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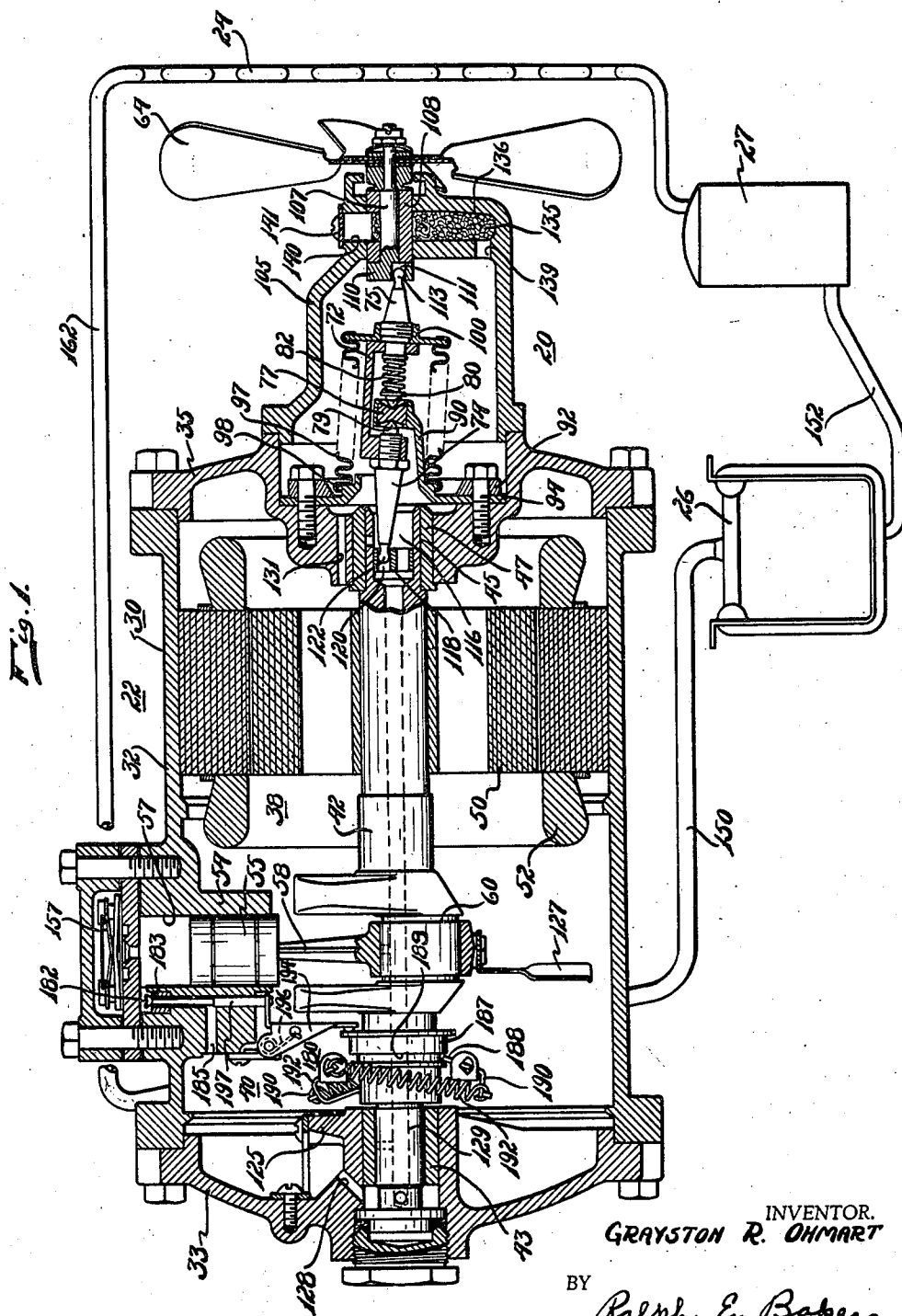
G. R. OHMART

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REFRIGERATING APPARATUS

Filed Oct. 7, 1932

2 Sheets-Sheet 1.



INVENTOR.
GRAYSTON R. OHMART

BY
Ralph E. Baker
ATTORNEY.

