

June 29, 1943.

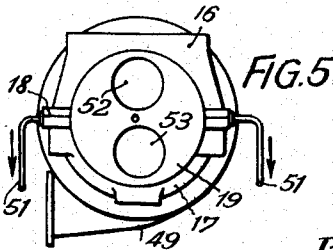
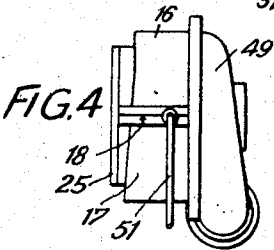
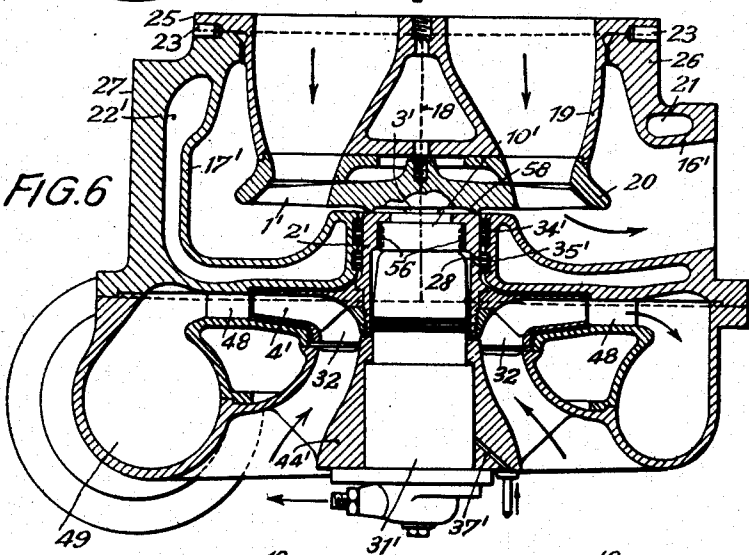
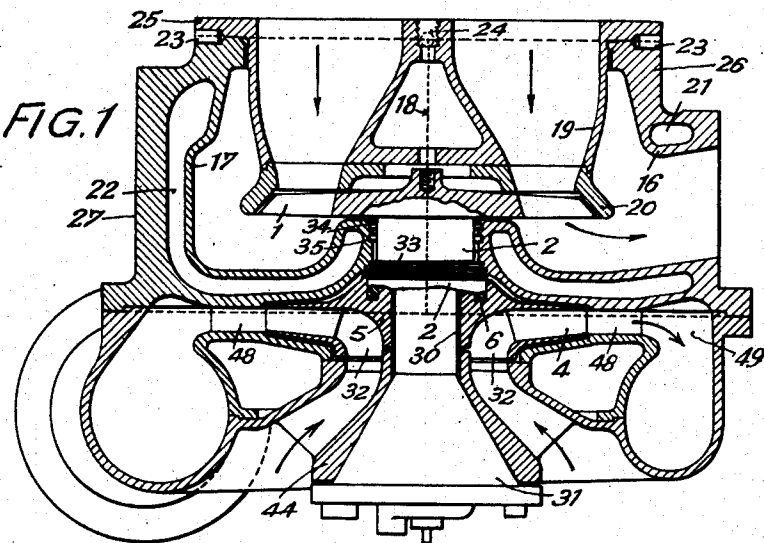
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2,322,824

TURBINE DRIVEN BLOWER

Filed Oct. 31, 1940

4 Sheets-Sheet 1



Inventor:

