

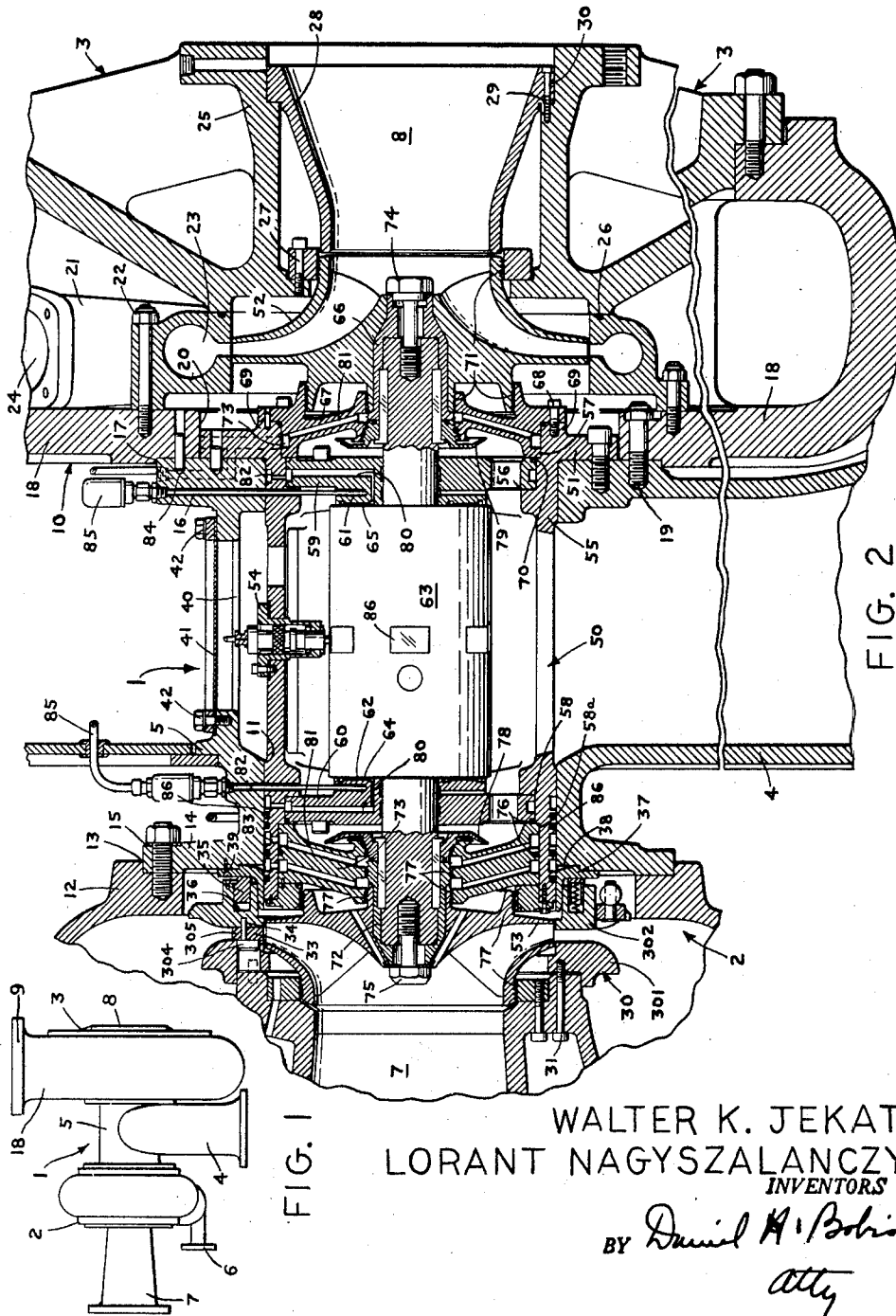
Sept. 29, 1964

W. K. JEKAT ETAL
TURBINE COMPRESSOR UNIT

3,150,820

Filed July 20, 1962

4 Sheets-Sheet 1