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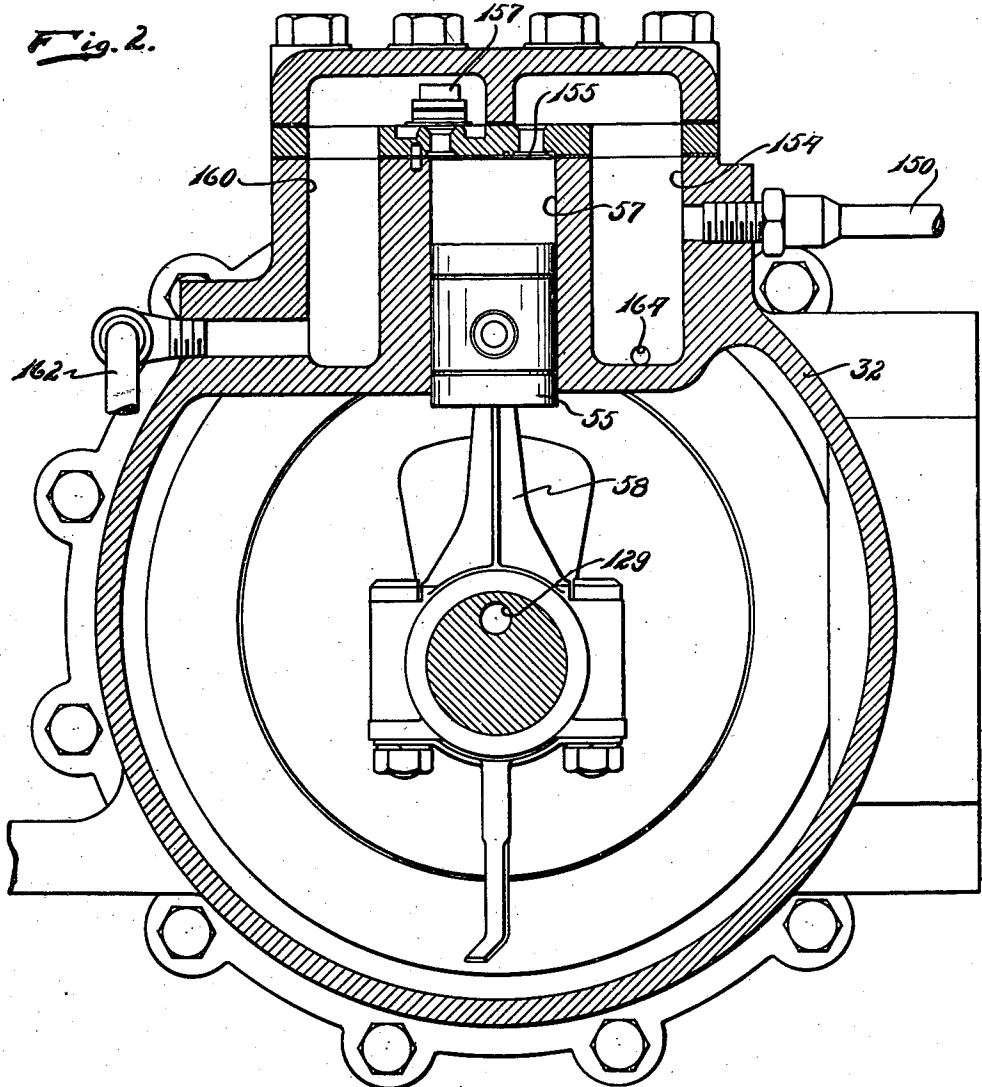
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INVENTOR.

GRAYSTON R. OHMART

BY

Ralph E. Baker

ATTORNEY.

UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

Grayston R. Ohmart, Detroit, Mich., assignor to
Kelvinator Corporation, Detroit, Mich., a cor-
poration of Michigan

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14 Claims. (Cl. 74-66)

This invention relates to refrigerating apparatus, and more particularly to refrigerating apparatus of the compression type.

It is one of the objects of this invention to provide a refrigerating system of the type including a compressor, a driving motor, a condenser and a refrigerant evaporator and an improved arrangement for cooling the condenser which is especially applicable to refrigerating apparatus wherein the motor and the compressor are both entirely enclosed in a fluid-tight or hermetically sealed casing.

