

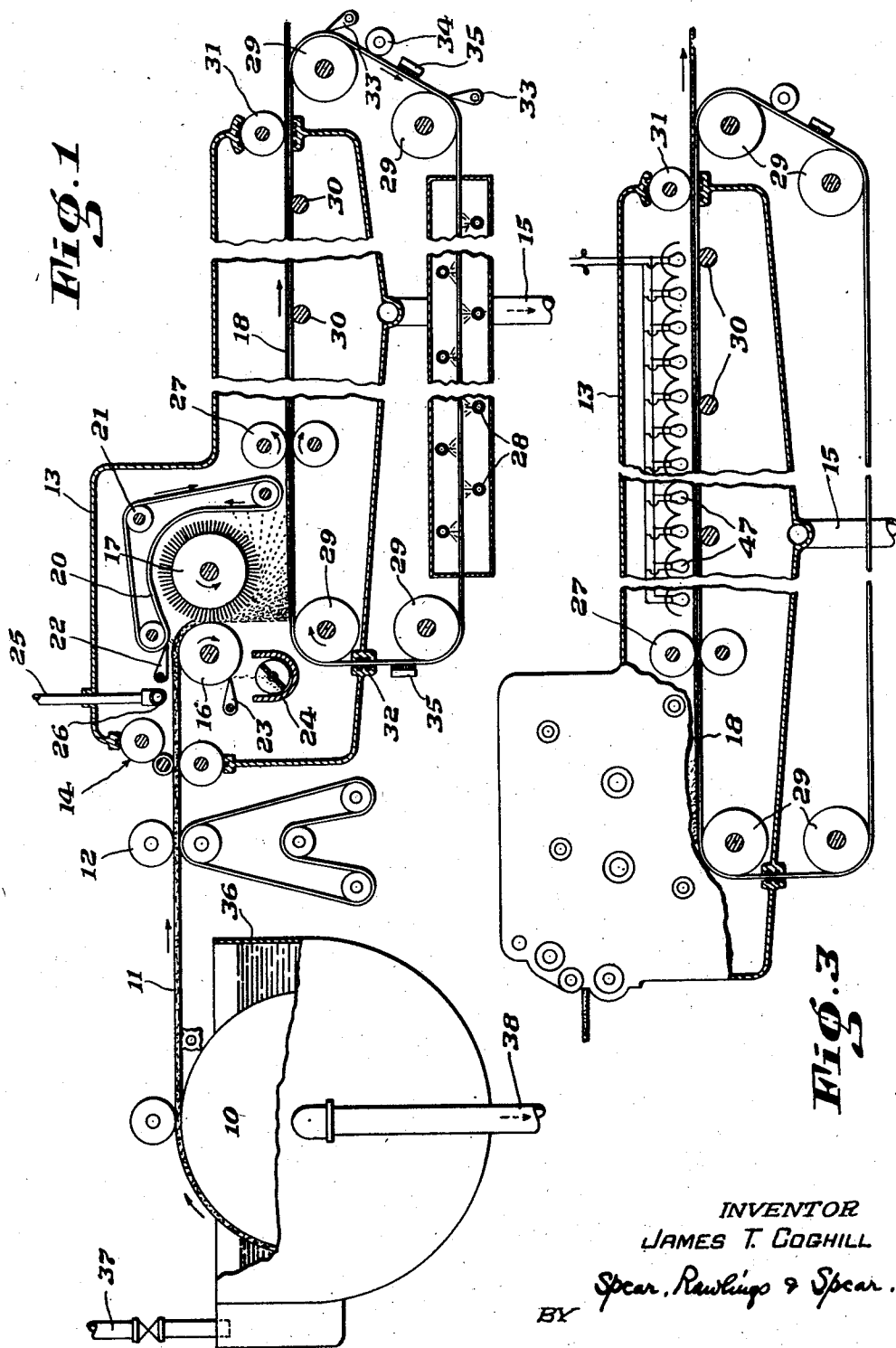
Aug. 17, 1948.