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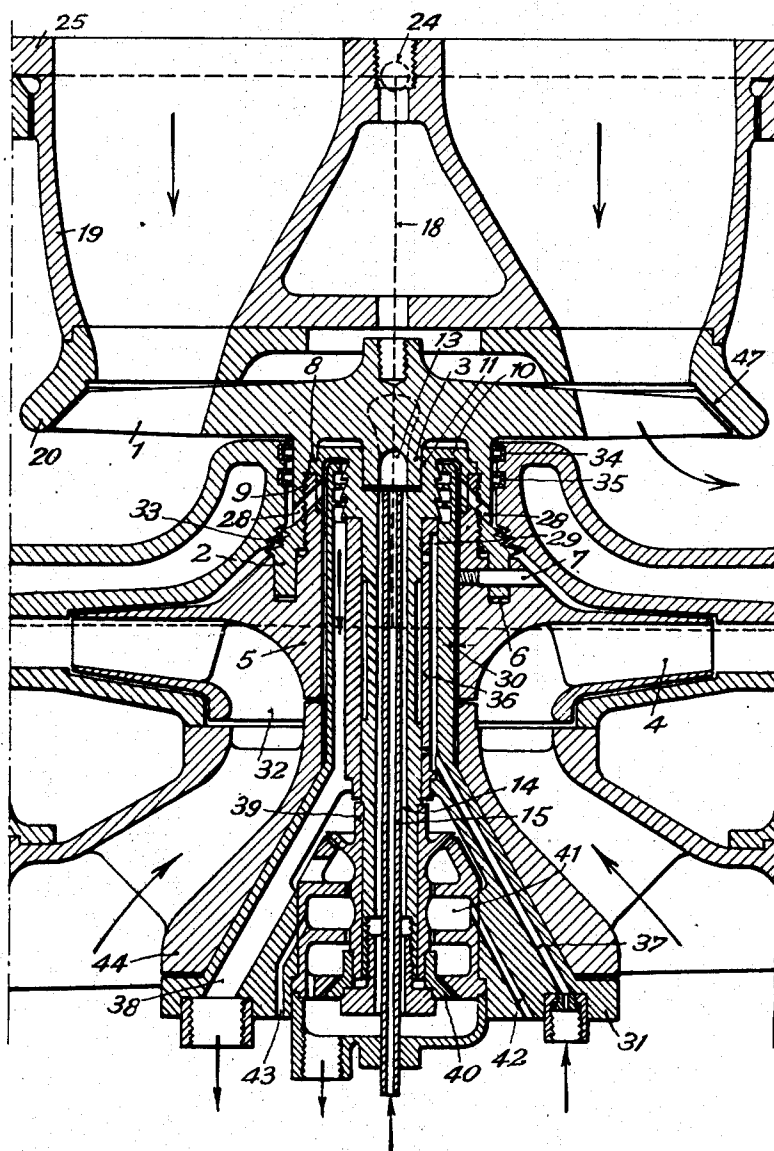
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4 Sheets-Sheet 3

