March 6, 1951 J. M. GOULDING 2,544,455

METHOD OF MAKING PRINT ROLLS

Original Filed Oct. 31, 1945 3 Sheets-Sheet 1

Fig. 2.

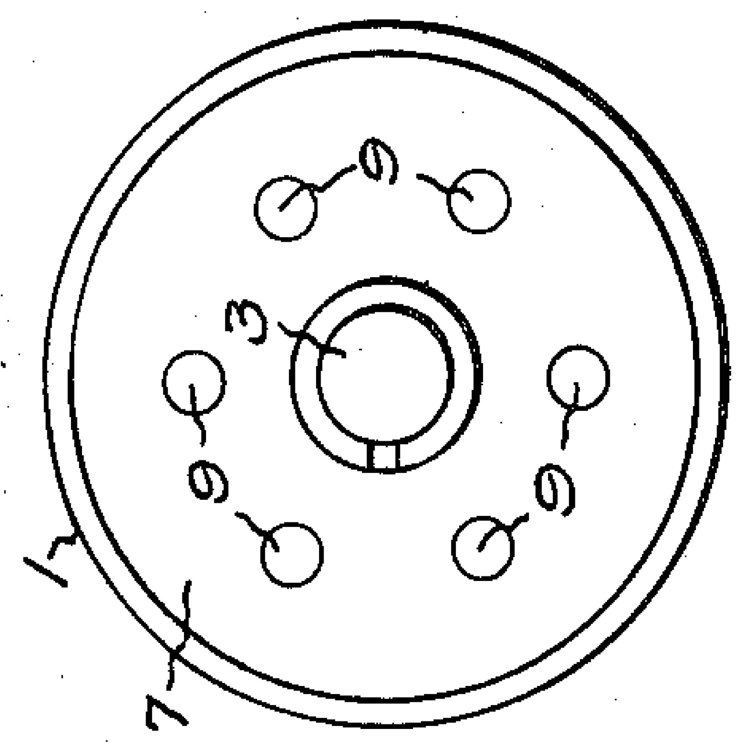


Fig. 1.

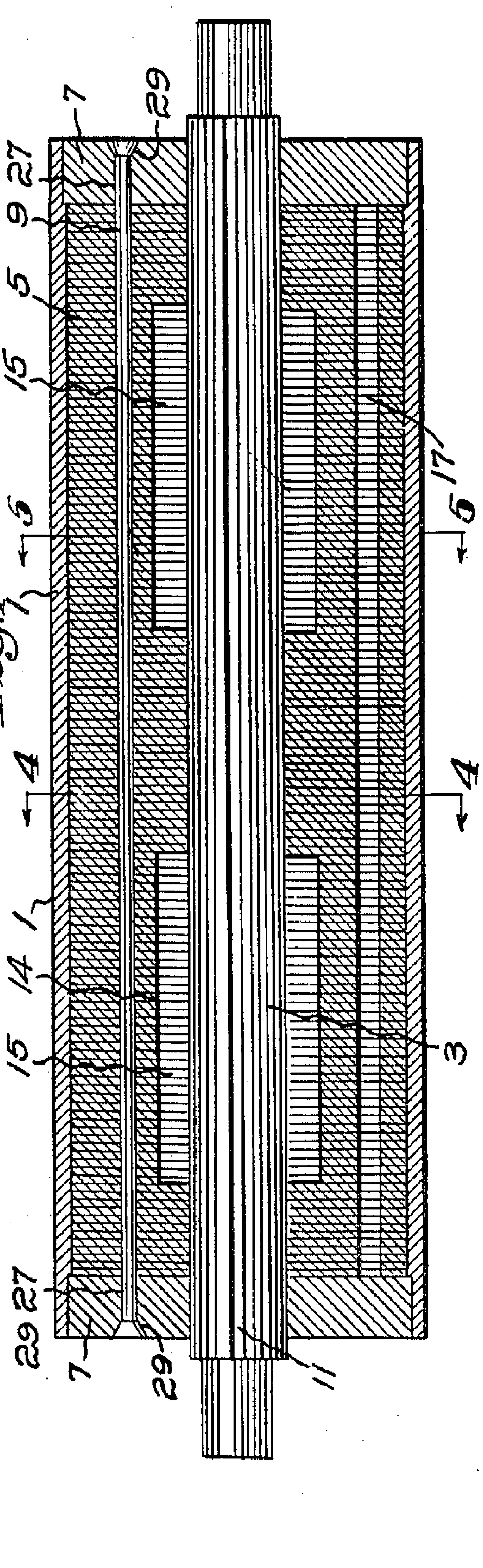
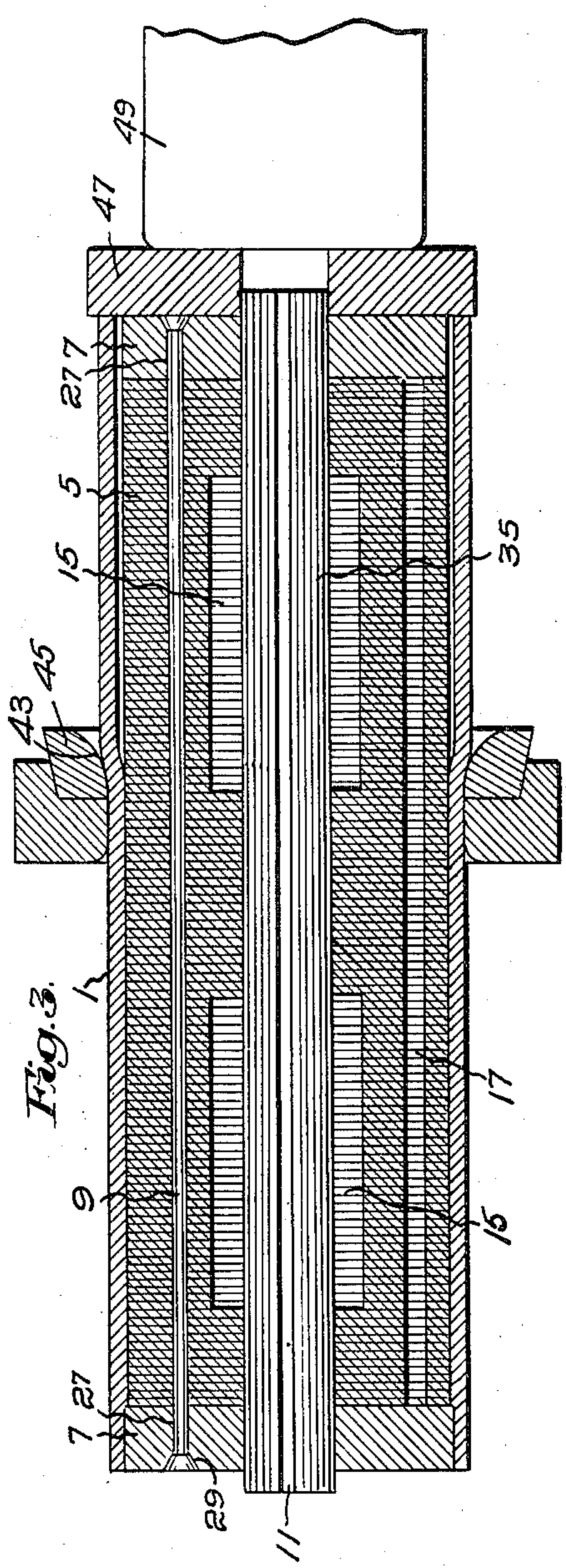


Fig. 3.



