Nov. 26, 1929. H. F. WEISS 1,737,283

MULTIPLY PAPER MACHINE

Filed Nov. 12, 1928 2 Sheets-Sheet 1

Fig. 1.

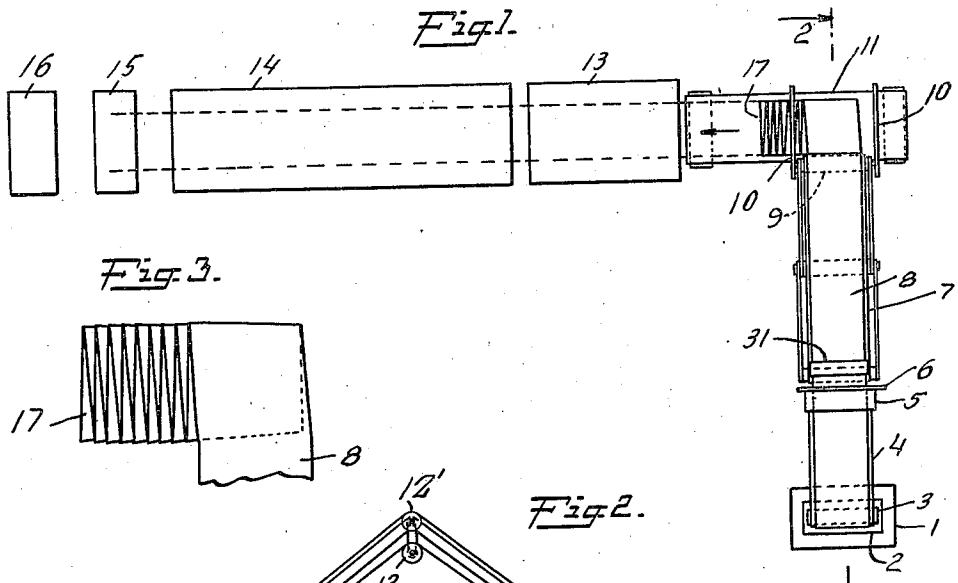


Fig. 3.

Fig. 2.

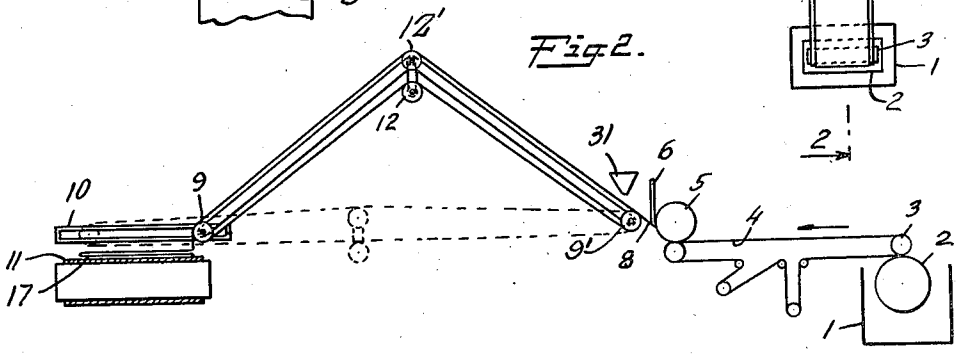


Fig. 4.

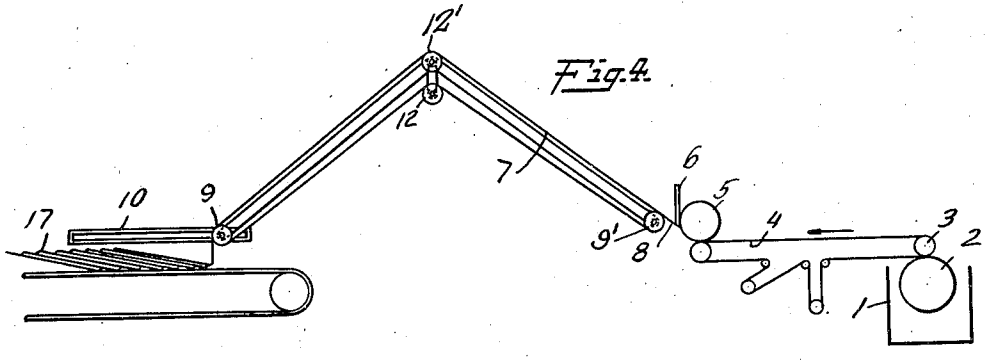


Fig. 5.

