No. 709,929. Patented Sept. 30, 1902.

A. RAVEN.

BLOWING ENGINE.

(Application filed Mar. 12, 1901.)

(No Model.) 6 Sheets—Sheet 1.

Fig. 1.

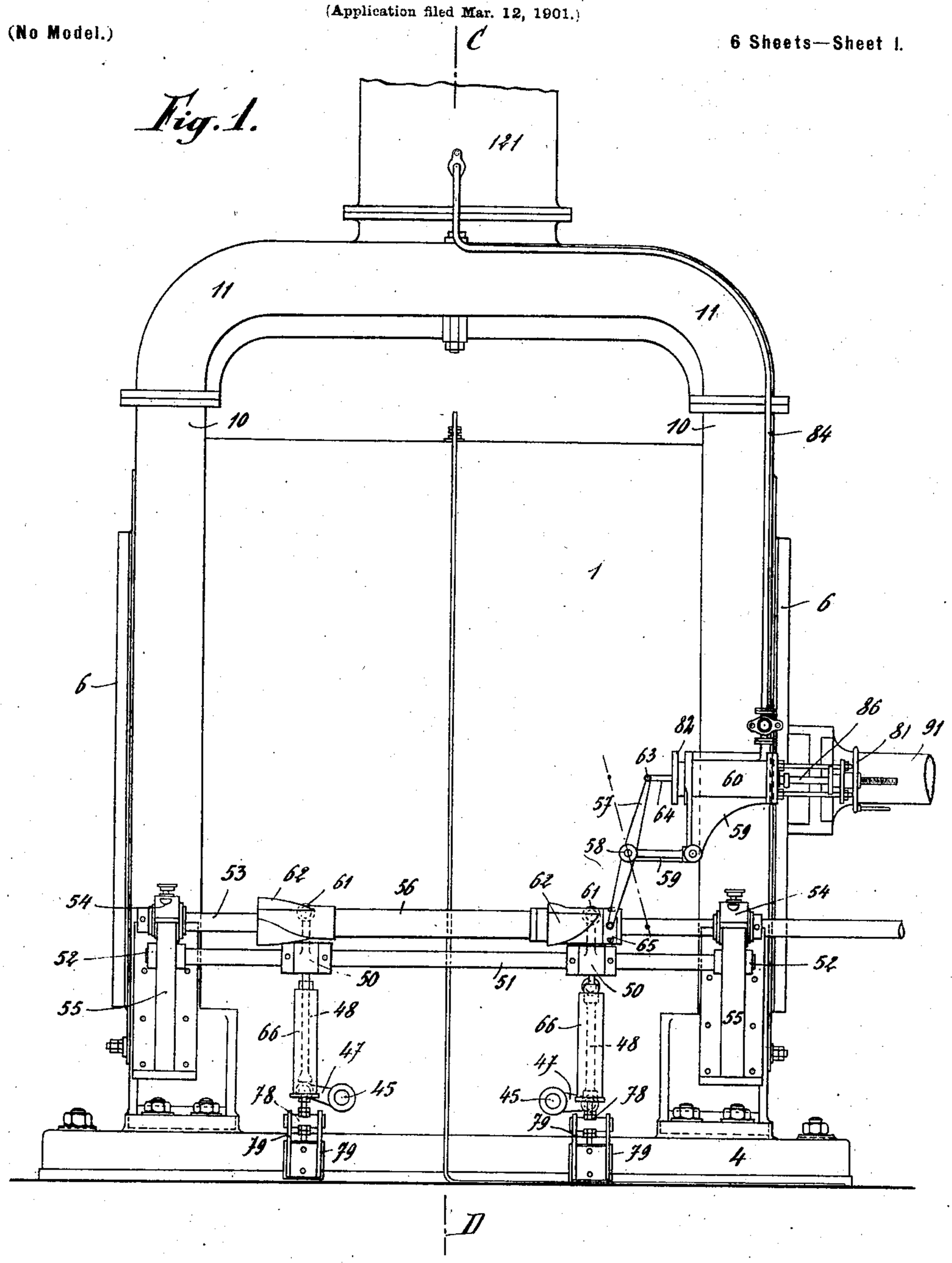

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Fig. 2.

