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ROLL SHAFT

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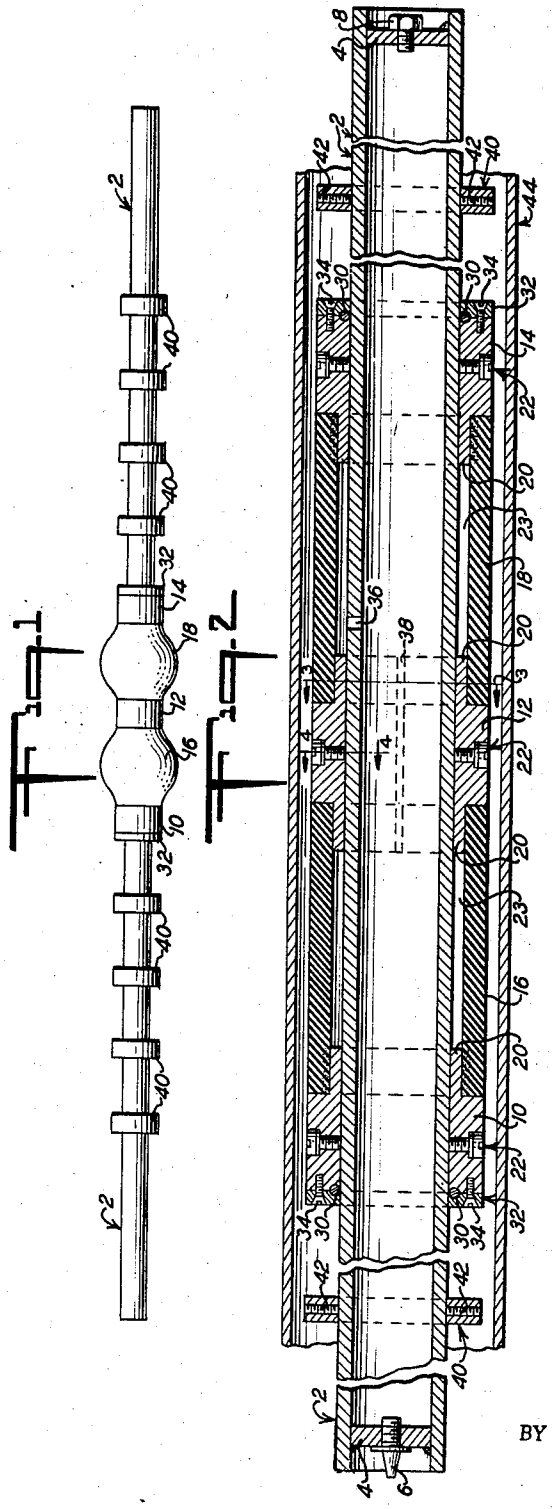


Fig. 1

Fig. 2

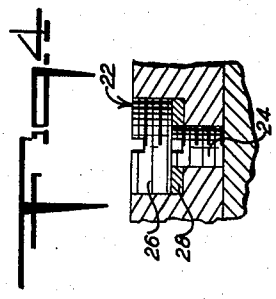


Fig. 4

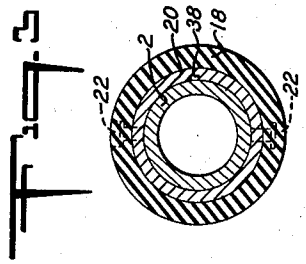


Fig. 3

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ROLL SHAFT

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This invention relates to roll shafts, and more particularly to a roll shaft for supporting a roll of paper, textiles, or other materials, during winding or unwinding operations.

Prior to the present invention, rolls of paper usually have been supported in machines, such as paper cutting machines and paper rewinding machines, by means of tapered bushings driven into the ends of the rolls. The bushings are supported directly upon the machines, and they are connected to suitable braking or drive means for controlling the rotation of the rolls.

The practice of using tapered bushings driven into the ends of rolls of material has several disadvantages. One important disadvantage is that substantial amounts of time and labor are expended in preparing the rolls for use. Another is that a large capital investment in bushings is required if the operations are to proceed in an orderly fashion.