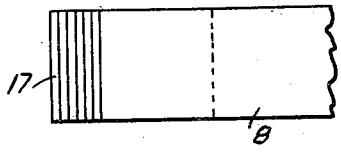


Fig. 6.



Fig. 7.



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Fig. 8.

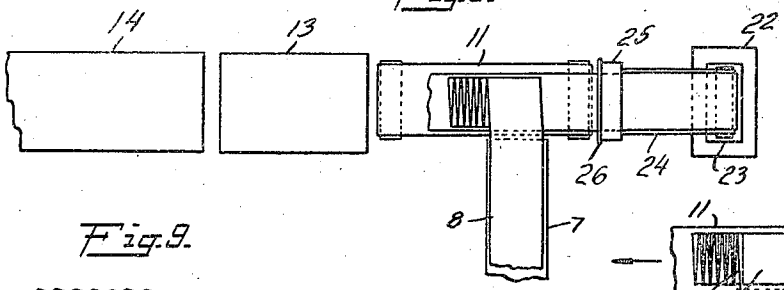


Fig. 12.

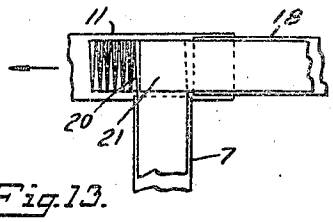


Fig. 9.

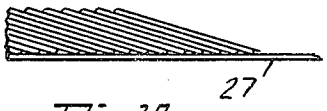


Fig. 10.

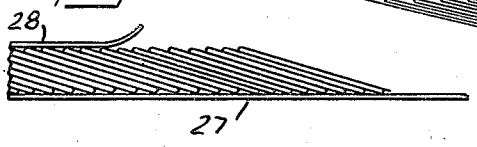


Fig. 13.

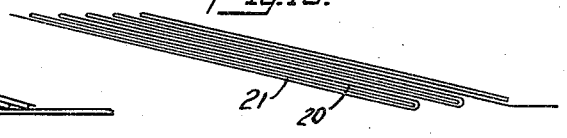


Fig. 15.



Fig. 11.

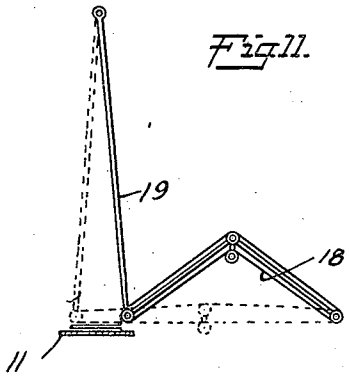


Fig. 16.

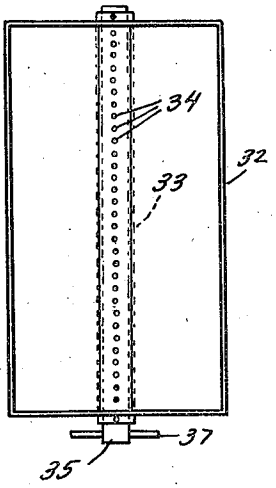


Fig. 17.

