

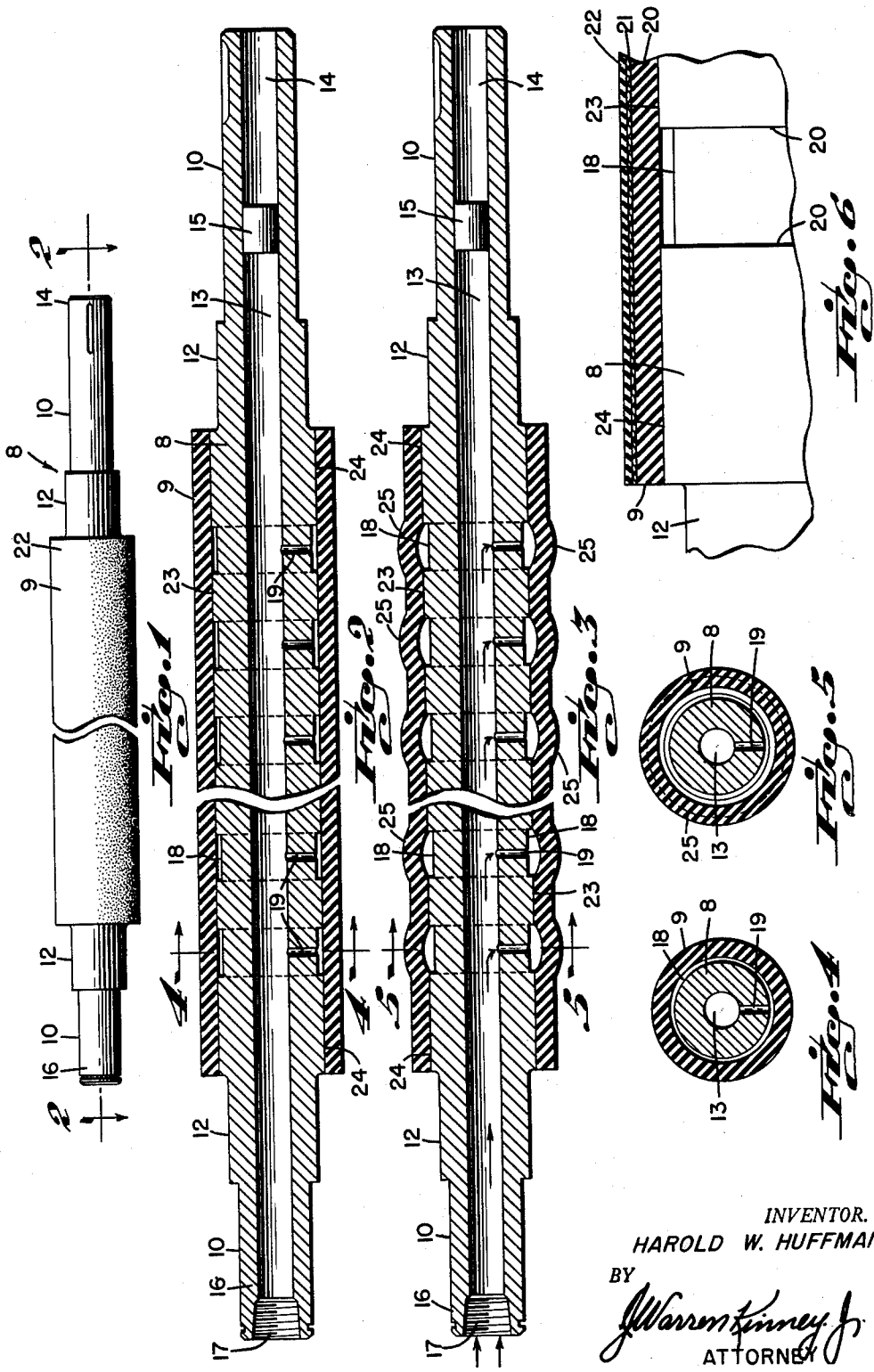
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AIR EXPANDABLE CORE SHAFT

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AIR EXPANDABLE CORE SHAFT

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The present invention relates to an expandable core shaft, such as may be employed in supporting rolls of paper or other web material while undergoing winding or unwinding.