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METHOD OF MAKING PRINT ROLLS

Original Filed Oct. 31, 1945 3 Sheets-Sheet 2

Fig. 4.

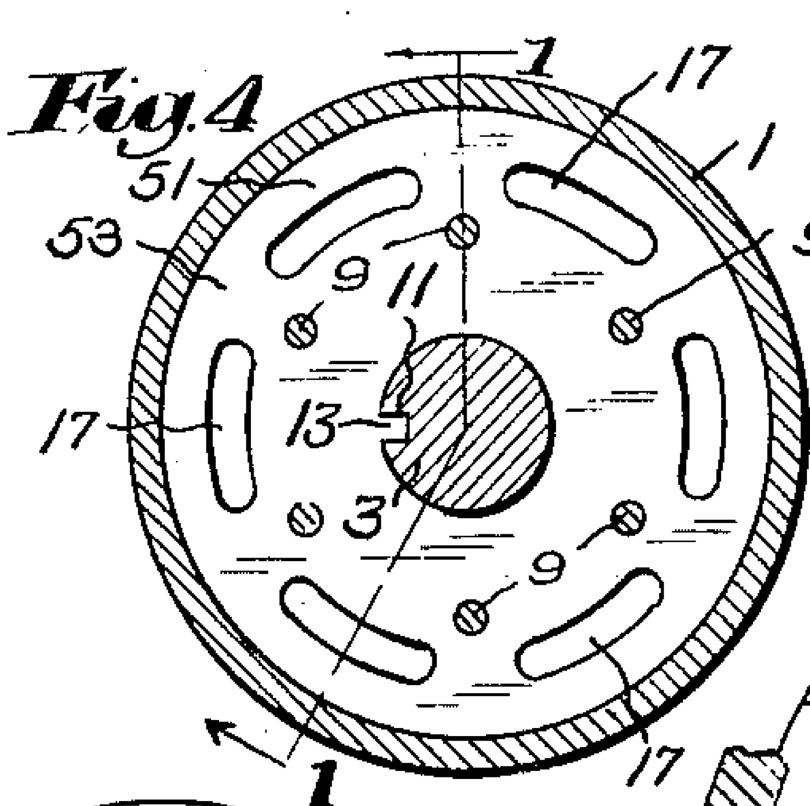


Fig. 5.

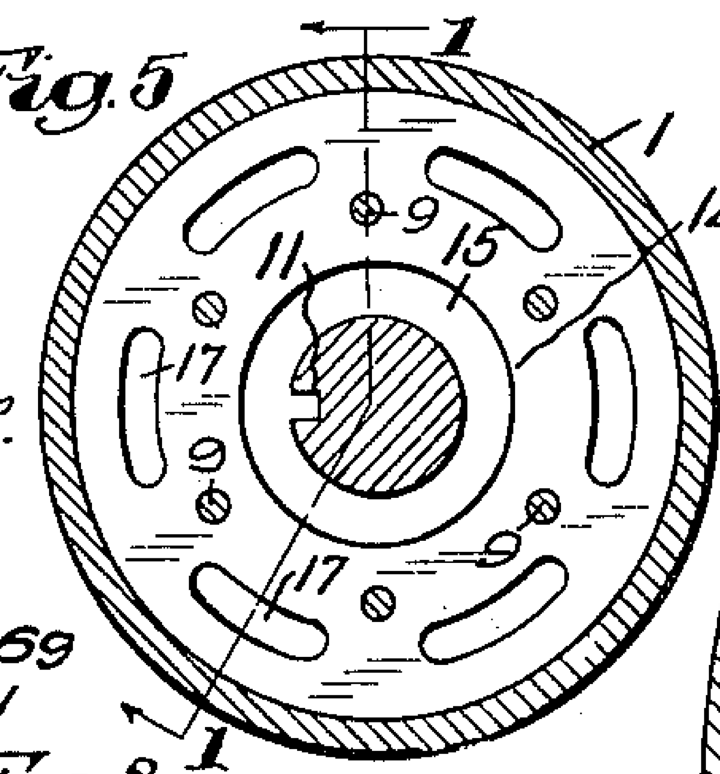


Fig. 9.

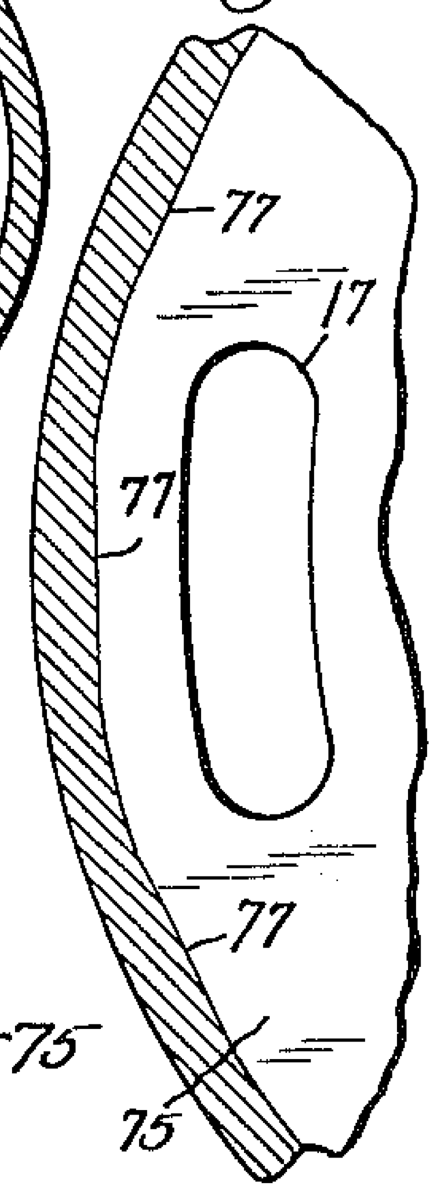


Fig. 7.

