Aug. 1, 1944. W. H. MILLSPAUGH 2,355,006

METHOD AND APPARATUS FOR MAKING MULTI-PLY PAPER SHEETS

Filed June 8, 1939 2 Sheets-Sheet 1

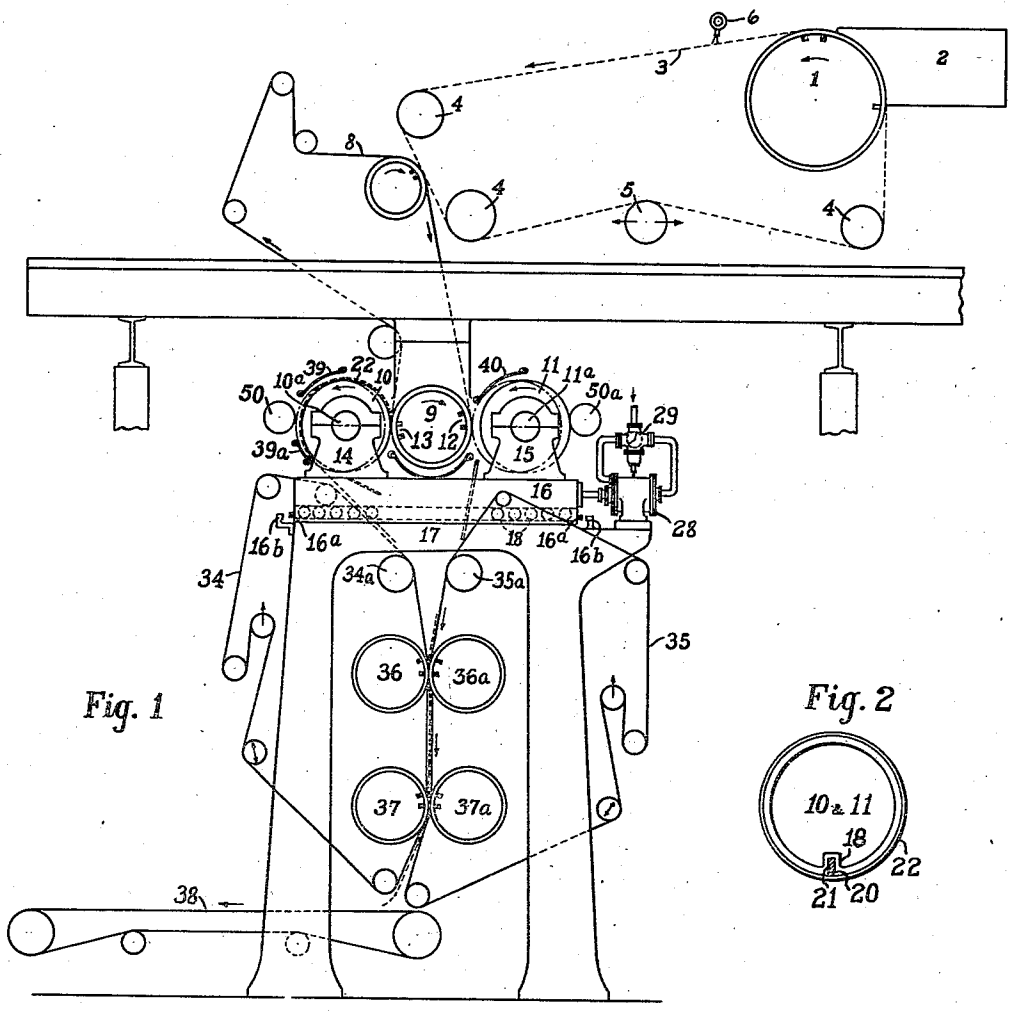


Fig. 1

Fig. 2

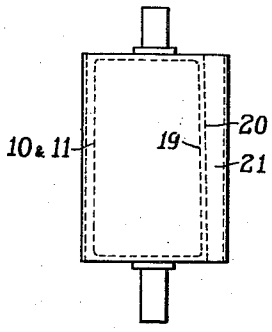


Fig. 3

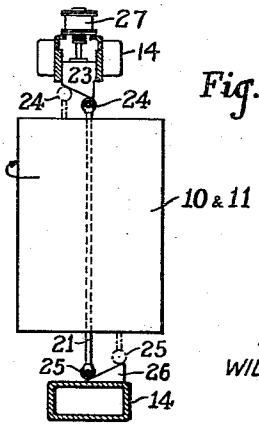


Fig. 4

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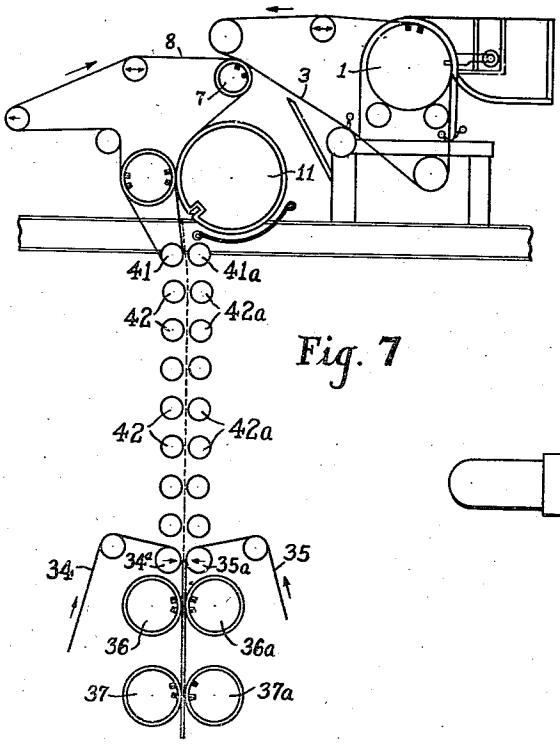


Fig. 7

Fig. 6

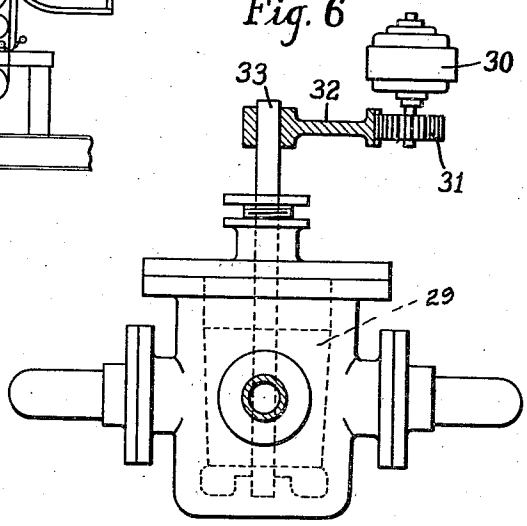
