G. B. PETSCHE.

BLOWING ENGINE.

APPLICATION FILED OCT. 17, 1907.

899,558.

Patented Sept. 29, 1908.

3 SHEETS—SHEET 1.

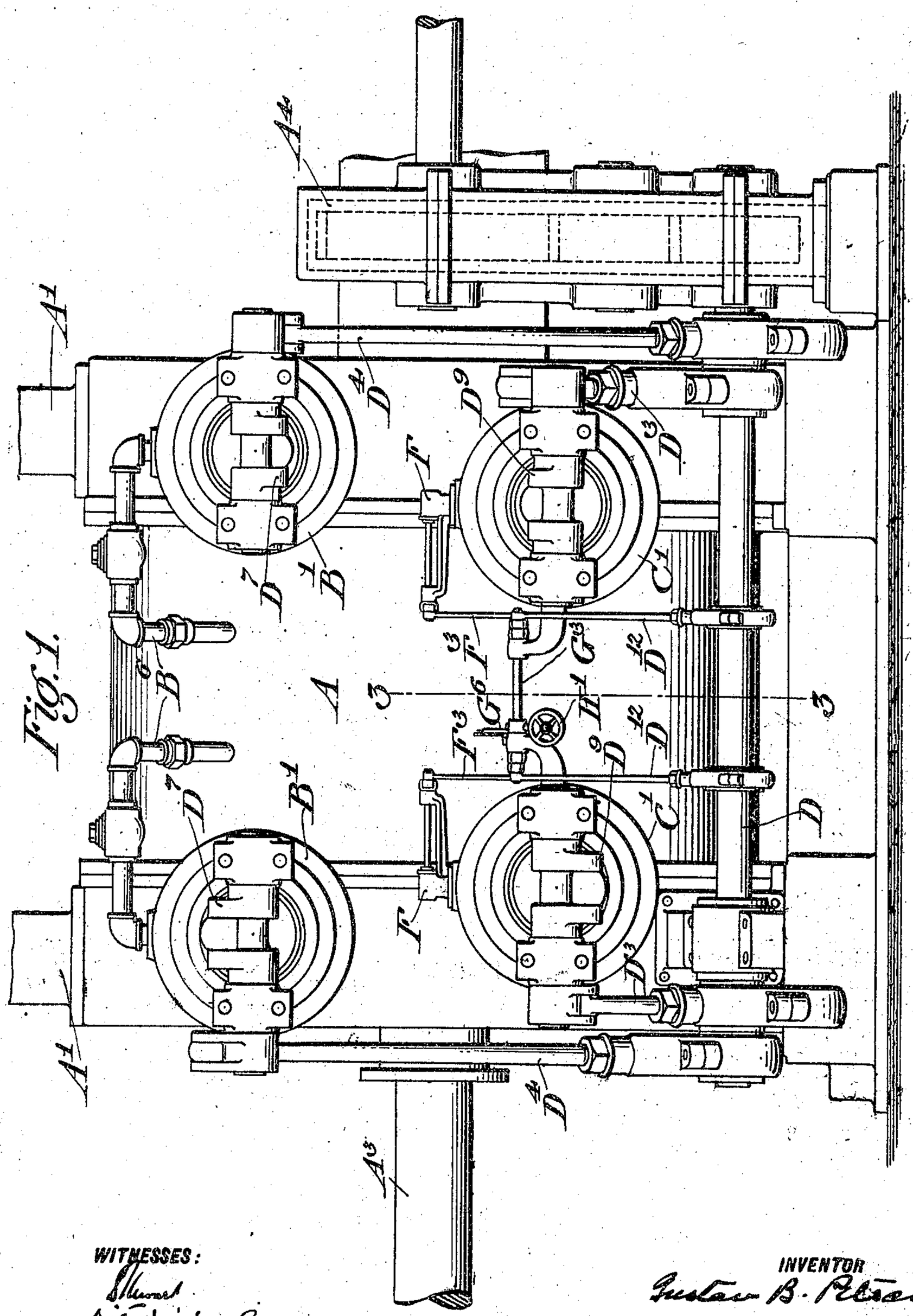

Fig. 1.