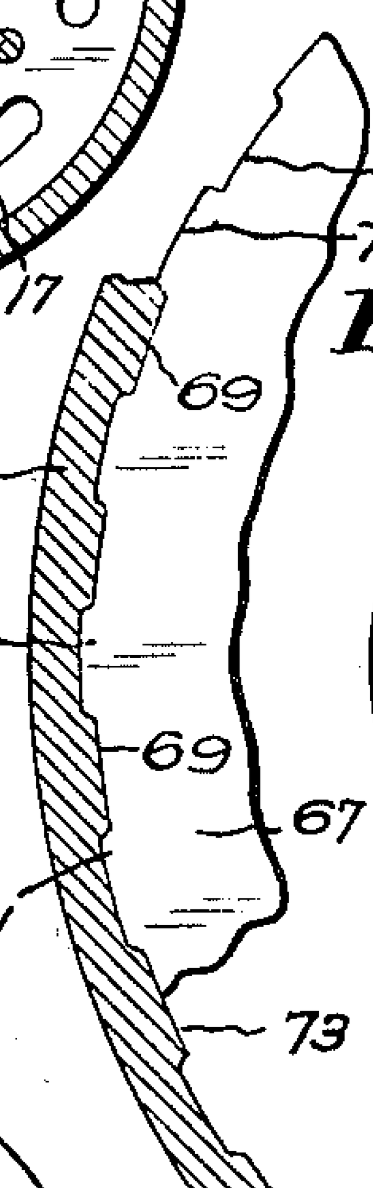


Fig. 6.

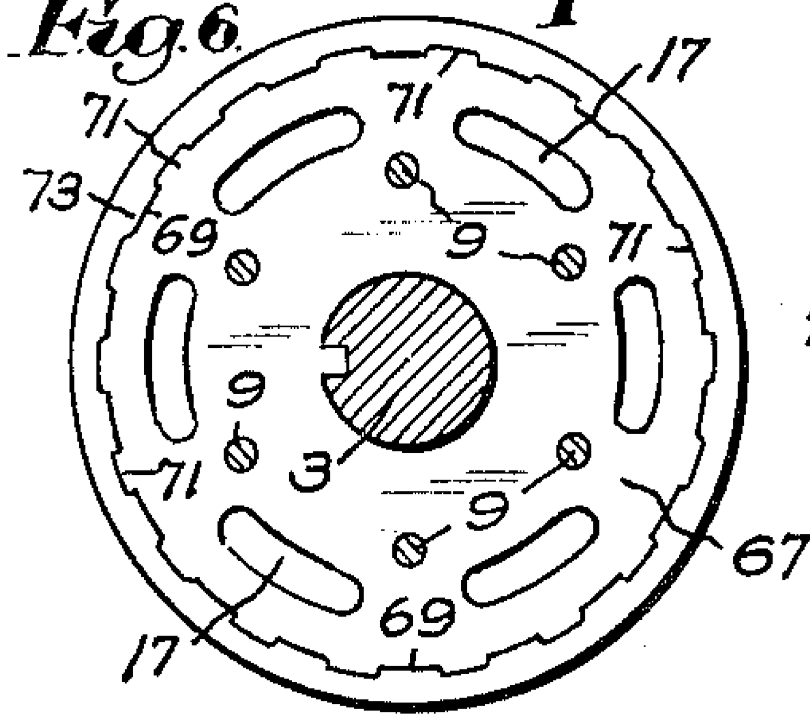


Fig. 8.

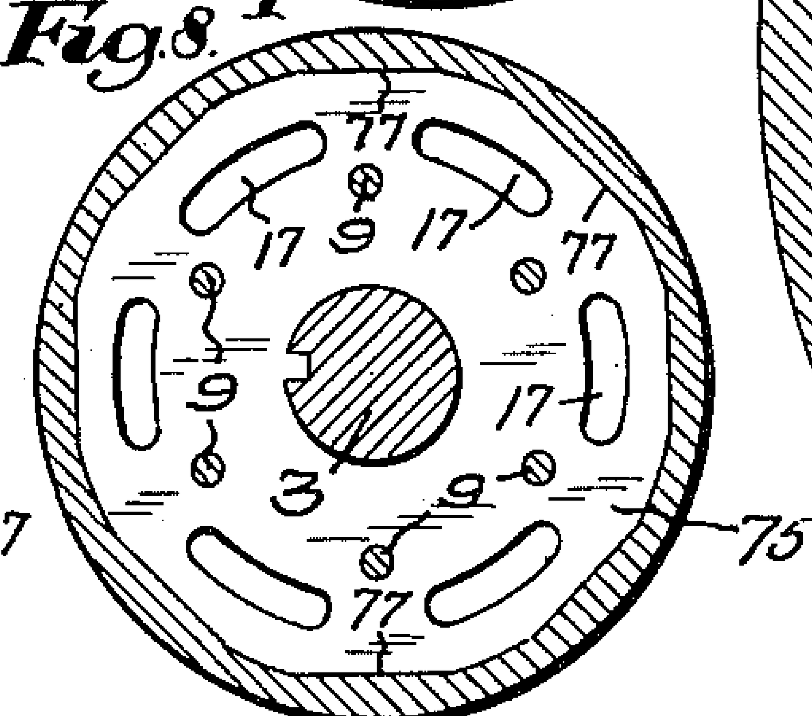


Fig. 10.

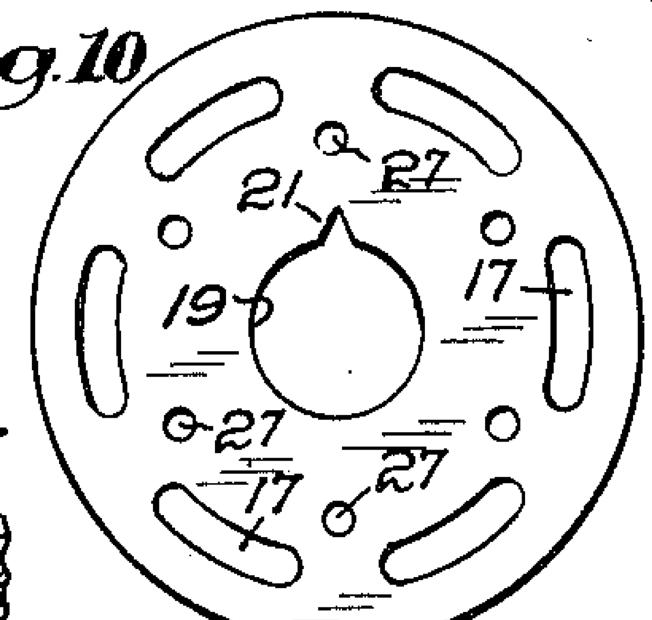


Fig. 11.

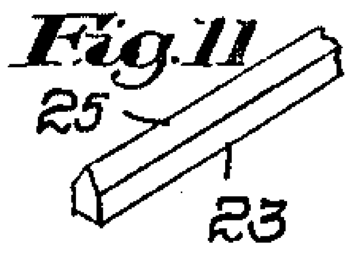


Fig. 12.

