

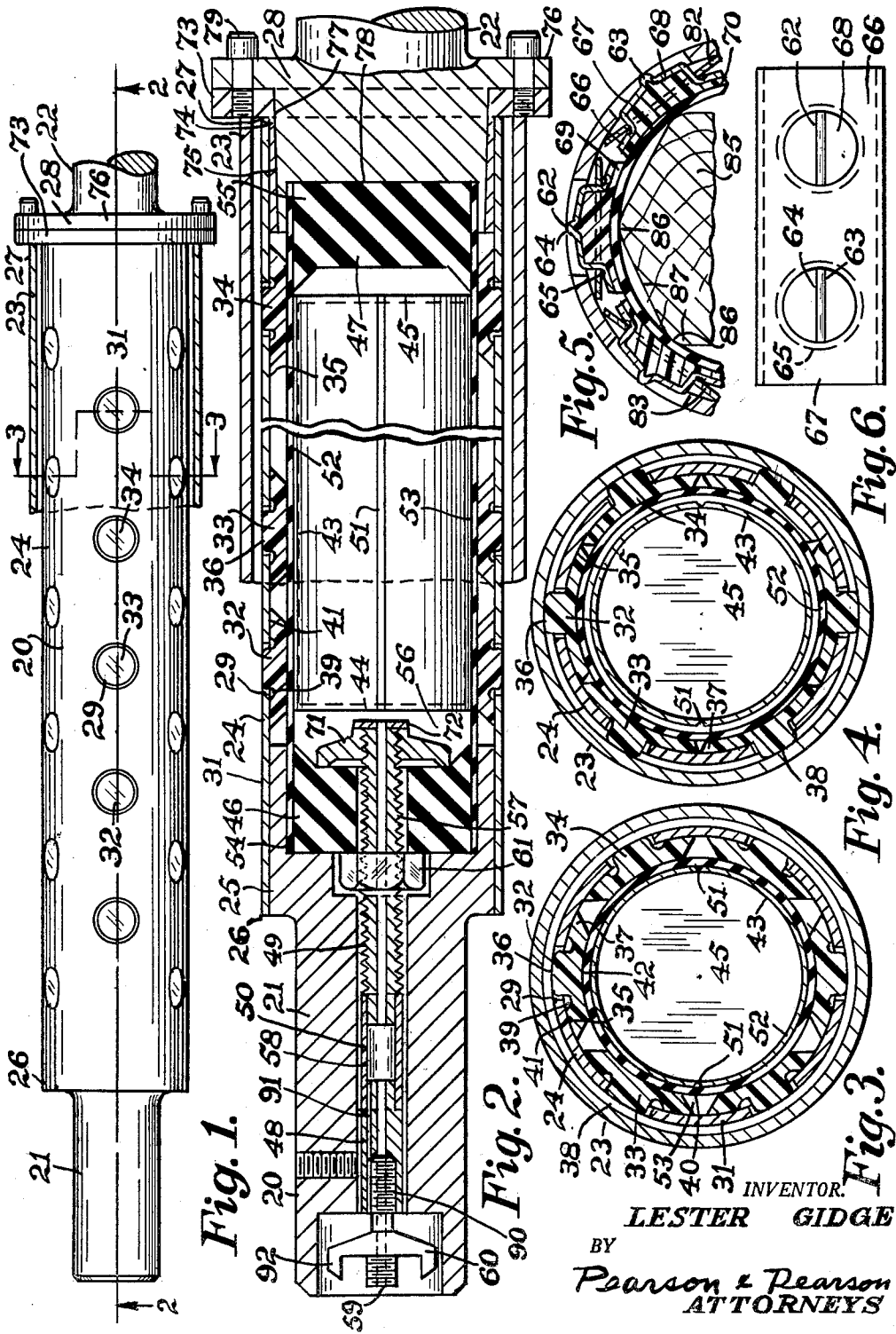
Sept. 11, 1962

L. GIDGE

3,053,467

EXPANSIBLE SHAFT

Filed Dec. 4, 1958



INVENTOR.
LESTER GIDGE
BY
Pearson & Pearson
ATTORNEYS

1

3,053,467

EXPANSIBLE SHAFT

Lester Gidge, Nashua, N.H., assignor to Nashua Industrial Machine Corporation, Nashua, N.H., a corporation of New Hampshire

Filed Dec. 4, 1958, Ser. No. 778,138

6 Claims. (Cl. 242-72)

This invention relates to expansible shafts, arbors or mandrels of the fluid pressure type. In particular it relates to a pneumatic expansible shaft on which the tubular core of rolls of paper may be supported for winding and unwinding.

