

March 3, 1970

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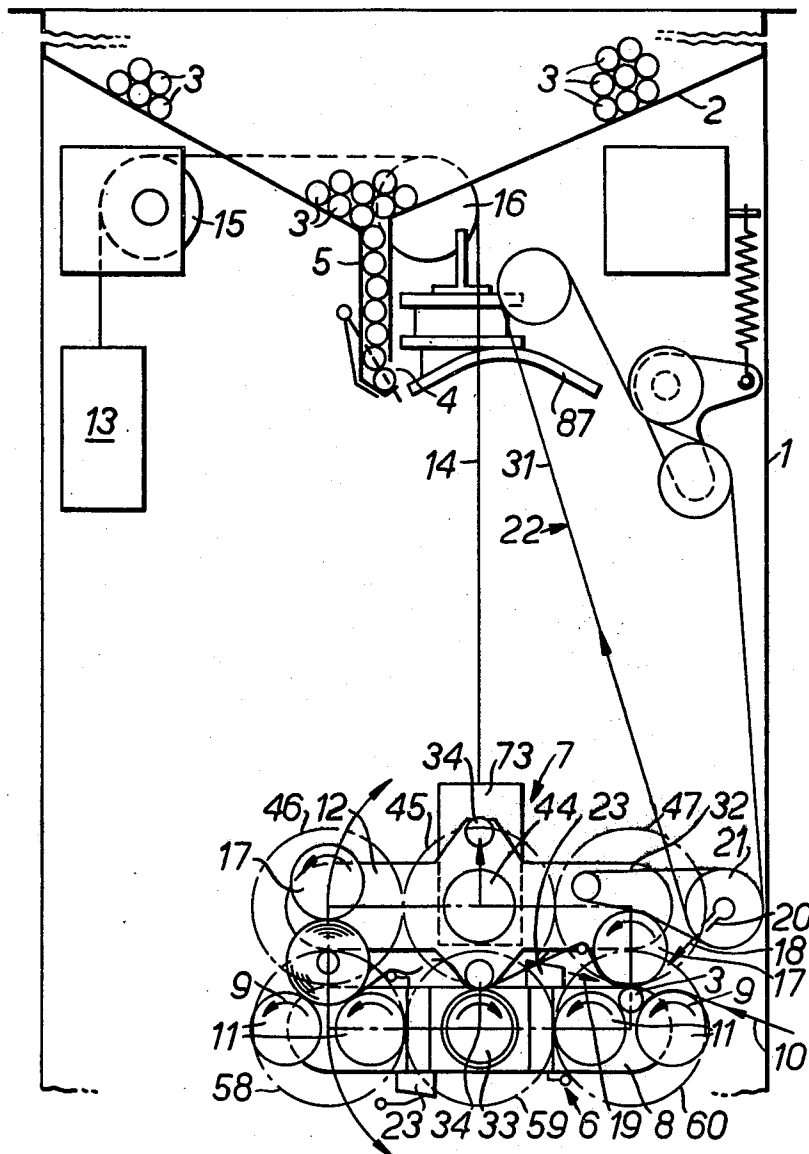
3,498,557

MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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18 Sheets-Sheet 1

FIG. 1.



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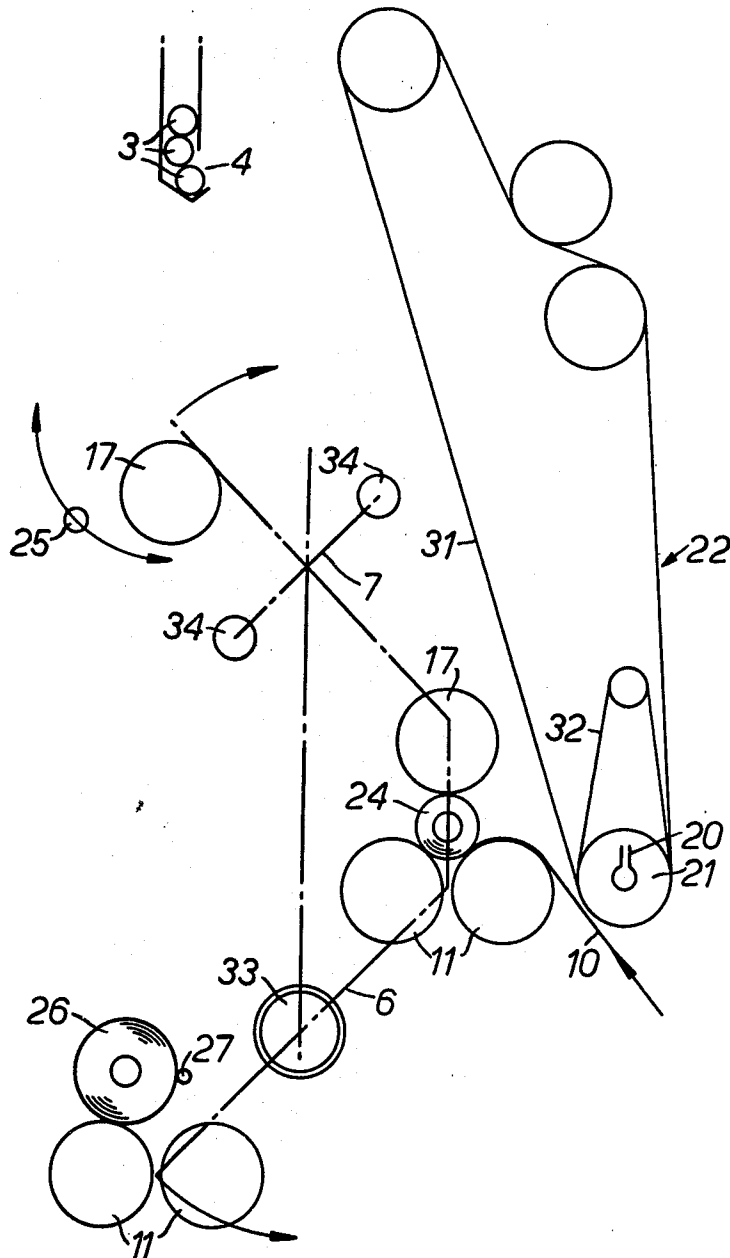
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FIG. 2.



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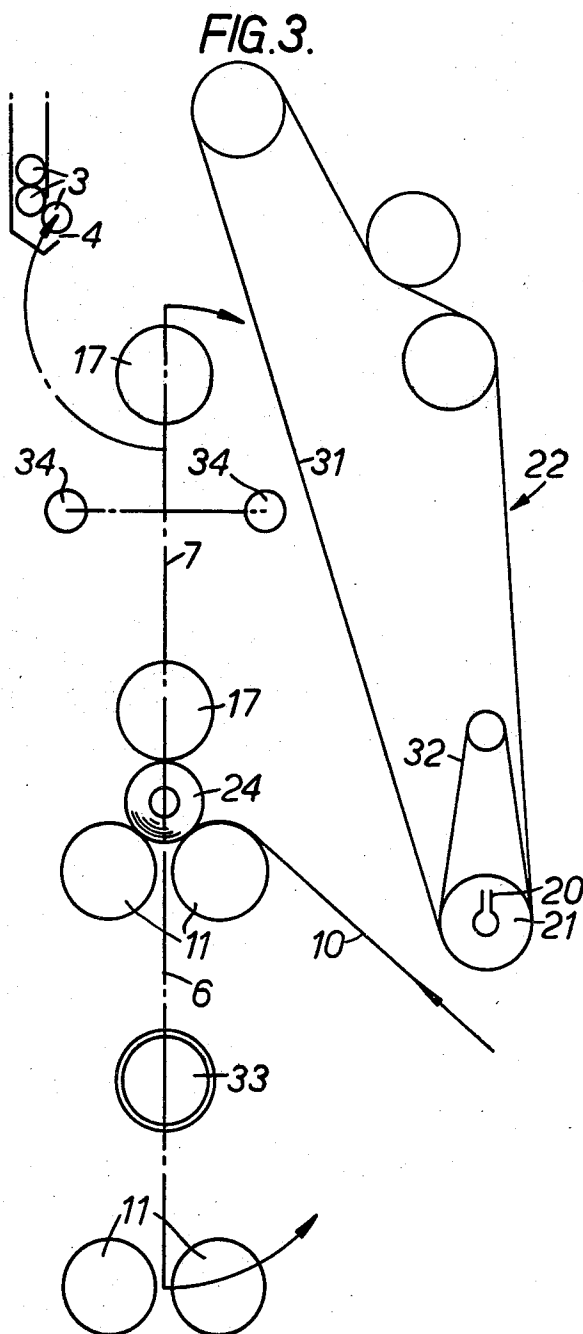
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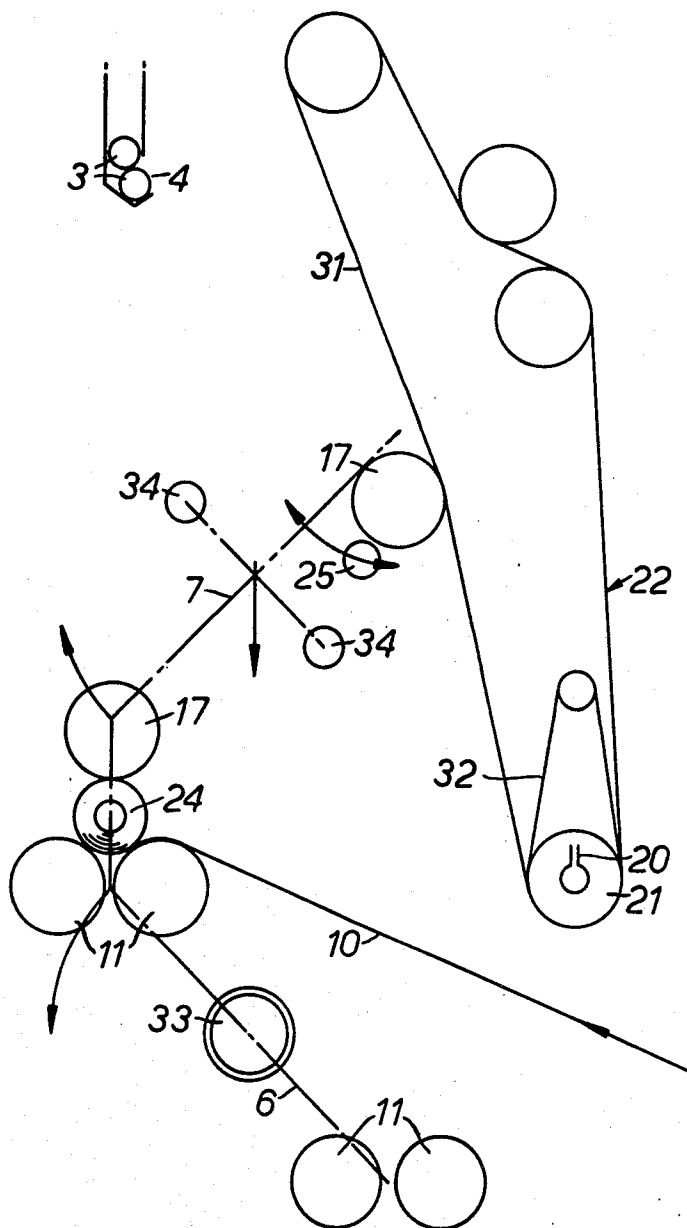
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FIG. 4.



