

Sept. 27, 1938.

R. C. PATTESON

2,131,453

ROTARY COMPRESSOR

Filed Feb. 28, 1938

3 Sheets-Sheet 1

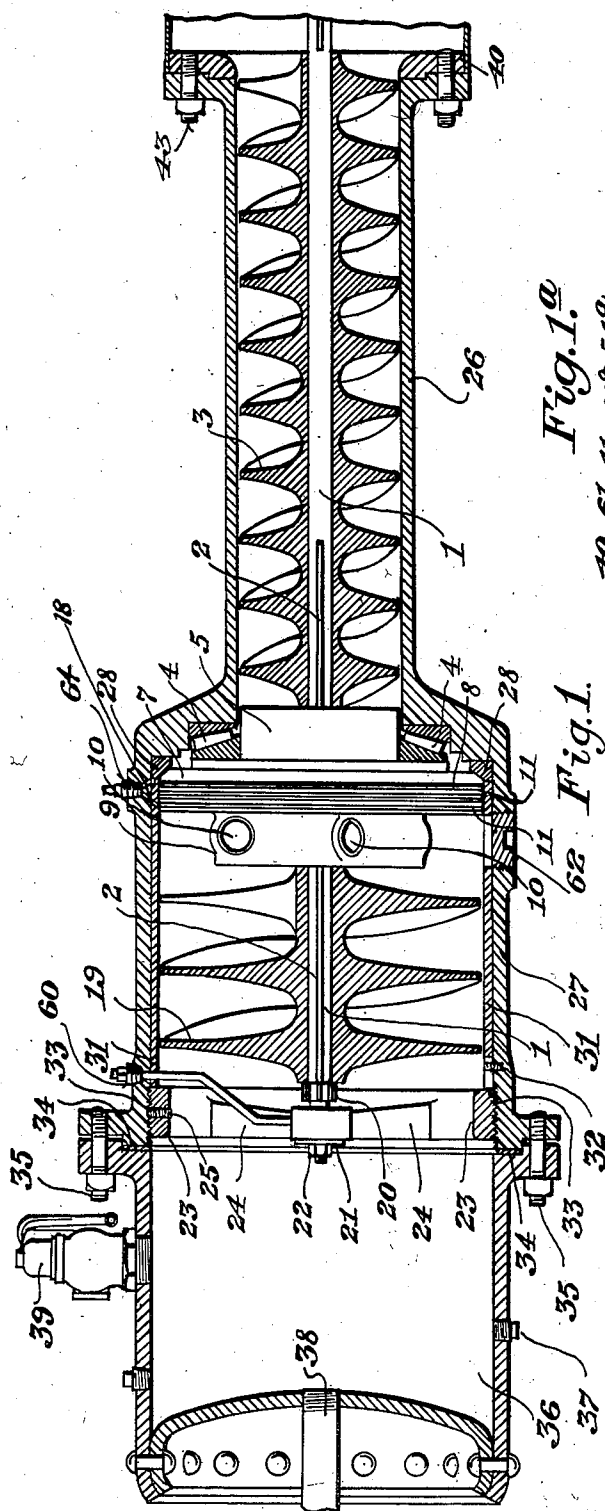
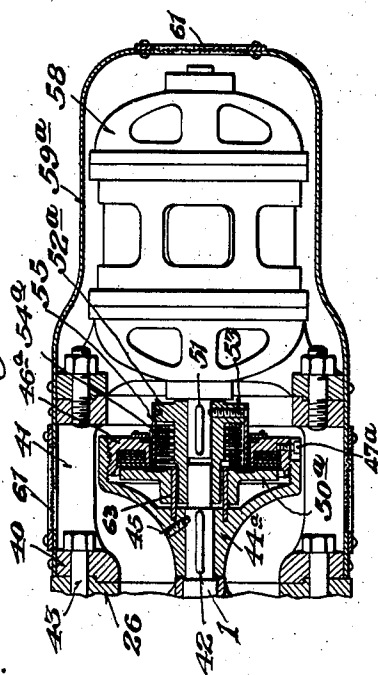


Fig. 1.

