

[54] **APPARATUS AND PROCESS FOR PLUGGING A PAPER ROLL CORE**

[76] Inventor: **Franklin C. Bittner**, Star Route North, Box 560, Newport, Oreg. 97365

[22] Filed: **July 8, 1974**

[21] Appl. No.: **486,601**

[52] U.S. Cl. **206/389**; 29/525; 242/68.6

[51] Int. Cl.² **B65D 85/676**; B23P 19/02; B65H 17/02

[58] Field of Search 242/68.6, 68; 229/67; 206/415, 416, 389

[56] **References Cited**

UNITED STATES PATENTS

1,775,224	9/1930	Hoyt	229/67 X
2,241,458	5/1941	Heizer.....	206/413
3,125,802	3/1964	Kenin et al.	242/68.6 X
3,547,367	12/1970	Brazeale	242/68.6
3,713,601	1/1973	Buhrman et al.	242/68.6

FOREIGN PATENTS OR APPLICATIONS

711,624	6/1965	Canada.....	242/68.6
---------	--------	-------------	----------

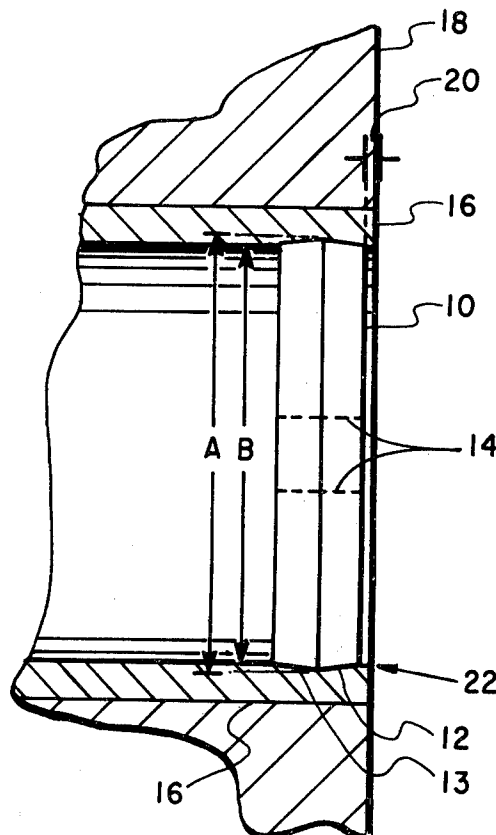
Primary Examiner—Leonard Summer

Attorney, Agent, or Firm—Chernoff & Vilhauer

[57] **ABSTRACT**

A relatively thin disc-shaped plug alternatively made from a variety of materials has a double-tapered perimeter and a central hole, and is sized to fit forcibly within the core of a paper roll at the end thereof. The plug is placed in the paper roll core by a mechanical insertion apparatus having resiliently mounted plug guide fingers and a powered plunger which forces the plug into the core between the fingers to a predetermined depth and thereafter automatically retracts the guide fingers from the core. Arm-like stops extending forwardly from the front of the insertion apparatus abut against the paper roll or other surface to steady the apparatus and prevent the fingers from being inserted into the core too far. The plug is installed in the paper roll by loading the insertion device, placing its guide fingers into the end of the paper roll core to a predetermined depth and actuating the plunger.