Another object is to provide a fan which is located exteriorly of the casing for cooling the condenser and to arrange for transmitting power from the motor within the casing to the fan by an improved mechanical connection without, in any way, affecting the fluid-tight qualities for hermetically sealing the casing enclosing the motor and the compressor.

Another object of this invention is to provide an improved power transmitting joint for transmitting power from the interior to the exterior of a hermetically sealed casing with but a negligible amount of friction and without in any way affecting the hermetical sealing qualities of the casing.

Another object of my invention is to provide intake and discharge chambers for the compressed fluid, which are of sufficient size so as to even out the periodic suction and discharge to and from the cylinder so as to provide silencers which enable the operation of the compressor without pulsation hums.

Another object of my invention is to provide an improved unloader which is arranged to bypass refrigerant from the compression cylinder until the motor attains a certain speed and which is also arranged to prevent the by-passing of refrigerant fluid from said cylinder after the motor attains a certain speed. In practicing the invention, a valve is used to close the by-passing and this valve is arranged so that it effectively closes the by-pass by mechanically operated means, which are assisted by the pressure created within the compression cylinder after the motor attains a predetermined speed.

Other objects and advantages will be apparent from the following description and accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a view showing a refrigerating system embodying features of my invention, partly illustrated diagrammatically and an enlarged ver-

tical cross sectional showing of the motor-compressor unit; and

Fig. 2 is a view in cross section, taken along the line 2-2 of Fig. 1.

In many refrigerating machines heretofore constructed, a separate compressor and a motor for driving the same have been provided with an external drive shaft for connecting the motor to the compressor. Such machines, however, require the provision of a stuffing box for the compressor shaft to prevent the escape of refrigerant fluid from, or the admission of air into, the compressor housing. These stuffing boxes required considerable attention to maintain a seal which was entirely fluid-tight. As refrigerating machines of the household type have a relatively small volumetric capacity, a slight amount of leakage of refrigerant or infiltration of air will interfere materially with the successful operation of the machine. In addition, it has been found that stuffing boxes after they have been used over an appreciable length of time become noisy, which renders the apparatus entirely unsuitable for household use. Refrigerating machines of this character are generally referred to as of the open type.

It has also been proposed to have the compressor and its driving motor located in a single, hermetically sealed casing adapted to contain refrigerant fluid. With such an arrangement, the stuffing box is entirely unnecessary as the entire operating mechanism may be confined within the interior of the casing, whereby complete fluid-tightness of the refrigerating system is assured. Refrigerating machines of this character are generally referred to as the enclosed type.

With refrigerating machines of the open type, a fan is usually mounted on the motor or compressor shaft for cooling the condenser. However, with machines of the enclosed type, the fan for cooling the condenser must be located on the exterior of the casing and, to drive this far, it has previously been proposed to provide a separate small motor. This necessitated the use of two motors together with starting and control apparatus for each. Furthermore, a motor of very small capacity is sufficient for driving the fan and such motors are relatively inefficient and relatively unreliable as compared with the motor used for driving the compressor. In addition, if separate motors are provided and the fan motor fails to operate, inadequate condensation of the gaseous refrigerant will result and dangerous high pressures will be produced as long as the compressor continues to operate.

In accordance with my invention, I eliminate the above objections by providing a refrigerating machine of the type which includes a motor and a compressor entirely enclosed within a hermetically sealed casing, and a fan for effecting forced circulation of air over the condenser, and, preferably, in addition, over the casing enclosing the motor and compressor, and have arranged for mechanically driving said fan by means of a connection which permits power to be transmitted from the compressor motor to said fan without in any way affecting the hermetical sealing of the enclosing casing. By this arrangement, stuffing boxes are eliminated and only one motor is required.

Referring now to the drawings for a more detailed description of my invention, the numeral 20 designates, in general, a refrigerating system comprising a motor-compressor unit 22, condenser 24, evaporator 26 and a high side float mechanism 27. The motor-compressor unit comprises a fluid-tight or hermetically sealed casing 30, which includes a central cylindrically shaped casing 32 and removable end casting portions or plates 33 and 35. Within the casing 30 there is disposed a motor 38 and compressor 40. The motor and compressor are operatively connected together by means of a drive shaft 42 which is journaled on one end thereof in a bearing 43 carried by end plate 33. The opposite end of the shaft 42 is provided with a reduced portion 45 which is journaled in a bearing 47 carried by removable end plate 35. The motor 38 includes a rotor 50, which is preferably press-fitted on the drive shaft 42, and a stator 52 carried by casting 32. The compressor includes a cylinder body 54, piston 55 which is adapted to be reciprocated in a cylinder 57 by means of connecting rod 58 operatively connected to the piston and an eccentric portion 60 of the drive shaft 42.

