May 26, 1970 S. K. SMITH **3,514,238**
CYLINDER FOR FLUID PUMP MOTOR AND THE LIKE
AND METHOD OF MAKING
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FIG. 1

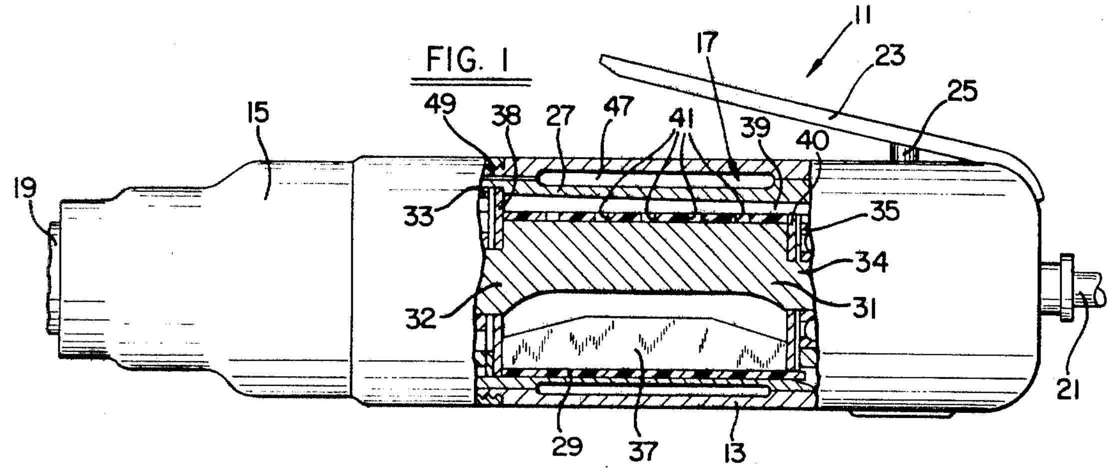


FIG. 2

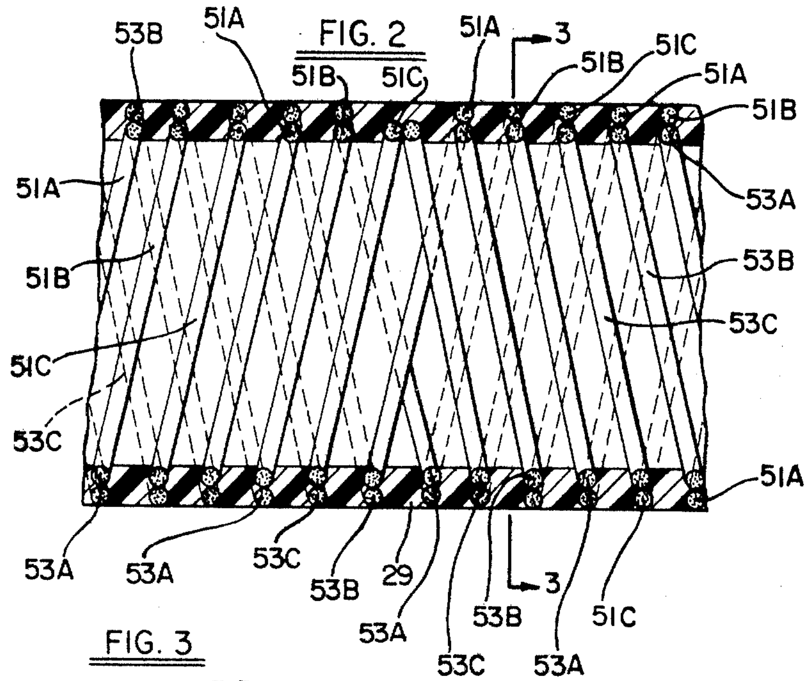
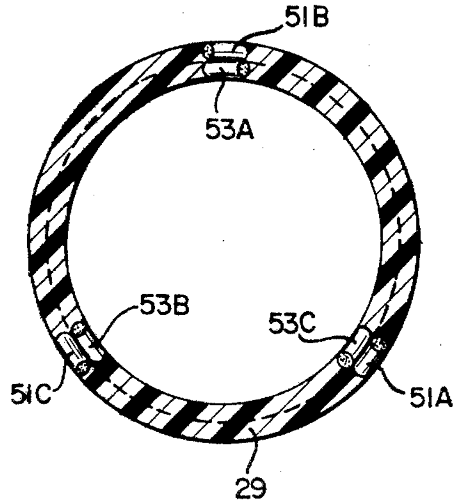


