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PRINTING ROLL AND METHOD FOR ASSEMBLING THE SAME

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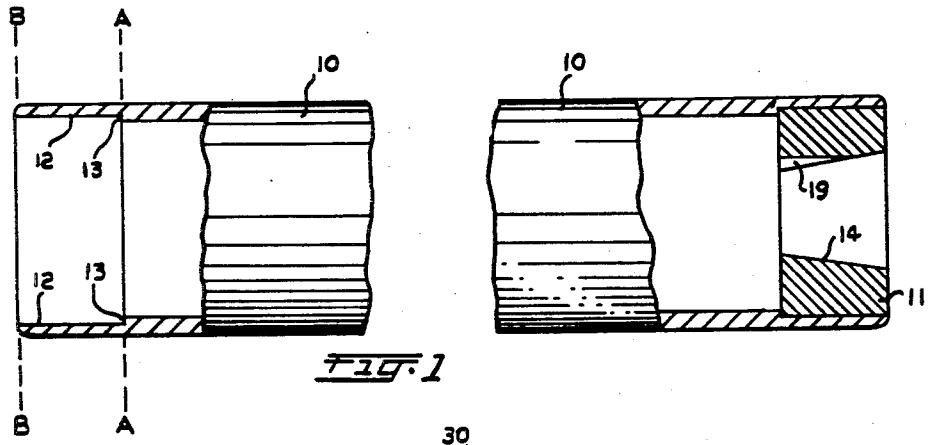


FIG. 1

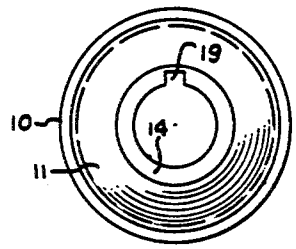


FIG. 2

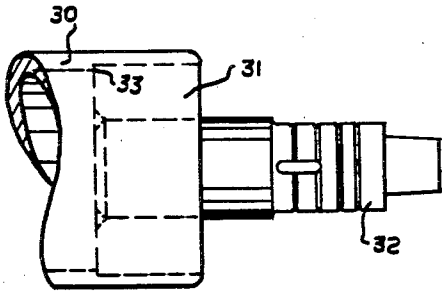


FIG. 3

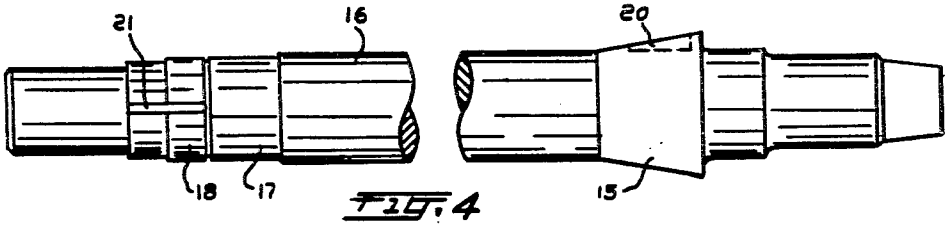


FIG. 4

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PRINTING ROLL AND METHOD FOR ASSEMBLING THE SAME

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6 Claims. (Cl. 101—375)

This invention relates to an improved printing roll and to an improved method for assembling the same. More particularly, it relates to a roll formed of extruded aluminum alloy and so constructed as to employ to a maximum the inherent capabilities of use of such alloy in modern printing practices.

The characteristics of aluminum, which make it well adapted for printing uses, such for example as light weight, high coefficient of heat conductivity, ease of plating and anodizing, have long been known. Moreover printing rolls made of cast aluminum have been used heretofore and extruded aluminum components of printing rolls likewise have been used. So far as I am aware, however, all such prior teachings have possessed one or more disadvantageous features which it is a purpose of this invention to overcome.

In particular, the strength of the assembled cast aluminum rolls made by the prior workers in this field has imposed limitations as to full acceptance of those rolls by the trade. As is known, printing rolls generally are of the shafted cylinder type wherein the press shaft is permanently fixed to the cylinder or of the cone or sleeve type wherein the shaft is detachably secured to the cylinder. In either case a manufacturing problem exists in assembling the shaft retaining means, commonly called gudgeons, into the cylindrical roll itself and in the last analysis the mechanical strength of the assembled roll is dependent upon the mode of assembling of these parts. The forcing of the gudgeon into a machined recess at the end of the cylinder and the shrinking of an expanded cylinder upon a gudgeon both have been suggested as a means of roll assembly. However, in both instances, when a cast aluminum cylinder is employed, the stresses imposed during assembly may later serve to cause breakage of the rolls. Such may occur especially when the web breaks during printing and builds up on a carrier roll in contact with the cast aluminum printing roll. Cast aluminum, for example may have a yield strength of about 15,000 p.s.i. and this comparatively small yield strength may contribute to easy breakage of the roll during such a printing incident, which is by no means rare considering the speeds at which modern presses operate.