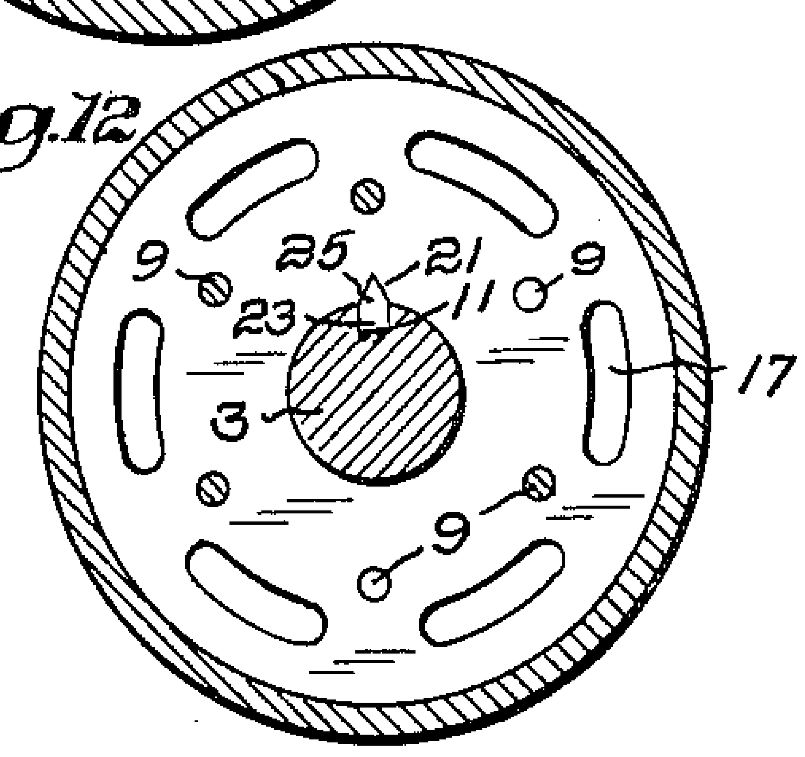


Fig. 14.

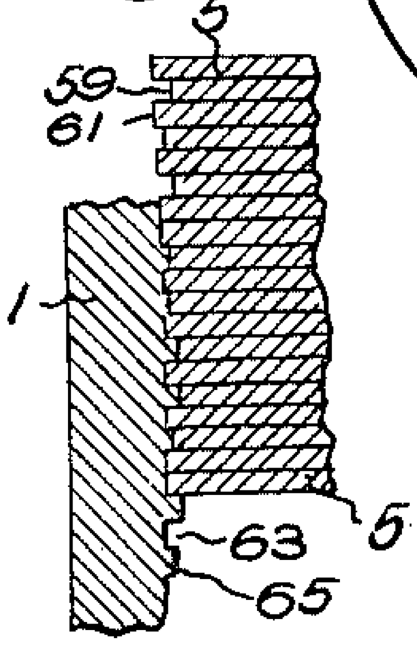
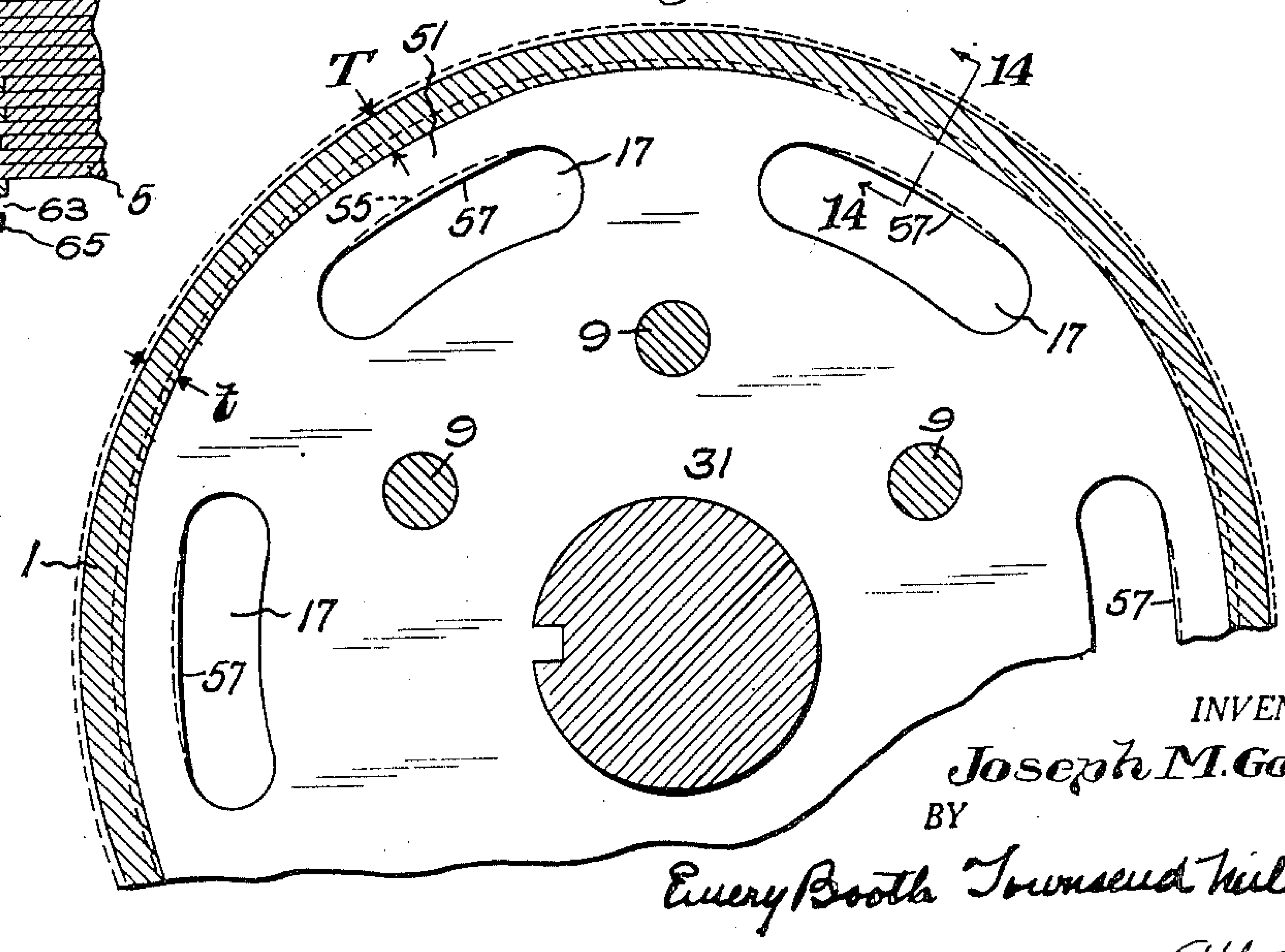


Fig. 13.