J. T. COGHILL
APPARATUS FOR THE MANUFACTURE OF PAPER
AND OTHER FELTED FIBROUS PRODUCTS

2,447,161

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 2

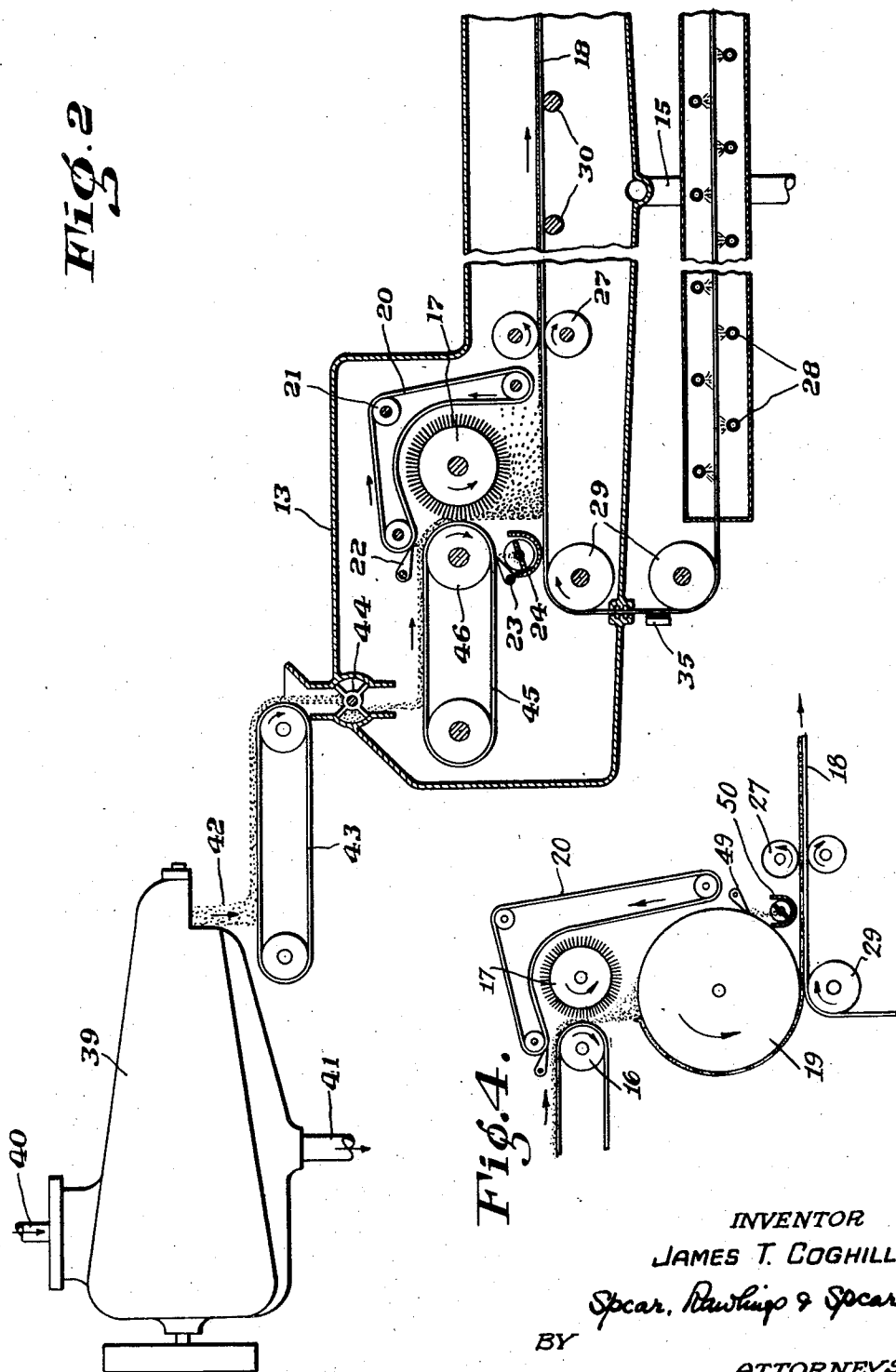


FIG. 4.