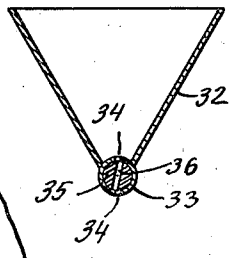
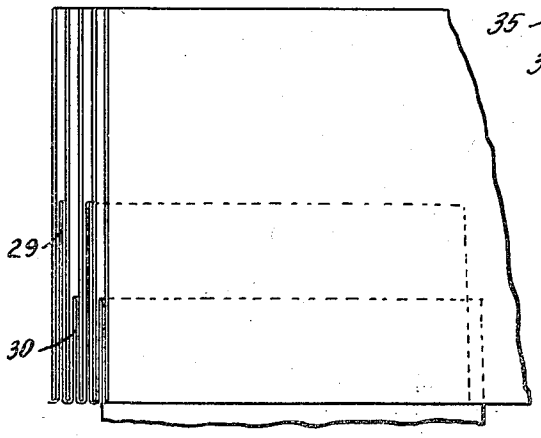


Fig. 14.



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UNITED STATES PATENT OFFICE

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MULTIPLY PAPER MACHINE

Application filed November 12, 1928. Serial No. 318,957.

My invention relates to improvements in paper making machines of the cylinder type and is a continuation in part of my copending application Serial No. 139,476 filed October 4th, 1926—fibrous material and method of making same. As disclosed in the said application, the present invention consists of apparatus whereby thin webs of paper stock or other fibrous material may be laid down in a moist condition in overlapping folds upon a moving conveyor and means are provided for controlling the speed of the conveyor to produce a product consisting of a succession of overlapped folds which may be then compressed into a coherent sheet. The present invention also comprises means for creping the paper stock and means for treating the webs with chemicals, fillers or other foreign materials.

It has been found to be impractical to produce thick sheets by forming a single thick web in the same way in which thin webs are formed. In the manufacture of thick fibrous sheets a multiple cylinder machine is usually used, the cylinders arranged in tandem and the resulting webs superimposed upon each other to build up a sheet of desired thickness. A multiple cylinder machine represents a considerable capital investment and has the disadvantage that its tonnage capacity is large and it cannot be a profitable investment unless a considerable market is available to absorb a large tonnage of thick fibrous sheets. Furthermore, it is impractical to build up boards that are more than one fourth inch in thickness on an ordinary cylinder machine because the laminated pulp web will not adhere sufficiently to the supporting felts. In the manufacture of pulp laps, the thick fibrous sheets are usually built up by allowing the thin pulp webs to accumulate upon a single roll. When the desired thickness is attained the sheet is stripped from the roll by a doctor to form a rectangular fibrous sheet with dimensions approximately equal to the width and circumference of the roll.

The fibrous sheet or paper made on present single or multiple cylinder machines has the fibers laid down in the general direction of movement of the sheet, called the machine direction. As a result, the sheet has greater strength in the machine direction than across the sheet.

If fillers, chemicals, or other foreign materials are to be incorporated into the fibrous sheet, they are mixed with the pulp slurry in the vat of the wet machine. The cylinder mould then picks up both the pulp and the foreign materials from the slurry. The "white water" which is separated from the pulp contains a considerable amount of these foreign materials which are lost, since the "white water" runs to waste.

It is the object of my invention to provide a machine for making a thick fibrous sheet which will necessitate only such investment cost as is commensurate with the desired quantity of production.

It is the object of my invention to provide a machine which, with only one cylinder, will build up a fibrous sheet of any desired thickness; will make a heavy sheet or board with considerable elasticity and stretch; will make a smooth, uniform thick fibrous sheet less "wild" than a thick sheet formed on an ordinary cylinder machine; will produce a tapered fibrous sheet which may be used for the production of tapered shingles; will produce a fibrous sheet which has equal strength or shrinkage in both directions; will produce a fibrous sheet which has greater strength at right angles to the machine direction of the sheet than do sheets produced by ordinary cylinder machines; and will incorporate waterproofing, fireproofing or other agents into the sheet without loss or wastage, in contrast to the large quantities of such materials now lost in the "white water" of present machines.