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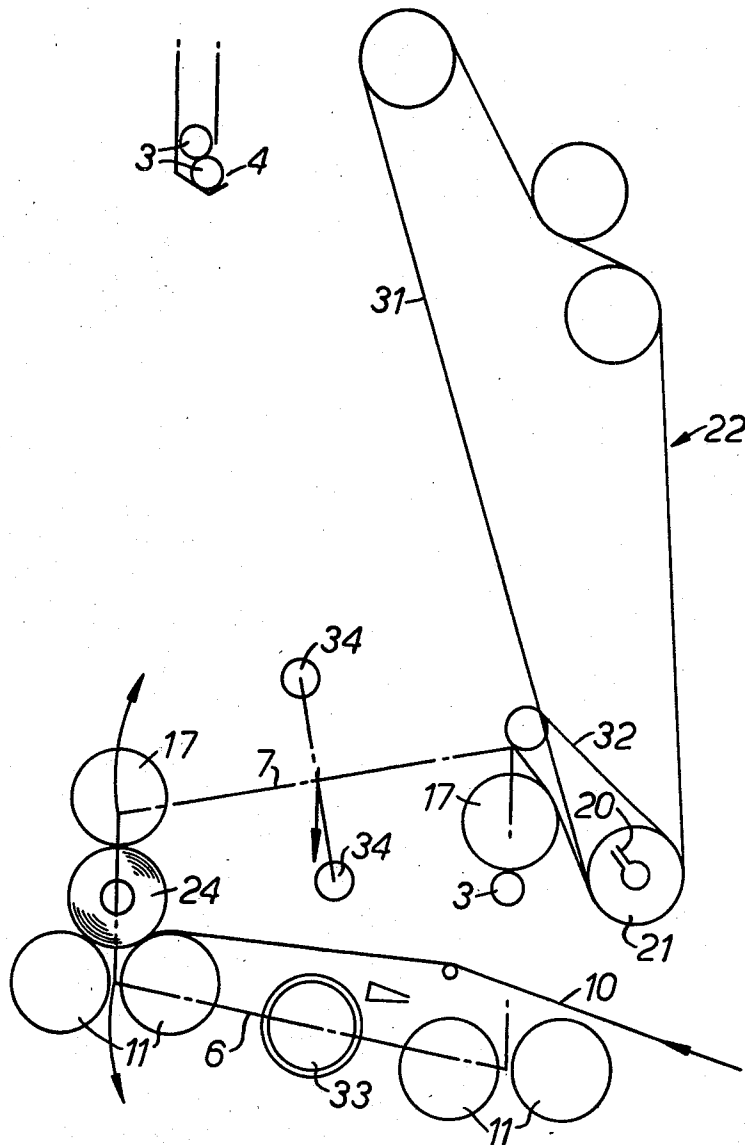
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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**FIG. 5.**



