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MACHINE UNIT INCLUDING A TURBINE AND A MACHINE DRIVEN THEREBY

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Fig. 1

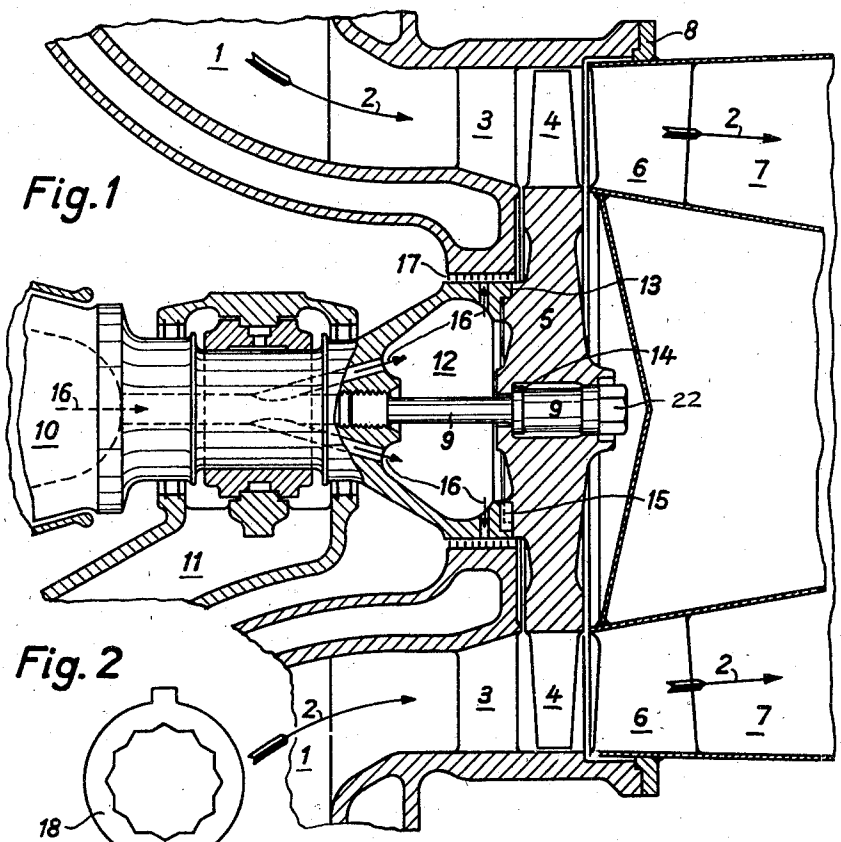


Fig. 2

Fig. 3

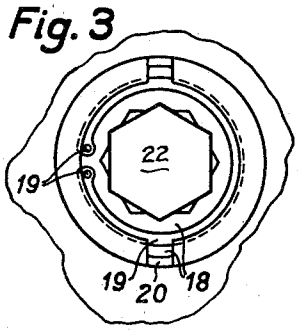


Fig. 4

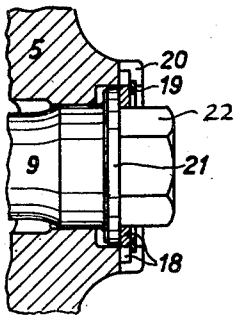
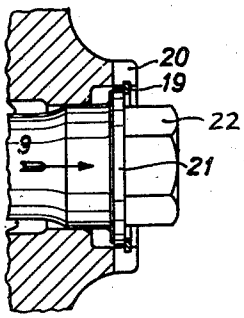


Fig. 5



INVENTORS
FRANZ SCHAER
MARTIN ALLEMANN.
BY K. A. Mayr
ATTORNEY

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MACHINE UNIT INCLUDING A TURBINE AND A MACHINE DRIVEN THEREBY

Franz Schaer and Martin Allemann, Winterthur, Switzerland, assignors to Sulzer Frères, Société Anonyme, Winterthur, Switzerland, a corporation of Switzerland

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4 Claims. (Cl. 287—52)

The present invention relates to a machine unit including a turbine and a machine driven by the turbine, more particularly to a unit consisting of a waste gas operated turbine and a compressor for supercharging an internal combustion engine.