15 Claims, 10 Drawing Figures



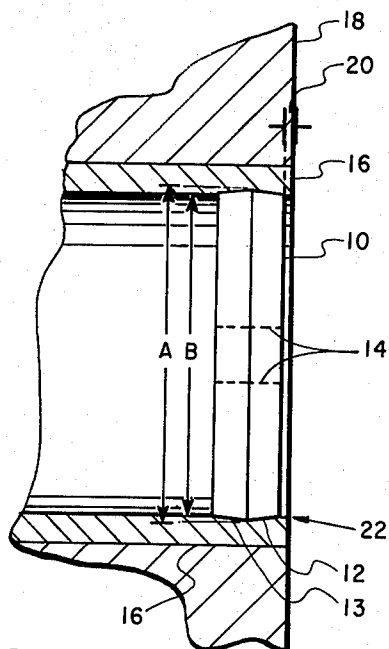


FIG. 2

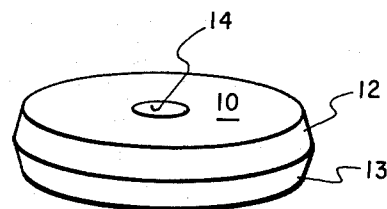


FIG. 1

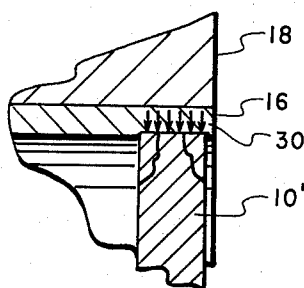


FIG. 3A

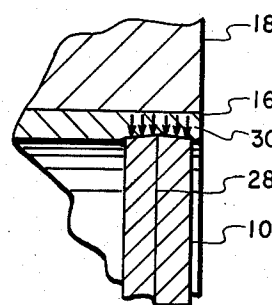


FIG. 3B

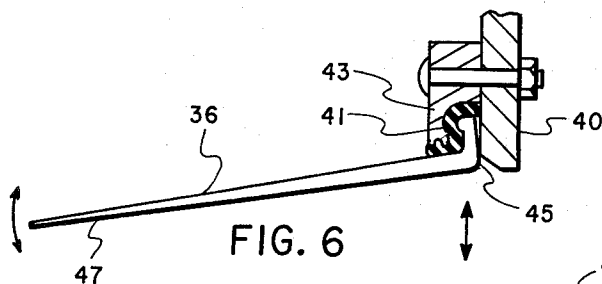


FIG. 6

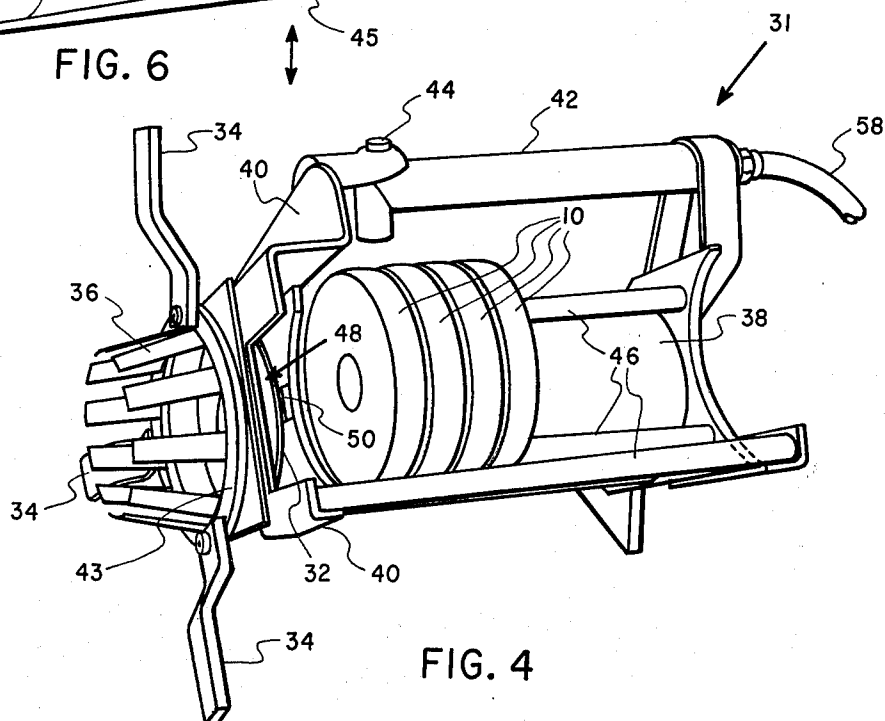


FIG. 4

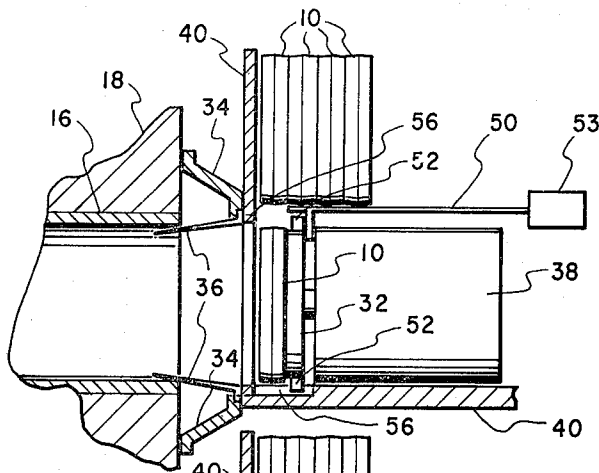