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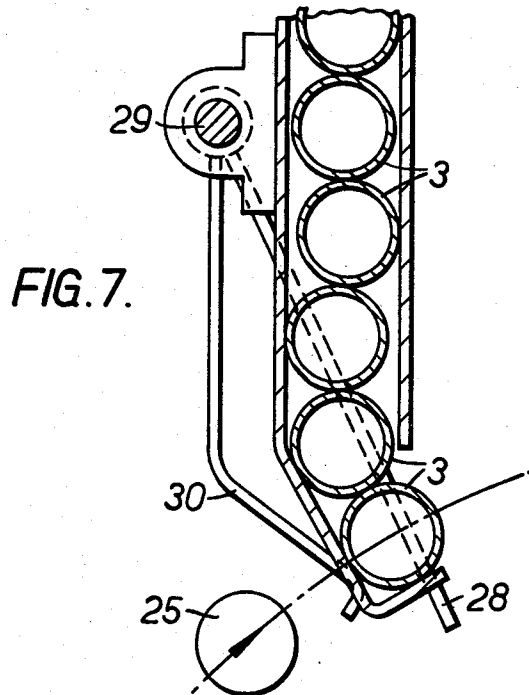
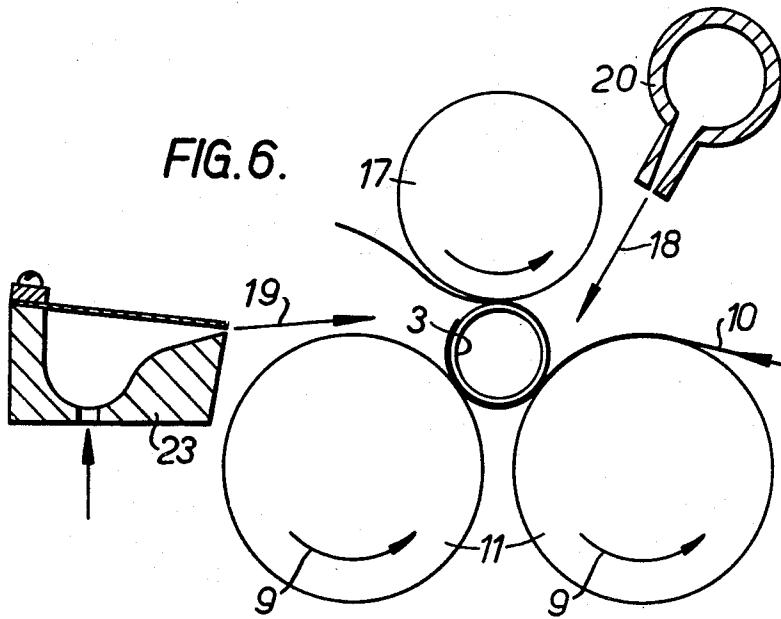
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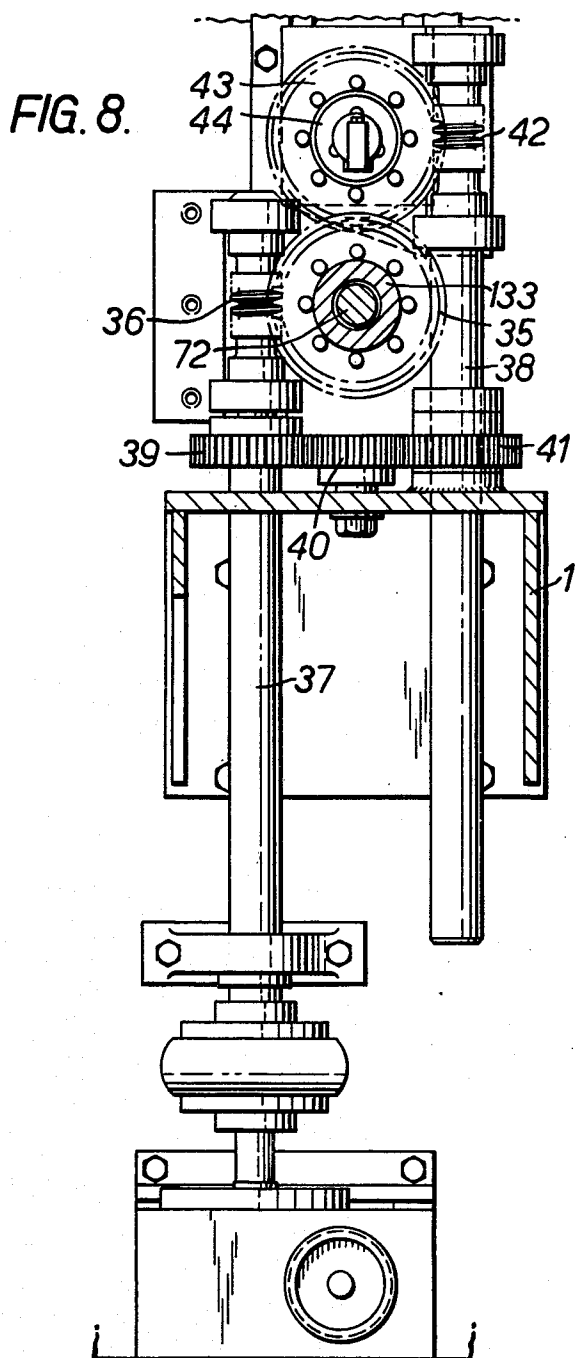
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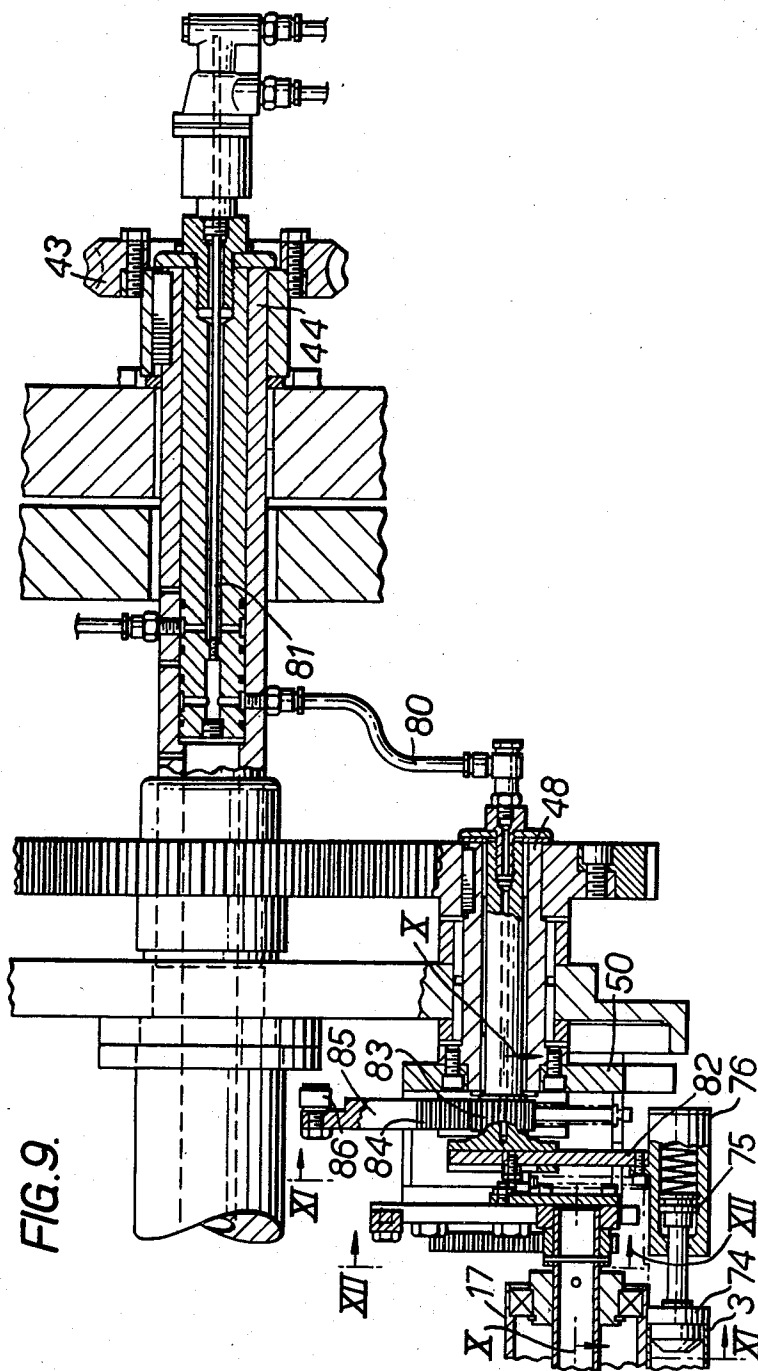
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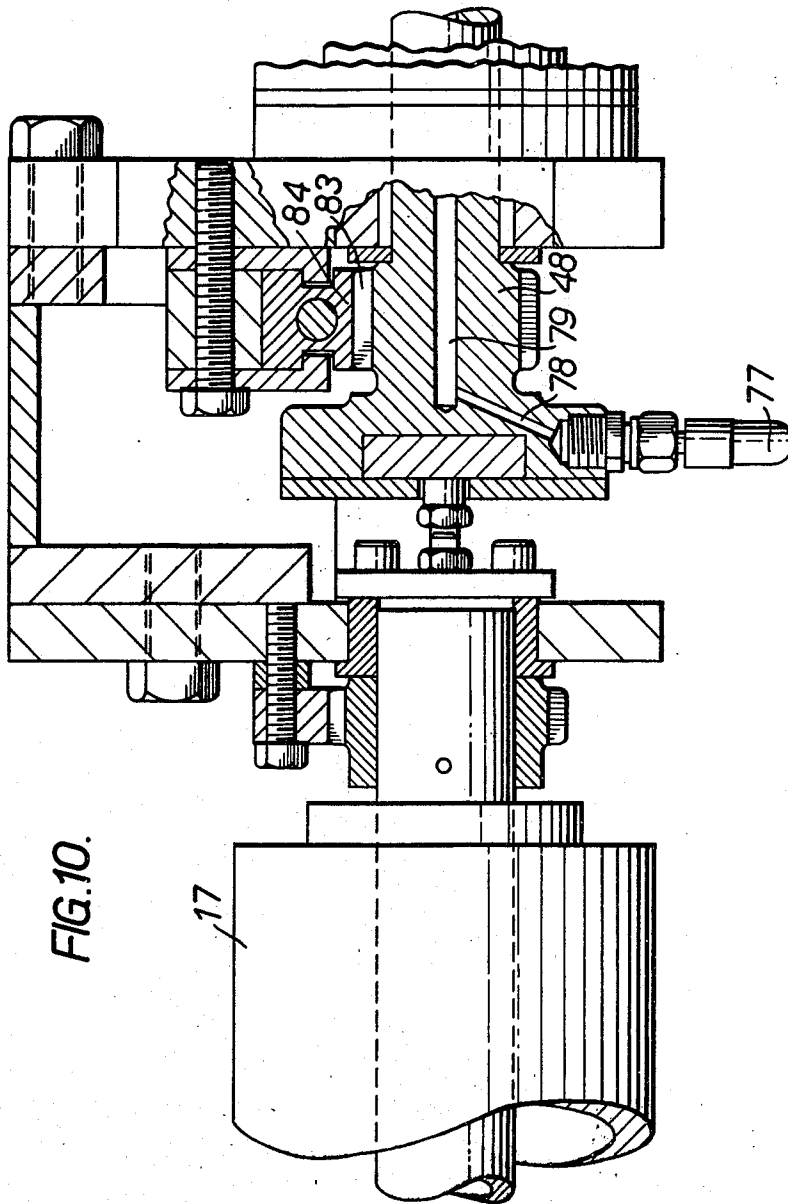
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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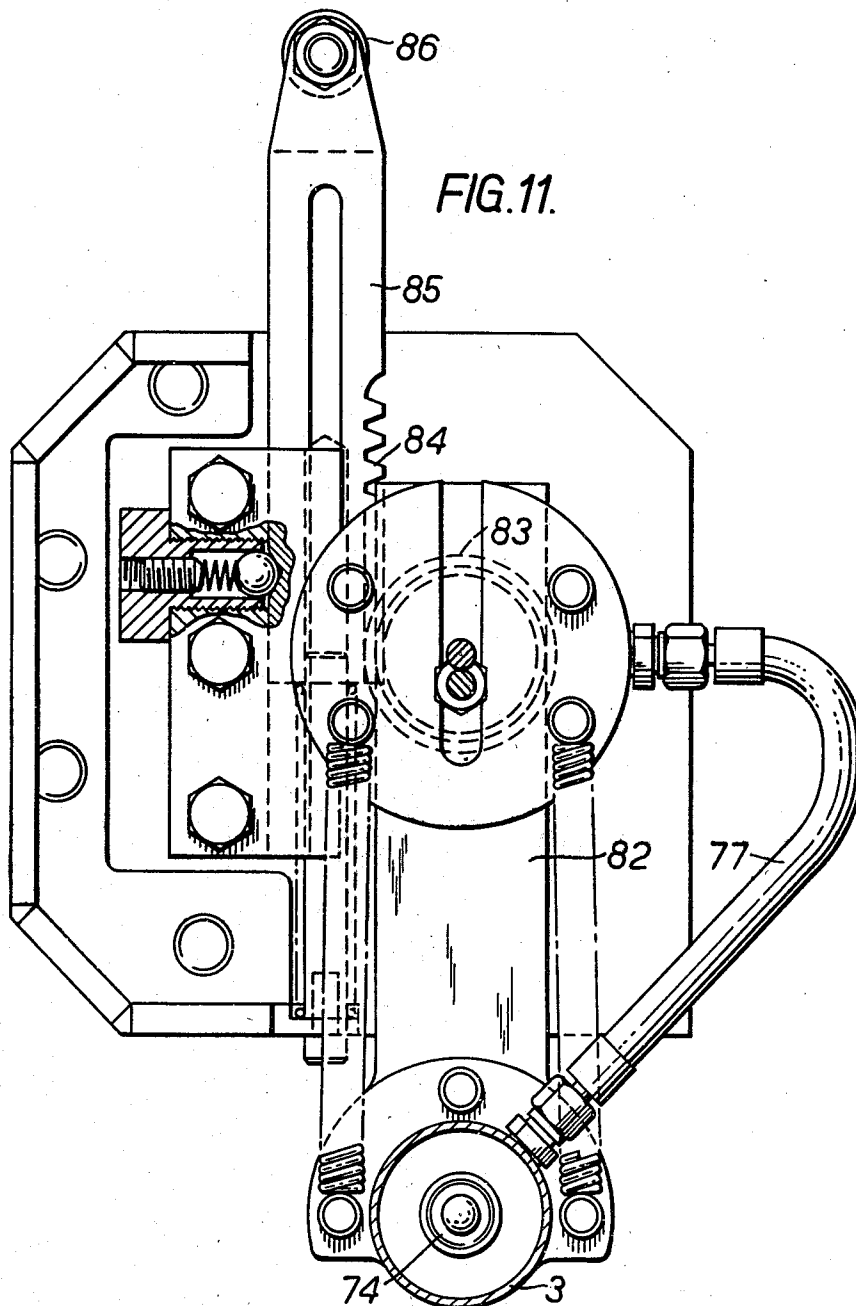
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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FIG. 12.

