No. 719,142.

PATENTED JAN. 27, 1903.

E. REYNOLDS & C. ROBINSON.

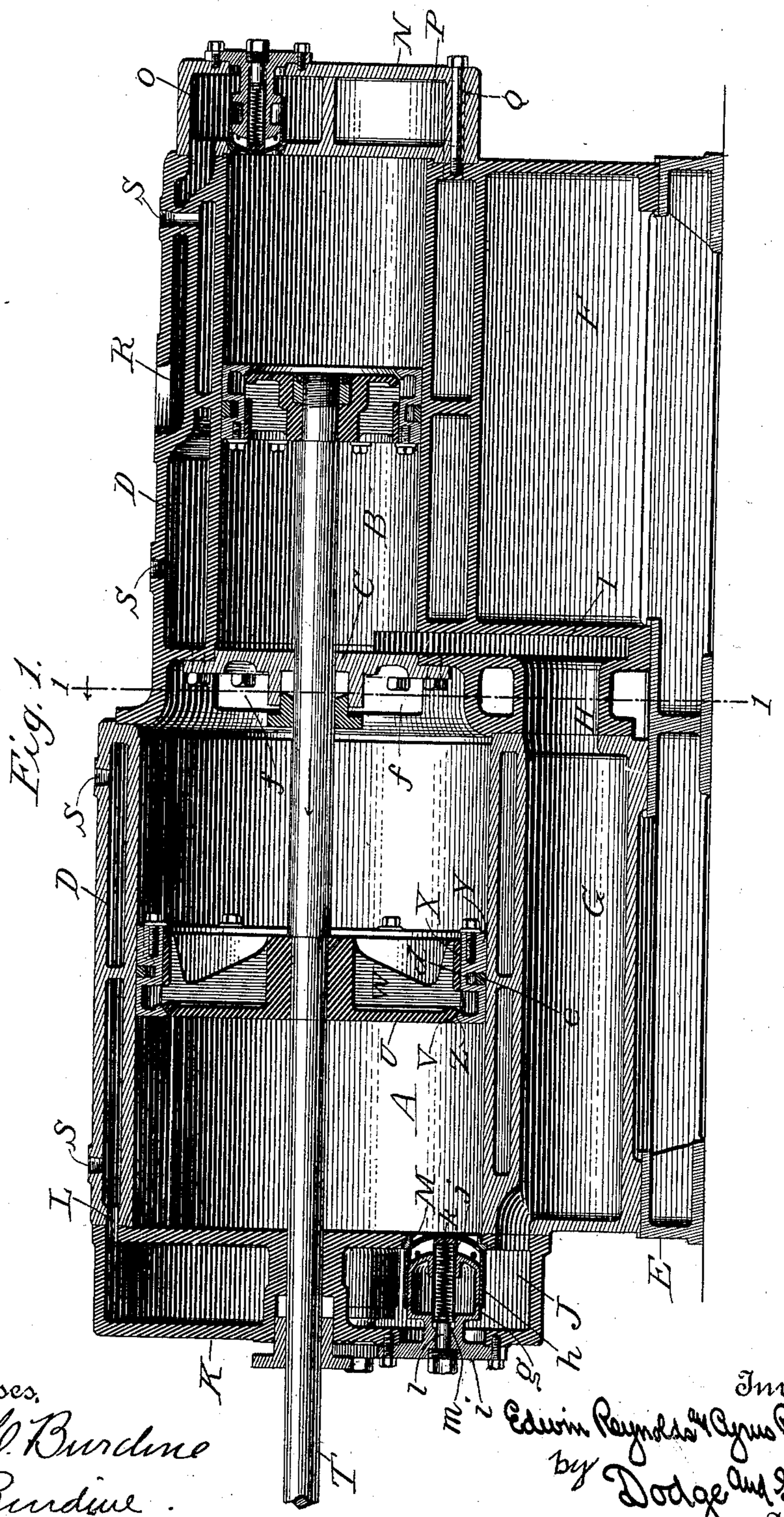
COMPRESSOR AND VALVE FOR SAME.

APPLICATION FILED APR. 1, 1899.

NO MODEL.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
Chas. C. Burdine
D. E. Burdine.

Inventors.
Edwin Reynolds & Cyrus Robinson,
by Dodge and Sons,
Attorneys

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3 SHEETS—SHEET 2

Fig. 2.