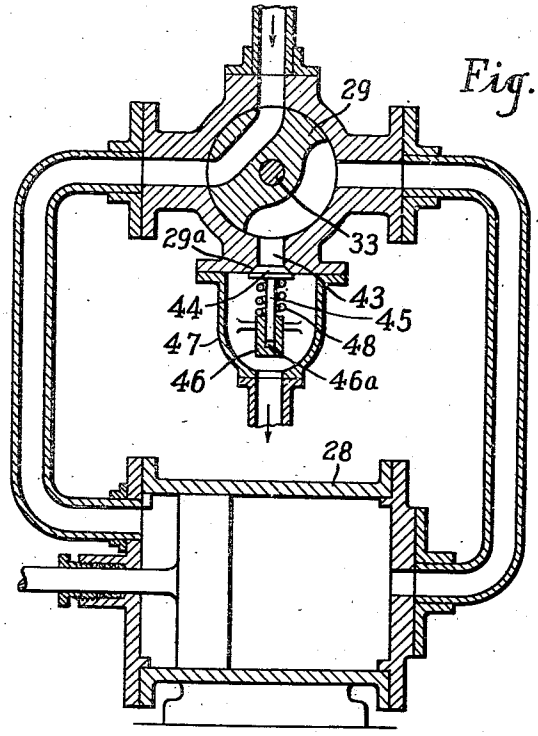


Fig. 5



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METHOD AND APPARATUS FOR MAKING MULTIPLY PAPER SHEETS

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Application June 8, 1939, Serial No. 278,151
In Great Britain June 11, 1938

8 Claims. (Cl. 92—67)

This invention relates to the manufacture of multi-ply sheets of fibrous material such as paper or the like, known as wood board, press board, wall board, pulp laps, etc.