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APPARATUS FOR THE MANUFACTURE OF
PAPER AND OTHER FELTED FIBROUS
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This invention relates to the manufacture of paper and other felted fibrous products, and has for its broad object the introduction of a basically new and more economical method for assembling fibres into felted sheets or other products of practical use.

In conventional papermaking processes the formation or arrangement of the fibres in the relationship desired in the finished product is done simultaneously with the removal of large quantities of the liquid of suspension, whereas in my process nearly all of the liquid is first squeezed out of the fibrous pulp by rough mechanical means and actual formation or arrangement of the fibres in their desired relationship is thereafter accomplished on a nearly dry basis accompanied by no liquid removal, except through evaporation.

This invention is based on my discovery that comparatively dry fibres, when manipulated under proper conditions, can be hurled upon a solid or imperforate moving surface and will there build up into a felted web similar in structure to that produced by the conventional papermaking process.

In the practice of this invention and, considering for purposes of illustration typical papermaking fibres carried in water, I preferably first remove from the pulp furnish all of the water which it is possible economically to remove by squeezing or pressing operations, such as by means of conventional concentrating machinery or screw presses. After this stage of my process, the pulp furnish is in the form of a moist, crudely-felted or granulated, fibrous material which is then subjected to the action of mechanical devices which accomplish its disintegration into essentially individual, moist fibres and project these fibres at high velocity in the form of a shower upon a continuously moving solid or imperforate receiving surface. This receiving surface is moved at suitable speed so that the shower of fibres builds up thereon into a felted web of the desired thickness. Following its formation, such web is preferably compressed in any suitable manner, as by means of press rolls. Moisture is removed from the felted web by evaporation, preferably while the web is still on the receiving surface.

I have found that the presence of air in association with the fibre, and the high velocity moving parts of the fibre projection apparatus, is objectionable from the standpoint of power consumption and the disturbance and misplacement of the fibres due to violent air currents set up.

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Accordingly, I prefer to carry out this step of my process in an atmosphere of greatly reduced density. This may be done by enclosing the apparatus in a chamber from which most of the air is evacuated, or by any other means, such as utilizing a gas lighter than air, which reduces the density of the atmosphere in which the operation is performed.

My process has many advantages over conventional papermaking processes. Among such are the following:

(1) A major portion of the equipment and operation cost of the conventional papermaking process is concerned with the careful removal of immense quantities of water from the pulp simultaneously with the proper formation of the fibre web, whereas in my process it is unnecessary to remove these large quantities of water simultaneously with the formation of the web. Hence in my process the removal of the water may be accomplished by very simple and economical apparatus, and after the water has been removed the formation of the moist fibres into a continuous felted web may likewise be accomplished by simple and economical apparatus. This represents a very considerable simplification of the conventional papermaking process and a great reduction in the weight and cost of the machinery required, as well as in operation and maintenance costs.

(2) In the conventional process the fibres are deposited from a dilute suspension upon a traveling screen. Large amounts of material, particularly the fine fibres and other finely divided constituents of the furnish, pass through the screen, most of which is subsequently reclaimed by recirculation. This results in a concentration of such fine constituents at the point of formation, complicating the forming step and resulting in losses as well as general complication of the entire water system of the mill, chemically as well as otherwise. In my process, there is no comparable separation of fibres or other constituents of the furnish at the point of formation. All of the fibres and any other entrained or added substances, such as size, filler, color, etc., which are projected upon the imperforate receiving surface remain thereon as constituents of the web and are converted into the finished product. Any portion of the furnish which is not deposited upon the receiving surface is of essentially the same character as that which is deposited and hence may be returned to the incoming furnish without affecting its character by the cumulative increase of any particular por-

tion of the furnish. This represents another important simplification of the conventional paper-making process and makes for worthwhile economies.