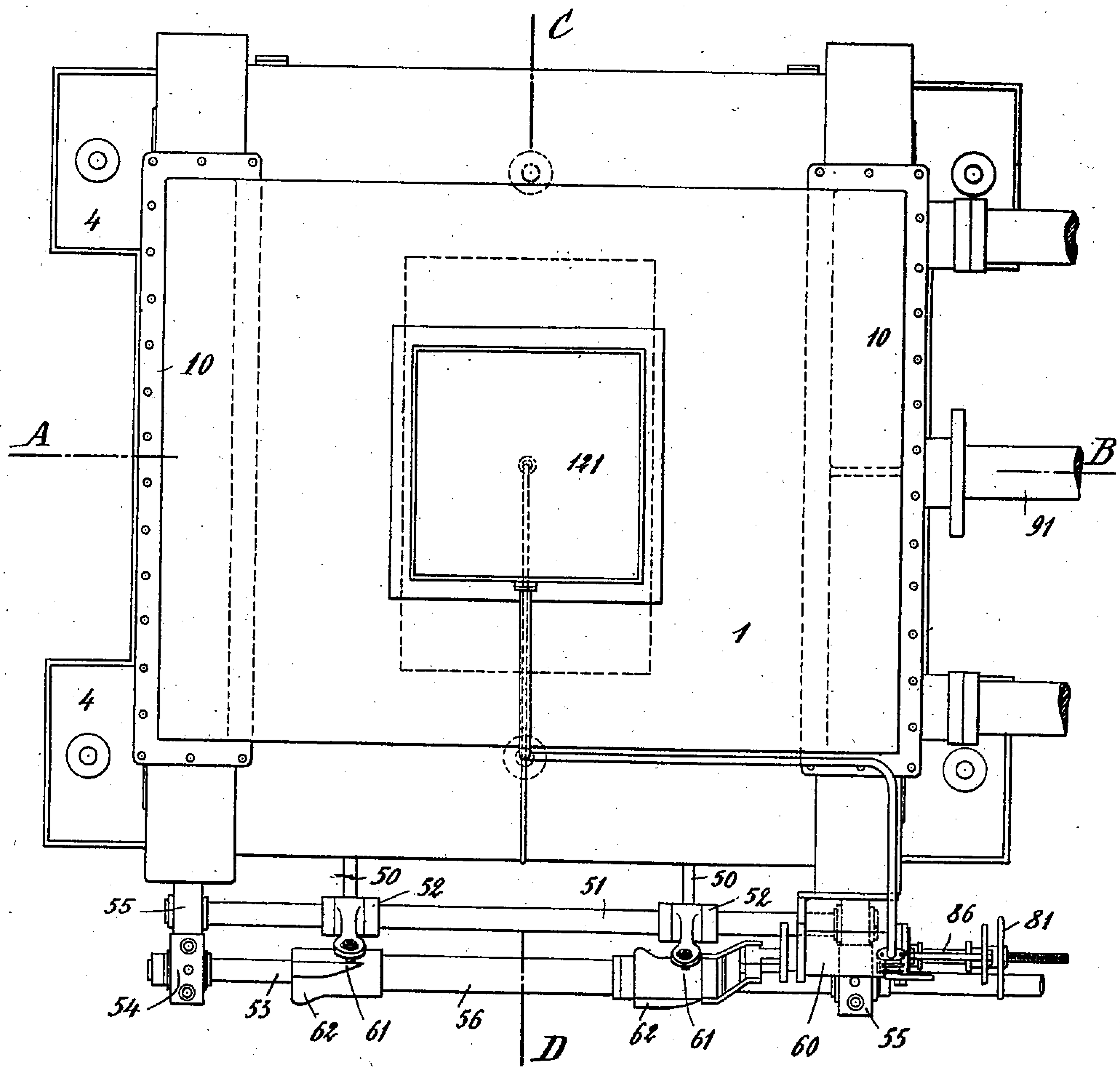

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Fig. 3.

