No. 865,218. PATENTED SEPT. 3, 1907.

A. WAGENER.

AIR SUPPLYING MEANS FOR EXPLOSIVE ENGINES.

APPLICATION FILED JULY 20, 1903.

3 SHEETS—SHEET 1.

Fig. 1.

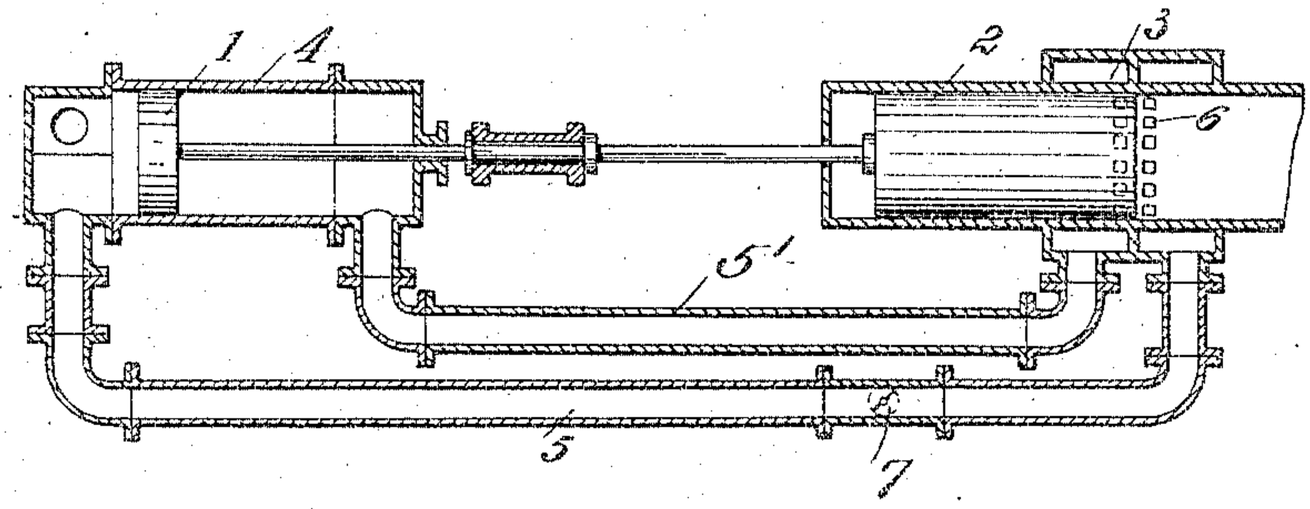
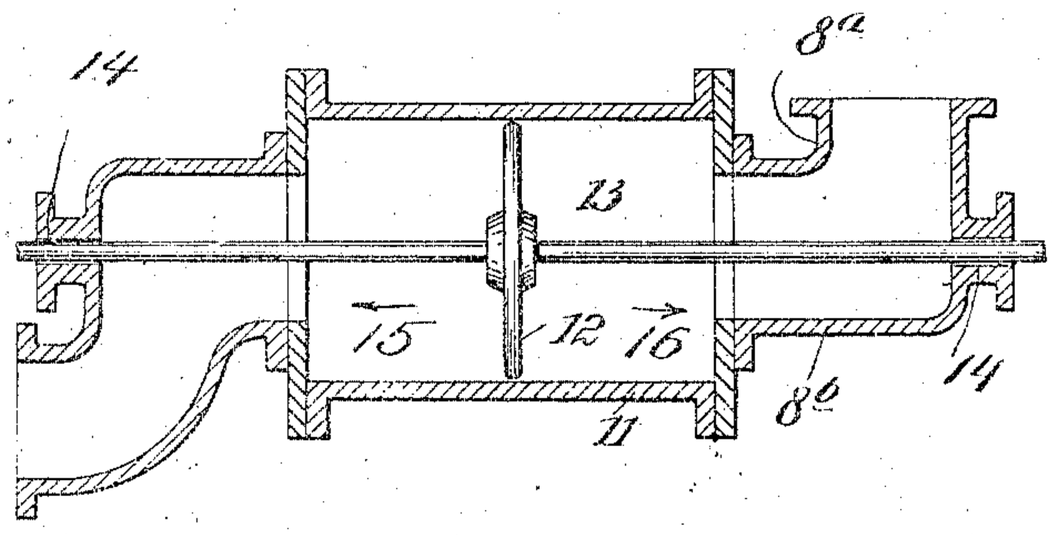


Fig. 2.

