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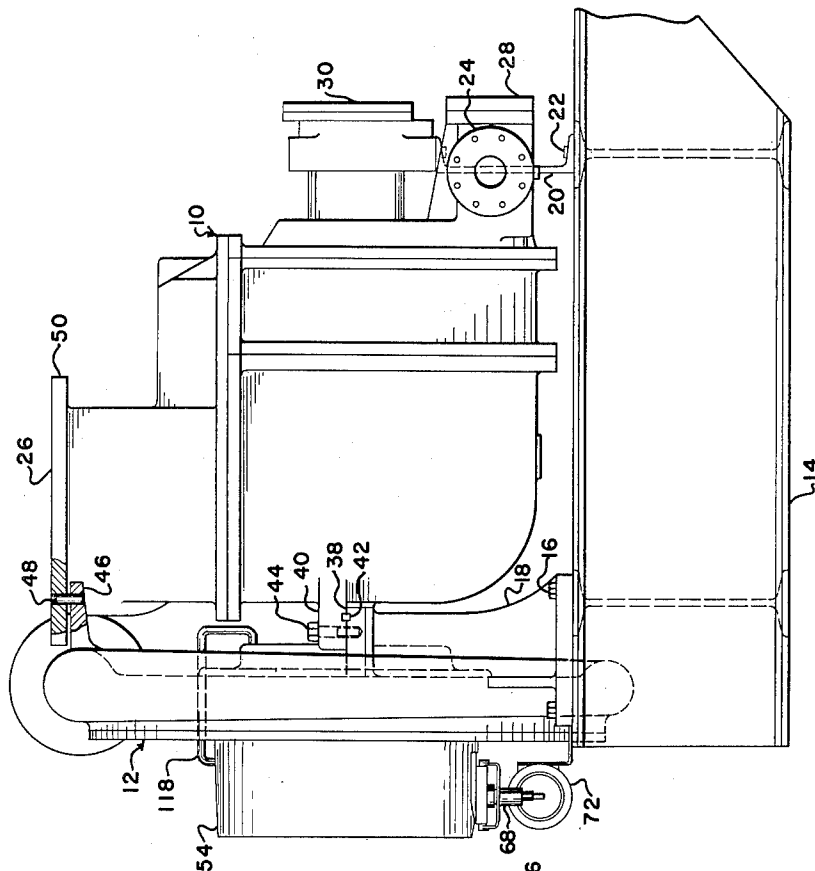
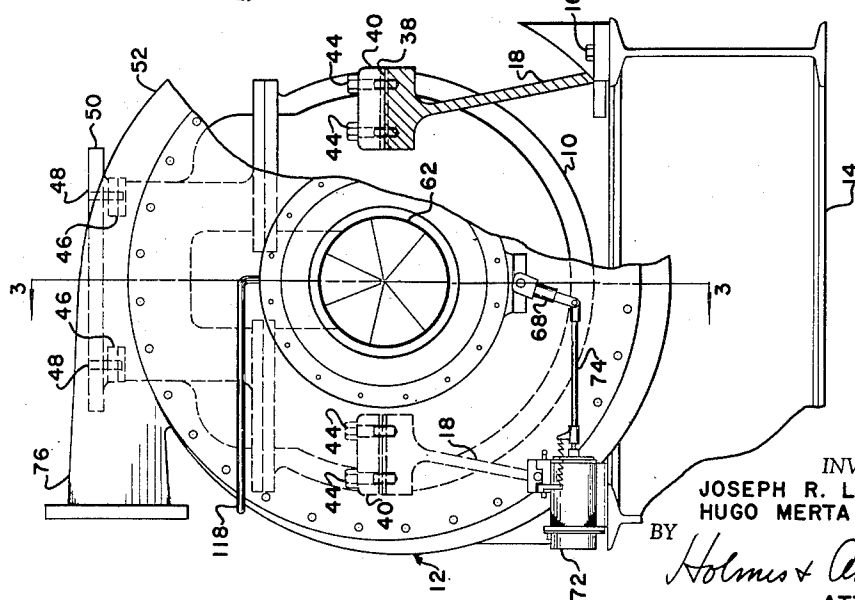
J. R. LEJK ETAL