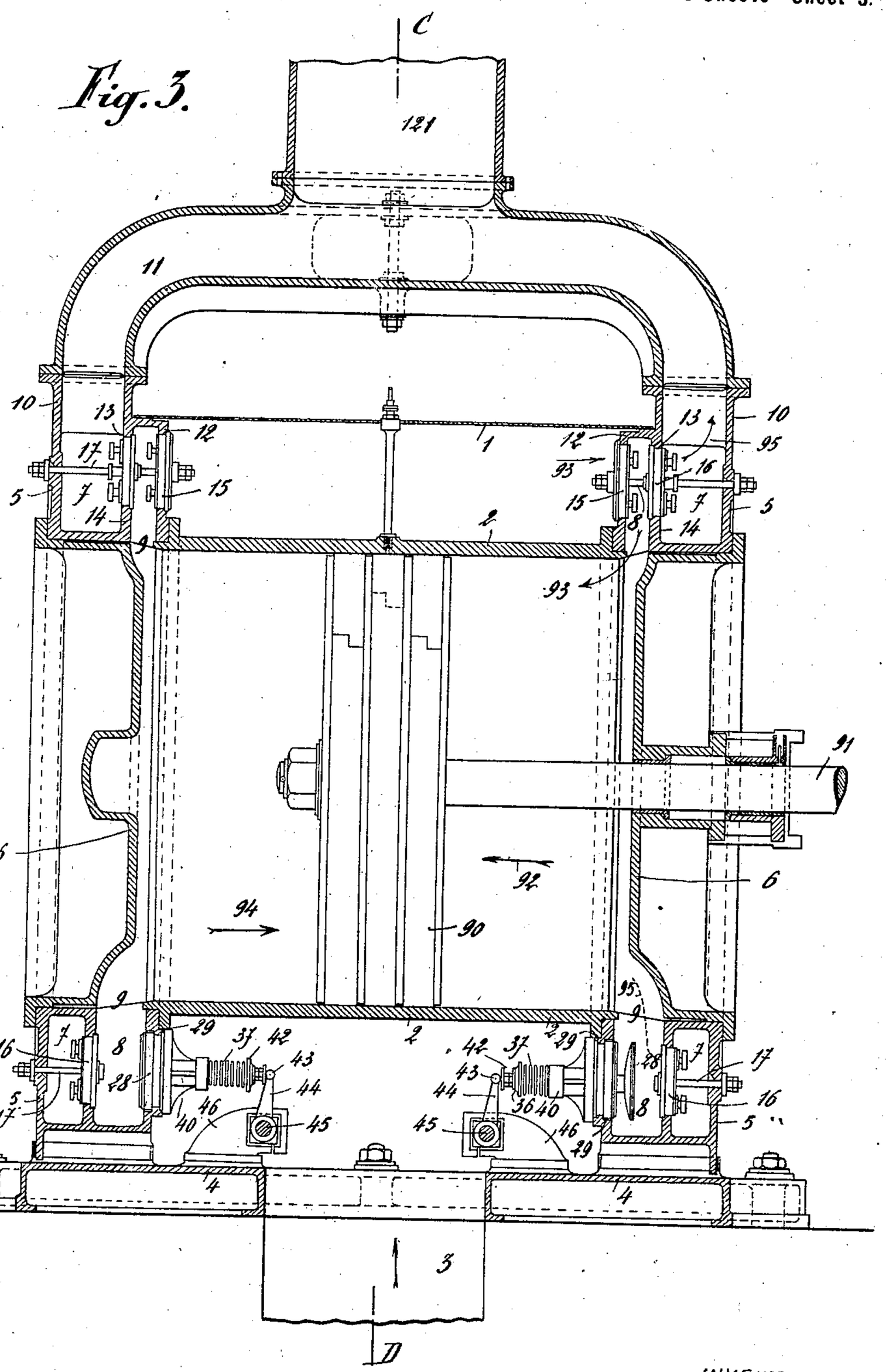

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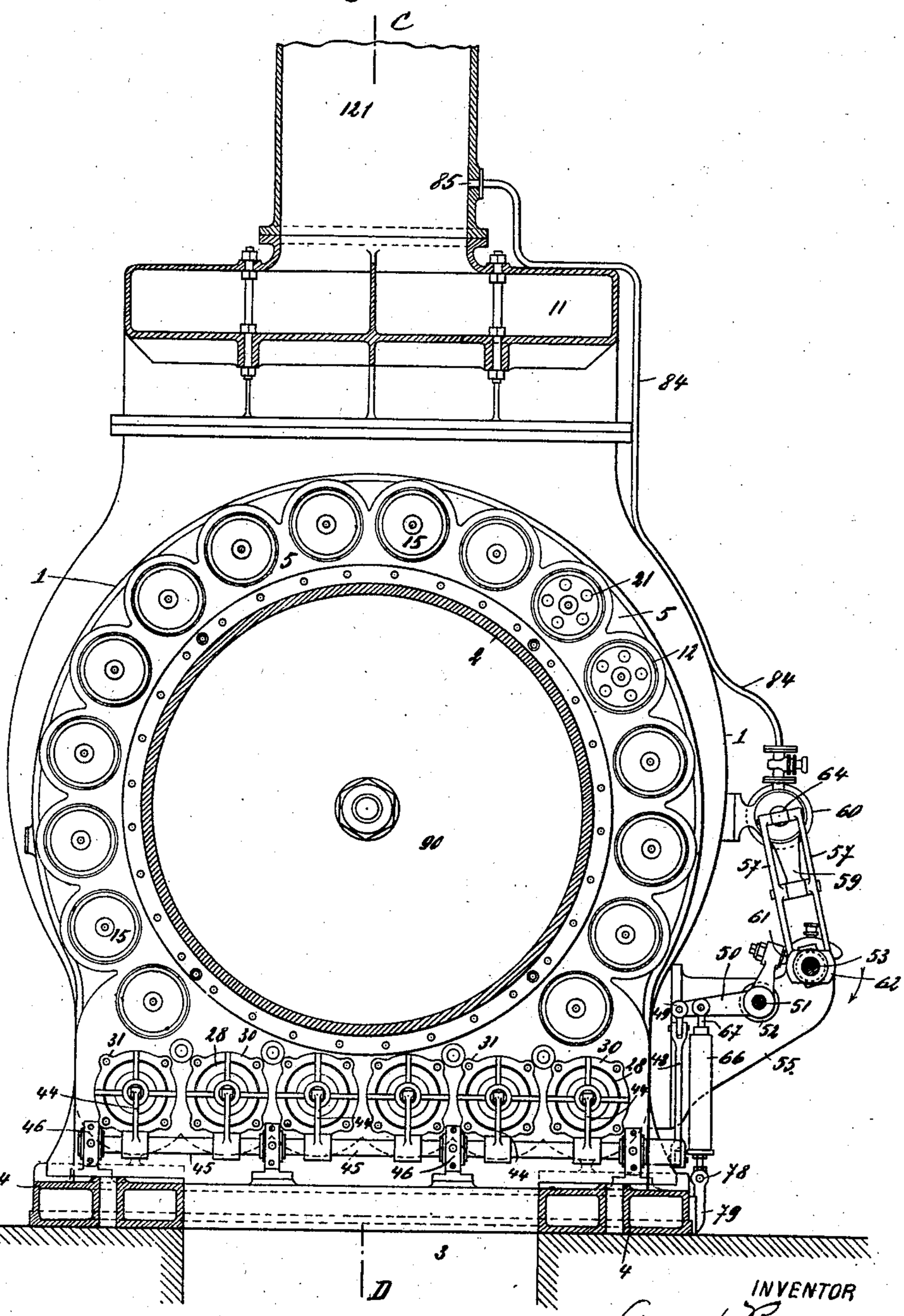
Fig. 4.



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(No Model.) 6 Sheets—Sheet 5.

Fig. 6.