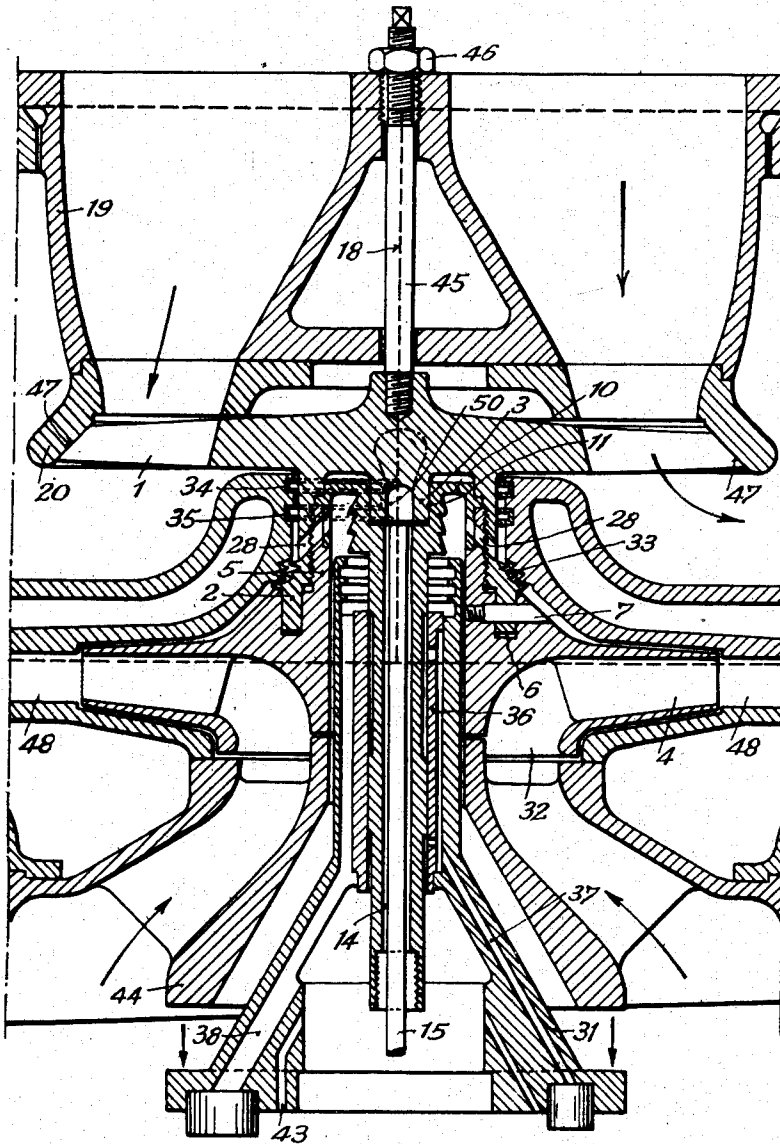


FIG. 3

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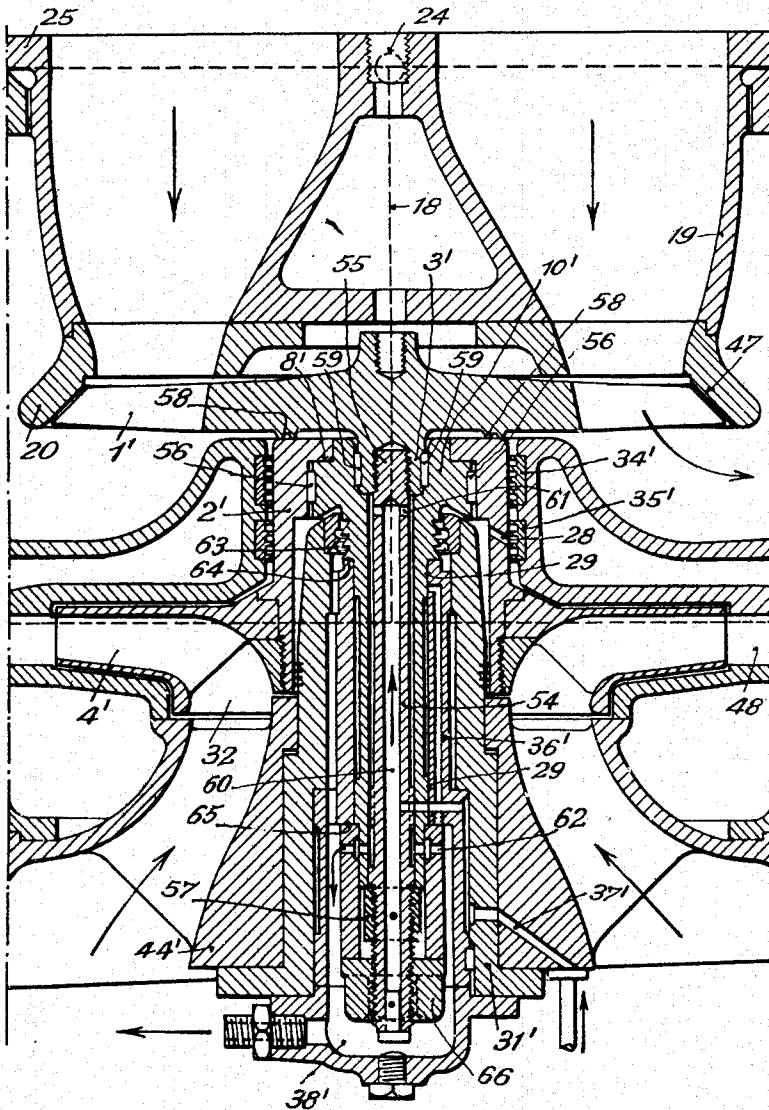


FIG. 7

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UNITED STATES PATENT OFFICE

2,322,824

TURBINE DRIVEN BLOWER

Alfred Buchi, Winterthur, Switzerland

Application October 31, 1940, Serial No. 363,766
In Switzerland October 31, 1939

13 Claims. (Cl. 230—116)

This invention relates to blower units driven by heat-emitting prime movers, particularly gas turbine-driven blowers, in which the turbine rotor and the blower rotor are interconnected by a sleeve, and is an improvement on the gas driven blower disclosed in my U. S. A. Patent No. 2,159,422.