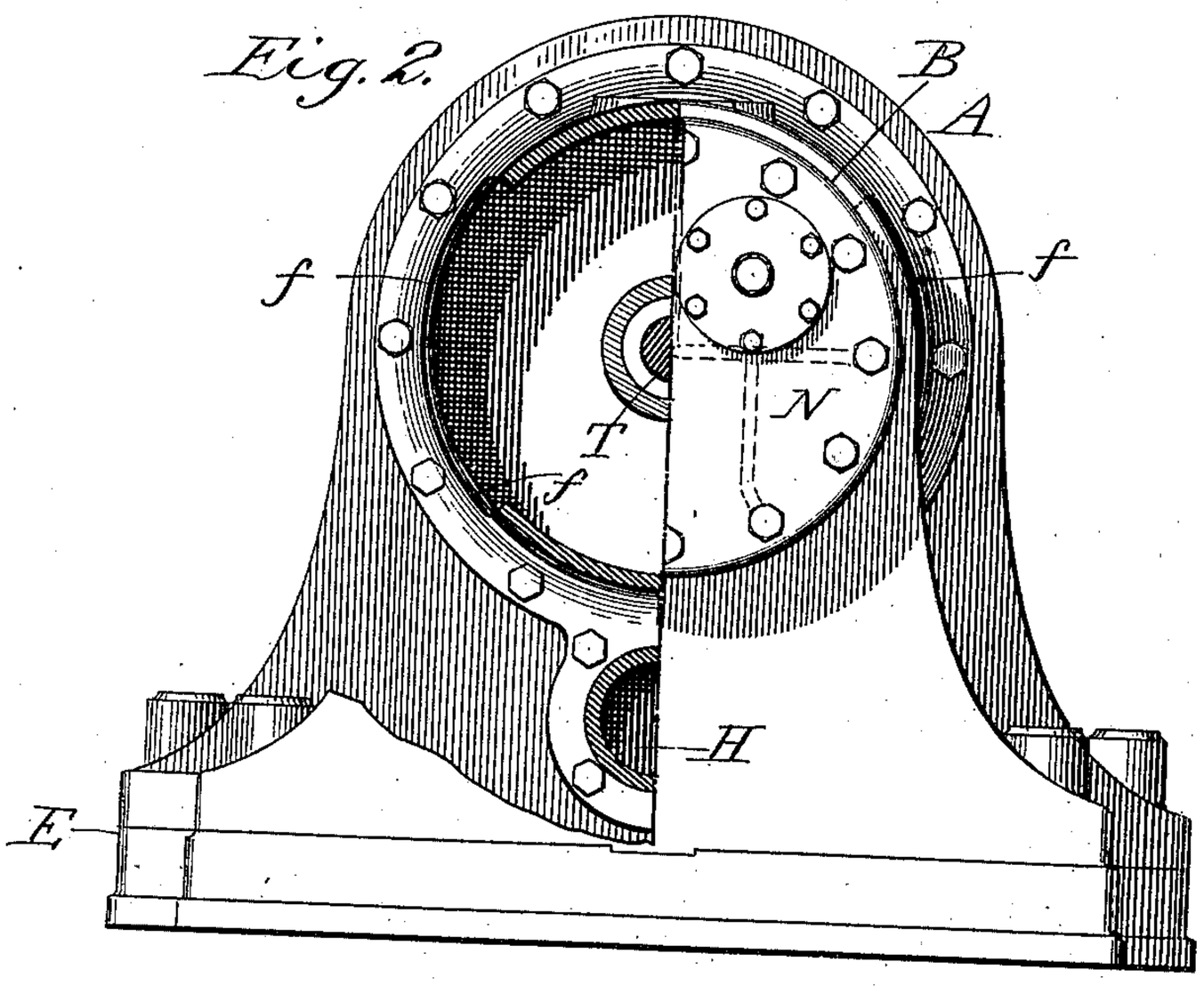