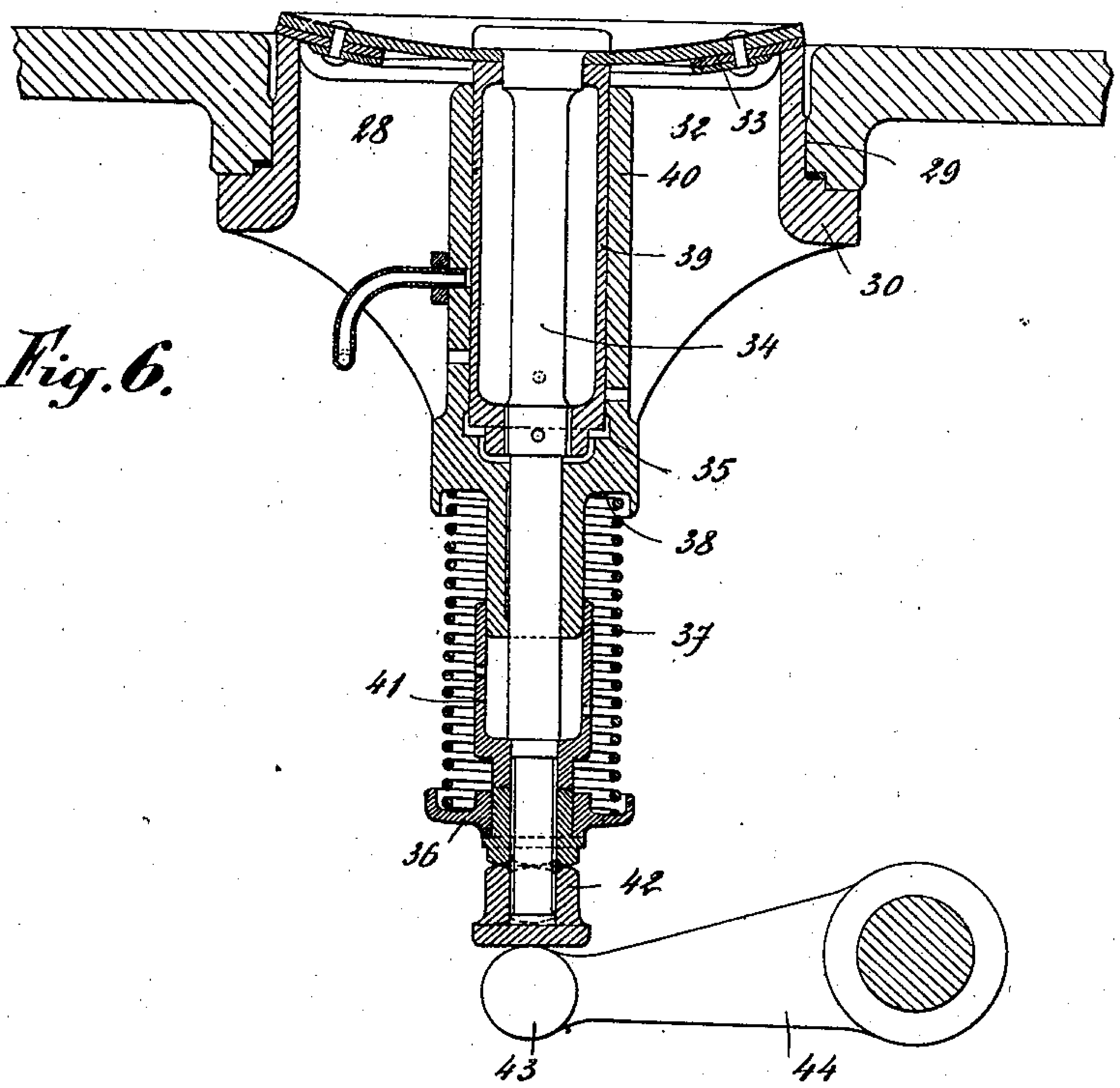
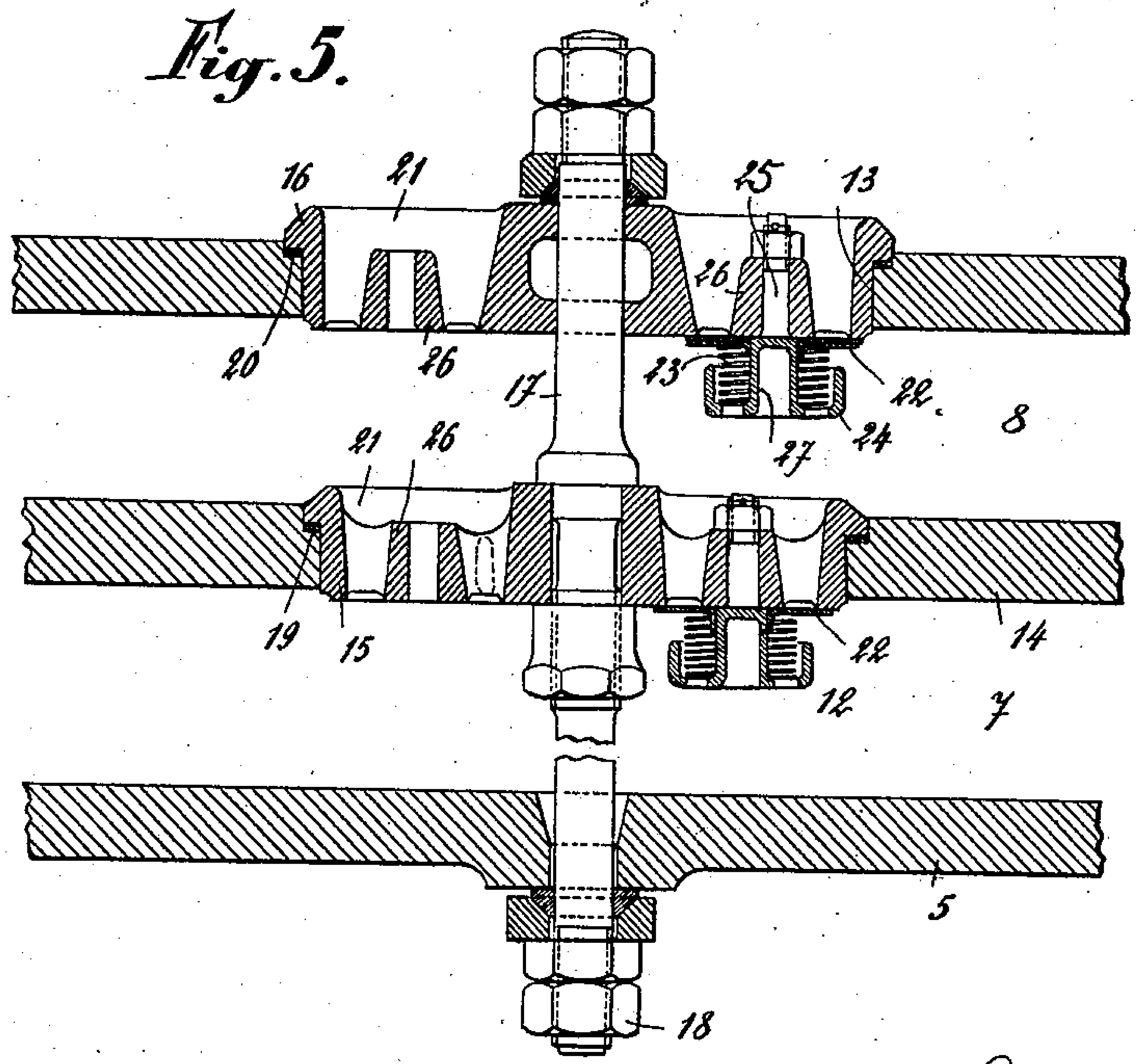


