W. K. RICHARDSON.

METHOD OR PROCESS OF COMPRESSING AIR.

APPLICATION FILED JUNE 25, 1907.

916,019. Patented Mar. 23, 1909.

3 SHEETS—SHEET 1.

Fig. 1

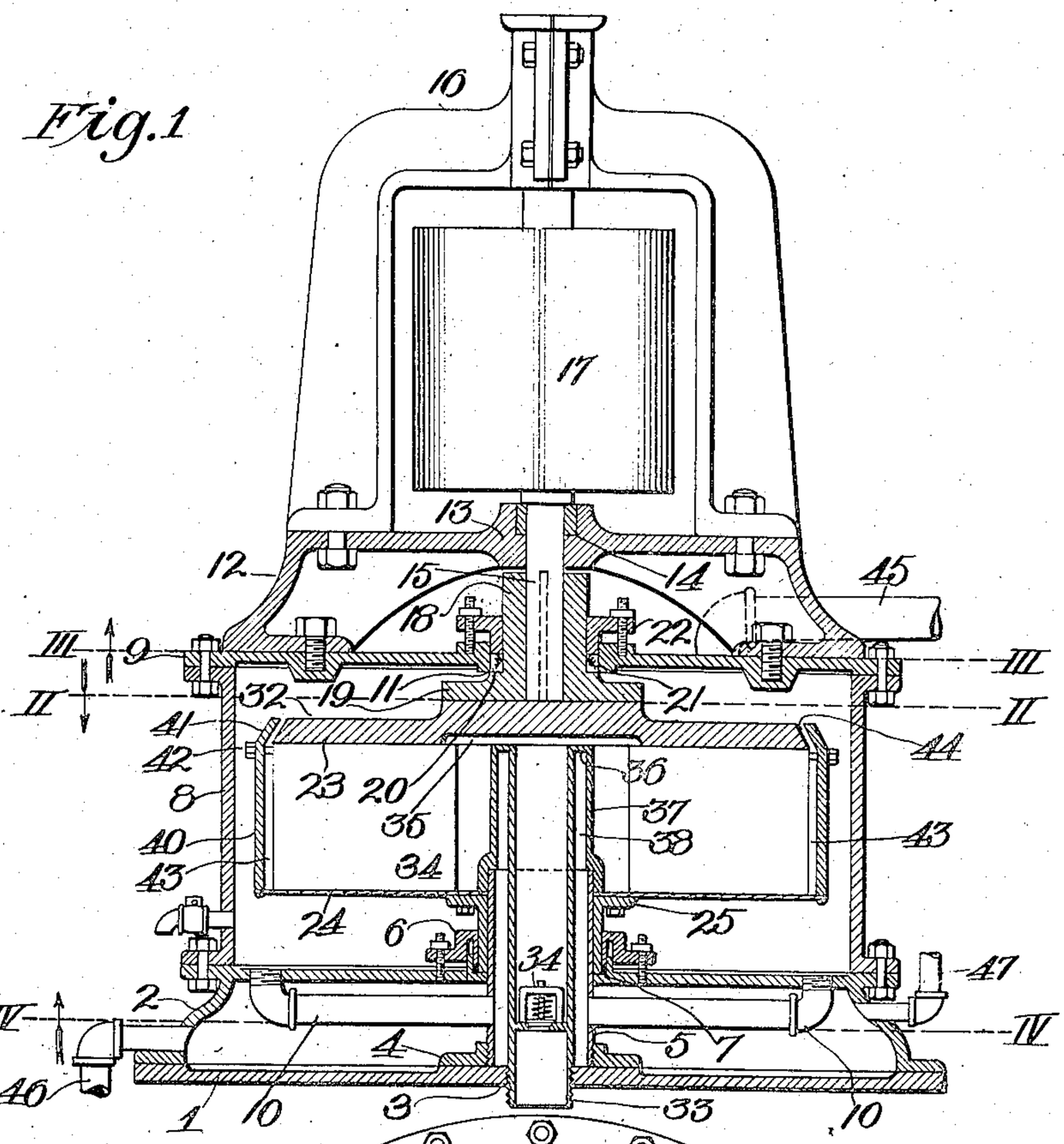
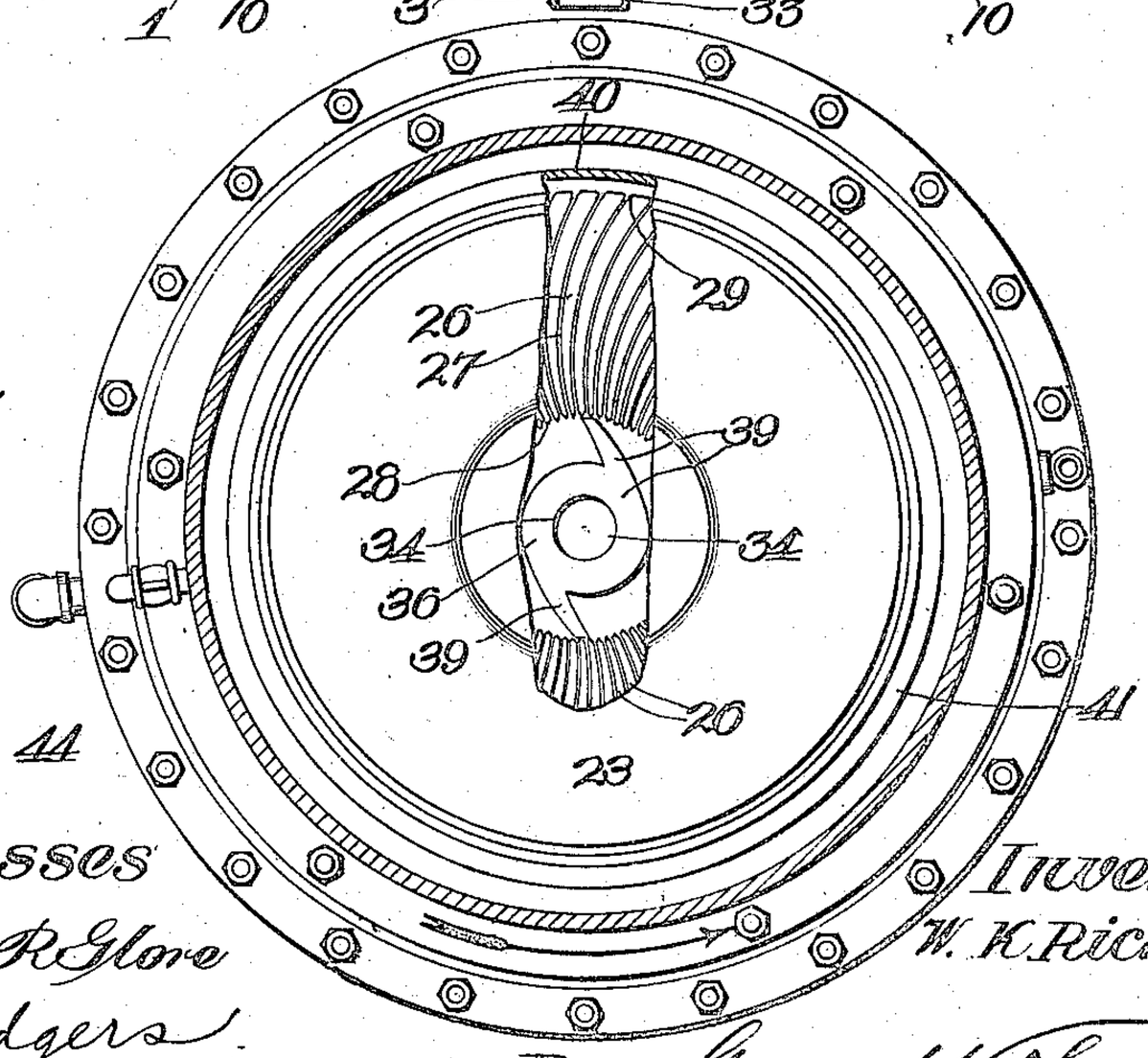