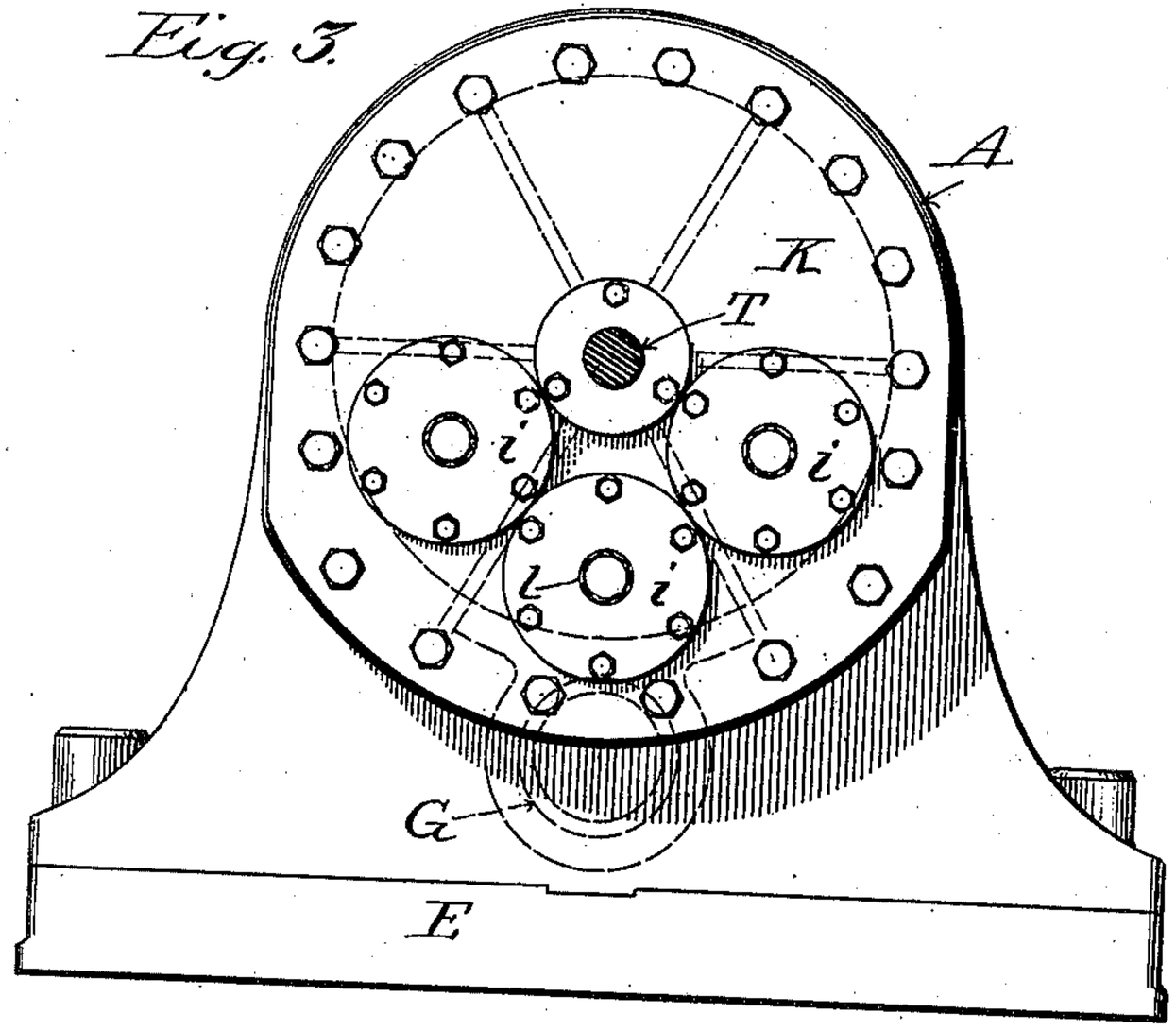