In an effort to overcome or eliminate the objections mentioned above, many proposals have been advanced directed to the use of expansible shafts for supporting rolls. Such a shaft was adapted to be inserted through the core of a roll and then expanded to such an extent that its surface contacted the core of the roll to provide a friction coupling between the two.

Some of the shaft structures proposed have included extremely complex mechanisms by which the effective diameter might be increased after the insertion of the shaft into the roll. For the most part, shafts of this character have not proved feasible. They are too expensive to construct and the complicated mechanisms do not function properly over extended periods of time.

Other shaft structures have been proposed in which the expansion of the shaft after insertion into the roll is brought about by the inflation of an expansible element. However, some of the inflatable shaft structures proposed were subject to the objection that rolls of different widths could not be handled conveniently.

According to another proposal, such a shaft included a single, elongated, inflatable member which might be expanded sufficiently to engage the core of a roll on the shaft. In practice, these shafts proved to be unsatisfactory because the large mass of fluid actually supporting the roll made the mounting somewhat unstable. The result was that during unwinding of the paper, the roll chattered or bounced rapidly, adversely affecting the operation of the machine.

An object of the invention is to provide a roll shaft which is economical to manufacture and is durable and efficient in service.

Another object of the invention is to provide a shaft structure which may be quickly and easily associated with a roll of any width without requiring adjustments.

Still another object of the invention is to provide an inflatable shaft structure which will not lead to chattering of the roll during unwinding operations.

The foregoing objects of the present invention are realized by a structure which includes an elongated tube

having two inflatable elements mounted upon its central portion in a novel manner and a number of carrier rings spaced along its length on opposite sides of the inflatable members. Means is provided for inflating the inflatable members by connecting an end of the tube to a source of fluid under pressure.

A better understanding of this invention and its many advantages will be gained from the following detailed description of the embodiment illustrated in the accompanying drawings in which:

Fig. 1 is a side elevational view of a roll shaft according to the present invention, with the inflatable members in their expanded positions;

Fig. 2 is a longitudinal cross sectional view of the roll shaft of Fig. 1, showing the inflatable members as they appear prior to inflation and showing also the core of a roll of material into which the shaft has been inserted;

Fig. 3 is a transverse cross sectional view of the roll shaft taken along the line 3—3 in Fig. 2; and

Fig. 4 is a cross sectional view taken along the line 4—4 in Fig. 2.

The roll shaft in the illustrated embodiment of the invention includes an elongated metal tube 2 of a length such that rolls of the maximum width which may be handled in the machine may be accommodated. Both ends of the tube 2 are closed off against the passage of air by plugs 4 which may be blank welded to the interior surfaces of the tube. Each of the plugs 4 may have a threaded opening along its axis for the reception of a valve 6 or a simple air stop 8. At least one valve 6 must be employed so that air may be introduced into and withdrawn from the interior of the tube 2. The details of the valve 6 form no part of the present invention, and no description of them is required.

The central portion of the tube 2 carries three spaced apart metal rings or sleeves 10, 12, and 14, upon which a pair of inflatable members 16 and 18 are mounted. Each of the rubber sleeves or tubes 16 and 18 is vulcanized at its end portions to shoulders 20 formed upon the metal sleeves 10, 12, and 14. The metal sleeves 10, 12, and 14, are detachably connected to the tube 2 by means of a set screw construction designated generally by the numeral 22 and illustrated in detail in Fig. 4. This method of attaching the inflatable members 16 and 18 to the shaft permits their removal from the tube 2 when desired, as for servicing purposes.

The inflatable elements 16 and 18 are in the form of sleeves of a material such as rubber. They may have suitable treads in their external surfaces to enhance the gripping action exerted upon the core of the roll. The inside diameter of each of the rubber sleeves is slightly greater than the outside diameter of the tube 2 to provide air spaces 23 between the tube 2 and the rubber sleeves.