Fig. 2.



Witnesses
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3 SHEETS—SHEET 2.

Fig. 3.

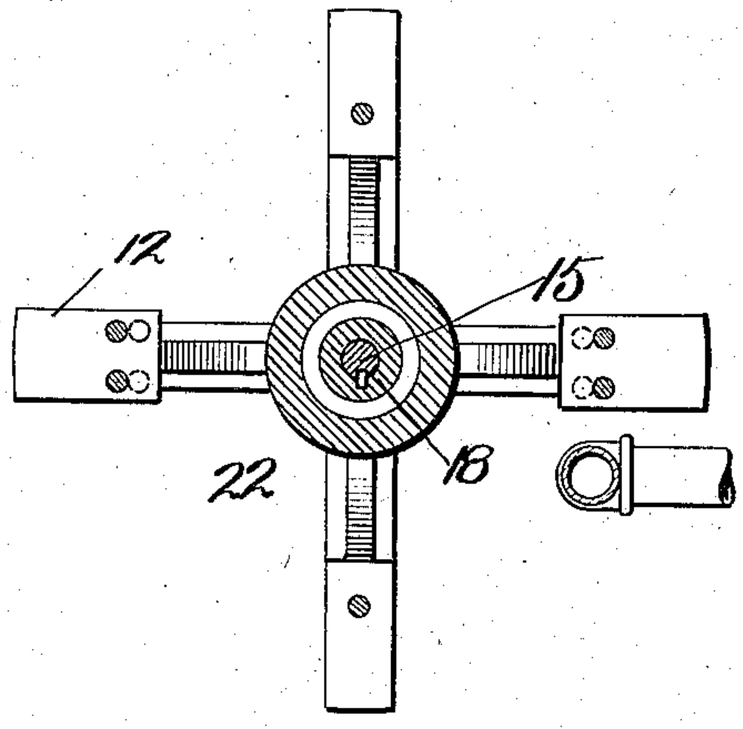


Fig. 4

