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METHOD AND MEANS FOR MAKING TIGHT ROLLS

Filed May 15, 1930

2 Sheets-Sheet 1

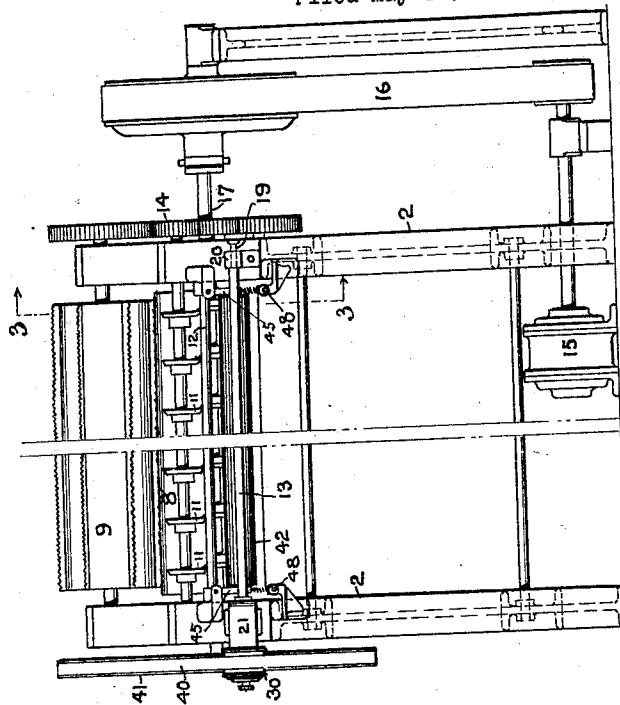


FIG. 2

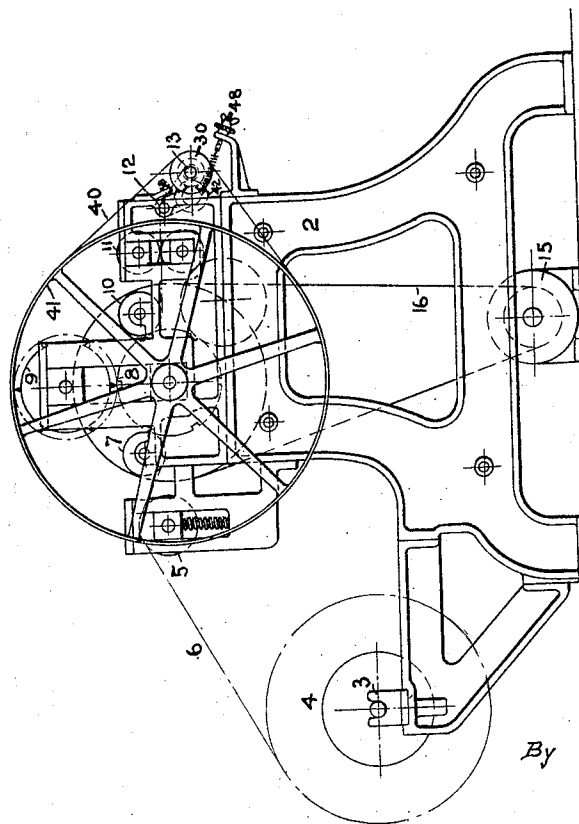


FIG. 1

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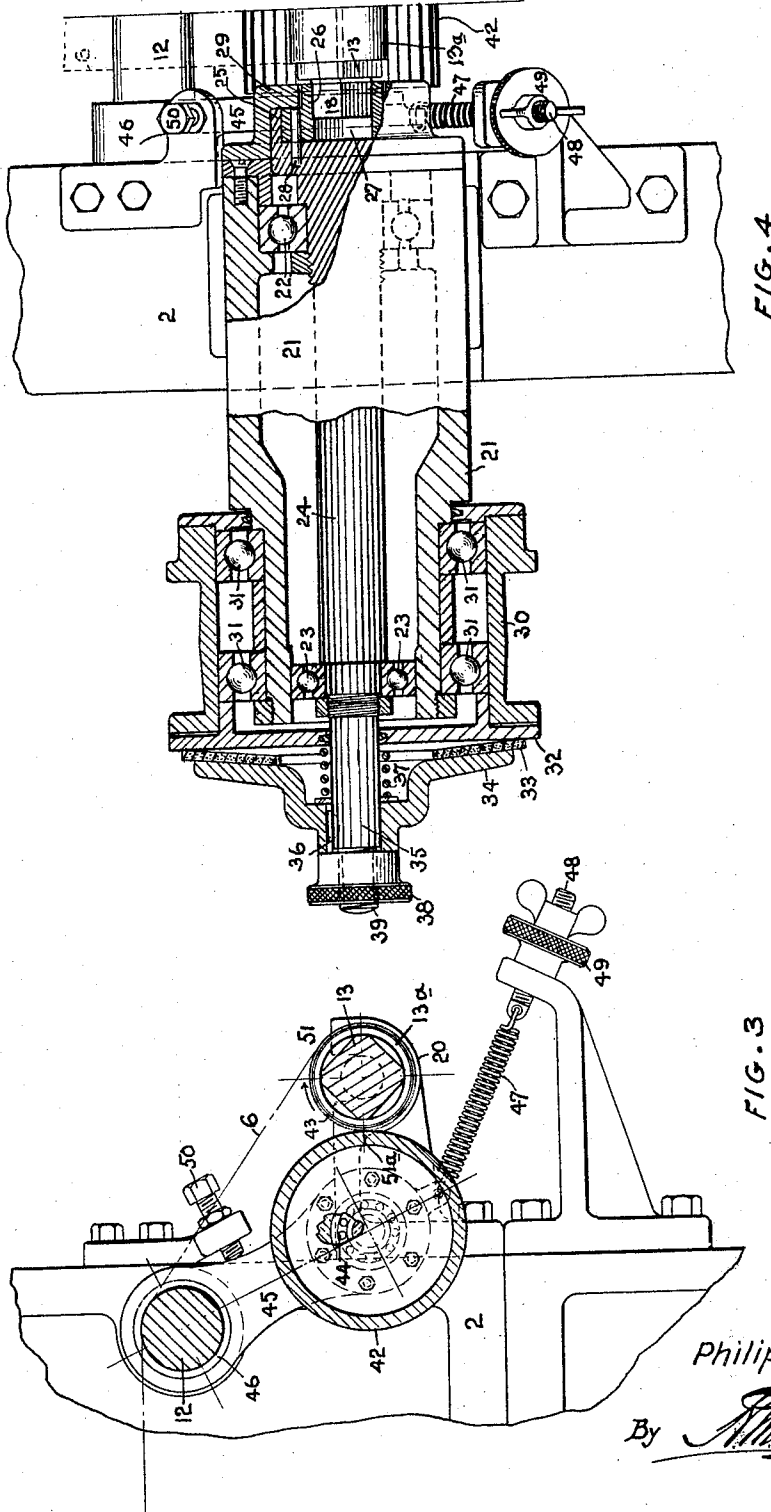
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METHOD AND MEANS FOR MAKING TIGHT ROLLS

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UNITED STATES PATENT OFFICE

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METHOD AND MEANS FOR MAKING TIGHT ROLLS

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In the manufacture of paper rolls and more particularly that class of rolls known as toilet paper, the paper web is wound upon a tubular core under a tension such, that when the rolls are removed from the winding mandrel, they lack firmness; and, as a result, if tightly packed in cartons, they lose their cylindrical form, and in many cases are so distorted as to be unsatisfactory as a saleable article.

Moreover, in those forms of paper known as creped paper, the texture is quite soft and pliable and very materially increases the looseness in the wound roll and consequently in papers of this character, the looseness of the roll is still more objectionable than the looseness existing in the rolls of those papers which have a relatively continuous smooth surface.

The object of my invention is to provide a means for causing the slit and perforated paper webs to be wound upon the mandrel under a sufficient degree of tension and under conditions which cause the web to tightly position itself, one layer upon the next throughout the formation of the roll, so that the convolutions of the paper from the core to the perimeter is of substantially uniform tension and compactness, with the result that the rolls are cylindrical and firm so as to avoid becoming distorted under any ordinary conditions, whether the paper web is of a smooth or creped character.

