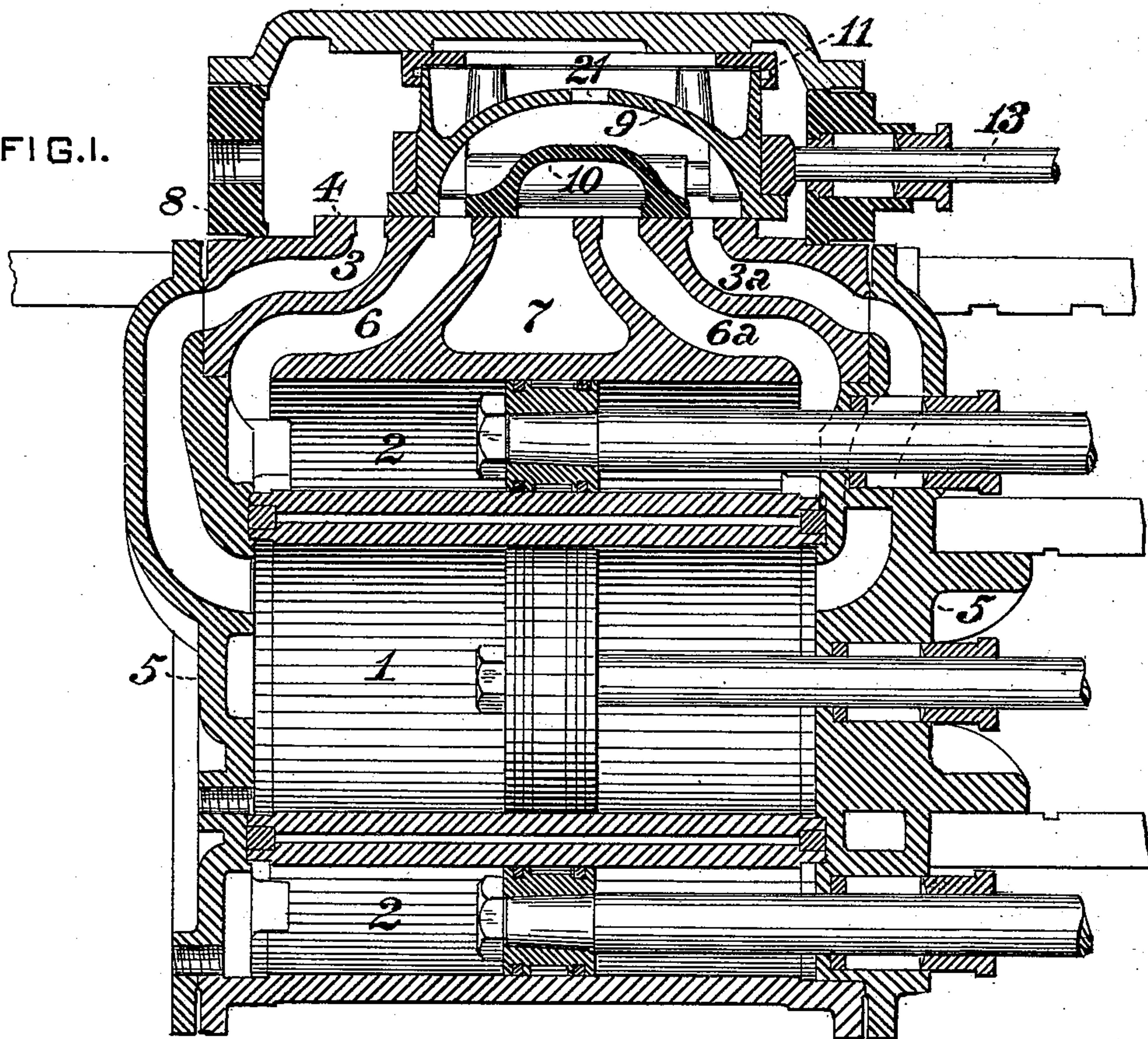
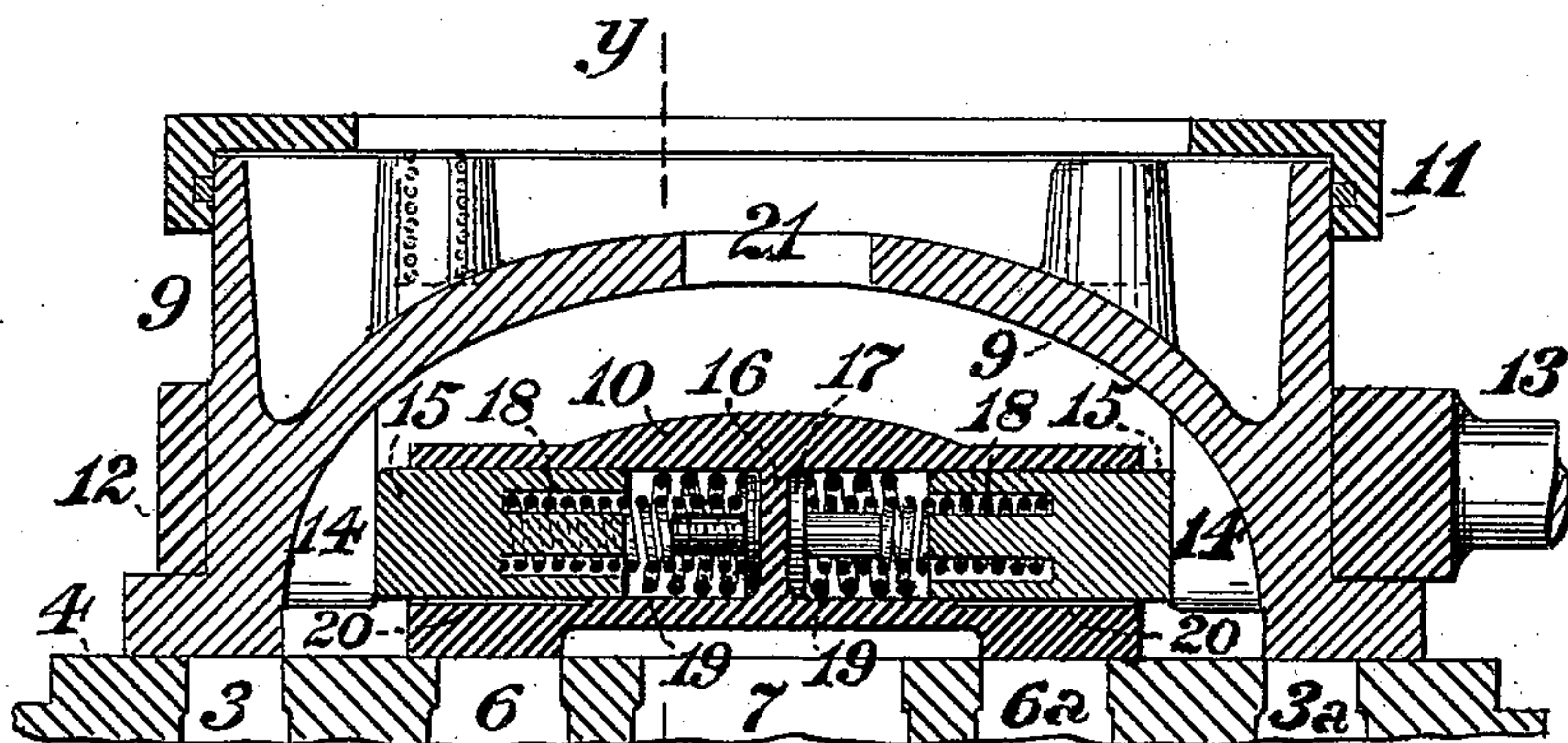