**3,017,071**

TURBINE COMPRESSOR ASSEMBLY

Filed June 23, 1958

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

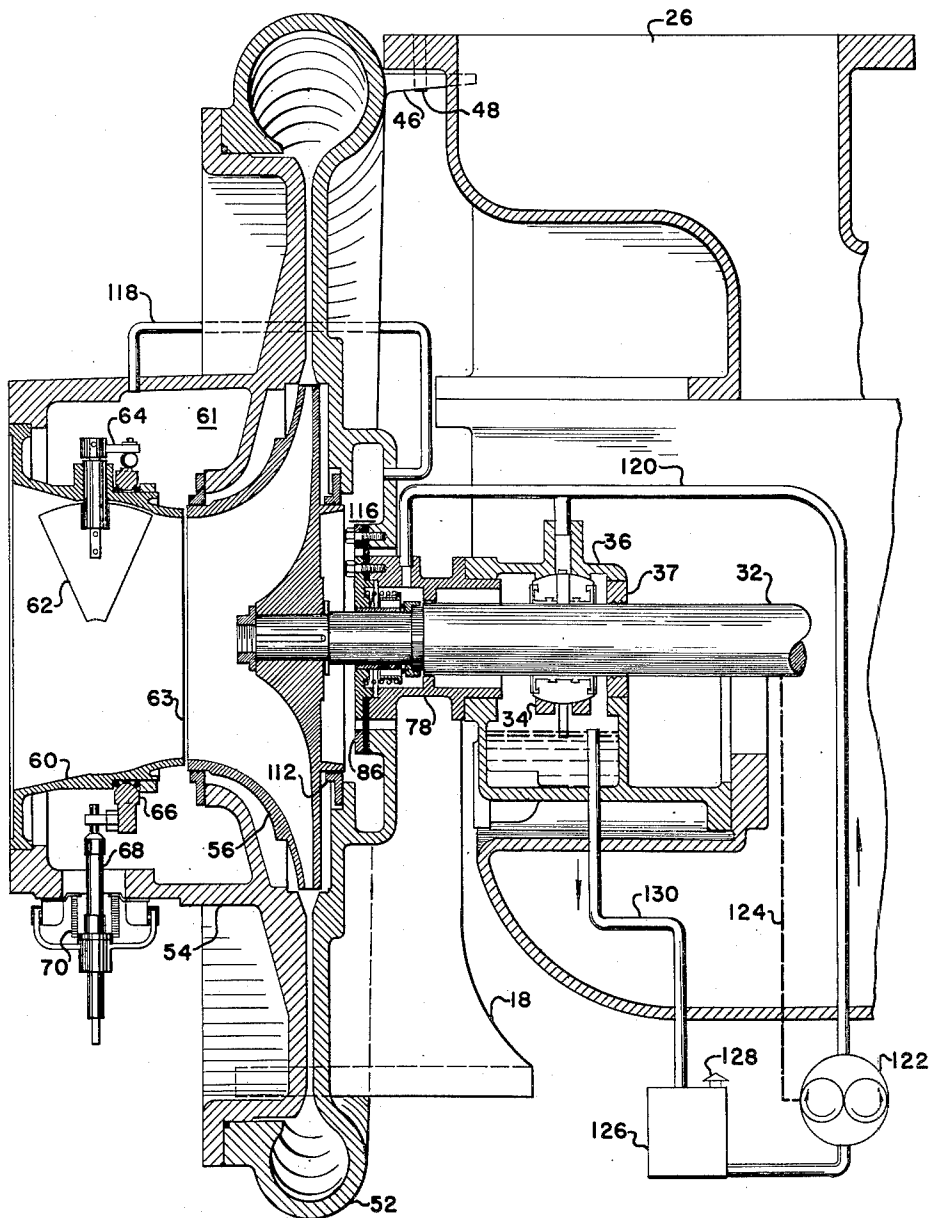


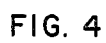
FIG. 3

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TURBINE COMPRESSOR ASSEMBLY

3 Sheets-Sheet 3



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3,017,071

## TURBINE COMPRESSOR ASSEMBLY

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7 Claims. (Cl. 230-116)

This invention relates to apparatus having a compressor and a turbine for the driving of the compressor. The compressor may handle various gaseous fluids, but it is particularly adapted for use as a compressor of a refrigerating machine.

It is an object of this invention to provide a mounting for a turbine and a compressor which will minimize the effect of expansion and contraction of the parts due to changes in temperature.

It is another object of the invention to mount the turbine and compressor to a unitary base and to each other whereby close alignment of the parts is maintained.

