No. 841,040. PATENTED JAN. 8, 1907.

M. A. NEELAND.

BLOWING ENGINE VALVE.

APPLICATION FILED MAR. 31, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

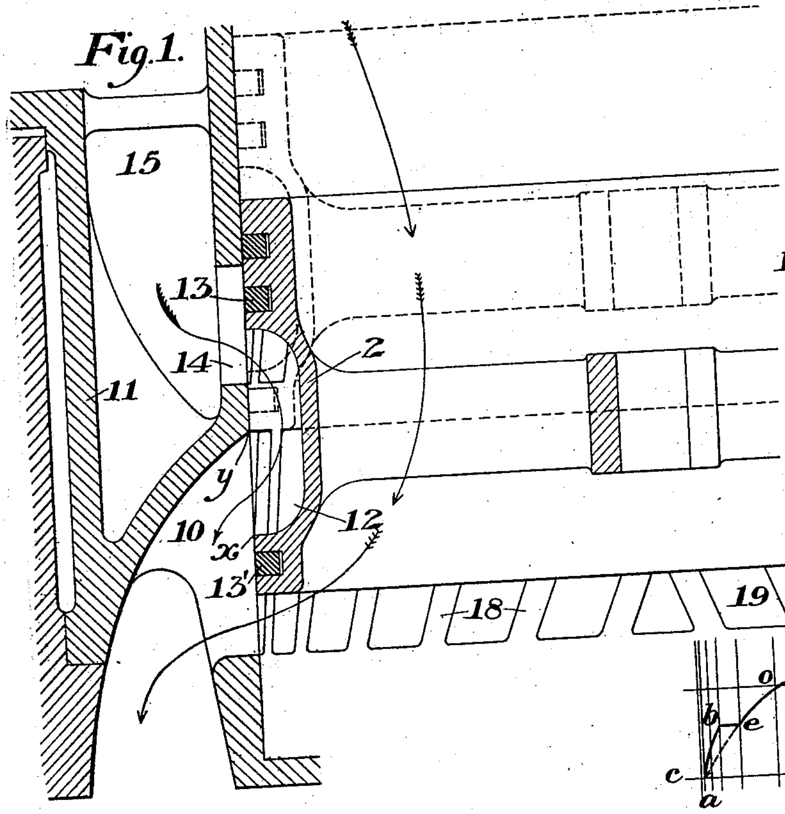


Fig. 3.

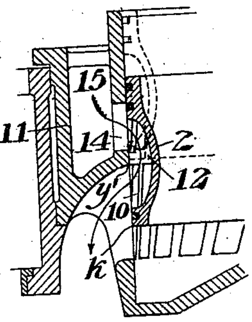


Fig. 4.

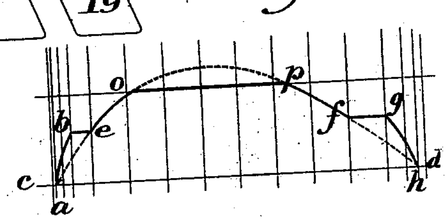
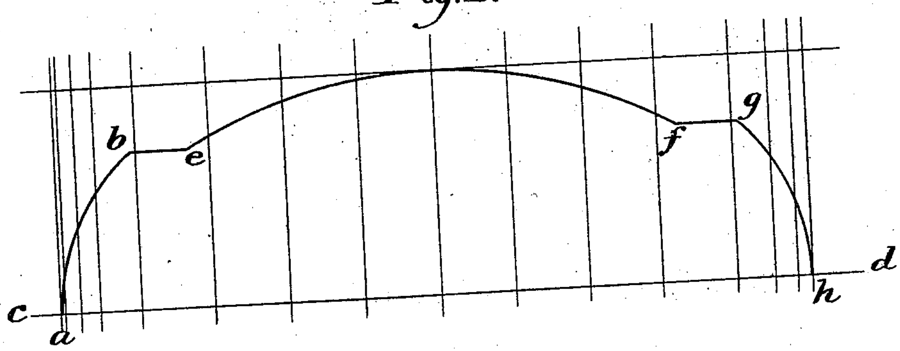


Fig. 2.