FIG. 5A

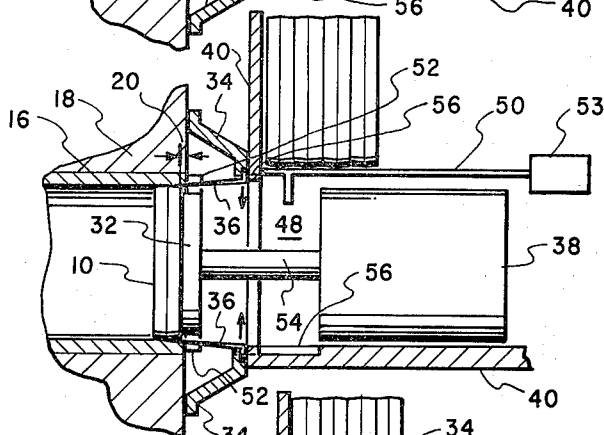


FIG. 5B

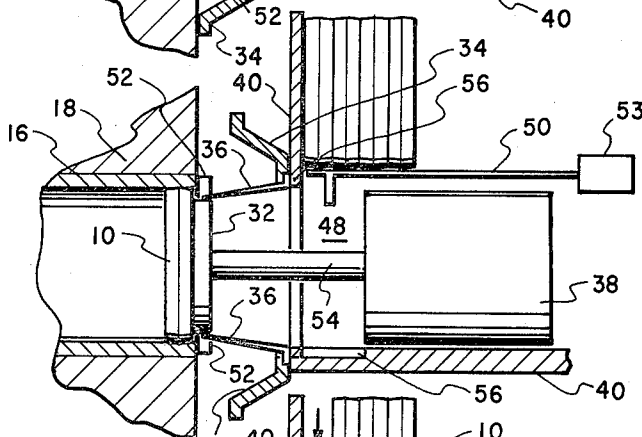


FIG. 5C

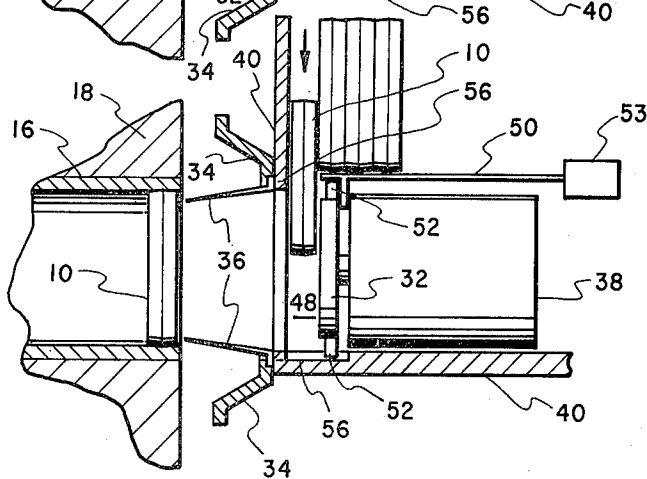


FIG. 5D

APPARATUS AND PROCESS FOR PLUGGING A PAPER ROLL CORE

BACKGROUND OF THE INVENTION

This invention relates to paper roll plugs, and to an apparatus and process for installing them in paper roll cores.