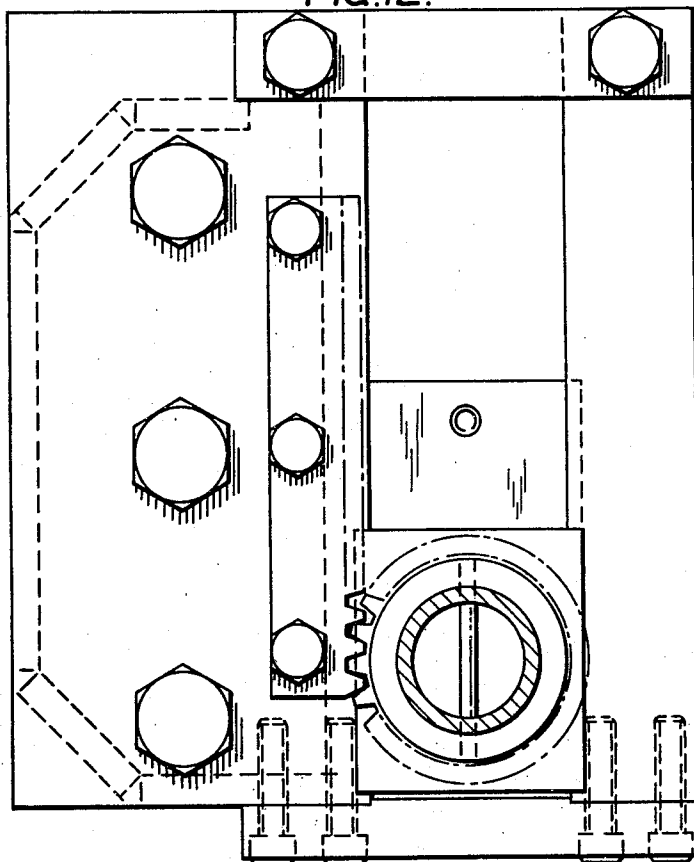
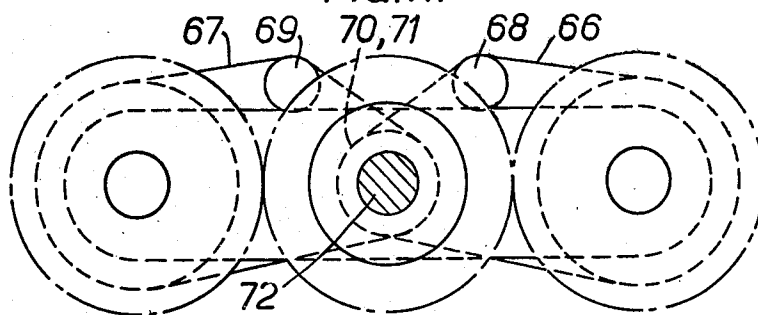


FIG. 17.