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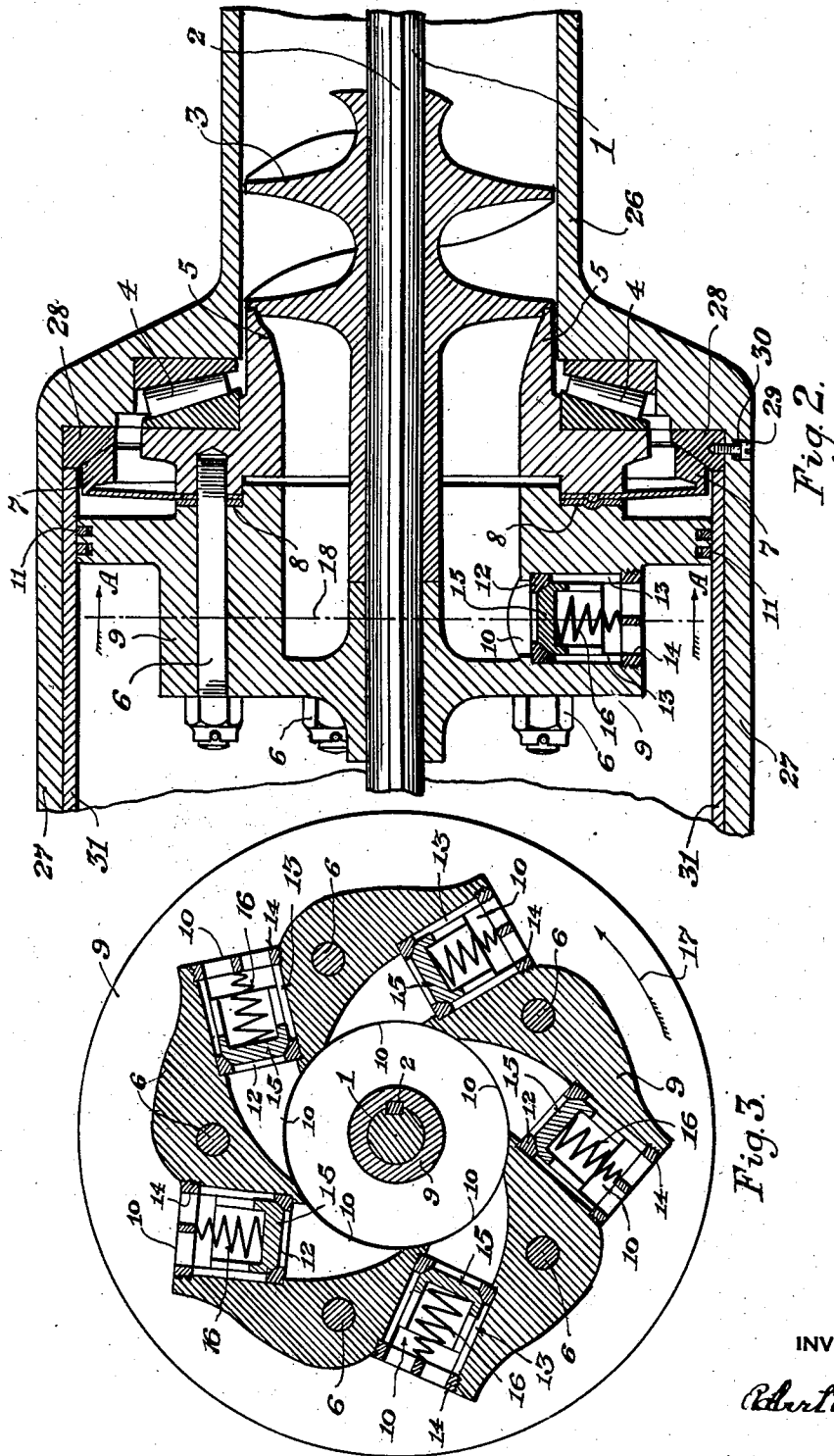


Fig. 3.