It is another object of the invention to provide a shaft seal between the turbine housing and the compressor housing, which seal is mounted on the turbine housing and has a flexible diaphragm connected to the compressor housing to prevent transmission of any substantial force from the compressor housing to the seal.

It is still another object of this invention to provide a unit which is inexpensive to manufacture and which is easily assembled and serviced.

Further objects and advantages will become apparent as the specification proceeds to describe the invention with reference to the accompanying drawings in which:

FIG. 1 is an elevational side view of the apparatus of this invention;

FIG. 2 is an elevational end view with portions of the compressor broken away to more clearly show a portion of the mounting;

FIG. 3 is a sectional view on an enlarged scale taken on line 3-3 of FIG. 2 and showing the lubrication system diagrammatically;

FIG. 4 is an enlarged view of the seal taken on a plane through the axis of rotation;

FIG. 5 is an enlarged view of a modification of the seal taken on a plane through the axis of rotation.

Referring now to the drawings and particularly to FIGS. 1 and 2, a turbine 10 and a compressor 12 are mounted on a common base 14. Bolts 16 secure the legs 18 of the compressor 12 to the base 14. A channel 20 is secured in any suitable manner to the turbine 10, and channel 20 is bolted to the base 14 by bolts 22. The turbine 10 has a steam inlet 24 and a steam outlet 26. The turbine 10 has a steam valve (not shown) secured to the turbine at 28 and a governor mechanism (not shown) which is also secured to the turbine at 28. The turbine 10 has an extension 30 which is substantially coaxial with the turbine shaft 32. Extension 30 houses a thrust bearing for the shaft 32.

The shaft 32 of the turbine is supported for rotation in bearings one of which is shown at 34. Bearing 34 is supported in bearing housing 36 which has the usual seal 37 for preventing fluid leakage between the bearing housing 36 and the atmosphere.

The legs 18 of the compressor have supporting bosses 38 having supporting surfaces arranged in a horizontal plane through the axis of rotation of the shaft 32. The turbine 10 has ears 40 which are supported on the supporting surfaces of bosses 38 of the legs 18 of the compressor. A key 42 engages with the ears 40 and the bosses 38 to permit relative movement therebetween radially of shaft 32, but preventing relative movement axially of shaft 32. Bolts 44 extend through holes in ears 40 and are threaded in bosses 38. The bolt holes

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in ears 40 are large enough to provide clearance around the bolts 44 and permit the relative movement between the ears 40 and the bosses 38 in the direction of the longitudinal axis of the key 42 which is radial to the axis of rotation of the shaft 32.

The main source of heat in the apparatus is from the steam in the turbine. It is a feature of this invention to provide a support in an axial plane so that expansion and contraction will have a minimum effect at the axis of the shaft 32 and at the sealing surfaces between the running parts and the turbine housing and compressor housing. The legs 18 and the channel 20 are also arranged with respect to the source of heat to prevent a substantial temperature rise. For instance, the heat from the turbine housing must pass outwardly through the ears 40 and downwardly through the legs 18 both of which are exposed to the cooling effect of the ambient air. In order for the heat from the turbine 10 to affect the channel 20, it must pass outwardly through the extension 30 and then downwardly through the channel 20, both of which are exposed to the cooling effect of the ambient air.

As a further support between the turbine 10 and the compressor 12, lugs 46 are provided on the compressor 12. Pins 48 engage in holes in the lugs 46 and in the flange 50 of the turbine to prevent any substantial relative movement between the turbine 10 and the compressor 12 in a horizontal plane.

Referring now more particularly to the compressor 12, a housing 52 and a suction cover 54 enclose a centrifugal impeller 56 which is mounted on the shaft 32 to rotate therewith. An inlet 60 is mounted in the suction cover 54 and is in fluid communication with the impeller 56. The inlet 60 and the suction cover 54 form a chamber 61 which is at substantially suction pressure because of the gap 63 between the inlet 60 and the impeller 56. A plurality of sector shaped vanes 62 are pivotally mounted on the inlet 60 and are connected by links 64 to a ring 66. The ring 66 is turned by a lever 68 which enters the suction cover 54 through a bellows seal 70. The lever 68 is adjusted by a fluid motor 72 which has a piston rod 74 connected to the lever 68 all of which is more fully set forth in patent to Arthur M. G. Moody, Serial No. 2,817,475, issued December 24, 1957. The vanes 62 are adjusted at an angle to the flow when it is desired to reduce the output of the compressor. The compressor housing 52 has a nozzle 76 through which the compressed gas is discharged.