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March 6, 1951 J. M. GOULDING 2,544,455

METHOD OF MAKING PRINT ROLLS

Original Filed Oct. 31, 1945 3 Sheets-Sheet 3

Fig. 15.

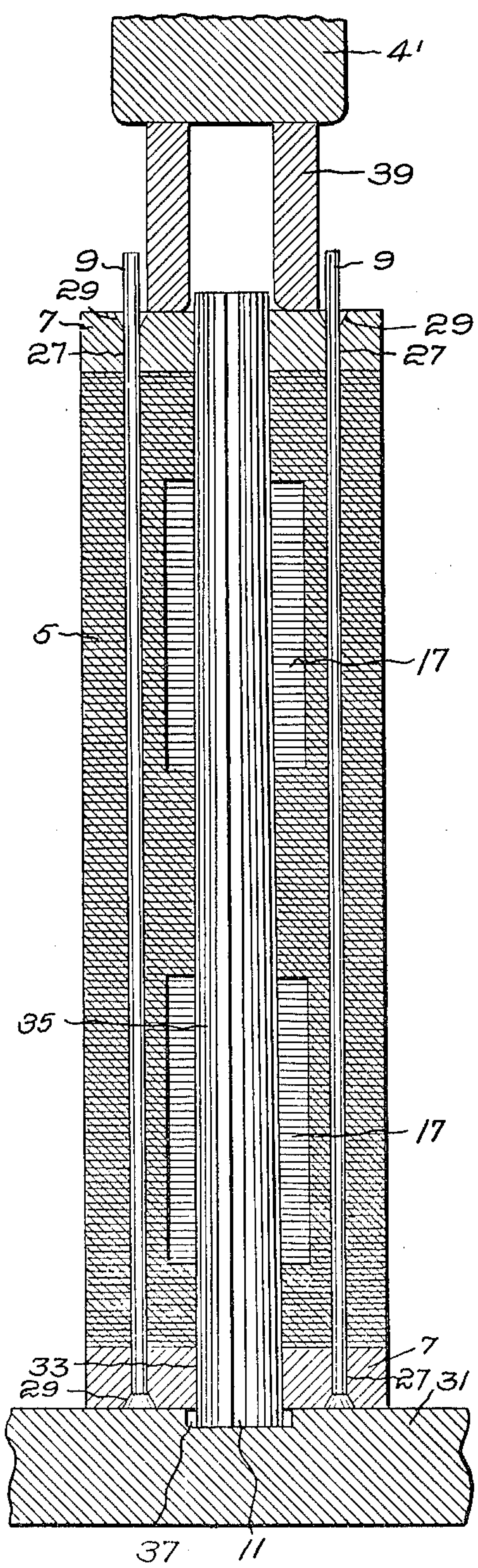
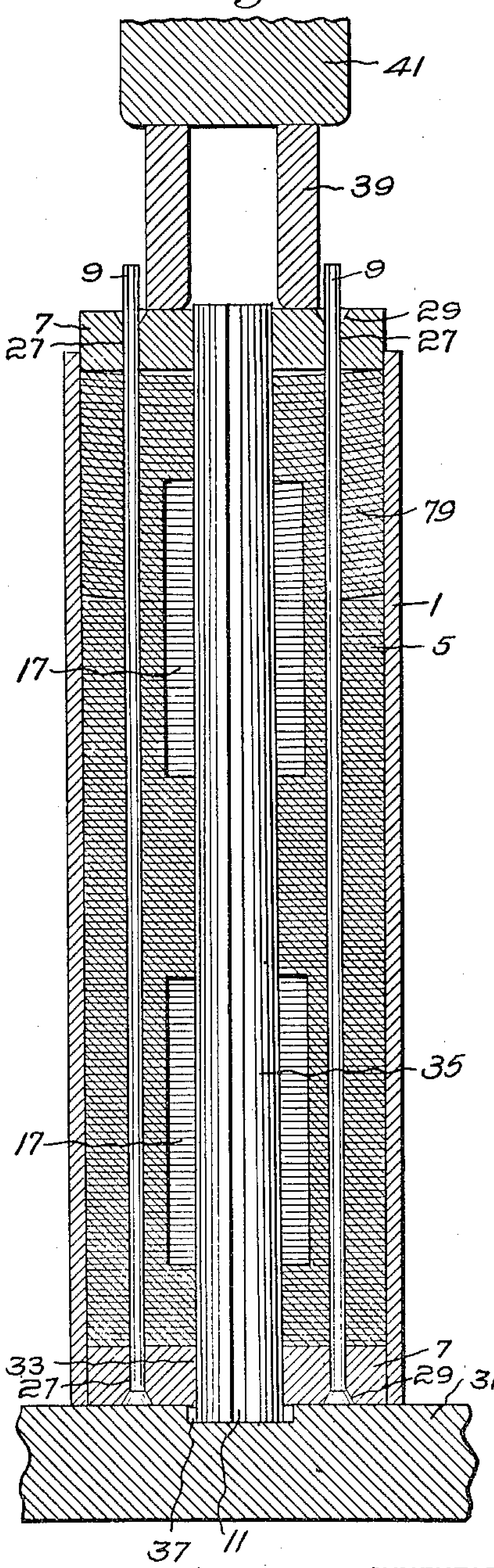


Fig. 16.



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Patented Mar. 6, 1951 2,544,455

UNITED STATES PATENT OFFICE

2,544,455

METHOD OF MAKING PRINT ROLLS

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Application October 31, 1945, Serial No. 625,846, which is a division of Serial No. 540,040, June 13, 1944. Divided and this application August 21, 1947, Serial No. 769,921

7 Claims. (Cl. 29—148.4)

1

My invention relates to methods of making print rolls, the present application being a division of my copending application Serial Number 625,846, filed October 31, 1945, now Patent No. 2,501,630, which application is a division of my copending application Serial Number 540,040, filed June 13, 1944, now Patent No. 2,501,629.

The invention, which has among its objects a method of making a print roll of lighter weight, and less expensive construction and manufacture, than prior print rolls, will be best understood from the following description of several embodiments of the invention, while the scope of the invention will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a longitudinal section on the lines 1—1 of Figs. 4 and 5, with parts in elevation, of a print roll made by a method according to the invention;

Fig. 2 is an end elevation of the print roll according to Fig. 1;

Fig. 3 is a more or less diagrammatic illustration of a step of a method according to the invention;

Figs. 4 and 5 are, respectively, sections on the lines 4—4 and 5—5 of Fig. 1;

Fig. 6 is a transverse section, corresponding to Fig. 4, of a modified form of print roll made by a method according to the invention;

Fig. 7 is a fragmentary transverse section, corresponding to Fig. 6, on an enlarged scale;

Fig. 8 is a transverse section, corresponding to Fig. 4, of a further modified form of print roll made by a method according to the invention;

Fig. 9 is a fragmentary transverse section, corresponding to Fig. 8, on an enlarged scale;

Fig. 10 is a plan of a lamination employed for the core of a still further modified form of print roll made by a method according to the invention;

Fig. 11 is an isometric view of a fragment of the length of a key employed in the print roll having the laminations according to Fig. 10;

Fig. 12 is a transverse section, corresponding to Fig. 4, of the modified print roll having the laminations according to Fig. 10 and the key according to Fig. 11;

Fig. 13 is a more or less diagrammatic fragment of a transverse section of the print rolls according to Figs. 4 and 12 on an enlarged scale;

Fig. 14 is a more or less diagrammatic fragmentary section on the line 14—14 of Fig. 13;

Fig. 15 illustrates a step in a method of making the core for a print roll to which the shell is applied in the way illustrated by Fig. 3; and

2

Fig. 16 illustrates a step in a further modified method of making a print roll according to the invention.