The invention has for its particular object the arrangement of a separate stub shaft, which serves as a mounting member, on the turbine rotor within a central area having a relatively small diameter, in such manner that the sleeve uniting the two rotors into a coaxial separable rotor system is free to expand unhindered under the action of heat and centrifugal force.

This arrangement may be such that the mounting stub shaft embraces a stud connected with the turbine rotor, or the turbine rotor may be provided with a central bore into which a projection on the mounting stub shaft engages. With a view to fixing the mounting stub shaft and the blower rotor to the turbine rotor against axial displacement, the mounting stub shaft may be provided with a circumferential collar which bears on the sleeve connected with the turbine rotor. The hub of the blower rotor may be provided with threads for screwing into a mating threaded portion on the sleeve interconnecting the two rotors, whereby the collar on the mounting stub shaft is clamped fast between the turbine rotor and the blower rotor. This connection may be carried into effect in various other ways. The sleeve interconnecting the two rotors may be so constructed that the respective end of the sleeve extends into the hub of the blower rotor or embraces this hub. For maintaining the turbine rotor and the blower rotor in their relative axial positions, appropriate locking means, such as screw means or the like, are provided. The jointing of the rotor system is so devised that by connecting the separable parts of the system the transfer of heat from the turbine rotor to the blower rotor is minimized.

In order to render the mounting shaft, including the bearing portions which are firmly screwed home in the blower casing, readily mountable and dismountable, an attaching device may be used which can be screwed into the turbine rotor from without. By means of this device the turbine rotor can be forced as a whole, for example, into bearing contact with the nozzle carrier rim or other abutment so as to be retained in position.

The turbo-blower unit on the whole is so jointed as to permit the parts of the assembly to be

readily dismounted in order that, for example, on the removal of only one-half of the turbine exit casing, access is obtained to the turbine rotor, the blower rotor, the sleeve connecting the two rotors, the diffusing blading adjoining the blower root, as well as the diffuser casing.

With a view to preventing the mounting shaft and the part of the turbine rotor connected thereto from substantially heating and expanding at the various conditions of operation, means for cooling the mounting shaft may be provided. This cooling may, advantageously, be effected through a bore in the mounting shaft itself and even be extended to the inner face of the turbine rotor.

In the accompanying drawings the invention is illustrated in detail in seven figures exemplifying two embodiments of the invention. In the drawings

Fig. 1 shows a vertical axial section of a first embodiment of the invention in the form of a turbine driven blower with the connecting means between the turbine rotor and the blower rotor and the mounting means of the same exposed to view;

Fig. 2 shows a similar section of this turbine driven blower on a larger scale with said means also sectioned;

Fig. 3 is a section like that shown in Fig. 2 but with the bearing supporting sleeve somewhat retracted from service position;

Fig. 4 illustrates a side elevation of a turbine driven blower according to the invention, the figure being turned through an angular range of 90° in the counterclockwise direction relatively to Figs. 1 to 3.

Fig. 5 is a top plan view of Fig. 4;

Fig. 6 shows a section similar to that represented in Fig. 1 of a second embodiment of the invention, and

Fig. 7 shows a section similar to that shown in Fig. 2 of the second embodiment.

The numeral 1 designates the turbine rotor one face of which is rigidly connected to a sleeve 2 and is provided with a central stud 3. The blower rotor which is designated by 4 is pushed on the sleeve 2 by means of its hub 5 having an annular groove 6 engaging over the outer end of this sleeve. The blower rotor is held in its relative axial position on the sleeve by means of pins 7. The sleeve 2 is provided with a retaining shoulder 8 and a screw bore 9 into which the hub 5 of the blower 4 is screwed. The threading of this screw joint is so arranged that the joint is automatically tightened in the operation

of the blower. The rotatable mounting stub shaft 10 is pressed against the retaining shoulder 8 between the hub 5 and the turbine rotor 1 by screwing the blower rotor hub 5 into the sleeve 2 and is thus clamped fast and secured in the axial direction. The stud 3 which is firmly connected to the turbine wheel projects into an inner bore 11, which is arranged in the mounting stub shaft 10 adjacent to the turbine wheel, in tightly fitting manner. The stud 3 is provided with an interior hollow space 13, which may have any appropriate form, for example that shown in full lines or that shown in chain dotted lines, in Fig. 2, into which space a cooling medium is supplied through a bore 14 in the mounting stub shaft 10 for example interiorly of a stationary pipe 15, and is discharged from this space again exteriorly of said pipe.