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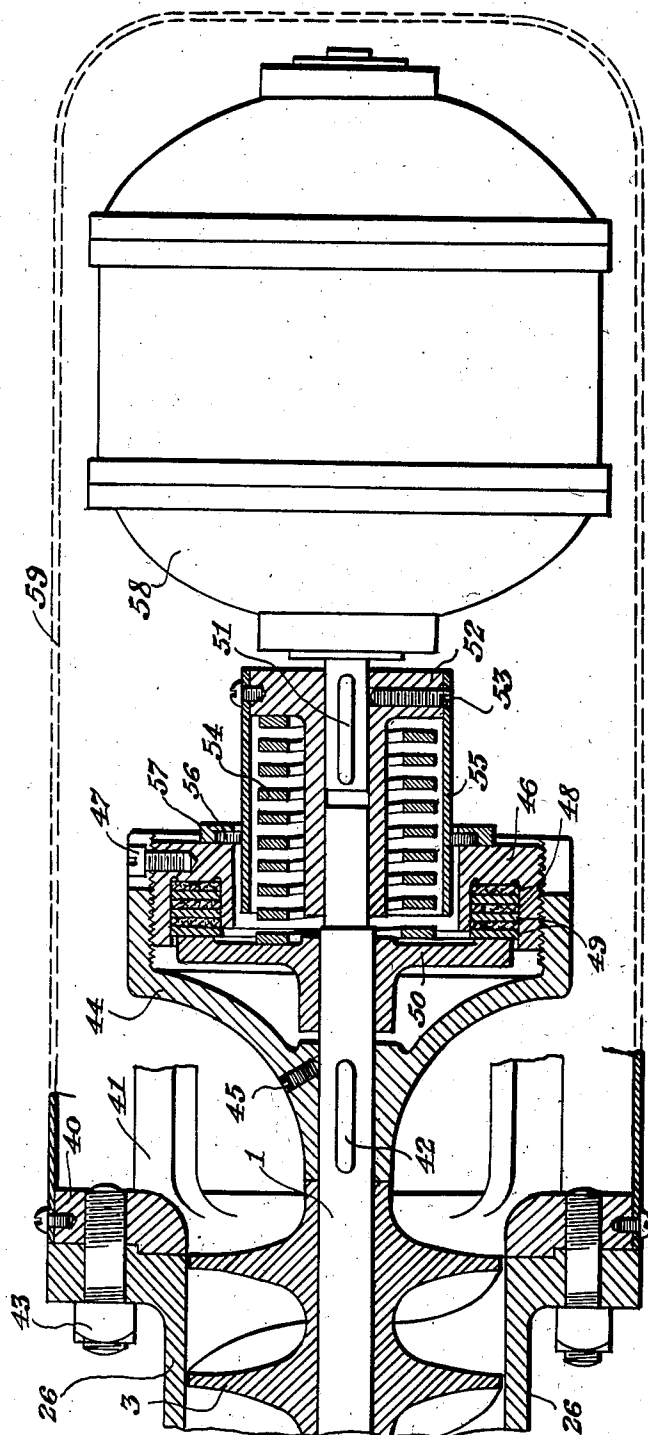


Fig. 4.

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UNITED STATES PATENT OFFICE

2,131,453

ROTARY COMPRESSOR

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15 Claims. (Cl. 230—122)

My invention relates to power driven means for furnishing compressed air or gas for operating pneumatic tools and motors, air brakes, air conditioning and refrigerating apparatus, and other purposes requiring a supply of gaseous fluid in substantial volume under a pressure of several atmospheres.

The invention aims to simplify the construction and improve the operation of such power driven means so as to lessen the first cost and reduce the operating and maintenance cost, and to increase their serviceability. Other aims and advantages of the invention are increased efficiency of operation and saving in power, reduced floor space required and less weight, with no unbalanced moving parts.

Further objects and characteristics of the invention appear in connection with the following description of a preferred form of the invention illustrated in the accompanying drawings, wherein

Figs. 1 and 1a together constitute a part axial cross-section and part side view of an air compressor driven by an electric motor;

Fig. 2 is an axial section of the end of the impeller and valve head on the line 2—2 in Fig. 3, drawn to a larger scale than Fig. 1;

Fig. 3 is a cross-section of the same on the line 3—3 in Fig. 2; and

Fig. 4 is an axial cross-section of a modified form of the clutch and motor end of the device, the motor casing being shown in side elevation.