One object of the invention resides in the provision of means for manufacturing multi-ply sheets of paper of the kind referred to and embodying a gathering roll on which a number of layers of a paper web are wound or gathered and then automatically severed at a predetermined time and then passed to press rolls, the construction providing sheets of substantially uniform thickness and capable of operation at a comparatively high speed.

Another object of the invention is the provision of apparatus of the character mentioned embodying a gathering roll and a suction press roll cooperating therewith and adapted to press the paper web at the point of gathering and to apply suction to the web as the web is gathered.

Another object of the invention is the provision of apparatus of the character mentioned including means for relatively moving the suction roll and the gathering roll to vary the distance between their axes.

Another object of the invention is the provision of apparatus for making multi-ply paper or the like and embodying a press roll, preferably a suction press roll, cooperating alternately with a plurality of gathering rolls which are automatically moved relatively to the suction roll and to which the web is applied in an alternate manner, the gathering rolls having automatically operable severing means which severs the gathered layers at a predetermined time in the sequence of operations.

Another object of the invention is the provision of an apparatus for making multi-ply fibrous material and including a gathering roll on which a paper web or the like is wound until a predetermined thickness is obtained, the gathering roll having a severing knife automatically operable at a predetermined time in the sequence of operations to sever the gathered layers so that individual multi-ply pieces of predetermined thickness may be supplied to press rolls for further treatment.

Other objects of the invention reside in the method of making individual sheets of fibrous material, of a number of plies, carried out in accordance with the apparatus above set forth.

Still other objects and advantages of the invention will be apparent from the following description, the appended claims and the accompanying drawings, in which:

Fig. 1 is an elevational view shown more or less diagrammatically, and embodying apparatus for making multi-ply sheets in accordance with the present invention;

Fig. 2 is a vertical section through one of the gathering rolls;

Fig. 3 is a side view of a gathering roll;

Fig. 4 is a top plan view of a gathering roll showing the knife controlling means illustrated partly in section;

Fig. 5 is a sectional view of the valve operating means by which the relative movement of the gathering roll and the cooperating press roll is controlled;

Fig. 6 is a plan view of the valve operating means shown in Fig. 5; and

Fig. 7 is an elevational view shown more or less diagrammatically of a modified arrangement of the invention embodying one gathering roll.

In accordance with the present invention, a thin web of paper pulp or the like is produced on a foraminous forming wire and is carried by means of a felt or other conveying means to a press roll, preferably a rubber covered suction press roll cooperating with one or more gathering rolls on which the web is wound or gathered until the desired thickness of multi-ply material is obtained, the gathered plies being cut automatically at the proper time in the sequence of operations and then passed between press rolls from which they may be delivered for further processing. Two gathering or winding rolls may be employed, working alternately against the suction press roll, the gathered plies on one gathering roll being cut at the proper time and supplied to press rolls while the paper web is gathered and wound upon the other gathering roll. The gathering roll or rolls are mounted for relative movement with respect to the suction press roll so that the distance between the axes of these rolls may be varied to allow for an increased spacing of the roll axes as the gathered sheet thickens. When two gathering and winding rolls are used they are preferably arranged on a movable table or tables adapted to be moved to cause the gathering rolls to alternately engage and disengage with the suction press roll.

The gathering and winding rolls are moved so that one or the other of the gathering rolls is moved in engagement with the suction press roll when the other gathering roll is moved away from the suction press roll, such movement being effected by means of a suitable control, such as a hydraulic cylinder provided with a ram adapted to move in opposite directions by pressure applied alternately through opposite sides of a piston. This controlling means preferably includes a fluid pressure controlled device which limits the speed of approach of the gathering roll to the suction press roll so that these rolls will be engaged without shock and without injury to the felt.

Means are provided for cutting the wound-up body of pulp and removing the pulp from the gathering roll, such means being automatically operable after a predetermined amount of material has been gathered. The cut pieces are

then supplied to suction press rolls the speed of which is properly related to the speed of movement of the gathering roll.