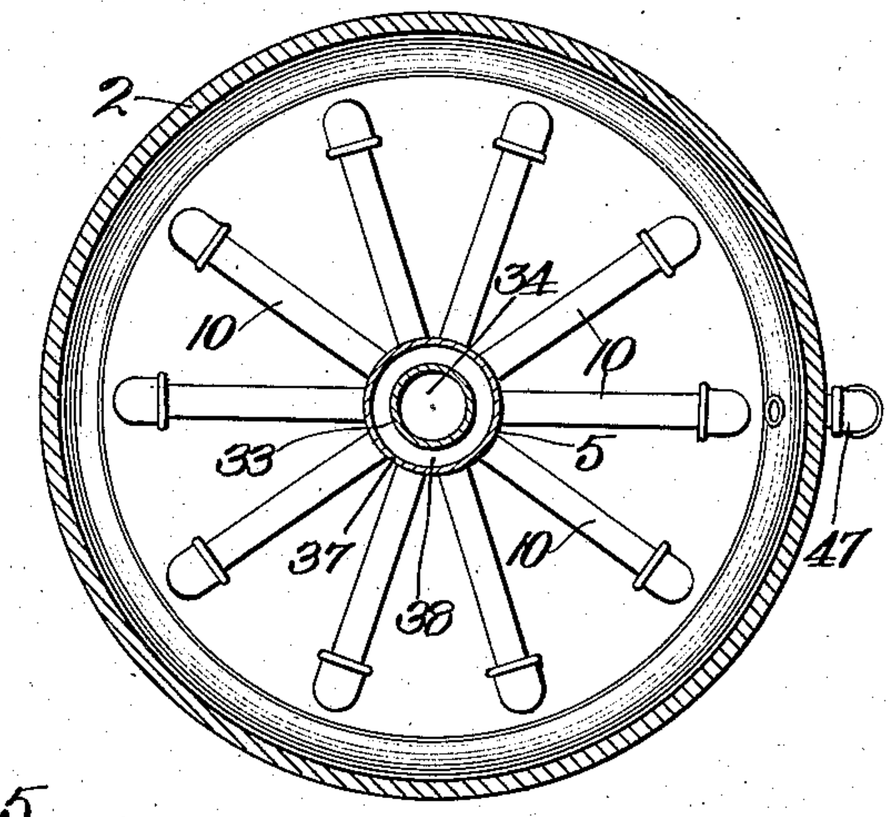


Fig. 5

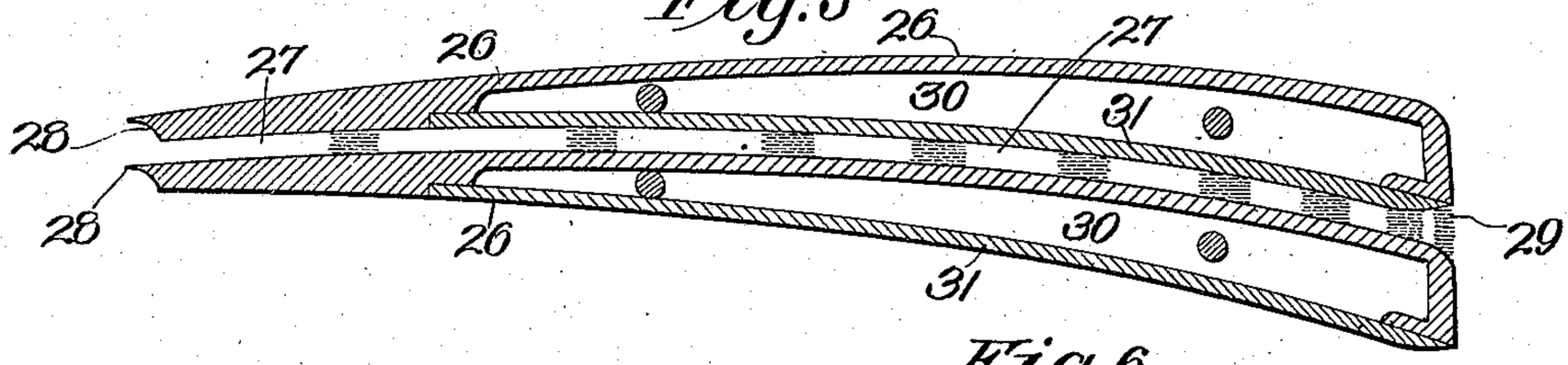


Fig. 6

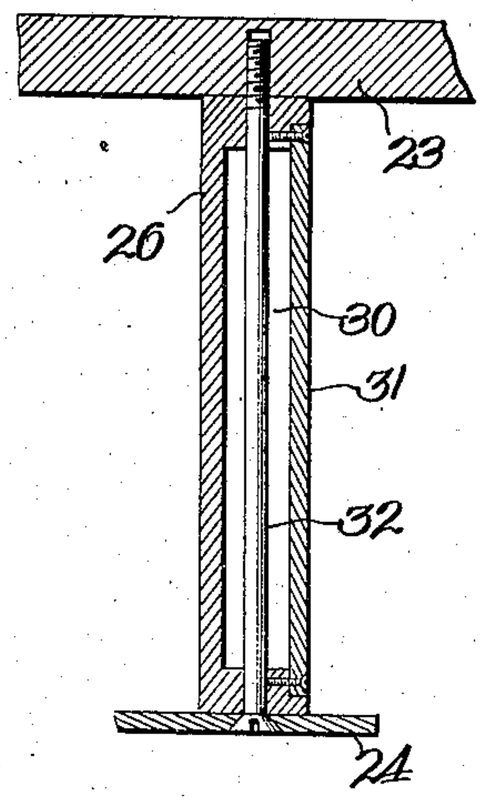
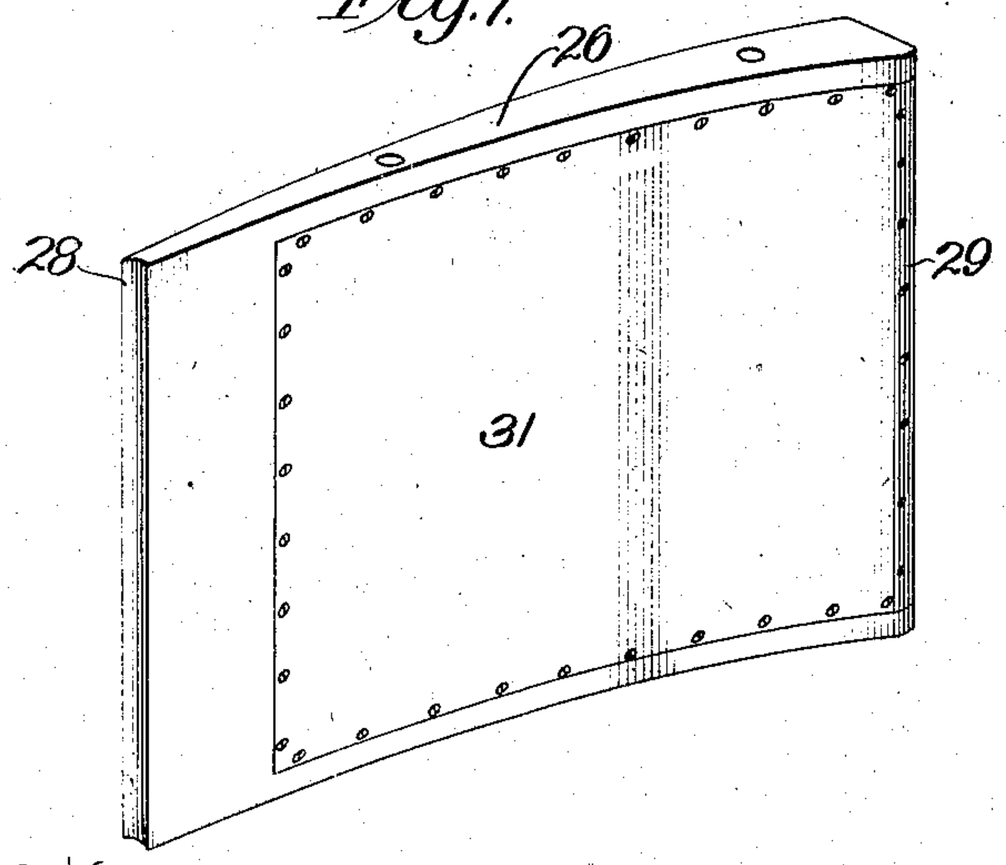