In the device shown in the drawings, which is selected for descriptive purposes as a convenient illustration of a self-contained form of the invention, the operating parts are contained in a generally cylindrical housing, being mounted upon an axial shaft 1, which is provided with a keyway 2 at its working end and upon which is splined the compressor impeller 3, consisting of a spiral vane nearly filling the intake cylinder 26 in which it is mounted, and forming therewith a passage leading to a valved head 9 having a hollow hub communicating with the passage, as shown in Figs. 1 and 2.

The axial pressure on the impeller shaft due to the reaction of the fluid being compressed against the compressor head 9 and packing members 11 is taken by a thrust bearing 4, which in the form shown is an antifriction tapered roller bearing supported in the end of the intake cylinder and in turn supporting the compressor head and shaft by means of a suitable bearing thimble or ring 5 to which the head is secured by bolts 6.

The compressor head 9 has five outwardly

opening passages or ports 10 closed by valves 15 which are held against their seats 12 by springs 16 except when thrown outwardly by centrifugal force to open them when the compressor is running at operating speed in the direction shown by the arrow 17 in Fig. 3. The valves and springs are retained in the openings in the valve head by means of threaded annular retainers or rings 14 which screw into the outer ends of these openings, and likewise retain the valve seats 12 in place by means of sleeves 13.

The valve head 9 has a peripheral flange which fits loosely in the lining sleeve 31 in the pressure cylinder 27, and is provided with packing rings 11 of the split expansion type to seal the space between the flange and liner and prevent leakage of fluid past the compressor head into the intake cylinder. A spring disc packing member or sealing ring 7 is secured to the valve head between it and the ring 5 to catch any leakage past the rings 11, a gasket 8 being provided between its inner edge and the head 9. This packing member 7 has a tapered conical face bearing against a conical sealing ring 28 which is secured in the end of the pressure cylinder by means of set screws 29 or other suitable means provided with gaskets 30 for preventing leakage at these points. These packing or sealing members are lubricated from a pressure lubricator (not shown) through ducts 18 leading to the working faces of the sealing members, the excess lubricant being carried into the bearing 4 by the fluid pressure and hence into the intake cylinder where it commingles with entering air or gas for lubricating the valve parts. Suitable channels are cut in the face of the sealing ring 7 for assisting in maintaining adequate supply of lubricant to the rubbing surfaces.

At the delivery end of the pressure cylinder an adjustable bearing spider or frame 23 is provided, which is screw-threaded on its periphery to screw into the internally threaded end 33 of the cylinder, where it is retained by a set screw 25. This spider retains the cylinder liner 31 in place against longitudinal movement. A pin 32, working in a slot in the liner, holds the latter against rotation.

The spider 23 has a central hub to which it is connected by spokes 24 and which hub supports the inner end of the splined shaft by means of a tapered roller bearing 21 or other suitable bearing means. A nut 22 on the end of the shaft holds the bearing and shaft in place. Lubricant may be supplied to the bearing 21 under pressure, a suitable supply pipe 60 being provided for this purpose.

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Between the end of the shaft 1 and the head 9 is a spiral vane 19 constituting a relief impeller and temperature reducer, and which is secured to rotate with the shaft by a key working in the spline 2. A nut 20 holds this impeller in place on the shaft. The clearance between the outer periphery of this vane 19 and the pressure cylinder liner is sufficient to prevent friction between the two, but not sufficient to pass any considerable volume of air, which is forced to follow the spiral passage defined between the vane and cylinder liner.

The spiral impeller vane 19 in the pressure cylinder abstracts heat from the compressed fluid and transmits some of it through the shaft to the spiral impeller vane 2 in the intake cylinder, which in turn gives up heat to the cold entering air, thereby tending to maintain more uniform temperature in the apparatus and reducing back pressure.

A reservoir cylinder 36 having an outlet pipe 38 and a relief valve 39 is bolted to the pressure cylinder by stud bolts 35 or other securing means, both cylinders being provided with suitable flanges between which a gasket of suitable material or other packing means 34 is placed for maintaining a tight joint. An opening closed by a plug 37 is provided in the reservoir cylinder for draining it periodically should oil, water or other liquid be deposited therein.