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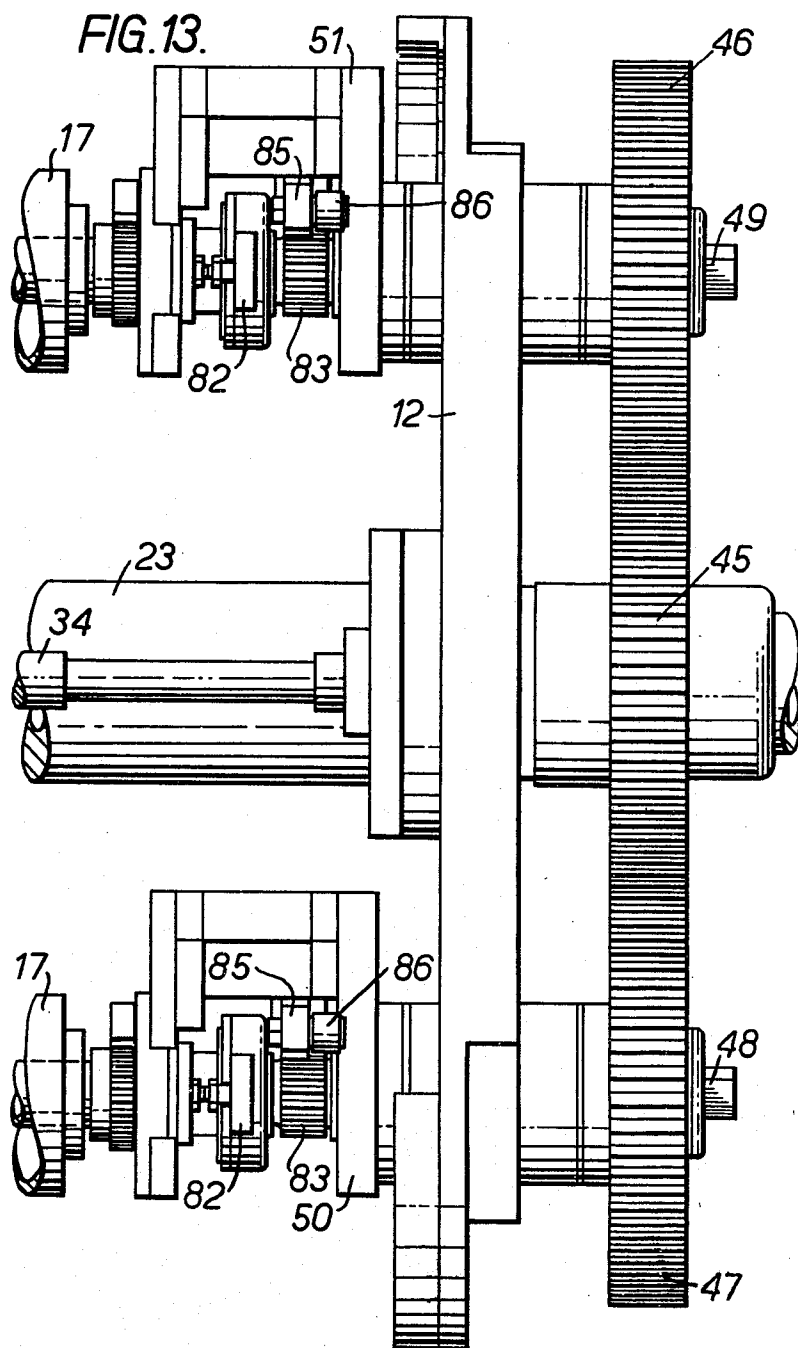
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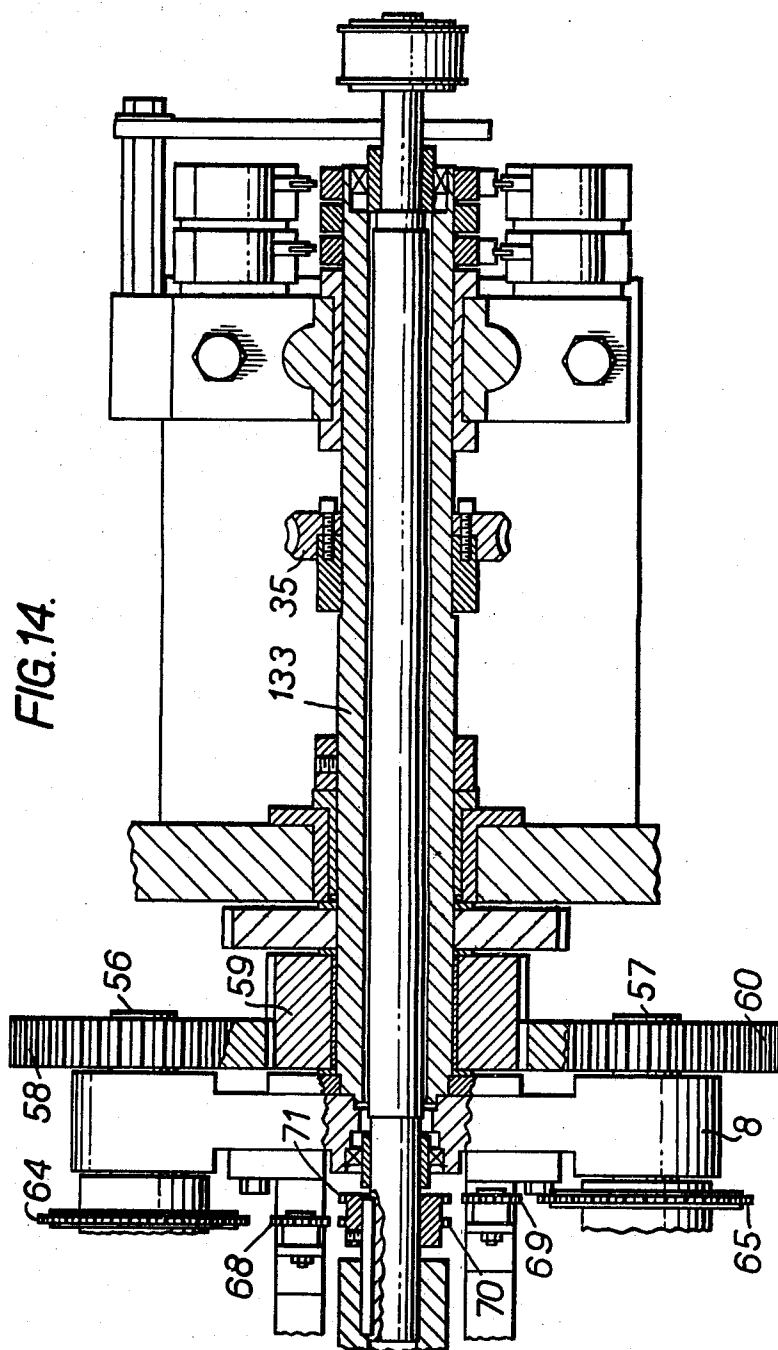
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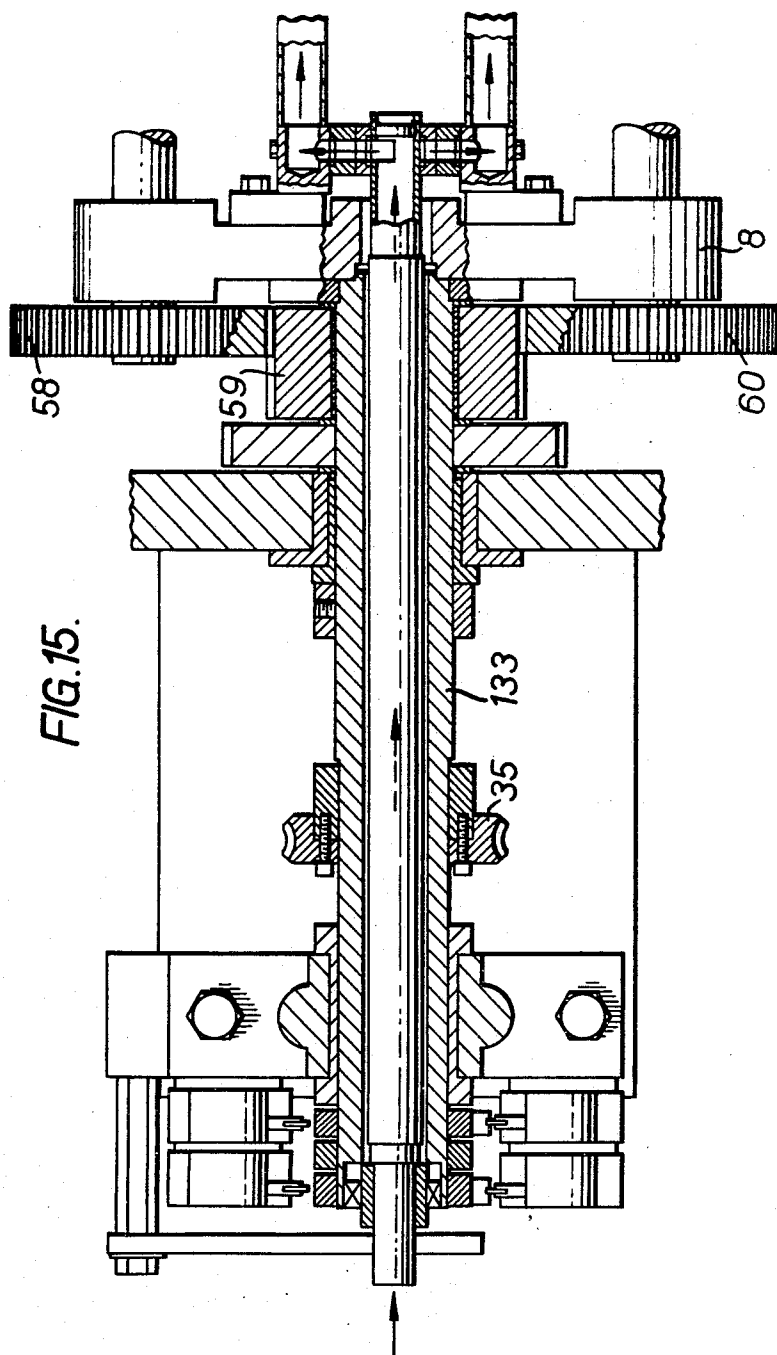


FIG. 15.