FIG. 3



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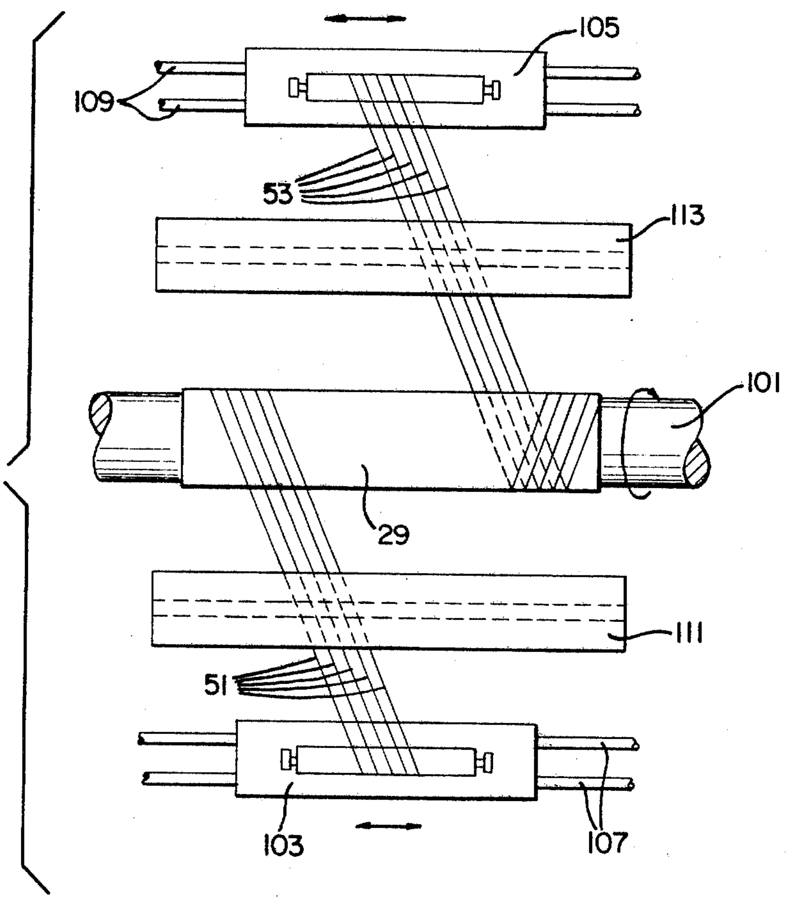

FIG. 4

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CYLINDER FOR FLUID PUMP MOTOR AND THE LIKE AND METHOD OF MAKING

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U.S. Cl. 418—153 6 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed herein a fluid powered, rotary device which includes a cylinder having a vane carrying rotor rotatably disposed therein. Pressurized fluid is admitted to the cylinder and acts on the vane or vanes causing the rotor to turn and the vane or vanes to ride along the inner wall of a cylinder liner. The liner has a novel construction formed in a novel manner which contributes significantly to its useful life and efficiency, its physical properties, and enhances the overall performance of the device.

SUMMARY OF THE INVENTION

The present invention is directed to a novel cylinder liner for use in a fluid operated, rotary motor, pump and the like and to a novel method of making the same. The liner encases a rotor which has one or more vanes slidably carried thereon and, during use, the vane or vanes slide around the inner liner wall. The liner is constructed of a synthetic formable material and is reinforced with a thread or threads wound therethrough and which are constructed from a relatively hard material which is relatively non-moisture absorbing and has a low coefficient of friction. Desirably, the threads are spirally wound through the liner in opposite directions on opposite sides of a radial plane substantially bisecting the liner, and the novel forming method disclosed provides for this spiraled, criss-cross arrangement. The basic, reinformed liner construction increases the dimensional stability thereof and the output of the device and contributes significantly to its life. The spiraled arrangement of the reinforcing threads has the advantageous effect of equalizing end loading on and centering the rotor vanes.

