(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 009 360**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **79301857.3**

(22) Date of filing: **10.09.79**

(51) Int. Cl.³: **B 41 C 1/18,** B 41 N 1/20

(30) Priority: **13.09.78 GB 3662678**

(43) Date of publication of application: **02.04.80**
Bulletin 80/7

(84) Designated Contracting States: **DE GB IT NL**

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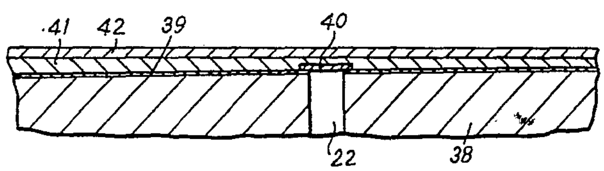
(54) Manufacture of printing sleeves.

(57) An all metal printing sleeve having a slight internal taper for fitting to a similarly tapered printing roll, applying air under pressure to outlets intermediate the ends of the roll to expand the sleeve slightly. The sleeve has an inner metal layer (41), e.g. of copper or zinc, and an outer electroplated metal layer (42), e.g. of copper. The inner layer may be sprayed in molten form onto a forming mandrel (38) having a slight taper and provided with a release coating (39). The sleeve may be removed from the forming mandrel by applying air under pressure to outlet holes (22) in the mandrel. A sprayed-on first layer may be transferred from the forming mandrel to a plating mandrel by heating the sleeve to expand it slightly (fig. 6 – not shown).



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MANUFACTURE OF PRINTING SLEEVES

This invention relates to printing rolls, and is especially applicable to rolls suitable for accepting photo-originating designs, such as used in the gravure or lithographic printing processes.

Conventionally, a gravure printing surface is provided by etching the surface of a metal printing roll. The production of the roll and the need to replace or discard it after use makes the process very expensive, and only suitable for relatively long printing runs.

Our British Patent Applications Nos. 609/76, 700/76 and 14060/77 describe improved methods of producing printing rolls, particularly for flexographic printing. A sleeve made of plastics material, preferably reinforced plastics material, is fitted onto a roll core which can be of metal construction. Thus, for different printing jobs different sleeves can be used with a common roll core. In order to assist in getting the sleeve on and off the core, the internal diameter of the sleeve is slightly larger at one end than the other, and the external diameter of the core is similarly slightly larger at one end than the other so that the sleeve can be slid partly onto the core before it wedges. The core is provided with apertures in that region which is initially covered by the sleeve and through which compressed air can be forced to slightly expand the sleeve so that it can be slid fully onto the core.

The present invention, however, provides a sleeve substantially as described in the foregoing paragraph, but made substantially entirely of metal so as to provide a conductive path from the inside to the outside of the sleeve to assist in electro-plating the outer surface of the sleeve.

More particularly, the invention provides a method of making such a sleeve, comprising taking a generally cylindrical mandrel the external diameter of which is slightly larger at one end than the other, and optionally having fluid outlet apertures in a region intermediate its ends, coating the outside surface of the mandrel with a release agent, applying a first layer of metal over the outside surface of the mandrel, grinding the outside surface of the first metal layer to provide it with a uniform external diameter, and electro-plating a second metal layer onto the first metal layer. Suitably at least one, and preferably both, of the metal layers are copper. It is particularly preferred that said second layer is copper. The outer surface of the second metal layer can be finished in conventional manner to provide a surface suitable for gravure printing. Such finishing may for example take the form of grinding, polishing and eventually etching to provide the imaged surface, and possibly flash chrome-plating to provide a more durable finish.

The first layer may be provided by spraying molten metal onto the outside surface of the mandrel, the fluid outlet holes having been masked beforehand. Alternatively, the first layer may be applied by straining a preformed metal sheet around the mandrel, with either a helical or a longitudinal butt seam, and welding the seam to secure the layer. In the case of a sprayed metal layer, the fluid outlet holes may be masked before or after application of the release agent, but preferably they are masked after, using metal shim, such as copper shim, which is thereby incorporated in the sprayed metal layer.