In order to provide means for cooling the condenser, a fan 64 has been provided. Preferably, the fan 64 is operated by power received from motor 38, which drives the compressor 40. In order to accomplish this, I have provided a mechanical connection between the motor 38 and the fan 64 and arranged such connection in such a manner that power is transmitted to the fan without, in any way, affecting the fluid-tight qualities of the hermetically sealed casing.

The improved mechanical drive connection between the motor 38 and fan 64 comprises, in general, wobble shaft means 70. The shaft means 70 comprises, in general, a yoke-shaped member 72 which serves to connect shaft ends 74 and 75. Between the ends of the yoke-shaped member 70 there is disposed a stationary pivot bearing support 77 for supporting the shaft means. Also, between the ends of the yoke-shaped member 72 there is provided a pivot point member 79 which is rigidly connected to the shaft means 70. This pivot point 79 is adapted to engage one side of the supporting member 77 and provides a point contact therebetween. In order to maintain engagement between the pivot point 79 and the supporting member 77, I have provided a second pivot point 80, which is adapted to engage, by a point contact, the opposite side of the supporting member 77. The pivot point 80 is held in engagement with the bearing support 77 by means of a coiled spring 82, which is disposed between the pivot point member 80 and the shaft end 77. The spring 82, by applying its tension to the pivot point 80, tends to urge the pivot point 79 toward the bearing support 77. The bearing support 77

is carried by means of a laterally extending portion 80 formed integrally with a cover plate 92 which is clamped between an end ring 94 and the removable end plate 35 by means of screws 95. The shaft end 74, pivot points 79 and 80 and the yoke-shaped member 72 are enclosed by means of a flexible expansible bellows 97 which is sealed upon one end thereof to flange 98 on the cover plate 92, and the opposite end is sealed to a member 100 to which the end 75 of the shaft is screw threaded and preferably soldered so as to provide a fluid-tight joint therebetween.

From the foregoing, it will be apparent that the casing 32 and plates 33 and 35, together with the cover plate 92 and expansible bellows 97, 15 provide a fluid-tight or hermetically sealed casing which entirely encloses the motor and compressor units.

In order to provide a suitable mounting for the fan 64, I have provided a casting 105, which 20 is preferably carried by the end plate 35, to which the casting 105 is secured by any suitable means. The casting also provides a housing for the flexible bellows and wobble shaft means. The fan 64 is carried by a suitable small shaft 107 which 25 is journaled in a bearing 108 which is preferably press-fitted within the casting 105. The shaft is provided with an enlarged head portion 110 in which there is provided a recess 111 for receiving a spherically shaped end 113 of the 30 wobble shaft means. Within the hollow portion 116 of the reduced portion 40 of the drive shaft, there is disposed a socket member 118 provided with a recess 120 for receiving a spherically shaped end 122 of the wobble shaft. As 35 will be noted in Fig. 1, the recesses 111 and 120 are eccentrically disposed with reference to the axis of the drive shaft and fan shaft. By this arrangement, movement of the drive shaft will affect orbital movements of the ends 113 and 122 40 of the shaft means to effect rotation of the fan 64. By the present arrangement, it will be noted that the pivot point 79 is held in engagement with the support member 77 by means of the pivot point 80 and spring 82. Consequently, any 45 movement of the wobble shaft will be substantially, if not entirely, free from friction, since there is but a point contact between the shaft means and its support.

In order to provide for lubricating moving elements of the compressor and fan driving mechanism, I have provided a well 125 in the end plate 33 for receiving oil from the lower portion of the casing 32 by means of an oil finger 127. Oil received in the well flows through passage 128 55 into a radial bore 129 in the drive shaft. Oil passes through the bore into the hollow portion 116 of the reduced end of the shaft 45, whence it passes to the bearing support and pivot points. In the event a large amount of oil is accumulated within the expansible bellows, it may readily be returned to the interior of the casing through passage 131. This prevents the accumulation of too large a quantity of oil within the interior of the bellows, which would prevent proper movement of said bellows.