Fig. 5.



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(Application filed Mar. 12, 1901.)

(No Model.)

6 Sheets—Sheet 6.

Fig. 7.

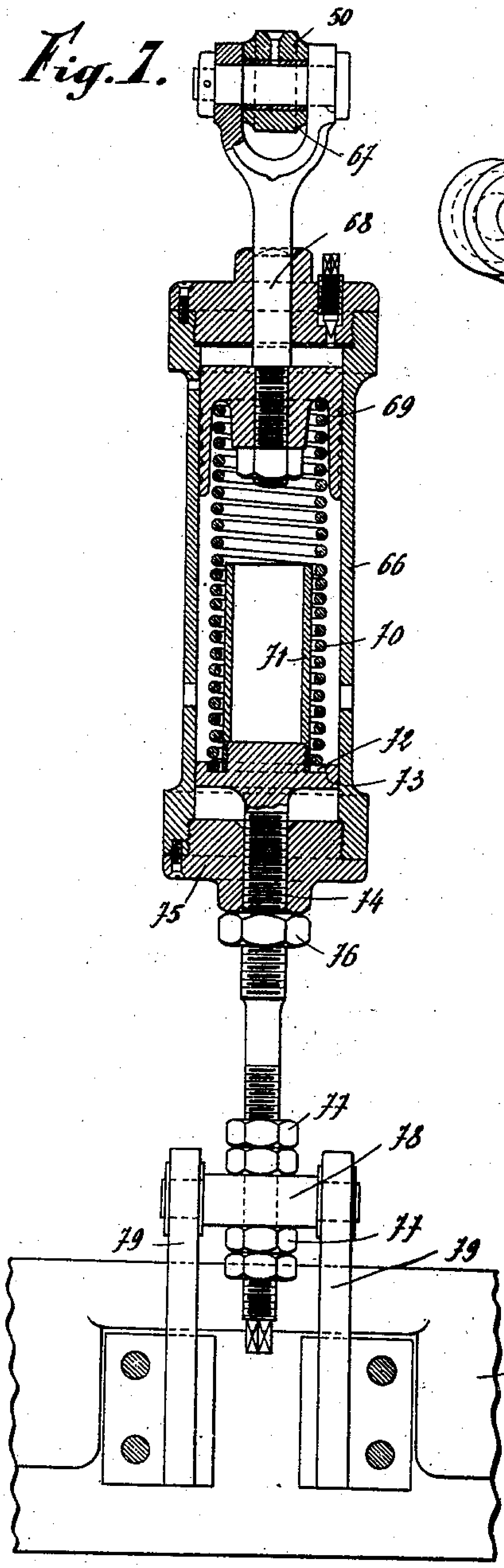
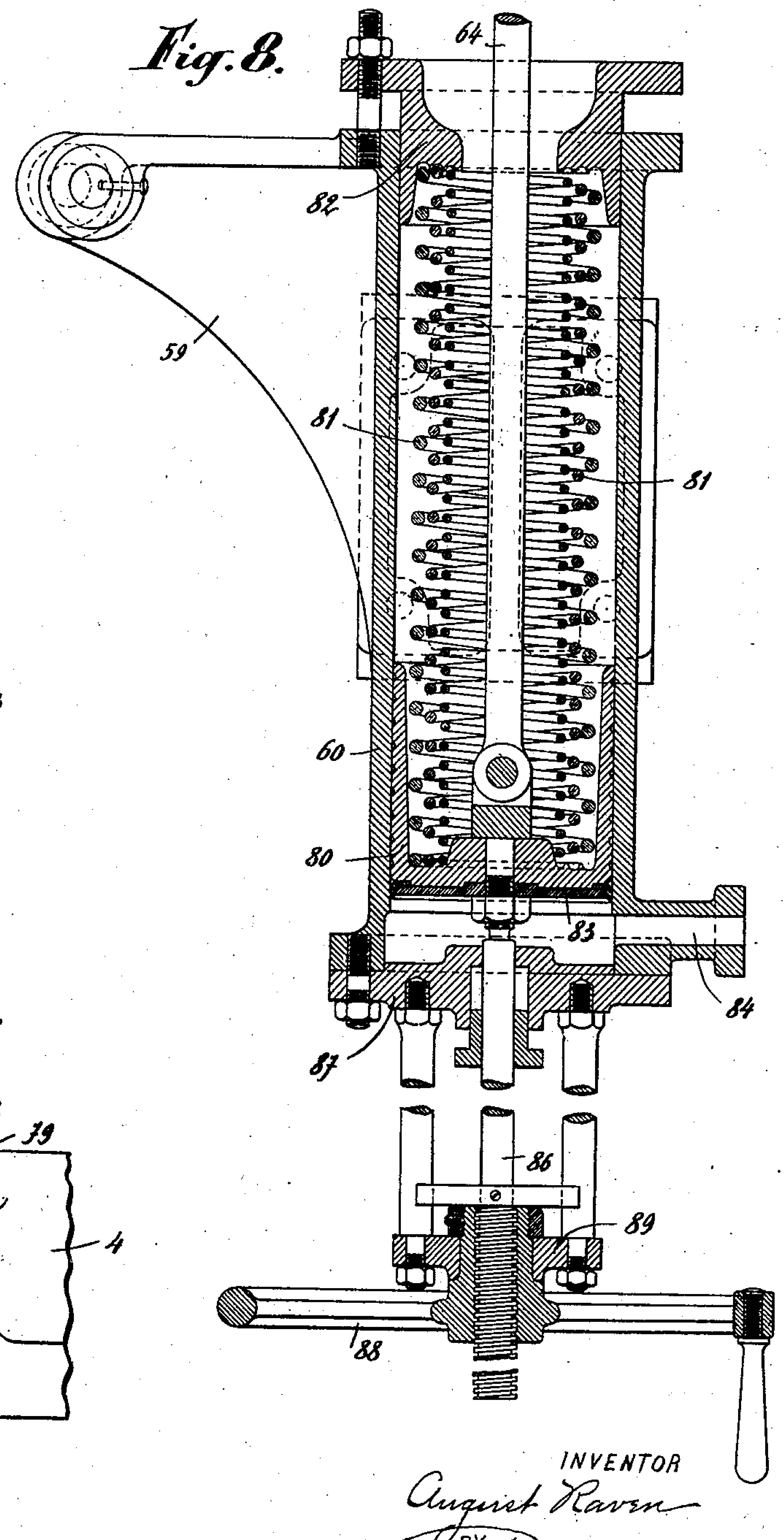