The metal sleeve is at some suitable point in the process removed from the mandrel. This may be done by applying fluid, for example air, under pressure to the apertures in the mandrel so as to slightly expand the sleeve and allow it to be withdrawn axially from the smaller diameter end. Removal from the mandrel may take place when the electro-plated layer has been fully finished. However, it may be desirable to mount the sleeve on different mandrels at different stages during the process; for example for applying the first metal layer, for the electro-plating, and for the etching. In such a case, the sleeve can be removed, in the manner described, from the one mandrel and fitted onto the next mandrel by a process which involves sliding the sleeve over the mandrel until the fluid outlet holes are covered and then applying fluid under pressure to the fluid outlet holes to slightly expand the sleeve so that it can be slid fully onto the mandrel. This is more completely described in our British Patent Applications referred to earlier. However, if the sleeve is transferred from one mandrel to another between applying the first layer and the electro-plating application of the second layer, the first layer may not be sufficiently strong or resilient to withstand the fluid pressure without distortion, and other means may be needed for removing it from the first mandrel and fitting it to the second mandrel. This may be achieved by heating and cooling so as to take advantage of thermal expansion and contraction.

The invention can be further understood by reference to the accompanying drawings wherein:

Figs. 1, 2 and 3 show diagrammatically in cross-section the stages in fitting a printing sleeve to a roll core in a manner more particularly described in the above-mentioned British Patent Applications;

Fig. 4 shows a diagrammatically enlarged cross-sectional view of part of one embodiment of sleeve being produced according to the present invention;

Fig. 5 shows a diagrammatically enlarged cross-sectional view of part of a second embodiment of sleeve being produced according to the present invention; and

Fig. 6 shows diagrammatically a cross-sectional side view through one end portion of a mandrel and sleeve at the electro-plating stage in an alternative procedure of the present invention.

Referring to Figs. 1 to 3, the sleeve 10 is made from a thermosetting resin, such as polyester or epoxy resin, reinforced with glass fibre, which is preferably spirally wound so as to provide hoop strength for the sleeve. The outside surface 12 of the sleeve is of uniform diameter, but the inside surface 14 has a very small taper from one end to the other. (This taper is greatly exaggerated in the drawing for the sake of clarity in explanation). The sleeve is removably mounted to a roll core 16, shown separately in Fig. 1, suitably made of steel, having an axle 18 for rotatably mounting the core. The outside surface of the core is similarly slightly tapered, and is dimensioned so as to allow the sleeve to be manually slid onto the core to rather more than half its length before the sleeve wedges on the core as shown in Fig. 2. An air supply passage 20 extends axially along the core and emerges at outlets 22 on the surface of the core about half way along its length. These outlets are thus covered by the sleeve at the point where the sleeve wedges onto the core. Compressed air is then applied through the passage 20 so as slightly to expand the sleeve and allow it to be completely slid onto the core, as shown in Fig. 3. The supply of air is then discontinued and the sleeve is then firmly fitted to the core.

Referring to Fig. 4; a steel mandrel 38 on which the sleeve is to be formed has the same general shape and construction as the roll core 16, but its outside diameter, point for point along its length, is very slightly less than that of the roll core to which the sleeve is eventually fitted. In this way, the sleeve thus produced will be slightly undersized with respect to the roll core, and will therefore be a tight fit on it. The mandrel has air outlets 22 about halfway along its length. In the first stage of construction, the outside surface of the mandrel is covered with a layer 39 of a silicone release agent. Then a strip or hoop of copper shim 40 is fitted around the mandrel so as to cover the outlets 22. Then a particulate copper composition is sprayed on to form a copper layer 41. This can be done by known techniques, for example by feeding copper rod or powder into a spraying head where a plasma electric arc melts it and forms minute droplets of molten copper which are protected from oxidation by an inert gas while they are sprayed onto the surface of the mandrel. The outside surface of this first layer is then ground so as to produce a uniform outside diameter (as compared with the slightly tapering outside diameter of the mandrel). Then the first copper layer is electro-plated to provide a second copper layer 42 of desired thickness, the outside surface of which is ground, polished, etched to produce the gravure printing surface, and finally flash chrome-plated.