Fig. 3.



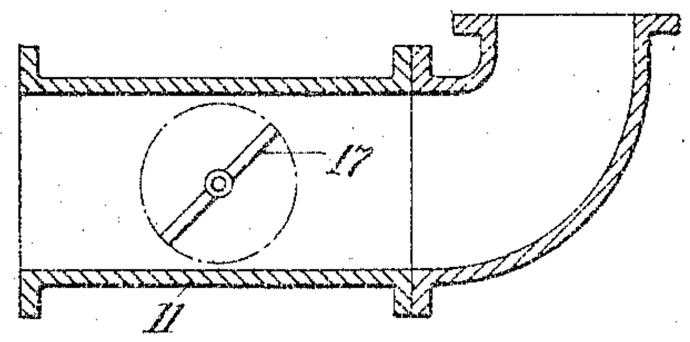
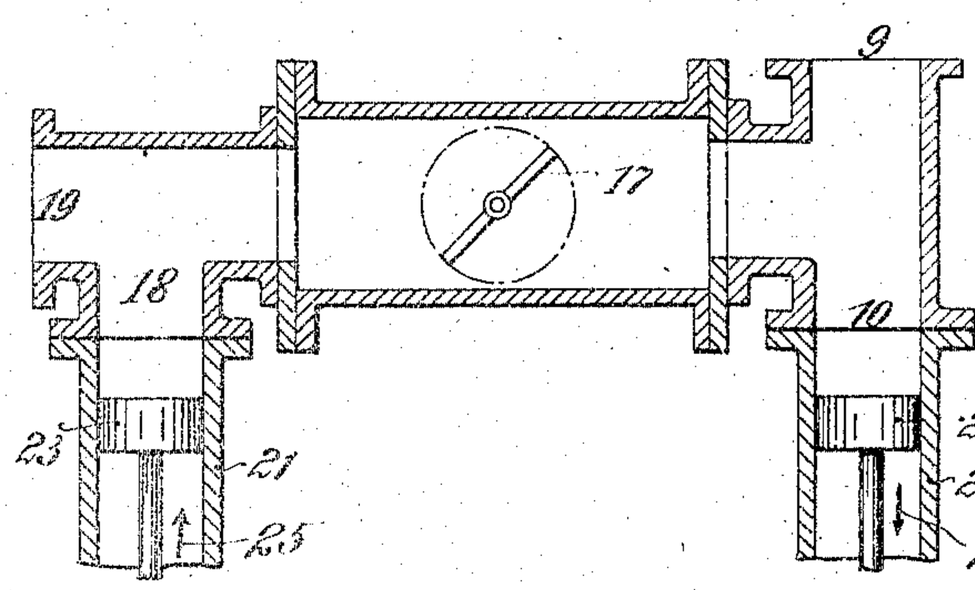
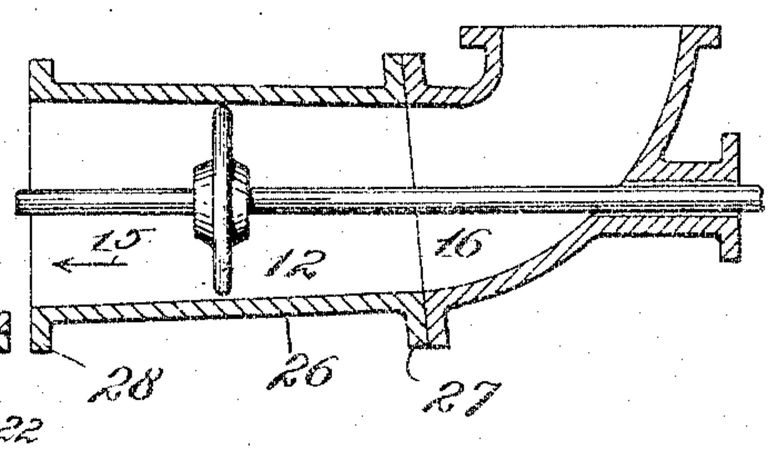


Fig. 4.

