(No Model.) 2 Sheets—Sheet 1.

W. E. GOOD.

COMPRESSING OR BLOWING ENGINE.

No. 381,876. Patented Apr. 24, 1888.

Fig. 2.

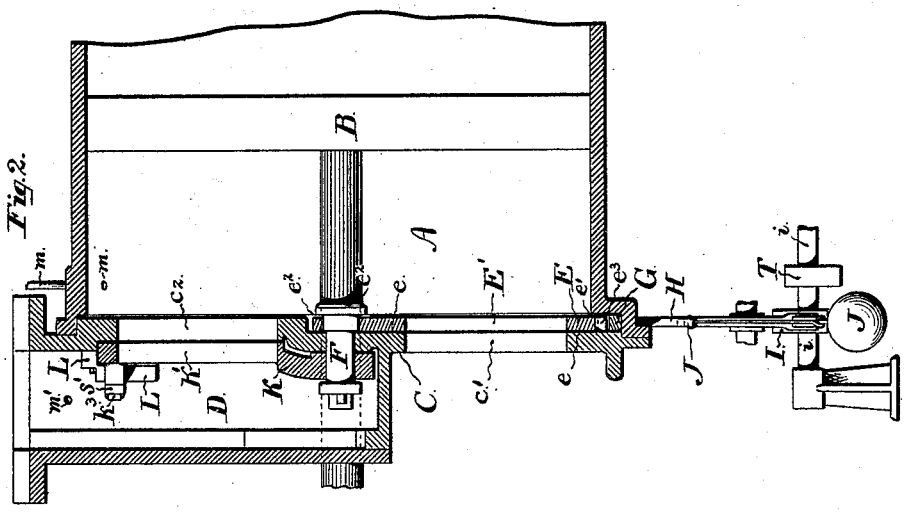
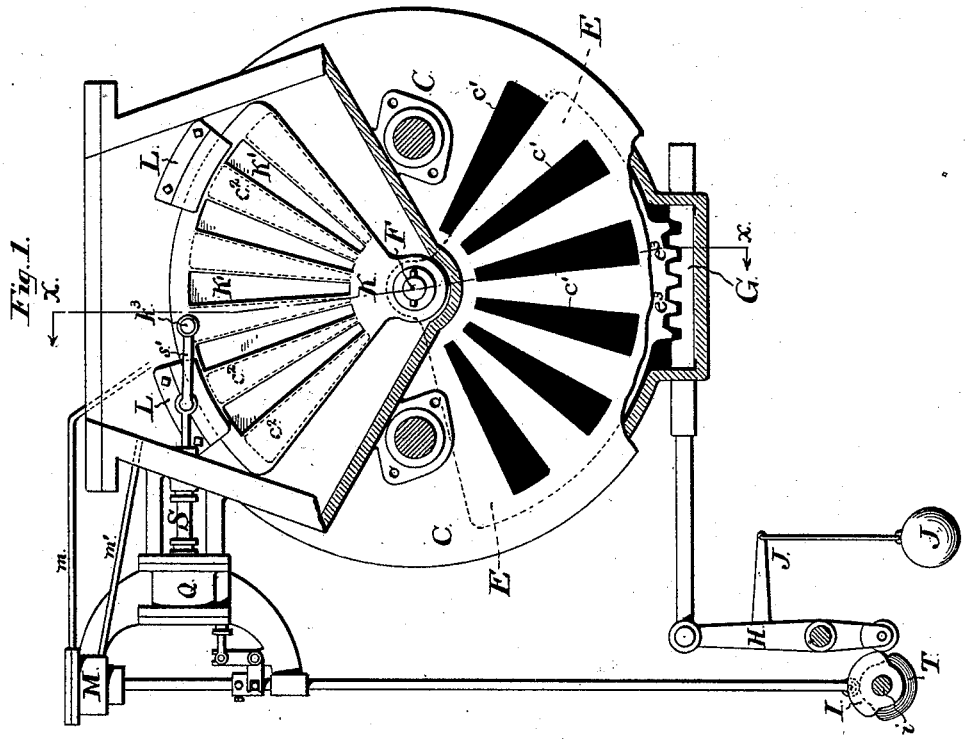


Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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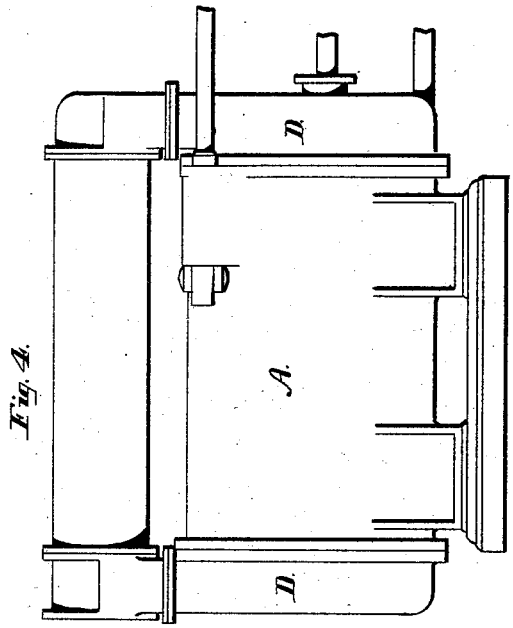

Fig. 4.

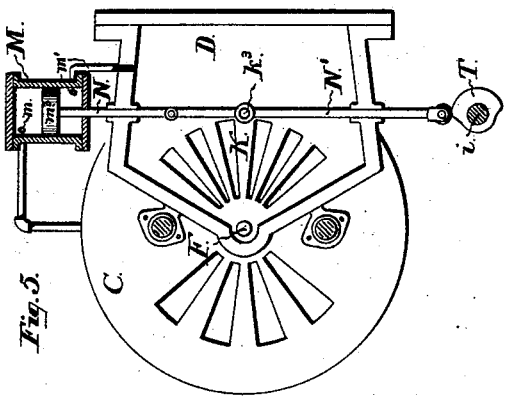

Fig. 5.

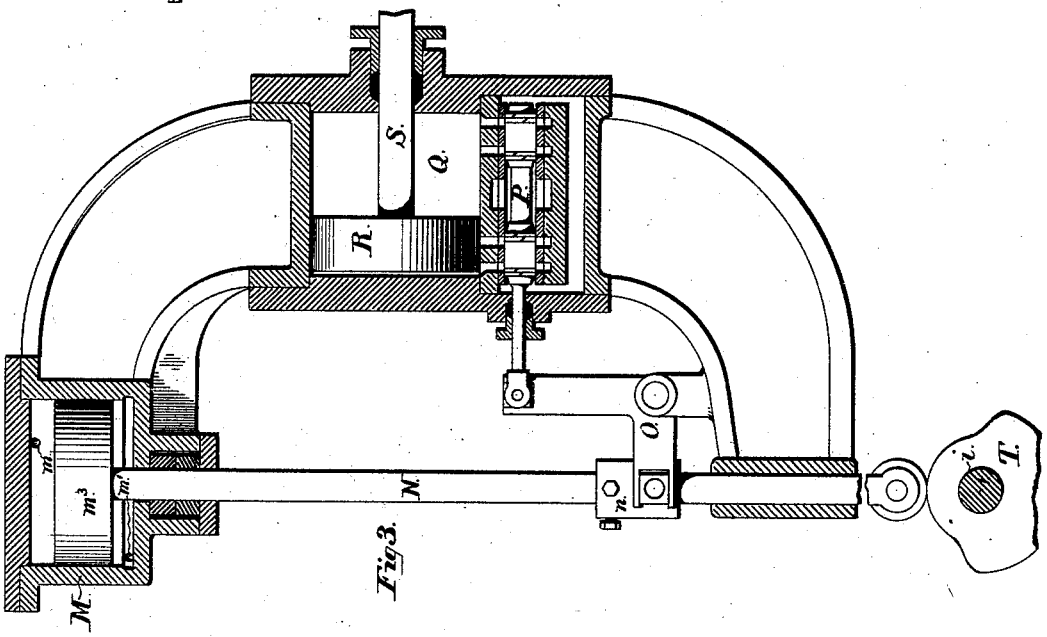

Fig. 3.

