Oct. 28, 1952 V. E. ENZ 2,615,644

EXPANDING MANDREL

Filed Sept. 12, 1950

Fig.1.

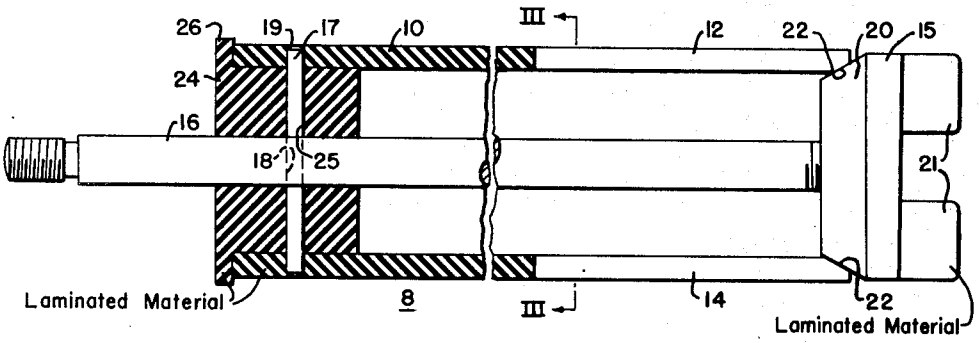



Fig.2.

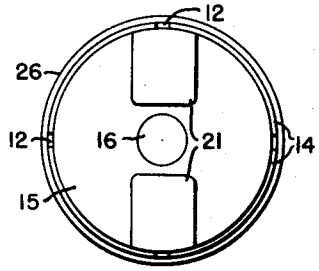
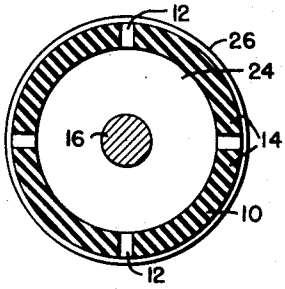



Fig.3.




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Patented Oct. 28, 1952

2,615,644

# UNITED STATES PATENT OFFICE

2,615,644

## EXPANDING MANDREL

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Application September 12, 1950, Serial No. 184,494

5 Claims. (Cl. 242—72)

1

This invention relates to mandrels and particularly to expanding mandrels.

Expanding mandrels have been employed heretofore in various industries to support winding cores or spools. However, the known expanding mandrels were made from a rigid, non-flexible material, with the result that it has been found to be difficult to expand and contract the mandrel. The stiffness or non-flexible characteristic of the known mandrels is a definite limitation on the use of such mandrels since considerable time must be spent in placing the winding core or spool on the mandrel and also in disassembling it from the mandrel.

It is desirable to provide an expanding mandrel which is light and so flexible that it can be readily expanded to securely hold the winding core or spool thereto and easily contracted to permit the rapid removal of the winding spool therefrom.

An object of this invention is to provide an expanding mandrel having a flexible end portion which can be readily adjusted to facilitate the mounting of a winding core thereon or the removal of the winding core therefrom.

Another object of this invention is to provide, in an expanding mandrel having a flexible end portion, means for frictionally engaging the flexible end portion to effect predetermined movement thereof, to control the expansion or contraction of the end portion and to prevent slippage between the engaging means and the flexible end portion after said predetermined movement is effected.

Other objects of this invention will become apparent from the following description, when taken in conjunction with the accompanying drawing, in which:

Figure 1 is a plan view partly in section of an expanding mandrel constructed in accordance with this invention;

Fig. 2 is an end view of the apparatus shown in Fig. 1; and

Fig. 3 is a view in section taken along the line III—III of Fig. 1 of the expanding mandrel constructed in accordance with this invention.

Referring to Fig. 1 of the drawing, there is illustrated an expansible mandrel 8 embodying the teachings of this invention. As illustrated the mandrel 8 comprises a tube body 10 formed from laminated layers of fibrous material impregnated with a resinous binder and consolidated under heat and pressure. The fibrous material may be either duck, cloth, paper, woven glass, or other similar fibrous materials. It is, however, preferable to used kraft paper as the fibrous material. The binder may be any suitable synthetic resin,

2

such as phenol-formaldehyde or urea-formaldehyde.

In order to provide an expansible and contractible mandrel 8, one end of the tube body 10 is provided with a plurality of slots 12. In this embodiment the slots 12 extend lengthwise and they are substantially evenly spaced around the tube body 10. The laminated material between the slots 12 form flexible fingers 14. The number of slots 12 that are cut is dependent on the material used for the tube body 10 as well as the wall thickness and the diameter of the tube.