WITNESSES

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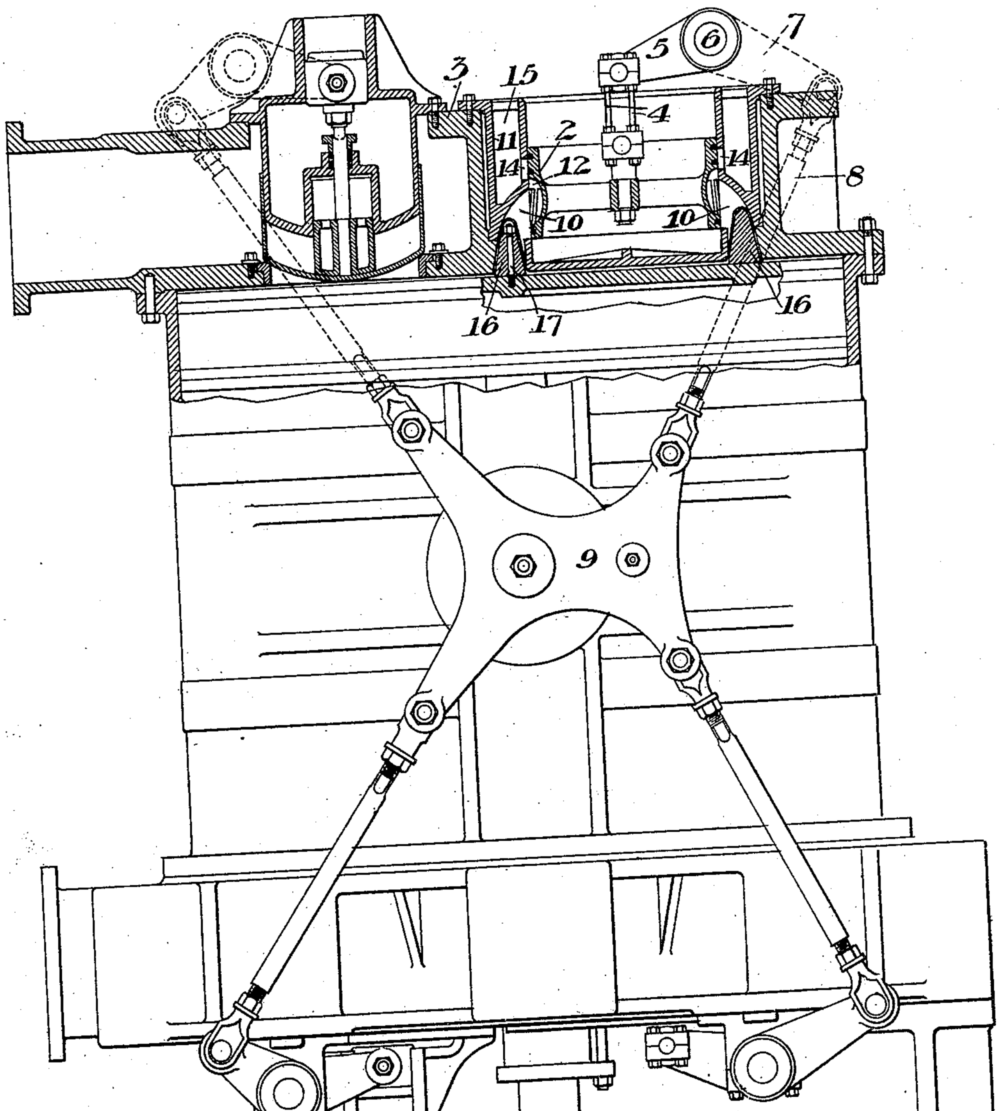
3 SHEETS—SHEET 2.

Fig. 5.