A seal housing 78 is secured in sealed engagement with bearing housing 36 in any suitable manner as by bolts (not shown). A seal cover plate 80 is secured to the seal housing by bolts 82. A flexible diaphragm 84 of neoprene or other plastic material is clamped between the seal housing 78 and the seal cover plate 80. As shown in FIG. 3, the diaphragm 84 consists of two laminations, however, more than two laminations may be used or a single sheet may be used if desired. The outer portion of the flexible diaphragm 84 is clamped to the compressor housing 52 by a ring 86 secured by bolts 88.

The rotating seal ring 90 has a slot 92 which engages a pin 94 extending from the shaft 32 to prevent relative rotation between the seal ring 90 and the shaft 32. An O-ring 96 of neoprene or other suitable flexible material provides a seal between the seal ring 90 and the shaft 32.

A sleeve 98 is supported in the seal cover plate 80 and is sealed thereto as by brazing. The sleeve 98 supports a gasket 100 of neoprene or other suitable flexible material. A ring 102 is supported on gasket 100 and in turn supports a sleeve 104 for relative axial movement. A ring 105 is supported in sleeve 104 and supports gasket

100 against displacement. A stationary seal ring 106, preferably of carbon, is supported in sleeve 104 and bears against gasket 100. A spring 103 is supported on the sleeve 104 and upon the seal cover plate 80. Spring 108, through sleeve 104, urges stationary seal ring 106 against rotating seal ring 90 to provide a running seal between the interior spaces of the compressor 12 and the turbine 10.

In the form shown in FIG. 5, the neoprene diaphragm 84 of FIG. 4 has been replaced by a sheet metal diaphragm 110 and gaskets 111 and 113. Gaskets 111 provide a seal between the diaphragm 110 and the housing 52 and ring 86. Gaskets 113 provide a seal between the diaphragm 110 and the seal housing 78 and the seal cover plate 80. The diaphragm 110 has a corrugation 115 to provide flexibility.

A ring 112 is secured by bolts 114 to the compressor housing 52. The ring 112 has a close running fit with the impeller 56 to prevent any substantial flow of refrigerant from the main portion of the compressor housing 52 to the chamber 116. A conduit 118 is in fluid and is secured at one end to the compressor housing 52 in fluid communication with the chamber 116. The other end of the conduit 118 is secured to the suction cover 54 and is in fluid communication with the chamber 61 which as explained above is at suction pressure. It is thus seen that the pressure in chamber 116 is maintained equal to suction pressure by the conduit 118. By maintaining the chamber 116 at suction pressure, the thrust on the shaft 32 is substantially eliminated.

The bearing housing 36 and the seal housing 78 are connected to receive lubricating fluid through conduit 120. A pump 122 preferably driven from the shaft 32 as indicated by dotted line 124 supplies lubricating fluid under pressure to conduit 120. A lubricating fluid sump 126 having an atmospheric vent 128 supplies fluid to the pump 122. The lubricating fluid flows from the shaft housing 78 into the bearing housing 36 from which it overflows through conduit 130 into sump 126. It should be understood that the pump 122 may be driven by a separate electric motor if desired.

The interiors of the bearing housing 36 and the seal housing 78 are substantially at atmospheric pressure because the sump 126 is vented to the atmosphere at 128. It is thus seen that atmospheric pressure is acting on one side of the seal face and suction pressure of the compressor is acting on the other side of the seal face. Normally the refrigerant used is one which will have a suction pressure less than atmospheric and therefore any leakage past the seal face will be air leaking into the compressor. Leakage of air into the refrigeration system is preferred over leakage of refrigerant out of the system and it is also preferred over leakage of water vapor into the system.

The mounting of the compressor 12 and the turbine 10 on the base 14 overcomes the problem of expansion axially due to changes in temperature. The legs 18 of the compressor are rigid in a direction axially of the shaft 32. Therefore, the compressor 12 and the adjacent end of the turbine 10 are substantially fixed. The channel 20, however, is relatively flexible and expansion of the turbine 10 is accommodated by deflection of the channel 20.

As the temperature of the turbine 10 increases and expansion takes place, the extension 30 moves to the right as viewed in FIG. 1 and the shaft thrust bearing housed in the extension 30 also moves to the right thus accommodating expansion of the shaft 32 and maintaining the impeller end of the shaft 32 fixed axially.