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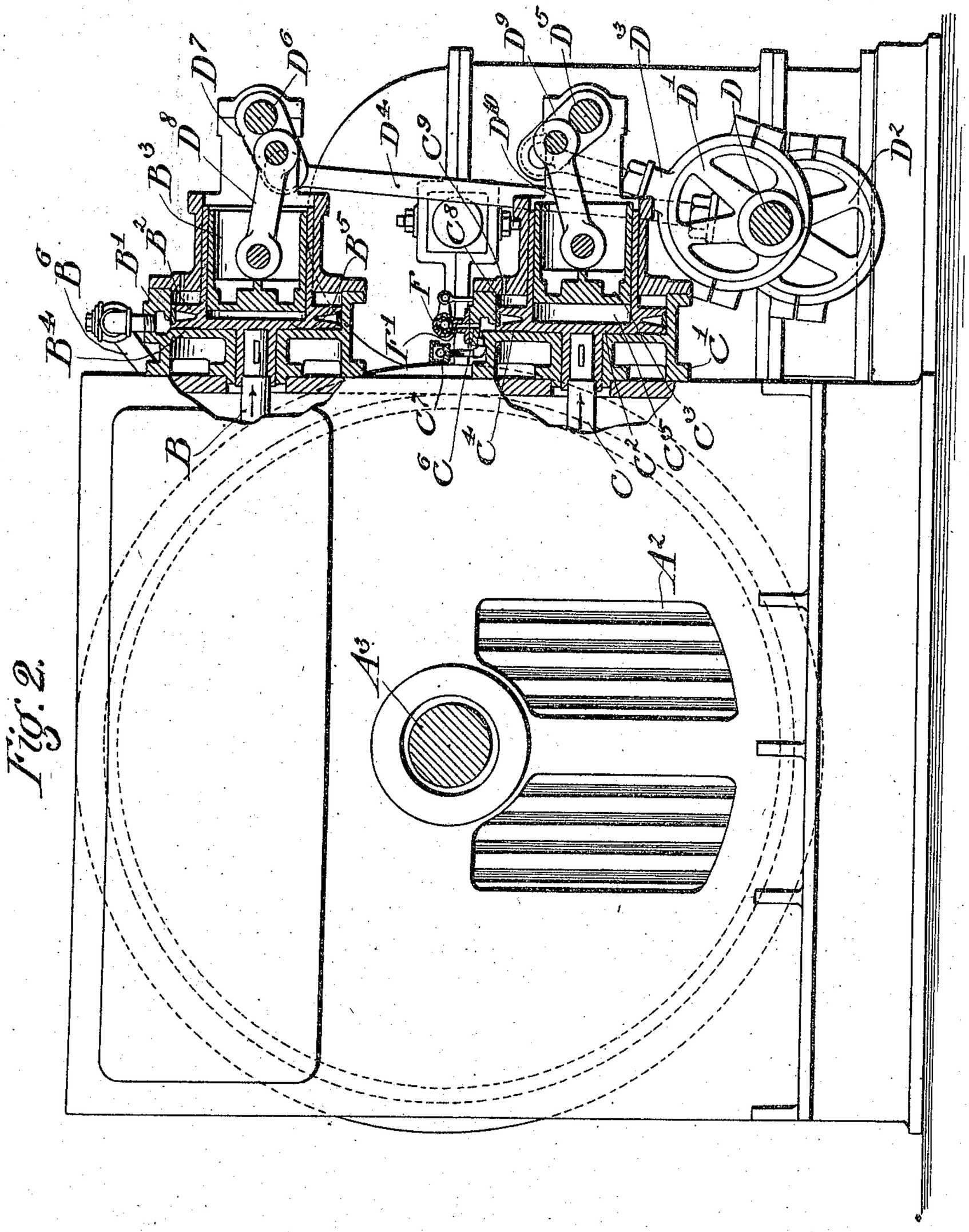