The mounting of the metal sleeves 10, 12, and 14, upon the tube 2 is designed to prevent the escape of air. The structures 22 are distinctive in this respect. Referring to Fig. 4, it will be seen that each of the set screw constructions 22 includes two Allen-head screws 24 and 26, and a lead washer 28. The small screw 24 actually engages the tube 2 to hold the metal sleeve in position. The larger screw 26 serves to squeeze the washer 28, which, as pointed out above, is made of lead or of some plastic material. Upon deformation, the washer expands laterally to form an airtight joint between the upper portion of the screw 24 and the sleeve to which it is attached.

The escape of air from the ends of the endmost metal sleeves 10 and 14 is prevented by O-rings 30 which are located in recesses in the sleeves and which are held in position to bear against the exterior surface of the tube 2 by means of caps 32 attached to the sleeves 10 and 14 by screws 34.

The air spaces 23 between the rubber sleeves 16 and 18

and the exterior surface of the tube 2 are connected to the interior of the tube 2 by means of one or two openings 36 through the wall of the tube. These openings 36 may be quite small, in the order of ⅛ inch diameter for example, to preserve the structural integrity of the tube 2. When, as illustrated, only one opening 36 is employed, communication between the two air spaces 23 is achieved by means of a small slot 38 along the inside surface of the metal sleeve 12. It is pointed out at this point that the ability of the tubes in prior art shaft structures to withstand stresses has been limited severely in many instances by the provision of a number of large openings through the walls of the tubes. This difficulty has been effectively surmounted by the present invention.

The portions of the tube 2 on opposite sides of the metal sleeves 10 and 14 carry a number of narrow carrier rings 40 of metal, hard rubber, or other suitable material, held in position by means of set screws 42. The carrier rings 40 are spaced so that they may support roll cores such as that designated by the numeral 44 in Fig. 2, of different widths. It should be noted especially that no adjustments whatever are required in order to adapt the shaft of this invention for the reception of rolls of different widths. Whatever width the roll might be, there will be a pair of carrier rings located near its ends to support it.

The diameters of the carrier rings 40 are slightly smaller than the diameters of the roll cores 44 to be supported thereby. This causes the axes of the roll and the roll shaft to be offset slightly from each other. However, the offset is not sufficient in extent to cause serious fatigue stresses in the rubber sleeves 16 and 18. It should be understood in this connection that the air pressure within the expanded sleeves 16 and 18 usually is not sufficient to support a roll. The sleeves 16 and 18 are deflected downwardly by the weight of the roll to bring the inner surface of the roll core 44 into contact with the upper surfaces of the carrier rings 40.

Although a detailed description of a single embodiment of the invention has been presented, various modifications will be apparent to persons skilled in the art. Therefore, it is intended that the foregoing description should be considered as exemplary only and that the scope of the invention should be determined from the following claims.

We claim:

1. A roll shaft for supporting a roll having a core comprising an elongated tube, said tube being imperforate except at its central portion and having a hole through its wall in said central portion, closure means at one end of said tube, valve means at the other end of said tube to permit fluid under pressure to be introduced into or withdrawn from said tube, an inflatable member surrounding the central portion of said tube and having its end portions secured to said tube to form a fluid chamber between the exterior wall of said tube and the interior wall of said inflatable member, means including said hole for conducting fluid between said inflatable member and the interior of said tube, and a plurality of spaced apart carrier rings secured to said tube on each side of and in spaced apart relation to said inflatable member for contacting the core of a roll and carrying the weight thereof.

2. A roll shaft for supporting a roll having a core comprising an elongated tube, said tube being imperforate except at its central portion and having a hole through its wall in said central portion, closure means at one end of said tube, valve means at the other end of said tube to permit fluid under pressure to be introduced into or withdrawn from said tube, a pair of inflatable members surrounding the central portion only of said tube and having their end portions secured to said tube to form fluid chambers between the exterior wall of said tube and the interior walls of said inflatable members, means including said hole for conducting fluid between said inflatable members and the interior of said tube, and a plurality of spaced apart carrier rings secured to said tube on each side of and in spaced apart relation to said inflatable members for contacting the core of a roll and carrying the weight thereof.