Fig. 5.





Witnesses,

W. B. Keelan

Ed. Kesler

Inventor

August Wagener

By

James L. Norris.

Atty.

No. 865,218. PATENTED SEPT. 3, 1907.

A. WAGENER.

AIR SUPPLYING MEANS FOR EXPLOSIVE ENGINES.

APPLICATION FILED JULY 20, 1903.

3 SHEETS—SHEET 2.

Fig. 6

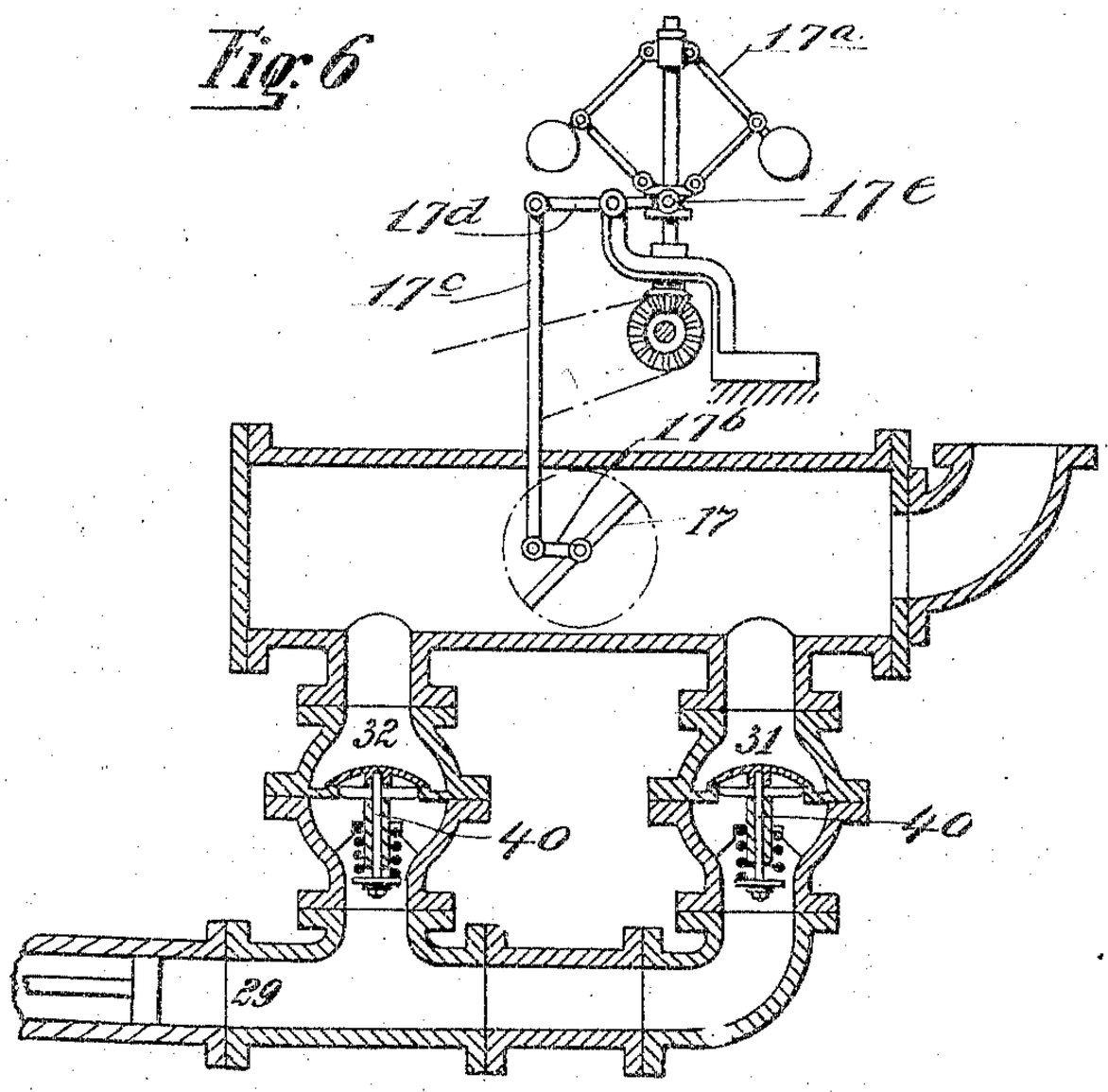


Fig. 7.