Referring to the drawings more particularly by reference numerals, 1 generally designates a vacuum forming roll having a stationary suction box opposite the surface of the roll to which the diluted pulp in the flow box 2 is applied. The vacuum forming roll 1 is provided with a large number of small, countersunk holes. The flow box is suitably arranged to maintain the fibers in a suitable state of agitation, the fibers being applied to the making wire 3 which passes around the forming roll and around directioning and tension rolls 4 and over an automatic wire guide 5 of any suitable character which maintains the edges of the wire 3 in a predetermined location. While the apparatus as herein shown embodies a foraminous cylinder mold partly submerged in a vat of diluted pulp, it will be apparent that the invention is not limited to this kind of a web forming machine.

The formed paper web carried by the wire 3 passes below a water jet 6 which may be employed for cutting the web of pulp at the required proper time in the sequence of operations so that the web may be transferred from one gathering roll to another, when two gathering rolls are used. When only one gathering roll is employed the water jet 6 is not required.

A vacuum transfer roll 7 having a stationary suction box transfers the formed paper web from the making wire 3 to a first press felt 8. This felt carries the web to a suction press roll 9 cooperating with a gathering roll around which the paper web is wound until the desired sheet thickness is obtained. As shown in Fig. 1 there are two gathering rolls 10 and 11 arranged on opposite sides of the press roll 9. The roll 9 is drilled with a large number of small holes and is preferably provided with a rubber covering having holes registering with the holes in the metal shell, and arranged within the roll is a stationary suction box 12 of such character that its approach side is above the bite or point of engagement with the gathering roll 11, the roll 9 also having a stationary suction box 13 so arranged that its upper limit is at the bite of rolls 9 and 10, the lower limit of this suction box being below this bite.

The gathering rolls 10 and 11 are so mounted that the distance between their axes and the axis of the roll 9 may be varied, the construction illustrated in Fig. 1 providing for movement of the gathering rolls 10 and 11 while the roll 9 is so arranged that its axis is in a fixed position. Rolls 10 and 11, as shown, are mounted in bearings 10a and 11a respectively, carried by brackets 14 and 15 which are mounted upon a laterally movable table or support 16. The support 16 is mounted on a base bed 17 provided preferably with balls or rollers 18 so that the table or support 16 may be readily moved in a direction normal to the axis of the roll 9. The brackets 14 and 15 are adjustable on the table or support 16 to permit of the use of different diameter rolls so that longer or shorter sheets of multi-ply material can be made to suit various requirements.

Each of the rolls 10 and 11 is provided with an internal rib 18 (see Figs. 2 and 3) which has a tapered groove 20 carrying a parting knife 21 the back of which is tapered so that when the back edge of the knife engages the inner surface of the groove 20 the edge of the knife will be flush with the cylindrical surface of the roll.

The arrangement is such that at starting, until the web is satisfactorily formed, the pulp which is applied to the making wire 3 is washed off with a shower pipe into a pit below the making wire as in accordance with the usual paper making practime, the transfer roll 7 being moved out of contact with the wire 3. However when the web is satisfactory, the suction transfer roll 7 is moved to engage the transfer felt 8 with the making wire 3. In the position shown in full lines in Fig. 1, the web is being collected on the gathering roll 10, the web passing around the roll 9 which is now spaced from roll 11, and being pressed against the gathering roll 10, which removes it from the felt 8 and bonds one ply or layer onto another until a cylindrical sheet 22 of the required thickness is formed on the roll 10. As the thickness of the material on the roll 10 increases, the roll automatically moves away from the suction press roll 9, and the other gathering roll 11 approaches the roll 9. When the sheet on the roll 10 has reached its desired thickness, an adjustable electrical contact point 16a on the left side of table 16, as viewed in Fig. 1, makes contact with a fixed contact point 16b on the frame of the apparatus and completes an electric circuit which actuates means for causing the knife on the gathering roll 10 to sever the gathered plies of material.