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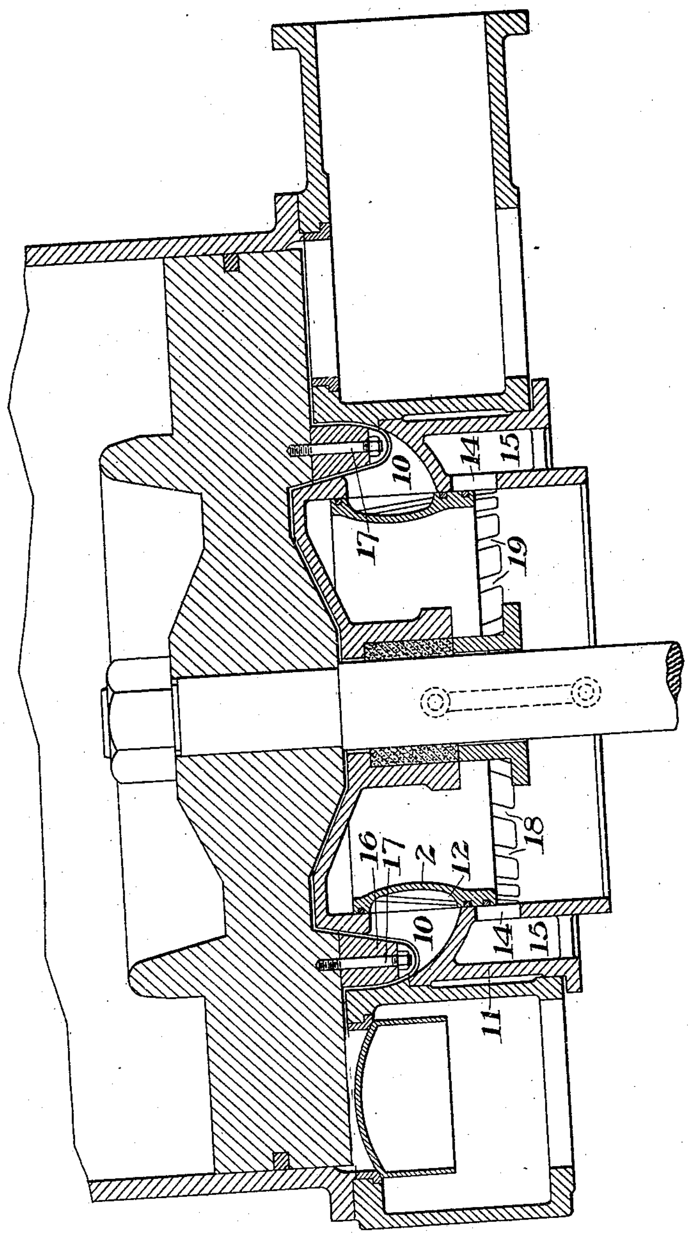
3 SHEETS—SHEET 3.

Fig. 6.



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UNITED STATES PATENT OFFICE.

MARVIN A. NEELAND, OF YOUNGSTOWN, OHIO.

BLOWING-ENGINE VALVE.

No. 841,040. Specification of Letters Patent. Patented Jan. 8, 1907.

Application filed March 31, 1904. Serial No. 201,014.

To all whom it may concern:

Be it known that I, MARVIN A. NEELAND, of Youngstown, Mahoning county, Ohio, have invented a new and useful Blowing-Engine Valve, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a partial vertical section showing the preferred form of an inlet-valve constructed in accordance with my invention. Fig. 2 is a diagram showing the port-openings obtained by the valve of Fig. 1. Fig. 3 is a view similar to Fig. 1, showing a modified arrangement. Fig. 4 is a view similar to Fig. 2, showing the port-openings obtained by the valve of Fig. 3. Fig. 5 is a side elevation, partly in section, showing the actuating connections and valve arrangement of the form of Fig. 1; and Fig. 6 is a partial vertical section showing the lower end of a blowing-cylinder with my improved valve arranged centrally in the head.

My invention relates to the valves for blowing-engines or air-compressors, and more particularly to the inlet air valve or valves, although the invention may be applied to the outlet valve or valves.