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

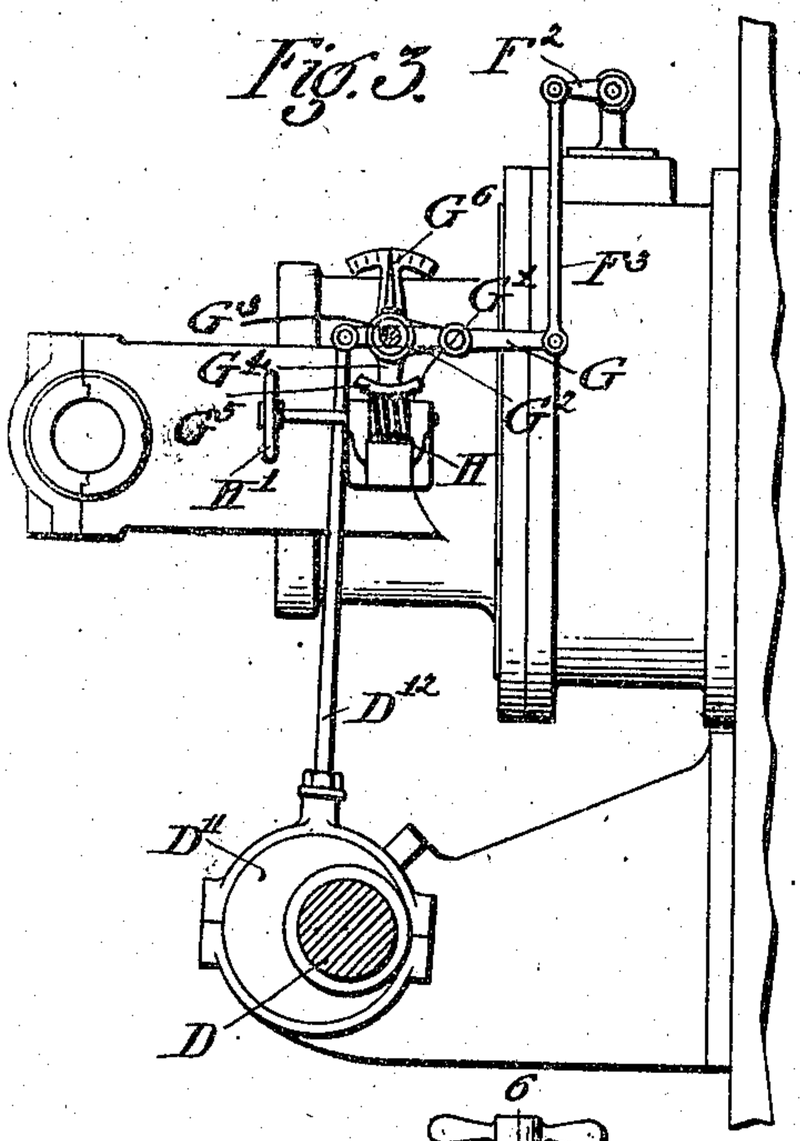


Fig. 4.

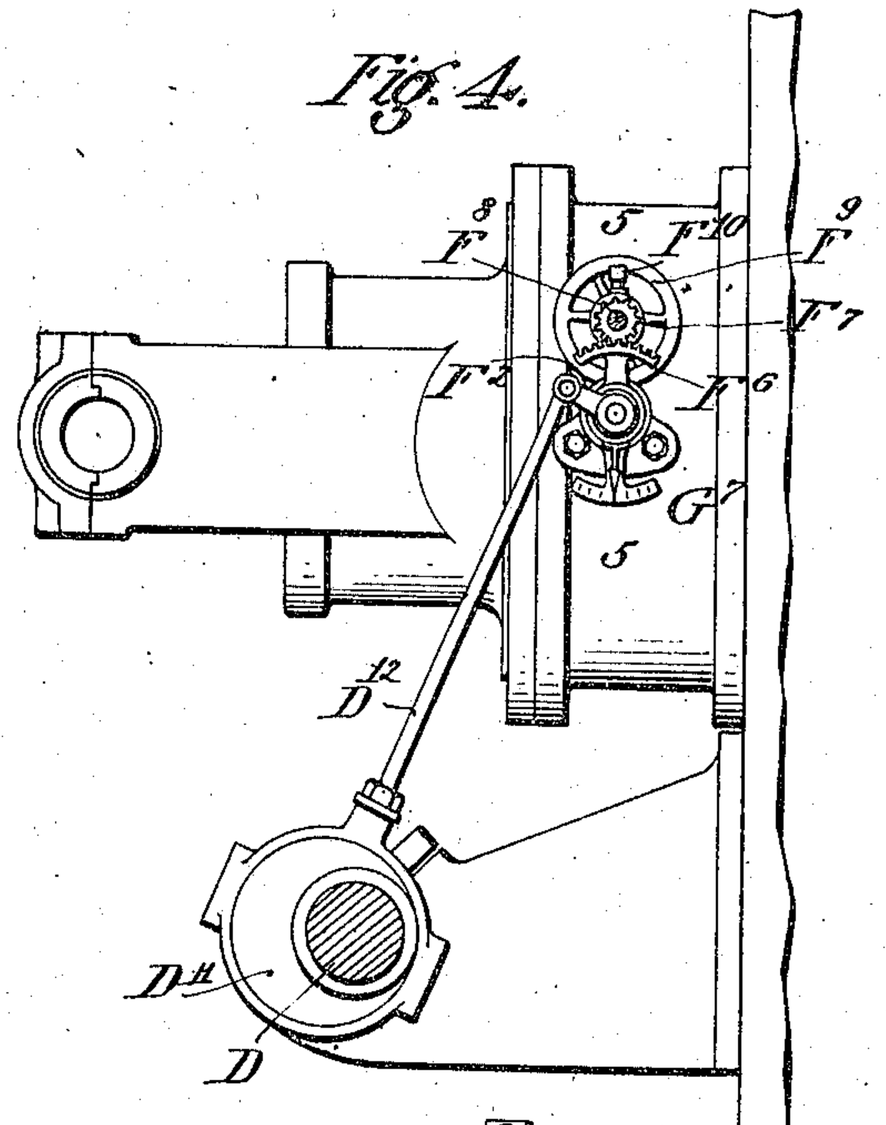


Fig. 5.