My object is further to enable the paper web to be tightly wound into roll form at a relatively high velocity (such for example as 1400 ft. or more per minute) with the result that not only is the time consumption in the manufacture of the rolls greatly reduced over the capacity of the winding machines heretofore in use for making toilet paper rolls (having capacity for winding 300 ft. per minute), but in addition thereto my invention enables a roll of given diameter to contain a relatively greater number of connected sheets (so-called). Furthermore, in the case of the soft creped papers, the greater tension, under which they are wound by my improvements, enables a roll of a given diameter to contain many more sheets (so-called) as com-

pared to what has been possible in forming such rolls under the low speed capacities of the machines as heretofore made an operated.

My invention consists of a roll making machine having means for feeding the web of paper at a substantially uniform speed and also having a winding mandrel supported in relatively fixed bearings and driven at a variable speed inversely proportional to the increasing diameter of the roll while being formed thereon, combined with a roll tightening device comprising a frictionally driven pressure roll suspended so as to be movable by pressure contact with the perimeter of the paper roll during its formation, in such manner that immediately after the web has taken form upon the mandrel, it is acted upon by the pressure roll in such a manner as to apply a stretching tension upon the web already received upon the mandrel or more particularly, upon that portion of the same between the pressure roll and where the web is tangential to the mandrel or the paper wound thereon.

My invention further consists in providing the pressure roll aforesaid with means permitting it to maintain a yielding contact with the perimeter of the paper roll being wound upon the mandrel and free to change its surface speed of rotation proportionately with the increasing diameter of the paper roll during its formation upon the mandrel, and preferably under such conditions as to increase its pressure upon the perimeter of the roll in a gradual manner commensurate with the increasing diameter thereof.

My invention also comprehends other features of improvement which together with those above enumerated, are fully described hereinafter and particularly pointed out in the claims.

Referring to the drawings, Fig. 1 is a side elevation of a roll making machine embodying my improvements; Fig. 2 is a front view of the same; Fig. 3 is an enlarged vertical sectional view of a portion of the winding devices taken on line 3—3 of Fig. 2; and Fig. 4 is an enlarged view of a portion of Fig. 2 of the means for frictionally driving the mandrel and shown partly in section.

2 is the main frame of the machine and

made of any suitable construction, 3 is a roll support for a roll of paper 4 from which the commercial rolls are formed, and 5 is a guide roll over which the paper web 6 is guided. The web is next guided under the guide roller 7, thence over a drum 8 upon which it is transversely perforated by a perforating roll 9, thence under a guide roll 10, thence under the slitting cutters 11, thence from the stationary guide rod 12 and finally received upon the mandrel 13 upon which it is wound in roll form.

As shown in Fig. 2, the main web is subdivided longitudinally into a large number of narrow webs by means of the plurality of slitting cutters 11 and it will also be noted that the transversely perforated cutter 9 and drum 8 provides transverse perforations at spaced intervals along the length of the webs. The general construction of the perforating and slitting devices thus referred to are more or less common to machines of that class and therefore, while I have illustrated these particular features for performing the functions of slitting and perforating, I do not limit or restrict my invention to their special use as any other devices of that character, capable of providing the perforated webs, may be employed in lieu thereof.

As a further detail of such mechanisms, I would point out that the perforating cutter 9 and cooperating drum 8, as well as the slitting cutters 11, are all geared together at 14 to insure their proper cooperation. is an electric motor for imparting motive power to the machine through the belt transmission 16 extending to the shaft 17 of the drum 8.

Referring now more particularly to the features of construction shown in Figs. 3 and 4 and their embodiment in the machine shown generally in Figs. 1 and 2, the following particular features are to be noted: the mandrel 13 is preferably a bar of substantially square cross section and having a square extension 18 at one end and a cylindrical journal 19 at the other end, the latter detachably received in a bearing 20. The square end 18 of the mandrel is driven by the mechanism more particularly shown in Fig. 4 and consisting of the following parts: a stationary bearing 21 provides at 22 and 23 a ball-bearing support for a central shaft 24, one end of which provides a socket 25 in which is received a bushing 26 having a square hole 27 in which is received the square extension of the mandrel 13 and by which it is rotated. The bushing 26 is replaceable but when fitted into the socket of the shaft 24, is pinned therein as at 28 so as to be positively rotated with the said shaft. The bushing is held longitudinally upon the shaft 24 by the cap 29 secured to the end of the stationary bearing 21. When the bushing becomes worn, it may be replaced by withdrawing the cap 29.