The driving motor 58 is supported by a frame 41 having a flange 40 bolted to the intake cylinder 26 by stud bolts 43 or other suitable means. The driving end of the shaft 1 carries a bell shape housing 44a, located near the end of the shaft and securely fixed in place by a key 42 and set screw 45. Upon the end of the shaft 1, within the open end of the housing 44a, there are journaled a clutch disc or face plate 50a and a clutch driving sleeve 52a, the latter extending beyond the shaft 1 and being splined upon the adjacent end of the aligned motor shaft 51 where it is held in place to rotate therewith by a set screw 53 or other suitable means.

The clutch plate drives the compressor shaft through friction rings, which are embraced between the friction face of the clutch and the adjustable clutch ring 46a that screws into the open end of the housing 44a and is held in adjusted position by a screw 47a or other locking means, as shown in Fig. 1a. A sleeve 63 is provided surrounding the hub of the driving sleeve 52a for the clutch plate 50a to turn and slide on, as is necessary in the operation of the device.

The clutch plate and driving sleeve are connected by means of a spiral tension and compression spring 54a which is rigidly secured thereto at its ends and serves as a flexible means to drive the compressor shaft 1 from the motor 58. This spring is shielded by a casing 55 mounted on the sleeve 52a, and which projects into the open end of the housing 44a on the compressor shaft and is provided with an annular packing or other means for keeping dust out. As casing 59a protects the motor 58, screened openings 61 being provided to permit air to enter.

In the modified form of slidable clutch illustrated in Fig. 4, the bell shape housing 44 is fixed on the driving shaft 1 near its end, and the face plate 50 is journaled directly on the driving shaft within the open end of the housing 44. The clutch driving sleeve 52 is also journaled on the end of the driving shaft 1 and splined on the end of the aligning motor shaft 51 to maintain the two shafts in axial alignment. A screw 53

holds the clutch driving sleeve fixedly on the end of the motor shaft.

Within the open end of the housing 44 is an annular clutch ring 46 which is threaded on its periphery and screws into the internally threaded housing, where it is held in adjusted position by the set screw 47 or other suitable means. The threads on the clutch ring are made left hand so that if the set screw should shear off in case of a jam or overload, the clutch ring would screw out of the housing and release the motor from the shaft.

This clutch ring has a space on its inner face within which friction rings 48, 49, are placed in juxtaposition to each other and to the working face of the clutch disc 50. These friction rings may be made of bronze, antifriction metal, vulcanized fibre or other material which is somewhat resilient and has sufficient toughness and strength to stand the friction and pressure to which they are subjected in starting the compressor. Preferably these rings are arranged in alternation, the rings 48 being made of fibre and the rings 49 being made of bronze or other metal. A packing ring or washer 56, held by a retainer ring 57, is provided for maintaining a lubricant and dust tight joint between the driving spring casing 55 and clutch ring 46 so that the entire clutch mechanism may be packed in grease. A motor and clutch guard casing 59 is also provided for protecting these parts.

The cylinder 27 may advantageously be provided with an inspection opening, closed by a plug or cover 62, through which access may be had to the valves 15 and associated parts should need be, and for examining the condition of the packing rings and cylinder lining. The lubricant feed pipe 64 which supplies oil or grease to the packing rings 11 and packing disc 7 may also be removed readily for inspection purposes.

The operation of the apparatus is simple. Upon starting the motor 58, which may be accomplished manually or by an automatic pressure responsive device when the pressure in the reservoir cylinder drops, because of the drag between the clutch disc 50 and friction rings 48, 49, the driving spring 54 winds up until the clutch disc bears against the friction rings with sufficient force to cause the impeller shaft 1 to rotate at the same speed as the motor, thus providing an easy starting means and friction drive. Atmospheric air or other compressible fluid is drawn in through and around the motor frame through the screened openings 61 in the motor casing 59, tending to keep the motor cool during its operation, and this compressible fluid continues through the spiral passage between the impeller vane 3 and intake cylinder 26 and into the valve head 9. The high speed of rotation opens the valves 15 and the fluid, which has appreciable weight, is thrown out by centrifugal force through the passages 10 into the pressure cylinder 27, where it proceeds through the spiral passage defined by the vane 19 and into the reservoir 36, giving up some of its heat on the way, and building up the pressure in the reservoir to that corresponding to the speed of rotation and density of the fluid.