In the paper products industry Kraft paper, newspaper and, to a lesser extent, other kinds of paper are rolled into cylinders for subsequent use. Ordinarily such cylinders have an axially disposed hollow round core comprising either a separate inner tubular member upon which the paper is wound or simply the interior wall of the paper roll itself which defines the hollow axial center of the roll, both of which are referred to in the specification and claims as a "core". The larger rolls, typically from 12 to 60 inches in diameter, are generally used for bulk shipping of paper which is to be remanufactured into secondary products. Each such large paper roll requires plugs to be placed into both ends of its core to prevent damage to the core by crushing or impact during shipping and storage, since it subsequently will be necessary to place an axle through the core for mounting the paper roll for unrolling. The smaller rolls, typically from 6 to 12 inches in diameter, are normally used as counter rolls for wrapping and packaging goods and require plugs for generally the same purpose. The plugs are usually provided with center holes coaxial with the core to facilitate their removal from the large rolls prior to insertion of an axle or, in the case of smaller rolls, to act as bearings for axles of lesser diameter.

At present, plugs used in paper roll cores are normally made of wood, usually alder, and are approximately frustrum-shaped with the grain of the wood running longitudinally of the plug in the same direction as the center hole. The length of these plugs is typically about two-thirds of their diameter and the normal method of insertion is to drive the smaller end into the core of the paper roll by pounding on the larger end with a mallet.

Because of their frustrum shape, the conventional plugs sometimes fall out of the core of a paper roll as a result of shrinkage of the plug due to dehydration, or loosening of the fit between the plug and the core caused by vibration. This is because the paper roll core, which has been expanded to accept the frustrum-shaped plug, blocks the plug's movement toward the center of the core while tending to force the plug toward the open end through which the plug was initially inserted. While conventional plugs might be made of a material not subject to shrinkage, thereby diminishing the loosening problem, their considerable mass would make such non-shrinking plugs expensive and they still might become loose as a result of vibration.

Another drawback of the conventional plug is that the relatively inexpensive wood used is subject to chipping, as well as shrinkage, and is not very resistant to transverse compressive forces especially since the grain ordinarily is longitudinal of the plug. Furthermore the inherent bulk of conventional plugs makes them difficult to store for reuse or to otherwise dispose of, and their shape makes them hazardous for a person inadvertently stepping on one of them. In addition, such plugs are not of a shape which is convenient for machine installation and considerable effort and time must be expended in installing them with a mallet.

SUMMARY OF THE PRESENT INVENTION

The present invention overcomes the aforementioned drawbacks in the use of prior conventional paper roll plugs by utilizing a new, relatively thin disc-shaped plug having a substantially double-tapered perimeter sized to be forcibly installed within the end of a paper roll core so that, once installed, the disc-shaped plug is positively prevented from moving in the core in either direction. The opposite tapers of the perimeter may be either flat or slightly rounded but in general they should be such that the diameter of the disc gradually increases from either side of the disc toward the center.

In addition to the basic shape of this plug and its inserted position in the paper roll core, which principally prevent it from loosening and slipping out the open end of the core, the required mass of the plug is considerably less than that of conventional plugs. Accordingly it can be made economically of materials which will not chip or shrink, thereby contributing to the plug's integrity and resistance against movement within the core. Moreover the flexibility in choice of construction materials for the plug, made possible by its economical shape, permits the plug to be made stronger and less likely to crush than conventional plugs made of wood. Also, since the novel plug is not as bulky as conventional plugs it is much easier to store for reuse or to dispose of as desired. Finally, its simple flat disc-shape provides a stable surface for any person inadvertently stepping on it and thus renders it less hazardous in the working environment.

A hole is preferably provided in the center of the plug for facilitating its removal when used in larger paper rolls. Alternatively the hole can act as a bearing for an axle on which a smaller roll may be mounted.

It is particularly significant that the size and shape of the plug permits its ready and efficient installation by a magazine-fed insertion apparatus, thereby overcoming the time and effort required to install conventional plugs. Because of its double-tapered construction, the plug can be loaded into the insertion apparatus facing in either of two directions since either side of the plug can be inserted into the core first. The insertion apparatus includes a frame in which is mounted a selectively actuated powered plunger for forcing the plug into the core. Several forwardly-projecting, inwardly-biased fingers which are resiliently mounted for temporary outward spreading extend from the front of the frame and are adapted to be placed into the open end of the paper roll core prior to actuation of the plunger so as to surround both the plunger and the plug and guide them into the core. The depth to which the fingers are placed into the core is limited by a plurality of arm-like stops projecting forwardly from the front of the plunger housing for abutment against the end of the paper roll or other comparable surrounding structure in which the core may be mounted.