(3) My process also makes possible great economies in the cost of drying. In the conventional manufacture of most paper, a greater weight of water must be evaporated per pound of dry paper than in my process, since pressing operations for removal of free water may be performed, in my process, under conditions and with machinery better adapted to the removal of the maximum amount of water by pressing. Therefore, less water need be removed by the more costly method of evaporation.

(4) Furthermore, the geographic location of paper mills utilizing conventional papermaking processes is controlled by the availability of adequate water supply. With my process water is not used for web formation but only for preliminary preparation of pulp. A mill using my process may be built and operated at almost any location where a small quantity of process water is available. Mills employing my process can therefore locate in situations favorable to markets and raw materials instead of being principally controlled by the availability of enormous quantities of good water.

(5) Another advantage of my process is that sizing, fillers, coloring materials and the like, either in dry or liquid form, may be introduced simultaneously with or immediately preceding the projection of the fibre in the web-forming operation and need not be mixed in a dilute suspension from which they must be reclaimed. This permits considerably more latitude in the choice of the kinds and the physical and chemical condition of the materials which may be added to the web to produce the characteristics wanted in the finished product.

(6) In making laminated sheets by conventional processes the possibilities are limited by the fact that the laminations must be joined in a very wet condition or the plies will not adhere. This requires that pressing be done gently and with very careful manipulation to avoid crushing and destruction of the composite web. Moreover, the thickness of such laminated webs is limited by the amount of moisture which can be economically removed, and inasmuch as this moisture must be removed from the interior of the web through the exterior laminations, the production of laminated webs of any considerable thickness is very costly. In my process the manufacture of laminated webs or sheets is unaffected by any such limitation, since there is no water removed, except by evaporation, following the formation of the composite web, and as many laminations may be laid down one upon another, as desired, each having whatever characteristics are suitable to its place in the composite product.

(7) Still another advantage of my process is that by means of it certain types of materials, such as flaked metals, flaked mica, pulverized mineral or other materials may be incorporated into the fibrous web, whereas in conventional papermaking processes such materials may be unsuitable for incorporation into such webs either due to their solubility in the water from which the web is precipitated or their specific gravity or other characteristics which make their incorporation impractical.

While the above stated advantages and many others, which will appear as the description proceeds, are particularly applicable to the paper-

making art, many of them also apply to associated arts, such as the manufacture of building and insulating board, asbestos sheets, wadding and insulating materials, and laminated or unlaminated fibrous products containing synthetic or natural resins.

In the accompanying drawings wherein I have illustrated several preferred forms of apparatus for the practice of my invention:

Fig. 1 is a side elevation diagrammatically showing one form of such apparatus.

Fig. 2 is a similar view showing a different method of removing water from the fibres prior to formation of the felted web.

Fig. 3 shows a modified method of evaporating moisture from the felted web, and

Figure 4 is a fragmentary view showing still another modification applicable to either form of the apparatus disclosed in Figures 1 and 2.

Referring to Fig. 1, I have indicated diagrammatically at 10 a type of pulp dewatering mechanism commonly used in the industry. This produces a continuous roughly-felted mat or pad 11 of fibre from which, by means of further conventional machinery, as the press rolls 12, as much water as possible is extracted.

From the press rolls 12 the dewatered pad is fed into an enclosed chamber 13, the inlet end of which is sealed by any suitable type of vacuum seal, indicated at 14. An atmosphere of substantially reduced density is maintained in chamber 13 in any suitable manner as by evacuating the chamber or by substitution of a lighter gas than air or both. If the chamber is evacuated, this may be accomplished by means of suction connection 15 to any suitable vacuum pump (not shown). Connection 15 also serves to carry off by way of any suitable condenser (not shown) the moisture of evaporation.