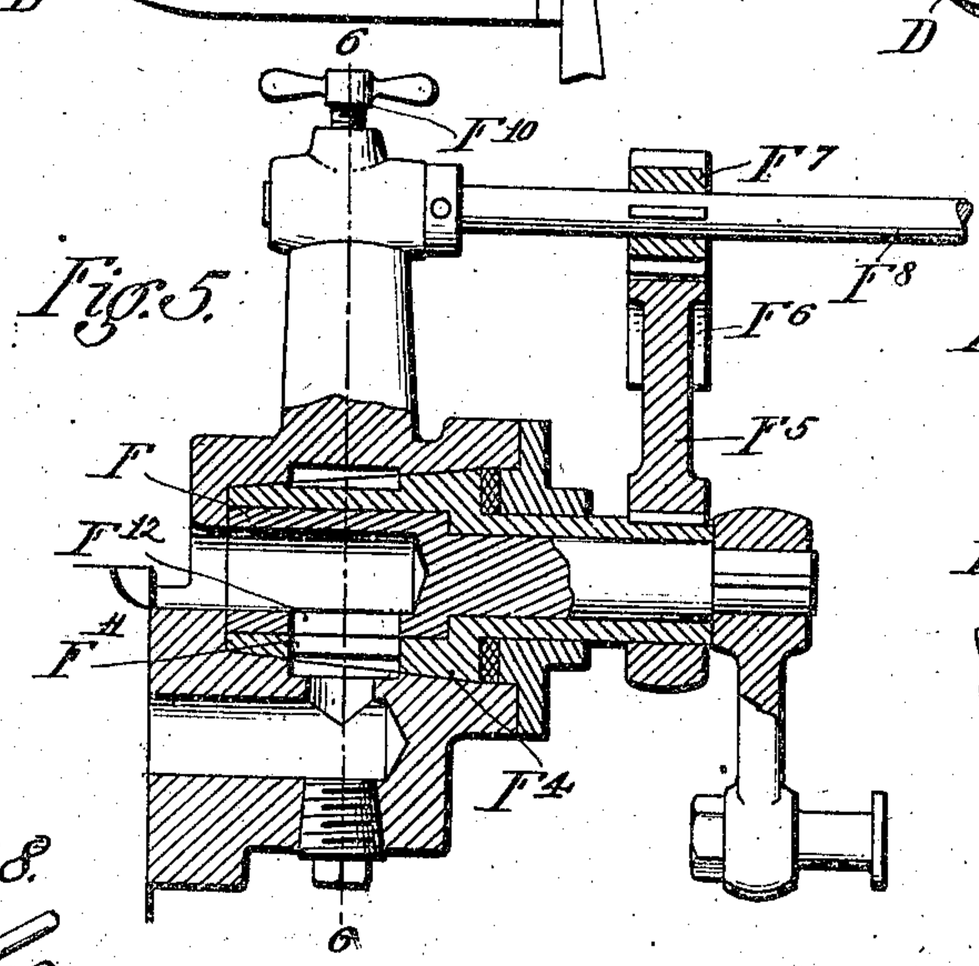


Fig. 6.

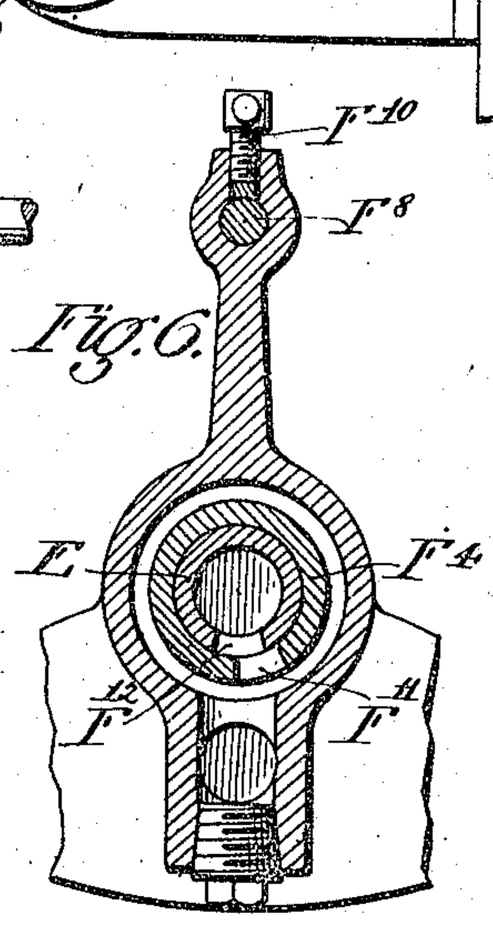


Fig. 8.