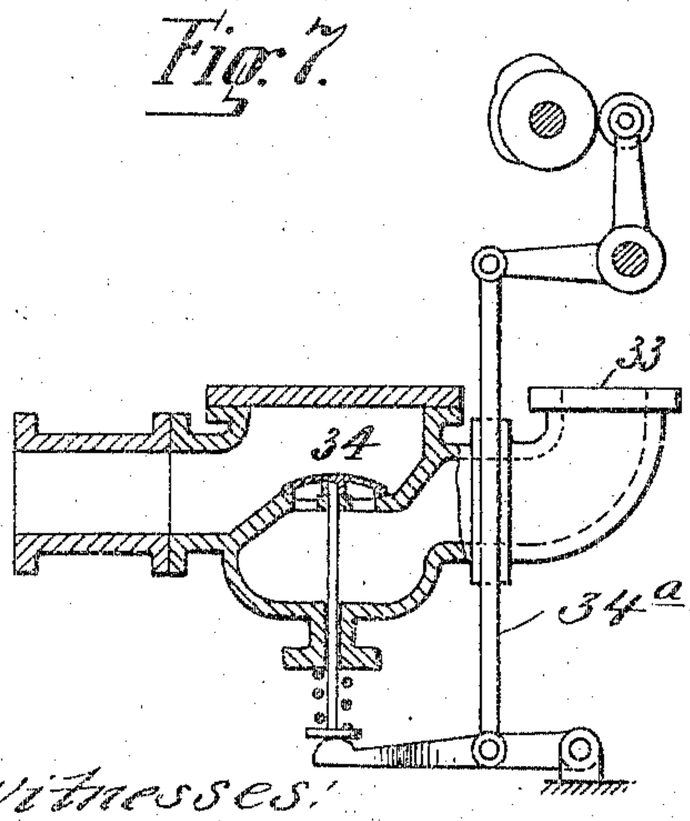
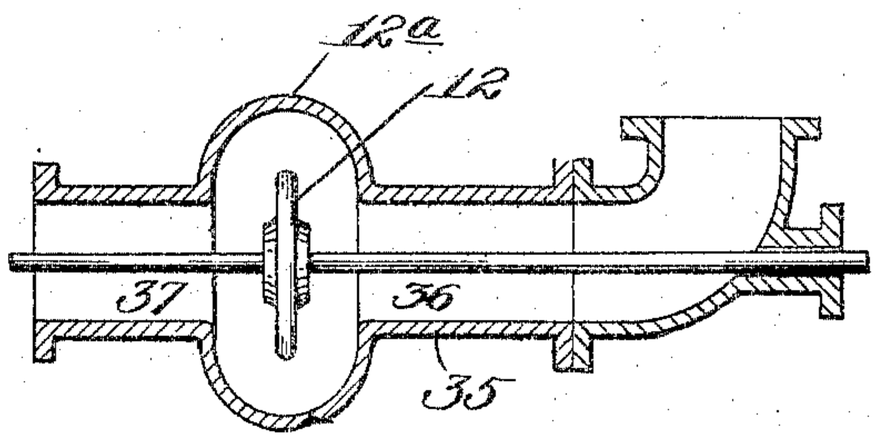


Fig. 8.



Witnesses:

H. B. Keeler

C. F. Kesler

Inventor

August Wagener

By

James L. Norris.

Atty.

No. 865,218. PATENTED SEPT. 3, 1907.