The turbine exit casing 16, 17 is made in two sections as illustrated by the chain-dotted joint 18. The turbine admission casing 19, however, is integral, in this instance, and supports a rim 20 carrying the inlet nozzle on its side adjacent to the turbine rotor. The discharge casing 16, 17 may be provided with cooling spaces 21, 22. In order that the preferably uncooled hot admission casing 19 shall remain concentric with the discharge casing 16, 17 at all times between the three parts 16, 17 and 19 keys 23, 24 may be arranged in crossed relation. Of these keys 23, 24 two pieces are arranged on each diameter concerned in opposed relation radially outwardly in the connecting flanges 25, 26, and 27.

Furthermore, one or more communication passages 28 pass through the sleeve 2 so as to lead into the interior in order that also the air being by-passed after having left the blower rotor 4 can be conveyed to the bearing portions 29 of the mounting stub shaft 10. By the provision of a narrow gap 30 between the hub 5 of the blower and the bearing supporting sleeve 31, air which enters through the passages 28 is prevented from traveling toward the intake 32 of the blower. The air passing through the passages 28 cools the sleeve 2 which is provided with cooling fins 33 and also serves for cooling the mounting stub shaft 10 at the bearing portions of the latter.

In order to prevent the gases from passing from the turbine into the blower rotor, packing arrangements 34, 35 are arranged in the turbine discharge casing 16, 17 for sealing relative to the sleeve 2. For the purpose of completely keeping the gases from passing into the blower rotor, the space between the said packing means may be vented.

The bearing support 31 carries a bearing sleeve 36. The lubricating oil is supplied through a bore 37 and returned through a collecting bore 38. The numeral 39 refers to a centrifugal oil-catching or throw-off device for the lubricating oil serving the purpose of preventing this oil from passing along shaft 10 to the outside. A catching device 40 is also provided for centrifugally throwing the cooling water passing out of the annular space 14 away from shaft 10. Between said two catching devices 39, 40 a vented space 41 is provided to which the air is supplied through a bore 42 and from which oil or water drops that may have been formed can escape through a bore 43. Instead of water, oil may be used as the cooling medium for the mounting shaft. Since, in that event, for the cooling as well as for the lubrication only one medium must be supplied, the feed and return means for the bearing

supply oil, and those for the cooling oil are simplified and the device 39 will function as a water-catching device.

In Fig. 3 the blower unit is shown to be disassembled to some extent, the bearing support 31 being somewhat retracted. The bearing support 31 is normally firmly connected with the blower admission casing 44. In order to provide that the disassembling of the bearing support can be effected safely and mounted in service position again without damage to the various closely assembled parts, first, the turbine rotor 1 is drawn toward the turbine inlet by means of a pin 45 which previously had been screwed into said wheel by tightening a nut 46 carried by this pin until the blading of the turbine rotor enters into bearing contact with the nozzle ring. This bearing contact may, for example, take place against a conical surface 47 of the nozzle carrier ring, as shown in the drawings, or against some other portion of this ring. By this means the turbine rotor 1 and the blower rotor 4 connected thereto by means of the sleeve 2, as well as the mounting stub shaft 10 clampingly connected to the turbine and blower rotors are firmly sustained. With this arrangement the bearing support 31 can be easily removed or reinserted in position respectively in spite of the small clearances existent between the individual parts.

From Fig. 3 it will be readily seen what parts are exposed when the upper section 16 of the turbine discharge casing is removed. By this means access is obtained to the turbine rotor 1, the sleeve 2, the blower rotor 4, and also to the diffusing blading 48 adjoining the latter as well as to the diffuser casing 49. The numeral 50 designates a groove-like pressure relief passage which is positioned between the two packing arrangements 34, 35, and through which the gases that may be present at this packing zone can escape.

Fig. 4 representing a side view of the turbine driven blower shows plainly the two sections 16, 17 with the intervening joint 18, the outer flanges 25 of the turbine admission end, and the diffuser casing 49. The numeral 51 denotes a conduit which leads the exhaust gases present in the groove 50 shown in Fig. 3 into the atmosphere.