Fig. 7.



Witnesses

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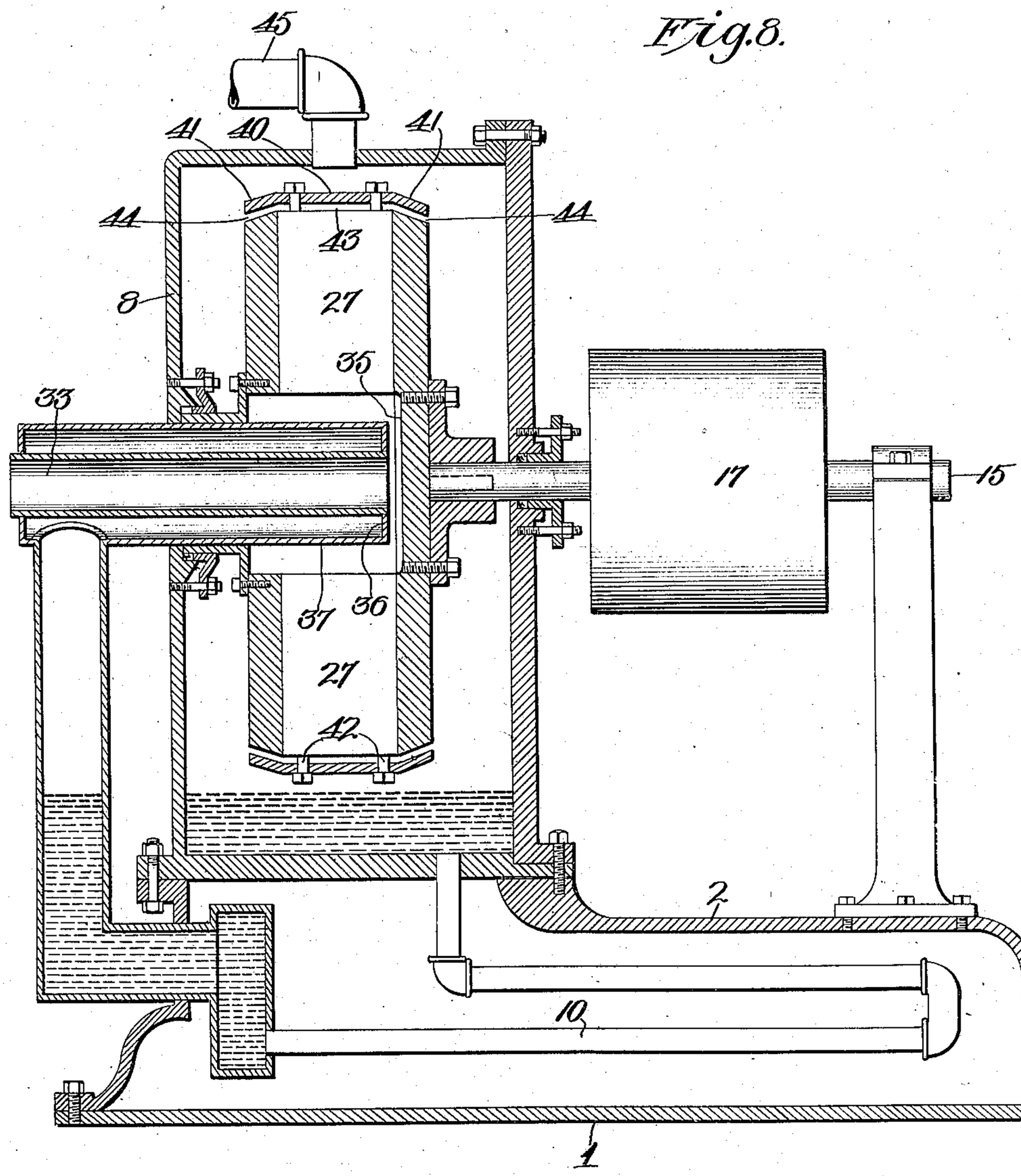
3 SHEETS—SHEET 3.

Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM K. RICHARDSON, OF LEAVENWORTH, KANSAS.

METHOD OR PROCESS OF COMPRESSING AIR.

No. 916,019. Specification of Letters Patent. Patented March 23, 1909.

Application filed June 25, 1907. Serial No. 380,825.

To all whom it may concern:

Be it known that I, WILLIAM K. RICHARDSON, a citizen of the United States, residing at Leavenworth, in the county of Leavenworth and State of Kansas, have invented certain new and useful Improvements in Methods or Processes of Compressing Air, of which the following is a specification.

This invention relates to a process or method of compressing air in a revolving receptacle by the centrifugal force of a non-elastic liquid, and my object is to evolve a process or method whereby air can be compressed to a greater density than the atmosphere at a comparatively small expense, within a small space per unit of power, at a comparatively small expenditure of mechanical power, and with a minimum attention on the part of the operator.

With apparatus employing this principle or process, the four principal sources of loss in air compressors are either entirely overcome or greatly reduced. These sources of loss are:

First.—Increase of temperature and therefore reduction of weight of air admitted to the compressor. In any compressor, compressing air to one hundred pounds and having a constant temperature of 120 degrees and admitting air at say sixty degrees normal, the air is expanded by heat before compression takes place, so that a cylinder full of air at a temperature of 120° represents about nine-tenths of the quantity or weight of air the cylinder would contain at 60°. This means not only a loss of 10% in the efficiency of the compressor, but a corresponding loss of power, for it requires the same power to compress this heated volume of air 90% in weight that it does to compress the same volume of air at normal temperature.

Second.—Heating of the air during compression and the greater force required for the compression on account of this heating due to the difference between the mean average pressure per stroke, compressing air isothermally and adiabatically.

Third.—Friction, this seldom ranges as low as 5% and such results are only obtained in compressors of large units.

Fourth.—Clearance space. This source is recognized as a source of loss, as it is an expenditure of power without result in compound relation to the clearance space to the delivery stroke, and the losses enumerated above.

With these objects in view, this invention consists in certain novel and peculiar features of construction and the utilization of certain laws of physics as hereinafter described and claimed and in order that it may be fully understood reference is to be had to the accompanying drawings, in which—

Figure 1, is a central vertical section of an apparatus for carrying out my invention, the upper part of the apparatus and the impeller-wheel vanes being shown in elevation. Fig. 2, is a horizontal section taken on the line II—II of Fig. 1 but showing the top part of the impeller wheel broken away to expose the arrangement of the vanes and the nozzles to discharge water into the passages between the vanes. Fig. 3, is a section on line III—III of Fig. 1. Fig. 4, is a section on line IV—IV of Fig. 1. Fig. 5, is a horizontal section of a number of the impeller vanes. Fig. 6, is a vertical section of one of said vanes. Fig. 7, is a perspective view of one of the vanes. Fig. 8, is a modification of this device differing in construction, but employing the same general principles involved in Fig. 1.

In the said drawing, the base or water chamber comprises the base plate 1, and the superposed cap 2, bolted or otherwise secured together, the base plate having a central threaded opening 3 and an internally threaded ring 4,—the internal diameter of the ring exceeding that of opening 3,—and secured at its lower end in ring 4 concentrically of opening 3 is a vertical cylindrical shell 5 surrounded by and spaced from the packing gland 6 carried by and at the upper side of cap 2, and clamping down upon said cap the gasket 7.

8 indicates a cylinder mounted upon and secured with a water-tight relation to cap 2, and 9 is the top plate of the cylinder, the same being connected with the interior of shell 5 by a series of radial pipes 10 arranged in the water chamber.

11 indicates a central opening in top plate 9 and 12 indicates a cross-shaped bridge bolted to the top plate and provided with a hub 13 and a wear ring 14 in the upper end of the hub, said hub and ring forming a journal for the reduced lower end of a vertical shaft 15, the upper or non-reduced portion of the shaft resting endwise on the wear

ring being journaled at its upper end in an arch 16 composed of a pair of similar bearing brackets bolted to the bridge, motion being imparted to said shaft through the medium of a belt wheel 17.