Other objects and advantages will become clear from the following description of my improved machines, which is to be taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a diagrammatic plan view of one embodiment of my invention;

Fig. 2 is a vertical, sectional view on line 2—2 of Fig. 1;

Fig. 3 is a portion of sheet produced by the apparatus of Figs. 1 and 2;

Fig. 4 is a diagrammatic side view of another embodiment of my invention;

Fig. 5 is a plan view of a sheet laid down in accordance with the modification shown in Fig. 4;

Fig. 6 is an exaggerated longitudinal section through a fibrous sheet before pressing and as laid down in accordance with the modifications shown in Fig. 4;

Fig. 7 is a similar view of the sheet shown in Fig. 6 after the latter has been pressed;

Fig. 8 is a plan view of apparatus somewhat similar to that shown in Figs. 1 and 2 by means of which the fibrous sheet is provided with a facing;

Fig. 9 is an exaggerated section of a fibrous sheet laid down by the apparatus shown in Fig. 8;

Fig. 10 is a similar view of a fibrous sheet provided with facings upon its upper and lower surfaces;

Fig. 11 is a detailed view of a guide member;

Fig. 12 is a diagrammatic view illustrating another modification of my invention;

Fig. 13 is an exaggerated sectional view of the sheet laid down in accordance with the modification shown in Fig. 12;

Fig. 14 is a plan view of a tapered sheet suitable for use in roofing;

Fig. 15 is a transverse sectional view of the sheet shown in Fig. 14;

Fig. 16 is a plan view of a device suitable for spraying asphalt upon a fibrous web; and

Fig. 17 is a sectional view along the line 17—17 of Fig. 16.

My improved machine and its method of operation can best be understood by referring to the accompanying drawings. Like numerals indicate like parts in the several figures.

The vat 1 of a wet machine contains the slurry of water and pulp. The usual perforate cylinder mould 2 picks up a web of pulp which is then carried to couch roll 3, around which felt 4 travels in the indicated direction. The wet pulp web is picked up and carried along on felt 4 from the perforate cylinder mould 2 and is then pressed by press roll 5. The moist pulp web is picked up by press roll 5 and is removed therefrom by doctor 6. This pulp web may be creped by the doctor or may be kept smooth as desired. To secure a high degree of smoothness the web may be arranged to be transferred from roll 5 to conveyor belt 7 without coming in contact with doctor 6. The pulp web 8 is then carried forward by a conveyor belt 7 which is part of a hinged reciprocating looping device which is shown in another position by the dotted lines in Fig. 2. Creping of the web is accomplished by adjusting the speed of conveyor belt 7 so that it is somewhat less than that of felt 4. The web is not taken away as fast as it is fed to the edge of the blade of doctor 6 and it crumples along transverse lines as it leaves the doctor. The crumpling action produces an effect similar to that produced by ordinary creping rolls except for the fact that the lines of creping are not so regular or distinct. The off-take roll 9 of the hinged looping device works at a uniform rate of speed equal to the travel of belt 7 along a guide 10 and distributes the pulp web 8 across the conveyor 11 as shown. Guide 10 is positioned parallel to the plane of conveyor 11. Roll 12 serves to keep conveyor belt 7 taut and directs the return travel of belt 7 along a path which is at all times as nearly as possible equal in length to that of the forward path. Roll 12 is so located with respect to the roll 12′ above it that the forwardly moving and returning portions of belt 7 are maintained substantially parallel to each other. The end rolls 9 and 9′ are connected to the intermediate rolls 12 and 12′ by bars (not shown) which permit the intermediate rolls to reciprocate with off-take roll 9 but in a direction nearly at right angles to the direction of movement of off-take roll 9. The receiving and delivery ends of belt 7, when measurements are made along the path of the web, are thus equally distant from each other for all positions of the delivery end. Since the delivery end of belt 7 is at all times the same distance from conveyor 11, the point of deposition of the web upon conveyor 11 is always equally distant from the receiving end of belt 7. The wet web is thus delivered by the feed device at the same speed as its point of deposition moves relative to conveyor 11 and there is no accumulation of web at some points or stretching and tearing at others. In Fig. 4 the inclination of the webs is greatly exaggerated and the surface of the webs is practically parallel to that of conveyor 11. Without this nice arrangement of equipment it is impossible to handle wet webs without wrinkling or rupture unless a variable and difficultly obtained compensating motion is imparted to off-take roll 9 by means of cams. In Figs. 1 and 2 the pulp web is distributed transversely on the conveyor 11 which is moving in the direction of the arrow of Fig. 1. In Fig. 4 the conveyor belt is moving parallel to the direction of the pulp web 8. The pulp web, when laid down transversely to the conveyor 11 of Figs. 1 and 2 forms a series of overlapping folds of pulp as illustrated in Fig. 3. These folds may be cut at the folded edges or may be used in the form shown. The folded edges come at the edge of the fibrous sheet but are not parallel to it and must be trimmed. The fibers when laid down transversely are at an angle greater than 45° to the machine direction of the conveyor 11, and are substantially at right angles to it. A fibrous