Fig. 5 being a top plan view of the turbine driven blower illustrated in Fig. 4 shows two gas admission ports 52, 53 as arranged in the one-part gas admission end 19, further the turbine discharge casing sections 16, 17, two gas discharge pipe conduits 54 and the diffuser casing 49 therebehind.

In Figs. 6 and 7 a modified connection between the turbine rotor 1', the mounting shaft 10', and the sleeve 2' on the one hand and the blower rotor 4' on the other is shown by way of example. The sleeve 2' is a separate cylindrical member one end of which carries the blower rotor 4', whereas to the other end of this sleeve the turbine wheel 1' is fastened together with the mounting shaft 10'. Instead of effecting the connection between said parts by means of an interior thread as provided in the sleeve 2 of Figs. 1 and 2, in this arrangement the stud 3' on the turbine rotor 1' is threadedly connected with a pin 54 having a threaded portion 55. The sleeve 2' is provided with a retaining shoulder 8' and is pushed on the mounting shaft. In order to provide that both parts rotate in unison they are locked to each other by means of keys 56. For assembling the blower rotor 4 together with the sleeve 2' with the turbine rotor 1' the mount-

ing shaft 10' is pushed onto the stud 3' and then the nut 57 is so tightened that axial displacement between the parts is prevented, that is, the butt end of the sleeve 2' adjacent to the turbine rotor is brought into snug bearing contact with an annular bearing strip 58 on the turbine rotor. Thereby a perfectly rigid connection between the rotors 1', 4' is obtained. The retaining shoulder 58 is, advantageously, provided with such a small bearing surface that the contacting surface between the hot turbine rotor and the sleeve 2' is relatively very small with a view to minimizing the amount of heat passing from the hot turbine rotor into the sleeve 2' and thence into the mounting shaft and the blower rotor.

In order to ensure that the turbine rotor moves the mounting shaft positively along with it connecting keys 59 are arranged also between the parts 3' and 10'. Also in this instance a bearing sleeve 36' having two bearing portions 29 is provided. The oil is supplied through the bores 37' on the one hand to the two bearing surface portions 29 and the hollow interior 60 of the pin 54 on the other. The oil entering the interior 60 of this pin 54 serves for cooling said pin and the stud 3'. The oil passes on to the outer side of the pin 54 at the points 61 and thence through the discharge passages 62 into the collecting space 38' and then to the outside. Therefore, this oil cools apart from the stud 3' particularly also the interior of the mounting shaft 10' and consequently also the bearing surface portions 29. The oil leaving said surface portions is gathered, for example by means of oil wiping devices 63, and is then conducted into the space 38' also.

The mounting shaft is stayed laterally by means of collars 64, 65. By accordingly adjusting the nut 66 a certain amount of play can be obtained between the rotatable mounting shaft 10' and the stationary bearing sleeve 36'. The bearing sleeve 36' is sustained by the bearing supporting sleeve 31' which is inserted in the blower casing 44'. In order that also in this case air delivered by the blower is supplied to the bearing surface portions passages 28 are arranged in the sleeve 2'. In the present instance these passages are located adjacent to the packing arrangements 35'.

What I claim is:

1. In a turbo-blower unit driven by an operating fluid, an encased turbine and an encased blower each having a rotor, the encasements for said turbine and said blower being assembled into a self-contained casing for the blower unit, and the portion of the encasement for the admission of the operating fluid including a terminal nozzle carrier rim for cooperation with said turbine rotor, a sleeve uniting said turbine rotor and said blower rotor into a coaxial rotor system, a stub shaft for mounting said rotor system for rotation relative to said casing arranged on said turbine rotor within a central area having a relatively small diameter, a dismountable bearing support for holding said mounting shaft in position, and an attaching device adapted to be screwed into said turbine rotor in the inoperative condition of said blower for forcing said turbine rotor against a point of said admission encasement portion serving as an abutment for said turbine rotor for holding said turbine rotor and said stub shaft to said abutment so that said bearing support can be safely dismounted.

2. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and

a blower each having a rotor, a sleeve disengageably connecting said turbine rotor and said blower rotor into a coaxial separable rotor system for conjoint rotation, a rotatable stub shaft for rotatably mounting said rotor system disengageably connected with said turbine rotor within a central area having a relatively small diameter, and jointing means for said disengageable connections on said rotor system inclusive of said stub shaft providing mutual minimum size heat-transmitting contacting surfaces on said connections and accordingly small heat transfer from said turbine rotor particularly to said shaft.

3. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and a blower each having a rotor, a sleeve disengageably connecting said turbine rotor and said blower rotor into a coaxial separable rotor system for conjoint rotation, a central centering stud arranged on said turbine rotor adjacent to said blower rotor, a stub shaft for rotatably mounting said rotor system and having a central recess loosely receiving said stud, thereby forming a disengageable connection between said stub shaft and said stud for maintaining the axial alignment between said shaft and said turbine rotor free from disturbance by heat expansion and wear within a central area having a relatively small diameter, and jointing means for said rotor system inclusive of said stub shaft providing mutual minimum size heat-transmitting contacting surfaces on said disengageable connections and accordingly small heat transfer from said turbine rotor particularly to said shaft.

4. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and a blower each having a rotor, a sleeve disengageably connecting said turbine rotor and said blower rotor into a coaxial separable rotor system for conjoint rotation, said turbine rotor having a central recess adjacent to said blower rotor, a stub shaft for rotatably mounting said rotor system disengageably connected with said turbine rotor within a central area having a relatively small diameter, a central projection on said stub shaft extending into said central recess in said turbine rotor, thereby forming a disengageable connection between said stub shaft and said turbine rotor for maintaining the axial alignment between said shaft and said turbine rotor free from disturbance by heat expansion and wear, and jointing means for said rotor system inclusive of said stub shaft providing mutual minimum size heat-transmitting contacting surfaces on said connections and accordingly small heat transfer from said turbine rotor particularly to said shaft.

5. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and a blower each having a rotor, a sleeve uniting said turbine rotor and said blower rotor into a coaxial separable rotor system, a hub on said blower rotor, said turbine rotor having a central recess of small diameter on the side toward the blower rotor, a stub shaft for rotatably mounting said rotor system separably connected with said turbine rotor within a central area having a relatively small diameter, a collar on said stub shaft abutting against said turbine sleeve, interengaging threaded portions on said sleeve and on said hub for threadedly connecting said turbine rotor, said stub shaft, and said blower rotor to each other and thereby retaining said stub shaft and said blower rotor in axial position relative to said turbine rotor, and jointing means separably con-

necting said turbine rotor and stub shaft providing only small area of contact to minimize heat transfer from said turbine rotor particularly to said shaft.

6. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and a blower each having a rotor, connecting means including a sleeve uniting said turbine rotor and said blower rotor into a coaxial separable rotor system, a hub on said blower rotor having a recess interengaging with the end of said sleeve adjoining said blower rotor, a stub shaft for rotatably mounting said rotor system separably connected with said turbine rotor within a central area having a relatively small diameter, the connecting means for said rotor system inclusive of said stub shaft having only small area of contact to minimize heat transfer from said turbine rotor particularly to said shaft.

7. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and a blower each having a rotor, a sleeve disengageably connecting said turbine rotor and said blower rotor into a coaxial separable rotor system for conjoint rotation, a hub on said blower rotor surrounded by the end of said sleeve adjoining said blower rotor for providing unrestricted relative heat expansion between said sleeve and said hub, a stub shaft for rotatably mounting said rotor system disengageably connected with said turbine rotor within a central area having a relatively small diameter, and jointing means for said disengageable connections on said rotor system inclusive of said stub shaft providing mutual minimum size heat-transmitting contacting surfaces on said connections and accordingly small heat transfer from said turbine rotor particularly to said shaft.

8. In a turbo-blower unit adapted to be driven by hot gases from a prime mover, a turbine and a blower each having a rotor, said blower rotor having air communication passages, a sleeve having air communication passages for registry with said passages in said blower rotor and disengageably connecting said turbine rotor and said blower rotor into a coaxial separable rotor system for conjoint rotation, locking means interengaging with said blower rotor and said sleeve for retaining said blower rotor and said turbine rotor in their relative positions with respective corresponding passages registering with each other, a stub shaft for rotatably mounting said rotor system disengageably connected with said turbine rotor within a central area having a relatively small diameter, and jointing means for said disengageable connections on said rotor system inclusive of said stub shaft providing mutual minimum size heat-transmitting contacting surfaces on said connections and accordingly small heat transfer from said turbine rotor particularly to said shaft.