18 indicates a collar keyed upon the lower end of the belt wheel shaft and extending through opening 11 and provided within the cylinder with an enlarged base 19, and an upwardly disposed shoulder 20 against which a gasket 21 is clamped by an adjustable packing gland 22, said gland forming a journal for the collar 18. Secured rigidly to the base 19 of the collar is an impeller wheel for revolving in the cylinder and said wheel is constructed as follows:

23 indicates a disk having its periphery beveled upward and inward, and 24 a second disk below and of slightly greater diameter than disk 23 and centrally perforated to fit around shell 5, a sleeve 25 depending from the bottom disk 24, being journaled on said shell and in the packing gland 6 hereinbefore described.

26 indicates a plurality of curved vanes which taper toward their inner ends so as to provide the interposed thin vertical passages 27, the inner ends of the vanes at their concave sides being channeled to provide flared mouths 28 for the inner ends of passages 27, and their outer ends at both sides beveled to provide flaring discharge ends 29 for such passages, as shown most clearly in Fig. 5. Each vane is channeled out at its concave side as at 30 to reduce its weight and said channel is bridged by a curved plate 31 and extending vertically through the vanes and secured to the top and bottom disks are bolts 32.

33 indicates a vertical air tube screwed at its lower end into opening 3 and provided at any suitable point desired, with a check valve 34 which will open and admit air into the cylinder when a partial vacuum is created in the chamber formed by and between the inner ends of the vanes of the impeller wheel, the said tube being disposed axially of the impeller wheel and communicating with the space at the inner ends of the vanes thereof through the shallow chamber 35 formed in the lower side of disk 23.

36 indicates an annular flange projecting outward from the upper end of tube 33 and depending from the outer edge of said flange is a cylindrical shell 37 externally embracing and resting on the upper end of shell 5 and forming in conjunction with said shell 5 the outer wall of an annular chamber 38 communicating with the inner ends of the water pipes 10, the said shell 37 being provided with one or more outwardly projecting spouts 39 which successively register with the mouths of passages 27 of the impeller wheel as the latter is driven in the direction indicated by the arrow Fig. 2.

40 indicates a cylindrical casing arranged concentrically around and spaced from the outer ends of the vanes and secured to and forming a water-tight joint with bottom disk 24 and provided with an upwardly tapering or conical portion 41 surrounding and paralleling the tapered edge of disk 23, bolts 42 extending through said casing and into the outer ends of a number of the vanes in order to provide and maintain at the outer ends of the vanes an annular water chamber 43 with a deflected upper portion 44, the form of the water chamber being such as to maintain an equilibrium between the force produced by thec entrifugal action of the water in the impeller wheel and the pressure of the air in the compression chamber or cylinder as hereinafter referred to.

45 indicates a pipe leading from the cylinder to an air receiver, not shown, and adapted to be equipped with a check valve to prevent back flow of air when the impeller wheel is not in operation, 46 is an inlet, 47 a water-discharge pipe communicating with the water chamber of the base, the circulation of water through said pipes and the base being to cool the water in pipes 10:

Now assuming the air within the compression chamber to be at normal pressure, cooling pipes filled, water reservoir in the compression chamber flooded to a level of the bottom part of the impeller disk, and inner chamber of impeller disk sufficiently filled with water to prime or fill the water discharge casing, and power applied to impeller disk. It being noticed that the upward and inward inclined portion 44 prevents the discharge of water upward therethrough unless the quantity of water is in excess of the capacity of chamber 43, in which event the excess or surplus water will overflow at the top of the impeller wheel, this construction being necessary to retain the water over the ends of the impeller vanes, and to obviate the necessity of immersing the impeller-disk below the surface of the water.

The revolving impeller-disk forces the water through the vanes filling the casing in which they discharge, the flow of water creates a suction or partial vacuum in the inner chamber of the impeller-disk, and a corresponding rise of pressure in the compression chamber, this causes the water to flow from the compression chamber through the spouting nozzle into the buckets of the impeller vanes. The air inlet valve opens owing to this vacuum, and as the buckets of the vanes pass the nozzle they are filled with water which is ejected by centrifugal force into the passages, and filling them in cross section, and forming successive moving plugs or liquid pistons which confine the air between them and the air previously confined in the impeller vanes, is ejected into the com-

pression chamber until a resistance is met equal to the weight of the water in the vanes per unit of area in cross-section, times the centrifugal force produced by the velocity of the impeller, it being understood that this force is just balanced by resistance in the compression chamber until a new charge or the last one to enter the impeller vanes causes a preponderance of pressure, and as the charge advances it overcomes the resistance by the fact of its own pressure and that of the other charges advancing and receiving a greater impetus.