Although the preferred embodiment of this invention has been described in detail, it is contemplated that various changes may be made without departing from the scope or spirit of our invention, and we desire to be limited only by the claims.

We claim:

1. A turbine compressor assembly comprising a base, a

scroll shaped compressor housing mounted on said base, a turbine, a substantially horizontal shaft, bearing means on said turbine rotatably supporting said shaft, said shaft having an overhung unsupported portion extending from one end of said turbine into said compressor housing, an impeller mounted on said shaft for rotation in said compressor housing, means on said compressor housing supporting said one end of said turbine on said compressor housing for limited relative horizontal movement substantially radial to the axis of said shaft whereby the turbine is free to expand and contract with changes in temperature, and means at the periphery of said compressor housing slidably securing said compressor housing and said turbine for relative movement in a plane normal to said shaft.

2. A turbine compressor assembly comprising a compressor housing, a turbine, a shaft extending from one end of said turbine into said compressor housing, an impeller mounted on said shaft for rotation in said compressor housing, a bearing housing on said turbine and surrounding said shaft, a bearing in said bearing housing, said bearing rotatably supporting said shaft, a seal housing secured to said bearing housing and surrounding said shaft, a flexible diaphragm secured to said seal housing and to said compressor housing to provide for relative movement between said housing and said compressor housing and to prevent leakage therebetween, and rotary seal means between said seal housing and said shaft to seal the interior of said seal housing from the interior of said compressor housing.

3. A turbine compressor assembly comprising a compressor housing, a turbine, a shaft rotatably mounted in said turbine and extending from one end of said turbine into said compressor housing, an impeller mounted on said shaft for rotation in said compressor housing, a bearing housing on said turbine and surrounding said shaft, a bearing in said bearing housing, said bearing rotatably supporting said shaft, a seal housing secured to said bearing housing and surrounding said shaft, a flexible diaphragm securing said seal housing in sealed engagement with said compressor housing, rotary seal means between said seal housing and said shaft to seal the interior of said seal housing from the interior of said compressor housing, a lubrication pump, means for conducting lubricant from said lubrication pump to said seal housing and to said bearing housing, and means for conducting lubricant from said seal housing and said bearing housing to said pump.

4. The combination as set forth in claim 3 including means for venting said last named means to the atmosphere.

5. A turbine compressor assembly comprising a base, a compressor housing mounted on said base, a turbine, a shaft extending from said turbine through an opening in said compressor housing, an impeller mounted on said shaft for rotation in said compressor housing, supports on said compressor housing substantially in a horizontal plane through the axis of said shaft, means at one end of said turbine secured to said supports for supporting said one end of said turbine on said compressor, means at the other end of said turbine for supporting said other end of said turbine for relative movement with respect to said base, a resilient annular sealing member surrounding said shaft and secured in the opening in said compressor housing, and means for connecting said resilient annular member to said turbine.

6. A turbine compressor assembly comprising a turbine, a centrifugal compressor housing, a bearing housing in said turbine, a bearing in said bearing housing, a turbine shaft rotatably mounted in said bearing and extending from said bearing housing into said compressor housing, an impeller mounted on said turbine shaft for rotation in said compressor housing, means supporting said turbine on said compressor housing for limited relative horizontal movement substantially radial to the axis of

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said shaft, means at the periphery of said compressor housing securing said compressor housing and said turbine against any substantial relative movement in a plane parallel to said shaft, annular flexible means enclosing said shaft and providing a sealed passageway between said bearing housing and said compressor housing and rotary seal means on said shaft and operatively associated with said last mentioned means for sealing the compressor housing from said bearing housing.

7. A turbine compressor assembly comprising a base, 10 a centrifugal compressor housing mounted on said base, a turbine, a substantially horizontal shaft extending from one end of said turbine into said centrifugal compressor housing, an impeller mounted on said shaft for rotation in said centrifugal compressor housing, bosses on said 15 centrifugal compressor housing having supporting surfaces spaced on opposite sides of said shaft and substantially in a horizontal plane through the axis of said shaft, ears on said turbine resting upon the supporting surfaces of said bosses for limited horizontal movement substantially 20 radial to the axis of said shaft, guide means between said

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bosses and said ears to limit relative movement between said bosses and said ears to a direction substantially radial of the axis of said shaft and means at the periphery of said compressor housing securing said compressor housing and said turbine against any substantial relative movement in a plane parallel to said shaft.

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