In contrast, this invention employs a printing cylinder made of an extruded aluminum alloy preferably possessing a yield strength of at least 40,000 p.s.i., the strong conventional alloys 6061 T6 and 7075 T6 being well suited for this purpose. While I describe the invention with particular reference to aluminum, it will be understood however that in its broader aspects it is not limited to that particular metal and on the contrary may be employed with other metals having the requisite strength, as for example various types of steels.

The porosity and inherent strength of cast aluminum has also been a detriment in the assembly of gudgeons into cast cylinders with a force which is commensurate with strong rolls. For example, in a typical cast roll assembled by conventional methods, a relatively much

weaker force will serve to push the gudgeon from the cylinder, whereas in the present invention due to the reverse taper later to be described, a force of about 15,000 pounds is required in order to separate the gudgeon from the cylinder. Moreover, the porosity of cast aluminum imposes a limitation with regard to machining, dynamic balance, and cylinder make-ready practices, not to be found in the usage of extruded aluminum rolls.

An object of the invention is to provide an improved printing roll characterized by a higher resistance to breakage than conventional rolls.

Another object is to provide an improved method of assembling a printing roll.

A further object is to provide an improved combination of a cylindrical gudgeon for a printing roll and an internally tapered cylindrical shell requiring greater forces to separate the parts after assembly than is found in similar combinations in conventional rolls.

Other objects and advantages will become apparent as the description proceeds and when considered in conjunction with the accompanying drawings in which

Fig. 1 is a view partly in section of a roll having a gudgeon of the cone type shown in place at one end of the roll and prior to insertion of a gudgeon at the other end of the roll.

Fig. 2 is an end view of the right end of the roll of Fig. 1.

Fig. 3 is a side elevation view of a gudgeon of the shafted type, suitable for insertion in the roll in accordance with the method of the invention, and

Fig. 4 is a side elevation view of a conventional cylinder shaft suitable for use with gudgeons of the cone type seen in Fig. 1.

In accordance with the invention, I provide a cylindrical tubular printing roll shell of requisite length, diameter, and strength having adjacent each of its ends a truncated conical recess formed axially therein. As a significant feature, the smaller diameter of each of these recesses is adjacent the corresponding end of the shell thus giving a reverse taper to the recessed shell as viewed from the ends thereof. The degree of taper, moreover, is carefully chosen with respect to the particular material from which the shell and gudgeons are made. A gudgeon which may either be of the cone type to receive a removable shaft or of the type having a shaft end rigidly fixed thereto and carried thereby, is provided for insertion into the recesses. As a significant feature, the outer surface of these gudgeons is cylindrical and with an outer diameter which under normal conditions at room temperature is not less than the larger diameter of the recesses of the shell while that shell also is at room temperature. Thus the outer diameter of the gudgeon, under normal condition, at room temperature is greater than the smaller diameter of the recesses of the shell while that shell is at room temperature.

To assemble the above-described elements in forming the roll, the invention provides an improved method whereby the shell is heat-expanded and the gudgeon is cold-shrunk, after which the respective parts are brought into and held in juxtaposed position and permitted to return to room temperature while in that position. Thereafter, the assembled roll may be suitably machined for balancing and given the necessary surface treatments preparatory to use as a printing roll.

Referring now to Fig. 1 a suitable shell **10** may comprise a tubular cylindrical member made of 7075 T6 extruded aluminum with a yield strength of about 73,000 p.s.i. As an example, using a typical roll having an outside diameter of 7 inches and an inside diameter of 5.5 inches, a gudgeon **11** having a length of 3 inches may be employed therewith. Such a gudgeon which likewise may

be formed from 7075 T6 alloy, or from other material of requisite strength, is machined to cylindrical form with an outside diameter of 5.750 inches.

The shell **10** is bored at each end forming truncated conical recesses such as shown at **12** and with the smaller diameter of each such recess being adjacent or at the outer end of that shell. This boring, moreover, provides an abrupt shoulder **13** internally of the shell and serving a purpose later to appear. Along the dotted line A—A for example, the diameter of the recess may be 5.750 inches and along the dotted line B—B the diameter of the recess may be 5.735 inches or about 0.015 inch less than the normal outside diameter of the gudgeon. I have found that for general usage, a taper of 0.0625 inch per linear foot of shell is satisfactory for use in the practice of the invention. However, the particular degree of taper may vary without departing from the teachings hereof, so long as the materials entering into the gudgeon-shell combination can withstand the pressures generated by the fitting together of these parts. In general, I have found that when using a shell material having not less than 40,000 p.s.i. yield strength, the degree of taper should not be less than $\frac{1}{32}$ inch per linear foot nor greater than $\frac{3}{32}$ inch per linear foot.

In practicing the method of my invention with parts of the dimensions outlined above, the shell **10** is heated to about 212° F. at which time, due to the characteristics of this particular aluminum alloy, the diameters of the entire shell are increased about 0.010 inch. In this condition the smaller diameter of the recess then becomes 5.745 inches. In addition, the gudgeon **11** is immersed in liquid nitrogen, Dry Ice, or the like for a sufficient time, one hour for example, at which time, due to the characteristics of the same aluminum alloy its entire diameter is shrunken about 0.022 inch. At this time, its outside diameter is then about 5.728 inches. The gudgeon in its cold-shrunken condition is then positioned within the recess of the shell in its heat-expanded condition and abutted against the shoulder **13** in that shell. Thereafter, while holding these parts in the described juxtaposed relationship they are permitted to return to room temperatures.