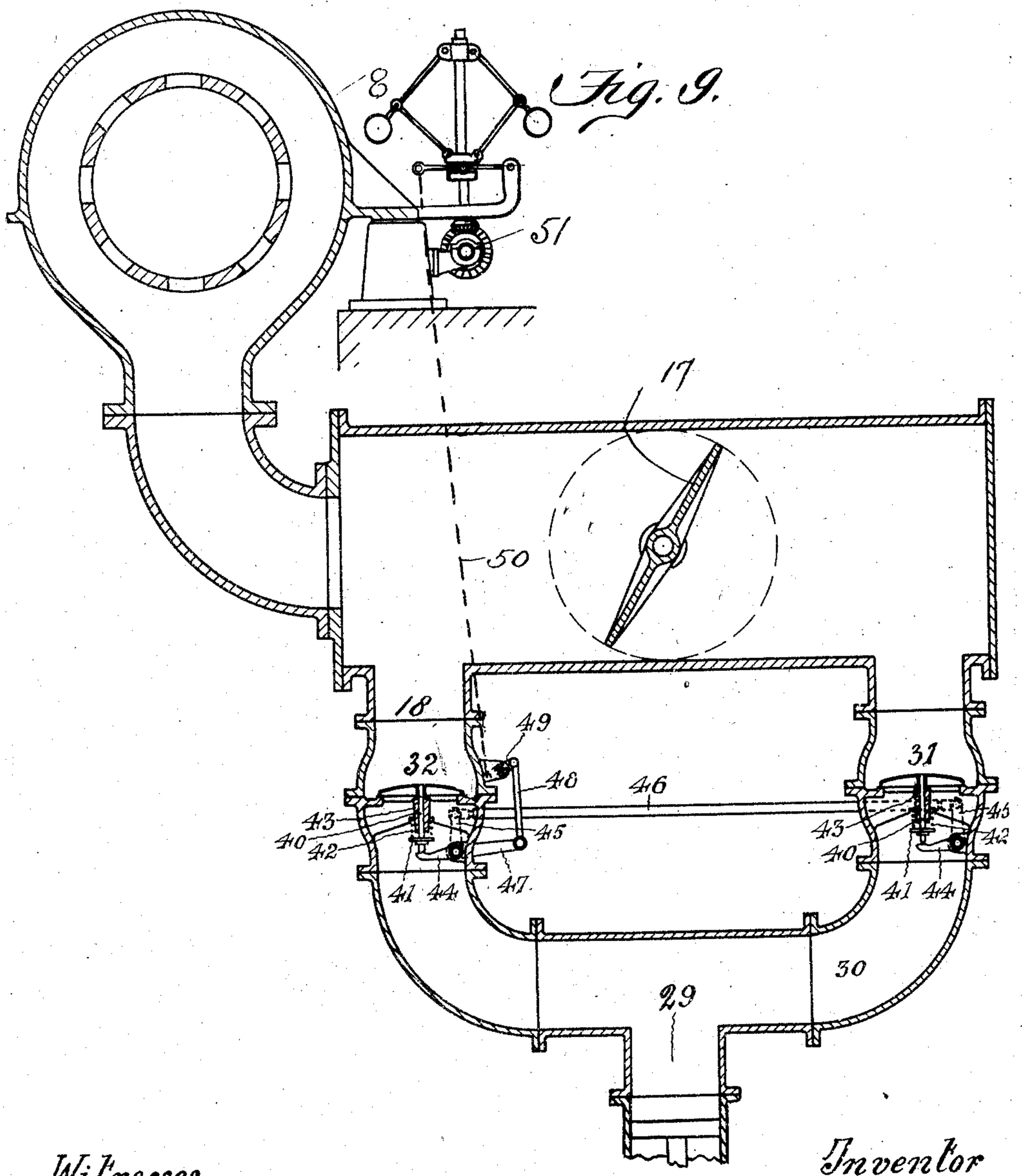
A. WAGENER.

AIR SUPPLYING MEANS FOR EXPLOSIVE ENGINES.

APPLICATION FILED JULY 20, 1903.

3 SHEETS—SHEET 3.

Fig. 9.



Witnesses
V. L. Bogan
C. L. Kesler.