The mandrel is readily inserted into the socket of the bushing and is held in that connection by the shoulder at the other end, adjacent to its cylindrical journal 19, coming in contact with the fixed bearing 20. For removing the mandrel, it is only necessary to raise the journal end 19 out of the bearing 20 and then withdraw the mandrel longitudinally from the socket 27 of the bushing 26.

Referring now to the means for frictionally driving the shaft 24, 30 is a belt pulley journaled by ball bearings 31 upon the outer portion of the stationary bearing 21 within which the shaft 24 is journaled. The outer end 32 of the belt pulley 30 provides a friction surface upon which a disc of leather 33 is pressed by a cap plate 34 sleeved upon the end 35 of the shaft 24 with capacity for longitudinal adjustment thereof, such adjustment being permitted by a spline connection 36.

A spring 37 arranged between the cap 34 and the end plate 32 of the pulley tends to reduce the frictional contact between the leather disc 33 and the end plate of the pulley 30, and 38 is a manually adjustable nut screwed upon the end 39 of the shaft extension 35 and provides capacity for varying the extent of the friction drive of the pulley 30. The pulley 30 is driven by a belt 40, said belt in turn being driven by a belt wheel 41 of large diameter secured to the end of the shaft 17 of the drum 8, the proportions of the belt wheel and pulley being such that the maximum revolutions of the mandrel per minute are slightly in excess of that necessary to wind the paper web as it leaves the perforating and slitting cutters and so that there is a slight release in the friction drive between the cap 34 and the end plate of the pulley 30.

As the diameter of the paper roll increases, the speed of revolution of the mandrel greatly decreases and as the driving pulley 41 has a constant speed, the difference in speed of the mandrel is compensated for by the slip in the friction clutch before referred to.

Referring now to the means for applying the tension upon the paper web as it is in the act of being wound in the roll form upon the mandrel: 42 is a pressure cylinder preferably of metal and extends parallel to the mandrel 13; and is free to swing to and from said mandrel, so as to apply pressure upon the perimeter of the paper roll 43 being wound upon the core 13a through which the mandrel extends (Fig. 3).

In this construction the pressure cylinder 42 is hung in two independently movable swinging arms 45 whereby the ends of the cylinder may move independently, but the cylinder as a whole being bodily movable to and from the mandrel.

The ends of the cylinder 42 are journaled at 44 in swinging arms 45 whose upper ends

are loosely journaled at 46 upon the transverse guide shaft 12 over which the paper web 6 is guided. The lower ends of the swinging arms 45 are connected with springs 47 whose tension may be manually adjusted by means of a screw 48 and adjustable nuts 49, so that the desired pressure of the cylinder 42 upon the perimeter of the paper roll may be secured.

50 are adjustable stops which limit the movement of the swinging arms 45 in a direction towards the mandrel and by means of these stops, the pressure cylinder 42 may be held slightly away from the core 13a upon the mandrel. The object of such adjustment is to enable the paper web to be quickly and easily attached into winding relation with the core and permit a few layers of winding to be had before the paper web comes into contact with the tightening cylinder 42.

It is desirable that there shall be at least 2 or 3 wrapping of the web upon the mandrel and core before the pressure of the cylinder 42 comes into actual operation. While I prefer capacity for this slight adjustment to retard the preliminary action of the pressure cylinder, I do not restrict myself to its use.