The sleeve is removed from the mandrel by applying air under pressure to the outlets 22 which slightly expands the sleeve so that it can be withdrawn lengthwise from the narrower end of the mandrel.

Referring to Fig. 5; in this method, a similar mandrel 38 just is used, and a silicone release agent applied to it. Then a thin sheet of copper 43 is strained around the mandrel so as to provide a butt joint 45 which is secured by plasma welding; that is using a very narrow well-defined electric plasma arc flame produced from a tungsten tip with inert gas protection, to locally melt the copper along the seam and weld the two butting edges together. Thereafter this first copper layer is ground to produce a uniform external diameter, before electroplating the second layer as previously described.

The all copper sleeves of this invention will generally have a somewhat smaller taper than the corresponding reinforced plastics sleeves described in our British Patent Applications referred to above. For example a taper of about 1:5000 might be appropriate for the sleeves one metre long.

In another procedure of the present invention, the mandrel coated with a silicone release agent is heated to about 100^{o}C above ambient temperature. An electrically conductive metal, preferably zinc, is sprayed onto the release coated mandrel to form a metal base sleeve. A typical wall thickness is of the order of 0.5 to 0.8 mm. The mandrel is heated in order to accept more easily the sprayed metal and also to assist in removing the metal base sleeve from the forming mandrel by contraction of the mandrel on cooling.

The metal base sleeve on the forming mandrel is then machined to a uniform external diameter and is ready for removal from the forming mandrel. The temperature of the mandrel in the meantime has cooled down and in order to remove the metal base sleeve its temperature is raised quickly and it is slid lengthwise off the forming mandrel. Air is used at this stage for the removal of the metal base sleeve from the mandrel, particularly if the metal base sleeve is made of zinc, since zinc is too soft and the sleeve would be distorted.

The metal base sleeve 48 is expanded by heat and slid onto a plating mandrel 50 (Fig. 6). The ends of the sleeve extend beyond the body of the mandrel and are closed by end plugs 52, e.g. of acetal resin, with O-ring seals 54 to prevent the migration of the plating bath solution between the sleeve and the mandrel but allowing the end faces of the sleeve to be plated. For this purpose a gap 55 is left between the end faces and the plugs. The metal base sleeve is then plated with copper to a required thickness and is then ground to a finish diameter. The copper layer strengthens the sleeve to such an extent that the sleeve can be removed from the plating mandrel and mounted and demounted from a printing roll core by compressed air as described above.

CLAIMS

1. A printing sleeve for fitting to a printing roll one end of which is of slightly larger diameter than the other end, the sleeve being similarly dimensioned so that it can be mounted on the roll by sliding it on lengthwise until it covers fluid outlet openings in the roll intermediate the ends of the roll, applying fluid under pressure to the outlets to slightly expand the sleeve, and then sliding the sleeve the rest of the way onto the roll; characterised in that the sleeve (10) is made entirely of metal and has an inner metal layer (41,43,48) which contacts the roll and an electro-plated outer metal layer (42).

2. A printing sleeve according to claim 1 characterised in that both the inner layer and said electro-plated layer are of copper.

3. A printing sleeve according to claim 1 characterised in that the inner layer is of zinc and said electro-plated layer is copper.

4. A method of making a printing sleeve for fitting to a printing roll one end of which is of slightly larger diameter than the other end, the sleeve being similarly dimensioned so that it can be mounted on the roll by sliding it on lengthwise until it covers fluid outlet openings in the roll intermediate the ends of the roll, applying fluid under pressure to the outlets to slightly expand the sleeve, and then sliding the sleeve the rest of the way onto the roll; characterised in that the method comprises taking a generally cylindrical mandrel (38) the external diameter of which is slightly larger at one end than the other, coating the outside surface of the mandrel with a release agent (39), applying a first layer (41,43,48) of metal over the outside surface of the

mandrel, grinding the outside surface of the first metal layer to provide it with a uniform external diameter, and electro-plating a second metal layer (42) onto the first metal layer.

5. A method according to claim 4 characterised in that said first layer is provided by spraying molten metal onto the outside surface of the mandrel.