A demand is now arising for a higher piston speed in air-compressors and blowing-engines. This increase in piston speed requires more inlet area, especially near the end of the piston-stroke. The valves usually employed in such compressors and engines when used at high piston speeds produce a decrease in cylinder-pressure near the end of the piston-stroke to below atmospheric pressure, and thereby decrease the capacity of the engine, due to insufficient port-opening at the right time. In other words, with single-ported valves the area of the ports for a period near the end of the piston-stroke is less than it should be for good efficiency. This is especially true of valves operated by eccentric or cranks and single-ported valves which vary the port-opening through the mid-portion of the stroke.

My invention is designed to overcome the difficulty above referred to by providing a valve-and-port arrangement by means of which the inlet-port area is maintained constant for a time just previous to and also just succeeding the time of maximum port-opening, (which occurs at the mid-portion of the complete valve-stroke,) at which time such area would otherwise be changing. I preferably employ for the purpose a valve which has two inlet passages or ports so arranged that while the inlet area may or may not be varied during the mid-portion of the stroke for certain periods thereafter and toward the ends of the stroke the area of one of said passages or ports will increase in the same proportion that the area of the other passage or port is decreasing, the total effect in the inlet area meanwhile remaining constant.

Where the double-ported valve is used, the valve-ports will be in communication with the inlet-port and will preferably vary the inlet area through the mid-portion of the stroke, and for certain periods near the ends of the piston-stroke the area of one of the ports will decrease substantially in proportion to the increase in area of the other valve-port, thus making the inlet area approximately constant for these periods.

The invention also consists in the connections for actuating the valve, in a peculiar arrangement of the bridges over the ports, and in a device for lessening the clearance-spaces.

In the drawings, referring to the form of Figs. 1 and 5, I show an inlet-valve 2 movable within the head 3 of the blowing-cylinder and connected by link 4 with lever 5, secured to a rock-shaft 6, having a lever 7, with a link connection 8 leading to the wrist-plate 9 of the blowing-engine cylinder. This wrist-plate is operated from a moving part of the motive cylinder actuating the blowing-engine piston.

It will be noted that the valve is closed when the link or connecting-rod 8 is in line with the axis of the wrist-plate, thus giving a toggle-joint connection which decreases the travel of the valve when closed. This enables me to allow for a continuous motion of the wrist-plate while the valve remains closed through the desired interval of time. In this form the inlet-ports 10 are formed in a cage 11 of annular form, which is secured to the head of the blowing-engine cylinder. The valve 2 reciprocates within the hollow cage and is of ring form, with an annular port 12 extending around it between the rings 13 and 13′ on either side of this port. The annular port 12 communicates through ports 14 with an annular air-chamber 15, formed in the cage and communicating at its outer end with the open air.

In Fig. 1 I show the position of the inlet-valve just after the period near the end of the stroke, through which the inlet is maintained substantially constant, one port increasing in area as the other decreases, until the valve begins to close. As the valve begins to move upwardly in opening the air flows into the cylinder through ports 10 both above and below the ring 13′, as indicated by the arrows, the lower ring 13′ moving upwardly over the ports 10 while its upper ring moves over the ports 14. Through this first part of the upstroke the available port-opening will increase until the area of the ports 14, the area of the ports 10 above the ring 13′, and the area of the ports 10 below the ring 13′ are all equal. From this point in the stroke of the valve until the upper corner *x* of ring 13′ reaches the lower corner *y* of the ring separating the ports 10 and 14 the port-opening will be constant. This is due to the increasing of the area of the ports 10 below the ring 13′ an amount equal to the decreasing of the ports 10 above the ring 13′. After the corner *x* of the ring 13′ reaches the corner *y* of the cage-ring the inlet area will increase until the valve reaches the upper limit of its stroke. From this point the same cycle is presented in the reverse order on the return stroke of the valve. Fig. 2 illustrates this diagrammatically. The horizontal line *a h* represents the piston-stroke, while the curved line *a b e f g h* indicates the amount of port-opening for the different positions of the piston through its stroke. The line from *a* to *b* shows the port-opening up to the moment that the three ports are equal in area, the line *b e* indicates the constant port-opening through the time until the corner *x* of the valve reaches the corner *y* of the cage-ring, and the line *e f* indicates the varying opening from the time the corner *x* reaches the corner *y* on the upstroke until it again reaches it on the downstroke. The line *f g* indicates the period corresponding to *b e* on the return stroke and the line *g h* the corresponding period to that of *a b* on the upstroke.

