June 7, 1960 T. ROWLANDS ET AL 2,939,645

WINDING APPARATUS

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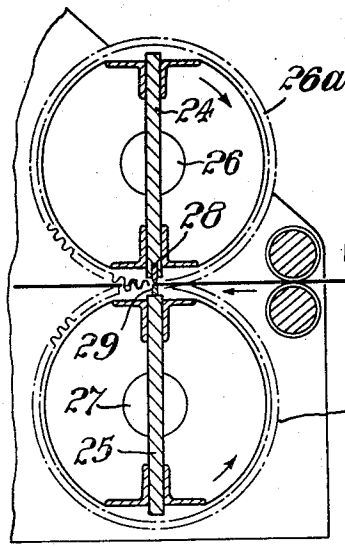

Fig. 2.

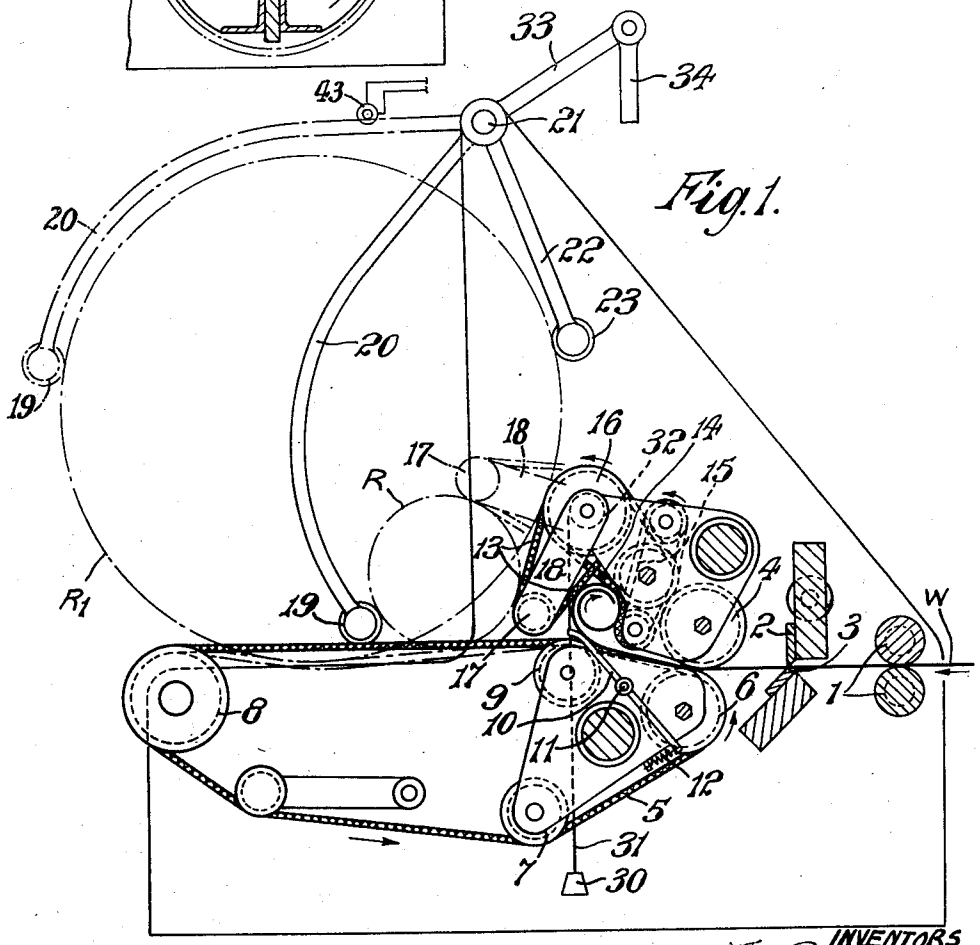

Fig. 1.

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FIG. 3.