Fig. 8.



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UNITED STATES PATENT OFFICE.

AUGUST RAVEN, OF JEMEPPE, BELGIUM.

BLOWING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 709,929, dated September 30, 1902.

Application filed March 12, 1901. Serial No. 50,793. (No model.)

To all whom it may concern:

Be it known that I, AUGUST RAVEN, engineer, a subject of the Emperor of Germany, residing at Jemeppe, sur Meuse, Belgium, have invented new and useful Improvements in Blowing-Engines, of which the following is a specification.

This invention relates to an improvement in blowing-engines; and it consists in certain means by the use of which the volume of air compressed by the engine-piston at each stroke can be reduced proportionately to the increase of pressure (when such an increase of pressure is required) in order not to exceed the ordinary working limit of the engine-actuating motor.

Referring to the annexed drawings, Figure 1 is a side elevation of a blowing-cylinder constructed according to my invention. Fig. 2 is a top view of the said cylinder. Fig. 3 is a section along line A B, Fig. 2. Fig. 4 is a section along C–D, Figs. 1, 2, and 3, seen from the left. Fig. 5 is a detailed sectional view of the inlet and outlet valves for the air in the blowing-cylinder. Fig. 6 is a detailed sectional view of supplementary inlet-valves constituting one of the essential features of my invention. Fig. 7 is a detailed sectional view of a balancing dash-pot combined with the mechanism acting on the supplementary valves. Fig. 8 is a detailed sectional view of an air-governor.

In the drawings, 1 indicates the outer casing of a blowing-cylinder 2, Fig. 3, the said outer casing being in communication with an air-inlet pipe 3, Fig. 3.

4 indicates the bed-plate of the blowing-cylinder, upon which the said blowing-cylinder is supported through ring-shaped or annular chambers 5, in the central hollow portion of which are fitted the ends or covers 6 of the blowing-cylinder. Each chamber 5 is divided into two compartments 7 8, one of which (compartment 8) communicates, through a lateral annular opening 9, with the interior of the blowing-cylinder, as clearly shown on the drawings, Fig. 3. The second compartment 7 is fitted at its upper part with a tubular connection 10, to which is connected a pipe 11, leading to the outlet 121 for the compressed air.

12 indicates circular openings in the inner faces of compartments 8, and 13 similar openings in a wall 14, separating the two compartments 7 8 of the annular chambers 5. These openings 12 13 are adapted to receive the ordinary inlet and outlet valves, respectively, mounted in circular valve-boxes 15 16.

The construction of the valves is shown more clearly on Fig. 5.

17 is a screw-rod, by means of which the valve-boxes 15 16 are fixed, respectively, in the openings 12 13 of the inner face and in the separating-wall 14 of the chambers 5, the said screw-rod being held in position by nuts 18, screwed on rod 17 outside of the outer face of the chambers 5, while the valve-boxes 15 16 are pressed in the openings 12 13, in which they rest on flanges 19 and 20, respectively, Fig. 5.

Each valve-box 15 16 is provided with a number of circular air-passages 21, adapted to be closed by valve-plates 22, pressed on their seats by means of springs 23, resting in caps 24, provided with a central screw-rod 25, fixed in a central supporting-piece 26. The valve-plates 22 slide backward on the central projection 27 of the caps 24 under the action of the atmospheric air for the inlet-valves and under the action of the compressed air for the outlet-valves and are pressed normally on their seats by aid of the springs 23. Similar inlet and outlet valves are mounted all around the blowing-cylinder in the annular chambers 5, as shown clearly, Fig. 4. Independently of the said inlet and outlet ordinary valves the chambers 5 are provided at the lower part of their inner faces with a number of supplementary valves 28, arranged on a straight horizontal line. The construction of the supplementary valves is shown in detail Fig. 6.