The action of the valve may be summarized as follows: The valve makes a movement from one end of its cage to the other and returns during the suction-stroke of the piston—that is to say, it moves into full-open and back to closed position while the piston makes the suction-stroke. During the first part of its opening movement the port area leading to the cylinder is increasing, as shown by the portion *a b* of the curve of Fig. 2. During the mid-portion of this opening stroke, however, the area remains constant for an interval corresponding to the part *b e* of the diagram curve. During the remainder of the opening movement of the valve the port area again constantly increases until the valve reaches its full-open position. On the return movement of the valve the port area decreases until the corner *x* of the valve passes the corner *y*. The port area now again remains constant during a portion of this return stroke, as indicated by the part *f g* of the diagram curve. During the remainder of the return stroke the port area is decreasing, as shown by the part *g h* of the diagram curve.

From the foregoing it will be seen that the periods of constant port area are respectively near the beginning and toward the end of each complete movement of the valve.

In the form of Fig. 3 the valve is the same as that of Fig. 1, except that it is shortened so that the lower corner *k* of the valve will lift beyond the lower corner *y′* of the port through the mid-portion of the stroke. This valve will give the same effect as the valve of Fig. 1 in maintaining the port substantially constant before and after the maximum port-opening; but in this case the port-opening will not vary through the mid-portion of the stroke, but will be constant between the points marked *o* and *p* on the diagram of Fig. 4.

In order to reduce the clearance-space in the inlet-port, I preferably use a removable bonnet 16, (shown in Figs. 5 and 6,) which is formed separately from the piston and is secured to it by bolts 17. This bonnet being made separately enables the piston and bonnet to be easily and cheaply made, and the bonnet when in position enters the annular inlet-port, and thus reduces the amount of clearance.

Instead of using a plurality of inlet-valves, as shown in Fig. 5, I may employ a single central inlet-valve of larger area, as shown in Fig. 6. In this case the outlet-valves, which are preferably four in number, are disposed around the inlet-valve. The construction of the inlet-valve in this case will be same as that in Figs. 1 and 5, and the operation will be the same. This will be readily understood when it is considered that the pressure within the cylinder is tending to blow out the bridges, and if these bridges were inclined all in the same direction they would form a simple beam subject to a bending movement. By inclining one half of them in one direction and the other half in the opposite direction the structure is converted from a beam into a strut, which is able to resist the pressure to which it is subjected.

In forming the bridges across the inlet-port I preferably arrange them in inclined form, those on one side being inclined in an opposite direction to those on the other. Thus in Fig. 1 the bridges 18 in one half of the circumference incline toward the right, while the bridges 19 of the other half incline toward the left. This gives a strong and efficient construction, while preventing improper wear of the valve packing-rings.

By placing the valve within the cage the pressure in the cylinder acts to compress the bridges, and hence they are better able to resist this pressure than if they were in tension.

The advantages of my invention result from preventing the inlet area being decreased toward the end of the stroke in such a way as to reduce the pressure in the blowing-engine cylinder below the desired inlet pressure. With the ordinary valve the inlet area near the end of the stroke will be too small and will cause the pressure to decrease in such a way as to reduce the capacity of the blowing-engine. By increasing the inlet area through a part of the latter portion of the stroke or retaining the area constant through such portion I prevent the pressure from dropping below atmospheric pressure during this portion of the stroke. In this way when the inlet valve or valves are closed the cylinder will be filled with air at atmospheric pressure. The line of an indicator-card on the return stroke will therefore start from the atmospheric line, whereas with former constructions at high speed this line will start below the atmospheric line, and consequently reduce the capacity of the blowing-engine cylinder.