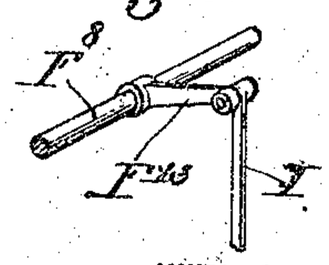
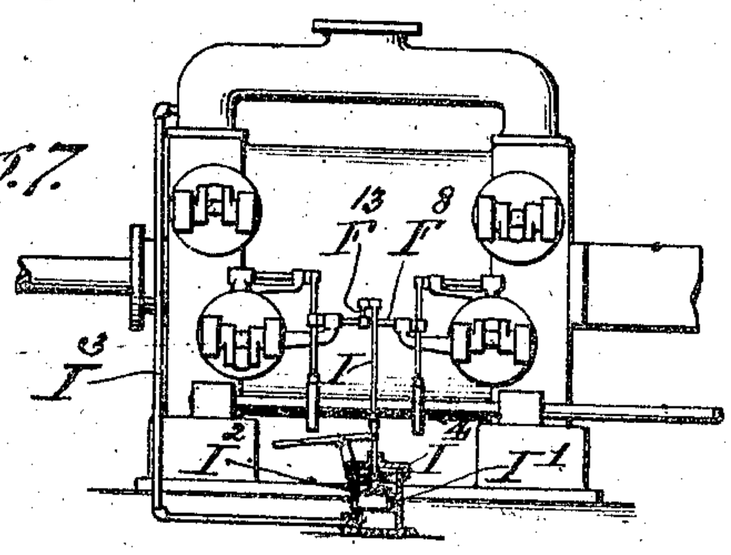


Fig. 7.



WITNESSES:

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UNITED STATES PATENT OFFICE

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BLOWING-ENGINE.

No. 899,558. Specification of Letters Patent. Patented Sept. 29, 1908.

Application filed October 17, 1907. Serial No. 397,818.

To all whom it may concern:

Be it known that I, GUSTAV B. PETSCHE, a subject of the Emperor of Germany, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Improvement in Blowing-Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

The present invention relates to blowing engines or air compressors, and particularly to the means for actuating the inlet or suction valves of such engines.

The primary object of the invention is to provide a connection between each inlet valve and the valve gear proper so that the inlet valve will if closed be moved positively into the open position at the proper period in the stroke of the reciprocating piston, while at the same time providing a suitable yielding connection, such as is formed by a piston and vacuum cylinder, between the valve and the valve gear which tends to close the inlet valve during the compressing stroke of the compressing piston, and also providing means controlled manually or automatically or in both ways for releasably holding the inlet valve in the open position. With these provisions the inlet valve may be released from its holding means and moved into the closed position at a definite period in the stroke of the compressing piston for normal operation, or may be delayed in closing where it is desired to compress less than the normal amount of air, or may be held open throughout the compressing stroke to reduce the load on the engine when for any reason no compression is required, as because the receiver pressure is high enough or to facilitate the starting of the engine, the latter being of particular importance when the driving engine is a gas engine or the like which does not start with readiness under load.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of this invention, however, and the advantages possessed by it, reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described forms in which the invention may be embodied.

Of the drawings, Figure 1 is an elevation of a blowing engine equipped with one form of my invention. Fig. 2 is an elevation taken at right angles to Fig. 1, with a portion of the mechanism shown in section. Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 1, but on a larger scale than Figs. 1 and 2, and showing a portion only of the mechanism. Fig. 4 is a view similar to Fig. 3, showing a modified construction. Fig. 5 is a partial sectional elevation taken on the line 5—5 of Fig. 4, but on a larger scale. Fig. 6 is a sectional elevation taken on the line 6—6 of Fig. 5. Fig. 7 is a somewhat diagrammatic representation of the engine taken generally similar to Fig. 1, and showing a further modification of the invention, and Fig. 8 is a perspective view showing in detail the construction of Fig. 7.