Fig. 3.



Witnesses
W. C. Burdine
D. E. Burdine

Inventor:
Edwin Reynolds & Cyrus Robinson,
by Dodge and Sons,
Attorneys.

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3 SHEETS—SHEET 3.

Fig. 4.

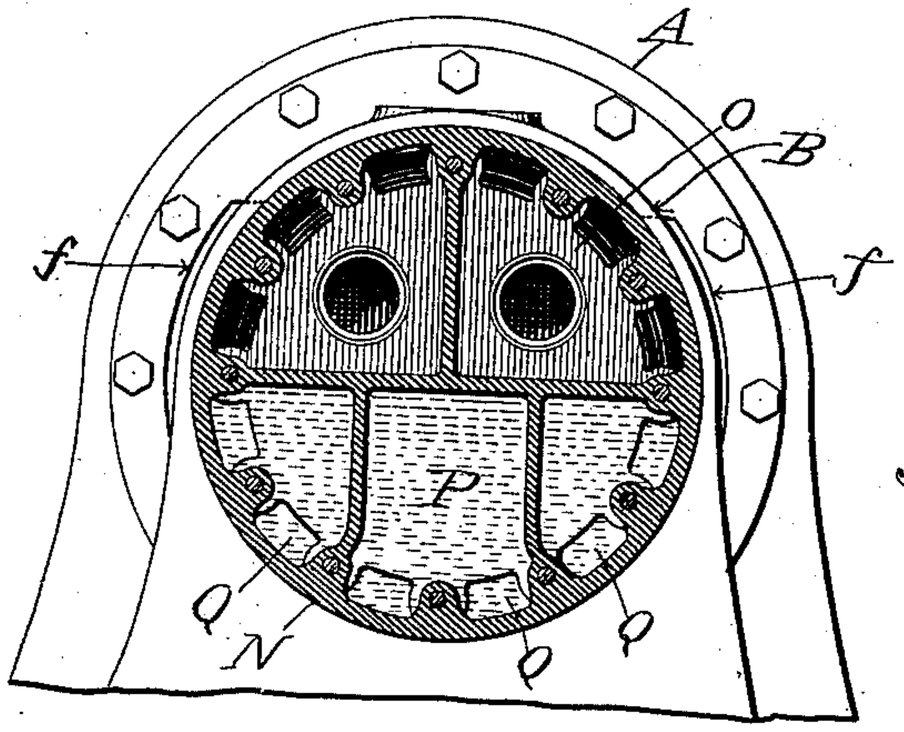


Fig. 5.

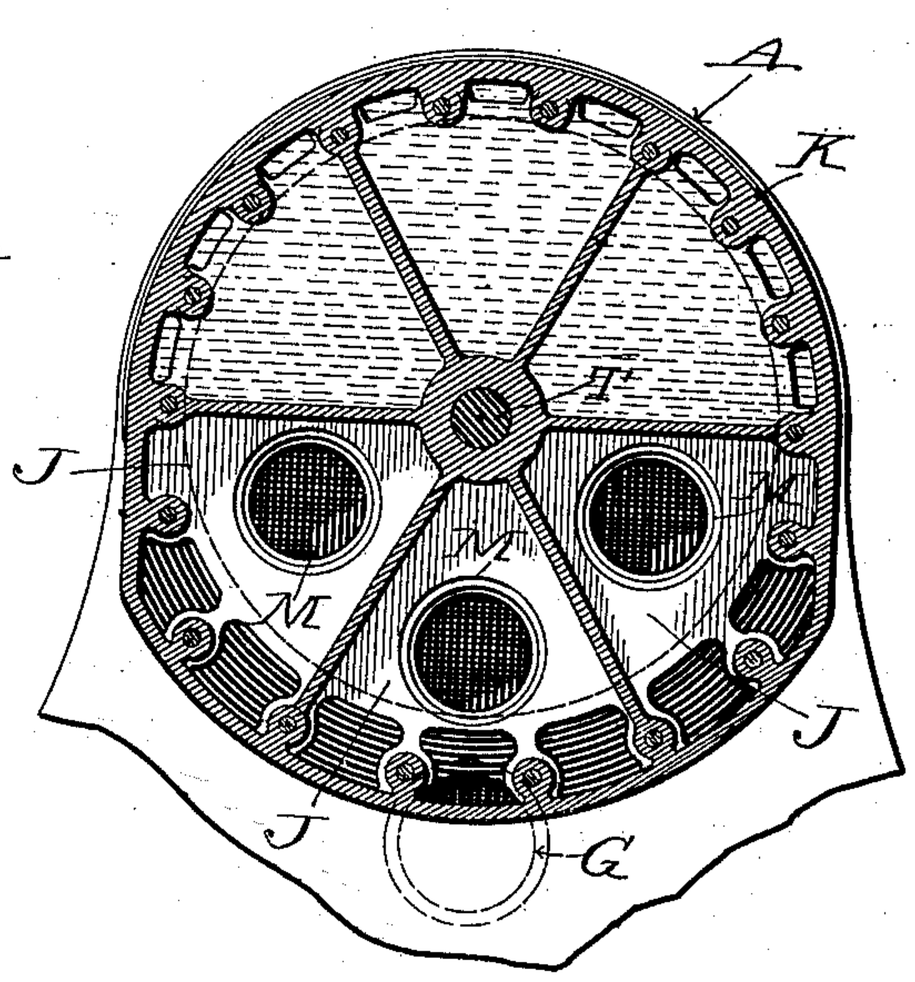


Fig. 6.