It has heretofore been proposed to provide an expansible shaft with a slotted shell, shoes radially movable in the slots of the shell and an inflatable air bag within the shell adapted to move the shoes outwardly in the shell slots.

The shoes have been fixed to an axially extending, rigid, segment and the segment has been retractable as a unit by coil springs.

It has also been proposed, as in U. S. Patent 2,215,069 to Meisel of September 17, 1940, to provide an expansible shaft with a multiplicity of individually expansible buttons, or plugs, with the individual plugs capable of receding under the force of gravity.

The object of this invention is to provide an expansible shaft of the fluid pressure type having a multiplicity of radially movable, individually, self retractable, gripping buttons closely spaced over the entire circumferential face of the shell thereby securing a tenacious grip on the interior face of a core without damaging the same.

Another object of the invention is to provide an expansible shaft with a gripping face substantially covered with individual, separate gripping buttons, each having a non slip outer face and resilient, deformable, retraction means, all of said buttons being movable; outwardly under uniform fluid pressure and self retractable inherently by the release of the stress of deformation.

A further object of the invention is to provide a self centering expansible shaft operable by the application of fluid pressure from within the shaft to radially project a multiplicity of independent, individual, self retractable, gripping buttons into contact with substantially the entire inner face of a core.

Still another object of the invention is to provide an expansible shaft with a multiplicity of individual gripping buttons or shoes each encircled by a flat, leaf spring and mounted to move radially outwardly by fluid pressure, but capable of self retraction to normal undeformed condition when the pressure is released.

A still further object of the invention is to provide an expansible shaft of the fluid pressure type in which a minimum amount of pressure is required to project the gripping members from their respective apertures into an unusually tenacious, adherence with a paper, or other core carried on the shaft.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawing and from the drawing in which

FIG. 1 is a plan view of an expansible shaft constructed in accordance with the invention with the gripping buttons retracted.

FIG. 2 is a fragmentary, enlarged, view in section on line 2-2 of FIG. 1 and showing the core of a paper roll slidably receiving the shaft.

FIG. 3 is an end view in section on line 3-3 of FIG. 1.

FIG. 4 is an end view similar to FIG. 3 but showing the fluid under pressure container inflated and the gripping members deformed outwardly and radially into engagement with a core.

2

FIG. 5 is a side view in section of a modified form of self retractable, gripping member and

FIG. 6 is a plan view of the member shown in FIG. 5 without the springs.

As shown in the drawing 20 is an expansible shaft constructed in accordance with this invention. The shaft 20 may be a small arbor or mandrel, a stub, or short core, shaft with a journal 21 at one end or an elongated shaft with a journal at both ends as shown at 21 and 22. The particular shaft selected for illustration is adapted for supporting the core 23 of a roll of paper or other web material and may be used for winding, unwinding or other purposes all as well known.

Shaft 20 includes an outer perforated, cylindrical, shell 24 of metal, or other rigid material, which may be shrink fitted, or otherwise fixed on the enlarged portion 25 of the journal 21. Preferably both ends 26 and 27 of the shell 24 are closed as by the portions 25 of journals 21 at each end, or by a suitable cap or plug such as 28 with or without a journal thereon.

The outer shell 24 is provided with a multiplicity of radial passages or perforations such as 29, each preferably of circular configuration and all relatively closely spaced to each other to substantially cover the outer face 31 of the shell. In the particular embodiment illustrated, there are six lines of passages 29 substantially coextensive longitudinally with the shell and spaced angularly therearound in a symmetrical pattern, and staggered relation to each other.