The most delicate part of a unit or group of the type described above is the turbine wheel. The latter is not only exposed to the high and variable temperatures and velocities of its operating medium but is also exposed to undesirable effects produced by the operating medium. If the operating medium is steam, it causes erosions, corrosions, and deposits. These effects are more pronounced, if combustion gases are used as operating medium. The blades of the turbine wheel may also be damaged by foreign objects carried along by the operating medium. Besides a reduction of the operating efficiency, the turbine wheel may become unbalanced so that serious destructions may occur unless the support of the turbine wheel is so well constructed that it can sustain a multiple of the stresses to which it is exposed at normal operating conditions.

It is an object of the present invention to provide a support for the wheel of a turbine forming part of a machine unit which support is extraordinarily sturdy, yet affording easy accessibility and a minimum of effort for inspection, cleaning, repairing, or interchanging of the turbine wheel.

According to the invention the turbine is supported by a bolt extending through a central bore in the wheel and pulling the turbine wheel at great initial tension against the end of the shaft of the machine which is driven by the turbine. The turbine wheel is thus mounted in overhung fashion on the end of the shaft of the driven machine. The end of the shaft of the driven machine is preferably shaped like a bell against the rim of which the turbine wheel is pressed, the bolt extending through the turbine wheel abutting against the latter substantially in the same plane in which the wheel abuts against the rim of the flared end of the shaft of the driven machine.

The bolt may be secured to the turbine wheel by means of a lock ring surrounding the head of the bolt and being prevented from revolving therearound. The lock ring may be received in a suitable axial recess in the hub of the turbine wheel and abutting against an internal shoulder in the hub of the wheel secured therein by means of a split ring. The lock ring may be provided with protuberances extending into suitable radial recesses in the body of the turbine wheel for preventing relative rotation of the lock ring and of the turbine wheel. The bolt is preferably provided with a collar having a greater outside diameter than the inner diameter of the split ring and being located at the side of the lock ring which is distal with respect to the split ring so that when the structure is disassembled, after removal of the split ring and of the lock ring and after preliminary loosening of the bolt, the split ring may be reinserted, the collar of the bolt now abutting against the split ring so that upon further unscrewing of the bolt, the collar of the latter presses against the split ring, forcing the turbine wheel away from the rim of the bell shaped end of the shaft of the driven machine.

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself however and additional objects and advantages thereof will best be understood from the following description of an embodiment thereof when read in connection with the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of a turbine and of the bearing of a machine driven by and adjacent to the turbine;

Fig. 2 is an enlarged scale plan view of a lock ring used in the structure according to the invention;

Fig. 3 is an end view of an assembly according to the invention for securing the central bolt for mounting the turbine wheel;

Fig. 4 is an axial sectional view of the system shown in Fig. 3;

Fig. 5 is an axial sectional view of the system according to Figs. 3 and 4 arranged for separating the turbine wheel from the shaft of the driven machine.

The same numerals designate the same parts in all figures.

Fig. 1 illustrates a portion of a machine group which is suitable for supercharging an internal combustion engine, not shown, and which includes a compressor, of which only one shaft bearing is shown, and a waste gas turbine.

A partly shown annular chamber **1** formed in the casing of a waste or exhaust gas turbine receives the superatmospheric exhaust gas of the internal combustion engine and directs the gas along the arrows **2** between guide blades **3** from which the gas flows between the running blades **4** of a turbine wheel **5**. The gas leaving the turbine wheel flows between outlet guide or support blades **6** which are arranged in a diffusor **7**. The latter is connected with the turbine casing by means of a flange **8** and can be easily removed from the casing for exposing the outer surface of the turbine wheel **5**.

The turbine wheel **5** is pulled by means of a pretensioned bolt **9** extending through a central bore of the turbine wheel against a compressor shaft **10** which extends beyond a bearing **11** outside of the compressor, the turbine wheel being connected with the compressor shaft in overhung fashion. The end of the compressor shaft **10** is flared, forming a bell **12** against the rim **13** of which the turbine wheel **5** is pressed by the pretensioned bolt **9**. The diameter of the rim **13** is substantially one half of that of the wheel **5**. This structure forms a rigid and solid connection between the shaft **10** and the wheel **5**. Since the wall thickness of the bell **13** can be made relatively small without impairing rigidity of the structure, the connection elastically yields in radial direction and throttles the heat flow from the turbine to the compressor.

The bearing **11** is protected against undesired heating by the turbine wheel **5**. On the other hand the temperature of the rim **13** of the bell **12** is almost equal to that of the turbine wheel so that it will follow the changes of diameter of the turbine wheel **5** caused by heating of the wheel and by centrifugal forces.