Expandable core shafts of one type or another are used quite generally in paper manufacturing plants, and in other establishments wherein rolls of paper are to be wound or unwound. Usually the rolls are very large and heavy, so that in rotating them at relatively high speed for winding or unwinding, it is necessary to provide rugged and reliable means for support thereof in order to preclude unbalance and possible resultant loss of control which might lead to serious consequences.

Web material in substantial lengths is usually wound upon a central core or tube of heavy cardboard or other suitable material, open at its opposite ends and having a uniform inside diameter throughout. This core or tube is adapted to receive therein a shaft or mandrel somewhat longer than the core or tube, so that the shaft ends may be supported in bearings permitting rotation of the shaft during winding or unwinding of the web. In some instances the roll is formed without the use of a central tubular core, in which case the inner convolutions of the web form the core and provide the necessary central bore to receive a shaft or mandrel for support of the roll.

The shaft or mandrel to support the roll is preferably one which may be inserted through the core with ease, and then expended within the core to establish a tight and secure mounting of the roll upon the shaft or mandrel so that full control of roll rotation may be had through the agency of the shaft or mandrel. It is essential that the mounting be secure, and that the shaft be concentrically maintained inside the core to avoid vibration and possible breakage of the shaft. Removal of the shaft from the core must be effected with ease and dispatch, and without resort to force and hammering, which might damage the shaft or its bearing ends.

An object of the present invention is to incorporate in an expandable core shaft certain improvements of structure which eliminate weaknesses inherent in core shafts of known construction.

Another object is to provide an expandable core shaft of improved design, which is substantially more serviceable and reliable in operation than previous shafts and which has a greatly extended useful life.

A further object of the invention is to provide an expandable core shaft having the advantages stated, and which in addition possesses the advantages of great simplicity and low cost coupled with maximum durability.

Another object is to provide for expeditious and inexpensive rebuilding of the core shaft than necessary, due to extended or hard service.

The foregoing and other objects are attained by the means described herein and illustrated upon the accompanying drawing, in which:

FIG. 1 is a fragmentary side elevational view of the improved expandable core shaft.

FIG. 2 is an enlarged cross-sectional view taken on line 2—2 of FIG. 1, and showing the normally contracted condition of the friction sleeve.

FIG. 3 is a cross-sectional view similar to FIG. 2, but showing the friction sleeve in expanded condition.

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FIG. 4 is a cross-sectional view taken on line 4—4 of FIG. 2.

FIG. 5 is a cross-sectional view taken on line 5—5 of FIG. 3.

FIG. 6 is a greatly magnified view in cross-section, showing the construction of the friction sleeve in detail.

With reference to the drawing, the improved device will be seen to consist of but two major parts, namely, a steel shaft 8, and a friction sleeve 9 surrounding the shaft intermediate its end bearing portions 10. The bearing portions are adapted for reception in suitable journals permitting rotation of the shaft. If desired, the bearing portions may be flanked by shoulders 12, as shown, and are preferably hardened to impart maximum wearing qualities.

The shaft 8 is axially bored to provide a chamber or manifold 13 extending preferably, though not necessarily, throughout the full length of the shaft. One end 14 of the chamber is to be closed, as by means of a plug 15 or other expedient, to preclude the escape of pneumatic or hydraulic fluid introduced to the chamber at the opposite end 16, under pressure. The end 16 may be adapted for connection to a pipe, hose, or other source of fluid under pressure, internal screw threads 17 being shown for the purpose by way of example. The main body portion of the shaft intermediate the shoulders 12—12, is machined or turned at spaced intervals to provide a series of annular shallow grooves 18, each of which is placed in fluid communicating relationship with the central bore or manifold 13, by means of transverse openings or drill holes 19 formed within the limits of the grooves as determined by the side walls 20—20, FIG. 6. The holes 19 are easily provided by drilling the shaft prior to application of sleeve 9.