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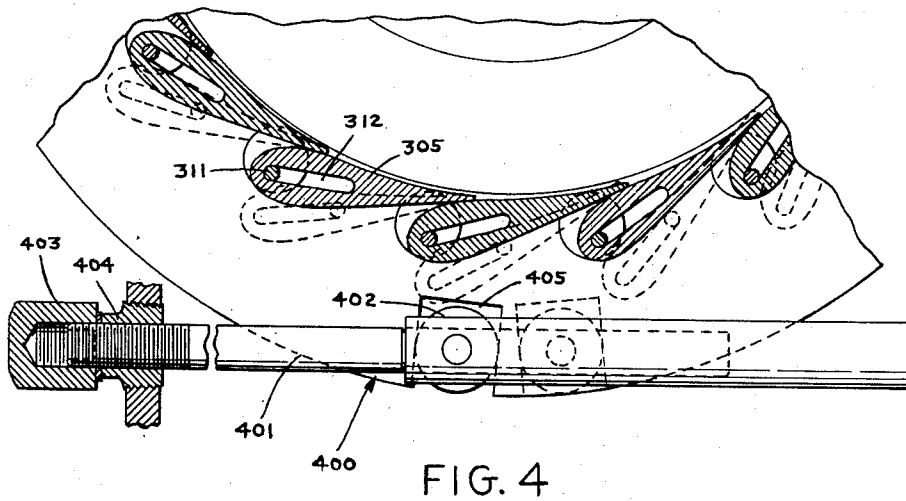
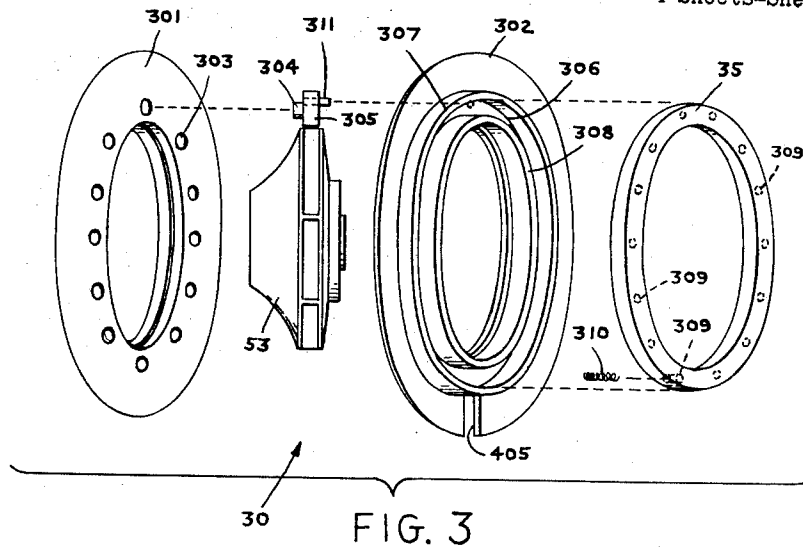
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4 Sheets-Sheet 3