The bolt **9** has a shoulder **14** abutting against a corresponding shoulder of the turbine wheel, transmitting the pull exerted by the bolt to the turbine wheel. The shoulder **14** is substantially in the same plane as the rim **13** of the bell **12**. Therefore axial expansion of the wheel **5** cannot change the pretension of the bolt **9**. The length of the bolt **9** is substantially equal to the thickness of the hub of the wheel **5** plus the longitudinal extension of the bell **12**. The thickness of the wall of the bell **12** changes in the axial direction so that the temperatures of the bell

and of the bolt 9 drop in the same manner in the direction away from the turbine wheel and the temperature differences between the bell and the bolt which may cause a change of the pretension of the belt are reduced to a minimum.

Relative rotation of the turbine wheel 5 and of the bell 12 is prevented by a key 15.

Compressed air is conducted along arrows 16 through a central bore in the compressor shaft 10 and through bores branching from the central bore into the interior of the bell shaped end of the shaft 10. The compressed air is conducted through radial bores from the interior of the bell into a labyrinth gland 17, acting as a seal. The air is much whirled about due to the action of centrifugal forces and assists in equalizing the temperature of the bell 12 and of the bolt 9 so that the pretension of the latter, which is elastic in longitudinal direction, is not changed to an undesired extent.

To further facilitate removal of the turbine wheel 5 from the shaft 10 and to avoid rough treatment of the delicate buckets 4 as might be the case if the wheel 5, after a long period of operation, sticks to the bell rim 13, the bolt 9 is provided with locking means, shown in Figs. 2 to 4, whose parts can also be used for pressing the turbine wheel away from the bell rim, as shown in Fig. 5.

A lock ring 18, shown in Fig. 2, is axially movable but unrotatable on the head 22 at the end of the bolt 9 and is held against slipping off the bolt head by means of a split ring 19, the latter being received in a suitable annular recess in the turbine wheel 5. The lock ring 18 has radial projections extending into appropriate recesses 20 in the turbine wheel 5 for preventing rotation of the lock ring relatively to the wheel. The bolt 9 is provided with a collar 21 at the base of the bolt head (Fig. 4), the outer diameter of the collar 21 being greater than the inner diameter of the split ring 19. When the turbine wheel is mounted on the shaft 10, the lock ring 18 is between the collar 21 and the split ring 19 and there is a clearance between the collar 21 and the turbine wheel. When it is desired to remove the turbine wheel from the shaft 10, the split ring and the lock ring are removed, whereupon the split ring is reinserted and the bolt 9 is loosened until the collar 21 abuts against the split ring 19. Upon further loosening of the bolt 9 the turbine wheel is pressed away from the rim 13 of the bell 12.

While a specific embodiment of the invention has been shown and described, it will be apparent to those skilled in the art that various changes, modifications, substitutions, additions and omissions may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A machine unit including a turbine and a machine driven thereby comprising a turbine wheel having a bore extending through the center of said wheel, a shaft for the driven machine, a bolt screwed into the end of said shaft and extending through said bore, the end of said shaft being flared to form a bell whose rim abuts against said turbine wheel, said bolt having a shoulder, a shoulder in said bore of said turbine wheel abutting against the shoulder on said bolt for pressing said wheel against the rim of the bell shaped end of said shaft upon tightening of the bolt in said wheel, said shoulders being in substantially the same plane as the rim of the bell shaped end of said shaft.

2. A machine unit as defined in claim 1, including a collar on the end of said bolt extending through the bore in the turbine wheel, a bolt head of angular cross section extending from said collar, a lock ring coaxially movably and unrotatably supported by said turbine wheel and surrounding said bolt head and being axially movable and unrotatable on said head for preventing relative rotation of said bolt and of said turbine wheel, an internal annular recess in and being coaxial of said turbine wheel, a split ring received in said annular recess for preventing slipping of said lock ring off said bolt head, the outside diameter of said collar being greater than the inside diameter of said split ring for affording abutment of said collar against said split ring after removal of said lock ring during removal of said turbine wheel from said shaft.

3. A machine unit as defined in claim 1 in which said bolt is substantially as long as the thickness of the center portion of said turbine wheel through which the bolt extends plus the axial extension of said bell.

4. A machine unit as defined in claim 1 in which the diameter of the rim of said bell is substantially half as great as the diameter of said wheel.

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