6. A method according to claim 4 or claim 5 characterised in that the sleeve is removed from the mandrel by applying fluid under pressure to said fluid outlet apertures to slightly expand the sleeve and allow it to be withdrawn axially from the smaller diameter end of the mandrel.

7. A method according to claim 5 characterised in that after applying the first metal layer (48) the sleeve is transferred from the first mandrel to a plating mandrel (50) at which the second layer is electro-plated.

8. A method according to claim 7 characterised in that the sleeve (48) is removed from the first mandrel by heating it to a higher temperature than the mandrel so that it expands relative to the mandrel and can be withdrawn axially therefrom.

9. A method according to claim 8 characterised in that the sleeve (48) is slid axially onto the plating mandrel (50) while at a relatively higher temperature so that it contracts to fit the plating mandrel (50) tightly on cooling.

10. A method according to any one of claims 7, 8 and 9 characterised in that the end portions of the sleeve (48)

extend beyond the body of the plating mandrel (50), the ends of the sleeve being closed by members (52,54) which seal against the inside surface of the sleeve, whereby the end faces of the sleeve (48) are exposed for plating.

FIG.1

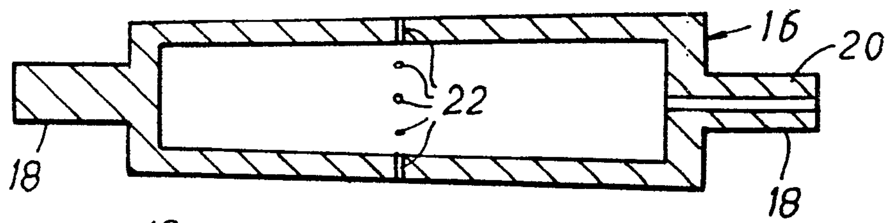


FIG.2

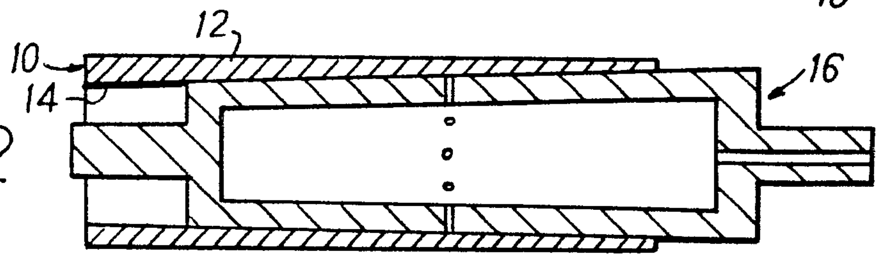


FIG.3

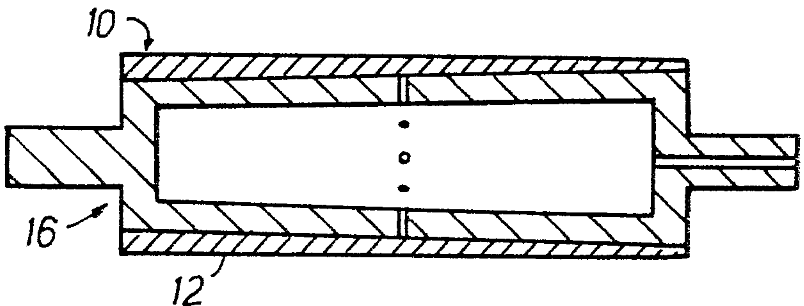


FIG.4

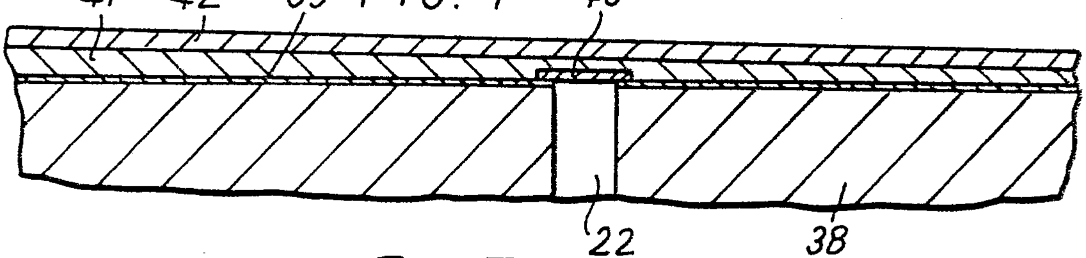


FIG.5

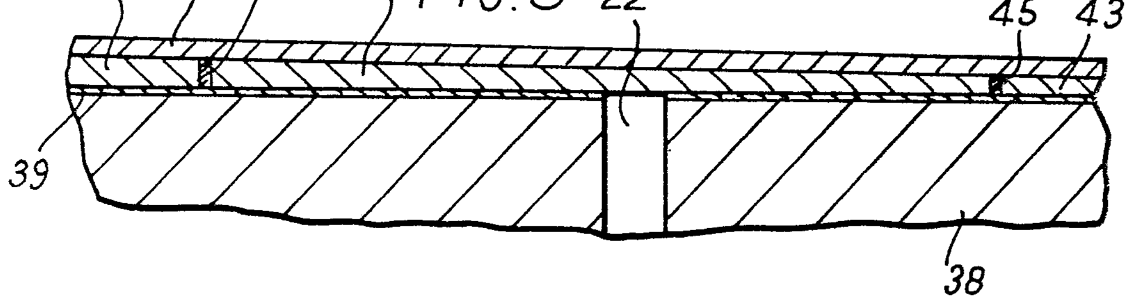
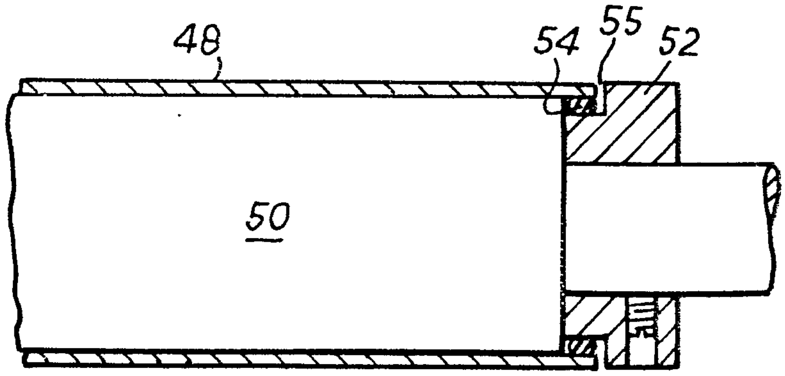