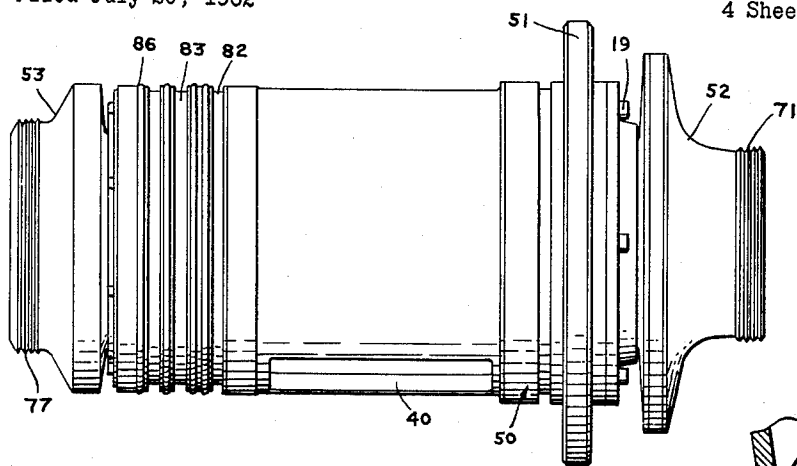


FIG. 5

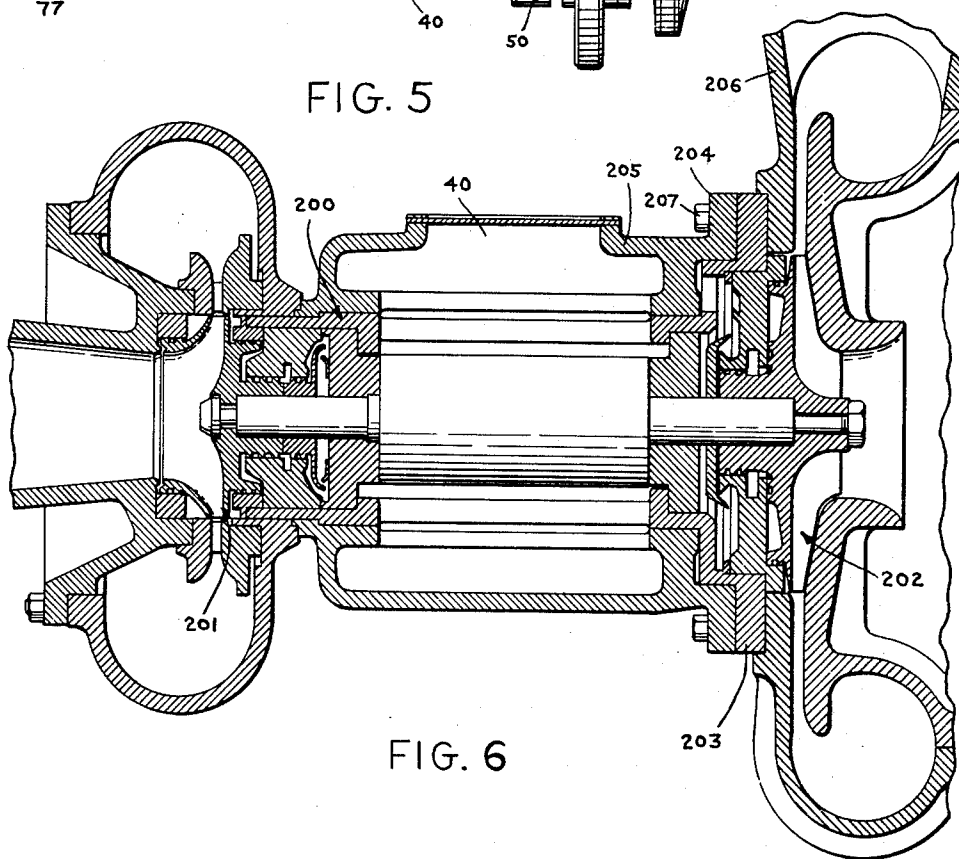


FIG. 6

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4 Sheets-Sheet 4

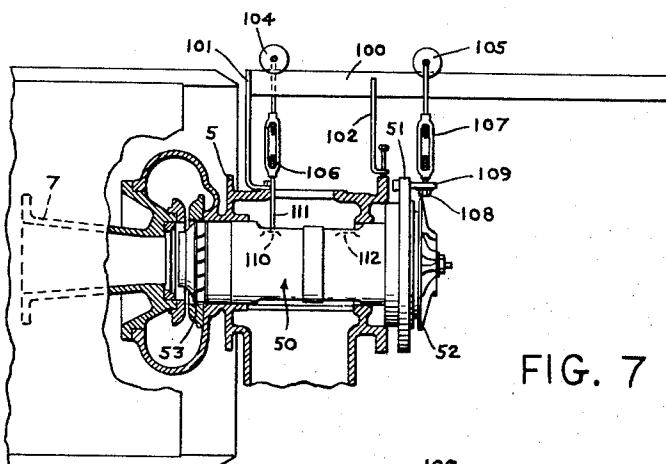


FIG. 7

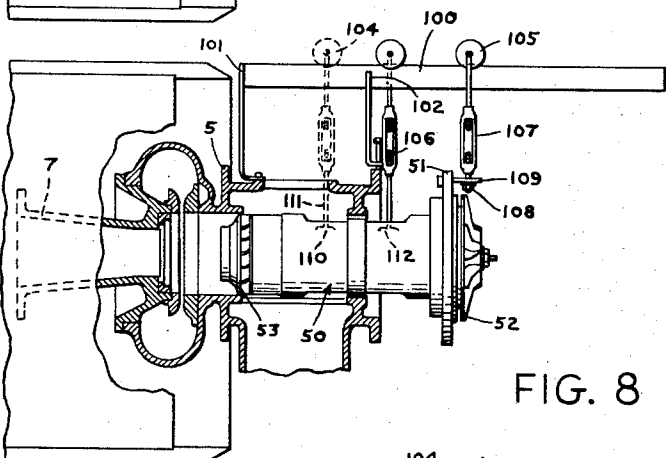


FIG. 8

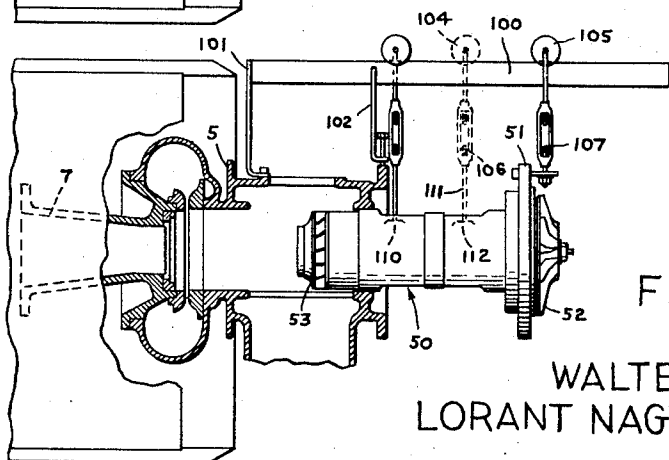


FIG. 9

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TURBINE COMPRESSOR UNIT

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4 Claims. (Cl. 230-116)

This invention relates to a turbine compressor unit or the like and more particularly provides an embodiment wherein the rotating and sealing portions of said unit are easily removable from the non-rotatable portions should replacement of same be necessary.

The application of a turbine pump unit or the like as is disclosed in U.S. Patent 2,991,722 serves to reduce the down time in the event that repair of the unit is necessary due to a malfunction. As is indicated in above patent circumferentially dividing the unit provides for easy access to the rotor and related elements even though permanent connection of the inlet and outlet tubes is provided.

While erection of such a unit as above discussed has the advantage of reducing the down time and providing a unit of lower cost, it is still necessary to disassemble or assemble the rotor and related elements in piece-meal fashion.

In contradistinction the present invention teaches dividing a turbine compressor or the like, referred to as a turbine compressor unit hereinafter for convenience, into a portion including the non-rotatable elements and a portion including the rotating elements wherein said portion including the rotatable elements may be removed from the first portion of the turbine compressor as a unit.

Accordingly, it is an object of the present invention to provide a turbine compressor unit with a removable cartridge including the rotatable elements and as a consequence eliminate the foregoing objections and further serve to reduce the down time in the event that repair to the unit is necessary.

It is a further object to assemble the rotating elements of the turbine compressor unit into or in association with a hollow cartridge which is adaptable for axial insertion into the turbine compressor unit.

It is another object of this invention to provide radial and thrust bearing means for the turbine compressor unit within the hollow cartridge and provide means in said bearings communicating with the exterior portions of the turbine compressor unit to permit the passage of a supply of lubricant to said bearings through said means.

It is a further object of this invention to provide means for readily disassembling the hollow cartridge from the turbine compressor unit.