In the embodiment illustrated, where the tube body 10 is made from laminated sheets of paper impregnated with phenol-formaldehyde, and the tube body 10 has a wall thickness of $\frac{13}{64}$ of an inch, with the tube body 10 6½ inches long and having an outer diameter of $1\frac{27}{32}$ inches, it has been found that four slots 12 each 2½ inches long will suffice to provide sufficient flexibility to the fingers 14. In other embodiments the number of slots 12 may be varied depending on the size and thickness of the tube body 10 and depending upon the degree of flexibility required.

In order to provide for controlling the expansion or contraction of the fingers 14, an expansion member 15, described more fully hereinafter, is utilized. For the purpose of supporting the expansion member 15, a shaft 16 is provided. The shaft 16 is provided with threads on both its ends and is so assembled as to be non-rotatable with respect to the tube body 10. Thus, the shaft 16 is secured in assembled relation with respect to the tube body 10 by inserting a pin 17 through the shaft 16 through aligned openings 18 and 19 in the shaft 16 and the tube wall, respectively. In practice the pin 17 is preferably of a length that when positioned in the openings 18 and 19, the ends of the pin 17 terminate within the confines of the wall of the tube body 10, the pin 17 being of a diameter to give a tight friction fit with the aligned openings 18 and 19. Both the shaft 16 and the pin 17 are preferably made from steel.

The expansion member or means 15 comprises a wing nut formed of laminated fibrous material impregnated with a resinous binder, the components thereof preferably being of the same material as that of the tube body 10. As illustrated, the expansion member 15 is provided with a truncated cone section 20 on one end thereof. When the expansion means 15 is threaded onto the shaft 16 and turned thereon in a predetermined direction as by applying a force to the wings 21 thereof, the truncated cone section 20 frictionally en-

gages the end portion of the fingers 14 so as to apply pressure thereto.

In order to provide an adequate friction engagement between the ends of the fingers 14 and the expansion member 15, the end portions of the fingers 14 and the side wall 22 of the truncated cone section 20 are beveled at complementary angles. In practice, the side wall 22 of the truncated cone section 20, and consequently, the beveled ends of the fingers 14, is provided with a slope which extends at an angle of between 15 and 40 degrees with respect to the horizontal axis of the expansion member 15. It is necessary to keep within this range in order that the expansion member or means 15 will be held so tightly in frictional engagement against the fingers 14 that it will not turn on the shaft 16 when the mandrel is rotating at a high speed. As will be appreciated the degree of frictional engagement between the fingers 14 and the side wall 22 depends on the coefficient of friction of the material from which the members 14 and 22 are formed, the slope of the side wall 22 and the cooperating beveled ends of the fingers 14, and the dimensions of the tube body 10 and the slots 12. The most desirable slope within the range given hereinbefore is one that makes an angle of 30 degrees with the horizontal axis of the expansion member 15. In practice the coefficient of friction of the materials from which the members 14 and 22 are formed is between 1 and 1.5 at break away.

Instead of forming the expansion means 15 from laminated fibrous material impregnated with a resinous binder as described hereinbefore, the expansion member or means 15 may be molded directly to a given shape or size from impregnated macerated material such as chopped duck or the like as is well known in the art.

In order to prevent a winding spool (not shown) from sliding off of the unexpanded portion of the tube body 10, a plug member 24 is provided for fitting into the unslotted end of the tube body 10. The plug 24 is preferably provided with a flange 26 at one end thereof, the flange 26 being of a size to be engaged by the winding spool (not shown). The plug member 24 can likewise be made of laminated cloth having a phenolic resin as a binder, or it can be molded from a macerated material. The plug member 24 is also provided with an opening 25 which is aligned with openings 18 and 19 for receiving the pin 17 which when in position in the aligned openings 18, 19 and 25, effectively locks the plug in position.

The expanding mandrel embodying this invention is especially useful for supporting in non-rotating relation, a winding core or spool on which it is desired to wind thread, cloth or paper or any other material.

In operation, when one desires to assemble the winding spool (not shown) on the tube body 10, the expansion member 15 is so positioned that the sloped side wall 22 thereof seats against the beveled ends of the unflexed fingers 14. The winding core or spool is then slipped over the tube body 10 until it seats against the flange 26. The expansion member or means 15 is then turned in its threaded engagement on the shaft 16 in a direction to cause the truncated cone member 20 to apply pressure to the fingers 14, expanding them outwardly. The expansion means 15 is turned until the outer surface of the fingers 14 bear tightly against the winding core or spool (not shown) so as to prevent rotation between the members. The expanding mandrel 8 is now in condition for use in winding material on the winding spool. After the winding operation has taken place and one desires to move the winding spool from the tube body 10, the expansion means 15 is turned in the opposite direction until the fingers 14 become disengaged from the winding spool (not shown) and return to their unflexed position. Once the fingers 14 have returned to this unflexed position, the winding spool can be readily removed from the tube body 10.

