Oct. 24, 1967 R. E. TAYLOR, JR., ETAL 3,348,477

PAPER CONVERTING, AND PARTICULARLY PRODUCING IMPROVED PAPER TOWELS

Original Filed Jan. 12, 1961 2 Sheets-Sheet 1

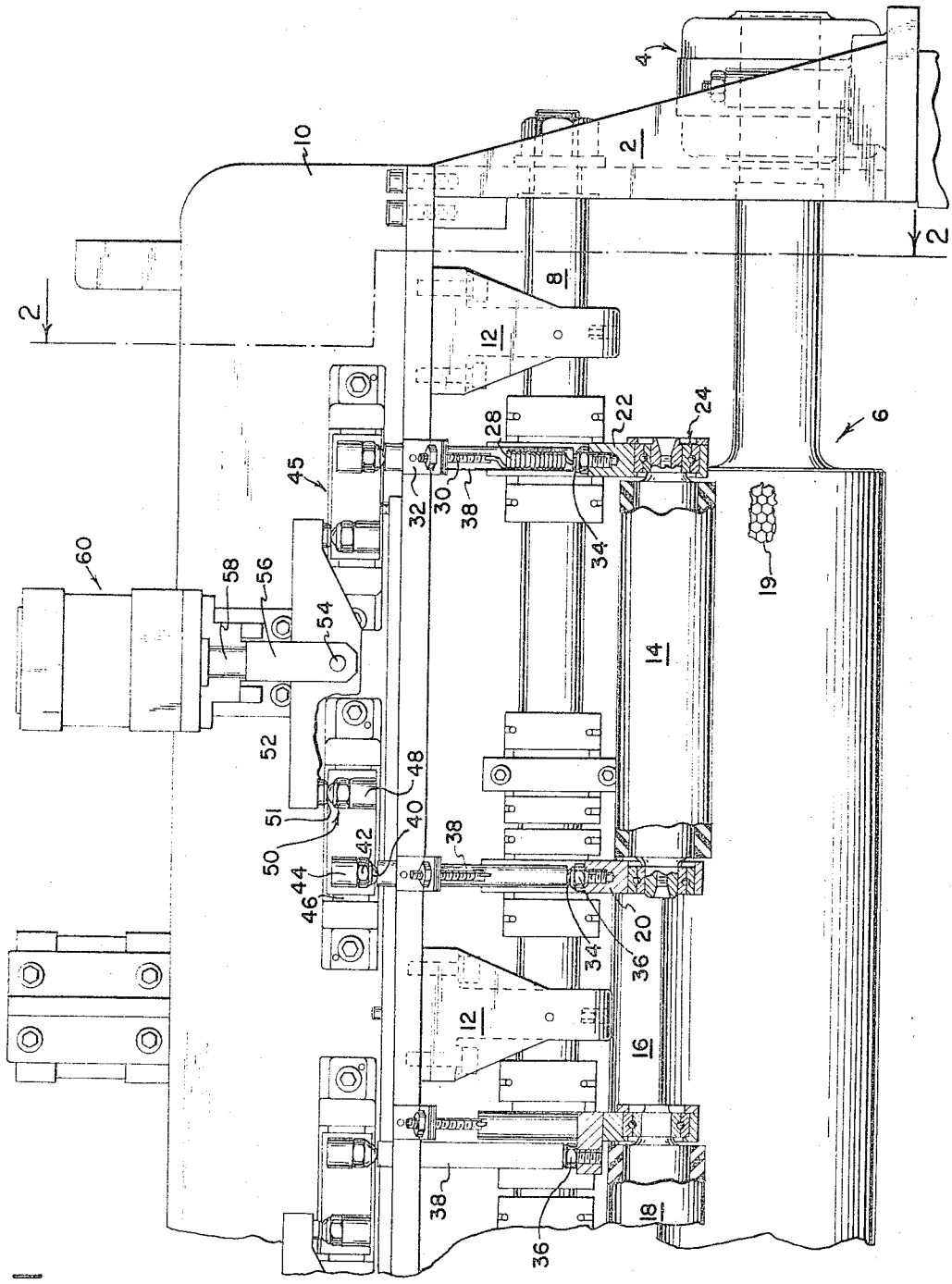

Fig. 1

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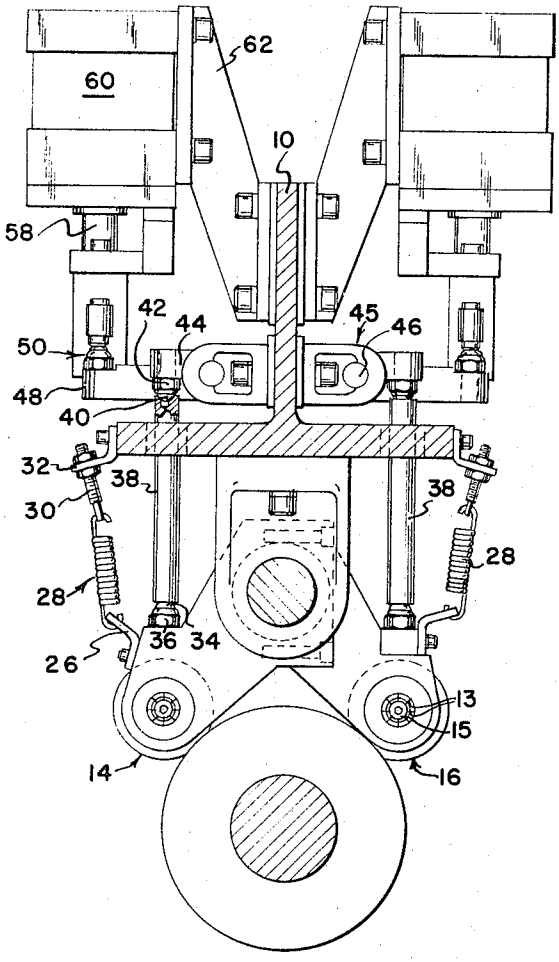
Fig. 2



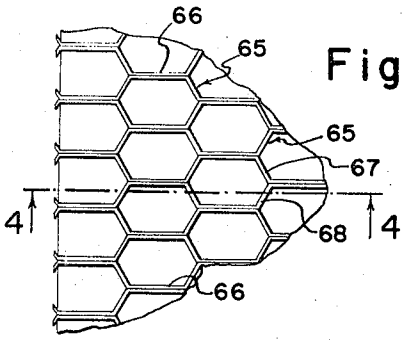


Fig. 3

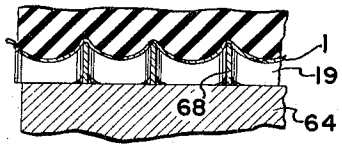


Fig. 4

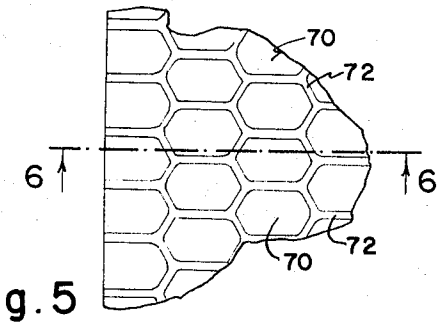


Fig. 5

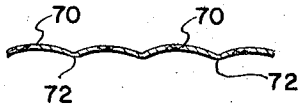


Fig. 6

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PAPER CONVERTING, AND PARTICULARLY PRODUCING IMPROVED PAPER TOWELS

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Original application Jan. 12, 1961, Ser. No. 82,319. Divided and this application Oct. 23, 1965, Ser. No. 510,439

9 Claims. (Cl. 101—23)

This application is a division of application Ser. No. 82,319, filed Jan. 12, 1961, now abandoned.