In the drawings, and referring at first particularly to Figs. 1, 2, and 3, the blowing engine shown is of a well known type, such as is shown and described in my Patent No. 784,122, granted March 7, 1905. A represents the double action compressing cylinder having receiver connections A′ at each end, and having also air inlet ports A^2 at each end. At each end of the cylinder are located an inlet valve and a delivery valve, but as the particular construction of these valves is well known and forms no part of the present invention, it is not thought necessary to illustrate them or describe them herein further than to say that they may be of the gridiron type as shown in my said prior patent, and that each delivery valve has a stem B, and each inlet valve a stem C, which extend into the corresponding casing B′ and C′.

The valve gear for operating both the inlet and outlet valves of the compressor comprise, in the form shown, a shaft D, which is rotated through gearing located in a housing A^4 in definite relation to the to and fro strokes of the piston rod A^3 secured to the compressing piston in cylinder A. The shaft D carries eccentrics D′ pertaining to the admission valve, and eccentrics D^2 pertaining to the outlet valves. The eccentrics D′ and D^2 oscillate rock shafts D^5 and D^6 through suitable connecting rods D^3 and D^4 and arms from the latter.

The means by which each delivery valve is operated from the rock shaft D^6 comprises a piston B^3 connected to crank arms D^7 of the

rock shaft D^6 by a rod D^8. The piston B^3 slides in a chamber B^5 formed to receive it in a piston head B^2 secured to the end of the valve stem or valve operating rod B, and sliding in a chamber B^4 formed in the casing B'. The delivery valve opens when the stem B moves outward in the direction of the arrow shown in Fig. 2. The valve is opened when the receiver pressure reaches the proper point by air admitted to the inner side of the piston B^4 from the compressing cylinder through the connection B^6 running from the compressing cylinder to the piston chamber B^4. The piston B^3 is at this time moved out of the position shown in Fig. 2 by the oscillation of the shaft B^6 so as not to interfere with the opening of the valve. The piston B^3 serves to close the valve at the proper point, and also as a means for trapping air in the chamber B^5 in which it plays to thereby cushion the opening movement of the delivery valve. Suitable means may be employed for regulating this cushioning action, as by regulating the leakage between the piston B^3 and the wall of the chamber B^5. No claims on the delivery valve operating mechanism are made herein as this mechanism is described and claimed in my prior application Serial No. 2,309, filed January 22, 1900.

Each rock shaft D^5 has secured to it crank arms D^9 connected by a rod D^{10} to a piston C^3 which works in the piston chamber C^5 formed in the piston C^2 secured to the outer end of the corresponding inlet valve stem or operating rod C. The piston C^2 works in the vacuum piston chamber C^4 formed in the casing C'. Admission of air from the atmosphere to the inner end of the piston chamber C^4 is controlled by a rotary valve F, which may be moved to open or close to the atmosphere the outer end of the port F' which communicates with the casing port C^6 running to the inner end of the chamber C^4. The escape of air from the chamber C^4 when the piston C^2 moves toward its inner end is permitted by the non-return or check valve C^7. The valve closing movement of the piston C^2 is cushioned by air trapped in the chamber C^8 at the front end of the piston, which may be regulated by the size of the restricted opening C^9. The outward movement is also checked to some extent by the slight leakage in the chamber C^5 which occurs in practice.

The valves F may be alternately opened and closed in regular succession by suitable connections from the shaft D. These connections, shown best in Fig. 3, include an eccentric D^{11}, a connecting rod D^{12}, a lever G, to the outer end of which the rod D^{12} is pivotally connected, a link F^3 connecting the inner end of the lever G and the outer end of an arm F^2 secured to the rotary valve F, and a movable fulcrum pin G' for the lever G. In the form shown, the fulcrum pins G' for the two levers G at opposite ends of the engines are carried by arms G^2 projecting from a rock shaft G^3, which has secured to it another arm G^4 carrying at its outer end a gear segment G^5. The gear segment G^5 meshes with a worm wheel H which can be rotated through a hand wheel H'. An indicator finger G^6 and cooperating dial show the position of the fulcrum pin.

It will be understood that each eccentric D' is so set and the connections between it and the corresponding rock shaft D^5 and between the latter and the piston C^3 connected to it are so arranged to cause the piston C^3 to move in and begin to open the admission valve connected with it, if the latter is closed, as soon as the corresponding suction stroke begins. The positive opening of the valve is preferably completed comparatively early in the suction stroke. After the inward movement of each piston C^3 is completed, the latter moves outward and is maintained at a distance away from the inner limit of its stroke equal to or exceeding the outward movement of the piston C^2, throughout the following compression stroke, so that at any point in this stroke the corresponding admission valve may, if released, open to its full extent under the action of the vacuum maintained in the chamber C^5. The movement of the piston C^3 is for convenience made greater than the movement of the piston C^2.