From the foregoing, it will be understood that fluid under pressure introduced to the manifold or bore 13 at the end 16 of the shaft, may pass freely to the series of spaced grooves or annular pockets 18, by way of the connecting passages provided by the transverse holes 19. This is indicated by small arrows upon FIG. 3.

With reference now to the friction sleeve 9, it will be noted that this member is an air-impermeable tube of specially reinforced resilient material snugly embracing the outer wall of the shaft body between the shoulders 12, 12. The sleeve is of uniform diameter and thickness throughout its length, and so may be easily manufactured and simply applied in one piece to shaft 8. FIG. 6 indicates that the sleeve may be constituted of several laminations, one being an inner tube 20 of flexible and resilient soft rubber or rubber-like substance capable of being vulcanized to shaft 8, this inner tube being covered by a reinforcing sheet 21 of cloth, preferably nylon or the like, and finally an outer tube 22 of flexible and resilient harder rubber having substantial wear-resisting characteristics. The several laminations are united to one another, preferably by vulcanization, to produce a unitary one-piece tube. The tube, or sleeve, upon being applied over the body of the shaft in accordance with FIG. 2, is subjected to vulcanization for welding it firmly to shaft 8 wherever the sleeve is in contact with the shaft, including the annular ridge areas 23 between all of the spaced grooves 18, and the areas 24 adjacent the shoulders 12. Where the sleeve overlies the various annular grooves 18, the material of the sleeve is free to flex and distend, as suggested by FIG. 3.

When a fluid under pressure, such as air, is introduced at the end 16 of the shaft, it enters the various grooves 18 and acts upon those areas of sleeve 9 which span the grooves, to there distend the sleeve material, resulting in the formation of spaced annular ribs 25 (FIGS. 3 and 5) which increase the effective diameter of the core shaft. If such expansion of the sleeve is effected while the shaft

supports a roll of paper, the core of the roll will, of course, limit the expansion and become firmly connected to the sleeve by forceful frictional contact, thereby to ensure fixation of the paper roll upon the shaft. When the pressure of fluid in the shaft bore is relieved, the sleeve resumes its normal shape according to FIG. 2, and releases the grip upon the roll core to permit removal of the expandable shaft from the core.

The structure disclosed is seen to be very simple and inexpensive to manufacture and assemble. There are but two major parts in the construction, these being the shaft and the single resilient sleeve. The sleeve itself is simple and easy to produce because of its uniformity of diameter and thickness, and the fact that it is in one single piece. Due to the uniformity in width of the many annular shaft grooves 18, the force of frictional contact of the sleeve within a core is equalized from one end of the shaft to the other, thereby ensuring accurate concentricity of the shaft within the roll core at all times, and eliminating any tendency of the assembly to vibrate when rotating at high speed.

It is noteworthy also that the shallow annular grooves 18, and the transverse drill holes 19, do not materially weaken the shaft at any location along its length, and for that reason the structure provides for maximum safety and durability in operation.

Finally, the combination of hard and soft rubber laminations in the sleeve, reinforced by cord or nylon cloth, ensures a long period of trouble-free service. To restore a worn or damaged shaft to new condition, it is necessary only to strip the sleeve 9 therefrom and replace it with a new sleeve as previously explained. It should readily be evident that the device of the present invention has many advantages over expandable core shafts as heretofore constructed.

In conclusion, it is to be understood that various modifications and changes in the structural details of the device may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed is:

1. In a device of the class described, the combination of a longitudinally bored one-piece shaft having opposite ends and an intermediate portion, said intermediate portion being provided with a series of shallow annular grooves alternated with annular ridge areas along the length of the intermediate portion of the shaft, and each shallow groove having therein a transverse opening placing each groove in fluid communication with the longitudinal bore of the shaft, and a resilient air-impermeable tube covering substantially the full length of the intermediate portion of the shaft and all the shallow grooves therein formed, said tube being vulcanized to the shaft at all areas between and adjacent to each groove.