FIG. 2.



WITNESSES:

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*F. E. Gaither*

INVENTOR,

*F. W. Johnstone*  
*by J. H. Brownell*  
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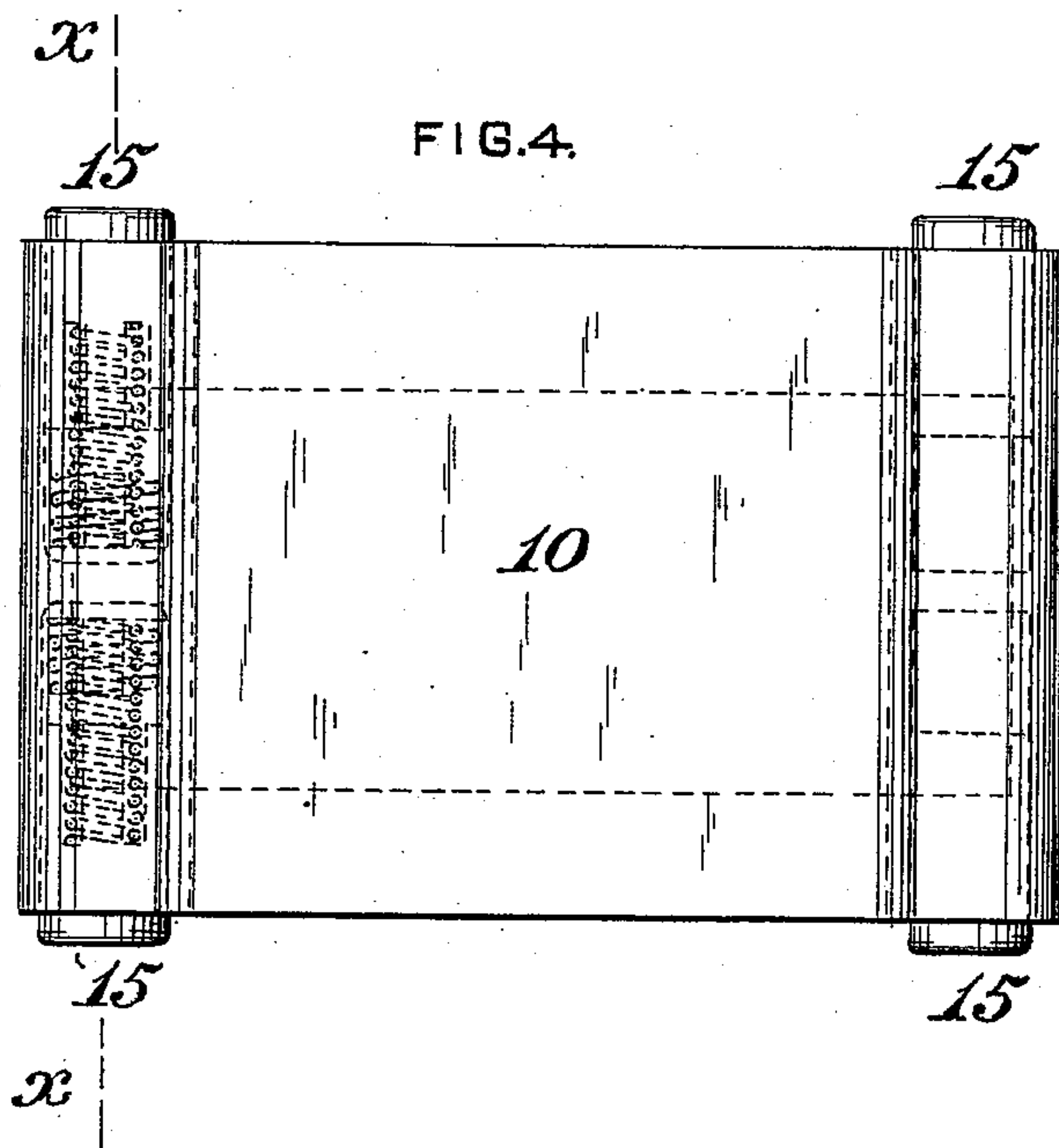
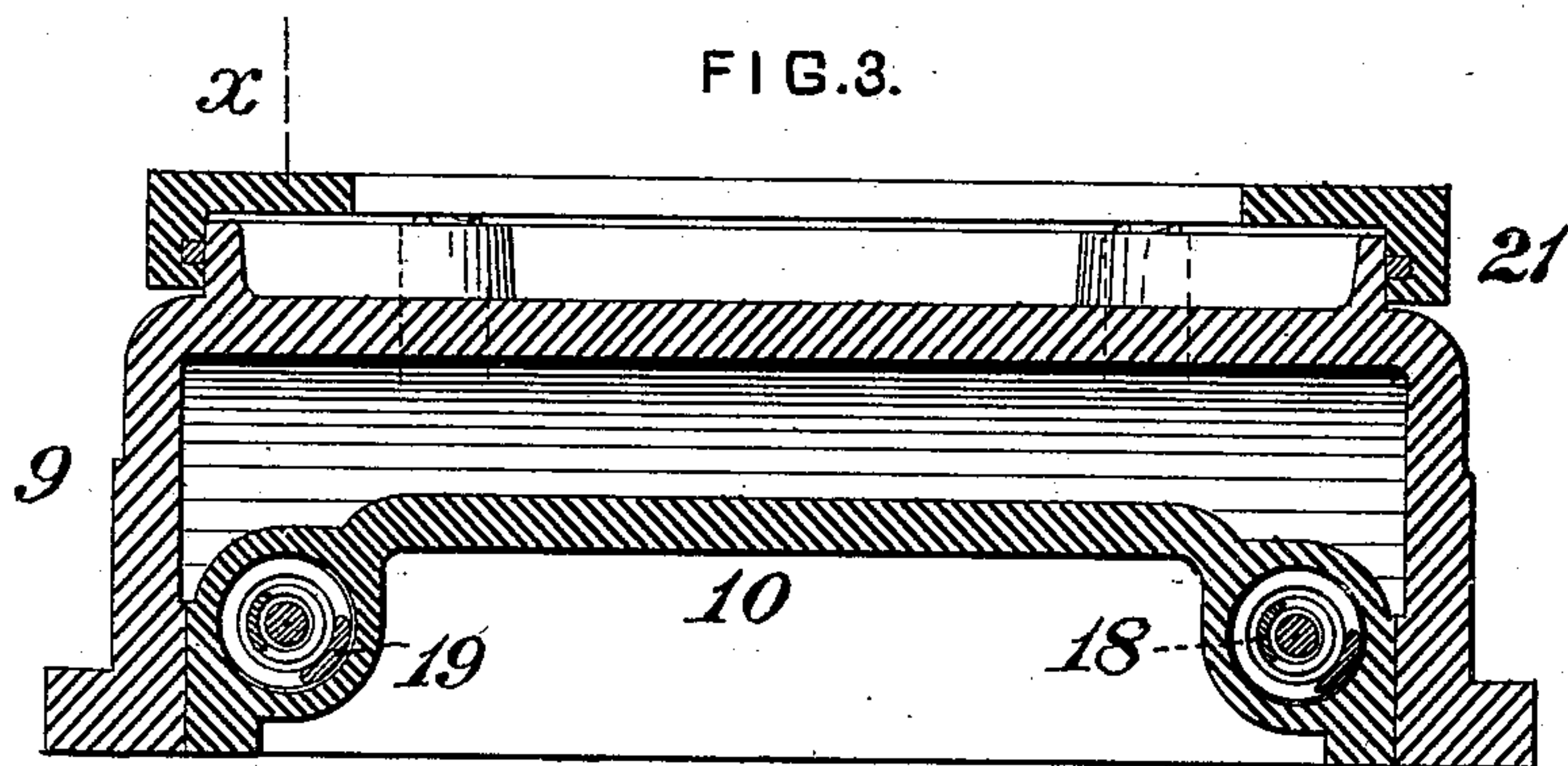
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2 Sheets—Sheet 2.