From the foregoing it is determined that I have evolved a method of compressing an elastic fluid at a high efficiency in cost of mechanical power, and for compressing over a great range of volume and variation of pressure required at constant speed. That the first and second sources of loss in air compression previously mentioned, by this method of compression are almost entirely overcome, as there are no heated passages for the air to enter through, and the great amount of cooling surface exposed during compression. The third source of loss is reduced to a minimum as there are no reciprocating, rubbing or wearing parts, except the shaft and its bearings, and the absence of heat from the compressor makes perfect lubrication of this bearing possible. The fourth source of loss is entirely overcome, as a full charge of air is admitted, compressed, and absolutely delivered.

The impeller which consists of the rotating parts within the casing is not herein specifically claimed, the same being shown and specifically claimed in my co-pending application 401,777, filed Nov. 11, 1907.

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

1. The process of compressing air, which consists in admitting air into a revolving receptacle between a body of water admitted under pressure to said receptacle at its intake, whereby it will form a liquid piston therein, and a body of water confined within said receptacle by means of an outlet passage therefrom of which some point of the outer wall of such passage is less removed from the center of the receptacle than the point of the inner wall of the passage farthest from the center of the receptacle; and of subjecting the air admitted to the receptacle, to the pressure of the water admitted at the intake to said receptacle, due to centrifugal force; and of expelling such air through the water in said outlet passage into an air and water chamber.

2. The process of compressing air which consists in admitting air into a revolving receptacle between a body of water admitted under pressure to said receptacle at its intake whereby it will form a liquid piston therein, and a body of water confined within said receptacle by means of an outlet passage therefrom of which some point of the outer wall of such passage is less removed from the center of the receptacle than the point of the inner wall of the passage farthest from the center of the receptacle; and of subjecting the air admitted to the receptacle, to the pressure of water admitted at the intake to the receptacle, due to centrifugal force; and of expelling such air into an air and water chamber; and of maintaining the supply of water admitted at the intake to said revolving receptacle, by the pressure of the air in said chamber.

3. The process of compressing air which consists in admitting air into a revolving receptacle between a body of water admitted at the intake to said receptacle under pressure, whereby it will form a liquid piston therein, and a body of water confined within said receptacle by means of an outlet passage therefrom which extends from points more removed, to points less removed from the center of the receptacle as to constitute a liquid seal at said outlet, subjecting the air to the pressure of the water admitted, due to centrifugal force and expelling it from the receptacle, through the liquid seal.

4. The process of compressing air which consists in admitting air into a revolving receptacle between a body of water admitted at the intake to said receptacle under pressure, whereby it will form a liquid piston therein, even when the receptacle is revolving at high speed, and a body of water confined within said receptacle by means of an outlet passage therefrom which extends from points more removed to points less removed from the center of the receptacle, thereby constituting a liquid seal at said outlet in position to resist backward flow of air to which it is subjected, subjecting the air to the pressure of water admitted, due to centrifugal force and expelling it from the receptacle through the liquid seal, the seal being replenished and maintained against losses by the water admitted as the latter reaches the outer port of the receptacle.

5. The process of compressing air which consists in admitting air and water into a revolving receptacle contained within a hollow shell, confining the air between a body of water admitted under pressure at the intake, and a liquid seal established within the discharge end of said revolving receptacle, subjecting the air pressure due to centrifugal force, and expelling the air and water admitted through the liquid seal into the hollow shell and replenishing and maintaining the flow of water admitted to said revolving receptacle by the pressure imposed on the water by the air compressed.

6. The process of compressing air which consists in admitting air and water into a revolving receptacle which is provided with

passages in which compression of the air occurs said receptacle contained within a hollow shell, confining the air by a body of water admitted under pressure at the intake of said passages and a liquid seal established within the discharge end thereof, subjecting the air to pressure due to centrifugal force and expelling the air and water admitted through the liquid seal into the hollow shell, and replenishing and maintaining the flow of water admitted to said revolving receptacle by the pressure imposed on the water by the air compressed.

In testimony whereof I affix my signature, in the presence of two witnesses.

WILLIAM K. RICHARDSON.

Witnesses:
G. Y. THORPE,
H. C. RODGERS.