As they so return to room temperatures the shell engages the gudgeon with heavy hoop stresses having a component of force, which tends to hold the gudgeon against the shoulder **13**, rather than tending to force them apart, as would be the case if the taper were in the opposite direction. This engagement of the shell and gudgeon accordingly, results in an exceptionally strong union and tests have shown that a total pressure of at least 15,000 pounds must be applied internally of the assembled roll in order to move the gudgeon axially outwards of the shell when using the above dimensions.

Referring now to Fig. 2 the gudgeon **11** may include a conventional tapered surface of about 10° with the axis of the gudgeon, giving a cone like surface **14** against which a cooperating surface **15** of a removable shaft **16** (Fig. 4) is adapted to seat. The shaft also is provided with a surface **17** on which a suitable conically shaped sleeve (not shown) may be removably fitted in order to engage with a similar gudgeon **11** when fitted in the other end of the shell. A surface **18** of the shaft has conventional threads (not shown) for receiving a threaded clamping means for holding such sleeve in place, all as known in the art. A keyway **19** is formed in at least one of the gudgeons and at least one keyway **20** is formed in the shaft to receive a key for holding the assembled shaft and roll against rotational displacement with respect to each other. Also a keyway **21** is formed in the shaft to receive a key engaging with the clamping means for the conically shaped sleeve after that clamping means has been fully tightened against that sleeve. Since these conventional means are well known in the art and form no part of the present invention, they accordingly are not illustrated herein.

Referring now to Fig. 3 one end of a shafted cylinder **30** is shown wherein a gudgeon **31** is assembled therein by the same method above described. In this arrangement the gudgeon has rigidly affixed thereto a stub shaft **32** which may be of steel or other suitable material for shafting purposes. It will be understood that during the shrink fitting of the shafted gudgeon both the cylindrical gudgeon **31** and its attached shaft are cooled as above described and that when they again reach normal temperatures the edge of the gudgeon is held against a shoulder **33** in the reversely tapered recess of the shell **30**.

By means of the invention greatly strengthened printing rolls are provided and such rolls may be of either the shafted or non-shafted types. During the subsequent machining of the roll after installation of the gudgeons, the slight outward bulging of the shell at its ends due to the presence of the gudgeon is machined away, as the cylinder is brought to its final cylindrical outer dimension in preparation for copper plating or for other desired treatment.

While in accordance with the patent statutes I have described what at present are considered to be preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and I, therefore, aim in the appended claims, to cover all such changes and modifications as fall within the true spirit of my invention.

What is claimed is:

1. A printing roll comprising a tubular cylindrical shell having a truncated conically shaped recess at each end thereof with the smaller diameters of said recesses adjacent the ends of said shell, the inner ends of each of said recesses terminating at a shoulder disposed in a plane normal to the axis of said shell, a pair of gudgeons each having a cylindrically shaped outer surface with a normal outer diameter greater than the normal smaller diameter of said recess and mounted in said recesses, each of said gudgeons having an inner end face disposed in a plane normal to the axis of said shell, said respective inner end faces of said gudgeons being in contact with the respective shoulders of said shell, thereby to employ the hoop stress exerted by said shell in conjunction with the reverse taper of said recesses for holding said gudgeons in place during rotation of said roll, and shaft means mounted on said gudgeons and extending from the ends of said roll.

2. A printing roll as defined in claim 1 wherein said shell comprises extruded aluminum alloy having a yield strength of at least 40,000 pounds per square inch.

3. A printing roll as defined in claim 1 wherein said shaft means comprises an elongated shaft extending through said shell and removably attached to said gudgeons.

4. A printing roll as defined in claim 1 wherein said shaft means comprises a pair of stub shafts, one of which is rigidly affixed to one of each of said gudgeons.

5. A printing roll comprising a tubular cylindrical shell formed of metal having a yield strength of at least 40,000 pounds per square inch, a truncated conical shaped recess at each end of said shell with the smaller diameter of said recesses being adjacent the ends of said shell and with the taper of said recesses being no less than $\frac{1}{32}$ inch per linear foot and no greater than $\frac{3}{32}$ inch per linear foot, the inner ends of each of said recesses terminating at a shoulder disposed in a plane normal to the axis of said shell, a pair of gudgeons each having a cylindrically shaped outer surface with a normal outer diameter greater than the normal smaller diameter of said recess and mounted in said recesses, each of said gudgeons having an inner end face disposed in a plane normal to the axis of said shell, said respective inner end faces of said gudgeons being in contact with the respective shoulders of said shell, thereby to employ the hoop stress exerted by said shell in conjunction with the reverse taper of said recesses for holding said gudgeons in place dur-

ing rotation of said roll, and shaft means mounted on said gudgeons and extending from the ends of said roll.

6. A roll as defined in claim 5 wherein said shell comprises extruded aluminum alloy.

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