This means comprises an electric motor which operates a valve controlling the supply of fluid under pressure to the fluid pressure cylinder 27 shown in Fig. 4, the supply of fluid to the cylinder 27 causing a tapered trip plate 23 to move forward to the position shown in Fig. 4 where it is in position to be engaged by the end 24 of the knife bar 21. As the knife bar 21 rotates, it comes into engagement with the tapered surface on the trip plate 23 which forces the knife longitudinally in the direction of its length, the knife also moving radially outwardly because of the inclination given to the bottom of the groove 20, thus severing the sheet. The sheet at the point of severance is wet and weaker than the other portions of the sheet because of the space provided at the inclined side of the knife. When the knife bar 21 has passed the trip plate 23 and severed the plies of pulp wound on the roll 10, it is promptly returned by means of a fixed tapered plate 26 carried by a bracket at the opposite end of the roll and engaging the opposite end 25 of the knife to cause the knife to return to its inoperative position.

The trip plate 23 may also be adapted to be brought into operative position by other suitable timing mechanism actuated by the number of revolutions the gathering roll has made, such as a wheel having one tooth and operating a pin or other mechanism to trip the operating mechanism of the trip plate 23 after a predetermined number of revolutions of the gathering roll 10, or the mechanism may be set in motion by a member such as a roller mounted on an arm which roller contacts with the wound-up web on the roll 10 and operates the control mechanism when the desired thickness of sheet is obtained on the roll 10.

As will be understood, the rolls 10 and 11 are of similar construction, each being provided with web severing means, the construction shown in Figs. 2, 3, and 4 being applicable to both of these gathering rolls.

The lateral movement of the rolls 10 and 11 is effected by means of a hydraulic cylinder 28, connected to a suitable pressure supply pump, not shown, through a valve 29 of such character

that pressure can be applied alternately to either end of the cylinder 26. The valve 29 may be operated manually or automatically in connection with the pulp cutting control means 23 by means energized with the motor which controls the valve for supplying pressure to the cylinder 27. Figs. 5 and 6 show a construction of valve operating means for operating the valve 29 to control the movement of the rolls 10 and 11 with respect to the suction press roll 9. In this construction 30 is an electric motor of the reversible type, actuated through suitable electric controls when its contacts 16a and 16b engage, to operate the valve 29 through pinion 31 and quadrant 32, the latter being provided on the valve stem 33. This same valve arrangement and motor control may be provided to control the pressure supplied to the piston in the valve 27 for operating the trip plate 23 except that the back pressure valve 44 is omitted and the device is provided for operating the trip plate 23 through only a single stroke.

Where two rolls 10 and 11 are used, when the multi-ply sheet 22 is cut at roll 10, and the severed end reaches the bite between the suction roll 9 and gathering roll 10, a reverse pressure is applied to the hydraulic cylinder 28 and the gathering roll 11 is brought into contact with the roll 9.

The gathering rolls may each be provided with operating mechanism 28, 29 if the gathering rolls are individually movable, so that if it is desired to start the web carried by the felt 8 onto the roll 11 as the cut made by the jet 6 approaches the bite of the rolls 9 and 11 this may be done. If this is accomplished the web that is past the suction box 12 may continue to be pressed against the pulp gathered on the roll 10, this length of web being equal to half the circumference of the roll 9. After the web end passes the suction box 13, the roll 10 is then caused to recede from the roll 9. In like manner this gathering roll may contact with the suction press roll 9 before the roll 11 is caused to recede.

When the multi-ply sheets gathered on rolls 10 and 11 have been cut they are passed onto felts 34 and 35 and travel between pairs of suction rolls 36, 36a and 37, 37a preferably arranged vertically, and thence move to a conveyor felt 38 which delivers the multi-ply sheets for further processing, where desired. The felts 34 and 35 are trained about rolls 34a, 35a respectively and around associated guide rolls. Curved guards 39, 39a are arranged partly around the roll 10 to support and guide the sheet after the latter has been severed as it is delivered to felt 34, and a guard 40 for similar purpose is arranged over roll 11. The pairs of press rolls 36, 36a and 37, 37a may be driven at the same speed as the forming wire 3 and the gathering rolls 10 and 11.