This invention relates to paper making, and more in particular to the production of improved paper towel products.

An object of this invention is to provide for the manufacture of paper towel products of improved construction. A further object is to provide machines and methods for the production of new paper products. Another object is to provide for the mechanical alteration of paper to impart new characteristics thereto, or to improve some characteristics which are present. A still further object is to provide for mechanicaly working crepe paper toweling in such a way as to improve its construction and utility. A further object is to provide for the above with equipment which is operable under conditions and at speeds which make it adaptable for use with standard paper converting equipment. A further object is to provide for the above with apparatus which is adaptable to various conditions of use and operation. A further object is to provide a mechanism of the above character which is adaptable for installation upon standard perforating and rewinding equipment. These and other objects will be in part obvious, and in part pointed out below:

In the drawings:

FIGURE 1 is a fragmentary elevation with parts broken away, showing one embodiment of the invention;

FIG. 2 is a sectional view on the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged detail of a portion of the anvil or grid roll of FIGURES 1 and 2;

FIGURE 4 is a sectional view on the line 4—4 of FIGURE 3, but illustrating the operating relationship between the rolls;

FIGURE 5 is an enlarged view of a portion of a paper towel produced by the mechanism of FIGURES 1 to 4; and,

FIGURE 6 is a sectional view on the line 6—6 of FIGURE 5.

Paper towels have been produced from wet creped paper having an over-all creped condition extending generally transversely of the web from which the towels are formed. Such towels have relatively good characteristics, but they tend to have a rough and stiff feel, and other objectionable characteristics. Attempts to overcome these objectionable characteristics and improve the general quality and utility of towels of this type have generally introduced over problems, which have, for example, resulted in products which are overly soft and filmsy. It is an object of the present invention to overcome difficulties which have been encountered with paper toweling, while avoiding objectionable characteristics of paper towels. It is a further object to provide products which are essentially new in the art, in the sense that they have characteristics different from any prior products.

Referring to FIGURE 1 of the drawing, a portion of a converting machine is shown, particularly one end of the mechanism incorporating the present invention. In addition to the equipmet shown in FIGURES 1 and 2, the machine includes a stand for holding a jumbo roll of paper toweling, and mechanism for perforating the web 1

of toweling, slitting it and rewinding the individual webs onto paper cores to form individual rolls, each containing a predetermined number of paper towels. Referring to the right-hand portion of FIGURE 1, a frame bracket 2 carries a bearing assembly 4 which supports one end of a rigid roll 6. Frame bracket 2 also supports the end of shaft 8 and a top frame member 10, both positioned above roll 6 and parallel therewith. Additional support is provided for shaft 8 by a plurality of spaced brackets 12 bolted to top frame member 10, and the other end of the construction is supported by a frame bracket similar to frame bracket 2. Shaft 8 provides a rigid support for a series of pressure rolls which are positioned in staggered relationship in contact with roll 6, there being: an end roll 14 positioned on the near side of roll 6 in FIGURE 1 and shown at the left in FIGURE 2; a roll 16 similarly positioned upon the other side of roll 6; a roll 18 in alignment with roll 14; and, the additional roll alternately in alignment with rolls 16 and 14. In this embodiment, there are seven such pressure rolls, three additional rolls in alignment with roll 14 and two with roll 16. Roll 6 is an anvil roll having a peripheral hexagonal honeycomb structure 19, and the pressure rolls have resilient rubber surfaces to be described more fully below.

During operation, a web of paper passes around roll 6 and is compressed against the honeycomb structure by the pressure rolls, and this "works" the paper to improve its use quality and impart new characteristics to it in a manner explained below. Each of the pressure rolls overlaps the end of the next adjacent roll or rolls so that the entire web is treated or "worked," but the grid pattern on roll 6 is continuous so that there is no disruption in the working pattern on the web of paper.

