Oct. 23, 1962 R. R. EICKERT 3,059,899

HIGH SPEED AIR MOTOR

Filed Jan. 19, 1959

Fig. 1.

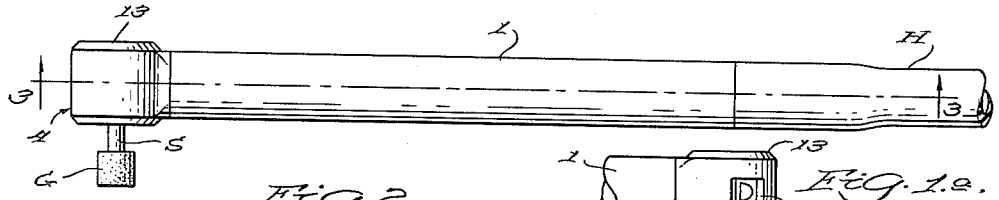


Fig. 1a.

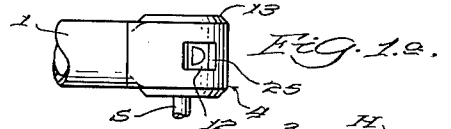


Fig. 2.

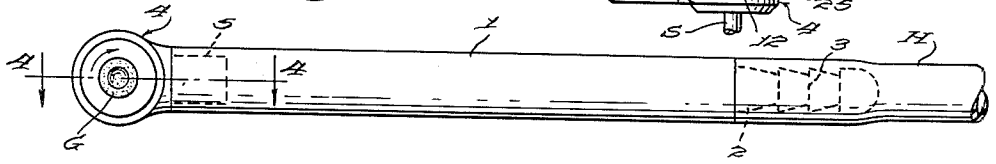


Fig. 3.

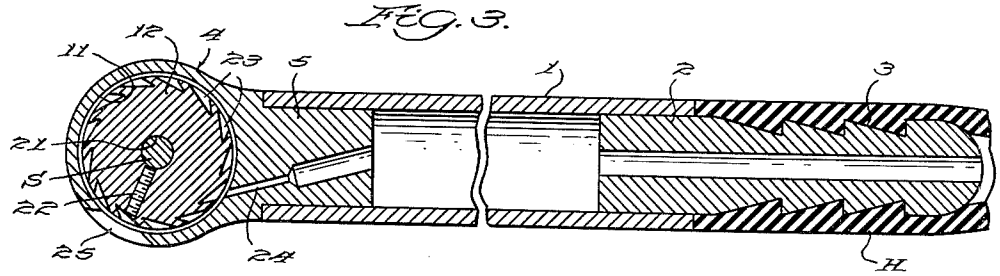


Fig. 4.

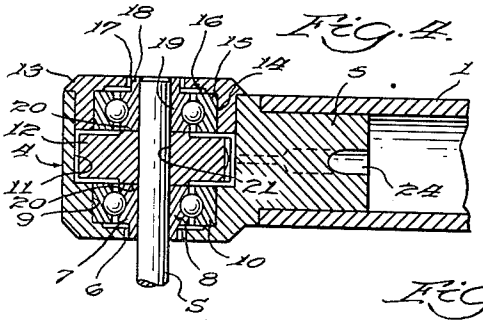


Fig. 5.

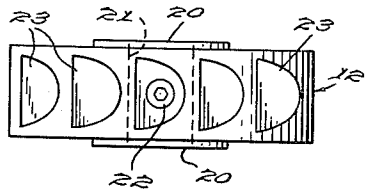


Fig. 8.

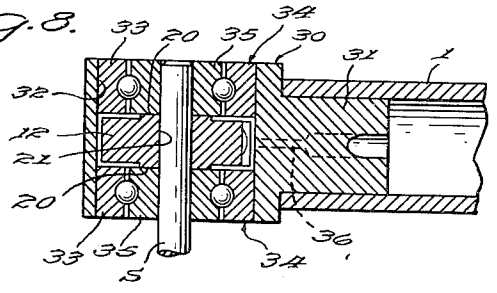


Fig. 7.

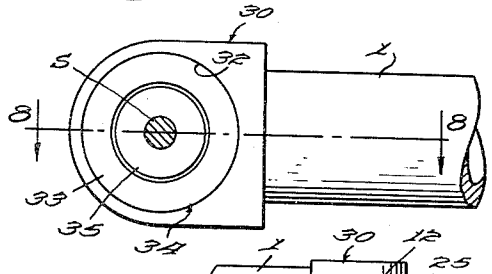
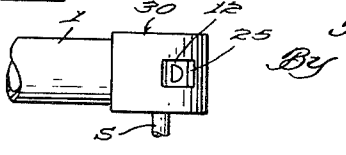


Fig. 6.



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3,059,899

HIGH SPEED AIR MOTOR

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4 Claims. (Cl. 253—2)

This invention relates to air motors and particularly to an improved form thereof adapted to serve as a handle for high speed rotary tools actuated thereby.