The continuous pad 11 of dewatered fibrous material is fed through the vacuum seal 14 by means of feed roll 16 driven in any suitable manner. The periphery of feed roll 16 is in close proximity to the surface of a rapidly moving projection device, here shown as a rotatable cylinder 17. The surface of cylinder 17 is preferably roughened in any suitable manner so that it will engage essentially individual fibres from the advancing pad of material. For this purpose I prefer to use a cylindrical wire brush rotating at such a high speed relative to the speed of the advancing pad of material that the bristles of said brush engage essentially individual fibres and hurl or project them tangentially from the surface of the brush against a solid or imperforate receiving surface 18 disposed beneath said brush.

The receiving surface 18 may be an endless belt as shown in Figs. 1, 2 and 3 or may be of cylindrical form as shown at 19 in Fig. 4. The projected fibres impinge upon the receiving surface in a directed shower and are gathered on said surface in the form of a continuous web of moist felted fibres. The receiving surface is driven by means (not illustrated) at a suitable speed so that the web deposited on it may be controlled as regards its thickness.

Although the majority of the fibres projected by the projection device 17 impinge upon the receiving surface, a small portion may tend to cling to the projection device and be discharged tangentially away from the receiving surface. In order to return such small portion for re-projection, I may arrange adjacent the projecting device 17 a

slowly moving endless belt 20 controlled by rolls 21 and supported in guides (not shown). Fibres which are deposited upon belt 20 are scraped off by a doctor 22 and fall back upon the incoming pad 11 of raw material from which they are re-projected as said pad reaches the projection surface of member 17.

In practice a small quantity of fibres usually adheres to feed roll 16 and in order to clean said roll I provide a doctor 23 which scrapes off such residue material and deposits it in a trough and worm illustrated at 24. The worm compresses the residue material as it is deposited into the trough and forces it along the trough through an orifice in the side of the chamber 13 for return to the furnish at an earlier stage (not illustrated) in the preparation thereof.

Where particular characteristics are wanted in the finished product, I may incorporate sizing, filler, coloring, adhesive or other materials with the advancing raw material prior to projecting the same onto receiving surface 18. For this purpose, I provide a supply pipe 25 leading to a header 26 through which such material in liquid form may be added to the furnish. Other commonly understood apparatus (not illustrated) suitable for the introduction of dry materials may be substituted for or used in conjunction with the introduction of liquid materials.

After the fibrous web has been formed upon the receiving surface 18 it may be compacted as desired. Preferably I compact it against the receiving surface as by means of rolls 27. The function of these rolls is primarily to compact the web when such an operation is necessary to provide desirable characteristics in the finished product.

In the form of my invention illustrated in Fig. 1, I have indicated means at 28 for heating the return run of the receiving surface 18 at a point outside the chamber 13. Where so heated, the receiving surface 18 is preferably in the form of an endless metal belt of such composition as to withstand the temperature changes and chemical actions to which it is subjected. For some purposes it may be desirable to provide the belt with a smooth polished surface. For other purposes it may be desirable to provide it with a roughened or etched surface. Where the belt is heated externally of the chamber, the heat may be applied by any desirable or economical means, as by gas burners, or by directly heating it from oil or pulverized coal, or by steam coils.

The endless receiving surface 18 is shown as carried on rolls 29 by means of which it is driven at a suitable speed by any conventional driving mechanism (not illustrated). At least one roll 29 is adjustable by any conventional tensioning device (not illustrated) to compensate for expansion and contraction of the receiving surface. The receiving surface is supported by means of rolls 30 applied at any point along the receiving surface where their use is necessary to support or direct said surface. The exit end of the chamber 13, through which the receiving surface 18 with felted web thereon passes, is provided with an appropriate vacuum seal 31. The point at which the receiving surface enters said chamber is likewise provided with a suitable vacuum seal 32.

Suitable doctors 33 and cleaning devices of rotating 34 or scrubbing 35 nature, may be provided to keep the receiving surface in suitable condition.

