

[54] POWER MODULE

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12776
[22] Filed: June 3, 1971
[21] Appl. No.: 149,626

[52] U.S. Cl. 417/477
[51] Int. Cl. F04b 43/08
[58] Field of Search.....417/474, 475, 476,
417/477, 412; 418/45, 49, 54; 92/13.2

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[57] ABSTRACT

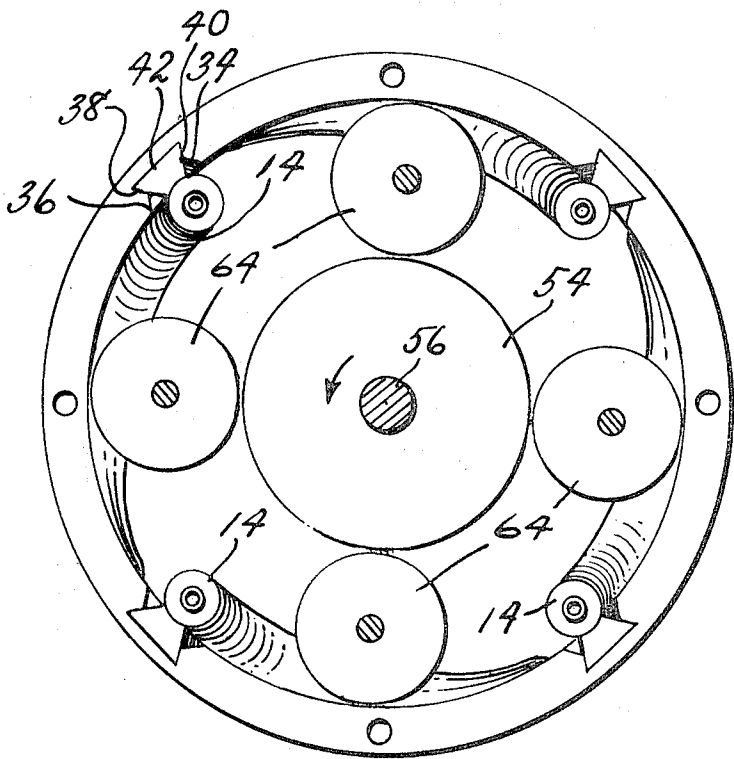
A power module for providing continuous rotational torque without direct contact between the propellant and module rollers. A plurality of flexible tubes are