The pressure rolls are mounted individually, and each is subject to "live" pressure, and this compensates for any deflection in roll 6 or shaft 8. The pressure on each roll is controlled separately and may be maintained at the same value on each of the rolls, or it may be different on the various rolls to compensate for a variation in the characteristics of the web or to produce special effects.

The mounting and operation of pressure roll 14 (FIGURES 1 and 2) will now be described, it being understood that each of the other pressure rolls is mounted in a similar manner. Two parallel arms 20 and 22 are rockably mounted on shaft 8, and each carries the outer race of a ball bearing assembly 24, the inner race of which is clamped to the journal of roll 14. Each roll journal is slit to form radial slots 13, which are at a depth equal to 90% to 95% of bearing race width and a set screw 15 having a tapered head is tightened against mating surfaces into an axial bore, so as to spread the outer surface of the journal into tight engagement with the internal bore on the inner race of the bearing. Fixed to each of arms 20 and 22 is a bracket 26, and a tension spring 28 is attached between this bracket and an eye bolt 30 which is adjustably supported by a bracket 32 on frame member 10. Each of arms 20 and 22 carries a ball 34 freely mounted in a cup 36 which has a spindle threaded into a recess into the arm (see also FIGURE 1). Resting on each ball 34, is the lower end of a pressure rod 38, the upper end of which rests against a similar ball 40 mounted in a cup 42 in a lever arm 44. The ends of pressure rod 38 are recessed to provide conical bearing surfaces into which the balls are seated. Each lever arm 44 is joined to a rocking lever bracket 45 which is journaled on a shaft 46 and which has another lever arm 48. Each lever arm 48 carries a ball assembly 50, the ball of which bears on a flat surface 51 on the end of an equalizer bar 52. Equalizer bar 52 is pivoted by a pin 54 in a clevis 56 which is rigidly mounted on the plunger rod 58 of an air cylinder and piston unit 60.

As shown best in FIGURE 2, the cyinder of unit 60 is

rigidly mounted by a bracket 62 upon frame member 10. When air under pressure is supplied to the upper end of unit 60, plunger 58 is urged downwardly so that pressure is exerted downwardly on clevis 56 and equalizer bar 52, and thence from the ends of bar 52 through the lever arms 48 and 44 of the lever brackets 45 and the associate pressure rods 38 to arms 20 and 22 to the ends of roll 14. Each of the levers 48 is slightly more than twice the length of its integral lever 44, so that the force exerted on roll 14 is more than that exerted by unit 60. Hence, pressure roller 14 is pressed downwardly by a force something more than twice that produced by unit 60, and the force is exerted evenly on the two ends of the roller. This downward force is against the action of springs 28, which act as counterbalance springs, and which also hold the elements in close operating relationship. When it is desirable to remove the pressure and lift roller 14, the air is exhausted from the upper end of unit 60 and air is supplied to the lower end of this unit. This lifts clevis 56 and lever 52, and springs 28 draw the arms 20 and 22 upwardly, thus lifting roller 14 away from roll 6.

Each of the pressure rolls is a solid steel mandrel having a rubber surface bonded to it. Illustratively, the steel mandrel is 2 inches in diameter, and the layer of rubber is ½ inch thick, and the over-all diameter of roll 6 is slightly greater than 7 inches. After use, the rubber covering on the pressure rolls is machined off to a minimum rubber thickness of ¼ inch. In this embodiment, the over-all dimension of the honeycomb cells is 3/10 inch. The honeycomb structure is formed by a series of hexagonal cells or pockets. Each of these cells or pockets has a dimension longitudinal of the web of ⅓ inch, and the cells are in rows longitudinally, the width of ten rows being 3¼ inches.