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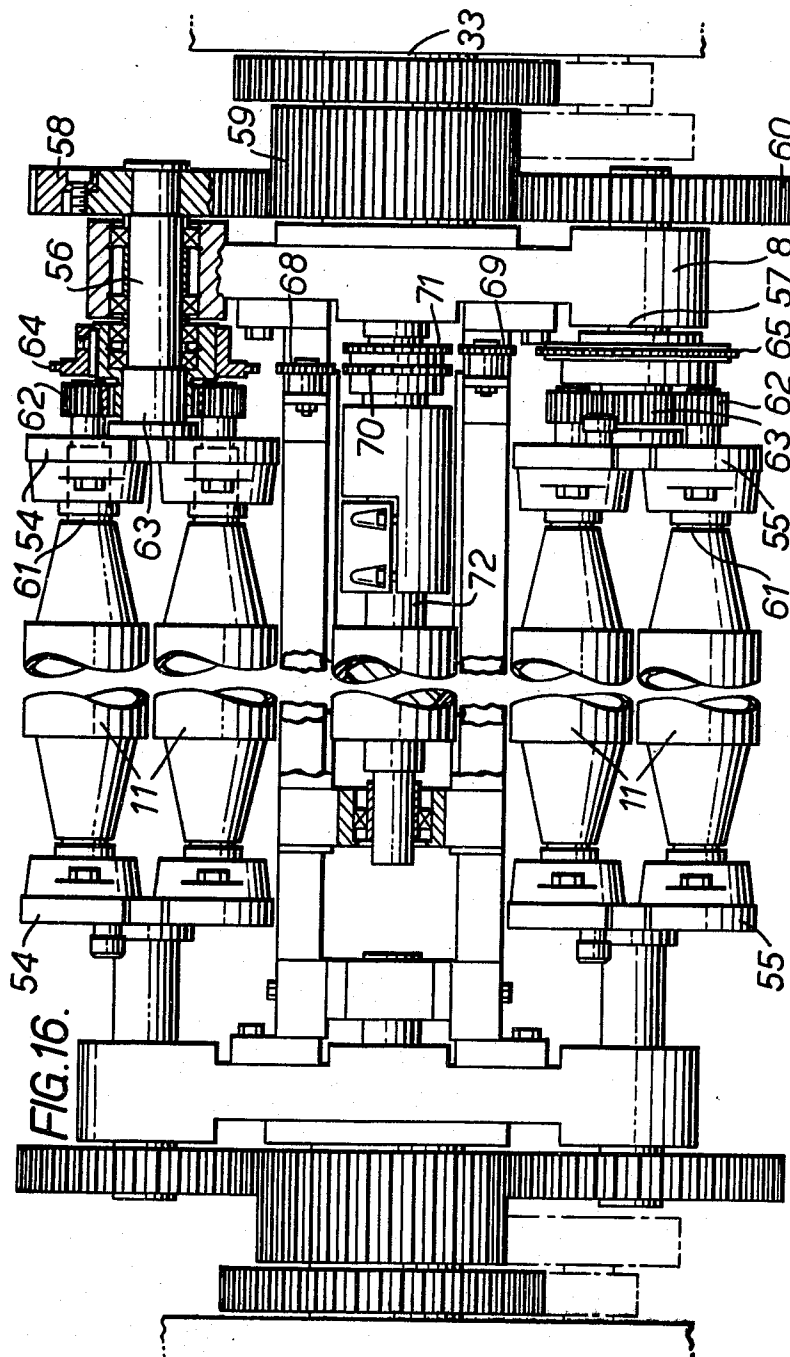
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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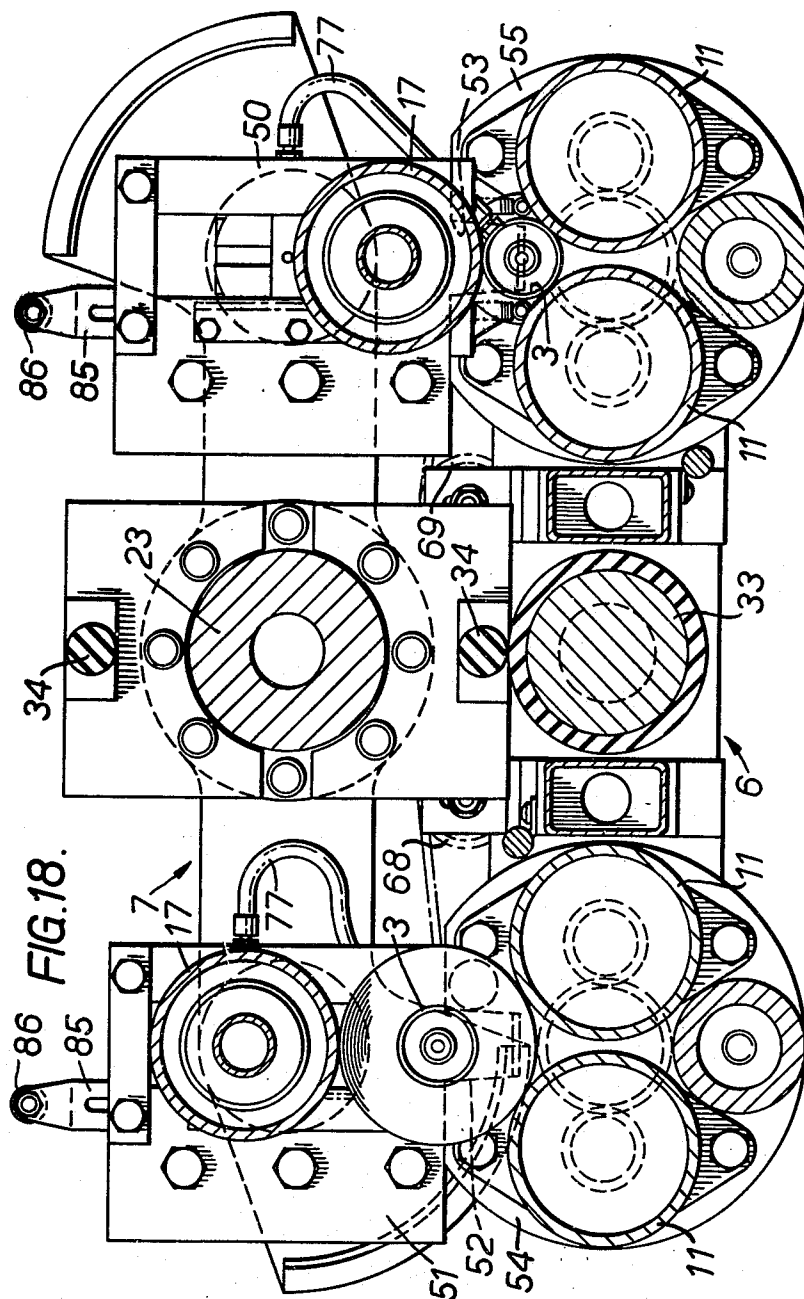
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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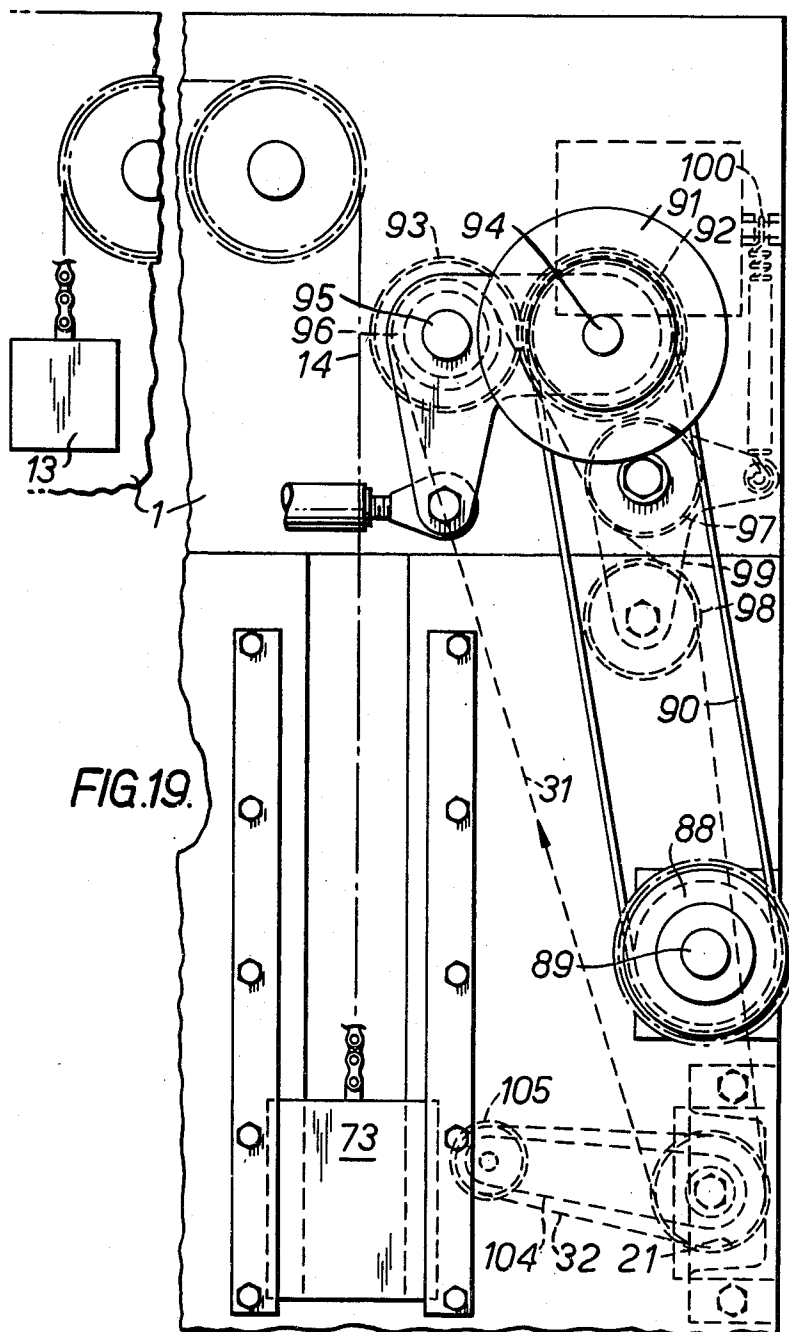
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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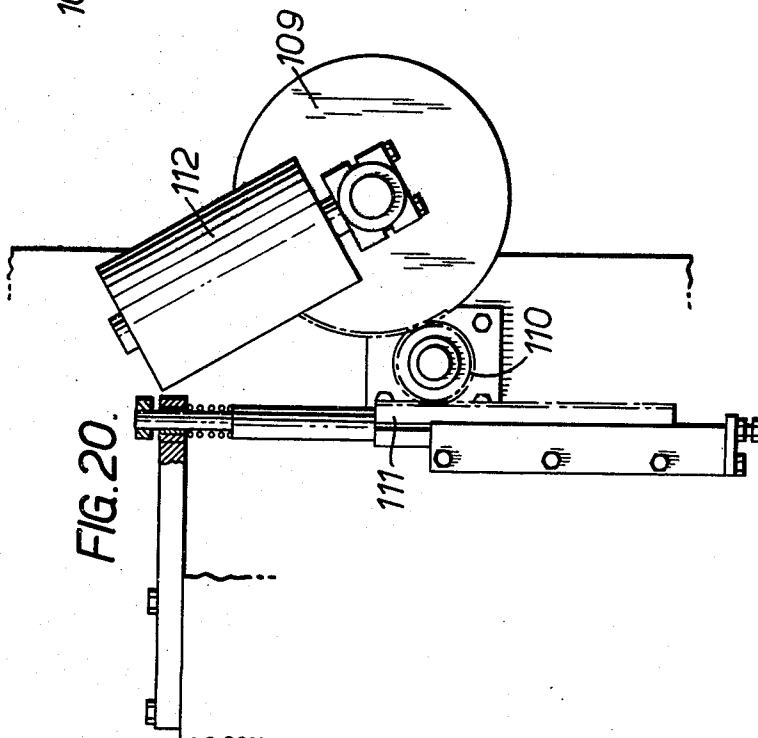
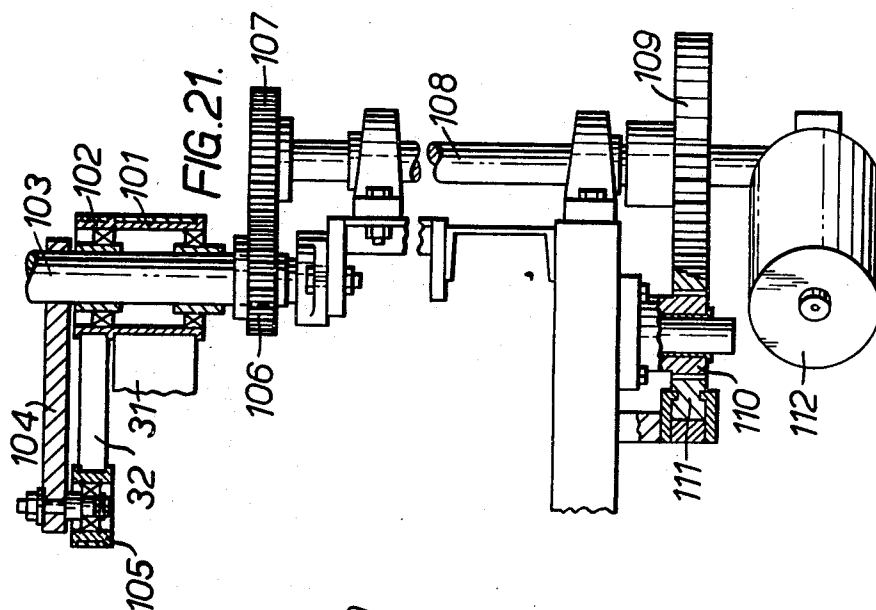
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MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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3,498,557