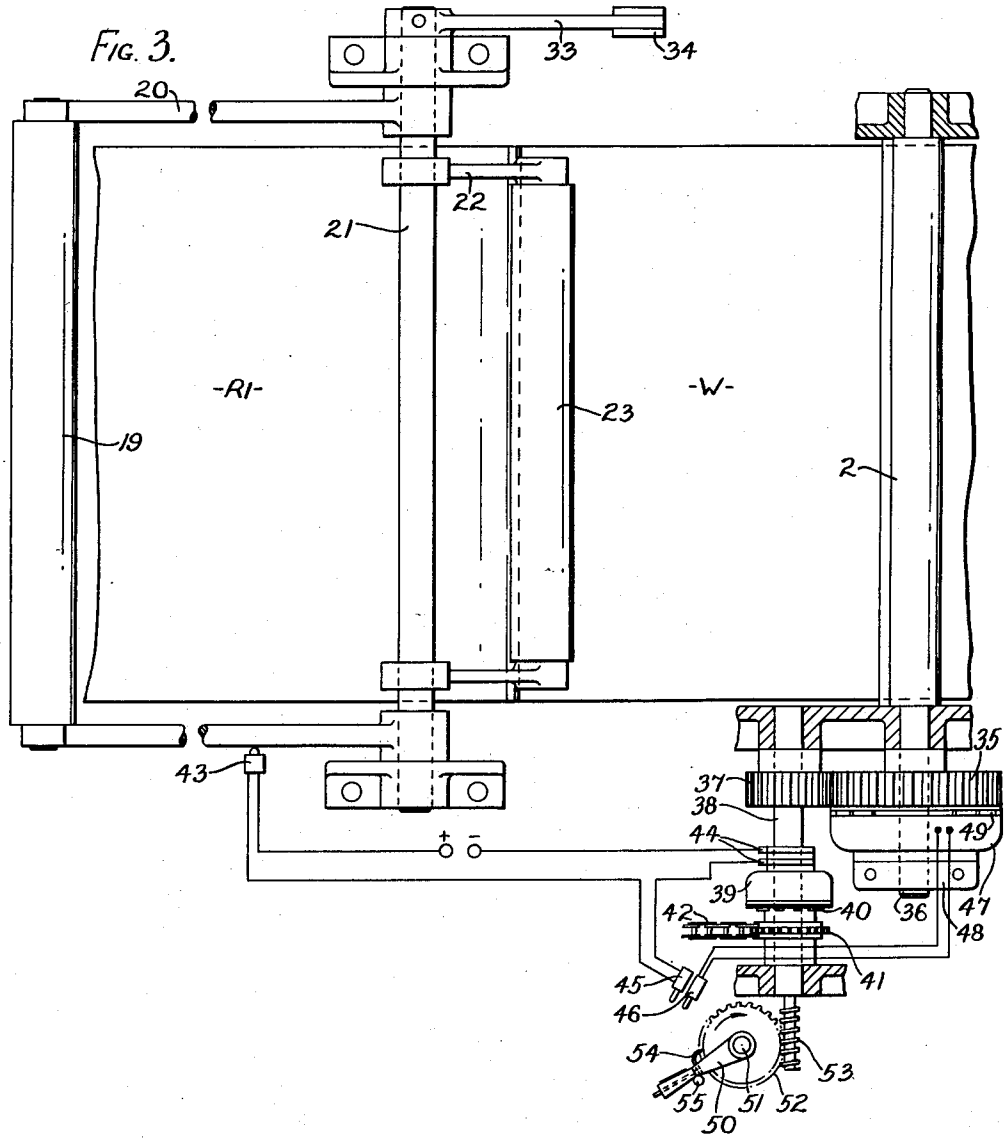

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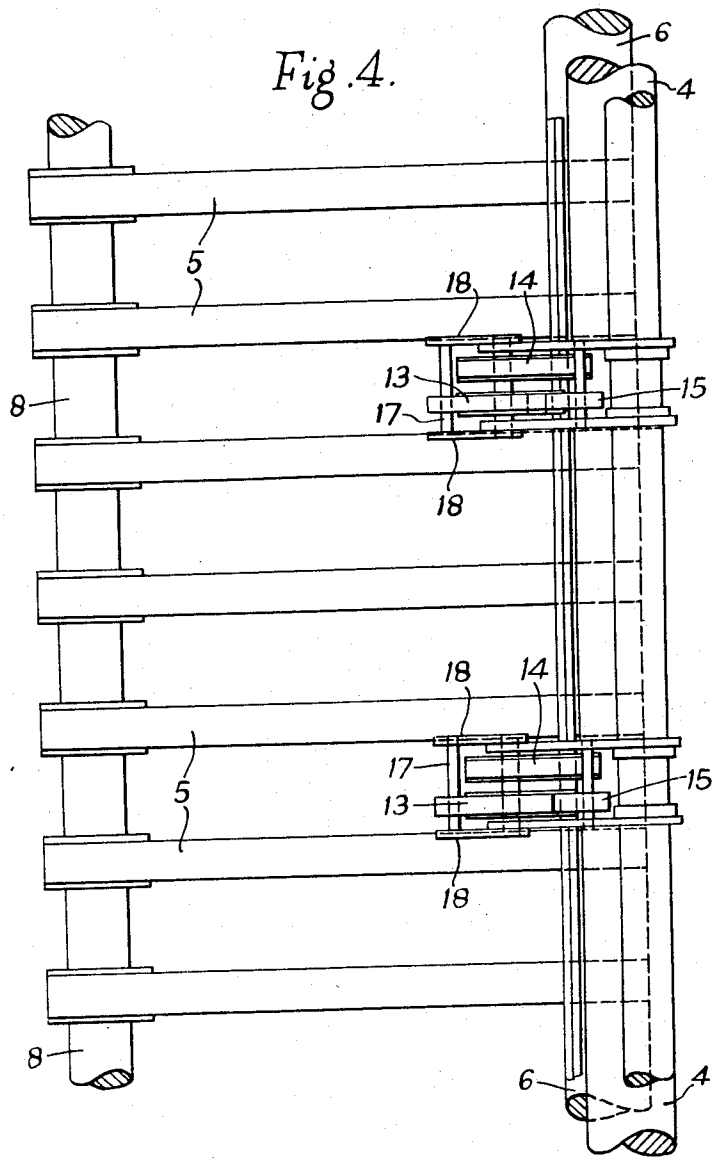
Fig. 4.



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WINDING APPARATUS

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5 Claims. (Cl. 242—56)

This invention concerns improvements in or relating to apparatus for forming rolls from a web of material, such for example as a web of corrugated paper.

According to the present invention, there is provided apparatus for forming rolls from a web of material, comprising a plurality of endless surfaces arranged to define a space between them, web-feeding means to feed a web into the said space, the said surfaces being arranged to engage the web within the said space and to move in directions such as to cause the web to wind on itself to form a roll, one of said surfaces being bodily displaceable in one direction to allow the roll so formed to move out of the space to a position such that the web extends from the roll through the said space, and in the opposite direction to return to its original position, means to engage the said roll outside the said space to continue its rolling action, cutting means to cut the web at such a position that the leading end of the cut web is engaged within the said space by the said surfaces and is thereby caused to wind on itself to form a further roll, while the trailing end of the web is wound on to the first roll to complete the formation of the latter. The displaceable surface may be arranged to be displaced in said one direction by pressure of a roll as the latter increases in size. The means to engage a roll outside the said space may comprise at least one of the said endless surfaces, for example, the said displaceable surface. Further, means may be provided to engage a roll outside the said space and urge it against the said displaceable surface.

Apparatus according to the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a side view, partly in section of winding apparatus intended to operate on a web of corrugated paper continuously issuing from a corrugating machine;

Figure 2 shows an alternative form of cutting mechanism for cutting the web;

Figure 3 is a diagram of control devices for the cutting mechanism; and

Figure 4 is a plan view of some of the apparatus shown in Figure 1.

A web W of corrugated paper is led from a corrugating machine (not shown) between draw rollers 1 and between a rotary knife 2 and a co-operating knife 3 to pass between a draw pulley 4 and the surface of a conveyor belt system 5 which passes over pulleys 6, 7, 8 and 9. The conveyor system 5 comprises a suitable number of relatively narrow belts or bands (e.g. ½ inch bands) spaced apart laterally from each other, as shown in Figure 4. Pivoted levers 10 project upwardly through the spaces between the bands so as to extend into the path of the web W, being urged in this direction about the pivot 11 by a spring or springs 12.