sheet made in this manner has a strength greater across the sheet than with the machine direction. If the folds of pulp web are laid down parallel to the machine direction by the machine of Fig. 4, the folded edges are across the sheet as shown in Figs. 5, 6 and 7. The cross sectional appearance of a sheet of this type is illustrated in Figs. 5 and 6 and at 17 of Fig. 4. The folds of pulp web made by this method extend from one surface of the fibrous sheet diagonally through to the other surface.

The fibrous sheet, formed by laying down the folds of pulp web either parallel or transversely to the direction of the conveyor 11, or in any other predetermined manner as may seem desirable, usually passes through a continuous press 13, which may be in the form of press-rolls. This operation compresses the loosely piled overlapping folds of pulp web into a homogeneous and coherent moist fibrous sheet. If the paper has been creped by doctor 6, the pressure of rolls or other press 13 interlocks the creped paper surfaces to form a fibrous sheet in which the overlapping folds adhere at their surfaces with greater tenacity than when the moist webs are not creped. For some purposes, as for absorbent pads, the overlapping folds of pulp web need not be pressed together, but may retain the appearance of Fig. 6. The moist fibrous sheet may either be dried or be used as a moist pulp product without drying after leaving the continuous press 13. If it is desirable to dry the fibrous sheet after leaving the continuous press 13, the sheet then passes through drier 14, after which it may pass through the trimmer 15 and cutter 16. Paper made in this manner has all of the desirable properties of paper made in the ordinary manner by a multiple cylinder machine and if the constituent webs have been creped it has, in addition, some of the elasticity of the constituent creped webs. My invention relates particularly to the machine for making a coherent fibrous sheet by building up a series of moist overlapping folds of pulp web and then pressing them into a homogeneous sheet.

The conveyor 11 may receive overlapping folded pulp webs from more than one machine and thereby build up the same thickness of fibrous sheet in a shorter time. This method may be used to make pulp laps, thereby eliminating "roll skinners" and a portion of the labor necessary to take off and fold the finished laps. The second series of overlapping folds of pulp web may be laid at right angles to the first series, thereby making a fibrous sheet which has approximately equal strength in both directions. The two or more constituent pulp webs may also be of different types of fibers, thereby making a composite paper.

An apparatus for laying down two series of overlapping folds of pulp web is shown diagrammatically in Fig. 12 of the drawings. In this construction the conveyor 7 of the looping device is arranged transversely of the conveyor 11 as in Figs. 1 and 2 of the drawings, and a similar conveyor 18 is arranged to lay down a folded web parallel to the direction of travel of conveyor 11. In this form of the invention the guides 10 are not employed as they would interfere with the operation of the looping devices. I accordingly support the moving end of the looping conveyor on an arm 19 (Fig. 11) which is actuated by suitable means, such as a cam (not shown) to intermittently swing through the arc indicated by the dotted lines. Arm 19 is of sufficient length to permit the take-off roll 9 to reciprocate in a plane substantially parallel to the plane of conveyor 11. The sheet formed is shown in Fig. 13 in which the folds formed by the looping device 7 are shown at 20 arranged within the folds 21 formed by the longitudinally extending looping device 18.