29 represents circular openings at the lower part of the inner faces of chambers 5, in which are fixed valve-boxes 30, attached to the wall of chamber 5 by means of screws 31, Fig. 4. The said valve-boxes have a circular air-passage 32, adapted to be closed by valve-plates 33, mounted at the end of a rod 34, Fig. 6, guided in a central supporting-piece 35 of the valve-box. Rod 34 is fitted at its end opposite the valve-plates 33 with a cap 36, in which rests a spring 37, bearing at its other end in a groove 38 of the central piece 35.

39 is a guiding-cylinder fixed on rod 34 and sliding in a hollow cylindrical projection 40 of the central piece 35. Independently of this guiding-cylinder the rod 34 is further guided on the central piece 35 by aid of a second hollow cylindrical guide 41, fixed on the said rod 34 at its end near the cap 36. Adjacent to cap 36 is screwed on rod 34 a nut or button 42, adapted to be acted upon by an impact-piece 43 of a lever 44, forming part of a mechanism which will be hereinafter described.

45 indicates two shafts mounted in bearings 46, bolted on the bed-plate 4. These shafts extend horizontally across the blowing-cylinder and are rigidly connected with the levers 44, adapted to act upon the nuts or buttons at the ends of the valve-rods 34.

The shafts 45 extend at one end outside the outer casing 1 and are provided each with a crank 47, Fig. 1, pivotally connected to a lever 48, Figs. 1–4. Each lever 48 is articulated at 49 to one arm of a rocking lever 50, adapted to oscillate on a shaft 51, mounted in bearings 52 on the side of the casing of the blowing-cylinder.

53 is a second shaft, mounted in bearings 54, supported by brackets 55 and extending longitudinally in a direction parallel to the axis of the blowing-cylinder, the said shaft being rotated by the motor of the engine at a speed proportional or equal to the working speed of the blowing-engine.

56 is a sleeve adapted to rotate with shaft 53 and to be longitudinally displaced upon said shaft by aid of two oscillating rods 57, pivotally supported on an axle 58, mounted on an arm 59, projecting from the cylinder 60 of an air-governor hereinafter described.

61, Fig. 4, indicates adjustable tappets carried by the second arms of the rocking levers 50 and adapted to be engaged by cams 62 on the sleeve 56 when the said sleeve is sufficiently displaced longitudinally upon the shaft 53 through the action of the air-governor 60 causing the rod 57 to oscillate. These rods 57 are pivotally secured at 63 to the end of a piston-rod 64 of the air-governor and to a loose collar 65 at the extremity of sleeve 56, allowing this sleeve to rotate freely with shaft 53, although being able to be displaced longitudinally by this collar in a well-known manner.

66 indicates balancing dash-pots or cataracts acting on the arms of levers 50, to which are connected the levers 48, acting on the cranks 47 of shafts 45. The construction of these balancing dash-pots is shown in detail Fig. 7.

Pivotally secured to each lever 50 is a forked arm 67, the stem 68 of which carries a piston 69, subjected to the action of a spring 70, partially coiled on a guiding-tube 71 and resting at its lower end in a groove 72 of a head 73 at the extremity of a rod 74, passing through a plug 75, closing the cylinder 66 at its lower end, the said cylinder being secured on the said rod 74 by aid of a nut 76. The rod 74 is adjustably connected by means of nuts 77 to a rocking shaft 78, mounted in bearings 79, attached to the side of the bed-plate 4. Owing to this construction it will be seen that when levers 50 oscillate on the action of the cams 62 upon the tappets 61 taking place each spring 70 will be compressed accordingly without interfering with the oscillating movement of levers 50, the cylinders 66 oscillating according to the oscillation of lever 50 upon the rocking shafts 78. As soon as the tappets 61 are released from the action of the cams 62 the springs 70, acting on levers 50 through the pistons 69 and rods 68, will bring back the levers 50 to their original position.

As already stated, 60 indicates the cylinder of an air-governor. (Shown in detail Fig. 8) This air-governor comprises a piston 80, moving in cylinder 60 and connected, through piston-rod 64, to the upper end of the oscillating rod 57. This piston 80 is subjected to the action of a number of springs 81, bearing at one end against the piston 80 and at the other end against a collar 82, bolted in the open end of the cylinder 60. The piston 80 fits tightly in the cylinder 60 and is subjected on its face 83 to the pressure of the compressed air admitted into the cylinder 60 of the air-governor through a pipe 84, connected at 85 to the outlet-pipe 121 of the blowing-cylinder. The piston 80 of the air-governor may also when required be moved manually by aid of a screw-rod 86, passing through the head 87 of cylinder 60 and provided with a hand-wheel 88, rotating freely in a cross-piece 89 and acting as a fixed nut to cause the longitudinal displacement of the rod 86 and of the piston 80, against which the said rod 86 may be pressed.

90 indicates the working piston of the engine, being reciprocated in the cylinder 2 by means of a suitable motor transmitting motion to the piston 90 by means of the piston-rod 91.