A multiplicity of individual self retractable, gripping members such as 32, 33 and 34, preferably of elastomeric material, are mounted along the inner face 35 of the outer shell 24, each having a radially extending portion received within one of the radial passages 29 and an enlarged anchoring flange 37 of greater area than the area of the portion 36 at the base of the radially extending portion 36. The members 32, 33 and 34 may be of polyvinyl chloride or any other suitable flexible resilient material and the radially extending portion 36 is preferably cylindrical with the free terminal tip 38 flat. Each elastomeric gripping member such as 32 is of inverted T shaped cross section with the stem, or cylindrical portion 36 radially movable in its passage 29 and with an annular groove 39 formed in the outer face 41 of the flange portion 37. The material of the members 32, 33 and 34 is deformable and when pressure is applied to the inner face 42 of the flange portion 37, the portion 36 deforms outwardly and radially in the passages 29 with the face 38 projecting beyond the shell 24 to increase the overall diameter of the shaft. The elastomeric, enlarged flange portion 37 encircles the base of the radially extending portion, or stem 36, in the annular chamber, or space, between the inside face of outer shell 24 and the outside face of an inflatable air bag, described hereinafter, and serves as resilient self retraction means for each radially extending portion 36 of each gripping member such as 32, 33 and 34. The resilient flange 37 is normally flat but is slightly bowed, when assembled in the shaft, as best shown in FIG. 3.

The preferred means for supporting the elastomeric, deformable gripping members 32, 33 and 34 in engagement with the inner face 35 of the cylindrical shell 24 is an imperforate filler, free of internal fluid passages, in the form of a cylindrical shell 43 coaxial with shell 24. The inner shell 43 is of rigid material, such as metal, and preferably is a hollow, fluid-tight, cylinder with closed ends at 44 and 45. A plurality of longitudinally extending grooves 51, each located opposite one of the longitudinally extending lines of radial passages 29, are provided in the outer, or external, face of the shell 43 to serve as a fluid passage therealong. The outside diameter of the inner shell 43 is of suitable relation to the inside

3

diameter of outer shell 24, and the thickness of the flange portions 37 whereby the inner shell tends to bow the flange portions 37 into arcuate configuration to conform to the cylindrical inner face 35 of shell 24. The inner shell 43 may be spot vulcanized to the bag 52, held in axial position by friction alone or secured in any other desirable manner. This is the normal undeformed condition of the elastomeric members with the portions 36 at the maximum retraction within radial passages 29 and no outwardly deforming pressure applied to the members even though the outer rim of the flanged portion is slightly bowed rather than flat.

The fluid pressure means for expanding the shaft 20 is preferably pneumatic since air under pressure is normally available in manufacturing plants, especially in paper mills. A fluid pressure container in the form of an inflatable bag 52, of rubber or any suitable material is mounted within the shaft 20 with an expandable, cylindrical wall 40 in the annular chamber or space 53 between the perforated outer shell 24 and inner shell 43. As shown, air bag 52 includes the end 54, vulcanized and sealed by rubber block 46, and the opposite end 55 vulcanized and sealed by rubber block 47. A fluid pressure chamber 56 is thus created within air bag 52 and substantially filled by inner shell 43, the fluid reaching the inner face of the bag by way of the axial passages 51. The air tight inner shell greatly reduces the volume of chamber 56 to enable the fluid to create pressure in the bag very rapidly. A suitable fluid conduit 58 may be provided in either end of shaft 20 leading from a source of fluid pressure, such as a compressed air tank, not shown, to the chamber 56 of the shaft. In the shaft shown, the conduit 58 is at the journal end 21 and includes an air valve 59 of the automobile tire type or any other well known type. Conduit 58 includes the outer portion 48 and the inner portion 49, each having a reduced terminal section upon which an intermediate portion 50 of any desired length is sleeved. Inner portion 49 is exteriorly threaded at 57 for a nut 61 and a clamp nut 71, the two nuts firmly clamping the rubber end block 46 therebetween.

The intermediate portion 50, may be of any desired length necessary to fit journals of various lengths and it is preferably soldered to the portions 48 and 49 to prevent air leakage. Similarly a cap 72 seals the inner end of the portion 49 of conduit 58.

A quick release air valve is preferably provided, as shown, wherein the cylindrical body 90 is threaded into conduit 58 but the threads are cut away longitudinally to form a grooved passage 91. An air hose may be permanently threaded on valve 60 to inflate the air bag 52 but a twist of the handle 92, of less than one turn, releases the pressure through passage 91.