Until air is admitted to the inner end of a chamber C^4 this chamber and its piston C^2 unite to form a lock holding the corresponding admission valve in the open position. Whenever air is admitted to the front end of a chamber C^4 by its valve F, the pressure of the air against the large front end of the piston C^2 closes the attached admission valve, since the pressure of the atmosphere has been taken off of a large portion of the outer end of the piston C^2 by the piston C^3.

In normal operation each valve F is opened through its operating connection from the shaft D at the beginning of the corresponding compression stroke. When it is desired for any reason to delay the point at which a valve F opens in order to delay the closing of the corresponding admission valve and thereby reduce the amount of air compressed at that stroke of the compressing piston, the corresponding hand wheel H' is rotated to properly adjust the fulcrum pin G' and thereby change the throw of the lever G. By displacing the fulcrum pin G' far enough the corresponding admission valve can be prevented from closing at all, thus preventing any compression from taking place in the corresponding end of the compressing cylinder.

Instead of the arrangement for varying the operation of the valve F shown in Figs. 1, 2, and 3, the arrangement shown in Figs. 4, 5, and 6 may be employed. In this modi-

fied form of the invention the connecting rod D^{12} is connected directly to the valve arm F^2. In this form, however, the valve seat F^4 for the valve F is made angularly adjustable, and has secured to it an operating arm F^5 carrying a gear segment F^6 which meshes with a spur gear F^7 carried by a shaft F^8 which may be oscillated by the hand wheel F^9. The shaft F^8, which runs between the two valves F at the opposite ends of the cylinder, may be locked in any position into which it may be turned by the set screw F^{10}. By rotating the valve seat F^4, and thereby angularly adjusting its port F^{11}, the point in the strokes of the compressing piston at which the ports F^{12} of the valves F register with the ports F^{11} and thereby admit air to the cylinders C^3 may be varied as desired.

Figs. 7 and 8 illustrate an arrangement in which the valves F are automatically maintained in the closed position, and the admission valves are consequently maintained in the open position whenever the receiver pressure rises above a predetermined value. In this construction, the shaft F^8 of Figs. 4 and 5 has secured to it an arm F^{13}, which is connected by the jointed rod I to a piston I′ working in a cylinder I^2. The lower end of the piston chamber is connected to one of the receiver casings A′ by a conduit I^3, and a spring I^4 is placed between the upper end of the piston and the upper wall of the piston chamber, the spring being so proportioned that as the receiver pressure rises above a predetermined value the piston will be raised and the shaft F^8 will be rotated to adjust the ports F^{11} and thereby reduce or entirely prevent compression from occurring in the compression cylinder. A hand lever I^5 forms a means in this construction by which the adjustment may be made manually.

The constructions described possess a number of important operating advantages. For one thing, the various valves are properly cushioned. The importance of this is obvious when it is considered that the inlet and outlet valves are massive and may exceed one thousand pounds each in weight in the larger size engines, and these valves are required to move very rapidly from the open to the closed positions to prevent wire drawing. The piston and vacuum cylinder connection for producing the outward pull on the inlet valves to move the latter when released possesses the advantages that the parts are subject to little wear and are not injured in operation, as would be the case for instance if spring connections were employed. By employing the pressure of the atmosphere to move the inlet valves to the closed position a definite and powerful moving force is obtained which may be controlled in an easy and effective manner.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a blowing engine having a compression chamber and an inlet and an outlet valve therefor, means for moving the inlet valve arranged to positively open the valve, if closed, at the beginning of each suction stroke in the compression chamber and tending to close the inlet valve throughout the following compression stroke, and means independent of the valve moving means for releasably holding the inlet valve in the open position.

2. In a blowing engine having a compression chamber and an inlet and an outlet valve therefor, means for moving the inlet valve arranged to positively open the valve, if closed, at the beginning of each suction stroke in the compression chamber, and tending to close the inlet valve throughout the following compression stroke, and means responsive to the pressure of the fluid compressed and independent of the valve moving means for releasably holding the inlet valve in the open position.

3. In a blowing engine having a compression chamber, an inlet and outlet valve therefor, a shaft rotating in definite relation to the speed of the engine and connections therefrom for moving the inlet valve, arranged to positively open the inlet valve, if closed, at the beginning of each suction stroke in the compression chamber and tending to close the inlet valve throughout the following compression stroke, valve controlled means for holding the inlet valve in the open position, a controlling valve for said means, and a connection from said shaft for opening and closing said controlling valve.

4. In a blowing engine having a compression chamber, an inlet and outlet valve therefor, a shaft rotating in definite relation to the speed of the engine and connections therefrom for moving the inlet valve, arranged to positively open the inlet valve, if closed, at the beginning of each suction stroke in the compression chamber and tending to close the inlet valve throughout the following compression stroke, valve controlled means for holding the inlet valve in the open position, a controlling valve for said means, a connection from said shaft for opening and closing said controlling valve, and means for adjusting the last mentioned means to regulate the time of closing the inlet valve.