Main objects, therefore, of the present invention are to provide a novel cylinder liner construction for use in a rotary fluid handling device, such as a motor, pump and the like which liner has superior dimensional stability and which provides superior performance characteristics and greater expected life.

Further important objects of the invention are to provide a novel cylinder liner construction of the above character which develops equal end loading on and centers the rotor vanes disposed therein, which is compatible with existing constructions and which is reliable in use.

Additional objects are to provide a novel method of making a novel cylinder liner construction of the above character which method is relatively inexpensive to perform, which is reliable and which provides consistent results.

Other objects and advantages of the present invention will become more apparent from a consideration of the detailed description to follow taken in conjunction with the drawings annexed hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view, partly in elevation and partly in section, illustrating a pneumatic motor device embodying the liner of the present invention;

FIG. 2 is an enlarged view of a portion of the liner of FIG. 1 shown with the rotor removed;

FIG. 3 is a sectional view of FIG. 2 taken along the line 3—3 thereof; and

FIG. 4 is a schematic illustration of a method of making the liner of FIGS. 1–3.

BROAD STATEMENT OF THE INVENTION

Broadly described, the present invention relates to a fluid handling, rotary device comprising a casing, a cylinder including a generally cylindrical liner fixed within said casing, end plate means on opposite sides of said liner, a rotor supported for rotation within said liner between said end plate means and having at least one slidable vane adapted to engage the inner surface of said liner during rotation of said rotor, said liner being constructed from a synthetic formable material reinforced with thread means wound therethrough, said thread means being constructed of a relatively hard material having relatively low moisture absorbing and friction coefficient properties.

In another aspect, the present invention relates to a rotary motor, pump and the like comprising a casing, end plates fixed to said cylinder, a cylinder including a generally cylindrical liner fixed within said casing, a rotor supported for rotation within said liner and having at least one slidable vane adapted to engage the inner surface of said liner during rotation of said rotor, said liner being constructed from a synthetic formable material reinforced with threads wound therethrough and around said liner, said threads being wound in spiral fashion starting at opposite ends of said liner and crossing at substantially the axial center thereof, whereby to generate substantially equal and opposite axial forces on said at least one vane during rotor rotation to center said vane between said end plates.

DETAILED DESCRIPTION

Referring now specifically to the drawings, a pneumatic powered, portable die grinding tool embodying the present invention is illustrated generally at **11** in FIG. 1. It will be understood, however, that this tool is exemplary only and that the principles of the invention apply generally to the class of rotary type, fluid handling devices which include pumps, motors and the like, pneumatic, hydraulic or otherwise and whether they are of the portable or stationary variety.

With this in mind, the die grinder **11** is seen to include a hollow, generally cylindrical motor casing **13** having a spindle housing **15** secured thereto. A rotary pneumatic motor **17** is disposed within the casing **13** and is adapted to impart rotary movement to a spindle **19** to which a grinding wheel (not shown) may be attached. The motor **17** is powered by pressurized air admitted through an inlet conduit **21** and controlled by a lever **23** and valve plunger **25**.

The motor **17** is seen to include a generally cylindrical housing **27** fixed within the casing **13** and having a cylindrical liner **29** fitted therein. A rotor **31** within the liner **29** has stub shafts **32, 34** rotatably supported by bearings **33, 35** within the housing **27** and has one or more radially extensible vanes carried thereby. A pair of end plates **38, 49** are fixed within the cylinder housing **27** to either side of the rotor **31**.