The depth to which the plug is inserted into the core by the plunger is limited by a plurality of lugs which project radially outwardly from the perimeter of the plunger. The lugs have front faces positioned in predetermined longitudinal relation with the face of the plunger which abut against the end of the core and thereby predetermine the extent to which the plunger can force the plug into the core. Thus the plug can alternatively be recessed wholly within the core if the plug faces are offset rearwardly from the plunger face,

3

or may be flush with the end of the core if the lug faces and plunger face are flush, or may protrude from the end of the core if the lug faces protrude forwardly from the plunger face. In any case, to prevent the possibility of loosening, the depth of plug insertion must be at least such that the largest diameter portion of the double tapered perimeter (i.e. its central portion) is recessed inside the core end. Preferably the entire plug is recessed.

The length of stroke of the plunger is such that the lugs stop the forward movement of the plunger with respect to the core while the plunger continues to move forwardly relative to the frame. Accordingly the frame thereafter moves rearwardly, automatically retracting the guide fingers from the core interior; however, the plunger does not move forwardly far enough relative to the frame that the fingers fall inwardly behind the plunger.

It is accordingly a principal objective of the present invention to provide a novel and improved paper roll plug for installation within paper roll cores.

It is another principal objective of this invention to provide a novel powered mechanical insertion apparatus for installing such plugs in paper roll cores.

It is yet another principal objective of this invention to provide a novel and improved process for installing such plugs in paper roll cores.

It is a principal feature of the present invention to provide a relatively thin disc-shaped paper roll plug having a double-tapered perimeter.

It is another feature of this invention to provide such a disc-shaped plug having a hole through its center.

It is yet another feature of this invention to provide a mechanical apparatus which utilizes a powered plunger with radial lugs for inserting such paper roll plugs to a predetermined depth within paper roll cores.

It is another feature of this invention to provide such a powered mechanical insertion apparatus which utilizes inwardly-biased forwardly-projecting fingers to guide such plugs into paper roll cores.

It is a principal advantage of the paper roll plugs of the present invention that they effectively resist movement inside a paper roll core in either direction and cannot be loosened by shrinkage or vibration.

It is another advantage of such paper roll plugs that their shape contributes to their economy, strength, ease of storage or disposal, safety and resistance against chipping at their edges.

It is still another advantage of the present invention that paper roll plugs of the type described can be quickly and easily installed in paper roll cores using a powered mechanical insertion apparatus.

The foregoing and other objectives, features, and advantages of the present invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an embodiment of the paper roll plug of the present invention.

FIG. 2 is a partially sectional side view of an embodiment of the paper roll plug of the present invention installed in the core of a paper roll.

FIG. 3A is a sectional detail view of the junction between the interior of a paper roll core and a hypothetical paper roll plug having a non-tapered perimeter.

4

FIG. 3B is a sectional detail view of the junction between the interior of a paper roll core and the double-tapered paper roll plug of the present invention.

FIG. 4 is a perspective view of a portable embodiment of the mechanical plug insertion apparatus of the present invention.

FIG. 5A is a partially sectional side schematic view of the insertion apparatus placed adjacent the end of a paper roll preparatory to actuation.

FIG. 5B shows the step of operation of the apparatus during which the plug is inserted into the core.

FIG. 5C shows the step of operation during which the apparatus withdraws itself after insertion of the plug.

FIG. 5D shows the step of operation of the apparatus during which it is reloaded.