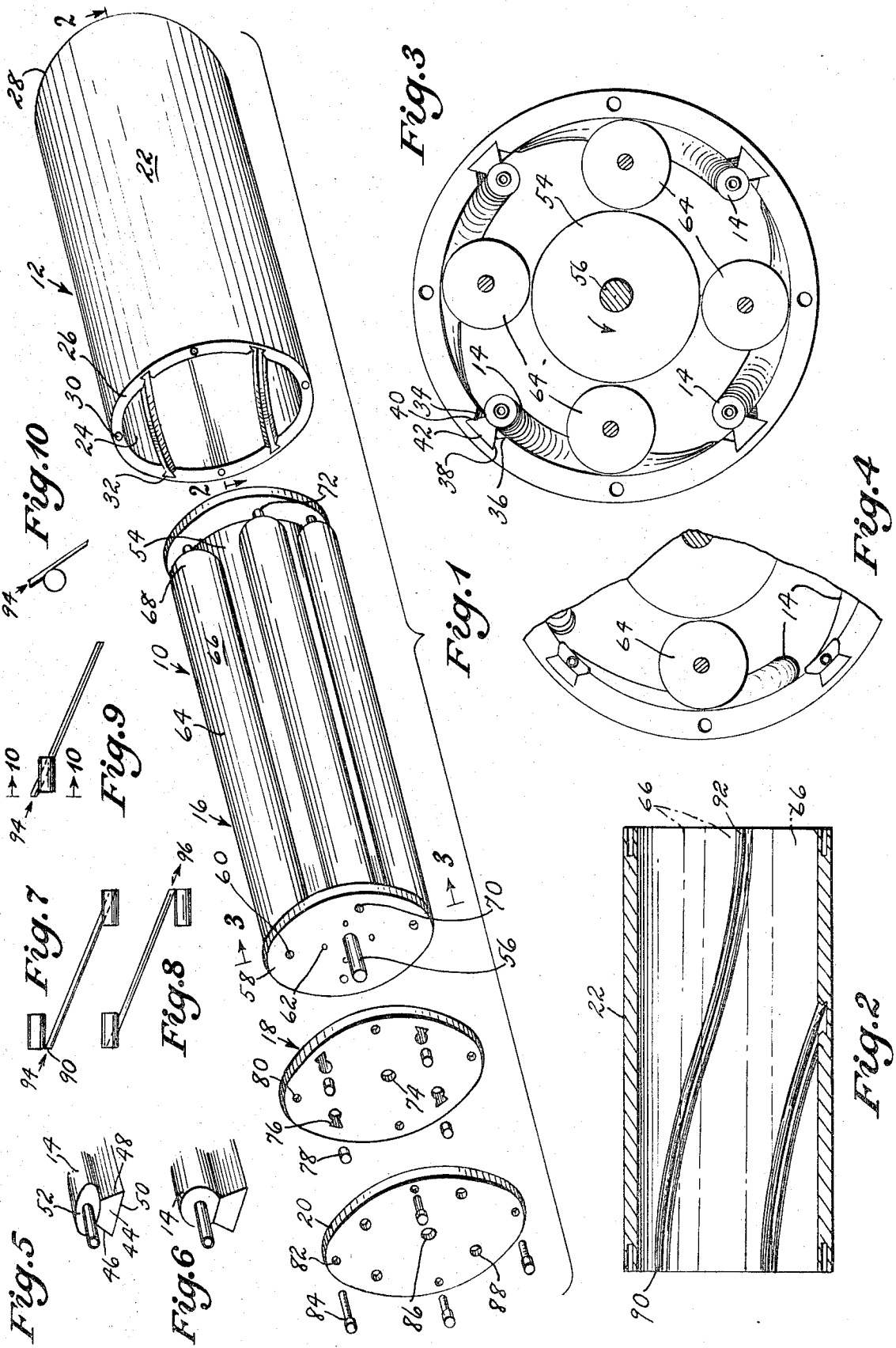
positioned within helical grooves in the inner surface of a cylinder casing. A rotor assembly having a plurality of rollers is positioned within the casing mounted for rotation against the inner surface and driving a power shaft.

The rollers and tubes are in angularly disposed contact with each other, preferably at substantially right angles. Pressure is applied to the tubes causing them to uniformly expand along the grooves and inwardly of the inner surface of the cylinder, driving the rollers. The chordal distance between the rollers and the location of the tubes along the inner surface of the cylinder is crucial and designed so that as the roller is forced off the edge of one tube, at the exit end, the succeeding roller is just about ready to make contact with the entrance end of the particular tube. As the first roller leaves the tube, the force causing a pressure build-up behind the roller is removed and fluid can be expunged therefrom. There is sufficient inertia in the succeeding roller to cause it to move onto the entrance end of the tube and the continuing fluid entering the tube immediately causes a pressure build-up behind the roller and the process begins again.

When the tubes have been completely expanded, the inertia within the rollers carries them until they are positioned just ahead of the next collapsed tube, and the procedure is repeated.

8 Claims, 10 Drawing Figures





POWER MODULE

PRIOR ART

There have been many methods developed of imparting torque from a power source, such as reciprocating steam engines, reciprocating and rotary hydro-carbon fuel engines, turbine-type engines, as well as many others. Even in the engines which develop their torque by continuous rotational movement, the fuel often comes in contact with the torque creating parts of the engine causing corrosion and continuous wear.

A disadvantage unique to the reciprocating engine is the requirement for additional structures such as fly wheels to smooth out the delivered torque.