The length of chamber 13 is such that ample opportunity is provided for the heat introduced into

said chamber by the heated receiving surface to penetrate the fibrous web during and after formation and evaporate the moisture contained therein.

In the operation of this form of my apparatus, the raw material furnish is introduced into the vat 36 of the dewatering device 10 as at 37. The water extracted therefrom is carried away through the suction pipe 38 leaving on the face of the cylinder mold a roughly felted pad which travels to further dewatering devices in the nature of felts and presses 12 which remove as much of the water from the pad as it is possible to remove by means of such devices so that when the pad reaches the feed roll 16 it carries a minimum of free water and is in the neighborhood of 40% or 50% dry fibre. In this condition it is suitable to be engaged by the surface of the projection member 17 and hurled as a directed shower of essentially individual fibres upon the receiving surface 18 without the web formed thereon being disrupted or disturbed by splashing effects of excessive free water. The fibres retain the random felted arrangement of their impingement upon the receiving surface and one another and require no further pressing operations for the purpose of water removal, since they are already as dry as possible to obtain them by mechanical pressing operations.

I have found that high surface speed of the projecting member 17 is favorable to the desired withdrawal from the advancing pulp pad of essentially individual fibres and projecting them as such. Speeds in the neighborhood of 20,000 feet per minute and higher have been found advisable. The speed of rotation of the feed roll 16 and the rate of advancement of the pad 11 of raw material is made adjustable by conventionally used mechanisms (not shown). The speed of the feed roll and associated mechanisms will depend upon the thickness of the pad 11, and in general needs only be sufficient to supply the raw material to the projection member 17 at a constant rate. The speed of the member 17 may be constant at whatever speed is found satisfactory for the nature of the material being handled.

The alternative form of apparatus illustrated in Fig. 2 is generally similar to and operates in substantially the same manner as that shown in Fig. 1, except that the manner of dewatering the raw material and introducing it to the projection member 17 is different. In Fig. 2, I have indicated at 39 a well known screw press dewatering mechanism. The raw material enters the press at 40 and the excess water is removed at 41. The dewatered fibrous material is discharged in the form of moist pellets 42 onto a feeding device 43 which is illustrative of well known devices for regulating the quantity of material fed. From the feeding device 43 the raw material is discharged through a suitably constructed seal 44 into the chamber 13 where it falls upon a feeding belt 45 driven by a feed roll 46 corresponding in function to that of the feed roll 16 in Fig. 1.

In Fig. 3 I have illustrated an alternate method of introducing heat for the purpose of evaporating moisture from the web on receiving surface 18. In this figure I arrange within the chamber 13 and facing the felted web on the receiving surface 18 a series of electrical heat-radiating units 47 which radiate onto the web sufficient heat to evaporate the moisture therein. These radiant heating units 47 may be used independent of or in conjunction with the method of directly heat-

ing the return run of the receiving surface 18 illustrated in Fig. 1. One advantage of using the units 47 is that for the manufacture of some products it is desirable to use an imperforate material other than metal, such as rubber or other compositions for the receiving surface. Such surface might not withstand direct heating, as in Fig. 1, but would withstand the application of radiant heat to the formed web, as in Fig. 3.

It will be understood that the surface of the formed web will conform to the receiving surface 18 upon which it is impinged and where such surface is of polished metal, the contacting surface of the web will be relatively glazed, whereas the top surface of the web will have a rougher finish. In order to equalize the quality of finish on the two sides of the formed web, I have illustrated in Fig. 4 a mechanism in which the web is deposited upon a rotating cylinder 19 and transferred therefrom upon a moving endless belt 18 accompanied by reversal of the surfaces of the web.