FIG. 6 is a partially sectional detail view of the resilient mounting joint between the inwardly-biased fingers and the frame of an embodiment of the insertion apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the paper roll plug 10 of the present invention is a flat, disc-shaped article having a double-tapered perimeter with substantially symmetrical sides 12 and 13 which may be either flat or slightly rounded convexly. A center hole 14 may optionally be provided for facilitating removal of the plug or providing an axle bearing. However, such hole reduces the strength of the plug and may be undesirable or unnecessary under some circumstances. The plug may be made alternatively of a variety of materials such as various woods, particle board, plywood, plastic, steel, ceramic or other materials having comparable low cost and high strength characteristics. Materials such as plastic, steel or ceramic which are not subject to shrinkage from dehydration, and particle board which is less susceptible to shrinkage than ordinary wood, are preferable but not critical since the shape of the plug effectively prevents loosening even if shrinkable materials are used. The plug may be easily manufactured by known fabrication techniques; for example, a wooden plug may be made by slicing a round wooden pole, drilling a center hole, and sanding or cutting the perimeter to achieve the required double taper. The use of plywood as the plug material permits manufacture by cutting a circular shape from a sheet of plywood and sanding the perimeter to obtain the double taper, resulting in a plug whose strength is increased due to the transverse orientation of its grain relative to the core axis.

In use, the paper roll plug 10 is forcibly placed inside the somewhat yieldable core 16 of a paper roll 18, preferably at a recessed position leaving a distance 20 between the plug and the end of the core as shown in FIG. 2. As a minimum, the largest diameter portion of the double-tapered perimeter of the plug must be recessed at least some distance within the end of the core or the ability of the plug to resist loosening in both directions will be defeated. For proper fit a plug should have a maximum outside diameter A which is somewhat larger than the inside diameter B of the paper roll core 16. Conversely the diameter of the plug faces should be slightly smaller than the inside diameter B. For a core having an inside diameter of 4 inches, a plug having a maximum diameter at the center of its double-tapered perimeter of $4 \frac{1}{32}$ to $4 \frac{1}{16}$ inches, a face diameter of $3 \frac{15}{16}$ to $3 \frac{31}{32}$ inches, and a thickness of about three-fourths inch is deemed preferable.

Upon insertion of the plug, the core material is compressively deformed at the junction 22 between the plug and the core when the plug is installed, thereby causing the interior wall of the core to press against both sides 12 and 13 of the tapered perimeter of the plug. Due to the opposite dual tapers of the plug there exist equal but opposite axial components of the binding compressive force directed inwardly toward the middle of the plug which resist movement of the plug in either axial direction, as opposed to the single tapered plug where the axial component of the binding force tends to loosen the plug. Even if the junction between the plug and the core should become loose, a substantial external force would be required to move the plug since movement would require deformation of a new section of the paper roll core.

Other advantages of the double tapered perimeter of the plug are emphasized by comparing the plug of the present invention to a hypothetical plug 10' shown in FIG. 3A, not having a tapered perimeter. In the case of the hypothetical plug, the transverse component of binding force 30 is distributed evenly throughout the width of the plug, imposing large compressive force near the faces of the plug which tends to shear off the edges and thus causes chipping. In contrast, the double tapered perimeter plug of the present invention, shown in FIG. 3B, causes the transverse component of binding force 30 to be distributed principally near the plug's central portion 28 of maximum diameter and away from its faces, thereby reducing the shearing force near the faces and diminishing the tendency of the plug to chip.

In addition, the double taper makes the plug especially well adapted for machine insertion utilizing guide fingers surrounding the plug in the manner to be described hereafter in detail. The increased binding force resulting from the placement of such guide fingers between the plug 10 and the core 16 during plug installation is concentrated over the small width of the maximum diameter portion of the plug due to the "V" shape of the perimeter, thereby facilitating withdrawal of the guide fingers.

Referring to FIG. 4, a powered mechanical insertion apparatus 31 is shown for installing plugs of the present invention in paper roll cores. The principal components of the device are a plunger 32 for forcing a plug 10 into a paper roll core, arm-like stops 34 for steadying the apparatus and placing it in a predetermined position adjacent the end of the core, and forwardly-extending fingers 36 for guiding the plug and plunger 32 into the paper roll core. The plunger 32 is powered by any suitable mechanical drive 38, such as a pneumatic or hydraulic cylinder, either double-acting or spring-loaded, or a screw driven by an electric motor, so as to provide positive action in both the forward and reverse directions. The plunger 32, stops 34, mechanical drive 38 and group of inwardly biased guide fingers 36 are all mounted preferably on a portable frame 40 having a handle 42 and a pushbutton 44 mounted at the front end thereof for actuating the mechanical drive through a fluid valve or electrical switch as the case may be. Holders 46, attached to the frame 40, constitute a magazine which supports a plurality of plugs 10 stored alongside the plunger for loading sequentially through a loading chute 48. A spring-loaded sliding gate 50 is mounted adjacent the loading chute 48, disposed between the plunger and the magazine for block-

ing the loading chute when the plunger is moved forward.

