Feb. 26, 1963 H. W. DOUGLAS 3,079,102

EXPANDABLE SHAFT

Filed May 17, 1960

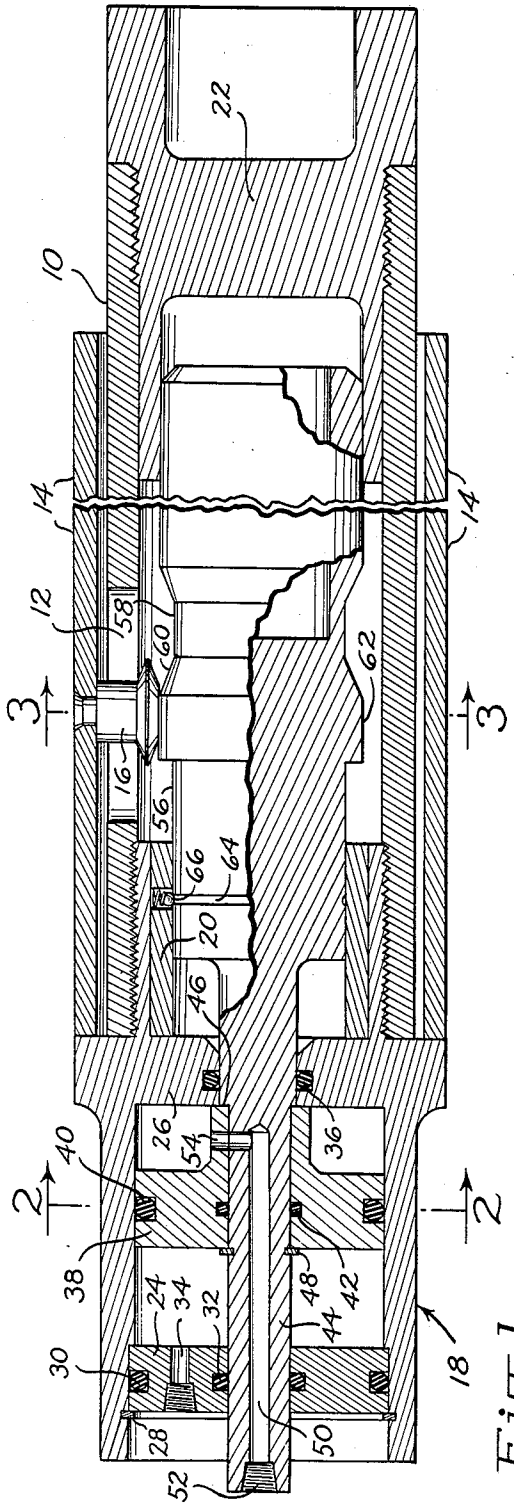

Fig. 1.

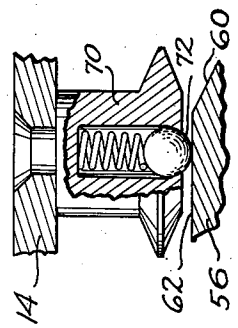

Fig. 4.

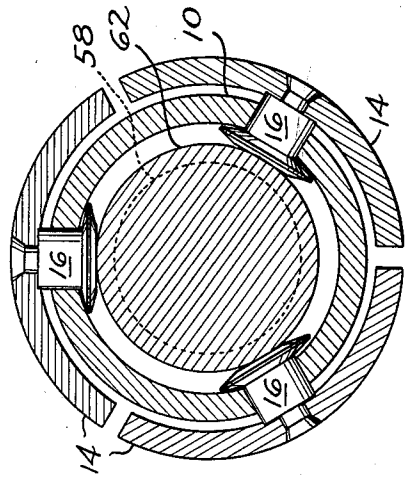

Fig. 3.

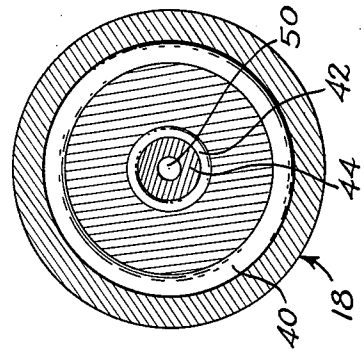

Fig. 2.