With the use of two gathering rolls 10 and 11, when the sheet has been gathered and severed on one roll, the roll upon which it has been gathered is forced away from the press roll 9 by the piston and cylinder 28 and is free to be revolved at a slower speed while delivering the severed sheet to the presses. For this purpose the winding roll 10 may contact with a roll 50 which may be a friction roll adjustably attached to the frame of the machine to enable it to be adjusted to suit different diameters of winding rolls 10 and 11, and adapted to be driven by a belt from roll 36, the said roll 36 being adapted to rotate at a slower speed than the making speed. In a similar manner the roll 11 is provided with a friction roll 50a adapted to be driven from a belt passing around the roll 36a. The belts for driving these rolls 50 and 50a are so arranged as to rotate the rolls 50 and 50a in the proper directions. By passing the severed sheets through the presses at a slower speed than the speed of travel of the felt 8, the power requirements are reduced and the felts are given a longer life, while the sheet is delivered with less moisture.

When using one gathering roll, the multi-ply sheet, when severed, is delivered from the gathering roll at the same high speed at which the press roll 9 operates, and passes to the presses at that speed. However this speed of movement of the cut sheets through the presses is preferably lower than the speed of operation of the press roll 9. Fig. 7 shows one form of construction in which the severed sheet is delivered vertically to the press rolls at a slower speed of movement than the speed of formation of the web. In this construction the felt 8 travels beyond the roll 9 to and around a small turning roll 41 coacting with another small roll 41a which is under spring tension, being held normally towards the roll 41 under the action of a spring so that it can be moved away from the multi-ply sheet coming between these rolls. Arranged below the rolls 41 and 41a is a series of pairs of tension rolls 42, 42a. The sheet passes between these rolls at the speed of the gathering roll until the forward end of the sheet enters between the last pair of rolls 42, 42a whereupon the spring tensioned roll 41a moves relatively to the roll 41 and operates a suitable controlling mechanism as by means of an electric contact to change the speed of operation of the press rolls 36, 36a and 37, 37a and the felts 34 and 35 cooperating therewith. The speed changing means may comprise any suitable electric motor or clutch control. The driving mechanism for the last pair of spring tensioned rolls is automatically released when the sheet enters between the press rolls.

In order to permit the gathering roll, when one such roll is used, to be brought into contact with the suction press roll 9, or each of two rolls to be brought alternately against the suction press roll without causing a blow thereon, the outlet 43 of the valve 29 may, as shown in Fig. 5, be provided with a valve seat 29a against which a valve 44 is adapted to bear. The valve 44 is provided with a stem 45 the lower end of which extends into a hole 46a formed in a bearing 46 carried by the part 47 and surrounded by coiled spring 48 pressing the valve against its seat. The arrangement is such that when a sheet of multi-ply pulp on the gathering roll has been cut, the pressure from a pump acting against one side of the piston and the cylinder 28 will cause the gathering roll to be moved against the suction press roll 9 and the valve 44 will act after the manner of a dashpot to prevent a sudden blow to the gathering roll against the roll 9.

In the bonding of multi-ply paper or board, the plies should come together with the correct moisture content, the web not being smoothed and being without pressure before it is bonded. The bonding is greatly improved by employing a suction roll at the point of gathering of the web, as there is an instant removal of the water expressed between the nip of the suction press roll and the gathering roll, this water being taken from the web through the felt at the preliminary pressing between the suction press roll and the gathering roll 10 or 11. The point of gathering is the first point at which pressure is applied to the web.

The felts 8, 34 and 35 are endless felts, kept in

proper operating condition by the suction press rolls although if desired they may be continuously washed as in accordance with usual board making practice. This washing may be done with shower pipes and whippers or by means of shower pipes and suction rolls.

By passing the multi-ply sheets between two felts, such as the felts **34** and **35** and between the strongly constructed suction press rolls **36**, **36***a* and **37**, **37***a*, having stationary suction boxes adjacent the nips of the rolls, the water in the sheet is drawn equally in opposite directions and from opposite sides of the web, and the multi-ply sheets emerge dryer than they would if the sheets were pressed in stacks between felts in a hydraulic press, and of course in accordance with the present invention the speed of production is high and the labor of handling is reduced to a minimum.