The elastomeric self retractable, gripping members 32, 33 and 34 are in engagement with the outside of the air bag 52 with both supported by the rigid inner shell 43. Upon introduction of air through conduit 58 to chamber 56 the bag 52 inflates rapidly to exert uniform radial pressure simultaneously on the inner faces of the flanges 37 of all of the elastomeric members. The radially extending portions 36 are moved radially outwardly in the passages 29 until each adheres, and grips, its respective zone of the inside face of a core such as 23. A tenacious grip is thus secured in a multiplicity of zones with little danger of damaging the core.

Upon release of air pressure in the air bag 52, the bag deflates and each individual gripping member 32, 33 or 34 automatically releases its grip on the core and retracts radially and inwardly within its passage 29 by reason of the inherent resiliency of the spring means formed by the encircling flange 37 with its grooved configuration at 39. Because of the symmetrical pattern of the multiplicity of members 32, 33 and 34 and the uniform pressure exerted simultaneously thereon by the bag 52, it will be apparent that the shaft 20 will centre itself in the core 23 as its

4

overall diameter is increased by inflation of the air bag. In the shaft shown, an air pressure of about 35-100 p.s.i. has been found to deform the elastomeric members 32, 33 and 34 outwardly into a tenacious contact with the interior of a tubular core of paper, the frictional contact achieved locking the shaft firmly in place under all ordinary manufacturing conditions.

However, when it is desired that the members actually dig into, or bite into, the inner face of a core, a metal ferrule such as at 62 may be affixed over the tip 38 of the gripping portion 36 of each radially extending button. The metal covering may be resilient, flexible and deformable so that each individual button may be flexed outwardly in the openings 29 and may retract by its inherent resiliency when fluid pressure is released.

In the modification shown in FIGS. 5 and 6 the metal ferrules 62 each include a non-slip face preferably in the form of rib 63 extending longitudinally of the shaft to assist in preventing rotation of the core relative to the shaft. The ribs 63 each have a sharp angular edge 64 which tend to embed themselves in the material of the core and exert an unusually strong grip thereon. Each ferrule 62 preferably includes an annular groove 65 corresponding to the groove 39 of the members 32, 33 and 34 and an anchoring flange portion 66 corresponding to the flange portions 37. Each modified gripping button, or member, such as 67 includes a cylindrical portion 68 and a flange portion 69 corresponding to the portions 36 and 37 of the members 32, 33 and 34 and formed of similar material such as poly vinyl chloride, or other elastomeric material, with the soft inner face 70 of the gripping member being engaged by the air bag such as 52.

The metal flange portions 66 and the poly vinyl chloride flange portions 69 of each two longitudinally adjacent gripping buttons such as 67 may be connected to form a single unit, as shown, the resulting shaft then having a multiplicity of gripping members each with two closely spaced gripping radially extending portions, or stems. The metal of the ferrules 62 and flange portions 66 may be relatively thick if desired with flat leaf springs such as 82 and 83 encircling each radially extending portion, or stem, for independent, self retraction purposes. While an air tight, hollow, inner, cylindrical shell 43 is preferred, as shown in FIG. 5 it is also possible to use a solid polygonal filler 85 of metal, wood or the like, having longitudinally extending angular corners such as 86 spaced to support the gripping members 67 in retracted position and having flat faces such as 87 forming longitudinal air passages for quickly inflating the bag 52 to project the radially extending portions 68. Similarly, a perforated shell having open ends can be used to support the gripping members with a solid filler of wood, or other suitable material, inside the shell to reduce the volume of the air chamber within the air bag.

I use the term "ferrule" herein to mean a ring or cap, usually of metal, put around at least the gripping portions of the gripping members to prevent wear thereon.

In the shaft shown in FIG. 1, the journal 21 is easily removable from its bearings for insertion of the shaft in the core 23 until the stop flange 73 is reached. The journal 21 is then replaced in the bearings with the core and roll on the shaft. As best shown in FIG. 2, the stop flange 73 extends outwardly from a collar 74 which is shrink fitted in the end 27 of shell 24 and provided with a tapered inside face 75. All of the interior parts of the apparatus may be removed through the tapered opening defined by face 75. The journal member 22 includes a flange 76 corresponding to flange 73, and a tapered portion 77 fitting the tapered face 75 and recessed at 78 to receive the block 47. Suitable bolts 79 are provided for connecting flanges 73 and 76 together.