This double-ported inlet-valve affords a simple and efficient mean for accomplishing this result, and I prefer to employ it, though other mechanism may be employed for obtaining this desirable result.

Many variations may be made in the form and arrangement of the blowing-engine, the valves, and valve connections without departing from my invention.

I claim—

1. A blowing-engine having air-inlet ports and a valve controlling said ports, said valve and ports being arranged to maintain a substantially constant inlet-port opening through a period after the maximum port-opening and during the closing movement of the valve and while it is so moving; substantially as described.

2. A blowing-engine having air-inlet ports, a valve controlling said ports, the valve and ports being arranged to vary the port area during the middle portion of the piston suction-stroke, and then to maintain said area approximately constant through a period near the end of the said stroke; substantially as described.

3. A blowing-engine having an air-inlet port, and an air-inlet valve arranged to provide two ports or passages to the said port, one of said ports or passages, during a portion of the valve-stroke, being arranged to increase in area while the other port or passage decreases in like proportion; substantially as described.

4. A blowing-engine having cylinder air-inlet ports, an inlet-valve having two ports through which air flows to the cylinder-ports, these two ports being arranged to maintain a substantially constant inlet area during a portion of the closing stroke of the valve at a period following the maximum port-opening; substantially as described.

5. A blowing-engine having a reciprocating valve of ring form with an air-port leading therethrough, and having also an annular port around its periphery; substantially as described.

6. A compressor having an inlet-valve and ports arranged to maintain a substantially constant inlet-port area during a portion of the valve-stroke between the mid and end positions of the valve and while the valve is constantly moving; substantially as described.

7. A compressor, having a double-ported inlet-valve arranged to maintain a substantially constant inlet-port area during a portion of the valve-stroke between its mid and end positions, in combination with actuating connections for said valve arranged to slow the travel of the valve during its port-closing position relatively to its travel at other positions, and thus decrease the length of its movement during its port-closing position; substantially as described.

8. A blowing-engine having a valve-cage with an annular port provided with inclined bridges, the bridges at one portion of the cage being inclined in opposite directions to those at the other portion of the cage; substantially as described.

9. In a fluid-compressor, a valve-cage having an annular chamber in its wall, said chamber communicating with the interior of the cage, said cage having ports communicating with the compressor-cylinder, and a reciprocating inlet-valve of ring form seated in said cage and arranged to control the communication between the said annular chamber and the cylinder-ports, said valve also having a port leading through its body and arranged to admit air to the cylinder-ports below the lower edge of the valve; substantially as described.

10. In a blowing-engine, a ring-valve with an annular recessed port and two or more packing-rings, a cylindrical cage for the valve with one set of ports leading to the cylinder and another set leading to the atmosphere, and a ring between said sets of ports, one or more of the packing-rings of the valve being in contact with the ring between the sets of ports when the valve is closed; substantially as described.

11. In a blowing-engine, a ring-valve with an annular recessed port and two or more packing-rings, a cylindrical cage for the valve with one set of ports leading to the cylinder, and another set leading to the atmosphere, and a ring between said sets of ports, and actuating connections between the valve and a movable part of the engine, said connections containing a toggle-joint substantially in a straight line when one of the packing-rings of

the valve is in contact with the ring between the sets of ports in the closed position; substantially as described.

12. In a fluid-compressor, the combination with a compressor-cylinder, of a valve-casing, a chamber therein open to the atmosphere at one end and closed at the other end, said chamber having ports through its inner wall, and a valve arranged to control the communication of said ports with the compressor-cylinder, and also to simultaneously admit air to the cylinder below its lower edge; substantially as described.

13. In a fluid-compressor, an inlet-valve, having two sets of inlet-ports arranged to admit air to the cylinder, said ports, during a portion of the valve-stroke, being arranged to combinedly maintain a substantially constant inlet area; substantially as described.

In testimony whereof I have hereunto set my hand.

MARVIN A. NEELAND.

Witnesses:
JOHN MILLER,
H. M. CORWIN.