The operation of the insertion apparatus 31, and resultant installation of the plug in a paper roll core, is described with reference to FIGS. 5A-D. As shown in FIG. 5A, the insertion apparatus 31 is placed with the forwardly-extending stops 34 abutting the end of a paper roll 18 or other comparable surface and the fingers 36 inserted inside the end of the paper roll core 16 to a depth predetermined by the stops 34. The fingers 36 may be mounted to the frame 40 in resilient rubber 41 by clamp 43 so as to spring-bias them inwardly to the position shown in FIG. 6 while permitting them to be temporarily spread outwardly by the plug, and permitting their bases 45 to move temporarily inwardly to prevent bending of their tips 47 around the inside edge of the core as the plug enters therein. Alternatively, the fingers themselves may be resilient and normally biased inwardly to permit their easy entrance into the end of the core. In the starting position of FIG. 5A a plug 10 is aligned in front of the plunger 32 supported by the frame 40 prior to being inserted into the paper roll core.

When the insertion apparatus 31 is actuated by pressing pushbutton 44 (FIG. 4) the mechanical drive 38 thrusts the plunger 32 forward, as shown in FIG. 5B. This forces the plug 10 forwardly between the surrounding fingers 36, spreading them apart, and thence into the paper roll core 16. Multiple lugs 52 project radially from the perimeter of plunger 32 and ride in grooves 56 in the frame 40 at locations between the fingers 36. Each lug 52 has a forward face preferably offset rearwardly a predetermined distance 20 from the forward face of the plunger. The plunger has a sufficiently small diameter that it will fit within the end of the core; however the lugs extend beyond the inside diameter of the core 16 and thus abut against the end of the core, thereby limiting the penetration of the forward face of the plunger to a depth equal to such predetermined distance. Alternatively, depending on the thickness and purpose of the plug, it may be desirable merely to make the lug faces and plunger face flush with one another or even to make the lug faces extend forwardly from the plunger face, in which cases the plunger need not necessarily be small enough to fit within the core. In any case, the lug faces must be positioned such that the depth of insertion of the plug is at least sufficient to recess the largest diameter portion (i.e. central portion) of the double-tapered perimeter inside the end of the core so that the plug will be restrained by the binding force against movement in either axial direction. When the plunger moves forward to insert the plug it permits gate 50 also to move forward under the force of a spring loading device 53, thereby blocking another plug from falling into the loading chute 48.

The plunger 32 will reach the limit of its penetration into the paper roll core 16 before the plunger rod 54, which attaches the plunger to the mechanical drive 38, reaches the full extent of its stroke. Thus, as shown in FIG. 5C, the remaining forward thrust of the plunger drives the insertion apparatus 31 rearwardly pulling the fingers 36 out of the paper roll core from their positions between the interior wall of the core and the perimeter of the installed plug. Accordingly, although the fingers are temporarily forcibly bound between the plug and the interior wall of the paper roll core, no effort is required to remove the apparatus due to the additional

thrust of the rod 54. However, the plunger rod does not extend forwardly far enough for the inwardly biased fingers 36 to fall behind the plunger 32.

Once the plunger rod 54 reaches the limit of its extension and extracts the fingers from the core, the operator may release the pushbutton 44 and thereby forcibly retract the plunger, as shown in FIG. 5D, either by spring force or by reversing the pneumatic or hydraulic pressure or electric current, as the case may be. Upon retraction the plunger draws back gate 50 permitting another plug to fall through the loading chute into place in front of the plunger 32. This leaves the apparatus removed from the plugged paper roll, loaded, and ready to be inserted into another paper roll core for installation of the next plug.