Heretofore print rolls, as a commercial proposition, have been almost exclusively made of a solid mass of copper pierced to receive the mandrel on which the roll is mounted. Such rolls, although on the whole satisfactory, nevertheless have the defect of employing a large amount of the relatively expensive and strategic metal copper, which latter being the heaviest of common structural metals except lead causes the print roll to be of objectionably great static weight, and, when rapidly rotated in the printing machine, to be subject to objectionably large rotative inertia and frequently to objectionable dynamic unbalance. The manufacture of such prior rolls, in order to secure copper of structural characteristics permitting satisfactory engraving, and secure copper of sufficiently homogeneous density to minimize in so far as is possible dynamic balance, has heretofore involved hot forging a copper billet, piercing it, and then extruding it over an arbor to shape it and form a key or keyway for splining it to the mandrel. Such manufacture not only involves expensive operations, but requires the use of expensive equipment. Thus, because of high material and labor costs, and high capital investment for specially designed equipment, and the cost of maintenance of the latter, print rolls have heretofore been produced only at a relatively high cost to the user. The present invention overcomes these defects and objections in the ways hereinafter set forth.

Referring particularly to Figs 1, 2, 4 and 5, the print roll illustrated comprises an outer shell 1 of copper or high copper content copper base alloy, the shell preferably being constituted by a drawn or extruded seamless tube of requisite external diameter. This tube, which preferably comprises the only copper included in the roll, may have walls about ⅜ inch thick. As shown, supporting the shell on the mandrel 3 is a core formed of a series of contacting laminations 5, each end of the core being provided with end disks 7, preferably of steel, which are connected by steel or other metallic tie rods 9 extending through the laminated core and the end disks.

The mandrel 3 is preferably tapered to permit it readily to be removed from the print roll and a new mandrel inserted. Such taper however need be very slight as, for example, that corresponding to a reduction of 0.0035 inch in diameter of the mandrel for each inch of length thereof. Preferably also, the core, but not the end disks, is keyed to the mandrel, the latter for this purpose in the form of the invention illustrated by Figs. 1, 2, 4 and 5 being provided with the longitudinally extending keyway **11**, while the laminations of the core contacting the mandrel are each integrally formed with a projecting tab-like portion **13** (Fig. 4) extending into the mandrel receiving bore of the lamination, the portions **13** of the series of adjacent laminations collectively forming a continuous longitudinally extending key fitting into the keyway of the mandrel.

As best illustrated in Figs. 1, 2, 4 and 5, all the laminations of the core need not contact the mandrel. To this end, as best illustrated in Fig. 1, groups of adjacent laminations may have a bore **14** larger than the diameter of the mandrel to form annular recesses **15** surrounding the mandrel, which laminations when such recesses are present are keyed to the mandrel only at the portions of the core between the recesses and between them and the end disks. The employment of these recesses lightens the core and simplifies its manufacture.

The core shown by Figs. 1, 4 and 5 is provided adjacent its periphery with longitudinally extending openings **17** of considerable angular extent symmetrically spaced with relation to the tie rods **9**. These openings or slots serve further to reduce the weight of the core, and, being positioned adjacent the periphery of the core, act to reduce the rotative inertia of the print roll, and further act to cause the shell to be secured to the core as will hereinafter be explained. The laminations may be formed with slots of the cross-sectional shape of these openings, and, when the laminations are assembled to form the core, the aligned slots collectively form such openings.

The laminations of which the core is formed are of light weight material such as sheet aluminum. Cardboard also may be employed which, although in some respects not perhaps as satisfactory a material as aluminum, is still lighter and less expensive. Sheet mild steel, which also is lighter than copper, may also be employed in some instances. The laminations preferably are thin, although their thickness is not at all critical. When aluminum or mild steel is employed for the laminations a thickness of about $\frac{1}{16}$ inch, and when cardboard is employed a thickness of about $\frac{1}{32}$ inch, has been found to give satisfactory results.

When aluminum or steel laminations are employed they are preferably keyed to the mandrel in the above described way illustrated by Figs. 1 and 4. However, when cardboard laminations are employed it has been found that the projecting portions **13** of the laminations, which in the assembled print roll collectively form keys, are liable to break during the punching operation for forming the laminations, or in assembling them. Consequently, when cardboard laminations are employed, they are preferably keyed to the mandrel in the way illustrated by Figs. 10, 11 and 12, according to which the mandrel receiving bore **19** of each lamination contacting with the mandrel in the assembled roll is formed with a notch **21** preferably V-shaped, while inserted in the keyway **11** of the mandrel **3** is a key **23** of such cross-sectional shape and dimensions as to provide, when so inserted, a longitudinally extending V-shaped portion **25** projecting from the mandrel, this V-shaped portion being of shape complementary to the notch **21** and serving to key the laminated core to the mandrel in the assembled roll.

Preferably, in making the print roll according to Figs. 1, 2, 3 and 4, or the modified print roll according to Figs. 10, 11 and 12, the laminations are first stamped out to the shapes illustrated and the end disks **7** are formed and the tie rods **9** cut to the proper length. As formed the end disks preferably are provided with bores **27** (Figs. 1 and 15) for receiving the tie rods, which bores at the outer faces of the disks are preferably countersunk as illustrated at **29**. With such construction the tie rods may be secured to the end disks by fusion welding which melts the projecting ends of the tie rods down into these countersinks, or the countersinks may be filled by a welding operation with separate weld metal which unites the tie rods to the end disks.