When the motor is stopped either by the attendant, or automatically by a pressurestat or other suitable control device, the valves 15 close as the impeller slows down, and whatever air or gas under pressure is stored in the reservoir is trapped there. This arrangement admits of compressing fluid to several atmospheres with a

comparatively small apparatus and maintaining this pressure until needed for use.

Preferably the cylinders are made of cast iron or steel, the reservoir of boiler plate, the impellers, clutch members and valve head of aluminum, and the valves, rings, liners and packing means of steel, bronze, lead and fibre, as may prove best adapted for different designs and conditions of service. The construction is compact, the moving parts are of light weight and are balanced upon their axes of rotation, and all operating parts are protected from injury and dirt by the cylinders and motor housing. Ample lubrication for the bearings, valves and packing means may be provided for operating the compressor for considerable periods of time without attention.

The design is such as to make this type of compressor suitable for severe use, and readily adapted to railways, construction work, mines, portable plants, refrigerating machinery, and many other special purposes for which a strong reliable compressor which will furnish a considerable volume of air under more pressure than can be obtained with blower type devices is desirable.

It is evident that modifications may be made in the size and shape of the cylinders and operating parts, and any usual means for mounting or attaching the apparatus upon a pedestal or foundation or other suitable support may be provided, within the skill of the designer.

The invention is not restricted to the design illustrated, but what I claim is as follows:

1. A gaseous fluid compressor comprising an impeller shaft and power driving means therefor, a first cylinder coaxial therewith and having an opening at the inlet end, a spiral vane mounted on said shaft to rotate therewith within said cylinder, an abutment adjacent the outlet end of said cylinder, a second cylinder coaxial with said shaft in axial alinement with said first cylinder, a valve carrying member mounted on said shaft to rotate therewith between said cylinders, said valve carrying member having an axial passage communicating with said first cylinder and symmetrically disposed outward branches opening into said second cylinder, valves disposed in said branches and means for normally holding them closed, said valves tending to open under the action of centrifugal force produced by the rotation of said shaft, and means cooperating with said abutment for preventing back flow of gaseous fluid from said second cylinder to said first cylinder.

2. A gaseous fluid compressor comprising an impeller shaft and power driving means therefor, a first cylinder coaxial therewith and having an opening at the inlet end, a spiral vane mounted on said shaft to rotate therewith within said cylinder, an abutment adjacent the outlet end of said cylinder, a second cylinder coaxial with said shaft in axial alinement with said first cylinder, a valve carrying member mounted on said shaft to rotate therewith between said cylinders, said valve carrying member having an axial passage communicating with said first cylinder and symmetrically disposed outward branches opening into said second cylinder, valves disposed in said branches and means for normally holding them closed, said valves tending to open under the action of centrifugal force produced by the rotation of said shaft, and means for preventing back flow of gaseous fluid from said second cylinder to said first cylinder, said last named means including a spring pressed annular packing member having

a wearing face carried by said valve carrying member.

3. A gaseous fluid compressor comprising an impeller shaft and power driving means therefor, a first cylinder coaxial therewith and having an opening at the inlet end, a spiral vane mounted on said shaft to rotate therewith within said cylinder, an abutment adjacent the outlet end of said cylinder, a second cylinder coaxial with said shaft in axial alinement with said first cylinder, a valve carrying member mounted on said shaft to rotate therewith between said cylinders, said valve carrying member having an axial passage communicating with said first cylinder and symmetrically disposed outward branches opening into said second cylinder, valves disposed in said branches and means for normally holding them closed, said valves tending to open under the action of centrifugal force produced by the rotation of said shaft, and means for preventing back flow of gaseous fluid from said second cylinder to said first cylinder, said last named means including expansion ring packing mounted on said valve carrying member and having a wearing face bearing against the wall of said second cylinder.