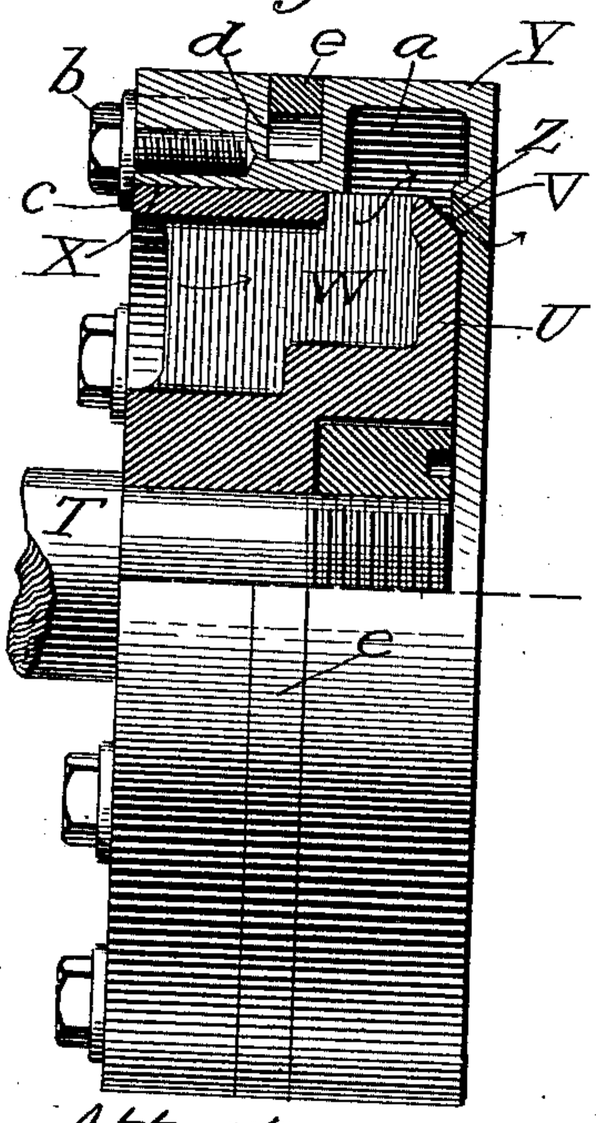
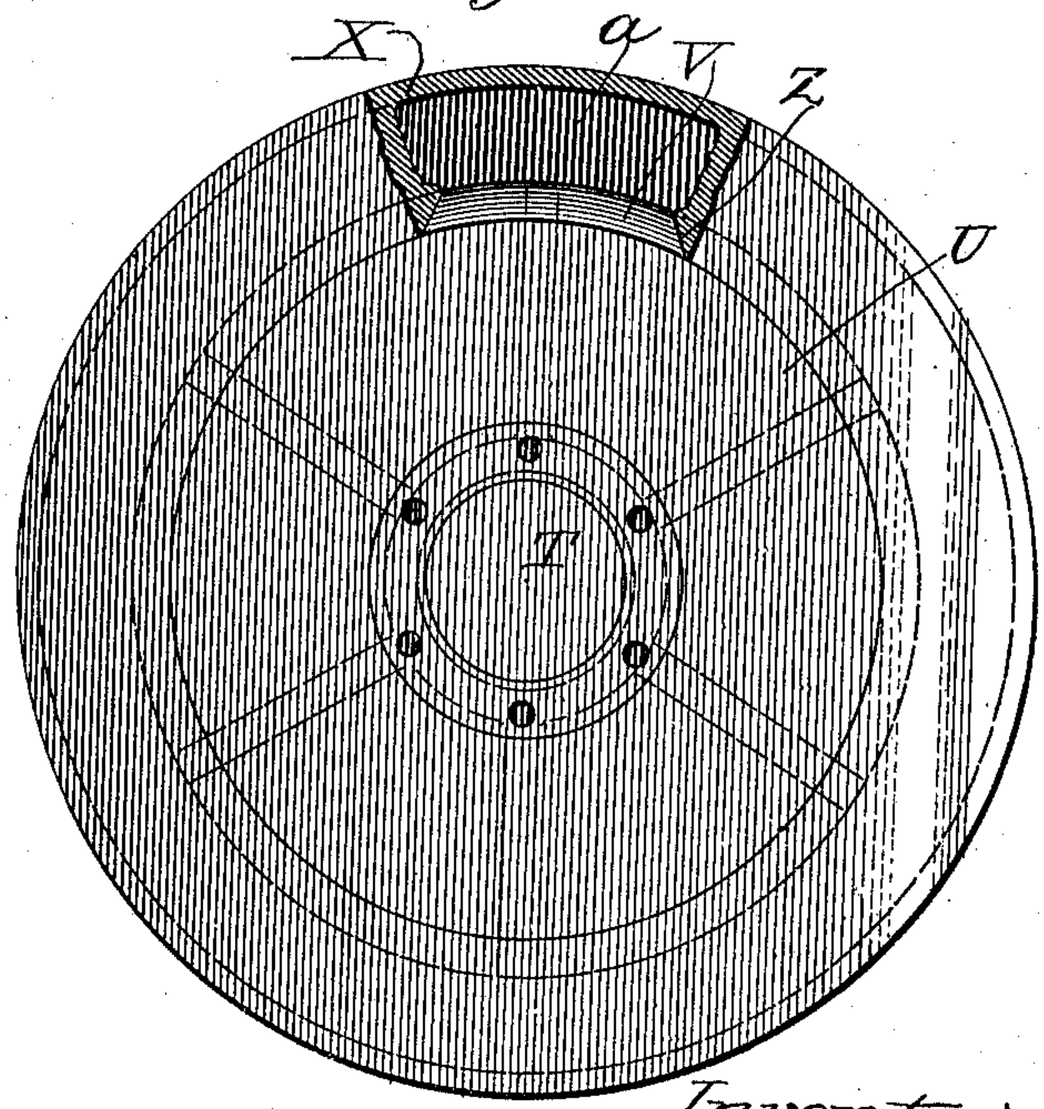