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EXPANDABLE SHAFT

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This invention relates to expandable shafts, the effective diameters of which may be increased and diminished alternately as required to fit the shafts to various applications.

In the winders and rewinders employed for winding sheets of paper, paper pulp, textiles, rubber, aluminum foil, plastics and the like, it is usual practice to provide a winder shaft which may be distended to an enlarged diameter after which the sheet material is wound upon it with or without the use of an interposed winding core. After the completed roll has been demounted from the winding apparatus, the shaft is collapsed, removed, and reused in another winding operation while the roll is moved to another location for further processing or storage.

It is the general purpose of the present invention to provide an expandable shaft useful in the foregoing or similar applications which shaft is positive in its action, durable, free from a tendency toward premature, vibration-induced collapse, easy and fast to apply, adaptable for use with winding cores of non-uniform diameter, and having a relatively long service life during which but a minimum of maintenance is required.

The manner in which the foregoing and other objects of the invention are accomplished will be apparent from the accompanying specification and claims considered together with the accompanying drawings, wherein like numerals of reference indicate like parts and wherein:

FIG. 1 is a foreshortened sectional view of the hereindescribed expandable shaft;

FIGS. 2 and 3 are sectional views taken along lines 2—2 and 3—3, respectively, of FIG. 1; and

FIG. 4 is a detail, sectional view of an alternate form of cam follower for use in the expandable shaft of my invention, making it adaptable for use with winding cores of non-uniform diameters.

In general, the expandable shaft of my invention comprises a casing or body having arranged thereon a plurality of longitudinally extending leaves mounted for lateral extension and retraction. Drive means, preferably cam means, are connected to the leaves for alternately extending and retracting them, thereby correspondingly increasing and shrinking the diameter of the shaft. Releasable locking means also are provided for releasably locking the shaft in its expanded position, thereby insuring against premature collapse.

As will be seen from the drawings, the expandable shaft of my invention includes an elongated body or casing **10** which in a typical case may be from 4 to 12 feet in length. The casing is formed with a plurality of radially spaced openings **12**, preferably provided in longitudinally spaced groups, the spacing of which may be at any desirable intervals such as, for example, from 9 to 12 inches.

A plurality of longitudinally extending leaves **14** are arranged about the casing. In FIG. 3, there are shown three such leaves of arcuate contour, each substending an angle of approximately 120° and forming a substantially continuous shell about the casing.

The leaves are secured to the casing by means of button-shaped members **16** arranged in longitudinally spaced groups, the members of which are spaced radially to correspond to the spacing of openings **12** through the casing. The bodies of these members are riveted to the leaves, extend through the openings, and are provided

with heads of enlarged cross section so that they can not be retracted through the openings. As will appear later, the heads of the leaf fastening members serve the further important function of acting as cam followers for extending and retracting the leaves in a lateral direction.

The end of a fluid operated cylinder **18** is threaded into the front end of casing **10** and houses a front bushing **20**. The rear end of the casing is closed off by a second bushing **22**.

The outer surface of cylinder **18** acts as a journal, as does the outer surface of the rearwardly extending portion of casing **10** and the aligned, flush surface of bushing **22** (FIG. 1). Accordingly the shaft may be mounted conveniently in the usual winder installation.

Cylinder **18** preferably is a pneumatic cylinder provided with a front cylinder head **24** and a rear cylinder head **26**. The front cylinder head is maintained in position by retaining ring **28** and is maintained in sealing engagement with the inside wall of the cylinder and piston rod by means of O-rings **30, 32**. A threaded inlet port **34** permits the introduction of fluid pressure. Rear cylinder head **26** is provided with O-ring **36**, the entire cylinder thus being sealed off to permit working of piston **38**.

