MACHINE FOR CUTTING AND FOLDING TISSUE

Fig. 3.

Fig. 4.

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It is an object of my invention to produce a combined tissue folding, assembling and cutting machine capable of handling an unlimited number of webs, of being serviced quickly and easily with a minimum of shut-down time, and in which the generation of static electricity shall be minimized.

It is a further object of my invention to provide a new and improved shearing device to be used in connection with the machine aforesaid.

It is a further object of my invention to produce certain types of roll bearing stands which while mutually differentiated nevertheless coast in series to produce optimum effects.

These and other objects will be clear from the following detailed description taken in connection with the annexed drawings in which—

Fig. 1 is a schematic plan view of the arrangement of my machine;

Fig. 2 is an elevation corresponding to Fig. 1;

Fig. 2A is a section through one of the folded webs of tissue illustrating the preferred form of fold;

Fig. 3 is a view in elevation showing the particular web assembling means of a typical roll supporting stand;

Fig. 4 is a section on the line 4-4 of Fig. 3;

Fig. 5 is an elevation partly in section through my improved shearing device; and

Fig. 6 is a section taken on the line 6-6 of Fig. 5.

The demand for facial or cleansing tissues has increased enormously in the last ten years. This constantly increasing demand has required the manufacturers of such tissues not only greatly to speed up their production but also to minimize, so far as possible, any and all waste of either material or effort.

Since the bulk of all facial tissues is sold in cartons or packages of from two hundred fifty to five hundred sheets, there has long been a problem of superimposing this great number of sheets and then severing the relatively soft and yielding mass which the superimposed sheets produce. The earliest efforts along these lines were directed to winding up on large wheels a continuous web of tissue stock. The stock, prior to being wound on the wheels, was folded to the desired configuration. When a sufficient number of plies were built up on the large wheel, the wheel was stopped, a pair of spaced clamps were applied to the periphery of the wheels, and the piled up stock was severed between the clamps. One end of the severed stock was then released and the piled up tissues were unwound from the wheel into a conveyor which fed them to a cutter which in turn severed the desired lengths from the piled up webs. The material lying between the clamps, of course, represents waste and the operations of stopping and starting the wheel made the whole operation essentially a batch process with consequent waste of time.

It was next proposed to mount in series a large member of rolls each having adjacent thereto an appropriate folder. Webs were drawn from each of the rolls over the respective folders and the folded webs were superimposed upon an endless conveyor belt until the desired number of plies were built up. The built up web was then transferred from the endless assembly conveyor to a gripping conveyor which fed it to the cutting mechanism.

I have discovered that the machine can be greatly simplified and its reliability for continuous operation greatly improved by elimination of the continuous assembly belt. Such belt is in fact more detrimental than helpful and adds materially to the electrostatic charge which the tissues will bear throughout the time they arrive at the cutter. In eliminating the main assembly belt, I have found it desirable, though not indispensable, to alter the mechanism at some of the roll supporting stands, which alteration will be discussed in detail hereafter.

Referring now to Figs. 1 and 2, I provide a series of stands 10, each of which supports a plurality of axles 12, the axles extending at each side of the stands 10. On each projecting end of each axle, I mount a supply roll 14 of facial tissue. These rolls are preferably wound double so that two superimposed piles of tissue may be drawn from each roll. Mounted in the path of the webs drawn from each roll 14 is a stationary folder 16 which folds the two plies drawn from the roll 14 to the general configuration indicated in Fig. 2a. This fold indicated in Fig. 2a is the one most used in the industry and is known as a "C" fold. Obviously, however, other forms of fold could be used, such for example as a simple "V" fold or a "Z" fold. Folders suitable for performing this work are old and conventional and are here given no detailed illustration.

Substantially at the center of each frame 10 I mount a pair of axes 18 and on each end of each of these axes I mount a collector roll 20,
So that on each side of the frame 10 there is a pair of collector rolls 20.

Referring now particularly to Figs. 3 and 4, two-ply webs are drawn from each of the supply webs 14, by means of two-ply web passes over a folder 16. The webs then pass between the collector rolls 20 for downward delivery. Near the base of the frame 10 I mount another pair of axles 22 and on each end of each axle I mount an assembly roll 24 so that at the bottom of the frame 10 and on each side thereof I have a pair of assembly rolls 24. The tissues which have been superimposed by the collector rolls 20 pass downwardly and then laterally between the assembly rolls 24.