The functioning of the tightening device will now be understood: Referring to Fig. 3 and assuming that the pressure of the cylinder 42 has just come into full play upon the perimeter of the paper roll 43, the tightening action of this cylinder upon the paper web being wound is due to the fact that it puts a drag upon the incoming web at point 51a, causing a binding upon the instant wound web layer of the roll so that the said layer at the point 51a is tightly clamped and holds back the incoming web thereat, which insures a direct and positive pull by the mandrel 13 circumferentially and inwardly in the direction of the arrow (Fig. 3) upon said outer layer, with the result that said pull extends back to the functional binding point of contact 51a between the cylinder 42 and the paper roll. The frictional contact at point 51a causes a strong drag upon the outer layer of the paper roll while the mandrel 13 internally winds the web and stretches it between the binding points 51 and 51a, the latter being the contact of the paper web of the roll with the cylinder 42. This stretching by the mandrel is rapidly done in the direction of the arrow away from point 51a and which acts to tighten said layer. In this manner, the stretching and tightening due to the presence of the cylinder 42 is largely confined to that portion of the paper web immediately after leaving the point of application of pressure by the cylinder 42 upon the paper roll. This tightening takes place, as a matter of fact, by increments and being confined at any moment to a small length of the web, its action is most effective and uniform throughout the

whole winding operation. It is to be understood that as the paper roll increases in diameter, the springs 47 automatically insure greater tension upon the pressure cylinder 42, and this is desirable since the increase in diameter of the toilet roll provides a greater length of web between the points 51 and 51a; and there is a corresponding increase of pressure and speed of rotation of the pressure cylinder 42 required and provided.

From the foregoing, it will be seen that instead of the mandrel or winding bar resting upon and between rotating cylinders and frictionally driven therefrom by the paper rolls formed on the bar resting in frictional contact with the cylinders as has been heretofore customary, I provide a definitely positioned winding mandrel or bar 13 which is positively rotated in a yielding manner under the retarding action of the paper web which is fed to it at a predetermined speed of approximately 1400 feet per minute; and wherein the speed of rotation of the mandrel is gradually reduced as the diameter of the roll increases, said decrease being compensated for by the yielding character of the frictional drive.

The said construction embodied in my improvements permits a high speed operation of the winder, and moreover, the adjustable support of the pressure cylinder against the paper roll facilitates its rotation and at the same time insures the tightening of the web during the act of winding. The result of these improvements enables a slitting and winding machine, modified by the substitution of my roll winder mechanism in place of the former means above referred to, to produce not only tightly wound rolls but increases the capacity of the machine approximately 500% and therefore the necessity of only $\frac{1}{5}$ the number of machines to insure a given output than has heretofore been required.

I have described my improved method and means in that particularity which I deem to be the best exposition of my invention, and that which I prefer in commercial practice, but I do not restrict or confine myself to the minor or secondary details, as such are susceptible of modification, which may be resorted to as a matter of mechanical skill and without a departure from the spirit of the invention.

I claim:

1. In a roll winding machine, means for winding a paper web upon a mandrel into roll form, combined with said mandrel, means to rotate the mandrel, paper tightening means comprising a pressure cylinder having an axis parallel to the mandrel and yieldingly pressed into frictional contact with the paper roll being formed on the mandrel, means for guiding the paper web to that portion of the mandrel and paper roll being

formed thereon which is rotating away from the pressure cylinder, and means for initially holding the pressure cylinder a slight distance away from the mandrel and the core thereon when present to permit the paper web to be wound upon the mandrel and core for a few turns before the web contacts with the pressure cylinder.

2. In a roll winding machine, means for tightly winding a paper web upon a mandrel in roll form, comprising said mandrel in combination with means to rotate the mandrel, paper tightening means including a pressure cylinder having an axis parallel to the mandrel and yieldingly pressed into frictional contact with the paper roll being formed on the mandrel, means for guiding the paper web to that portion of the mandrel and paper roll being formed thereon which is rotating away from the pressure cylinder, and the pressure cylinder being hung in two independently movable swinging arms whereby the ends of the cylinder may move independently, and the cylinder as a whole being movable bodily to and from the mandrel.

3. In a roll winding machine, means for tightly winding a paper web upon a mandrel in roll form, comprising said mandrel in combination with means to rotate the mandrel, a paper tightening means including a pressure cylinder having an axis parallel to the mandrel and yieldingly pressed into frictional contact with the paper roll being formed on the mandrel, means for guiding the paper web to that portion of the mandrel and paper roll being formed thereon which is rotating away from the pressure cylinder, and means for initially holding the pressure cylinder at a sufficient distance away from the mandrel to permit the paper web to be wound upon the mandrel for a few turns before the outer layer of the paper roll contacts with the pressure cylinder.

In testimony of which invention, I hereunto set my hand.

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