5. In a blowing engine having a compression chamber and outlet and inlet valves for said chamber, operating means for the inlet valve comprising a pair of members, one movable with the inlet valve and the other independently thereof, means for giving said other member a to and fro movement in definite relation to the engine movement, a yielding connection between said members tend-

ing to close the inlet valve during the compression stroke in the compression chamber, said connection comprising a piston carried by one of said members which enters the open end of a piston chamber formed in the other member and open at one end only, and means releasably holding the inlet valve in the open position.

6. In a blowing engine having a compression chamber and an inlet and outlet valve therefor, a member connected to the inlet valve and formed with a piston chamber C^5, a piston C^3 fitted in said piston chamber, means for moving said piston C^3 in definite relation to the speed of the engine and so that it engages said member to move the valve, if closed, into the open position at the beginning of each suction stroke and is maintained during the compression stroke away from the member when the latter is in the closed position a distance equal to or exceeding the opening movement, whereby a vacuum is then maintained in said chamber so long as the valve remains open tending to move the valve into the closed position, and means for releasably holding the valve in the open position.

7. In a blowing engine having a compression chamber and an inlet and an outlet valve therefor, a casing C′ having a piston chamber C^4, a piston C^2 movable in said chamber and connected to the inlet valve and having a piston chamber C^5 formed in it, a piston C^3 fitted in said chamber C^5, means for moving said piston C^3 in definite relation to the speed of the engine and arranged to engage the piston C^2 and open the valve, if closed, at the beginning of the suction stroke, and to maintain a vacuum in said chamber C^5 tending to close the valve during such portion of the compression stroke as the valve remains open, and means for releasably holding the piston C^2 in the valve open position, said means comprising a valve controlling the admission of air to the chamber C^4.

8. In a blowing engine having a compression chamber and an inlet and an outlet valve therefor, a casing C′ having a piston chamber C^4, a piston C^2 movable in said chamber and connected to the inlet valve and having a piston chamber C^5 formed in it, a piston C^3 fitted in said chamber C^5, means for moving said piston C^3 in definite relation to the speed of the engine and arranged to engage the piston C^2 and open the inlet valve, if closed, at the beginning of the suction stroke, and to maintain a vacuum in said chamber C^5 tending to close the inlet valve during such portion of the compression stroke as the inlet valve remains open, means for releasably holding the piston C^2 in the valve open position, comprising a valve controlling the admission of air to the chamber C^4, and connections for opening and closing said controlling valve in definite relation to the speed of the engine.

9. In a blowing engine having a compression chamber and an inlet and an outlet valve therefor, a casing C′ having a piston chamber C^4, a piston C^2 movable in said chamber and connected to the inlet valve and having a piston chamber C^5 formed in it, a piston C^3 fitted in said chamber C^5, means for moving said piston C^3 in definite relation to the speed of the engine and arranged to engage the piston C^2 and open the inlet valve, if closed, at the beginning of the suction stroke, and to maintain a vacuum in said chamber C^5 tending to close the inlet valve during such portion of the compression stroke as the inlet valve remains open, mechanism controlling the admission of air at the proper time to the chamber C^4 to permit the inlet valve to close, comprising a hollow rotary valve member F provided with a valve port F^{12} and an angularly adjustable valve seat member F^4 provided with the port F^{11}, means for oscillating the valve F in definite relation to the movement of the engine speed, and means for adjusting the valve seat member F^4 to adjust the time in which the ports are brought into register.

10 In a blowing engine having a compression member and an inlet and an outlet valve therefor, a casing C′ having a piston chamber C^4, a piston C^2 movable in said chamber and connected to the inlet valve and having a piston chamber C^5 formed in it, a piston C^3 fitted in said chamber C^5, means for moving said piston C^3 in definite relation to the speed of the engine and arranged to engage the piston C^2 and open the inlet valve, if closed, at the beginning of the suction stroke, and to maintain a vacuum in said chamber C^5 tending to close the inlet valve during such portion of the compression stroke as the inlet valve remains open, mechanism controlling the admission of air at the proper time to the chamber C^4 to permit the inlet valve to close, comprising a hollow oscillatory valve member F provided with a valve port F^{12} and an angularly adjustable valve seat member F^4 provided with the port F^{11}, means for controlling the valve F in definite relation to the movement of the engine speed, and means for adjusting the valve seat member F^4 to adjust the time in which the ports are brought into register in response to the pressure of the receiver into which the blowing engine discharges.

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Witnesses:
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