It is also possible to face the fibrous sheet with a similar or different type of pulp web. The fibrous sheet may be faced by laying a moist pulp web of the desired surfacing material on conveyor 11 of Fig. 8, then supporting the overlapping folded pulp web 8 on it. The moist pulp web is laid on conveyor 11 preferably by means of a surfacing mould vat 22 and a couch roll 23. The couch roll 23 delivers the web to a belt 24, which is provided with a press roll 25 and doctor 26. The product is shown in Fig. 9 having a facing 27. A similar facing 28 may be secured to the other surface of the sheet as shown in Fig 10 of the drawings. The surfacing material may be of different stock than the folded webs.

If desired, the fibrous sheet may be built up so that the sheet is tapered in cross section at right angles to the machine direction, thereby making it useful in the manufacture of tapered shingles. This may be accomplished by several methods, one of which is to provide a slower travel of the looping conveyor on one side of the conveyor belt 11, thereby allowing more folds of pulp web to pile up at this point; another is to have additional folds of pulp web distributed at one side of the conveyor belt 11 and thereby building up thicker sections at this point. A sheet of this character is shown in Figs. 14 and 15 of the drawings. The additional folds 29 and 30 may be laid between the folds forming the main body of the sheet by apparatus of the type shown in Figs. 11 and 12, and if desired, the stroke of the auxiliary looping devices may be varied to provide additional loops varying in size.

If the machine shown in Figs. 1 and 2 is used, the width of the fibrous sheet may be changed easily by varying the travel of the reciprocating looper on the guide 10. This may be done without any change in the ca-

pacity of the wet end of the machine. The advantages of this feature will be apparent to those skilled in the art. When using the machine shown in Fig. 4, it is necessary to vary the width of the pulp web in order to secure sheets of corresponding width.

Chemicals, fillers or other foreign substances may be incorporated in the fibrous sheet without introducing these materials into the pulp slurry in vat 1. These chemicals may be incorporated by sprinkling or spraying the desired material in finely divided form or in solution on the pulp web 8 after leaving either the couch roll 3 or press roll 5, preferably the latter. The pulp web may also pass through a solution of the desired chemicals before being laid down on conveyor 11. If the pulp web is creped, fillers may be incorporated to better advantage than when the pulp web remains smooth. By this method none of the foreign materials are lost in the "white water" from cylinder mould 2. Although my improved fibrous sheet does not require any adhesive for the proper adhesion between the overlapping pulp folds it may be desirable for certain conditions to size the sheet. The size can be incorporated on the pulp web 8 as hereinbefore described. Water resistant compounds such as asphalt, which is used in manufacturing shingles, may be readily incorporated in my improved fibrous sheet by dusting or sprinkling these compounds preferably in finely divided form on the pulp web 8. Better adhesion of asphalt upon the wet web is secured if a small amount has been previously incorporated, as by mixing into the slurry in vat 1. A suitable device 31 for spraying asphalt upon the fibrous web is shown in Fig. 2 and is illustrated in detail in Figs. 16 and 17. A suitable container 32, preferably of metal, is adapted to be heated, as by means of steam coils, (not shown) and is supplied with asphalt from a suitable source of supply. Two of the sides of container 32 converge toward the bottom where a metal pipe 33 is secured as by welding, to the sides. Pipe 33 is perforated in its uppermost and lowermost portions along its length to provide holes 34. Within pipe 33 is rod 35 which is free to revolve and which is provided with holes 36 extending therethrough. Holes 36 are arranged to register with holes 34 in pipe 33. A short rod 37 pierces rod 35 and provides means for the manual operation of the former. The hot asphalt flows in streams from the bottom of container 32. The rod 36 serves as a valve to regulate the rate or to stop the flow entirely. In Fig. 17 the rod is shown in a position in which the holes 36 do not register exactly with holes 34. Such an adjustment results in a diminished flow of asphalt from container 32. Other foreign materials, such as sodium silicate possessing characteristics such as viscosity, different from asphalt, requires a different means for spraying upon the pulp webs.