Above the supporting bands 5 is provided an assemblage of sets of endless moving bands which are arranged to co-operate with one another and with the bands 5 so as to provide an enclosed space into which the web W is fed. There are three sets of bands 13, 14 and 15, each set consisting of a suitable number of half-inch bands laterally separated and spaced apart from each other and mounted on pulleys, the bands of the set 14 being offset laterally from those of the other two sets so that the bands of one set can pass between those of another, or in other words the bands can intermesh. The bands are arranged to move in the directions indicated by the arrows. Thus the co-operating endless surfaces constituted by the sets of bands 5, 13, 14 and 15 all move in directions such as to impart a rolling motion to the web on the enclosed space between them, so as to cause the web to wind on itself to form a roll, since as will be seen these co-operating surfaces (that is, those parts of the bands which define the enclosed space) together move in a roughly circular direction. As already stated, these surfaces are formed by laterally separated narrow bands and are therefore not continuous surfaces, and accordingly the space said to be defined by these surfaces is to be understood as the space between the planes in which the operative parts of the bands lie.

The purpose of the pivoted levers 10 is to guide the leading end of the web upwardly so as to lead it into engagement with the guide surface 13 and thus to cause it to curl backwardly so as to start a winding or rolling movement in which the web rolls or winds on itself to form a roll. This rolling movement is, of course, assisted by the guide surfaces 14 and 15, as well as by the bands 5, which also form a support surface for the roll.

In the drawing the web W, shown as a thick line, is seen to have started rolling on itself within the enclosed space.

As this winding action continues, the roll formed thereby progressively increases in size, and the enclosed space which contains it must be enlarged to accommodate it. The endless surface constituted by the bands 13 is arranged to be bodily displaceable in one direction so as to permit this enlargement of the space, and also to allow the roll to move out of the space, towards the left as viewed in Figure 1, to a position on the support surface 5 such that the web extends from it through the space, while bodily displacement of the bands 13 in the opposite direction returns them to their original position. For this purpose the bands 13 are arranged to pass about pulleys 16 and 17, mounted on swingable arms 18 which are free to swing about the axis of the pulleys 16. Thus as the roll increases in size, it presses against the bands 13 and this pressure causes the arms 18 to swing to the left as viewed in the drawing, away from the other guide surfaces, thus enlarging the space between the guide surfaces and allowing the growing roll to move progressively to the left, and to move out of the space defined by the endless surfaces 5, 13, 14 and 15. A suitable counterweight may be provided to urge the arms 18 counterclockwise, as viewed in Figure 1, against the pressure of the roll. This is shown as a weight 30 attached to a strap 31 running round a drum 32.

In the drawing the roll, designated by the reference R, is shown in dot and dash line in a position it occupies after it has grown to the size shown, and the bands 13 and arms 18 are also shown in dot and dash lines in the position they have assumed at this stage. It will be seen that as the size of the roll increases further, it will move still further to the left, and the arms 18 will eventually be free to swing down again under gravity to their original position as shown in full line. As the roll increases in size, the arms 18 and pulleys 17 are forced upwardly until they are positioned wholly to the right of the center of the roll (as viewed in Figure 1) and thereafter the weight of the arms 18 and pulleys 17, supplemented by the weight 30, exert a pressure on the roll at a position to the right of its center, this pressure being sufficient to urge the roll to move bodily continuously

toward the left (Figure 1). As such movement of the roll proceeds, the pulleys 17 start to move downward as the arms 18 start to swing counterclockwise. After the arms 18 have reached a position such that the axes of the pulleys 17 and 16 lie in the same plane as the axis of the roll, the roll ceases to support the pulleys 17, which then return to the position shown in full line in Figure 1. During the bodily movement of the roll to the left as just described, the roll is held in engagement with the bands 13 by a roller 19, to be described shortly, which engages the other side of the roll but exerts insufficient force against the roll to resist this bodily movement. The partly completed roll will then have moved out of the space between the co-operating guide surfaces of the bands 5, 13, 14 and 15, but will be still engaged by the displaceable surface, that is by the bands 13, which will still impart rolling motion to it, as do the support surface constituted by the bands 5 on which it is supported.