The principal object of the invention is to provide a small, light weight air motor capable of operating at speeds ranging between about 100,000 and 200,000 r.p.m. Which additionally serves as the handle means for a rotary tool carried and actuated thereby.

Another object of the invention is to provide an air motor capable of extreme high speed rotation and adapted further to serve as a handle means for an abrading tool carried and actuated thereby which motor is so constructed and arranged that the air which serves to actuate the rotor thereof additionally serves to prevent the entry of dust and grit into the motor bearings.

A further object of the invention is to provide a high speed air motor for actuating a rotary tool in which provision is made for inter-changing of tools and in which the shank element of the tool installed in the motor serves as the rotor supporting shaft of the motor.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts, and in the construction, combination and arrangement of parts described, by way of example, in the following specification of certain presently preferred modes of execution of the invention, reference being had to the accompanying drawings which form a part of said specification in which drawings:

FIG. 1 is a side elevational view of an air motor embodying one mode of execution of the invention,

FIG. 1*a* is a fragmentary, reduced scale elevational view of the side opposite that shown in FIG. 1.

FIG. 2 is a bottom plan view of the air motor shown in FIG. 1,

FIG. 3 is an enlarged longitudinal sectional view taken on the line 3—3 of FIG. 1, an intermediate portion of the handle component being broken away to conserve space in the drawing,

FIG. 4 is an enlarged fragmentary medial sectional view taken on the line 4—4 of FIG. 2,

FIG. 5 is a further enlarged side elevational view of the rotor element,

FIG. 6 is a fragmentary side elevational view of an air motor embodying a second mode of execution of the invention,

FIG. 7 is an enlarged bottom plan view of the motor shown in FIG. 6, and

FIG. 8 is a medial sectional view taken on the line 8—8 of FIG. 7.

Referring first to the form of the invention shown in FIGS. 1, 2, 3 and 4, the motor comprises a hollow metal tube **1** serving as a handle element, said tube at one end thereof having a nipple element **2** inserted therein and projecting beyond the end of the tube, said nipple having a serrated outer surface **3** for insertion into a hose H through which air may be transmitted through the tube **1** and thence to the rotor.

The motor, per se, comprises a frame member **4** having a cylindrical shank element **5** adapted to be inserted into the opposite end of the tube **1** and secured therein by any suitable means such as, for example, brazing or soldering. Beyond the shank **5**, the motor frame **4** has a series of concentric bores extending therethrough

comprising a bore **6** for the end of the inner race **7** of a ball bearing assembly **8** which projects therethrough. Inwardly of the bore **6** the frame member is provided with a larger bore **9** to accommodate and hold the outer race **10** of the said ball bearing assembly **8**. Beyond the bore **9** and at the mid length of the series of bores through the frame member, is an enlarged bore **11** affording clearance for the rotor **12** which extends to the opposite end of the frame member **4**.

Tightly fitting the outer end of the bore **11** is the outer peripheral face of a cap element **13** which on its inner face is provided with a bore **14** in which the outer race **15** of a second ball bearing member **16** is received. At its outer face the cap member **13** is provided with a smaller bore **17** affording clearance for the end **18** of the inner race **19** of said ball bearing assembly **16**.

The rotor **12** is formed from a thick disc of rigid material (preferably metal) and has hub faces **20** at each side thereof and a bore **21** extending axially therethrough in alignment with the axial bores in the inner races of the two ball bearing assemblies. The shank S of a tool may be inserted in these aligned bores and clamped to the rotor by a set screw **22** extending radially from the bore **21**. The outer periphery of the rotor is provided with a series of cups **23** which are generally semi-circular as viewed in plan elevation and which are arranged (see FIG. 3) to receive a blast of air delivered substantially tangentially thereto by an air passage **24** extending through the shank portion **5** of the motor frame from the interior of the tube **1** to the bore **11** directly opposite the mid width of the rotor. The hubs **20**, **20** of the rotor engage the ends of the inner races **8** and **19** of the ball bearing assemblies and thus keep the sides of the rotor spaced from the side walls of the cavity within which it is contained comprising the bore **11**, the shoulder formed by the juncture of the bores **9** and **11**, the outer race **10**, the inner end face of the cap member **13**, and the associated face of the outer race **15** of the other ball bearing assembly. This clearance, although somewhat exaggerated for the sake of clearness of illustration in the drawings, permits a portion of the air which is impinged on the buckets or cups **23** of the rotor to escape through the bearing assemblies and thus because of the air currents flowing out of the opposite ends of the device the entry of grit and dust during the operation of the motor is effectually precluded. The main escape of the air is through an exhaust port **25** at one side of the motor frame element.