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VALVE FOR COMPOUND ENGINES.

No. 464,175.

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WITNESSES:

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# UNITED STATES PATENT OFFICE.

FRANCIS W. JOHNSTONE, OF MEXICO, MEXICO.

## VALVE FOR COMPOUND ENGINES.

SPECIFICATION forming part of Letters Patent No. 464,175, dated December 1, 1891.

Application filed November 4, 1890. Serial No. 370,321. (No model.)

*To all whom it may concern:*

Be it known that I, FRANCIS W. JOHNSTONE, a citizen of the United States, residing at the city of Mexico, in the Republic of Mexico, have invented a certain new and useful Improvement in Valves for Compound Engines, of which improvement the following is a specification.

The object of my invention is to attain an improved distribution of steam in compound engines by the provision of a valve, in the operation of which a retardation of steam release may be effected, thereby effecting a higher degree of expansion in the high and low pressure cylinders and a reduction of the back-pressure due to compression in the low-pressure cylinder.

To this end my invention, generally stated, consists in a valve composed of two independent sections movable relatively one to the other, one of said sections controlling the admission and exhaust of steam to and from a high-pressure cylinder and the other the admission of steam from the high-pressure to a low-pressure cylinder and its exhaust from the low-pressure cylinder.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a longitudinal central section through the cylinders, valve-chest, and distribution-valve of a compound engine embodying my invention; Fig. 2, a similar section, on an enlarged scale, through the distribution-valve at the line  $x x$  of Figs. 3 and 4; Fig. 3, a transverse section through the distribution-valve at the line  $y y$  of Fig. 2, and Fig. 4 a plan or top view of the inner section of the distribution-valve.