9. In a turbo-blower unit driven by an operating fluid, an encased turbine and an encased blower each having a rotor, the encasement of said blower including a diffuser casing having diffuser blades, the encasements for said turbine and said blower being assembled into a self-contained separable casing for the turbo-blower unit, and the circumferential portion of the turbine encasement for the exit of the operating fluid being made in two sections for giving access to most of the vital parts of said unit on removal of either of said sections, a sleeve disengageably connecting said turbine rotor and said blower rotor into a coaxial separable rotor system for

conjoint rotation, said sleeve, together with said turbine and blower rotors and said diffuser casing and blades, constituting said vital parts, a stub shaft for mounting said rotor system for rotation relative to said casing disengageably connected with said turbine rotor within a central area having a relatively small diameter, and jointing means for said disengageable connections on said rotor system inclusive of said stub shaft providing mutual minimum size heat-transmitting contacting surfaces on said connections and accordingly small heat transfer from said turbine rotor particularly to said shaft.

10. In a turbo-blower unit driven by an operating fluid, an encased turbine and an encased blower each having a rotor, the encasements for said turbine and said blower being assembled into a self-contained separable casing for the turbo-blower unit, a nozzle carrier rim included in said turbine for cooperation with said turbine rotor, said nozzle carrier rim and the portion of the encasement for the admission of the operating fluid to said turbine each forming an integral piece, a sleeve uniting said turbine rotor and said blower rotor into a coaxial separable rotor system, a stub shaft for mounting said rotor system for rotation relative to said casing separably connected with said turbine rotor within a central area having a relatively small diameter, and jointing means for said rotor system between the turbine rotor and stub shaft, said stub shaft having only small area of contact to minimize heat transfer from said turbine rotor particularly to said shaft.

11. In a turbine-driven blower unit a turbine and a blower each having a rotor, a sleeve uniting said turbine rotor and said blower rotor into a coaxial separable rotor system, a stub shaft for rotatably mounting said rotor system separably connected with said turbine rotor within a central area having a relatively small diameter, bearing portions on said mounting shaft, said sleeve having an opening providing a by-pass for air leaving said blower rotor for cooling said sleeve by conducting the air entering said by-pass through said sleeve and on to at least one of said bearing portions and thence into the atmosphere, and jointing means for said rotor system between the turbine rotor and stub shaft, said stub shaft having only small area of contact to minimize heat transfer from said turbine rotor particularly to said shaft.

12. In a turbo-blower unit driven by a cooperating fluid, an encased turbine and an encased blower each having a rotor, the encasements for said turbine and said blower being assembled into a self-contained separable casing for the turbo-blower unit, a sleeve uniting said turbine rotor and said blower rotor into a coaxial separable rotor system, packing diaphragms arranged between said sleeve and the circumferential portion of the turbine encasement for the exit of the operating fluid so as to limit an intervening sealing zone, said packing zone being vented for leading any gas which may have leaked into said zone from said turbine into the atmosphere, a stub shaft for mounting said rotor system for rotation relative to said casing separably connected with said turbine rotor within a central area having a relatively small diameter, and jointing means for said rotor system between the turbine rotor and stub shaft, said stub shaft having only small area of contact to minimize heat transfer from said turbine rotor particularly to said shaft.

13. In a turbo-blower unit adapted to be driven

by hot gases from a prime mover, a turbine and a blower each having a rotor, a sleeve uniting said turbine rotor and said blower rotor into a coaxial separable rotor system, a central stud arranged on said turbine rotor adjacent to said blower rotor, a stub shaft for rotatably mounting said rotor system, and having a central recess embracing said stud, separably connected with said turbine rotor within a central area having a relatively small diameter, cooling means asso-

ciated with said stud and said stub shaft for keeping down the temperature of the stud and stub shaft for maintaining the connection between said turbine rotor and said stub shaft at a temperature as uniform as possible, and jointing means for said rotor system between the turbine rotor and stub shaft, said stub shaft having only small area of contact to minimize heat transfer from said turbine rotor particularly to said shaft.

ALFRED BUCHI.