FIG.6



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EUROPEAN SEARCH REPORT

0009360

Application number
EP 79 30 1857

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	BE - A - 856 427 (STRACHAN AND HENSHAW) * Figures; claims *	1,4,6	B 41 C 1/18 B 41 N 1/20
D	& GB - A - 14 060/77 --		
	US - A - 3 146 709 (W.E. BASS et al.) * Claims; figures * --	1,4,6	
	US - A - 4 030 415 (STANLEY FELLOWS) * Claims; figures * --	1,4,6	TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
	US - A - 4 024 045 (H. THIERSTEIN) * Column 2, line 16 - column 4, line 16; figures * --	1,4,7	B 41 C 1/18 B 41 N 1/20 C 25 D 1/02
	US - A - 3 354 519 (L. JANSEN) * Claims * --	8,9	
	GB - A - 975 147 (P. ZIMMER) * Claims * --	8,9	CATEGORY OF CITED DOCUMENTS
	GB - A - 782 767 (G.E. BRACKENBURY) * Claims * --	8,9	X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
	FR - A - 599 777 (T.W.S.)HUTCHINS) ./.	4,8,9	
X	The present search report has been drawn up for all claims		&: member of the same patent family, corresponding document

Place of search	Date of completion of the search	Examiner
The Hague	20-12-1979	RASSCHAERT

EPO Form 1503.1 06.78

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EUROPEAN SEARCH REPORT

0009360

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	* Abstract *		
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	US - A - 2 074 860 (A.O. ROSS) * Claims; figure *	4	
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	DE - A - 2 645 427 (BRAUN A.G.) * Claims; page 3, line 23 - page 4, line 21 *	9	
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