3. A roll shaft comprising an elongated tube, a plurality of sleeves secured to the central portion of said tube in spaced apart relation, and a plurality of inflatable tubes surrounding said central portion of said elongated tube and having their end portions secured to said sleeves to form fluid chambers between the exterior wall of said elongated tube, the interior walls of said inflatable tubes and adjacent ones of said sleeves, said elongated tube having a hole in its wall to permit the passage of fluid between the interior of the elongated tube and one of said fluid chambers.

4. A roll shaft comprising an elongated tube, a plurality of sleeves secured to the central portion of said tube in spaced apart relation, and a plurality of inflatable tubes surrounding said central portion of said elongated tube and having their end portions secured to said sleeves to form fluid chambers between the exterior wall of said elongated tube, the interior walls of said inflatable tubes and adjacent ones of said sleeves, said elongated tube having only one hole in its wall to permit the passage of fluid between the interior of the elongated tube and one of said fluid chambers, and certain of said sleeves being shaped to permit fluid to pass between adjacent fluid chambers.

5. A roll shaft comprising an elongated tube, three rings surrounding the central portion of said tube in spaced apart relation and being provided with shoulders on the proximate ends thereof, a pair of inflatable sleeves secured to the shoulders of adjacent ones of said rings in fluid-tight relation to form fluid chambers, means for securing the endmost ones of said rings to said tube so as to prevent the escape of fluid from said fluid chambers along the exterior of said tube, closure means at one end of said tube, valve means at the other end of said tube, and means for conducting fluid between said fluid chambers and the interior of said tube.

6. A roll shaft comprising an elongated tube, three rings surrounding the central portion of said tube in spaced apart relation and being provided with shoulders on the proximate ends thereof, a pair of inflatable sleeves secured to the shoulders of adjacent ones of said rings in fluid-tight relation to form fluid chambers, a set screw in each of said rings for securing the rings against rotation relative to said tube, means associated with each of said set screws to prevent the escape of fluid through the opening provided therefor, and means for preventing the escape of fluid between the tube and the endmost rings, closure means at one end of said tube, valve means at the other end of said tube, and means for conducting fluid between said fluid chambers and the interior of said tube.

7. A roll shaft comprising an elongated tube, three rings secured to the central portion of said tube in spaced apart relation and being provided with shoulders on the proximate ends thereof, a pair of inflatable sleeves secured to the shoulders of adjacent ones of said rings in fluid-tight relation to form fluid chambers, O-rings surrounding said tube on opposite sides of the endmost of said three rings, means for holding said O-rings in position to prevent the escape of fluid between said tube and said endmost rings, closure means at one end of said tube, valve means at the other end of said tube, and means for conducting fluid between said fluid chambers and the interior of said tube.

8. A roll shaft comprising an elongated tube, three rings surrounding the central portion of said tube in spaced apart relation and being provided with axially extending shoulders on their proximate ends, a pair of rubber sleeves vulcanized to the shoulders of adjacent ones of said rings in fluid-tight relation to form fluid chambers, a set screw in each of said rings for securing the rings against rotation relative to said tube, a deformable washer associated

with the outer end of each of said set screws, a screw overlying each of said washers for deforming it so as to form a fluid-tight seal, O-rings surrounding said tube on opposite sides of the endmost of said three rings, means for holding said O-rings in position to prevent the escape of fluid between said tube and said endmost rings, closure means at one end of said tube, valve means at the other end of said tube, means for conducting fluid between said fluid chambers and the interior of said tube, and a plurality of spaced carrier rings detachably secured to said tube on opposite sides of said central portion thereof.

9. A roll shaft comprising an elongated tube, a plurality of sleeves secured to the central portion of said tube in spaced apart relation, a plurality of inflatable tubes surrounding said central portion of said elongated tube and having their end portions secured to said sleeves to form fluid chambers between the exterior wall of said

elongated tube, the interior walls of said inflatable tubes and adjacent ones of said sleeves, said elongated tube having a hole in its wall to permit the passage of fluid between the interior of the elongated tube and one of said fluid chambers, and a plurality of carrier rings secured to and surrounding said tube on opposite sides of and in spaced apart relation to said plurality of sleeves.

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