It is a further object of this invention to provide an improved turbine compressor unit embodying the above described features.

Other objects and advantages of the invention including the basic design and the nature of the improvements thereon will appear from the following description taken in conjunction with the following drawings, in which:

FIGURE 1 is a side elevation of the turbine compressor unit contemplated by this invention.

FIGURE 2 is a longitudinal view partly in section showing one form of the present invention.

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FIGURE 3 is an exploded perspective view showing the nozzle portion of the turbine compressor unit.

FIGURE 4 is a section on line 4-4 of FIGURE 2 showing the nozzle vanes and the means for adjusting the vanes.

FIGURE 5 is a side elevation showing the hollow cartridge of the turbine compressor unit shown in FIGURE 2.

FIGURE 6 is a simplified schematic longitudinal view partly in section of a modified turbine compressor unit embodying the principles of the present invention.

FIGURE 7 is a side elevation partly in section showing the first step of disassembling the cartridge including the rotating elements from the turbine compressor unit.

FIGURE 8 is a longitudinal view partly in section showing the second step of disassembling the cartridge from the turbine compressor unit.

FIGURE 9 is a longitudinal view partly in section showing the third step of disassembling the cartridge from the turbine compressor unit.

Referring to FIGURE 1 the turbine compressor unit, generally designated 1, comprises a turbine portion 2 and a compressor portion 3. A frame 4, taking the form of a hollow conduit, is connected to the central housing 5 of the unit and the frame 4 serves as a mount for the unit.

While the turbine and compressor portions are shown as being respectively at the left and right sides as depicted in the drawings it is not intended to limit the construction to this arrangement.

The turbine portion 2 includes the usual inlet 6 and outlet 7. In the present instance, while any type of motive fluid normally employed to operate a turbine can be used, an expander is shown and air is supplied from a source not shown to inlet 6 and serves to drive the unit.

Compressor portion 3 functions as is usual to move system fluid from inlet 8 through outlet 9 to a source of use.

Now referring particularly to FIGURE 2 the turbine compressor unit or expander 1 comprises a first portion generally designated 10 and clearly shown in FIGURE 1 including what are termed in the art the non-rotatable and associated elements and a second portion 50 shown in FIGURES 1, 2 and 3 including the rotatable and associated elements.

The first portion 10 comprises the frame and related casings of the expander or turbine compressor. More particularly the central housing 5 including a bore 11 therethrough is connected at one end to turbine housing 12 by any well known method. In the drawings housing 12 includes a counterbore 13 for receiving the flange 14 formed at the turbine end of the central housing 5. Bolt members 15 connect these two elements in fluid tight relation. At the compressor end of the central housing is formed a flange 16 which is mounted in a circumferential counterbore 17 formed in the compressor discharge casing 18.

The central housing 5 is connected to the discharge housing 18 by bolt means 19.

It is evident that the central housing 5 and frame 4 may be readily formed as a unitary element or of split construction as shown in FIGURE 2 without departing from the scope of the present invention.

The compressor discharge housing 18 is provided with

an axial bore 20 which coacts with flange 16 to form a stop means for the flange 51 formed on the portion of hollow cartridge 50 including the rotatable elements.

A diffuser 21 is connected to the discharge housing 18 by bolt means 22 and the diffuser 21 is provided with an inlet 23 spaced relative the wheel or impeller 52 of the compressor and an outlet 24 communicating with the upper interior portion of the discharge housing 18 of the compressor portion.

The compressor inlet casing 25 is connected to the discharge housing 18 by any well known means. Seal means 26 are provided to maintain these elements in fluid tight relation as is well known in the art.

While the discharge housing 18, diffuser 21 and inlet portion 25 are shown as separate elements, it will be apparent that all can be of unitary construction without departing from the scope of the present invention.

The usual wearing rings 27 are shown as connected to the inlet housing 25 and insert 28 is mounted in a counter-bore 29 of the housing 25 and held in operable position by bolt means 30. The insert functions to improve the flow conditions of the fluid being passed to the wheel 52.