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UNITED STATES PATENT OFFICE.

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COMPRESSING OR BLOWING ENGINE.

SPECIFICATION forming part of Letters Patent No. 381,876, dated April 24, 1888.

Application filed July 7, 1887. Serial No. 243,616. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. GOOD, a resident of Reading, county of Berks, State of Pennsylvania, and a citizen of said State, have invented a new and useful Improvement in Compressing or Blowing Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to the class of engines used for compressing air or other gases and vapors and delivering the compressed air or other gas into a receiver or conveying-tube to be used as a blast or for other purpose, and particularly to the construction and operation of the inlet and outlet valves of such engines.

The object of my invention is to so construct the valves and the devices which operate them that they may move with little or no noise, shock, or friction, and to open and close them automatically at the proper times, thus insuring the economical working of the engine; and my invention consists of the devices hereinafter fully described, and which are illustrated in the drawings, which show my improvements applied to a blowing-engine, and in the form and arrangement which I believe will be found most useful and efficient.

In the drawings, Figure 1 is an end view of the compression-cylinder of a blowing-engine having my improved valves and valve-actuating devices, the top of the receiving-conduit being removable in order to show the outlet-valve. Fig. 2 is a cross section on the line *x x* of Fig. 1. Fig. 3 is a detailed view of my preferred device for actuating the outlet-valve. Fig. 4 is an elevation of the compression-cylinder of a blast-engine, and Fig. 5 a view illustrating a modification of the device for actuating the outlet-valve.

A is the compression-cylinder, which, as shown in Fig. 4, is provided with valves and conduits for the blast at each end.

B is the piston of the compression-cylinder.

C is the head of the cylinder A, preferably recessed, as shown, on each side for the reception of the entrance and exit valves, and provided with slotted openings c' c^2 for the entrance and exit of air, these slots being preferably arranged radially, as shown, and of small size, as of course the more numerous the slots the shorter distance the valves will have to move in order to cover and uncover them.

D is the exit-conduit, through which the compressed air is led to the point of use.

E is the entrance-valve, made in the form of a grid, with arms separated by open slots, said arms being of somewhat greater breadth than the openings c' and corresponding with these openings in length and shape. As used with the radial slots c', the valve E is pivoted on the pin F, secured in the center of head C, and I prefer in both cases to place it on the inside of the head C, the face e of which forms its seat and has a bearing-surface, e', opposite to its seat e and distant from it by slightly more than the thickness of the valve-plate E. This back bearing, e', is here provided by counterboring the edge of cylinder A, and is continued to the central bearing of the valve by making the surface e^2 of the head of pin F in the same plane as e'.

On the bottom edge of valve E, as shown in the drawings, I have cast teeth e^3, which engage with a rack, G, actuated through a pivoted lever, H, by a cam, I, and retractive weight J. The devices, however, by which the motion of the cam I may be made to actuate the valve E may be of any desired form, that shown being simply given as one well adapted for this purpose.

i is a shaft upon which cam I is secured, and which is driven by the engine which drives the compression-piston.

There is of course in all compression-cylinders of the kind shown a quantity of air or gas left at the end of the stroke between the piston and the end of the cylinder. This air is under compression, and will by its expansion to the atmospheric pressure assist the engine in the return-stroke of the piston, if not released and wasted by the premature opening of the entrance-valve; but as the pressure in the cylinder will at times vary it is impossible to arrange any definite point in the return-stroke for the opening of the valve which will insure its opening at the exact point when the pressure behind the piston will equal the pressure of the atmosphere, and of course it will not do to have the opening of the valve

delayed beyond this point. In valves of the kind heretofore generally used their movement depends entirely upon the air-pressure, the valve (generally circular and guided by a spindle) moving to or from its seat, according as the pressure within the cylinder was more or less than that outside. Owing to various well-understood causes, such valves require an excess of pressure on one side to actuate them, thus involving some loss of power, and their movement is necessarily so great as to involve a great deal of noise and so abrupt as to frequently result in breaking, and not only necessitating the stoppage of the engine, but also frequently causing worse damage by falling into the cylinder and damaging it or the piston.