Another major disadvantage of the prior art was the failure to develop a high efficiency engine, especially one which would prove commercially acceptable while using propellants or fuels having a low pollutant level.

OBJECTS AND ADVANTAGES

Accordingly, it is among the principal objects of the present invention to provide a power module which will provide a continuous torque, while the propellant never touches any of the driving parts.

Still another object of the present invention is to provide a power module which will provide a continuous torque to the drive shaft.

Still yet another object of the present invention is to provide a power module which can operate on expanded vapors, such as steam, or pressured gases, or from the kinetic energy in small rivers and streams.

Still yet a further object of the present invention is to provide a power module of the character described which requires no valves, and exhibits no slippage.

Still yet a further object of the present invention is to provide a power module which can utilize propellants heretofore useful only in low efficiency engines, under high efficiency conditions.

Still yet a further object of the present invention is to provide a power module which may also be used as a flow meter for caustic and corrosive chemicals.

Still yet a further object of the present invention is to provide a power module which may be operated in either rotational direction by simply reversing the flow of the propellant.

Still yet another object of the present invention is to provide a power module which is simple and inexpensive to manufacture and assemble and yet will be durable to a high degree in use.

SUMMARY OF INVENTION

The present invention contemplates a power module or unit having a cylindrical casing or housing with helical grooves cut in the inner wall thereof. Flexible tubing, preferably made of materials which are non-reactive with corrosive substances, are placed within the grooves so that the outermost portion of the tubing does not extend substantially beyond the inner surface of the casing. A rotor assembly is then placed within the casing. The rotor assembly consists of a plurality of rollers journaled to end plates, and with a central rotor cylinder, rigidly connected to the drive shaft, the shaft passing through the end plate. The rollers do not contact the inner surface of the housing but they do contact the tubing as will be described below. The entire

unit is then sealed within the housing, the shaft being the only portion thereof extending outside thereof. Pressurized fluids are then uniformly introduced to the same ends of all the flexible tubings. As the tubes begin to expand on the far end, the rollers, which are positioned just at the leading edge of the tubes, are forced to travel in a slight rotational movement. As the tubes begin to expand down their length and along their helical path, the rollers are continually forced to rotate in the direction of the helical curve.

When the tubes are fully expanded, the rollers are holding a pressurized build-up of the fluid behind them. The locations of the tubes and the rollers are so designed so that as the rollers leave the ends of the tubes, and the force retaining the fluid is released, the fluid can be rapidly expunged, as the leading end of the succeeding roller, which has moved by inertia, to a position just on the entrance end of the tube, placing a forwardly extending force from the rear of the tube on the fluid remaining therein. Since there is no oppositely disposed force, the fluid is rapidly expunged from the tube. In a like manner, as the roller continually moves onto the tube, the pressure force still entering the tube will cause the roller to be moved forward in a similar manner and the process is repeated. It can be seen that by utilizing a pressurized fluid such as steam, the power module could be used to propel a vehicle such as an automobile.

The above description and objects of the present invention will become apparent from a reading of the following description taken with reference to the accompanying drawings, wherein:

FIG. 1 is an exploded perspective view of the elements of the power module, showing the cylinder casing with four grooves and the flexible tubing removed therefrom, the rotor assembly, the inner plate and the outer end plate;

FIG. 2 is a cross-sectional view taken along the line 2—2 of FIG. 1, showing the helical pattern of the inner grooves;

FIG. 3 is a cross-sectional view taken along the lines 3—3 of FIG. 1, with the assembly positioned within the casing, and the flexible tubing in position within the grooves, the flexible tubing being shown in its expanded condition;

FIG. 4 is a cross-sectional view similar to FIG. 4, and partly cut away, showing the flexible tubing being partially expanded, and pushing the rollers ahead as a result of the expansion;

FIG. 5 is a view of the flexible tubing in its collapsed state;