## MACHINE FOR FORMING WOUND ROLLS OF SHEET MATERIAL

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U.S. Cl. 242—56

13 Claims

### ABSTRACT OF THE DISCLOSURE

In a machine for rewinding webs of toilet tissue or other material into rolls of predetermined diameter or reeled length, continuous operation is achieved by the provision of a rotatable winding head having a plurality of pairs of winding rollers operable in turn to wind the web upon cores fed thereto in succession from a hopper and means, operable while a roll is being wound, for removing a fresh core from the hopper, rotating it to a speed equal to the speed of the web and depositing it in operative relation to the web and the next operable pair of winding rollers ready for winding a new roll thereon upon severance of the web between it and the preceding completed roll.

This invention relates to machines for rewinding webs of material into rolls of predetermined diameter or reeled length and its object is to obviate the necessity for interrupting the operation of such machines upon completion of a roll and so increase their rate of output.

To this end, according to the invention, there is provided a machine for automatically rewinding webs of material into rolls of predetermined diameter or reeled length, comprising a frame provided with a container for a plurality of cores, a winding station rotatably mounted in said frame and provided with two sets of winding rollers operable alternately on a web during each half-revolution of said winding station to wind the web into a complete roll on one of said cores, transfer means operable during each half-revolution of said winding station to remove a core from said container, rotate it to a speed equal to that of the web and deposit it before the end of said half-revolution on that part of the web passing over the temporarily inoperative set of rollers, means for applying the end of the web to said core whereby it is wound thereon to form a roll, means slidably mounted in said frame and operable during each half-revolution of the winding station to exert top pressure upon the core and the roll being wound thereon, means operative upon completion of each roll to sever it from said web, and means operable to eject the completed and severed roll from said winding station.

The invention is particularly applicable to machines for rewinding webs of toilet tissue or other sheet material into logs which are subsequently cut up into small rolls, and will be described with reference to a machine of this type in which each log is wound upon a hollow cylindrical core which is maintained in the nip between one of two pairs of horizontal winding rollers over which the web is trained, by a vertically displaceable rider roller.

One embodiment of the invention will be described in detail with reference to the accompanying drawing in which:

FIGURE 1 is a diagrammatic end view of the machine showing the parts in the positions occupied at the time of completion of one roll and commencement of another;

FIGURES 2 to 5 are diagrammatic end views showing the positioning of the parts at various stages in the winding of each roll;

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FIGURE 6 is a diagrammatic view showing the application of the end of a web to a new core;

FIGURE 7 is a vertical section through the outlet of the core container showing in diagrammatic form, the path taken by the core transfer means;

FIGURE 8 is an elevational view of the drive to the winding station and top pressure means at one end of the machine;

FIGURE 9 is a horizontal section through one end of the top pressure means showing the air supply connection to the core transfer means;

FIGURE 10 is an enlarged section on the line X—X of FIG. 9;

FIGURE 11 is an enlarged section on the line XI—XI of FIG. 9;

FIGURE 12 is an enlarged section on the line XII—XII of FIG. 9;

FIGURE 13 is a plan view of the top pressure means;

FIGURE 14 is a horizontal section through one end of the winding station showing the drive to the winding rollers;

FIGURE 15 is a plan view, partly in section, of the other end of the winding station showing the air supply passages therein;

FIGURE 16 is a plan view, partly in section, of the winding station;

FIGURE 17 is a diagrammatic end view of the winding station showing the chain drive to the winding rollers;

FIGURE 18 is a transverse section through the winding station and top pressure means when in the position illustrated in FIG. 1;

FIGURE 19 is a partial end view of the machine, on an enlarged scale showing the acceleration belt assembly;

FIGURE 20 is a side view of part of the belt assembly shown in FIG. 19; and

FIGURE 21 is a plan view, partly in section, of the features shown in FIG. 20.

The general arrangement and operation of the machine will be described initially with reference to the diagrammatic views shown in FIGS. 1 to 6.

As shown in FIG. 1, a frame 1 is provided at its upper end with a hopper 2 containing a plurality of tubular cores 3 which can be discharged one by one through an outlet 4 connected to the main part of the hopper through a narrow passage 5. Beneath the hopper 2, which extends the length of the machine, is the winding mechanism which comprises a lower sweep assembly 6 providing the winding station and an upper sweep assembly 7 providing the top pressure means. The lower sweep 6 includes a pair of arms 8 rotatably mounted at opposite ends of the frame for rotation in an anti-clockwise direction as looked at in FIG. 1. Extending between and rotatable relative to said arms in the direction of the arrows 9 at a speed equal to the speed of movement of a web 10 fed to the machine from an automatic perforator, are two pairs of winding rollers 11, the driving means for which and for the upper and lower sweeps will be described more fully hereinafter. The upper sweep 7 includes a pair of arms 12 which are mounted at opposite ends of the frame 1 for rotation in a direction opposite to that of the arms 8 and vertical displacement relative to the arms 8, balanced by counterweights 13 connected thereto by cables 14 passing over pulleys 15 and 16 mounted on opposite ends of the frame 1. Extending between the arms 12 and rotatably mounted thereon are rider rollers 17 for alternate engagement with a roll being wound.

At the commencement of operations the end of the web 10 is applied to a core 3 newly deposited in the nip between the winding rollers 11 at the right-hand end of the lower sweep, as looked at in FIG. 1, by jets of compressed air supplied in the direction of arrows 18 and 19 through nozzles 20 associated with the lower pulleys 21

of an acceleration belt assembly 22 and from one of two air chests 23 (shown more clearly in FIG. 6) on the lower sweep.

FIGS. 2 to 5 illustrate the relative positions of the upper and lower sweeps at various stages during the winding operation commenced in FIG. 1. Relative rotation of both sweeps causes vertical upward movement of the central axis of the upper sweep due to the engagement of the operative rider roller 17 thereon with the partly formed roll 24 which not only increases in diameter but also follows a circular path about the axis of the lower sweep. After relative rotation through 45° the upper sweep has completed the first half of its upward movement and the core transfer means 25 associated with the inoperative rider roller is moving angularly upward about the axis of that roller. This position is shown in FIG. 2 which also shows the previously completed roll 26 being ejected from the inoperative pair of winding rollers by one of two ejector members 27 on the lower sweep.

FIG. 3 illustrates the half-way position in which the top sweep has reached the end of its upward travel at which point transfer means 25 removes a new core 3 from the hopper 2. The core release mechanism is more clearly shown in FIG. 7 and comprises an arm 28 in the path of said transfer means and secured to the same pivot 29 as a second arm 30 which, upon movement of the first arm by the core transfer means is moved to displace the lowermost core from the hopper for engagement of its ends by the core transfer means.