I arrange my cam I so that it will open the valve E at the point where the pressure within and without the cylinder will be equal when the air is being compressed to the maximum point, and by leaving a slight clearance for the valve E between its seat *e* and back bearings, *e' e²*, I permit it to open slightly by atmospheric pressure in case the interior and exterior pressures become equal before this point is reached, the slight movement of the valve away from its seat being accomplished without noise or jar, and the numerous openings around the edges of the slots *e'* thus left open being amply sufficient to admit the air during the short period before the cam I moves the valve and opens the slots wide. A great advantage which I obtain by this construction is that the valve is out of contact with its seat *e* when it is opened, and hence there is no friction or wear at this point.

The cam I is of course so shaped as to close or permit the closing of the valve E at the end of the reverse stroke of the piston B, this closing being also effected without friction of the valve on its seat.

The device shown for actuating the valve E by means of a rack, G, through teeth on its periphery is advantageous in view of the fact that the valve is on the inside of the cylinder-head; but a connecting-rod and pin could be substituted for it, if desired. While I prefer the device of radial slots and a centrally-pivoted valve, E, such a construction being obviously of great convenience and excellence, it will be at once seen that the main features of my invention can be embodied in a structure where straight slots or holes in the head C are opened and closed by a valve moving in a straight line, instead of being pivoted, as in the preferred form shown.

Passing now to the outlet-valve, which is indicated by the letter K, and which is in all respects similar to the inlet-valve E, being, like it, adapted to close radial slots, (here indicated by the letter c^2,) said valve is secured upon the outside of the head C and has a clearance between its seat *k* on the slotted head and the back bearing, *k'*, and k^2 on the pin F.

k^3 is a crank-pin secured on valve K, and to which is secured an actuating-rod, as shown. It is my object to open this valve at the exact point where the pressure in the compression-cylinder equals that in the delivery-conduit, this being, of course, necessary in order to obtain the maximum efficiency of the engine, and the premature or delayed opening of the valve inevitably resulting in a loss of power. It is also necessary to close the valve before the piston begins its reverse movement. To accomplish these results I make use of the devices illustrated in the drawings, Figs. 1 and 3 showing my preferred construction, and Fig. 5 a simplified modification.

M is a cylinder connected at one end with a pipe, *m*, leading into the end of the compression-cylinder A and at the other end with a pipe, *m'*, leading into the exit-conduit D.

m^3 is a piston in cylinder M. This piston may be either balanced or of a differential form, according to the construction and balance of the mechanism with which it connects.

N is the piston-rod of piston m^3; *n*, an adjustable sleeve on rod N, engaged with a pivoted bell-crank lever, O, which again connects with the balanced steam-valve P of a cylinder, Q.

R is a piston in cylinder Q, and S the piston-rod, which, as shown in Fig. 1, passses through a packed bearing in the conduit D and is attached through rod *s* to the pin k^3 of the valve K. The rod N is continued below the sleeve *n* and rests upon or is connected with a cam, T, which, like cam I, is driven by the engine. The cams T and I are, indeed, preferably on the same shaft, *i*. The cylinders M and Q and their connections are of course secured on proper bearings cast with or secured to the cylinder A or its head C.

The closing of the valve K at the proper time is secured by the cam T, which, by raising the rod N, moves the bell-crank lever O, and through it the valve P, in such position as to admit the steam or air into cylinder Q on the side of the piston, which will move it and its attachments to close the valve K. The cam T is so proportioned as to hold the valve closed by maintaining the rod N in its elevated position during the reverse stroke of the piston B and to release it as soon as the piston moves forward again, in which case, if not otherwise supported, the rod N will fall and open the valve K through its action on the valve P, as before described. The rod N, however, being attached to the piston m^3, can only move with it, and this piston is actuated by the difference in pressures above and below it, the pressure above being that of the compression-cylinder, and that below being that of the exit-conduit. Obviously, therefore, the piston m^3 will not move downward until the pressure of the cylinder A is equal to that of the exit-passage D; but on reaching this point it will move down, permitting the rod N to fall and open the valve K, as before described.