4. A gaseous fluid compressor comprising an impeller shaft and power driving means therefor, a first cylinder coaxial therewith and having an opening at the inlet end, a spiral vane mounted on said shaft to rotate therewith within said cylinder, an abutment adjacent the outlet end of said cylinder, a second cylinder coaxial with said shaft in axial alinement with said first cylinder, a valve carrying member mounted on said shaft to rotate therewith between said cylinders, said valve carrying member having an axial passage communicating with said first cylinder and symmetrically disposed outward branches opening into said second cylinder, valves disposed in said branches and means for normally holding them closed, said valves tending to open under the action of centrifugal force produced by the rotation of said shaft, a second spiral vane mounted on said shaft to rotate therewith and coaxial with said second cylinder, a pressure reservoir communicating with the delivery end of said second cylinder, and means for preventing back flow of gaseous fluid from said second cylinder to said first cylinder.

5. A gaseous fluid compressor comprising an impeller shaft and power driving means therefor, a first cylinder coaxial therewith and having an opening at the inlet end, a spiral vane mounted on said shaft to rotate therewith within said cylinder, an abutment adjacent the outlet end of said cylinder, a second cylinder coaxial with said shaft in axial alinement with said first cylinder, a valve carrying member mounted on said shaft to rotate therewith between said cylinders, said valve carrying member having an axial passage communicating with said first cylinder and symmetrically disposed outward branches opening into said second cylinder, valves disposed in said branches and means for normally holding them closed, said valves tending to open under the action of centrifugal force produced by the rotation of said shaft, a thrust bearing supported by said abutment, a cooperating bearing member supported by said impeller shaft, and means for preventing back flow of gaseous fluid from said second cylinder to said first cylinder.

6. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said

shaft adjacent the outlet end of said supply duct, a pressure container surrounding said shaft in front of said abutment, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container.

7. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said shaft adjacent the outlet end of said supply duct, a pressure container surrounding said shaft in front of said abutment, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container, said last named means including a flexible diaphragm secured to said valve carrying head and having its periphery provided with a wearing face bearing against a wearing face integral with said pressure container.

8. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said shaft adjacent the outlet end of said supply duct, a pressure container surrounding said shaft in front of said abutment, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container, said last named means including a packing means associated with said valve carrying head and said pressure container.

9. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said shaft adjacent the outlet end of said supply duct, a thrust bearing between said shaft and abutment, a pressure container surrounding said shaft in front of said abutment, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating

with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container.

10. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said shaft adjacent the outlet end of said supply duct, a thrust bearing between said shaft and abutment, a pressure container surrounding said shaft in front of said abutment, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container, said last named means including a packing means associated with said valve carrying head and said pressure container, and means for lubricating said packing means and bearing.

11. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor including a slippable clutch device, a fluid supply duct coaxial with said shaft, a valve carrying head mounted on said shaft to rotate therewith, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means for preventing back flow of fluid along said shaft.

12. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor including a friction clutch device having a driving member and a driven member connected by a torsion spring, a fluid supply duct coaxial with said shaft, a valve carrying head mounted on said shaft to rotate therewith, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means for preventing back flow of fluid along said shaft.

13. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor including a friction clutch device having a driving member and a driven member connected by a torsion spring, friction means between the adjacent faces of said driving and driven members, the torsion spring having

sufficient tension to hold said means in frictional contact with said driving and driven members, a fluid supply duct coaxial with said shaft, a valve carrying head mounted on said shaft to rotate therewith, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means for preventing back flow of fluid along said shaft.

14. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said shaft adjacent the outlet end of said supply duct, a pressure container surrounding said shaft in front of said abutment, a thrust bearing between said shaft and abutment, an adjustable bearing in said pressure container for supporting the adjacent end of said shaft, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said

means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, and means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container.

15. A gaseous fluid compressor comprising an impeller shaft and impeller and power driving connection therefor, a fluid supply duct coaxial with said shaft, an abutment surrounding said shaft adjacent the outlet end of said supply duct, a pressure container surrounding said shaft in front of said abutment, a thrust bearing between said shaft and abutment, an adjustable bearing in said pressure container for supporting the adjacent end of said shaft, a valve carrying head mounted on said shaft to rotate therewith in said pressure container, said valve carrying head having an axial passage communicating with said fluid supply duct and outwardly extending branches discharging into said pressure container, valves disposed in said branches to open outwards and means for holding them closed, said means permitting opening of said valves when the speed of rotation of said shaft exceeds a predetermined minimum number of revolutions per minute, means cooperating with said abutment for preventing back flow of fluid along said shaft from said pressure container, and means for lubricating said bearings.

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