The fan shaft 107 is provided with lubrication by means of a wick 135 formed of a body of fibrous material disposed within a cavity 136 adjacent the shaft and bearing in casting 105. When 70 the device is assembled, a quantity of oil may be disposed within the casting, which is in open communication with the cavity through passage 139. Thus, the oil within the casting will supply lubricant to the wick, which in turn will, by 75

capillary action, lubricate the shaft 107 and bearing 108. In the event additional lubricant is required for the shaft and bearing, it may be supplied readily by removing plate 140 and inserting through opening 141.

During operation of the apparatus hereinbefore described, the compressor withdraws gaseous refrigerant from the evaporator through a vapor conduit 150, compresses the gaseous refrigerant and delivers it to the condenser wherein it is liquefied and from which it is delivered to the high side float mechanism. Liquid refrigerant is supplied to the evaporator by means of a liquid supply conduit 152. As shown in Fig. 2, gaseous refrigerant enters the compressor through an intake chamber 154, whence it passes into the cylinder under the control of a reed valve 155. The compressed refrigerant is discharged from the compression cylinder through a discharge valve mechanism 157, whence it passes into an outlet or discharge chamber 160 and through conduit 162 to condenser. In the event any oil is returned from the evaporator to the compressor, it will, upon entering the intake chamber, descend into the lower portion thereof and pass through an opening 164, which is in communication with the interior of the casing 30.

As will be noted in the drawings, the intake and discharge chambers are considerably larger than the cross sectional interior area of the intake conduit 150 and discharge conduit 162. By providing a suction chamber of this type, it has been found that it acts as an oil separator and which provides for automatically returning oil to the crankcase. A relatively large suction chamber also acts as a gas surge chamber which evens out the periodic suction of the cylinder to an even flow of gas through the suction line. By providing a relatively large discharge chamber, it has been found that it acts as a surge chamber to even out the discharge from the cylinder, which is periodic, to even the flow through the discharge conduit. The discharge chamber also acts as a silencer of the discharged gas through the discharge valve.

Preferably, the motor-compressor unit is intermittently operated and in order to control the operation of the motor-compressor unit, any suitable thermostatically controlled switch may be provided which is responsive to changes of temperatures in the compartment to be cooled by evaporator, or responsive to changes in temperature in evaporator. If desired, a suitable low pressure control of the well known type may be provided for controlling the operation of the motor-compressor unit in accordance with changes of pressure within the vapor conduit 150.

Preferably, the motor is of the split phase type and has a low starting torque. Under these conditions, it has been found desirable to provide some sort of an unloader to allow the motor to come up to speed before assuming the load of the compressor. Thus, I have provided an improved unloader 180 which is adapted to hold a valve member 182 away from its seat 183 until the speed of the motor attains a certain value. By this arrangement, gas entering the compression chamber is by-passed through passage 185 into the interior of the casing 30 and no work is accomplished by the compressor until such certain speed is attained by the motor and the valve member is closed by the unloader actuating mechanism. When the valve member is in the closed position any pressures created within the

compression cylinder tends to maintain or to urge the valve member towards its seat. The unloader actuating mechanism comprises a suitable sliding collar 187 carried by the drive shaft, which is adapted to be moved by means of a finger disposed within a recess 188 of the collar 187. When the motor begins to operate the unloader actuating mechanism does not effect movement of the valve 182 until the speed of said motor attains a certain value. When such a speed is attained, a pair of weights 190, which are actuated by centrifugal force against the action of springs 192, tend to move the finger 188 toward the left side view in the drawings to move the collar in that direction. When this takes place, a lever 194 is moved by the action of a spring 196 and this lever, by means of push-rod 197, tends to move the valve member downwardly to close the valve. When the compressor ceases operation, the slidable collar 187 is returned to the position shown in Fig. 1 of the drawings by the action of springs 192, which overcome the action of spring 196 to slide the collar 187 which moves lever 194 and push rod 197 to open valve 182.