As shown best in FIGURES 3 and 4, anvil roll 6 is a solid steel roll or mandrel 64, with the cylindrical honeycomb structure 19 bonded to the mandrel surface by a suitable bonding material which in this embodiment is an epoxy-urethane resin. The honeycomb structure is formed of narrow strips 65 of stainless steel fabricated directly into the cylindrical shape, which is then placed onto the mandrel and bonded into place. Hence, the strips of the honeycomb structure form radial walls which define the hexagonal cells or pockets throughout the surface of the roll, and each pocket is surrounded by walls having flat tops upon which the web of paper rests as it passes in fixed relative relationship with the rotating roll surface. The longer parallel walls 66 of each cell extend transversely of the web and longitudinally of roll 6, and these are formed by double thicknesses of the strips 65. The shorter, angular, parallel cell walls 67 and 68 are of single thickness. The pressure rolls are urged against roll 6 with sufficient pressure to cause a nip having a width of the order of .5 inch or more, and within this nip the relatively soft rubber tends to bulge into each of the hexagonal pockets (see FIGURE 4). Hence, as a particular hexagonal pocket on roll 6 approaches a pressure roll, the pressure roll first clamps the paper against the top of the leading wall 66 of the pocket. During the progressive rotational movement, the roll area over the pocket bulges downward into the pocket and works the paper, and it contacts and presses the paper against the entire wall structure of that pocket. When the nip is wider than the longitudinal dimension of the pocket, there is a tendency for air to be trapped and compressed somewhat as the roll bulges downwardly into the pocket, as the pocket approaches and passes the nip center line of roll 6. This compression of air appears to favorably act on the sheet and assist quick release of the web. Cell depth is to be great enough to give clearance between the bottom of the cell and the paper when using full pressure.

The pressure rolls squeeze the web of paper against the tops of the honeycomb structure walls 66, 67 and 68, so as to compress the paper along strips 72 (see also FIGURE 5), while the hexagonal portion of the web over each cell is trapped and held firmly at its periphery, with a progressive action. The web of paper is thus worked progressively into a continuous series of hexagonal bulges or bubble-like structures 70 which are interconnected by strips 72 of tightly compressed paper. When the web moves away from the pressure roll, the paper fibers tend to "relax" or recover slightly toward their original conditions. However, the fibers have been moved somewhat with respect to each other, and have been bent and rubbed somewhat, and the paper retains the general changed conditions. The resulting product is represented in FIGURES 5 and 6 where the compressed lines 72 form a structurally strong network defining the hexagonal portions which are dome-like and hexagonal in outline. Hence, the finished product comprises a web which retains substantial strength and is imperforate, but the texture and feel of the paper has been changed to improve its use qualities. As indicated above, the web is slit, perforated, and wound into individual rolls of paper towels by a mechanism which is not shown.

The present invention contemplates other and modified mechanisms for working the paper. The invention also contemplates that other papers may be worked to change their characteristics and improve their use qualities. An important aspect of the invention is the accurate controlling of the pressure exerted on each of the pressure rolls. Each of the units 60 is provided with a separate air supply line extending from a pressure regulating mechanism. The pressure exerted by each unit 60 is transmitted with minimum friction to the two ends of the pressure roll, and the working lever brackets 45 act to increase the pressure and reduce the movement of the roll. The unit 60 maintains live pressure upon the pressure rolls so that each of the rolls exerts the exact pressure which is desired, even though roll 6 or shaft 8 deflects and there is lost motion or play in the mechanism.

It has been indicated above that the various pressure rolls 14, 16, 18, etc. are similarly mounted. In this particular embodiment of the invention, roll 14 and the corresponding pressure roll at the other end of roll 6 are identical and they are mounted identically. However, the other five rolls are slightly longer, and, as shown in the lower left-hand portion of FIGURE 1, each of the other five rolls is provided with a mounting for the ball assembly 34–36. In this way, the two ball assemblies 34–36 for each of the rolls are spaced the same distance apart, and the leverage assembly and other components of the pressure mechanism are identical for all of the pressure rolls.