The latter member is sealed by means of O-rings **40, 42**. It is fixed to a piston rod **44** by abutting it against a shoulder **46** in the latter and releasably locking it in position with a retaining ring **48**. The piston rod is provided with a passageway **50**, the outer segment **52** of which is threaded and the inner segment **54** of which communicates with the space within the cylinder head of piston **38**.

Preferably formed as an integral extension of piston rod **44** is an elongated rod **56** which extends substantially the full length of casing **10** and which reciprocates in bushings **20, 22**. Rod **56** is formed with spaced, annular grooves **58** which merge with cam area **60** and lands **62**. Cam means thus is afforded for driving the button-shaped heads of cam followers **16** which work in openings **12** and cause lateral extension and retraction of leaves **14**.

Means also are provided for releasably locking rod **56** in its advanced position wherein leaves **14** are extended. In the illustrated form of the invention, such means include an annular groove **64** about the inner end of rod **56** opposite forward bushing **20**. A spring pressed ball **66** is housed in this bushing and releasably seats in the groove. Thus the shafts may be prevented from inadvertent collapse caused by vibration of the winder in which it is used.

In the form of the invention illustrated in FIG. 4, a button-shaped connector **70** is shown which is analogous in function to connectors **16** of FIGS. 1–3. However, it is formed with an axial recess which houses a spring-pressed ball **72**. The latter bears against cam area **60** and land **62** of rod **56**. This adapts the shaft for use with winding cores of non-uniform diameter. It also minimizes wear on the relatively movable parts of the assembly.

Operation

In operation, air or other fluid under pressure is connected to the threaded section of port **34**. This drives piston **38**, piston rod **44**, and the integral cam drive rod **56** forwardly, i.e. to the right as viewed in FIG. 1. Movement of rod **56** in this direction elevates cam followers **16** and extends leaves **14** so that the effective diameter of the shaft is materially increased, as is evident in FIG. 3.

The shaft is journaled in a winder and the end of the paper or other sheet material to be wound affixed to it,

with or without the interposition of an intermediate spool.

After the roll has been wound, the roll and shaft are removed together from the winder. Air under pressure then is connected to the threaded end of passageway **50**, retracting piston **38**, i.e. driving it toward the left as viewed in FIG. 1. This simultaneously retracts rod **56** so that the button-shaped heads of cam followers **16** gravitate into grooves **58**. This collapses leaves **14** and reduces the effective diameter of the shaft so that it may be removed readily from the roll and returned to another cycle of operation of the winder.

It is to be understood that the form of my invention herein shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. A portable, power expandable shaft comprising a hollow casing having a plurality of circumferentially spaced openings therein, a plurality of leaves longitudinally disposed relative to the casing, a plurality of cam followers secured at one of their ends to said leaves and projecting freely through the openings in the casing, a head portion on the other end of the cam followers having a tranverse dimension greater than the transverse dimension of the openings for connecting the leaves to the casing, the length of the cam followers being greater than the thickness of the casing to permit radial expanding movement of the leaves relative to the casing, an elongated rod having at least one spaced, annular, tapered groove on its circumferential surface adjacent the openings in the casing and forming cam surfaces, the surface of the rod adjacent the groove being parallel to the axis of rotation of the rod and defining a cam follower seat, said rod being mounted freely in the casing for longitudinal movement between a set retracted position in which the head portions seat in the groove to retract the leaves and a set extended position in which the head portions rest on said seat to expand the leaves, journal portions on each end of the casing for detachable connection of the shaft to a winding apparatus, one of the journal portions being hollow and forming in its interior a fluid cylinder, a piston operable in the cylinder, a pair of fluid line connections leading to opposite sides of the piston and adapted for connection to a source of fluid under pressure for reciprocating the piston, and an end extension on the rod secured to the piston whereby the rod is movable by the piston between its retracted and extended positions.

2. The expandable shaft of claim 1 wherein the cylinder has an end wall incorporating one of the fluid line connections for supplying fluid to one side of the piston, and the end extension on the rod incorporates the other fluid line connection.

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