According to one method of making the print roll, one end disk is placed on the upper horizontal face of the bed **31** (Fig. 15) of a hydraulic press, preliminary to which one of the ends of each tie rod is secured to that end disk in one of the ways above explained so that the tie rods project upwardly from said bed. Through the mandrel receiving bore **33** of this end disk is placed a vertically extending mandrel form **35**, which as illustrated in Fig. 15 extends into and rests upon the bottom of a recess **37** in the bed **31** of the press. The mandrel form **35** is shown as provided with a keyway corresponding to the keyway **11** of the mandrel to be used with the finished roll. This keyway in the mandrel form may contain a key corresponding to the key **23** (Fig. 11) or not depending upon which of the ways above described the mandrel is to be keyed to the finished roll. Preferably, also, the mandrel form is slightly tapered upwardly as shown in Fig. 15 to correspond with the taper of the mandrel to be used with the print roll. The laminations forming the core **5** are then slipped, say one by one, over the upper ends of the mandrel form and tie rods. When sufficient laminations are thus assembled to secure a core of the desired length the upper end disk **7** is slipped over the mandrel form and tie rods, and a sleeve **39** having a bore for receiving the mandrel form is placed on that end disk, whereupon the plunger head **41** of the press is caused to descend upon the upper end of the sleeve **39** and compress the laminations. While the laminations are thus pleced under pressure the head **41** of the press is locked in position and the upper projecting ends of the tie rods **9** are cut off and welded to the upper end disks in one of the ways above described, whereupon upon removal of the pressure of the head **41** on the core the latter will be maintained under compression by the tie rods. When the length of the roll is such as to make it necessary the laminations on the mandrel form and tie rods may be subjected to pressure to compact them when the core is partially built up, and several such compacting operations may be necessary as the core is gradually built up and before the upper end disk is placed in position and the core is subjected to the final compacting operation. These preliminary compacting operations may be readily performed by employing a dummy upper end disk **7** and sleeves **39** of requisite length.

The core, end disks and mandrel form assembled as above described may then be removed from the press and the core turned in a lathe to remove all excess projections and preferably make it of the same diameter as the end disks, relative slipping of the laminations transversely of the core being prevented by the compression under which the core is held by the tie rods. A shell 1 which at this stage has an inner diameter slightly greater than the outer diameter of the core, say about 0.05 inch greater, is then slipped over the core and the entire assembly pushed through an opening 43 of a suitably supported die 45, as illustrated diagrammatically in Fig. 3, to reduce the diameter of the shell and cause it intimately to contact with the core. For moving the assembly through the die opening a block 47 of sufficient diameter to engage both an end of the shell and the adjacent end disk is placed between the assembly and the head 49 of the hydraulic press which forces the assembly through the die opening. After the assembly is advanced for almost its entire length through the die opening a smaller diameter block may be substituted for the block 47 to permit the assembly to be entirely pushed through the die opening.

The above described reducing operation on the shell somewhat compresses the laminations radially so that the outer diameter of the core between the end disks becomes slightly less than the outer diameter of those disks as illustrated in Fig. 1, the laminations being compressed against the mandrel form to cause them tightly to fit and conform with said form. When the core is keyed to the mandrel, as illustrated by Figs. 10, 11 and 12, this compression of the laminations causes the V-shaped notches in the laminations tightly to fit the key.

To compensate for the taper of the mandrel form the laminations as placed on that form in the steps illustrated by Fig. 15 are preferably so formed that groups of adjacent laminations contacting the mandrel form in the finished roll have mandrel receiving bores of diameter corresponding to the maximum diameter of the portion of the mandrel form with which that group is to contact. The compression of the core by the reducing operation on the shell illustrated by Fig. 3 serves to cause all the laminations of each group to compress sufficiently to contact with the mandrel form. The length of the portion of the mandrel form with which each group contacts will depend upon the radial compressibility of the material of the core. This length may be shorter for aluminum laminations than for cardboard laminations, and may be still shorter for mild steel laminations.

When the openings 17 are formed in the core those portions 51 (Figs. 4 and 13) of the laminations which lie between such openings and the peripheries of the laminations are slightly depressed inwardly as a result of the reducing operation on the shell, more than are those portions 53 of the laminations which lie between the opposed ends of adjacent openings. This is diagrammatically illustrated in Fig. 13 where, as a result of the reducing operation on the shell, the outer walls of the openings 17 are pressed inwardly from their dotted line positions 55 to their full line positions 57, causing the thickness T of the shell radially opposite the openings to be somewhat greater than the thickness t at points between the opposed ends of adjacent openings. The metal of the shell flows during the reducing operation so that the inner surface of the shell will conform to the outer surface of the core thus deformed, while its outer surface will be cylindrical as determined by the shape of the die opening through which the assembly is forced. As a result of this operation the outer surface of the core is made roughly polygonal in cross-section while the inner surface of the shell is made of complementary shape, which acts to insure against any possibility of angular slip between the shell and the core when the roll is in use, it being understood that when the roll is in use it is under very great pressure. Furthermore, in these respects, the various laminations are not deformed to the same extent due to variations in their thickness, temper, hardness, and the like. As a result, after the reducing operation the outer surface of the core, particularly the portions opposite the opening 17, will be more or less irregular as diagrammatically indicated in Fig. 14, which figure shows the outer surface of certain laminations forming recesses 59 relative to projections 61 formed by the outer surface of other laminations, while the shell is formed with recesses 63 in which these projections 61 fit and with projections 65 projecting into the recesses 59, as a result of which the shell is locked against movement of the core axially thereof.

If desired, the laminations of which the core is formed may take the form of those shown by Figs. 6 and 7, in which form the laminations 67 are so stamped out as to provide their peripheries, after the core is turned in the lathe, with a series of shallow recesses 69 and intervening projections 71, illustrated on a larger scale in Fig. 7. When the laminations are assembled over the tie rods the core formed will be provided with spaced longitudinally extending grooves and projections corresponding to the recesses and projections of the laminations. When the shell is placed on the core and reduced the metal of the shell will flow as a result of the reducing operation and form projections 73 filling these longitudinal grooves in the core, thus acting to lock the core against angular slippage relative to the core. Otherwise the print roll may be constructed identically with those above described.

According to the modification of the invention shown by Figs. 8 and 9, the print roll is constructed identically with that described in connection with Figs. 1, 2, 4 and 5 except that the laminations 75 are provided with a series of flattened portions 77 on their peripheries, shown on an enlarged scale in Fig. 9. As a result, when the laminations are assembled on the tie rods, a core is formed with spaced longitudinally extending flattened outer surfaces, and, when the shell is placed over the core and reduced by passing the assembly through the die opening, the metal of the shell will flow and fill what in substance amount to recesses formed by these flattened surfaces, which will act to lock the shell against angular slippage relative to the core.

If desired, the core of the roll according to Figs. 6 and 7, and that according to Figs. 8 and 9, may also be formed with the openings 17 hereinbefore described, which will lighten the core adjacent its periphery and secure the additional effects described in connection with Figs. 13 and 14. Otherwise the roll according to both of these modifications may be constructed and manufactured the same way as the roll according to Figs. 1, 2, 4 and 5.