In use, pressurized air entering through the conduit **21** passes into a passageway **39** formed between the housing **27** and the liner **29** and flows into the liner **29** by way of ports **41**. This air impinges upon one side of the vane or vanes **37** causing the rotor **31** to turn and centrifugal force on the vanes **37** causes them to slide around the inner surface of the liner **29**. Air exits the liner **29** and the housing **27** by way of discharge openings **43, 45** therein and passes into a pasageway **7** formed between the casing **13** and the housing **27**. From there, air passes through passages **49** and exits the front or left-hand end of the spindle housing **15**.

It will be appreciated that friction between the outer, longitudinal edge of the vane or vanes **37** and the inner surface of the liner **29** and between the lateral or transverse vane edges and the end plates **38, 40** affects the speed and output of the device and, in addition shortens the life of the vanes **37**. A novel vane construction, disclosed and claimed in the copending application of William S. Brucker, Ser. No. 575,887, filed Aug. 29, 1966, now Pat. No. 3,417,664, granted Dec. 24, 1968, to a great extent has obviated this problem by providing a dimensionally stable vane construction having a reduced coefficient of friction thereby making possible closer tolerances, reducing friction, increasing output and extending life. The present invention attacks the problem from another aspect, namely, by building greater dimensional stability into the cylinder liner and lowering its coefficient of friction. In addition, this invention provides a centering action on the rotor vanes which further reduces friction and increases the efficiency of the device.

Thus, as seen best in FIGS. 2 and 3, the cylinder liner **29** is constructed from a formable, synthetic material and has thread means wound therethrough. The particular material chosen for the liner **29** depends to a great extent upon the physical characteristics required in the particular installation. In a number of pneumatic motor installations, for example, the general class of phenolics has been found to be satisfactory.

The thread means preferably includes one or more continuous threads, **51, 53** wound through the liner material in spiral fashion in opposite directions on opposite sides of a radial plane substantially bisecting the liner **29**. One way of doing this is to wind the threads **51, 53** starting at opposite ends of the liner **29** to cross over each other substantially at or near the center thereof. In the embodiment shown in FIGS. 2 and 3, there are three of threads **51**, namely **51A, 51B** and **51C**, and three of threads **53**, namely **53A, 53B** and **53C**. The threads **51A, 51B, 51C** are wound in spiral fashion from the left-hand end of the liner **29** while the threads **53A, 53B, 53C** are wound in spiral fashion (opposite to that of threads **51A, 51B, 51C**) starting from the right-hand end of the liner **29**. These threads **51, 53** meet and cross over each other at substantially the center of the liner **29** and preferably continue on out to the right- and left-hand ends, respectively, of the liner **29** as shown in FIG. 2. It will be appreciated that the liner thickness will be determined by the layers of wound threads **51, 53** so that if a thicker liner **29** is desired the threads **51, 53** may be wound back over themselves as many times as necessary.

The threads **51, 53** are desirably constructed from a relatively hard material which is relatively non-moisture absorbing and has a low coefficient of friction. For example, threads made of glass, graphite or alumina fiber have been determined to be satisfactory. In addition to the desirable physical characteristics these materials possess, they will not melt at the curing temperatures of phenolics so that they permit forming of the illustrated liner **29**.

In use, the rotor **31** turns about an axis passing through the bearings **33, 35** and the vane or vanes **37** ride around the inner wall of the cylinder liner **29**. The threads **51A, 51B, 51C** and **53A, 53B, 53C** present exposed surfaces to the vanes **37** as they ride around the liner **29**. The spiral arrangement of the threads **51A, 51B, 51C** and **53A, 53B, 53C** has a twofold purpose: first, each of the exposed thread surfaces sweeps across the outer edge of the vanes **37** so that this edge of each vane **37** is polished thereby reducing friction between the vanes **37** and the liner **29** as well as pressure losses past the vanes **37**. The threads, being constructed of a relatively hard material having a low coefficient of friction further reduces friction so that the efficiency and output of the device is maximized and the problem of heat dissipation is minimized. Second, the spiral arrangement of the threads **51A, 51B, 51C** and **53A, 53B, 53C** generates forces on the vane or vanes **37** in a lateral direction. The opposed spiral arrangement disclosed, wherein the threads **51** are inclined at substantially the same but opposite angle from the threads **53**, develops opposing forces which substantially cancel one another thereby effectively centering the vane or vanes **37** between the end plates **38, 40**. This is beneficial again because it reduces friction between the vanes **37** and end plates **38, 40** and enhances the efficiency of the device.