Fig. 7.



Attest;
W. C. Burdine
D. E. Burdine

Inventors:
Edwin Reynolds and Cyrus Robinson,
by Dodge and Sons,
Atty's.

UNITED STATES PATENT OFFICE.

EDWIN REYNOLDS AND CYRUS ROBINSON, OF MILWAUKEE, WISCONSIN.

COMPRESSOR AND VALVE FOR SAME.

SPECIFICATION forming part of Letters Patent No. 719,142, dated January 27, 1903.

Application filed April 1, 1899. Serial No. 711,458. (No model.)

To all whom it may concern:

Be it known that we, EDWIN REYNOLDS, a citizen of the United States, and CYRUS ROBINSON, a subject of the Queen of Great Britain, both residing at Milwaukee, Wisconsin, have invented certain new and useful Improvements in Compressors and Valves for Same, of which the following is a specification.

Our present invention pertains to air and gas compressors and the valves therefor, the construction and advantages whereof will be hereinafter set forth, reference being had to the annexed drawings, wherein—

Figure 1 is a longitudinal sectional view, the pistons being shown midway of the cylinders; Fig. 2, an end elevation partly in section, the section being taken on the line 1 1 of Fig. 1; Fig. 3, an end elevation looking toward the larger cylinder; Fig. 4, a vertical sectional view of the discharge-head of the smaller cylinder, the valves being omitted; Fig. 5, a similar view of the head of the larger cylinder; Fig. 6, a side elevation, partly in section, of one of the combined pistons and intake-valves; and Fig. 7, an end view thereof.

The object of our invention is to produce a simple and compact compressor which at the same time will be highly efficient and durable.

Referring to the drawings, A denotes the low-pressure cylinder, and B the high-pressure cylinder, a head C being secured intermediate the two. Each cylinder is provided with a water space or jacket D and supported or mounted upon a suitable base E by downwardly-extended skirts or frames F.

Beneath the low-pressure cylinder A there is a receiver or chamber G, which communicates at one end through a pipe H and passage I with one end of the high-pressure cylinder B. The opposite end of said chamber is in communication with a chamber J, formed in the lower half of head K, which is mounted on the outer end of cylinder A. As will be seen upon reference to Figs. 1 and 5, the upper portion of the head K is utilized as a water space or chamber which communicates, through openings L, with the space or jacket D. Openings are formed in the head, and in said openings are mounted valve-seats M. Suitable valves, to be hereinafter described, are mounted within the chamber J and normally close the openings just referred to.