The roll according to Figs. 1, 2, 4 and 5, and the roll according to Figs. 10, 11 and 12, particularly when the laminations are formed of cardboard, may also be formed by the method indicated by Fig. 16. According to this method, the lower end disk 7, with the tie rods 9 welded to it in the manner hereinbefore described, is placed on the bed 31 of the press with the shell 1 surrounding that disk. The laminations 5, having a diameter slightly greater than the inner diameter of the shell, are then successively pushed into the shell one at a time. Because of their having a greater diameter than the inner diameter of the shell this will cause the laminations to be slightly cupped as indicated at 79 (Fig. 16). After the shell is thus filled with laminations the upper end disk 7 may be placed in position as indicated in Fig. 16, and the press head 41 by means of a sleeve 39 placed between it and that end disk may be caused to descend to compress and flatten the laminations to cause them to bind tightly against the shell, the mandrel form, and the key or keyway of the mandrel form. As hereinbefore described, the press head may then be locked and the upper projecting ends of the tie rods 9 welded to the upper end disk while the laminations are under pressure. Instead of flattening all the laminations at once, and particularly when the shell is of considerable length, a removable dummy end disk may be placed in the shell after about one-quarter of the laminations are placed on it, and, by use of a longer sleeve 39 than shown in Fig. 16, the dummy end disk may be placed under pressure to flatten the laminations and then be removed. This operation may be repeated until the final fraction of the laminations is placed in the shell, whereupon the end disk 7 to be used in the finished roll may be placed in position and the laminations subjected to the final compressing and flattening operation. The pressure employed for forcing the upper end disk into place may be considerable, satisfactory results having been secured with a shell 12 inches internal diameter with a pressure of about 70 tons. Such pressure not only flattens the cup-shaped end disks, but actually tends to cause them to expand after they are flattened particularly when the laminations are formed of cardboard, aluminum, or other relatively soft material. As the upper end disk is welded to the tie rods while the head of the press is locked to maintain this pressure the core formed by the laminations exerts such pressure against the shell as to bind the core and shell together against relative movement when the roll is in use. The roll made according to this last described method preferably is formed with the openings 17 for reducing the weight of its portions adjacent its periphery. Such openings also act to cause the laminations at their peripheries opposite the openings to bear resiliently against the inner wall of the shell with great pressure, particularly when the laminations are of steel or other metal.

It will be understood that within the scope of the appended claims wide deviations may be made from the forms of the invention described without departing from the spirit of the invention.

I claim:

1. The method of forming a print roll or the like having a tubular metal shell surrounding a laminated core, which method comprises forcing into said shell from one end thereof preformed flat bendable laminations of greater diameter than the inner diameter of the shell to cause said laminations when so entered into said shell to be cupped with their concave sides facing said end

of the shell and with their peripheries in slidable contact with the inner surface of the shell for sliding longitudinally of the latter, and, after the laminations are so entered into the shell, subjecting the mass of cupped laminations to pressure applied longitudinally of the shell over substantially the entire transverse cross-section of said mass for moving individual laminations longitudinally of the shell for compacting said mass and for flattening the laminations for forcing their peripheries into intimate contact with the inner surface of the shell whereby to bind the shell to the core.

2. The method of forming a print roll or the like having a tubular metal shell surrounding a laminated core, which method comprises forcing into said shell from one end thereof preformed flat bendable laminations of greater diameter than the inner diameter of the shell to cause said laminations when so entered into said shell to be cupped with their concave sides facing said end of the shell and with their peripheries in slidable contact with the inner surface of the shell for sliding longitudinally of the latter, and, after the laminations are so entered into the shell, subjecting the mass of cupped laminations to pressure for compacting that mass comprising entering into the shell through the end thereof through which said laminations were entered a presser member substantially fitting the interior bore of the shell for moving the peripheral portions of the cupped laminations longitudinally of the shell to flatten said laminations and force their peripheries into intimate contact with the inner surface of the shell whereby to bind the shell to the core.

3. The method of forming a print roll or the like having a tubular metal shell surrounding a laminated core, which method comprises forcing into said shell from one end thereof preformed flat bendable laminations of greater diameter than the inner diameter of the shell to cause said laminations when so entered into said shell to be cupped with their concave sides facing said end of the shell and with their peripheries in slidable contact with the inner surface of the shell for sliding longitudinally of the latter, and, after the laminations are so entered into the shell, subjecting the mass of cupped laminations to pressure for compacting that mass comprising entering into the shell through the end thereof through which said laminations were entered a flat faced presser member substantially fitting the interior bore of the shell for moving the peripheral portions of the cupped laminations longitudinally of the shell to flatten said laminations and force their peripheries into intimate contact with the inner surface of the shell whereby to bind the shell to the core.

4. The method of forming a print roll or the like having a tubular metal shell surrounding a laminated core, which method comprises forcing into said shell from one end thereof preformed flat bendable laminations of greater diameter than the inner diameter of the shell to cause said laminations when so entered into said shell to be cupped with their concave sides facing said end of the shell and with their peripheries in slidable contact with the inner surface of the shell for sliding longitudinally of the latter, providing rigid end members for the core formed by the laminations, which end members fit the inner surface of the shell and at least one of which is slidable longitudinally of the shell, pressing said

end members relatively toward each other for applying pressure to the mass of cupped laminations within the shell over substantially the entire transverse cross-section of said mass for moving individual laminations longitudinally of the shell for compacting said mass and for flattening the laminations for forcing their peripheries into intimate contact with the inner surface of said shell, and while the mass of laminations is thus placed under pressure tying said end members to each other for maintaining such pressure whereby to insure permanent binding of the shell to the core.

5. The method of forming a print roll or the like having a tubular metal shell surrounding a laminated core, which method comprises forcing into said shell from one end thereof preformed flat bendable laminations of greater diameter than the inner diameter of the shell to cause said laminations when so entered into said shell to be cupped with their concave sides facing said end of the shell and with their peripheries in slidable contact with the inner surface of the shell for sliding longitudinally of the latter, providing rigid end members for the core formed by the laminations, which end members fit the inner surface of the shell and at least the one of which positioned at the end of the shell through which the laminations are entered is slidable longitudinally of the shell, pressing the last mentioned end member toward the end member positioned at the opposite end of the shell for moving the peripheral portions of the cupped laminations longitudinally of the shell to flatten said laminations and force their peripheries into intimate contact with the inner surface of the shell and for compacting the mass of laminations within the shell, and while the mass of laminations is thus placed under pressure tying said end members to each other for maintaining such pressure whereby to insure permanent binding of the shell to the core.

6. The method according to claim 1 in which the laminations are provided with central openings through which extends a mandrel positioned axially of the shell, the operation of flattening the cupped laminations also forcing the walls of said openings into intimate contact with said mandrel.

7. The method according to claim 4 in which the laminations are provided with central openings through which extends a mandrel extending through and fitting central openings in the end members for positioning said mandrel axially of the shell, the operation of flattening the cupped laminations also forcing the walls of the central openings of said laminations into intimate contact with said mandrel.

JOSEPH M. GOULDING.

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FOREIGN PATENTS

Number	Country	Date
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