As many possible embodiments may be made of the steps of the method and the mechanical features of the above invention herein described, all without departing from the scope of the invention, it is to be understood that all matter hereinabove set forth, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. In paper converting apparatus, the combination of, an anvil roll comprising a rigid mandrel and a peripheral structure thereon presenting an arrangement of radial walls defining pockets with each pocket being surrounded by a continuous wall structure and with the wall structures providing support for a web of paper passing thereabout along a path which is a segment of a cylinder, a plurality of pressure rolls longitudinally spaced along said anvil roll and each extending only a portion of the length thereof, each pressure roll having a relatively soft flexible cover and having its axis parallel to the axis of said anvil roll and adapted to be positioned in contact with a web of paper passing around said anvil roll, and means to press said pressure roll toward said anvil roll with sufficient pressure to cause the pressure roll to bulge into said pockets, said means comprising a plurality of separately operable pressure mechanisms corresponding in number with the number of said pressure rolls and

respectively associated therewith whereby the pressure exerted on each of said pressure rolls may be individually controlled.

2. Apparatus as described in claim 1, wherein said peripheral structure comprises a honeycomb structure formed of narrow metal strips.

3. Apparatus as described in claim 2, wherein said pressure roll comprises a structurally stable mandrel having a cylindrical layer of rubber-like material bonded thereto.

4. Apparatus as described in claim 1, wherein each of said pressure mechanism comprises, a pair of spaced arms providing a swinging mounting for its pressure roll, spring means to swing the pressure roll away from said anvil roll, a force equalizing bar positioned to transmit force swinging the pressure roll toward said anvil roll, spring means to swing the pressure roll away from said anvil roll, a pressure rod positioned to transmit force swinging the pressure roll toward said anvil roll, and an air cylinder and piston unit adapted to exert force through said rod to said arms.

5. Apparatus as described in claim 4, wherein each of said pressure mechanisms includes a double lever member having one lever arm mechanically related to said rod and another lever arm mechanically related to said unit, and a ball assembly comprising a fixed pocket and a ball rotatably positioned therein and providing the mechanical relationship with one end of said rod.

6. Apparatus as described in claim 4, wherein each of said pressure mechanisms includes a clevis attached to said unit through which force is exerted to said roll, an equalizer bar swingably mounted in said clevis and projected oppositely therefrom to transmit equal forces to the opposite ends of said pressure roll.

7. Apparatus as described in claim 1 which includes mounting means for each of said pressure rolls comprising, a pair of journals and ball bearing assemblies positioned respectively upon the opposite ends of said pressure roll and each having an inner race, each journal of said pressure roll being slit to permit expansion thereof and a set screw having a tapered surface and threaded therein and holding the journal of the roll expanded into fixed relationship with its inner race.

8. In paper converting apparatus, an anvil roll having a peripheral structure forming a plurality of open pockets throughout its periphery separated by radial wall structures along which a web of paper passes, said peripheral structure comprising a honeycomb structure formed by strips of metal fabricated to form walls of double thickness longitudinally of the anvil roll and of single thickness at right angles thereto, and a pressure roll assembly providing a resilient cylindrical surface engaging the web of paper and pressing portions of the paper into the respective pockets and producing a working of the paper.

9. In paper converting apparatus, the combination of, an anvil roll comprising a rigid mandrel and a peripheral structure thereon presenting an arrangement of radial walls defining pockets with each pocket being surrounded by a continuous wall structure and with the wall structures providing support for a web of paper passing therearound along a path which is a segment of a cylinder, a plurality of pressure rolls the length of each of which is a fraction of the length of said anvil roll and which are longitudinally spaced along said anvil roll with overlapping ends whereby the pressure rolls cooperate to cover the entire width of a web of paper passing around said anvil roll, alternate pressure rolls being arcuately offset on said anvil roll, each of said pressure rolls having a relatively soft flexible cover and having its axis parallel to the axis of said anvil roll and adapted to be positioned in contact with a web of paper passing around said anvil roll, and means to press said pressure rolls toward said anvil roll with sufficient pressure to cause the pressure roll to bulge into said pockets.

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