From the foregoing, it will be noted that I have provided a refrigerating system of the type including a refrigerant compressor, a motor for driving the compressor, a condenser and a refrigerant evaporator and an improved arrangement for cooling the condenser, which is especially applicable to refrigerating apparatus wherein the motor and the compressor are both entirely enclosed within the fluid-tight or hermetically sealed casing. Also, it will be noted that I have provided for a fan located outside of the casing for cooling the condenser by power received from the compressor driving motor without, in any way, effecting the fluid-tight qualities of the hermetically sealed casing. In addition, I have provided for operating the fan in such a manner so as to minimize frictional losses.

Although only a preferred form of the invention has been illustrated, and that form described in detail, it will be apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A power transmitting joint comprising a wall, a wobbling shaft associated with said wall and being adapted for transmitting power, a bearing support for the shaft, and anti-friction means associated with the shaft and said bearing support and being arranged for providing a point contact between itself and said bearing support intermediate the ends of said shaft.

2. A power transmitting joint comprising a flexible wall, a wobbling shaft associated with said flexible wall and being arranged for transmitting power, a bearing support for the shaft, and anti-friction means associated with said bearing support and said shaft intermediate the ends of said shaft, said anti-friction means being arranged for providing a pointed contacting engagement between itself and said bearing support which is relatively small with respect to the size of said shaft.

3. A power transmitting joint comprising a wall, a wobbling shaft associated with said wall and being adapted for transmitting power, and pivoted means for supporting said shaft with a pointed relatively small contacting surface with respect to the size of said shaft.

4. A power transmitting joint comprising a wall, a wobbling shaft extending through said wall for transmitting power, a bearing support for the shaft, anti-friction means providing a point contact between said shaft and said bearing support, and means for maintaining said point contact between said anti-friction means and said bearing support.

5. A power transmitting joint comprising a wall, a wobbling shaft extending through said wall for transmitting power, a bearing support for the shaft, anti-friction means providing a point contact between said shaft and said bearing support, and a flexible bellows for sealing the joint between the shaft and said wall.

6. A power transmitting joint comprising a wall, a wobbling shaft extending through said wall for transmitting power, a pivot bearing member for supporting said shaft, and a pivot point associated with the shaft and in engagement with said pivot bearing member.

7. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, a support for the shaft intermediate its ends, and a pivot point operatively associated with said shaft and said support, the ends of said shaft being eccentrically connected to said rotatable elements whereby movement of one of said rotatable elements will effect orbital movements of the ends of the wobble shaft to transmit rotary motion from one of said rotatable elements to the other.

8. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, a support for the shaft intermediate its ends, means connecting the shaft to said support and resilient means including a bellows and a spring urging said first means toward said support.

9. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, a support for the shaft intermediate its ends, an expansible bellows responsive to pressures within the casing for sealing the joint between the shaft and the casing, means connecting the shaft to said support and means including a spring which cooperates with the action of said bellows for urging said first named means toward said support.

10. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, said shaft including a yoke-shaped member between the ends thereof, a stationary support for the shaft disposed between the ends of the yoke-shaped member, and a pivot point carried by the shaft in engagement with said support.

11. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, said shaft including a yoke-shaped member between the ends thereof, a stationary support for the shaft disposed between the ends of the yoke-shaped member, a pivot point carried by the shaft in engagement with one side of said support and a second pivot point associated with said shaft and in engagement with the opposite side of said support.

12. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, said shaft including a yoke-shaped member between the ends thereof, a stationary support for the shaft disposed between the ends of the yoke-shaped member, a pivot point carried by the shaft in engagement with one side of said support, a second pivot point associated with said shaft and in engagement with the opposite side of said support, and a spring associated with the second pivot point for maintaining engagement between the first named pivot point and said support.

13. A device with which to connect a rotatable element within a hermetically sealed casing with a rotatable element located outside of the casing comprising a wobble shaft extending through a wall of said casing, said shaft including a yoke-shaped member between the ends thereof and a stationary member disposed between the ends of the yoke-shaped member for supporting said shaft.

14. A device with which to connect one rotatable element with another comprising a wobble shaft including a yoke-shaped member intermediate its ends and a stationary member disposed between the ends of said yoke-shaped member for supporting said shaft.