The overlapping pulp folds containing the water-resistant compound or asphalt are then passed through heated press rolls to dry the pulp and melt the water-resistant compound and thereby thoroughly saturate the fibrous sheet or board which may be of tapered cross section. The board may be given a further coating of water-resistant compound followed by a layer of crushed rock to complete a stock suitable to be cut into shingles.

Throughout the claims the term "folds" is used to define, not only the folded edge, but the entire overlapping portions formed by each reciprocation of the looping device; and the term "edge" when used in conjunction with "folds" is intended to mean either the folded edge or loop, or the non-folded side edge of the portion of the web forming the folds.

It is the aim of the foregoing specification to describe a practicable embodiment of my invention without including details of design or structure. Where such details appear, they are understood to be merely illustrative rather than to limit the scope of the invention.

I claim:

1. In a machine of the character described, means for laying down overlapping folds of moist pulp web.

2. In a machine of the character described, means for creping a moist pulp web and laying down said creped web in overlapping folds.

3. In a machine for making a fibrous sheet, means for laying down overlapping folds of moist pulp web and means for pressing said succession of folds into a coherent sheet.

4. In a machine for making a fibrous sheet, the combination of means for creping a moist pulp web, means for laying down said pulp web in overlapping folds, and means for pressing said folds into a coherent sheet.

5. In a multi-ply paper machine of the cylinder type, means for laying down overlapping folds of moist, pulp web upon a moving conveyor.

6. In a machine for making a thick sheet of paper in continuous lengths, the combination of means for laying down overlapping folds of a thin moist paper web, means for spacing said individual folds from each other and means for pressing said succession of folds into a coherent sheet.

7. In a machine for making a thick sheet of paper from a single thin pulp web, the combination of means for laying down overlapping folds of a thin moist pulp web, means for spacing said individual folds in the machine direction of the finished sheet, and means for pressing said succession of folds into a coherent sheet.

8. In a machine for making a fibrous sheet,

the combination of means for creping a moist pulp web, means for laying down said creped pulp web in overlapping folds, means for spacing said folds in the machine direction of the finished sheet and means for pressing said folds into a coherent sheet.

9. In a machine for making a fibrous sheet, the combination of means for laying down overlapping folds of a thin pulp web in a direction transverse to the machine direction of the finished sheet, means for spacing said individual folds in the machine direction of the finished sheet, and means for pressing said pulp folds into a coherent sheet.

10. In a machine for making a fibrous sheet, the combination of means for laying down overlapping folds of thin pulp web, means for pressing said folds into a coherent sheet, and means for drying said pressed sheet.

11. In a machine for making a fibrous sheet, the combination of means for creping a moist pulp web, means for laying down said creped pulp web in overlapping folds, means for pressing said folds into a coherent sheet, and means for drying said pressed sheet.

12. In a machine for making a continuous fibrous sheet, the combination of means for laying down two or more moist pulp webs in overlapping folds and means for pressing said folds into a coherent sheet.

13. In a machine for making a faced fibrous sheet, the combination of means for laying down overlapping folds of thin pulp web, means for facing said folds with a continuous moist pulp web, and means for pressing said web into a coherent sheet.

14. In a machine for making a fibrous sheet having a tearing strength approximately equal in both directions, the combination of means for laying down overlapping folds of moist pulp web in a direction transverse to the machine direction of the finished sheet, and means for simultaneously laying down overlapping folds of pulp web in a direction parallel to the machine direction of the finished sheet.