N indicates a cylinder-head mounted upon the outer end of the high-pressure cylinder B. Said cylinder-head is formed with an air-chamber O and with a water space or chamber P, the water-space in this instance being at the lower side of the cylinder-head and communicating with the water space or jacket D of the high-pressure cylinder through suitable openings Q. (Shown in dotted lines in Fig. 1 and in full lines in Fig. 4.)

Within the air space or chamber O there are mounted eduction-valves similar to those carried by the head K, and the air space or chamber is in direct communication with a passage R, which may connect with any suitable receiver or the like.

Referring to Fig. 1, it will be seen that suitable openings S enter directly into the water space or jacket of each cylinder, and these openings are connected to a source of supply which maintains a constant circulation of cold water in the water space or jacket, and consequently around the cylinders and also above the expansion-chamber G. Not only does this construction provide means whereby the air and the parts of the compressor may be kept cool, but it also forms a very strong and rigid machine, giving an exterior support for the cylinder against outward pressure.

The piston-rod T extends through the head K and the intermediate head C, a suitable packing-gland being provided in each head. Upon the inner end of said rod, within the high-pressure cylinder B, there is provided a combined piston-head and valve, which is built up in the manner shown in Figs. 1, 6, and 7. The piston comprises a central head U, provided on its forward edge with an inclined valve-seat V. Suitable passages W extend through the head U intermediate the ribs radiating from the hub thereof to the outer circumferential face X.

Mounted upon the circumferential face of the head U is a sliding collar or valve Y, which is of a width slightly in excess of the width of the head, as most clearly indicated in Fig. 6. Said collar is provided with a bevel-face Z, which when the parts are brought together fits closely upon the seat V

of the piston-head proper. Adjacent to said face Z is an annular chamber *a*, which is at all times in communication with the ways or channels W of the head. To prevent the collar or valve from becoming detached from the head, we provide suitable bolts *b* and washers *c*, held thereby, said washers, as indicated in Figs. 1 and 6, extending down, so as to engage with the rear edge of the circumferential face or rim X. When the parts are positioned as indicated in Fig. 6, the faces V and Z are out of contact and there is a clear passage through the channels or ways W, the annular space *a*, and the space intermediate the seat V and the face Z. Valve or collar Y is provided with an annular groove *d*, within which is seated a packing-ring *e*, tending at all times to bear against the inner face of the cylinder, forming a tight joint therewith and preventing any escape of air or gas between the outer face of the collar and the inner face of the cylinder.

Within the low-pressure cylinder A and carried by the piston-rod T there is a combined piston-head and valve similar in construction to the piston and valve mounted within the smaller cylinder. It will be noted, however, upon reference to Fig. 1 that the collar or valve works in a reverse direction from that in the smaller cylinder. These collars, in connection with the pistons, form the induction-valves for their respective cylinders, and it will be seen that little or no clearance for the parts is required, the construction being such that the piston may move in its forward stroke—that is to say, when it is compressing air within its cylinder—clear to the cylinder-head.

Adjacent to the head C and leading into the cylinder A are openings *f*, which communicate directly with the atmosphere. (See Figs. 1, 2, and 4.)

Upon reference to Fig. 1 it will be noted that the eduction-valves of the two cylinders A and B are substantially the same in construction—that is, they comprise a cylindrical head *g*, upon which works a cup-shaped valve *h*, which bears when closed directly upon the seat M. Head *g* is secured in its proper position in the air-chamber by means of a plate *i*, which is formed integral therewith and is bolted, as shown, directly to the cylinder-head K. Working within the head *g* is a tube *j*, closed at its lower end, which bears directly upon the cup-shaped valve *h*, and in said tube there is mounted a spring *k*, a plug *l* bearing against the upper end of the spring. The spring tends to hold the valve normally to its seat. Should it become necessary to replace a spring in one of the valves, it can readily be done by removing plug *l* and withdrawing the broken spring, the end of tube *j*, resting against a shoulder *m*, preventing its being blown out. It will thus be seen that the spring can be replaced without lowering the receiver-pressure.

It is of course manifest that cooling-pipes could, if desired, be placed within the chamber G to reduce the temperature of the air which passes therethrough.

Openings *f f* to the lower pressure-cylinder may be arranged so as to communicate with a receiver or pipe-line, so that the compressor can be used for a second and third stage or third and fourth stage, as the case may be, or may be used for compressing gas.

The arrangement of compressor described may be used on a vertical engine, in which case the annular valves would be balanced by springs.