Inventor
August Wagener
By James L. Norris
Atty.

UNITED STATES PATENT OFFICE.

AUGUST WAGENER, OF BERLIN, GERMANY, ASSIGNOR TO SOCIETY DEUTSCHE KRAFTGAS-GESELLSCHAFT M. B. H., OF BERLIN, GERMANY.

AIR-SUPPLYING MEANS FOR EXPLOSIVE-ENGINES.

No. 865,218. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed July 20, 1903. Serial No. 166,369.

To all whom it may concern:

Be it known that I, AUGUST WAGENER, a subject of the Emperor of Germany, residing at Berlin, Germany, have invented certain new and useful Improvements Relating to Air-Supplying Means for Explosive-Engines, of which the following is a specification.

The subject of this invention is applicable for use with explosion or internal combustion engines of the kind in which air is forced by means of a special charge-pump into a receptacle and in the neighborhood of the dead point position of the piston, after the exhausting of the products of combustion, this compressed air passes into the driving or working cylinder in such a manner that the part thereof first entering serves as scavenging air and the remainder enters as mixing air simultaneously with the fresh charge of gas and mixing with the latter in the driving or working cylinder forms a combustible mixture.

Figure 1 is a sectional elevation of a portion of an explosive engine embodying the features of this invention. Figs. 2 and 3 are sectional modifications. Fig. 4 is a sectional view showing the construction for altering the position of a throttle valve. Fig. 5 is a sectional detail showing a modified construction of tube for employment in connection with the structure shown in Fig. 2. Figs. 6, 7 and 8 are modifications of throttling means, and Fig. 9 is a sectional elevation of a valve-actuating gear.

In Fig. 1, the driving piston 2 connected with the pump-piston 1 is shown in the position which it assumes during its outwardly-directed motion on opening of the gas-inlet apertures 3. In the previous stroke, gas has been compressed on the right-hand side of the charge-pump 4 and has been pumped into a receptacle, the high-pressure gas pipe 5′, where it remains until the opening of the gas-inlet apertures 3. On the left-hand side of the charge-pump, air has been compressed in the following stroke and pumped into a receptacle, the high-pressure air pipe 5. In the position of the working piston shown in Fig. 1, a part of this air has already passed through the air-inlet apertures 6 into the driving or working cylinder. The remainder of the air thrown by the charge-pump, after the driving piston in its further outward stroke has also uncovered the gas-inlet apertures, passes into the driving cylinder simultaneously with the gas which has previously been compressed in the same manner. An arrangement of this kind has the disadvantage that the division of the total amount of air into the correct quantities of scavenging air and air for mixing with the gas is not attained directly for the different conditions which result in particular cases from the length and width of the high-pressure air pipe, the speed of rotation, duty, etc.

It has now been shown by experiments that a correct division of the air into scavenging air and mixing air is attained with much more certainty by introducing a throttling device in the high-pressure air-pipe, for example, a throttle-valve disk 7 which offers a definite resistance to the passage of the air. In this case, the compressed air passes very quickly out of the part of the high-pressure pipe which lies between the throttle-valve and the driving cylinder, after uncovering of the air-inlet apertures, into the driving cylinder, while the air from the other part of the high-pressure pipe flows slowly after under the throttling action of the valve-disk, as is required for the proper formation of the mixture. It has moreover been shown that the scavenging air and the mixing air, which are supplied to the driving cylinder, are proportioned to each other as regards their quantity approximately as the capacity by volume of the part of the high-pressure pipe between the throttling device and the driving cylinder to the capacity by volume of the other part of the high-pressure pipe. Finally it is clear that the speed at which the mixing air flows in is less as the throttling becomes greater and conversely. Thus, by altering the position of the throttling device, the quantities of scavenging air and mixing air can be varied, and by altering the amount or degree of throttling, the speed at which the mixing air passes in can be varied. An arrangement which permits alteration of the position of the throttling device, is shown in Fig. 2, which is a section 8 and through the high-pressure air-pipe, in which arrangement the charge-pump is considered as arranged by the side of the driving cylinder and the high-pressure air connection of this pump is considered to be attached to the flange 8^a of the coupling 8^b. The high-pressure pipe comprises the cylindrical tube 11 in which the throttle disk 12 can be moved towards either end by means of the rod 13 which extends to the exterior through two stuffing boxes 14, 14. The diameter of the throttling valve-disk 12 is less than the clear width or opening of the tube 11, so that the throttling disk throttles at its periphery. If the throttling disk is moved in the direction of the arrow 15, this causes a reduction in the amount of scavenging air and an increase in the amount of the mixing air; the converse is effected by moving the throttling disk in the direction of the arrow 16. In this arrangement, the amount of throttling is unaltered. Should it be desired not to alter the position of the throttling device but only the amount of the throttling, this object can be attained by an adjustable throttle-valve 17 arranged in the tube 11, Fig. 3. An alteration of the relative position of the throttling device can be effected by means of an arrangement such as that shown in Fig. 4. In this case, the flange 9 of the T-piece 10 is connected on to the high-pressure air-connection of the charge-pump, and the flange 19 to