2. In a device of the class described, the combination of a longitudinally bored shaft having opposite ends and an intermediate portion of generally uniform diameter, said intermediate portion being provided with a series of exterior shallow annular grooves alternated with annular ridge areas which correspond in diameter with the overall diameter of the shaft intermediate portion, and each shallow groove having therein a transverse opening placing each groove in fluid communication with the longitudinal bore of the shaft, and a resilient tube snugly applied to the intermediate portion of the shaft in spanning relationship with all the shallow grooves and covering the annular ridge areas adjacent thereto, the tube forming with said annular ridge areas a series of air-tight barriers between said grooves.

3. In a device of the class described, the combination of a longitudinally bored one-piece shaft having opposite ends, and an intermediate portion of generally uniform

diameter, said intermediate portion being provided with a series of shallow annular grooves circumferentially thereof, and a single resilient tube of uniform diameter snugly applied over the intermediate portion of the shaft, in spanning relationship to all of the annular grooves, the tube being affixed to the shaft at the tube ends and between adjacent grooves to form air-tight barriers therebetween, and means placing each of the tube-covered grooves in fluid communication with the longitudinal bore of the shaft.

4. In a device of the class described comprising a circular shaft having an enlarged center portion and reduced end portions, the end portions being supportable in bearings, the shaft having a bore therethrough, means adjacent one end to close the bore and connecting means adjacent the other end for attachment to a source of fluid pressure, the enlarged center portion having a plurality of spaced circumferential shallow grooves therein, passageways from the bore to each groove, the enlarged center portion also having a plurality of circumferential smooth face ridges interposed between each of the shallow grooves and at each end of the center portion thereby forming alternate hills and dales circumferentially around the center portion, an elastic sleeve substantially coextensive with the center portion positioned over the center portion and being attached to the ridges of the center portion thus forming a plurality of circumferential pockets between the grooves and the inner surface of the sleeve, the circumferential pockets being extended beyond the normal outer surface of the sleeve when fluid pressure is applied to the connecting means adjacent the other end of the shaft whereby the extended pockets will engage and hold cores and the like when placed on the shaft.

5. In a device of the class described comprising a one-piece circular shaft having an enlarged center portion and reduced end portions, the end portions being supportable in bearings, the shaft having a bore therethrough, means adjacent one end to close the bore and connecting means adjacent the other end for attachment to a source of fluid pressure, the enlarged center portion having a plurality of spaced similarly formed and dimensioned circumferential shallow grooves therein and with passageways from the bore to each groove, the enlarged center portion also having a plurality of similar intermediate circumferential smooth face ridges of substantially the cross-sectional thickness of the grooves interposed between each of the shallow grooves, at each end of the center portion there being a similar smooth surfaced end ridge for permanently securing and sealing thereto the respective end portions of an elastic sleeve and the cross-sectional thickness of which ridges are substantially greater than the cross section of the grooves, the elastic sleeve being substantially coextensive with the center portion positioned over the center portion and being attached to the ridges of the center portion and the enlarged end ridges thus forming a plurality of circumferential pockets between the grooves and the inner surface of the sleeve, the circumferential pockets being adapted to be extended and form a corrugated effect beyond the normal outer surface of the sleeve when fluid pressure is applied to the connecting means adjacent the outer end of the shaft and the extended pockets in the form of corrugations will engage and hold cores and the like when placed on the shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

2,035,660	Lippitt	Mar. 31, 1936
2,289,519	Randall	July 14, 1942
2,583,117	Piperoux et al.	Jan. 22, 1952
2,712,338	Hurt	July 5, 1955
2,876,961	Cole et al.	Mar. 10, 1959