While the method herein described, and the forms of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and forms of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for making individual sheets of multiply paper comprising means for making a web of paper, a press roll, means for moving the web to the press roll, a support, a pair of gathering rolls on said support rotatable on opposite sides of said press roll, means for bodily moving said support to bring said gathering rolls alternately into pressure engagement with said press roll, and means for severing the gathered plies on said gathering rolls.

2. Apparatus for making individual sheets of multiply paper comprising means for making a web of paper, a suction press roll, means for transferring the web to the suction press roll, a gathering roll cooperating with said suction press roll, means for relatively moving said suction press roll and gathering roll to vary the spacing between their axes, means for severing the gathered plies on the gathering roll, and fluid pressure means limiting the speed of approach of said rolls.

3. Apparatus for making a multi-ply sheet comprising means for making a web of paper, a press roll, means for transferring the web to the press roll, a pair of gathering rolls, said press roll having a plurality of stationary suction boxes one adjacent the nip of each gathering roll, means for severing the gathered layers on said gathering rolls, and means for relatively bodily moving said gathering rolls and press roll to bring the gathering rolls alternately into and out of pressure engagement with said press roll.

4. Apparatus for making a multi-ply sheet comprising means for making a web of paper, a press roll, means for transferring the web to the press roll, a gathering roll, said press roll having a stationary suction box adjacent the nip of the gathering and press rolls, means for severing the gathered layers on said gathering roll, and means for relatively moving said gathering roll and press roll to bring the gathering roll alternately into and out of engagement with said press roll, said means comprising a fluid pressure cylinder and means controlled by the thickness of the gathered web on said gathering roll for controlling said fluid pressure cylinder.

5. Apparatus for making individual sheets of multi-ply paper comprising means for making a web of paper, a suction press roll having a plurality of stationary suction boxes at a plurality of peripherally spaced locations, means for supplying the web of paper to the suction press roll, a plurality of gathering rolls adapted for pressure engagement one at a time with said suction press roll adjacent the respective locations of said suction boxes, means for cutting the gathered plies on the gathering rolls, and means for moving a succeeding gathering roll into operative engagement with said press roll while the gathered plies on said preceding roll are cut therefrom.

6. Apparatus for making individual sheets of multi-layer paper comprising means for making a paper web, a suction press roll, means for transferring the web to said suction press roll, a pair of gathering rolls, means for alternately bringing one of said gathering rolls into pressure cooperation with said suction press roll to wind a multi-layer web thereon and for simultaneously moving the other gathering roll away from said suction press roll to permit of the unwinding of the web thereon, means for cutting the gathered layers on each said gathering roll during the time said roll is moved away from said suction press roll, press rolls for receiving the cut layers successively from the gathering rolls, means for operating said press rolls at a peripheral speed substantially less than the speed of movement of the web to said gathering rolls, and means for operating each gathering roll when moved away from said suction press roll at a peripheral speed substantially corresponding to that of said press rolls to provide for unwinding of said cut layers at reduced speed while the next multi-layer web is being formed on a gathering roll in contact with said press roll.

7. The method of manufacturing individual sheets of multi-ply fibrous material comprising forming a fibrous web, continuously supplying the web to first one and then another of a plurality of gathering rolls, gathering and winding the web on a gathering roll into a multi-ply tube, continuously applying pressure and outward suction to the tube at the point of gathering as the web is gathered, severing the gathered plies successively while still on the respective gathering rolls, delivering the severed sheets successively from the gathering rolls in a common path of travel, and subjecting the sheet coming from one gathering roll to a pressure operation while the web is gathered on another gathering roll to form the next succeeding sheet.

8. The method of manufacturing individual sheets of multi-ply paper comprising forming a web of paper, supplying the web continuously to a roll and gathering the web from that roll into a multi-ply tube at one point along the roll circumference while concomitantly applying outward suction to the tube at the point of gathering and pressing the tube at the point of gathering, alternately gathering the web into another multi-ply tube and applying suction and pressure to said other tube at another point along the roll circumference, severing the respective tubes, and unwinding each of said severed tubes while the gathering operation for the forming of the other tube is in progress.

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