I claim:

1. An expansible shaft comprising an outer cylindrical 75 shell of rigid material having a multiplicity of radial

5

openings forming a symmetrical pattern thereover; a series of T-sectioned gripping members in the form of distortable buttons having their stems lying in the respective openings and their heads lying within said shell proximate the inner face thereof, each said gripping member being of resilient material with the head thereof of greater area than the area of the stem and with an annular groove in the outer face of said head encircling the base of said stem; an inflatable fluid pressure container within said shell, the outer face thereof defining an elongated annular chamber with the inner face of said shell for housing said heads, and fluid operated means on said shaft, controllable from outside said shell and operable to inflate said container within said shell to distort said buttons and move their stems outwardly in said openings so as to protrude from the shell at its outer face, the buttons when so distorted becoming stressed in such a way that they retract their stems into said openings when said fluid-operated means is released.

2. In an expansible shaft of the type having an outer cylindrical shell with a multiplicity of radial passages, an inflatable, cylindrical, air bag within said outer shell and an inner, filler element within said air bag, the combination of a multiplicity of identical, individual gripping members each having at least one radially extending portion received in one of the radial passages of said outer shell, the outer end of each said portion including a non slip face and the inner end of each said portion including an integral, enlarged anchoring flange within said outer shell and overlying said air bag, said flange extending entirely around the base of said radially extending portion, and a normally flat leaf spring, constituting a chord to the curve of said cylindrical outer shell, encircling each said radially extending portion between said anchoring flange and the inside face of said outer shell for individual self retraction of each radially extending portion of each said gripping member.

3. A combination as specified in claim 2 wherein there are two radially extending portions on each said gripping member, wherein a single anchoring flange is common to both said portions and wherein said leaf spring is apertured to fit over the said two radially-extending portions of said gripping member.

4. A combination as specified in claim 2 wherein said inner filler element within said air bag is a block of polygonal cross section having generally angular corners, said

6

block forming a plurality of circumferentially spaced, shallow pressure chambers within, and of substantially the same length as, said air bag, and supporting said gripping members in retracted position along its angular corners.

5. A combination as specified in claim 2 wherein the inner face of each said anchoring flange is of soft, yieldable material for engaging and overlying said air bag.

6. In an expansible mandrel of the type having an outer cylindrical shell with a multiplicity of radial passages, an inflatable, cylindrical air bag within said outer shell and an inner, cylindrical shell within said air bag, the combination of a multiplicity of identical, individual, gripping members each having at least one radially extending portion received in one of the radial passages of said outer shell, the inner end of each said portion including an integral, enlarged anchoring flange within said outer shell and overlying said air bag, said flange extending entirely around the base of said radially extending portion; a metal ferrule, mounted on the outer end of each said radially extending portion, said ferrule including a central exterior rib forming a non slip face, and spring means encircling each said radially extending portion between said anchoring flange and the inside face of said outer shell for individual self retraction of each radially extending portion of each said gripping member.

References Cited in the file of this patent

UNITED STATES PATENTS

1,297,809	Dixon et al. -----	Mar. 18, 1919
1,858,607	Whalen -----	May 17, 1932
2,145,806	Schnedarek -----	Jan. 31, 1939
2,215,069	Meisel -----	Sept. 17, 1940
2,331,743	Sullivan -----	Oct. 12, 1943
2,537,492	Tidland -----	Jan. 9, 1951
2,558,689	Miller -----	June 26, 1951
2,616,631	Bauer -----	Nov. 4, 1952
2,711,863	Grettve -----	June 28, 1955
2,849,192	Fairchild -----	Aug. 26, 1958
2,852,874	Grubb -----	Sept. 23, 1958

FOREIGN PATENTS

8,543	Great Britain -----	of 1896
543,649	Germany -----	Feb. 8, 1932
866,907	Germany -----	Feb. 12, 1953