15. In a machine for making a fibrous sheet containing a foreign substance, the combination of means for treating moist pulp web with a desired foreign substance, means for laying down said treated web in overlapping folds, and means for pressing said folds into a coherent sheet.

16. In a machine for making a fibrous sheet containing a foreign substance, the combination of means for spraying or dusting a foreign substance upon moist pulp web, means for laying down said web in overlapping folds, and means for pressing said folds into a coherent sheet.

17. In a machine for making a water-resistant fibrous sheet, the combination of means for treating moist pulp web with finely divided water-resistant material, means for laying down said treated web in overlapping folds, means for heating and pressing said folds into a dry, coherent, water-resistant sheet.

18. A machine for making fibrous sheets comprising in combination, means for forming moist pulp web, means for treating said web with foreign substances, means for pressing together the opposite faces of said web to increase the density thereof, means for laying down said moist web in a continuous succession of overlapping folds, means for regularly spacing said individual folds in the machine direction of the finished sheet, means for compressing said folds of moist web into a coherent sheet, means for drying said compressed sheet, means for side-trimming the edges of said dried sheet, and means for cutting said sheet into lengths.

19. A machine for making a water-resistant fibrous sheet comprising in combination, means for forming moist web of pulp and finely divided asphalt, means for spraying additional asphalt upon said moist web, means for laying down said asphalt treated web in a succession of overlapping folds, and means for heating and pressing said overlapping folds to dry, bind, and saturate said folds with said asphalt to form a coherent, water-resistant sheet.

20. In a multi-ply paper machine of the cylinder type, the combination of a conveyor continuously moving in a single direction and a second continuously forward moving conveyor, said second conveyor having its off-take roll above said first conveyor, said off-take roll having a backward and forward reciprocating motion.

21. In a multi-ply paper machine of the cylinder type, the combination of a moving conveyor, and means for delivering a moist pulp web to said conveyor and form overlapping folds of said web on said conveyor.

22. In a multi-ply paper machine of the cylinder type, the combination of a moving conveyor and a reciprocating feed device adapted to deliver a moist pulp web to said conveyor in overlapping folds.

23. In a multi-ply paper machine of the cylinder type, the combination of a moving conveyor and a reciprocating feed device adapted to deliver a moist pulp web to said conveyor in overlapping folds, means for maintaining equal the rate at which said feed device delivers said web and the rate at which the point of delivery of said web moves relative to said conveyor.

24. In a multi-ply paper machine of the cylinder type, the combination of a moving conveyor and a reciprocating feed device adapted to deliver a moist pulp web to said conveyor in overlapping folds, said feed device having a receiving end, means for maintaining said receiving end and the point of deposition of said web upon said conveyor

equally distant from each other, as measured along the pulp web, for all positions of said feed device.

25. In a multi-ply paper machine of the cylinder type, the combination of a moving conveyor and a feed device adapted to deliver a moist pulp web to said conveyor in overlapping folds, said feed device comprising an endless belt having a fixed receiving end and a reciprocating delivery end, and means for maintaining the forwardly moving and return portions of said belt substantially parallel to each other to maintain said receiving end and the point of deposition of said web upon said conveyor equally distant from each other as measured along the pulp web for all positions of said feed device.

26. In a multi-ply paper machine of the cylinder type, the combination of a moving conveyor and a reciprocating feed device adapted to deliver a moist pulp web to said conveyor in overlapping folds, means for maintaining equal the rate of delivery of said web from said device and the rate at which the point of delivery of said web moves relative to said conveyor, said means comprising the combination of a fixed receiving roll, a delivery roll reciprocating in a plane parallel to said conveyor, intermediate rolls rigidly spaced from said receiving and delivery rolls and reciprocating at nearly right angles to the direction of movement of said delivery roll and an endless belt guided upon said rolls so that forwardly moving and returning portions thereof are substantially parallel to each other at all positions.

In testimony whereof I affix my signature.

HOWARD F. WEISS.