the air-receiver of the driving cylinder. To the T-pieces 10 and 18 are connected cylindrical tubes 20 and 21 in which the pistons 22 and 23 can be moved. When the pistons are simultaneously moved in the directions of the arrows 24 and 25, for which purpose the pistons are preferably actuated by common driving gear, a reduction in the amount of scavenging air and an increase in the amount of mixing air is produced. If, in this case, a rigid throttling device be not employed but an adjustable throttling valve 17, by means of an arrangement of this kind both an alteration in the amounts of scavenging and of mixing air and also an alteration in the speed at which the mixing air flows in, can be produced.

The same object can be attained by employing, in the arrangement shown in Fig. 2, a conical tube 26, Fig. 5, instead of the cylindrical tube 11. If the flange 27 of this tube is arranged towards the charge-pump and the flange 28 towards the air-receiver of the driving cylinder, a movement of the throttling-disk 12 in the direction of the arrow 15 produces a reduction in the amount of scavenging air and an increase in the speed at which the mixing air flow in, while the opposite effects are produced by movement in the direction of the arrow 16. The angular or linear displacement of the devices employed in the arrangements above characterized can obviously be effected either by hand or by means of a governor. If it be desired to employ a very great amount of throttling, the arrangements characterized would have the disadvantage that in their employment the charge-pump, under otherwise similar conditions, would require a correspondingly greater amount of power than with a less amount of throttling. This disadvantage can be obviated by employing one or more driven or automatic valves. An arrangement of this kind is shown in Fig. 6. In this case, the branch 29 is attached to the high-pressure connection of the charge-pump. During the compression, the air passes through the automatic or driven valves 31 and 32 into the spaces of the high-pressure pipe on both sides of the throttle-valve 17. After completion of the compression, closing of the valves 31 and 32 takes place. As shown in Fig. 6 the throttle valve 17 is actuated from a governor 17^a. To the valve 17 by the link 17^b is attached the actuating rod 17^c, the latter carrying a lever arm 17^d which has one end, as at 17^e engaging and shifted by the governor 17^a. This arrangement can be combined with any of those previously characterized, for example, with that shown in Fig. 4, or with similar ones.

An arrangement, such as that shown in Fig. 7 can also be employed. The flange 33 is attached to the high-pressure air connection of the charge-pump. During the compression of the air, the valve 34 is opened by means of valve-gear 34^a, so that it permits free passage to the air. When the compression is entirely or partially complete, the valve 34 is caused to approach its seat by the valve-gearing up to a definite distance therefrom, so that it acts as a throttling device during the entrance of the mixing air into the driving cylinder. The amount of the throttling can be varied by the action of the governor on the valve-gearing. Instead of driving the valve itself, the loading of the valve-spring can also be varied by means of a controlling device on which the governor can also act, so that the valve is unloaded during the compression and, shortly before the entrance of the air into the driving cylinder, is more or less loaded by a greater or less tensioning of the spring and the throttling is accordingly increased or decreased. This arrangement also can be combined with that shown in Fig. 4. Instead of a valve of this kind, any other device, such as a throttling disk 12, Fig. 8, of the same kind as that shown in Fig. 2, can be employed, and the tube in which it can be moved, is provided with an expansion 12^a, so that the throttling disk, when it stands in the middle of the expansion permits free passage of the air during the compression. Prior to the beginning of the entrance of the air, the throttling disk is moved by valve-gearing, so that it comes approximately into the position 36 or 37 and accordingly influences the division of the compressed air and the speed at which the air enters. In this case, also, numerous combinations are possible either with the arrangements above described or with similar ones, or by making one or both ends of the tube 35 so as to taper off conically in one or the other direction near the expansion.