The adjustment of the apparatus is of course to be carefully attended to in order to insure the instant movement of the piston m^3 at the

proper moment; but this adjustment is easily ascertained, and the clearance allowed to the valve K between its seat *k* and bearings *k' k²* permits a safe margin for the movement of the parts, and, as before described, prevents friction and wear on the valve and its seat. The cam T should close the valve K while the pressures in the cylinder M are in equilibrium, thus avoiding friction in closing the valve.

Instead of operating the valve K through the intermediate mechanism of a cylinder, Q, &c., as described, the rod N may connect directly with the pin *k³*, as is shown in Fig. 5, and any convenient intermediate connections may be used instead of the cylinder Q, &c.

The cam T may of course be placed so as to act on any of the intermediate mechanism which is connected and moves positively with the rod N, and, as will be readily understood, many of the features of my improvement may be used separately as well as conjointly.

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

1. In a compressing or blowing engine, a cylinder-head slotted to form air passages in it, in combination with a sliding slotted valve arranged to register with the slots in the cylinder head, as described, said valve being seated on the cylinder-head and provided with a back bearing arranged at a distance from its seat slightly greater than the thickness of the valve.

2. In a compressing or blowing engine, a cylinder-head having slots formed in it to serve as air-passages, in combination with a pivoted sliding and radially slotted valve arranged to register with the slots in the cylinder-head, as described, said valve being seated on the cylinder-head and provided with a back bearing arranged at a distance from its seat slightly greater than the thickness of the valve.

3. In a compressing or blowing engine, a cylinder-head having slots formed in it to serve as air-passages for the entrance and outlet of air, all of said slots radiating from the same point on the cylinder-head, in combination with radially-slotted sliding valve plates pivoted at the point from which the slots in the head radiate, the valve-plate registering with the inlet-slots being on the inside of the head, and the valve plate registering with the outlet-slots on the outside of said head, and back bearings for said valve-plates, arranged at a distance from their seats on the cylinder-head slightly greater than the thickness of the valve.

4. In a compressing or blowing engine, the combination of an air-inlet opening formed by slots in the cylinder-head with a sliding slotted valve seated upon the inside of the head and having back bearing arranged at a distance from its seat slightly greater than its thickness, a cam, I, driven by the engine and connected with the inlet-valve so as to open it substantially at the point where the pressures within and without the compressing-cylinder are equal when the air is being compressed to the maximum point, and mechanism connecting the cam and valve, substantially as and for the purpose specified.

5. In a compressing or blowing engine, the combination of a cylinder-head slotted to form openings for the outlet of the air, a slotted sliding valve seated on the outside of said head, a back bearing for said valve, situated at a distance from its seat slightly greater than the thickness of the valve, so that it will leave its seat when the air-pressure inside exceeds that outside the cylinder, a cylinder, M, connected at one end with the compression cylinder and at the other end with the outlet-conduit, a piston situated in said cylinder and arranged to move when the pressure in the compression-cylinder approximates that of the outlet conduit, and a connecting device uniting the sliding outlet-valve with said piston, as described, whereby the motion of the piston acts to open the valve.

6. In a compressing or blowing engine, the combination of a cylinder-head radially slotted to form openings for the outlet of the air, a pivoted and radially-slotted sliding valve seated on the outside of said head, a back bearing for said valve, situated at a distance from its seat slightly greater than the thickness of the valve, so that it will leave its seat when the air-pressure inside exceeds that outside the cylinder, a cylinder, M, connected at one end with the compression cylinder and at the other end with the outlet-conduit, a piston situated in said cylinder and arranged to move when the pressure in the compression cylinder approximates that of the outlet-conduit, and a connecting device uniting the pivoted sliding outlet-valve with said piston, as described, whereby the motion of the piston acts to open the valve.