Now referring again to the turbine portion 2 as is best shown in FIGURE 2, the inlet 6 is connected to a source of working fluid which is passed to the wheel 53 by the usual nozzle means 30 which are connected to the housing 12 by bolt means 31.

The nozzle means 30 in FIGURE 3 is shown as comprising side plates 301 and 302. Side plate 301 is connected to the housing 12 by bolt means 31. The side plate 301 includes a plurality of openings 303 for pivotably receiving the buttons 304 formed on one side of the vanes 305 which are held in spaced relation relative impeller or wheel 53 by side plate 302 which is movably mounted in abutment with locator member 37.

Side plate 302 includes an annular recess 306 formed between annular lips 307 and 308. Sealing means 35 comprising an annular ring including a plurality of spring receiving openings 309 is disposed in recess 306 and in assembly springs 310 force the seal means 35 into abutment with locator member 37 to coact with side plate 301 to hold the vanes 305 in operating position.

The seal means 35 at the other end abuts locator member 37 which sits at the lower portion thereof in a counterbore 38 formed on the frame 4 and said ring 37 at the upper end is connected to flange 14 by bolt means 39.

Means designated 400 for adjusting the vane position relative the wheel 53 are mounted on the side plate 302 which as is evident is rotatably mounted relative member 37. More particularly dowels 311 fixed to plate 302 are disposed in slots 312 formed in the vanes.

Any type of device for translating motion to side plate may be used. In FIGURE 4 there is shown a rod and roller arrangement designated respectively 401 and 402 mounted in a frame member 403 including a stop member 404. The roller 402 is mounted in slot 405 in side plate 302. In this fashion manipulation of rod 401 which would be located for easy access within limits set by stop member 404 permits adjustment of the vanes 305 as desired.

While one form of device for translating motion to the side plate is shown it is not intended to limit the invention to this form as other motion translating arrangements may be devised for operation with the nozzles, all within the scope of the appended claims. In FIGURE 4 applicant has shown in phantom and in adjusted position the vanes of the nozzle as moved by the motion translating unit 400.

A hand hole 40 is formed in the top of the central housing 5 to provide easy access to the magnetic speed pick-up 54 discussed in detail hereinafter and is closed by cover 41 connected to the central housing by bolt members 42.

It will be apparent from FIGURE 2 that removal of the inlet housing 25, associated elements and diffuser 21

will permit removal of the hollow cartridge 50 from the central casing and its associated elements.

The bore 11, the ring 37 and nozzle are of a dimension that allows the sliding of the cartridge therein to provide a unit which forms an operable turbine compressor unit.

As will be evident the external dimensions of the hollow cartridge 50 is of slightly lesser dimension than the dimension of the above mentioned elements.

The hollow cartridge 50 comprises a casing 55 including first and second counterbores 56 and 57 at the end including flange 51. Circumferential counterbores 58 and 58a are also formed at the other end of the unit.

Counterbores 56 and 58 form supporting members for the radial bearings 59 and 60 which include thrust members 61 and 62 formed as disc-like plates and as integral portions of these radial bearings.

Shaft 63 is rotatably mounted in the bearings 59 and 60 and at the respective ends 64 and 65 the shaft is in proximate relation with the thrust members 61 and 62.

The shaft 63 is necked down and extends through the bearing members 59 and 60 and includes the impeller 52 mounted thereon at one end and the impeller 53 mounted thereon at the other end.

Sleeve 66 including labyrinth seal elements thereon is keyed to shaft 63 and said sleeve is disposed in a seal diaphragm 67 which is disposed in the circumferential counterbore 57 of the hollow cartridge 50. Bolt members or like 68 hold the radial bearings and seal diaphragm in operable relation on the lip 69 formed on the flange 51 of the hollow cartridge.

Seals 70 of the O-ring type and 71 of the labyrinth type are provided to maintain the desired fluid tight relation.