The operation of the engine is as follows: The piston 90, being reciprocated in the cylinder 2, moves, for instance, in the direction of the arrow 92, Fig. 3. The suction of the piston causes the inlet-valves of the valve-boxes 15 (which will be mentioned hereinafter as "inlet-valves" 15 for sake of simplicity) to be unseated and air to be drawn into the cylinder 2, the said air entering the casing 1 through pipe 3 and passing through the air-passages of the inlet-valves 15 into compartment 8 of the chamber 5 at right hand of the cylinder and through the annular passage 9 into the cylinder, as indicated on the drawings by arrows 93. Simultaneously with the inlet-valves 15 the supplementary valves 28 are also automatically unseated in the same manner as the valves 15, the buttons 42 leaving momentarily the impact-pieces 43 at the end of the levers 44. Air is consequently drawn into the cylinder through all the valves, covering the air-passages in the inner

face of the right-hand chamber 5 in the casing 1. The piston having completed an entire suction-stroke (the cylinder 2 being consequently full of air at the atmospheric pressure) starts on the return or compression stroke. (Indicated by the arrow 94, Fig. 3.) At this moment the inlet-valves 15 and the supplementary valves 28 are pressed upon their seats by the pressure of air. The outlet-valves, (arranged in the valve-boxes 16,) on the contrary, are unseated by the said pressure, and the compressed air is allowed to escape from the blowing-cylinder into chamber 7, as shown by the dotted arrows 95, Fig. 3, passing from chamber 7 into the outlet-pipe 121. During this compression-stroke of the piston air is drawn in on the other or left-hand face of the piston in the same manner as above indicated for the front or right face of the piston. The suction and compression strokes are repeated alternately in the same manner so long as the pressure does not exceed a given limit. During this normal operation of the engine the pressure of the compressed air acting through pipe 84 in the cylinder 60 of the air-governor is not sufficient to overcome the pressure of the springs 81. The piston 80 remains consequently unvariable in position, and the cams 62 of the sleeve 56, rotating with shaft 53, do not come in engagement with the tappets 61 on the rocking levers 50. Now as soon as an increased pressure (above the normal) is required it is evident that the normal working limit of the motor would be exceeded if the same volume of air had to be compressed at the said increased pressure; but at this moment the excess of pressure acting in the air-governor on the piston 80 overcomes the action of the springs 81 and causes a displacement of the piston 80 in the cylinder 60. As a consequence the rods 57 are oscillated, causing a displacement of the sleeve 56 along shaft 53, so that the cams 62 are brought in engagement with the tappets 61. The said tappets being raised by the said cams, the levers 50 are oscillated, pushing down the levers 48, which partially rotate the shaft 45 in such a manner that the impact-pieces 43 at the end of the levers 44 press upon the buttons 42 of valve-rods 34, causing the supplementary valves 28 to be unseated at the beginning of the compression-stroke. At this moment consequently the air compressed in the cylinder is allowed to escape through the air-passages of the supplementary valves 28, which are positively actuated. The shape of the cams 62 being conveniently calculated and the said cams rotating with the shaft 53 at a speed proportional or equal to the working speed of the engine, the said cams will release the tappets 61 after a portion of the compression-stroke proportional to the pressure required, the value of which is given by the displacement of the piston 80 in the cylinder 60 of the air-governor. The tappets 61 being released from the action of the cams 62, the rocking levers 50 are brought back in their original position by the balancing dash-pot 66, and the shaft 45 rocking partially backward causes the levers 44 to be disengaged from the rods 34 of the supplementary valves 28. These valves close consequently again, and the compression takes place during the remaining portion of the compression-stroke. The volume of air to be compressed being thus reduced, this reduced volume may be compressed at the increased pressure, according to the necessities of the moment. Without that the normal working limit of the motor may be exceeded. The same operation will take place at the beginning of each compression-stroke, the engine delivering at each stroke during a portion of the stroke a reduced volume of air, but at an increased pressure, until the normal conditions of working having been reëstablished the piston 80 of the air-governor will return to its original position, bringing thus the cams 62 in the position in which they cannot come in engagement with the tappets 61.

As shown on the drawings and as above stated, the piston 80 of the air-governor may also be displaced manually by aid of a hand-wheel 81, so as to bring the cams 62 in engagement with the tappets 61. This is especially useful in order to relieve the motor when starting. In this case the sleeve 56 is displaced sufficiently to be brought in its extreme position, in which the tappets 61 remain in contact with the cams 62 during a complete rotation of the said cams, corresponding to a full stroke of the piston 90, in such a manner that the supplementary valves are kept open during the full compression-stroke and that no delivery takes place.

What I claim is—

1. In a blowing-engine in combination with the cylinder and the piston, automatic inlet and outlet valves, supplementary automatic inlet-valves 28 at each end of the cylinder, levers 44 adapted to act upon the said supplementary valves, two shafts 45 carrying the said levers, a crank 47 at the end of each shaft, tappets 61 mounted on rocking levers 50 connected to said cranks, a shaft 53 rotating at a speed proportional or equal to the working speed of the engine, a sleeve 56 rotating with said shaft but adapted to be displaced longitudinally upon said shaft, cams 62 on said sleeve, adapted to engage the tappets 61, and an air-governor acting to regulate the value of the portion of the compression-stroke during which the cams 62 must be in engagement with the tappets substantially as described and for the purpose set forth.

2. In a blowing-engine in combination with the cylinder and the piston, automatic inlet and outlet valves, supplementary automatic inlet-valves 28 arranged on a straight line at each end of the cylinder, levers 44 adapted to act upon the said supplementary valves, two shafts 45 carrying the said levers, a crank 47 at the end of each shaft, tappets 61 mounted

on rocking levers 50 connected to said cranks 47, balancing dash-pots acting on the oscillating levers 50, a shaft 53 rotating at a speed proportional or equal to the working speed of the engine, a sleeve 56 rotating with said shaft but adapted to be displaced longitudinally upon said shaft 53, cams 62 on the sleeve 56, the said cams being adapted to engage the tappets 61, oscillating rods 57 connected at one end with the sleeve 56 and at the other end with the rod 64 of a piston 80 adjusting tightly in a cylinder 60, springs 81 acting upon said piston and a communication between the cylinder 60 and the outlet-pipe for the compressed air, substantially as described and for the purpose set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

AUGUST RAVEN.

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