The expanding mandrel embodying the teachings of this invention has several advantages over the expanding mandrels heretofore used. The expanding mandrel embodying the teachings of this invention can be quickly operated since the fingers 14 thereof can be readily expanded and contracted. Since the mandrel can be easily and quickly operated, it saves both time and labor. In addition, due to its simple construction, its original cost of manufacture is relatively small.

I claim as my invention:

1. A rotatable mandrel comprising, in combination, a tube formed of a plurality of layers of fibrous material impregnated with a resinous binder, the tube having a plurality of slots extending lengthwise from one end, the slotted end of the tube having a beveled end surface, expanding means having a truncated cone member of impregnated fibrous material the slope of whose side wall corresponds to the slope of said beveled end surface, the side wall of the cone being so disposed as to frictionally engage said beveled end surface of the tube to apply pressure thereto, the cone and tube of impregnated fibrous material having a coefficient of friction of between 1.0 and 1.5 at break away whereby the frictional engagement of the cone with the beveled end surface of the tube prevents movement of the cone relative to the tube when the mandrel is rotating, and means disposed to support the expanding means in said frictional engagement with the slotted end of the tube, the expanding means being disposed for movement on the supporting means to vary the pressure applied to the slotted end portion of the tube to control movement thereof.

2. A rotatable mandrel comprising, in combination, a tube formed of a plurality of layers of fibrous material impregnated with a resinous binder, the tube having a plurality of slots extending lengthwise from one end, the slotted end of the tube having an end surface which is beveled at an angle with the horizontal of between 15 and 40 degrees, expanding means having a truncated cone member of impregnated fibrous material the slope of whose side wall corresponds to the slope of said end surface, the side wall of the cone being so disposed as to frictionally engage said beveled end surface of the tube to apply pressure thereto, the cone and tube of impregnated fibrous material having a coefficient of friction of between 1.0 and 1.5 at break away whereby the frictional engagement of the cone with the beveled end surface of the tube prevents movement of the cone relative to the tube when the mandrel is rotating, and means disposed to support the expanding means in said frictional engagement with the slotted end of the tube, the expanding means being disposed for movement on the supporting means to vary the pressure applied to the slotted end portion of the tube to control movement thereof.

3. A rotatable mandrel comprising, in combination, a tube formed of a plurality of layers of fibrous material impregnated with a resinous binder, the tube having a plurality of slots extending lengthwise from one end, expanding means of impregnated fibrous material disposed to frictionally engage the slotted end portion of the tube to apply pressure thereto, the expanding means and tube of impregnated fibrous material having a coefficient of friction of between 1.0 and 1.5 at break away whereby the frictional engagement of the expanding means with the slotted end portion of the tube prevents movement of the expanding means relative to the tube when the mandrel is rotating, and a shaft non-rotatably disposed with respect to the tube for supporting the expanding means in said frictional engagement with the slotted end of the tube, the expanding means being rotatable on the shaft to vary the pressure applied to the slotted end portion of the tube to control movement thereof.

4. A rotatable mandrel comprising, in combination, a tube formed of a plurality of layers of fibrous material impregnated with a resinous binder, the tube having a plurality of slots extending lengthwise from one end, the slotted end of the tube having an end surface which is beveled, expanding means having a truncated cone member of impregnated fibrous material the slope of whose side wall corresponds to the slope of said end surface, the side wall of the cone being so disposed as to frictionally engage said end surface of the tube to apply pressure thereto, the cone and tube of impregnated fibrous material having a coefficient of friction of between 1.0 and 1.5 at break away whereby the frictional engagement of the cone with the beveled end surface of the tube prevents movement of the cone relative to the tube when the mandrel is rotating, and a shaft non-rotatably disposed with respect to the tube for supporting the expanding means in said frictional engagement with the slotted end of the tube, the shaft having a threaded end portion for receiving the expanding means, the expanding means being disposed to be rotated on the threaded end portion of the shaft to vary the pressure applied to the slotted end portion of the tube to control movement thereof.



5. A rotatable mandrel comprising, in combination, a tube formed of a plurality of layers of fibrous material impregnated with a resinous binder, the tube having a plurality of slots extending lengthwise from one end, the slotted end of the tube having an end surface which is beveled at an angle with the horizontal of between 15 and 40 degrees, expanding means disposed to engage the beveled end of the tube, the expanding means having a truncated cone member of impregnated fibrous material having a slope corresponding to the slope of said beveled end surface, the cone member being so disposed as to frictionally engage said beveled end surface of the tube to apply pressure thereto, the cone and tube of impregnated fibrous material having a coefficient of friction of between 1.0 and 1.5 at break away whereby the frictional engagement of the cone with the beveled end surface of the tube prevents movement of the cone relative to the tube when the mandrel is rotating, and a partially threaded shaft disposed in threaded engagement with the expanding means to support the expanding means in said frictional engagement with the slotted end of the tube, the expanding means being rotatable on the threaded portion of the shaft to vary the pressure applied to the slotted end portion of the tube to control movement thereof.

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