FIG. 6 is a view of the flexible tubing in its expanded state;

FIG. 7 is a flattened, schematic view showing a first roller proximate the exit end of a tube and the succeeding roller about to contact the entrance end of the tube;

FIG. 8 is a schematic view similar to FIG. 7 showing the first roller just breaking contact with the exit end of the tube and the succeeding roller just engaging the entrance end of the tube;

FIG. 9 is a schematic view similar to FIGS. 7 and 8 showing the succeeding roller sufficiently in engagement with the tube and being moved by the fluid pressure from the entrance end; and

FIG. 10 is a cross-sectional view taken along the lines 10—10 of FIG. 9.

Turning in detail to the drawings, and more particularly to FIG. 1, there is shown a power unit 10, broadly comprising a cylindrical casing or housing 12 containing flexible tubing 14 (FIG. 5), a rotor assembly 16, the unit being sealed by an inner plate 18, and an outer end plate 20.

The cylindrical casing 12 may be made of any rigid material and is defined by a cylindrical outer surface 22, and an inner surface 24. For purposes of explanation, attention will be centered upon the exposed entrance end surface 26, although it is understood that the same structure is basically present on the exit end surface 28. A plurality of threaded bores 30 are located within the casing wall extending inwardly from the surface 26, for the purpose hereinafter appearing.

A plurality of grooves 32 are cut into the casing wall from the inner surface 24. As seen in FIG. 3, the groove consists of two angularly disposed sidewalls 34,36 and two oppositely disposed angular sidewalls 38,40 connected by a bottom wall 42. The grooves are cut so as to form a helical path within the casing wall.

The flexible tubing 14 may be made of standard material tubing, such as medical tubing, and consists of a lower naturally more rigid portion 44, defined by side walls 46,48, and a bottom wall 50. The walls 46,48,50 have basically the same, although slightly smaller, dimensions than the walls 38,40,42, and are designed to be received for anchoring purposes within the said section of the grooves. The upper flexible portion 52 consists of the basically hollow collapsed flexible tube which easily fits within the cubic space defined by the walls 34,36, and especially so that in its collapsed state, the tubing does not extend too substantially inwardly of the surface 24 into the interior of the casing.

The rotor assembly 16 consists of a rotor center cylinder 54 with a shaft 56 extending outwardly from the central axis thereof. The shaft is rigidly secured to the cylinder 54. The shaft and cylinder are also rigidly secured to an inner end plate 58. The end plate contains a plurality of journal bores 60. Optionally, the plate may also include a series of bores 62 which mate with pins (not shown) extending from the end wall of the cylinder, to further rigidify the connection between the plate and the cylinder.

The power rollers 64 are basically cylindrical in design, having an outer surface 66, and having rounded end surfaces 68. Extending outwardly from both ends and along the central axis are shafts 70, 72. These shafts fit within the journal holes 60, to allow rotational movement of the rollers within the end plates. The rollers do not directly contact the cylinder 54, and are able to rotate thereabout, nor do they contact the inner surface 24 of the housing 12.

The inner plate 18, contains a central opening 74 to allow the shaft 56 to pass therethrough. Furthermore, the plate contains a series of openings 76 which are basically identical in cross-section to the grooves 32, and particularly to the dimensions of the flexible tubing 14, when it reaches its expanded dimensions as shown in FIG. 6. There are sufficient openings 76 to match the number of grooves 32. Ferrule 78 may be positioned within the openings 76. There are also a plurality of openings 80, which are aligned with the openings 30.

To completely seal the power module, the end plate 20 is positioned as shown in the exploded view. The end plate contains openings 82 aligned with the

openings 80 and 30, the openings receiving screws 84 to seal the unit. Furthermore, there is a central opening 86 to allow the shaft 56 to pass out from the power module. There are also additional openings 88 to mate with the openings 76, and to allow a pressurized power fluid source to communicate with the grooves 32. There may be oil seals (not shown) mounted around the shaft 56 as it passes through the opening 74, 86, to insure that there will be no leakage from the interior of the power module.