During the next stage of the operation the core transfer means, by which the new core is rotatably held at its ends, is gradually returned to a position beneath the inoperative rider roll while the latter moves into engagement with the main belt 31 of the acceleration belt assembly 22. The position reached after rotation through 135° is shown in FIG. 4, following which the rotation of the inoperative rider roller and of the core 3 when this has reached the position shown in FIG. 5, is taken up by an auxiliary belt 32 which is swung about the axis of the pulley 21. The position is then as shown in FIG. 5 with the inoperative rider roller and new core rotating at the same speed as that of the web.

After another 10° of movement the two sweeps take up a position similar to that shown in FIG. 1 with the respective winding and rider rollers displaced through 180°. In this position the new core is seated on the web in the nip between the previously inoperative winding rollers and the web is severed from the completed roll at a pre-formed line of perforations therein by pressure exerted thereon by a reverse-running breaker roll 33 on the lower sweep co-operating with one of two rolls 34 on the upper sweep.

It will thus be seen that the machine will run continuously until the web is exhausted.

The lower sweep 6 is provided at each end with a shaft 133 which extends through the end of the machine frame and carries a worm wheel 35 meshing with a worm 36 on a driving shaft 37 which latter drives a shaft 38 in the same direction through gears 39, 40 and 41. Each shaft 38 is provided with a worm 42 which meshes with a worm wheel 43 on a shaft 44 extending through the machine frame and connected to the upper sweep 7, the worm wheels 35 and 43 being so arranged in relation to the respective worms 36 and 42 that the sweeps are rotated in opposite directions.

The shaft 44 extends through the arms 12 of the upper sweep 7 and is provided adjacent each arm with a gear wheel 45 which meshes with the gear wheels 46 and 47 on shafts 48 and 49 respectively which pass through the arm and are provided on the other side thereof with plates 50 and 51 respectively on each of which is rotatably mounted a rider roller 17. The plates 50 and 51 are each provided with a projection 52 which is adapted to be received in a recess 53 in either of two plates 54 and 55 carried on shafts 56 and 57 respectively which pass

through the arm 8 of the lower sweep and carry gear wheels 58 and 59 respectively which mesh with a gear wheel 60 rotatably mounted on the shaft 133. The plates 54 and 55 each carry two winding rollers 11 which are mounted on shafts 61 each carrying a gear wheel 62 and each pair of gear wheels 62 mesh with a gear wheel 63 on the shafts 56 and 57 respectively. The shafts 56 and 57 carry chain sprockets 64 and 65 respectively which are connected by driving chains 66 and 67 passing over idler sprockets 68 and 69 to sprockets 70 and 71 respectively on a shaft 72 passing through the shaft 133 and connected to suitable driving means which may be the same as or synchronised with the means for driving the web. The shaft 44 of the upper sweep is mounted in bearings 73 which are slidably arranged in opposite ends of the machine frame and secured to one end of each of the cables 14, and the shafts 38 are slidably arranged in the gears 41 to accommodate the vertical movement of the upper sweep.

The core transfer means associated with each rider roller and designated 25 in the diagrammatic representations in FIGS. 2 to 5, comprises a pair of core holders 74 for insertion in the opposite ends of a core 3 and each connected to a source of compressed air through a flexible pipe 77, passages 78 and 79 in the shaft 48, a pipe 80 and a passage 81 in the shaft 44. Each cylinder 76 is secured to one end of an arm 82 which is secured to a pinion 83 which meshes with a rack 84 on an arm 85 provided at its end with a cam roller 86 adapted, during upward movement of the upper sweep, to engage and run along a cam track 87 (FIG. 1) secured to the machine frame. Each cam roller co-operates with the cam track to move the arms 85 which movement is transmitted to the cylinders 76 through racks 84, pinions 83 and arms 82, to move the cylinders radially and then angularly about the axis of the rider rollers into axial alignment with the lowermost core in the hopper whereupon a switch or the like is operated by a cam on the shaft 44 to supply compressed air to the cylinders 76 to insert the core holders 74 into the ends of the core after which the arm 85 returns the core holding mechanism to its original position beneath the rider roller as previously described.

Air is supplied to the air chest 23 on the bottom sweep, under the control of switches operated by cams on the shaft 133, through the end of the shaft 34 opposite to that through which the driving shaft 72 passes. The path taken by the air is shown by the arrows in FIG. 15.

The breaker roll 33 already referred to is, as shown more clearly in FIG. 18, a rubber covered roll which co-operates alternately with the two rubber rolls 34 on the top sweep to provide sufficient tension in the web to cause a clean break at one of the lines of perforations between the breaker rolls and the completed roll.

The two plates 51 and 54 or 50 and 55 carrying the temporarily operative rider and winding rolls are positively interlocked during the winding operation by means of the mating projections 52 and recesses 53 and are maintained in correct alignment throughout by the inter-engaging gears 45, 46, 47 and 58, 59, 60 on the upper and lower sweeps respectively.

The acceleration belts 31 and 32 at opposite ends of the frame are driven at the same speed as the web from pulleys 88 on a motor shaft 89 through belts 90, on further pulleys 91 and meshing gears 92 and 93 on the shafts 94 and 95 of the pulleys 91 and further pulleys 96 respectively, idler pulleys 97 and 98 on bellcrank levers 99 connected to the frame by springs 100 being provided to maintain tension on the belts. Each pulley 21 is provided with two sheaves 101 and 102 for the belts 31 and 32 respectively and is rotatably mounted on a shaft 103 which carries one end of an arm 104 the other end of which carries a pulley 105 around which the belt 32 passes. The shaft carries gear wheels 106 which mesh with gears 107 on shafts 108 each of which carries a coun-

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terweight 112 and a gear 109 meshing with a pinion 110 which in turn engages a rack 111 operable in any convenient manner to rotate the pinion and, through the mechanism described, the arm 104 carrying the pulley 105 and also the nozzle 20, between the positions shown in FIGS. 1 and 2.

I claim:

1. A machine for automatically and continuously re-winding webs of material into rolls of predetermined diameter or reeled length, comprising a frame provided with a container for a plurality of cores, a winding station rotatably mounted in said frame and provided with a plurality of sets of winding rollers operable in turn on a web during successive parts of a revolution of said winding station to wind the web into a complete roll on one of said cores, transfer means operable during each part-revolution of said winding station to remove a core from said container, rotate said core to a speed equal to that of the web and deposit it before the end of said part-revolution on that part of the web passing over a temporarily inoperative set of rollers, means for applying the end of the web to said core whereby it is wound thereon to form a roll, means slidably mounted in said frame and operable during each part-revolution of the winding station to exert top pressure upon the core and the roll being wound thereon, means operative upon completion of each roll to sever it from said web, and means operable to eject each completed and severed roll from said winding station.

2. A machine according to claim 1, wherein said winding station is rotatable at its centre about a fixed horizontal axis and said rollers are arranged in pairs on said station, each pair of rollers being closely spaced and rotatable in the same direction about parallel horizontal axes.

3. A machine according to claim 1, wherein said top pressure means is rotatable at its centre about a horizontal axis which is displaceable vertically relative to and in the same vertical plane as the axis of rotation of said winding station and carries rollers which are operable in turn to ride on a roll being wound.

4. A machine according to claim 2, wherein said winding station and top pressure means are rotatable in opposite directions at the same speed by common driving means.

5. A machine according to claim 3, wherein said transfer means comprises pairs of arms mounted on said top pressure means in association with said rider rollers, the pair of arms associated with a temporarily inoperative rider roller being angularly movable about the axis of said roller during upward movement of said top pressure means to engage end portions of a tubular core in said container and during downward movement of said top pressure means to lower said core onto a part of the web in the nip between the next operative pair of winding rollers.

6. A machine according to claim 1, wherein the web

to be wound is pre-perforated and said web-severing means comprises a rubber-covered roller on said winding station which is rotatable in the opposite direction to that of said station and alternately co-operates with each of two rollers on said top pressure means to exert sufficient tension on the web to sever the latter along a pre-formed line of perforations.

7. A machine according to claim 3, wherein the ends of said winding rollers and of said rider rollers are mounted in plates mounted on shafts at the ends of oppositely rotatable arms forming parts of said winding station and top pressure means respectively, the two plates carrying the temporarily operative winding and rider rollers being interlocked during winding.

8. A machine according to claim 7, wherein the shafts carrying said plates also carry gears which mesh with gears mounted on shafts passing through the centre of each arm.

9. A machine according to claim 7, wherein said winding rollers are continuously driven through gearing from a shaft passing through and coaxial with the central shaft of said winding station.

10. A machine according to claim 5, wherein the core-engaging portions of said core transfer means are applied to the ends of a core by compressed air supplied through the central shaft of said top pressure means.

11. A machine according to claim 3, wherein a temporarily inoperative rider roller is rotated, during the downward movement of the top pressure means, by engagement with an acceleration belt driven at the same speed as said web and transfers said rotation to a new core prior to its being deposited on the web by said core transfer means.

12. A machine according to claim 11, wherein a second acceleration belt is automatically swung into engagement with said rider roller when its curved path of movement departs from said first belt.

13. A machine according to claim 12, wherein the end of the web is applied to a new core by jets of air issuing from said winding station and from nozzles associated with said acceleration belt.

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