Similarly turbine impeller 53 is mounted on sleeve 72 keyed to shaft 63 whereby sleeve 72 is held in operable position by seal diaphragm 73. The usual bolt means 74 and 75 are provided to connect the impellers to the shaft 63.

Seals 76 are also provided at the turbine end and a labyrinth arrangement 77 functions to break down any leakage from the turbine.

Seal members 86 are also provided in annular grooves about the periphery of the hollow cartridge 50 to form a fluid tight relation between said unit and the casing 5 when said unit 50 is disposed therein.

Lubricant slingers 78 and 79 are disposed about the shaft 63 and between the seal diaphragm 73 and radial bearings 59.

Passage means 80 and 81 are respectively formed in the bearings 59 and seal diaphragm 73 and communicate respectively with ports 82 and 83 formed in the outer portion of the hollow cartridge 50. Lubricant or sealing fluid as is desired by the user or conditions for which the turbine compressor is called to perform can be supplied to these ports by well known means, for example, the port 84 can be connected to a source of supply.

Thermocouples 85 are shown as connected to the bearings 59 to provide a convenient means for measuring the temperature of the unit.

A magnetic pick-up 54 is disposed relative projections 86 on shaft 63 and is connected to a tachometer to register the speed of the unit as is clearly shown in FIGURE 2.

A modified arrangement of the turbine pump unit is shown in FIGURE 4 of the drawings. The elements comprising the removable portion are cross-hatched and those comprising the non-removable elements are shown in section but not cross-hatched for clarity.

Thusly the hollow cartridge 200 includes the removable and associated elements of the turbine portion designated 201 at one end and the removable and associated elements of the compressor portion 202 at the other end.

The flange 203 is connected between a flange 204 on central housing 205 and the compressor discharge housing 206 and to the flange 203 of the hollow cartridge by bolt means 207.

To disassemble the unit it is thusly only necessary to

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disconnect bolt means 207 and remove housing 206 and then the hollow cartridge 209 and associated elements can easily be removed.

With the above described arrangement it will be apparent that a convenient and reliable construction is provided wherein the rotatable elements of the unit included in a hollow cartridge can be readily removed from the stationary portion of the turbine compressor unit.

To facilitate the disassembly and assembly of the hollow cartridge 50 from the casing, a support member or rail 100 is conveniently mounted to the casing 6 as by frame members 101 and 102.

Slide members or trolleys 104 and 105 are slidably arranged on rail 100. Slide members 104 and 105 are provided with a turnbuckle or like 106 and 107. After removal of the inlet housing 25 and diffuser 21, hollow cartridge 50 can be moved axially in bore 11. Turnbuckle 107 with threaded end 108 can be connected to an element 109 which is connected to flange 51 of the hollow cartridge 50.

The hollow cartridge is then moved axially to a point where threaded member 110 can be seen through hand hole 40 and the threaded element 111 is connected thereto as best represented in FIGURE 7 of the drawings.

Cartridge 50 is at a point shown in FIGURE 8 and the member 104 and threaded member 111 may be disconnected from the member 110 and conveniently connected to threaded member 112.

In this fashion the unit can then be moved as is shown in FIGURE 9; slide member 104 can at this time be moved back and connected to element 110 and the unit completely extracted from the casing.

It will be apparent that two or more slide members may be used and furthermore one skilled in the art will understand that the reversal of said operation will conveniently provide for rapid assembly of the unit.