The arms 18 having returned to their original position as shown in full line, the bands 13 are in position to engage a new length of web as soon as the web is cut by the knives 2 and 3.

The roll R is engaged by a roller 19 suported on arms 20 which are pivoted on a bar 21, the roller 19 resting lightly against the roll and tending to urge the roll against the bands 13. As the roll continues to increase in size, it forces the arms 20 further to the left as viewed in the drawing, until they reach the position shown in dot and dash line. The roll at this stage is also indicated in dot and dash line, and identified by the reference R^1. When a sufficient length of web has been wound (for example when the arm 20 reaches the position shown) the movement of the arm actuates a switch which causes the knives 2 and 3 to operate to cut the web. For example a limit switch may be arranged to actuate the rotary knife 2 by means of a suitable one-revolution clutch or equivalent device.

A diagrammatic arrangement for this purpose is shown in Figure 3. The rotary knife 2 has a large gear wheel 35 on its shaft 36 which is driven by a gear wheel 37 half its diameter. The gear wheel 37 is fixed to a shaft 38 on which is mounted the magnet hub 39 of a magnetic clutch. The cooperating armature 40 is loose on the shaft and fixed to a substantial sprocket wheel 41 driven by rocker chain 42. The chain is driven by any suitable means from the corrugating machine and runs continuously. As an arm 20 rises to the position where the roll is big enough for the web to be cut it operates a micro-switch 43 and current is fed through brushes 44 to the clutch magnet. The line includes a further microswitch 45 which is normally closed. The clutch magnet therefore engages the armature 40 and the rotary knife is driven, but as it is to stop after one complete revolution the shaft 38 has to make two revolutions and then stop. Stopping is effected by the switch 45 which breaks the clutch circuit at the appropriate time and a further switch 46 which engages to feed current to a magnetic brake 47 mounted around the shaft 36 of the rotary knife but fixed to a bracket 48. As the brake is energized its plate 49 is engaged and as this plate is attached to the gear wheel 35 the knife is stopped from further movement.

To operate switches 45 and 46 at the proper time there is provided a switch operating arm 50 which is loose on a shaft 51 to which is fixed a wormwheel 52.

A worm 53 on shaft 38 drives the wormwheel and the arm is provided with a thumb-controlled detent 54 which can engage the worm teeth to cause the arm to rotate with the wheel. At rest, the arm is, as shown, touching a fixed stop 55. When the switch 43 makes contact, the knife shaft 36 is driven, and the wormwheel rotates. The arm strikes the switch 45 a very short time before shaft 38 has completed two revolutions and the switch 46 an instant before the end of the shaft movement and the brake 47—49 brings the knife to a standstill at the desired moment.

After the roll has been removed so that the arm 20 can return to its first position the operator grasps the arm and presses on the detent thumb-knob and returns the arm to the position shown, whereupon he releases the thumb-knob to re-engage the detent in the wormwheel.

When the web is cut, the rear or trailing end of the length of the web forming the roll R^1 continues to wind on to the roll to complete its formation, and simultaneously the leading end of the cut web is deflected by the levers 10 into engagement with the moving endless surfaces constituted by the bands 13, 14 and 15 to start the winding of a further roll.

The completed roll R^1 may be removed from the supporting bands 5 by means of arms 22 pivotally mounted on the bar 21 and carrying a roller 23. This is effected by swinging the arm 22 to the left, which may be done manually by lever 33 and link 34, or by any suitable automatic means.

An alternative form of cutting mechanism is illustrated in Figure 2. This comprises knife holders 24 and 25 consisting of wide flat plates mounted for rotation, on shafts 26 and 27, in the directions indicated by the arrows. The holder 24 carries a knife 28 while the holder 25 carries either a co-operating knife or, as shown, an anvil 29. In the position shown in Figure 2, the knife 28 and anvil 29 are in contact such as to cut the web W.