As shown in Fig. 9, the valves 31, 32 are provided with guide stems 40, 40, bearing rollers 41, 41 and the valves 31, 32 are normally held against their seat by springs 42, 42. These springs are arranged between the flanges 41, 41 and the fixed guides 43, 43. The valves 31, 32 are moved off their seats by means of levers 44, 44, which act upon the stems 40, 40 and are coupled together by arms 45, 45 and a connecting rod 46. The levers 44, 44 are actuated from the governor 51 through the medium of an arm 47, link 48, lever 49 and link 50.

All these arrangements present the essential feature that, by their aid, both the division of the air and also the speed at which the air enters can be varied as desired. The correct division of the air into scavenging air and mixing air and the correct adjustment of the speed at which the air enters have great effect on the working of the engine.

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

1. The combination, in an explosion-engine, of an air-compressor, a driving cylinder, an air-conduit connecting said air-compressor and said driving-cylinder, and through which the whole of the compressed air passes to said cylinder, a device for throttling part of the air in said conduit, and means for varying the proportion which the throttled air bears to the unthrottled air in said conduit.

2. The combination, in an explosion-engine, of an air-compressor, a driving cylinder, an air-conduit connecting said air-compressor and said driving cylinder, and through which the whole of the compressed air passes to said cylinder, a device for throttling part of the air in said conduit, means for adjusting the amount of throttling exercised by said device, and means for varying the proportion which the throttled air bears to the unthrottled air in said conduit.

3. The combination, in an explosion-engine, of a pump-cylinder and a piston therein, a driving cylinder having two series of ports, a gaseous-fuel-conduit connecting the series of ports nearest one end of the driving cylinder with one end of said pump-cylinder, an air-conduit connecting the other series of ports with the other end of said pump-cylinder, a throttling device arranged between the ends of said air-conduit, and a piston in said driving-cylinder for successively opening and closing said series of ports.

4. The combination, in an explosion-engine, of a pump, a driving-cylinder, an air-conduit communicating at one end with said driving cylinder, a throttling device arranged

between the ends of said conduit, pipes connecting said pump with said conduit at each side of the throttling device, and valves in said pipes.

5. The combination, in an explosion-engine, of a pump, a driving-cylinder, an air-conduit communicating at one end with said driving cylinder, a throttle device arranged between the ends of said conduit, pipes connecting said pump with said conduit at each side of the throttling device, valves in said pipes, and means for opening and closing said valves.

6. The combination, in an explosive-engine, of a pump, a driving-cylinder, an air-conduit communicating at one end with said driving cylinder, a throttling device arranged between the ends of said conduit, means for varying the amount of throttling exerted by said device, pipes connecting said pump with said conduit at each side of the throttling device, and valves in said pipes.

7. The combination, in an explosion engine, of a pump, a driving-cylinder, an air-conduit communicating at one end with said driving cylinder, a throttling device arranged between the ends of said conduit, means for varying the amount of throttling exerted by said device, pipes connecting said pump with said conduit at each side of the throttling device, valves in said pipes, and means for varying the proportion the throttled air bears to the unthrottled air in said conduit.

8. The combination, in an explosion-engine, of a pump, a driving-cylinder, an air conduit communicating at one end with said driving cylinder, a throttling device arranged between the ends of said conduit, means for varying the amount of throttling exerted by said device, pipes connecting said pump with said conduit at each side of the throttling device, valves in said pipes, cylinders arranged at the ends of said conduit, and pistons adjustable in said cylinders.

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

AUGUST WAGENER.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.