When the device is used with air pressures of the order of, say, 90–100 p.s.i., the rotor and the tool operated thereby develop tremendous speeds, the speeds being of the order of over 100,000 r.p.m.'s, and, on occasion, may be as high as 200,000 r.p.m.'s. The tools employed may be small grinding wheels such as shown at G in FIGS. 1 and 2 or metal burrs or the like. The tool shank S serves as the motor shaft and the interchange of tools is effected by releasing the set screw **22**, access being had thereto through the exhaust port **25**, the tools exchanged and the replaced tool being then secured by the set screw **22**. By this means the necessity of providing a holding chuck or equivalent devices is eliminated with a consequent important and material reduction in the rotating mass to be actuated by the rotor and this contributes materially to the high speeds achieved. These speeds, further provide an ease of operation not heretofore achieved on any device as small as the motor of the instant invention. Additionally, this novel means of using the tool shanks as the motor shaft reduces the manufacturing cost appreciably.

Referring next to FIGS. 6, 7 and 8 there is shown a second and simpler embodiment of the invention in which the identical rotor is, however, retained. The

motor frame 30 is provided with a cylindrical shank 31 which is secured in the end of the metal tube 1 by soldering or brazing and said motor frame has a bore 32 extending therethrough transversely to the axis of the shank portion 31. Tightly pressed in the opposite ends of the bore 32 are the outer races 33, 33 of identical ball bearing members 34, 34. The rotor 12 is interposed between the ball bearing members and the hub portions thereof engage the inner races 35, 35 of said ball bearing assemblies. The tool shank S extends through the aligned inner races 35, 35 and the bore 21 in the rotor 12. The tool shank being secured to the tool shank in the same way as disclosed in FIG. 3. A tangentially extending passage 36 delivers the air to the periphery of the rotor 12 in the same manner as the passage 24 in the first described form of the invention. The rotor is spaced from the adjacent faces of the outer races of the ball bearing members by the hub portions 20, 20 and from the interior surface of the bore 32 so that a portion of the air used to rotate the rotor and the tool shank S escapes around the sides of the rotor and thence between the inner and outer races of the ball bearing assemblies thus precluding the entrance of dust and grit into the bearings during the operation of the device as in the first described embodiment of the invention. The said second embodiment of the invention is capable of reaching the same speeds as the first embodiment and is equally efficient in use. The only advantage achieved is that of more economical manufacture but this, as will be appreciated from a comparison of FIGS. 4 and 8, is at the expense of a lack of protection of the bearing assemblies in the second form of the device. It is most suitable for use in connection with work on materials which do not produce an abrasive type of dust and is probably more useful in such locations as dental laboratories or in fine model making.

The first described embodiment of the invention is equally useful in such locations but additionally it can be employed to better advantage for such uses as polishing or fine detail grinding or cutting of dies and similar types of work where there is a greater likelihood of the production of abrasive dust.

While, in the foregoing specification, there has been disclosed certain presently preferred embodiments of the invention, it is not to be inferred therefrom that the invention is limited to the exact modes of execution thereof thus disclosed by way of example and it will be understood that the invention includes as well all such changes and modification in the parts, and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. A high speed motor for actuating rotary tools comprising

a frame,

a pair of ball bearings mounted therein and disposed one at each side of said frame in spaced, axial alignment with each other;

the inner races of said ball bearings each having an axial bore extending therethrough and said bores being accessible from the respective sides of said frame,

a rotor freely mounted in said frame in the space between said ball bearings and disposed with the axial line thereof coincident with the axial line of said ball bearings;

said rotor having jet receiving buckets around the periphery thereof

and further having an axial, tool shank receiving bore disposed in alignment with said bores in said inner races of said ball bearings, the outer periphery of said rotor engaging said frame sufficiently closely to effect said axial alignment of said bores,

means carried by said rotor and accessible from the exterior of said frame manually operable to secure said rotor to a tool shank inserted in said bore in said rotor;

said tool shank also extending through said bores in said inner races of said ball bearings and serving as a shaft on which said rotor is mounted for bearing support by said ball bearings,

means in said frame for directing a jet of compressed air against said buckets on said rotor in a direction which is substantially tangential to the periphery of said rotor, and means including interengaging surfaces between said rotor and said ball bearings forming clearances effective to permit the escape of air laterally through the ball bearings after having impinged against said buckets.

2. A high speed air motor as claimed in claim 1 in which

said frame is provided with an exhaust port disposed opposite the peripheral face of said rotor and beyond the discharge end of said jet directing means in the direction of rotation of said rotor;

said exhaust port being located so that it may register with said tool shank securing means.

3. A high speed air motor as claimed in claim 1 in which

said frame is provided with an inner surface spaced from and parallel to the periphery of said rotor, and in which the sides of said frame coincident with the outer faces of said ball bearings are open.

4. A high speed air motor as claimed in claim 3 in which

said rotor is provided with a hub at each side thereof engaging the adjacent end faces of the inner races of said ball bearings;

said hubs securing said rotor against axial movement and

additionally, spacing the sides of said rotor from the sides of said ball bearings adjacent to the side surface of said rotor radially outwardly of said hubs to form said clearances for the passage of air axially outwardly between the races of said ball bearings to oppose the entry of dust or other deleterious material into said ball bearings during operation of the motor.

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