The shafts 26 and 27 are geared together for rotation by gearwheels 26^a and 27^a, but the gearwheel on one shaft has one more tooth than has the gearwheel on the other shaft. Due to this difference in the number of teeth, the knife 28 and anvil 29 (or co-operating knife if employed) will meet only once in a number of revolutions equal to the selected number of teeth on the gears. This number can be so chosen, in relation to the diameters of the circles through which the knife and anvil move, that the latter meet and cut the web at predetermined times to cut off a desired length each time. Moreover, by suitable selection of the number of teeth on the gears and the size of the holders 24 and 25, the device can be so arranged that on the revolution immediately following that during which the web is cut, the knife 28 is sufficiently clear of the anvil 29 to avoid damage to the web. It will be seen that with this construction the cutting mechanism can be run continuously without any need for starting and stopping at each cut as in the arrangement previously described with reference to Figure 1.

The bands 13, 14 and 15 are preferably driven at the same speed as the bands 5, and in that case they will slip slightly on the roll due to the fact that the roll moves gradually in the direction of feed of the web as its size increases, so that peripheral speed of the roll is slightly less than the speed at which the web is fed forwardly. The bands 13, 14 and 15 could, however, if desired be driven slightly slower than the bands 5, so as to have the same speed as that of the periphery or outer surface of the roll.

It is customary when winding corrugated paper to slit the web lengthwise into desired widths before winding it. This operation can also be performed when the winding is effected in the manner described above, the slitting devices (not shown) being located at any convenient position. Where herein a "web" of material is referred to, this expression is to be understood as including not only a single web, but also a plurality of side-by-side webs such as produced by longitudinally slitting a single web into a number of desired widths.

It will be seen that the apparatus according to the present invention makes it possible to cut the web and start the formation of a new roll while the formation of the previous roll is still being completed. This is made possible by the arrangement whereby one of the endless surfaces (namely, the set of bands 13) defining the en-

closed space is displaceable in one direction to allow a roll to move out of the space, where its winding or rolling action continues, and then in the opposite direction to return to its original position so that when the web is cut its leading end will immediately start to wind on itself within the said space, while the formation of the roll which previously moved out of the space is completed as the trailing end of the web winds on to it.

Thus, the winding or formation of any one roll may be said to be started within the space defined by the endless surfaces formed by the bands 5, 13, 14 and 15, and completed outside that space. This ensures that at the moment when the web is cut, the endless surfaces which define the space are already in position to start the formation of a further roll. Also, it will be seen that the space in which the formation of a roll is started can be relatively small, as a roll can move out of the space at an early stage in its formation and the greater part of its formation can be effected outside the space.

What we claim as our invention and desire to secure by Letters Patent is:

1. Apparatus for forming rolls from a web of material, comprising a plurality of endless surfaces arranged to define a space between them, one of said surfaces forming a support surface and having a part extending outside said space, web feeding means to feed a web into said space, the said surfaces being arranged to engage the web within said space, means to move said surfaces in directions such as to cause the web to wind on itself to form a roll, one of said surfaces being bodily displaceable in one direction to allow a partly formed roll to move along said support surface out of said space to a position on said extending part of the support surface such that the web extends from the said partly formed roll through said space, and in the opposite direction to return to its original position, means including said part of said support surface and at least one further moving surface to engage said partly formed roll outside said space to continue its rolling and winding action, cutting means, operative only after the partly formed roll has moved out of said space, to cut the web at such a position that the leading end of the cut web is engaged within said space by said surfaces and is thereby caused to wind on itself to form a further roll, while the trailing end of the web is wound onto the first roll to complete the formation of the latter outside the said space.

2. Apparatus as claimed in claim 1, wherein said means to engage a roll outside said space includes said displaceable surface.

3. Apparatus as claimed in claim 2, comprising further means to engage a roll outside said space and urge it against said displaceable surface.

4. Apparatus as claimed in claim 1, wherein the said displaceable part is pivotally mounted for bodily swinging movement away from and toward the said support surface and is arranged to engage a partly formed roll both inside and outside the said space, and means to maintain engagement between said displaceable part and a partly formed roll outside the said space, whereby the displaceable part imparts rolling motion to a roll during the whole of its formation.

5. Apparatus as claimed in claim 1, wherein said displaceable surface is formed by the surfaces of a set of bands arranged to move about pulleys on a swingable member, which latter is arranged to be swung so as to cause said displaceable surface to move away from the other endless surfaces and allow a roll to move out of said space, and then to be swung back to its original position, while continuing to engage the roll.

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