The insertion apparatus is preferably a small, light, portable tool as shown in FIG. 4 so as to be adaptable for use with heavy, hard to move, paper rolls. A pressurized air or hydraulic supply or source of electric current can be carried or wheeled on a hand truck or supplied from a fixed location through a flexible conduit such as 58 (FIG. 4). The installation process is therefore particularly useful in a large plant where heavy paper rolls are stacked over a large area. However, although the foregoing insertion apparatus and process are especially well suited for the plugging of already wound paper rolls, it may in certain operations be desirable to insert the plugs into separate tubular-type cores in advance of the winding process. In such case the bare tubular-type core may be held in any suitable type of mounting fixture providing a surface comparable to the end of a paper roll against which the stops 34 of the portable insertion apparatus may abut. Alternatively the insertion apparatus may be mounted in a non-portable frame and a mechanism may be provided for holding a paper roll or bare core in predetermined relation to the apparatus for plugging.

The terms and expressions which have been employed in the foregoing abstract and specification are used therein as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

What is claimed is:

1. A deformable plugged paper roll core having a predetermined inside diameter corresponding to said core's undeformed condition, and a plug inserted coaxially within one end of said core, said plug having a generally double-tapered circular perimeter defined by a first portion of said plug having a diameter greater than said core's predetermined inside diameter and respective plug portions on either side of said first portion decreasing in diameter therefrom for deforming said core at a junction between said plug perimeter and the interior of said core, said plug being inserted in said core adjacent said end thereof at least to a sufficient depth that said first portion of said plug is recessed at a location entirely within said core spaced inwardly from said end expansively deforming said core at said recessed location, said core throughout that portion of said junction of said core and plug located outwardly of said recessed location having an inside diameter which is less

than the expansively deformed inside diameter of said core at said recessed location.

2. The paper roll core of claim 1 wherein said inside diameter of said core, throughout said outward portion of said junction of said core and plug, decreases gradually in a direction toward said end of said core.

3. The paper roll core of claim 1 wherein said respective plug portions on either side of said first portion each decrease in diameter gradually to a face having a diameter less than said core's predetermined inside diameter.

4. The paper roll core of claim 1 wherein said plug includes means defining a hole in its center extending axially therethrough.

5. The paper roll core of claim 1 wherein said plug is disc-shaped.

6. The paper roll core of claim 3 wherein the ratio of said diameter of said first portion of said plug to the axial thickness of said plug is between about 5 and 6.

7. The paper roll core of claim 1 wherein said respective portions of decreasing diameter on either side of said first portion of said plug are symmetrical.

8. The paper roll core of claim 1 wherein said respective portions of decreasing diameter on either side of said first portion of said plug are recessed entirely within said end of said core.

9. The paper roll core of claim 1 wherein said plug is made of a particle board.

10. The paper roll core of claim 1 wherein said plug is made of plywood.

11. The paper roll core of claim 1 wherein said plug is made of a plastic.

12. The paper roll core of claim 1 wherein said plug is made of steel.

13. The paper roll core of claim 1 wherein said plug is made of a ceramic material.

14. A process for plugging a deformable paper roll core having a predetermined inside diameter, said process comprising inserting a paper roll plug coaxially into one end of said core and thereby deforming said core at a junction between the interior of said core and the perimeter of said plug, said plug having a double-tapered circular perimeter defined by a first portion of said plug having a diameter greater than the inside diameter of said core and respective plug portions on either side of said first portion decreasing in diameter therefrom, said method further comprising inserting said plug a sufficient distance into said core that said first portion of said plug is recessed at a location entirely within said core spaced inwardly from said end, thereby expansively deforming said core at said recessed location, and shaping said deformable core throughout that portion of said junction of said core and plug located outwardly of said recessed location to have an inside diameter which is less than the expansively deformed inside diameter of said core at said recessed location.

15. The process of claim 12 wherein said shaping of said deformable core includes shaping the inside diameter of said core, throughout said outward portion of said junction of said core and plug, to decrease gradually in a direction toward said end of said core.

* * * * *