My invention is herein illustrated as applied in connection with a compound engine for locomotive service, having its high-pressure cylinder within an annular low-pressure cylinder; but it will be obvious that it is equally applicable to compound engines whose cylinders are differently disposed or which are adapted to other classes of service. In this instance there is formed in the cylinder-casting a high-pressure cylinder 1, surrounded by an annular low-pressure cylinder 2. High-pressure steam-passages 3  $3^a$  lead

from ports on a valve-face 4 through the cylinder-casting and through the removable heads 5 to opposite ends of the high-pressure cylinder, and low-pressure steam-passages 6  $6^a$  lead from ports on the valve-face to opposite ends of the low-pressure cylinder. A central exhaust-passage 7 extends from a port on the valve-face 4 to a suitable exhaust-nozzle or discharge-opening. A valve-chest 8, to which steam from the boiler is admitted through a suitable steam-passage, is secured upon the cylinder-casting above and around the valve-face and ports of the steam and exhaust passages.

In the practice of my invention I provide a distribution-valve of the D-slide type, which is fitted to reciprocate on and control the ports of the valve-face 4. The distribution-valve is composed of an outer section 9 and an inner section 10, the general form of each of which accords with that employed in standard practice. The outer section may be balanced by a ring 11, as shown, or in any other suitable manner, and is connected to and reciprocated through the intermediation of a yoke 12 and valve-stem 13, which are actuated by any proper and preferred system of valve-gearing in the usual manner. In the instance exemplified the inner section 10 of the valve is moved by the outer section 9; but it may, if preferred, be actuated by an independent valve-stem, the only essential of the relative movement of the two sections being that the inner section shall have a less degree of traverse than the outer section, to the end that there shall be a period of rest or dwell of the inner section at and immediately succeeding the beginning of the movement of the outer section in each direction.

The inner section 10 of the valve is made of sufficient length to cover the ports of the low-pressure steam-passages 6  $6^a$ , and give the desired amount of outside lap thereon when at the middle of its stroke, its length being less than the distance between the opposite faces of abutments 14 on the inside of the ends of the outer section, by contact with which abutments the inner section is moved in each direction. The difference between the length of the inner section and the distance between the opposite faces of the abut-



ments of the outer section is equal to the distance through which the outer section moves in each direction while the inner section remains stationary, or, in other words, the degree of rest or dwell of the inner section at the commencement of the stroke of the valve in each direction. The outer section 9 of the valve is provided with an opening 21 for the passage of steam from the boiler to the space between the inner and outer sections in order to effect direct admission of steam to the low-pressure cylinder when required in starting the engine. For this purpose a suitable starting-valve, of which numerous constructions are known in the art, is employed to control communication between the steam-supply pipe and the opening 21. The movement of the outer section is preferably, as shown, imparted to the inner section from the end abutments 14 of the former through the intermediation of buffer-pistons 15, fitting chambers in the inner section 10. In this instance four of said pistons are employed, two being located on each side of the valve in line with two abutments 14, one at each end of the outer section 9. The buffer-pistons may be cushioned, so as to prevent undue shocks in the reversal of direction of movement of the inner section, either by the admission of steam to the piston-chambers or by springs; or, as in this case, both these means may be employed. A central abutment 16 is interposed between the inner ends of the piston-chambers on each side of the valve, said abutment being preferably protected by steel facing-plates 17 to reduce wear of the metal of the section 10, as well as to reduce the volume of steam-space when steam is employed to cushion the valve. Helical springs 18, which are uniformly under compression, are interposed between the facing plates 17 and seats on the pistons 15, and springs 19 of greater resistance are fitted in the piston-chambers, said springs abutting against the facing-plates and against the inner ends of the buffer-pistons when the latter are forced into their chambers by the abutments 14, thereby preventing the institution of objectionable shocks upon the valve-section 10. A longitudinal groove 20 may be formed in each piston-chamber or equivalently in the piston 15 fitting therein, its length being such that when the piston is moved outwardly by the spring 18 in the movement of the outer section in one direction during the period of rest of the inner section steam will enter the piston-chamber and will be confined therein by the movement of the outer section and buffer-piston in the opposite direction, thereby serving as a cushion between the inner and outer sections of the valve.