Extending from stand to stand and passing between the assembly rolls 24 of each stand is a continuous trough or chute 26, the interior surface of which is preferably highly polished. At each stand, the tissues passing from the collector rolls 20 around the assembly rolls 24 come to rest on a group of tissues 28 which are moving along the trough 26 from preceding stands. The floor 30 of the trough 26 is preferably broken along the length of the lowest assembly roll 24 so that the periphery of the roll can project at least flush with and preferably slightly above the level of the floor 30.

For the greatest ease of operation, both the collector rolls 20 and the assembly rolls 24 should be positively driven. This is accomplished as shown in Figs. 3 and 4 by gears 32 mounted on the axles 18, the lowermost axle 18 also mounting a sprocket wheel 34 which is driven by a chain 35. The axles 22 of the assembly rolls are connected by gears 38 and on the uppermost axle 22 is a sprocket 40 which drives the chain 35. On the lowermost axle 22 is a sprocket 42 driven by a chain 44 which runs from one to another of any desired number of stands.

When the complete arrangement illustrated in Figs. 3 and 4 is used, the collector rolls 20 perform the task of drawing the several webs from their respective supply rolls 14 over their respective folders 16, and the assembly rolls 24 operate primarily to advance the tissues resting in the trough 26.

Referring once again to Figs. 1 and 2, it will be noted that the several are simultaneously built up two lines of superimposed folded tissues 28. When these are complete, they pass into the grip of feeding belts 48 which serve as the primary force drawing the tissues through the respective troughs 26. The two lines of tissues are then mutually superimposed and brought into the grip of a conveyor 50 which feeds a shear indicated generally at 52 and illustrated in detail in Figs. 5 and 6.

While a straight line arrangement of all stands is desirable, considerations of space and plant arrangement may make it desirable to place some of the stands a floor above or below the floor on which the shear is located, and because of the variety of operating conditions which may thus ensue, it is difficult to restrict my recommendations to any particular form as optimum under all circumstances. For that reason I intend here to set forth various alternative arrangements of stands, it being understood that a single machine may, at one point or another, utilize several somewhat different types. The selection of these will, however, in the light of this discussion, depend on the skill of the plant designer.

With the foregoing in mind, it is to be understood that, except as expressly limited in the annexed claims, my invention embraces the following combinations:

1. Positive drive of the collector rolls and the assembly rolls;
2. Positive drive of the collector rolls, assembly rolls free;
3. Positive drive of assembly rolls, collector rolls free;
4. Both collector rolls and the assembly rolls free;
5. Positive drive of collector rolls, elimination of lowermost assembly roll, and positive drive of upper assembly roll;
6. Positive drive of collector rolls, elimination of lowermost assembly roll, uppermost assembly roll running free;
7. Collector rolls free, elimination of lowermost assembly roll, positive drive of uppermost assembly roll; and
8. Collector rolls free, elimination of lowermost assembly roll, and uppermost assembly roll running free.

Not all of the above combinations have been illustrated for the reason that the drawings by the first condition and all of the remaining conditions can be met by the mere elimination of elements from the drawings. The choice between the several conditions will be dictated largely by the task assigned to the particular machine. Clearly the greater the number of sheets to be handled, the greater will be the benefit of applying a positive drive to all elements, and for a given number of sheets the benefits of positive drive increases with the linear speed at which the sheets are to be moved. It is entirely possible that in a given installation the earlier stands will be rigged with a minimum of positive drive and only the later stands, receiving the greatest number of sheets, will have recourse to full positive drive. It will of course be further understood that when the lowermost assembly roll is eliminated, the trough receiving the tissues will not have any opening below the uppermost assembly roll but will present a continuous polished surface.

Reference will now be made to the particular form of flying shear illustrated in Figs. 5 and 6. This shear is especially designed for servicing this machine where the utmost continuity and speed of movement is desired. The shear, which is indicated at 52 in Figs. 1 and 2, comprises a pair of frame members 54 in each of which is journaled a stub shaft 56. Gears 58 are mounted on the stub shafts. Each of gears 58 carry eccentric pins 60 which fit into bearings 62 in an upper frame member 64. On the upper frame member 64 is journaled a shaft 66 carrying a rotary knife 68. The knife is driven by means of a pulley 70 and a belt 72 from a motor 74 which is mounted on a portion of the frame 64. As the eccentric pin 60 revolves with the gear 58, the frame member 64 is given an orbital movement which precisely follows that of the pins 60.