The unit is assembled by simply securing all the parts as shown in the exploded view of FIG. 1. As the pressurized fluid is introduced into the flexible tubing, they begin to expand at the entrance end 90. As the expansion occurs, the rollers which are in contact with and angularly disposed to the flexible tubing are caused to be moved, as the portion 52 expands outwardly into the interior of the casing, this will cause the rollers to be moved, literally forced, ahead of the expanding tubing. As more and more pressurized fluid is introduced into the tubing, the expansion of portion 52 extends along the grooves. Since the grooves are helical, pressure is continually exerted against the rollers, forcing them to rotate. When the tubes are completely expanded, the rollers are just about ready to leave the exit edges thereof (FIG. 7). A force 94 has been built up behind the rollers and if one stops the motion for a split second of time, it is analogous to that of a body of water behind a dam.

As the rollers leave the exit end of the tubing, the force retaining the fluid is removed, and the fluid can then leave the tubing within the cylinder. Since the succeeding rollers just begin to make contact with the entrance end 90 of the tube expungement 96 of the fluid occurs and the tube collapses (FIG. 8).

The rollers have sufficient inertial force stored within themselves, after leaving the exit end of the tubing (FIG. 7), to travel the circumferential distance necessary to recontact the entrance ends of the next tube (FIG. 8) where the force 94 has no effect, and to pass over the entrance end 90 thereof, where the force 94 once again can take effect (FIG. 9). The continuous force of the fluid on the entrance end of the tubing once again begins to build up sufficient force to cause the rollers to be moved along the tubing, and since the tubing is angularly disposed at the point of contact to the rollers, rotational movement of the rollers is affected. It has been found that if the angle formed at the point of contact between the rollers and the tubing is substantially 90°, the greatest efficiency can be developed within the unit (FIG. 10).

The terms and expressions which have been employed here are used as terms of description and not of limitation and there is no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. A power module for providing continuous rotational torque without direct contact between the propellant and module comprising:

a. a casing;

b. flexible expanding means secured to the inner surface of the casing along a helical path, capable of

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expanding inwardly of the casing in response to a signal passing therethrough;

c. a plurality of rollers mounted for rotational movement within said casing;

d. drive means, the rollers connected to the drive means and imparting rotational torque thereto;

e. a source of pressurized fluid secured to the flexible expanding means;

f. said flexible expanding means and said rollers being so positioned that when contacting each other they form an angle therebetween, only one roller contacting said expanding means at a time, the pressurized fluid in the expanding means applying a force by means of the expansion to the roller in contact therewith, causing rotational movement of the roller and travel along the expanding means, whereby a continuous rotational torque is applied from the rollers to the drive means.

2. The invention according to claim 1, the flexible expanding means and the rollers being positioned so that as a roller disengages the expanding means, a succeeding roller contacts said means, causing expungement of the fluids therein, the initial force in the succeeding roller causing further movement across said expanding means until the pressurized fluid once again

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exerts a force on said succeeding roller, causing rotational movement along said expanding means.

3. The invention according to claim 2, the casing being cylindrical.

4. The invention according to claim 2, the casing having pins passing into the cylinder from said inner surface to provide anchoring for said flexible expanding means, said flexible expanding means including elastic tubing expanding inwardly of said inner surface.

5. The invention according to claim 4, said tubing being angularly disposed along said inner surface to form an angle between said tubing and said roller of approximately 90° over a substantial portion of travel.

6. The invention according to claim 2, the number of rollers being equal to the number of flexible expanding means in said casing.

7. The invention according to claim 2, the rollers being substantially cylindrical in configuration, said drive means being substantially circular end plates located on either end of the rollers, the rollers being journaled therein, said drive means being rigidly secured to axial center of said plates.

8. The invention according to claim 7, the end plates also carrying a centrally positioned cylindrical member to the system providing inertial force for the rollers.

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