The operation of the machine is as follows: As the piston-rod moves forward in the direction indicated by the arrow in Fig. 1 air is drawn in through the openings *f*, behind the piston in the low-pressure cylinder A, while the air or gas, as the case may be, which is within the cylinder intermediate the cylinder-head K and the piston will be compressed as the valve or ring Y is seated upon the piston-rod and no air can escape therethrough. The continuous forward movement of the piston-head and pistons carried thereby will cause the air in the cylinder A to be compressed and in time to unseat the eduction-valve and permit the escape of the compressed air into the receiver G. At the same time or during the forward movement of the piston-rod the eduction-valve carried by the piston-head in the smaller cylinder is drawn away from its seat, and any air which may be within the chamber G may pass up into the cylinder B through the pipe H and passage I to the rear of the piston in the smaller or high-pressure cylinder. The eduction-valves in head N of the high-pressure cylinder will of course remain closed during the forward movement of the piston-rod and pistons. When, however, the forward movement has been completed and the compressed air or gas forced out of the cylinder A and the return stroke is begun, the eduction-valve of the low-pressure cylinder will close and the induction-valve carried by the piston will open, for the reason that there would be a vacuum intermediate the cylinder-head K and piston-head, and also for the reason that the packing-ring *e* tends by the frictional contact with the cylinder to hold the valve or collar Y back, so as to open communication through the piston-head. The valve or collar Y of the smaller piston-head will, however, as soon as the return movement begins, be closed, due to the friction of the packing-ring *e*, as above stated, and also for the reason that the air forward of the piston-head will become slightly compressed as soon as the piston has moved a short distance. As the piston-rod continues to move to the rear, the air which has entered the high-pressure cylinder from the receiving-chamber G will be further compressed and discharged into the air-chamber O of the head N and out through the passage R, a fresh sup-

ply of air meanwhile being drawn into the low-pressure cylinder A ready for the return movement of the piston-rod.

The same operation of the parts as above described will of course take place upon the forward and return movements of the piston-rod and its attached parts.

The advantages of the type of induction-valve described are—

First. Minimum clearance at the discharge end of the cylinder, the only clearance made necessary by this form of inlet-valve being that required for the mechanical operation of the compressor.

Second. Full port area during the entire stroke, except the small distance at the beginning of the intake portion of the stroke, when the piston-head is moved without the annular valve. This, as will be seen from the construction, is not more than one per cent. on a cylinder thirty-two inches in diameter, the large diameter of the valve making it necessary to have only a very small movement of same.

Third. Ability to get a large port-opening without the sacrifice of other valuable features.

Fourth. The securing of what is practically a positively-operated inlet-valve without the use of any valve-gear or connection with the shaft.

No claim is made herein to the formation or construction of the water-jacket nor the combination of said jacket and the cylinder-heads having the water chambers or spaces and the air-chambers.

Having thus described our invention, what we claim is—

1. In an air-compressor or the like, the combination of a low-pressure cylinder, provided with a suitable air-intake; a head secured to said cylinder and formed with an air-receiving chamber; eduction-valves mounted within said chamber and closing ports leading into the cylinder; a high-pressure cylinder; a receiver G connecting the said air-receiving chamber with the intake end of the high-pressure cylinder; a chambered head for the opposite end of said high-pressure cylinder; eduction-valves mounted therein for controlling the ports communicating with the high-pressure cylinder; a piston-rod working in said cylinders; a piston mounted in each of said cylinders, and connected to the rod; and induction-valves carried by said pistons.

2. In an air-compressor or the like, the combination of a low-pressure cylinder; a high-pressure cylinder arranged adjacent to and in line with said low-pressure cylinder, with an air port or passage formed intermediate the two for the admission of air to the low-pressure cylinder; a hollow head secured to said cylinder; eduction-valves mounted in said head; a receiver connecting the chamber in said head with the intake end of the high-pressure cylinder; a hollow cylinder-head arranged at the opposite end of said high-pressure cylinder; eduction-valves mounted in said head; a piston-rod working in said cylinders; a piston mounted in each of said cylinders and connected to the rod; and induction-valves carried by the pistons, said valves working in opposition to each other, substantially as and for the purpose described.

In witness whereof we hereunto set our hands in the presence of witnesses.

EDWIN REYNOLDS.
CYRUS ROBINSON.

Witnesses to the signature of Edwin Reynolds:

GEO. L. TIFFT,
DAISY M. PIERCE.

Witnesses to the signature of Cyrus Robinson:

M. R. MACMILLAN,
HOMER SLY.