Although this invention has been described with reference to specific apparatus it will be appreciated that a wide variety of changes may be made within the ability of one skilled in the art without departing from the scope of this invention. For example, some of the components of the apparatus may be reversed, certain features of the invention may be used independently of others, and equivalents may be substituted for the apparatus, all within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In a turbine-compressor unit having rotatable and non-rotatable components, a centrally positioned supporting frame, said supporting frame having a bore extending through a portion thereof; a turbine housing supported by said frame and covering one end of said bore, said turbine housing carrying the non-rotatable components of said turbine; a compressor housing supported by said frame and covering the opposite end of said bore, said compressor housing containing the fixed components of said compressor; a replaceable cartridge unit, said cartridge unit including a non-rotatable hollow casing dimensioned to closely and slidably fit into said bore, stop means on said cartridge unit for limiting inserted movement of said unit into the bore of said frame, and a rotatable shaft journaled in said hollow casing, said shaft having secured thereto at one end the rotatable components of said turbine which extend into an opening in said turbine housing, and at the opposite end the rotatable components of said compressor which extend into an opening in said compressor housing; means for breaking away one of said housings for axial removal of said replaceable cartridge unit from said frame in the direction of said one housing; the said opening in said one of said housings having a dimension larger than the largest transverse dimension of that part of said replaceable cartridge unit to be passed therethrough for free, axial relative movement of said one housing and said cartridge unit; the maximum diameter of the rotatable components in the other of said housings

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being equal to or less than the minimum transverse dimension of said bore; the cartridge unit being thereby adapted for unitary removal and replacement with a similar unit without dismantling of said cartridge unit.

2. In a turbine-compressor unit having rotatable and non-rotatable components, a centrally positioned supporting frame, said supporting frame having a bore extending through a portion thereof; a turbine housing supported by said frame and covering one end of said bore, said turbine housing carrying the non-rotatable components of said turbine; a compressor housing supported by said frame and covering the opposite end of said bore, said compressor housing containing the fixed components of said compressor; a replaceable cartridge unit, said cartridge unit including a non-rotatable hollow casing dimensioned to closely and slidably fit into said bore, stop means on said cartridge unit for limiting inserted movement of said unit into the bore of said frame, and a rotatable shaft journaled in said hollow casing, said shaft having secured thereto at one end the rotatable components of said turbine which extend into an opening in said turbine housing, and secured thereto at the opposite end the rotatable components of said compressor which extend into an opening in said compressor housing; means for breaking away one of said housings for axial removal of said replaceable cartridge unit from said frame in the direction of said one housing; the said opening in said one of said housings having a dimension larger than the largest transverse dimension of the part of said replaceable cartridge unit to be passed therethrough for free, axial relative movement of said one housing and said cartridge unit; the maximum diameter of the other rotatable components in the other of said housings being equal to or less than the minimum transverse dimension of said bore; said frame having an elongated opening therein substantially parallel to the axis of said replaceable cartridge unit; and means extending through said opening to engage and support said cartridge unit during removal and insertion, said elongated opening providing for substantial axial movement of said cartridge unit and its supporting means.

3. In a turbine-compressor unit having rotatable and non-rotatable components, a centrally positioned supporting frame, said supporting frame having a bore extending through a portion thereof; a turbine housing supported by said frame and covering one end of said bore, said turbine housing carrying the non-rotatable components of said turbine; a compressor housing supported by said frame and covering the opposite end of said bore, said compressor housing containing the fixed components of said compressor; a replaceable cartridge unit, said cartridge unit including a non-rotatable hollow casing dimensioned to closely and slidably fit into said bore, stop means on said cartridge unit for limiting inserted movement of said unit into the bore of said frame, and a rotatable shaft journaled in said hollow casing, said shaft having secured thereto at one end the rotatable components of said turbine which extend into an opening in said turbine housing, and secured to the opposite end thereof the rotatable components of said compressor which extend into an opening in said compressor housing; means for breaking away one of said housings for axial removal of said replaceable cartridge unit from said frame in the directions of said one housing; the said opening in said one of said housings having a dimension larger than the largest transverse dimension of the part of said replaceable cartridge unit to be passed therethrough for free, axial relative movement of said one housing and said cartridge unit; the maximum diameter of the other rotatable components in the other of said housings being equal to or less than the minimum transverse dimension of said bore; said frame having an elongated opening therein substantially parallel to the axis of said replaceable cartridge unit; a support means positioned above said opening, and slidable means on said support means

engaging and supporting said cartridge unit during removal and insertion, at least one of said slidable means extending through said opening.

4. The combination of claim 3 wherein said support means is secured to and supported by said frame.

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