7. In a compressing or blowing engine, the combination of a cylinder head slotted to form openings for the outlet of the air, a slotted sliding valve situated on the outside of the head, a cylinder, M, connected at one end to the compression-cylinder and at its other end to the exit-conduit, a piston situated in said cylinder and arranged to move when the pressure in the compression-cylinder approximates that of the exit-conduit, a piston-rod, a connecting device uniting the piston-rod and outlet-valve, whereby the motion of said rod operates to open and close said valve, and a cam, T, arranged to move the piston-rod in the direction to close the valve and to keep it in said position during the return stroke of the compressing-piston.

8. In a compressing or blowing engine, the combination of a cylinder-head slotted to form openings for the outlet of the air, a slotted sliding valve situated on the outside of the head, back bearing for said valve, situated at a distance from its seat on the cylinder-head slightly greater than the thickness of the valve, so that it will leave its seat when the air-pressure inside exceeds that outside the cylinder, a cylinder, M, connected at one end to the compression-cylinder and at its other end to

the exit-conduit, a piston situated in said cylinder and arranged to move when the pressure in the compression-cylinder approximates that of the exit-conduit, a piston-rod, a connecting device uniting the piston-rod and outlet-valve, whereby the motion of said rod operates to open and close said valve, and a cam, T, arranged to move the piston-rod in the direction to close the valve and to keep it in said position during the return-stroke of the compressing-piston.

9. In a compressing or blowing engine having a cylinder-head provided with slots to form openings for the outlet of the compressed air and having a slotted sliding valve adapted to register with said openings, as specified, the combination of a cylinder, M, connected at one end with the compression-cylinder and at the other to the exit conduit, a piston situated in said cylinder, a piston rod, N, actuated by said piston, a cylinder, Q, having a piston, R, and piston-rod S, connecting with and actuating the said outlet-valve, a valve, P, placed to open and close the ports of cylinder Q, and connecting mechanism whereby the valve P is actuated by piston-rod N, all substantially as and for the purpose specified.

10. In a compressing or blowing engine having a cylinder-head provided with slots to form openings for the outlet of the compressed air and having a slotted sliding valve adapted to register with said openings, as specified, and having a back bearing situated at a distance from its seat slightly greater than the thickness of the valve, so that it will leave its seat when the air-pressure inside exceeds that outside the cylinder, the combination of a cylinder, M, connected at one end with the compression-cylinder and at the other to the exit-conduit, a piston situated in said cylinder, a piston-rod, N, actuated by said piston, a cylinder, Q, having a piston, R, and piston-rod S, connecting with and actuating the said outlet-valve, a valve, P, placed to open and close the ports of cylinder Q, and connecting mechanism whereby the valve P is actuated by piston-rod N, all substantially as and for the purpose specified.

11. In a compressing or blowing engine having a cylinder-head provided with slots to serve as openings for the outlet of the compressed air and having a slotted sliding valve adapted to register with said openings, as specified, the combination of a cylinder, M, connected at one end with the compression-cylinder and at the other to the exit-conduit, a piston situated in said cylinder, a piston-rod, N, actuated by said piston, a cylinder, Q, having a piston, R, and piston-rod S, connecting with and actuating the said outlet-valve, a valve, P, placed to open and close the ports of cylinder Q, and connecting mechanism whereby the valve P is actuated by piston-rod N, and cam T, acting on the rod N to force it into position to close the outlet-valve and retaining it in said position during the return-stroke of the compression-piston, all substantially as and for the purpose specified.

12. In a compressing or blowing engine, the combination of a cylinder-head, C, radially slotted to form openings for the entrance and outlet of the air, pivoted sliding and radially-slotted valves for opening and closing said openings, a rod, N, connected with the outlet-valve, so as to open or close the same as it is moved, a piston secured to rod N and situated in a cylinder, M, connected with the compression-cylinder and exit-passage, as described, so that the piston and rod N will move to open the valve when the pressures of the compression-cylinder and exit-passage are approximately the same, a cam, I, connected with the inlet-valve, so as to close it and keep it closed during the forward stroke of the compression-piston and a definite portion of its return-stroke, and a cam, T, connected with rod N, so as to move it to close the outlet-valve and keep it closed during the return-stroke of the compression-piston, all substantially as and for the purpose specified.

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