In operation steam supplied from the boiler to the valve-chest 8 is admitted to the opposite ends, alternately, of the high-pressure cylinder 1 by the outer section 9 of the valve through the high-pressure steam-passages 3 3<sup>a</sup>, and is admitted from the high-pressure

cylinder to opposite ends, alternately, of the low-pressure cylinder by the inner section 10 of the valve through the high-pressure steam-passages 3 3<sup>a</sup>. The space between the inner and outer valve-sections and the low-pressure steam-passages 6 6<sup>a</sup>, preliminarily to the admission of steam to the low-pressure cylinder through the passage 3 or 3<sup>a</sup> the passage 6<sup>a</sup> or 6, as the case may be, is opened to the space between the inner and outer valve-sections by the outer valve-section. The exhaust of steam from the low-pressure cylinder is effected by the inner section 10 through the passages 6 6<sup>a</sup>, the exhaust-cavity of the valve-section 10, and the exhaust-passage 7 in the ordinary manner.

It will be seen that the rest or dwell of the inner valve-section 10 in the preliminary movement of the outer valve-section 9 effects a retardation of cut-off and compression in the low-pressure cylinder, thereby allowing a longer period of admission to the low-pressure cylinder without necessitating a corresponding diminution in the amount of expansion therein. It will also be seen that the same period of rest or dwell in the movement of the inner valve-section 10, by which the closure of the exhaust from the low-pressure cylinder is delayed, causes a corresponding delay in the opening of the low-pressure cylinder passage, which admits the exhaust from the high-pressure cylinder to the low-pressure cylinder. In other words, while the outer valve-section 9 passes over and opens the valve-face port of the high-pressure steam-passage to the space between the inner and outer valve-sections, the actual or substantial release from the high-pressure cylinder does not commence until the inner section uncovers the valve-face port of the low-pressure steam-passage. The release of steam from the high-pressure cylinder is thereby delayed, and consequently a greater expansion of the steam is effected in the high-pressure cylinder. This result is attained without in any way interfering with the admission to the low-pressure cylinder at the proper time—that is to say, while the period of expansion in the high-pressure cylinder is prolonged. The admission to both the high and the low pressure cylinders begins at the same time—to wit, at the beginning of the stroke of the pistons.

I claim as my invention and desire to secure by Letters Patent—

1. A valve for compound engines, composed of two independent valve-sections movable relatively one to the other, one of said sections controlling the admission and exhaust of steam to and from a high-pressure cylinder and the other having its movement coincident with that of the former, but through a shorter range of traverse, and controlling the admission of steam from the high-pressure cylinder to a low-pressure cylinder and its exhaust from the low-pressure cylinder, substantially as set forth.



2. A valve for compound engines, composed of an outer section and an independent inner section, the outer section being provided with internal end abutments for imparting movement in each direction to the inner section, and the length of the inner section being less than the distance between said abutments, whereby a rest or dwell of the inner section may be effected at the commencement of the traverse of the outer section in each direction, substantially as set forth.

3. In a valve for compound engines, the combination of an outer section having internal end abutments, an inner section whose length is less than the distance between said abutments, and cushioned buffer-pistons interposed between the end abutments and the inner section, substantially as set forth.

4. In a valve for compound engines, the combination of an outer section having internal end abutments, an inner section whose length is less than the distance between said abutments and so located relatively to the outer section as to present an interposed steam-passage, a balance-ring fitting the outer section and adapted to bear on a valve-chest, and a passage or opening formed in the outer section within the balance-ring to enable the direct admission of steam to be effected to the

steam-space between the valve-sections, substantially as set forth.

5. In a valve for compound engines, the combination of an outer section having internal end abutments, an inner section whose length is less than the distance between said abutments, buffer-pistons fitting chambers in the inner section and adapted to bear against said abutments, and springs interposed between said buffer-pistons and bearings on the inner section, substantially as set forth.

6. The combination of a high-pressure cylinder, a low-pressure cylinder, steam-passages leading from opposite ends of each of said cylinders to a valve-face, an exhaust-passage leading from said valve-face, and a distribution-valve composed of an outer section and an independent inner section and controlling the valve-face ports, said valve providing a passage for steam between the sections from the high-pressure to the low-pressure cylinder and its inner section having a shorter range of traverse than its outer section, substantially as set forth.

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Witnesses:

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