Still another and related advantage lies in the fact that the resistance to moisture absorption and dimensional stability of the threads **51A, 51B, 51C** and **53A, 53B, 53C** renders the liner **29** similarly dimensionally stable. Thus, expansion of the liner **29** during use is minimized and the distance between the end plates **38, 40** remains substantially constant so that the vanes **37** can be dimensioned to close tolerances with respect to the axial length of the liner **29**. This further reduces losses in the device and enhances its efficiency.

A novel method used to from the novel liner of the present invention is illustrated in FIG. 4. Here, the cylinder liner **29** is shown as being formed on a rotating mandrel **101**. The threads, there shown to be five in number, are supported on bobbins **103, 105**, respectively, which are adapted to be reciprocated along guide rails **107, 109**, as shown by the arrows. The number of threads **51, 53** may vary from one of each up to any reasonable number, according to particular desires and it will be appreciated that with more threads, the angle each makes with a radial plane through the liner **29** is greater as is the centering forces on the vanes **37**. In any event, the threads **51, 53** are fed through baths **111, 113** containing the liquid liner material, e.g. phenolic, and are spirally wound on the mandrel **101** starting from axially spaced positions thereon and progressing toward each other. The threads **51, 53** cross over each other at a midpoint and are wound on top of one another as shown back out to the starting point. The process may be repeated for as many thread layers as desired according to the desired liner thickness. The resultant product is then cured or otherwise treated to cause the liner material to set up.

By the foregoing, there has been disclosed a novel cylinder liner for rotary fluid handling devices and a novel method of making said liner calculated to fulfill the inventive objects hereinabove set forth, and while a preferred embodiment of the present invention has been illustrated and described in detail, various additions, substitutions, modifications and omissions may be made thereto without departing from the spirit of the invention as encompassed by the appended claims.

I claim:

1. A fluid handling, rotary device comprising a casing, a cylinder including a generally cylindrical liner fixed within said casing, end plate means on opposite sides of said liner, a rotor supported for rotation within said liner between said end plate means and having at least one slidable vane adapted to engage the inner surface of said liner during rotation of said rotor, said liner being constructed from a synthetic formable material reinforced with thread means wound therethrough, said thread means being constructed of a material selected from the group consisting of glass, alumina and graphite fiber and being relatively hard and having relatively low moisture absorbing and friction coefficient properties.

2. A device as defined in claim **1** wherein said thread means includes threads wound in spiral fashion in opposite directions on opposite sides of a radial plane substantially bisecting said liner, whereby substantially equal and opposite axial forces are generated on said at least one vane during rotor rotation to center said vane between said end plate means.

3. A device as defined in claim **1** wherein said synthetic formable material is a phenolic material.

4. A rotary motor, pump and the like comprising a casing, a cylinder including a generally cylindrical liner fixed within said casing, end plates fixed to said cylinder, a rotor supported for rotation within said liner and having at least one slidable vane adapted to engage the inner surface of said liner during rotation of said rotor, said liner being constructed from a synthetic formable material reinforced with threads wound therethrough and around said liner, said threads being wound in spiral fashion starting at opposite ends of said liner and crossing at substantially the axial center thereof, whereby to generate substantially equal and opposite axial forces on said at least one vane during rotor rotation to center said vane between said end plates.

5. A device as defined in claim 4 wherein said threads are formed of material selected from the group consisting of glass, alumina and graphite fiber.

6. A device as defined in claim 4 wherein said threads include a plurality of continuous threads wound at substantially the same but opposite angle on opposite sides of the liner axial center.

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HENRY F. RADUAZO, Primary Examiner

U.S. Cl. X.R.

93—121; 418—179