In the lower portion of frame members 54 is journaled a shaft 75 on which are keyed gears 71 which mesh with gears 58. At the center of shaft 75 is an eccentric member 76. The eccentric member 76 is journaled in a cross head 78 which slides in bearings 80 mounted in a lower frame member 82. The lower frame member 82 receives vertical support from anti-friction members 84 and is driven by the eccentric 76 in the manner of a Scotch yoke so as to have simple harmonic motion in a horizontal plane. The upper frame 64 and the lower frame 82 are guided
with respect to each other by rods 84 which are slidably mounted in bearings 86 in the lower frame 82 and in bearings 88 in the upper frame 64. The eccentric pin 80 which moves the upper frame and the eccentric 76 which moves the lower frame are mutually adjusted so that the horizontal simple harmonic motion of the lower frame 62 is synchronized with the horizontal component of the orbital movement of the upper frame 84. As a result, during horizontal movement of the lower frame 62 in one direction, the knife 68 mounted on the upper frame 64 tends to approach the lower frame 82 while at the same time moving at the same speed and in the same direction horizontally as the lower frame 62. At the end of this horizontal motion, both the upper frame 64 and the lower frame 82 begin a reverse movement while the knife 68 is moving, in the vertical, away from the frame 82. It will be clear in this arrangement that the maximum vertical travel of the knife 68 must be equal to the horizontal travel of the lower frame 82.

Mounted on the upper side of the lower frame 82 are a number of anti-friction rollers 90. A belt 92 passes over the rollers 90 and, at approximately the center of the lower frame 82, the belt is drawn down out of the plane of the rollers 90 and over a roller 92 after which it comes back and passes over the remaining rollers 90. This belt is driven from a pulley 94 and passes over guide rolls 96 and a tension roll 98. The guide rolls 96 and the tension roll 98 are mounted on a portion of the stationary machine frame 64 and do not take part in the movement of the upper frame member 54 and the lower frame member 82.

The knife 68 is so mounted as to pass below the effective plane of the belt 92 and to enter the space created by the deflection of the belt 92 over the roller 94. The belt 92 is driven at constant speed and is synchronized with the conveyors 43 and 50 (Figs. 1 and 2) so that the assembled tissues move into the region of activity of the cutter without alteration of the speed. Since, however, the movement of the lower frame 82 is simple harmonic motion, there will be a slight difference in speed between the frame 82 and the linear speed of the belt 92. The tissues carried by the belt 92 will be held in place during the cutting action by a stripper plate 100 mounted on the upper frame 64. This gripping action will prevent relative movement between the belt 92 and the frame 82 so that while the gripper is effective there will be a slight variation in linear speed of the belt 92. This, however, is compensated for by the tension roll 98 and does not, therefore, affect the constant speed of the driving pulley 94. During the return motion of the lower frame 82, the knife 68 and the stripper plate 100 have been lifted out of contact with the tissues, the pulley 94 takes control of the motion of the belt 92 which continues to move in a linear direction opposite to the then linear motion of the frame 82. During this time, therefore, the belt 92 acts to remove the tissues just severed by the knife 68 and also to advance a fresh supply of the tissues for severance at the next operation of the knife.

What is claimed is:

1. A machine of the class described comprising a shearing; a supporting means for each of a plurality of rolls of tissue; folding means associated with each roll supporting means; a polished surface receiving folded webs from said rolls in superimposed relationship; and means for drawing the superimposed webs continuously along a polished surface and for presenting said webs to said shears.

2. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue, and having a folding device associated with each such roll; a pair of collector rollers mounted on said stands receiving a folded web from each roll and bringing the several folded webs into superimposed relationship; a polished surface receiving, in sequentially superimposed relationship, the superimposed folded webs from each of the several stands; and means for drawing all of the webs over said polished surface for presentation to said shearing.

3. A machine of the class described comprising a flying shear; a series of stands each mounting a plurality of rolls of tissues, and having a folding device associated with each such roll; a pair of collector rollers mounted on each such stand receiving a folded web from each roll, and bringing the several folded webs into superimposed relationship; a polished surface receiving, in sequentially superimposed relationship, the superimposed folded webs from each of the several stands; and means for drawing all of the webs over said polished surface for presentation to said shearing.

4. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue, and having a folding device associated with each roll; a polished surface underlying the stands to receive folded webs from the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers at each stand, the lowermost roller being adjacent said polished surface at the break therein; and the uppermost roller being spaced above the lowermost roller by a distance equal to the thickness of the accumulated folded webs passing over the polished surface at that point.

5. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive folded webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair being adjacent said polished surface at the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed, folded webs on the polished surface at that point.

6. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting.
4. slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowest roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point; and means for drawing all of the webs along said polished surface.

7. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point, all of said rollers being positively driven.

8. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point, all of said rollers being positively driven.

9. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point, all of said rollers being positively driven.

10. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point, all of said rollers being positively driven.

11. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point, all of said rollers being positively driven.

12. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue and having a folding device associated with each roll; a polished surface underlying the several stands to receive webs supplied by the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers mounted on each stand and receiving webs from each roll over its respective folder and thus superimposing the folded webs; a second pair of rollers receiving the superimposed webs from the first pair of rollers, the lowermost roller of said second pair projecting slightly above said polished surface through the break therein, and the uppermost roller of said second pair being spaced from the lowermost roller by a distance equal to the accumulated thickness of the superimposed webs on the polished surface at that point, all of said rollers being positively driven.
of rollers at each stand, the lowermost roller projecting slightly above said polished surface through the break therein; and the uppermost roller being spaced above the lowermost roller by a distance equal to the thickness of the accumulated webs passing over the polished surface at that point; positive driving means for at least one of said rollers; and means for drawing all of the webs over said polished surface.

15. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue, and having a folding device associated with each roll; a polished surface underlaying the stands to receive folded webs from the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers at each stand, the lowermost roller projecting slightly above said polished surface through the break therein and the uppermost roller being spaced above the lowermost roller by a distance equal to the thickness of the accumulated webs passing over the polished surface at that point; a flying shear; and means for drawing all of said webs along said polished surface for presentation of said flying shear.

16. A machine of the class described comprising a series of stands each mounting a plurality of rolls of tissue, and having a folding device associated with each roll; a polished surface underlaying the stands to receive folded webs from the stands in sequentially superimposed relation, said surface being broken below each stand; a pair of rollers at each stand, the lowermost roller projecting slightly above said polished surface through the break therein and the uppermost roller being spaced above the lowermost roller by a distance equal to the thickness of the accumulated webs passing over the polished surface at that point; positive driving means for at least one of said rollers; a flying shear, and means drawing all of said webs along said polished surface for presentation of said flying shear.

17. A flying shear comprising a reciprocating member and a member having orbital movement; means synchronizing the movement, in one dimension, of said orbitally moving member with the movement of said reciprocating member; a constantly driven, work supporting belt passing over the reciprocating member; a pulley, mounted on the reciprocating member out of the normal plane of the belt, around which the belt is deflected; and shearing means mounted on the orbitally moving member and adapted to pass below the normal plane of said belt in the region of its said deflection.

18. A flying shear comprising a reciprocating member and a member having orbital movement; means synchronizing the movement in one dimension of said orbitally moving member with the movement of said reciprocating member; a constantly driven, work supporting belt passing over the reciprocating member; a pulley, mounted on the reciprocating member out of the normal plane of the belt, around which the belt is deflected; and shearing means mounted on the orbitally moving member and adapted to pass below the normal plane of said belt in the region of its said deflection, said belt serving to advance a continuous web to said shearing device and to remove the lengths severed therefrom.

19. A flying shear comprising a reciprocating member and a member having orbital movement; means synchronizing the movement, in one dimension, of said orbitally moving member with the movement of said reciprocating member; a constantly driven, work supporting belt passing over the reciprocating member; a pulley, mounted on the reciprocating member out of the normal plane of the belt, around which the belt is deflected; and shearing means mounted on the orbitally moving member and adapted to pass below the normal plane of said belt in the region of its said deflection, said belt serving to advance a continuous web to said shearing device and to remove the lengths severed therefrom.

20. A flying shear comprising a reciprocating member and a member having orbital movement; means synchronizing the movement, in one dimension, of said orbitally moving member with the movement of said reciprocating member; a constantly driven, work supporting belt passing over the reciprocating member; a pulley, mounted on the reciprocating member out of the normal plane of the belt, around which the belt is deflected; shearing means mounted on the orbitally moving member and adapted to pass below the normal plane of said belt in the region of its said deflection; and means synchronizing the travel of said belt with the movement of said reciprocating member in one dimension.

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