In this figure, the projected shower of fibres from projection member 17 impinges on the surface of the pick-up cylinder 19 which may be heated or cooled as desired and are transferred therefrom to the receiving belt 18 which corresponds to and functions in the same manner as that described in Figs. 1 and 2. Compacting rolls corresponding to the rolls 27 in Figs. 1 and 2 are provided, together with a doctor 48 for removing residual fibres from pick-up cylinder 19 which are returned for re-projection by means of a worm and trough 50 corresponding to that indicated at 24 in Fig. 1. The surface of pick-up cylinder 19 may be of any desired nature but preferably is slightly porous to facilitate the transfer of the formed web to the receiving surface 18.

It will be seen that in cases where the raw material is of such a nature that it need not be suspended in water or other liquid in treatments preliminary to the dewatering devices illustrated in Figs. 1 and 2, such as asbestos fibre, which is normally produced and handled in dry form, the dewatering steps illustrated may be eliminated and the dry material supplied directly to the projecting device 17.

Where the characteristics wanted in the final product make it desirable to do so, all of the several mechanisms illustrated permit introduction of sizes, fillers, coloring matter, adhesives or other substances either along with the fibrous raw material being fed or unassociated with fibrous raw material in independent projecting units.

If desired, I may impress an electrical potential upon the fibre-projecting surface or cause the directed shower of projected fibres to pass through an electrostatic field so that the fibres will be all charged with the same polarity and hence will tend to maintain themselves separated during projection. This results in a more uniform distribution and more effective felting of the fibres on the receiving surface. The receiving surface may or may not be impressed with an electrical potential of the same or opposite polarity to that of the projecting surface, depending upon the character of the fibres and the results desired in the finished product.

As used herein, the term "imperforate" means a surface which unlike a wire screen or felt has no passages through it, such as for example, a solid

metal or rubber-like surface through which neither the fibrous material nor the liquid of suspension will pass, but such surface might be absorbent or might conduct vapors during the drying process or might be a solid metal or rubber-like surface with an absorbent covering.

As used herein, the term "paper" or "paper-like products" includes such products as paper board, building and insulating boards, wadding and like felted fibrous products of vegetable, mineral or animal fibres, or mixtures thereof, either with or without the addition of adhesives, binders, fillers, colors, or other impregnating substances.

What I therefore claim and desire to secure by Letters Patent is:

1. Apparatus for manufacturing a web of felted fibrous material from an aqueous pulp furnish, comprising dewatering means for partially dewatering said furnish, a conveyor for carrying said dewatered furnish away from the dewatering means, a continuously revolving fibre-projector arranged adjacent to the discharge end of said conveyor for withdrawing moist fibres from said dewatered furnish and projecting them, an imperforate conveyor upon which said projected fibres impinge and are formed into a continuous web, press rolls for physically compacting said web against said last-named conveyor, and means for heating said imperforate conveyor to evaporate from said web while it is on said heated conveyor most of the liquid contained therein.

2. The apparatus of claim 1 wherein a pick-up cylinder is interposed between said fibre-projector and said last-named conveyor.

3. The apparatus of claim 1, and means for incorporating additional fibre-bonding material with the de-watered furnish for projection therewith by the fibre projector.

4. The apparatus of claim 1, and means for maintaining an atmosphere of substantially reduced density about said fibre projector and about said imperforate conveyor.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
480,588	Kellner	Aug. 9, 1892
598,241	Case	Feb. 1, 1898
645,080	Fletcher	Mar. 13, 1900
1,336,402	Weiss	Apr. 6, 1920
1,541,928	Durham	June 16, 1925
1,756,468	Moller	Apr. 29, 1930
1,907,046	Darrah	May 2, 1933
1,947,106	Plumstead	Feb. 13, 1934
2,007,551	Tompkins	July 9, 1935
2,043,181	Lamort	June 2, 1936
2,062,563	Fair	Dec. 1 1936
2,074,455	Carleton	Mar. 23, 1937
2,152,901	Manning	Apr. 4, 1939

FOREIGN PATENTS

Number	Country	Date
29,226	Austria	Oct. 30, 1884
89,033	Sweden	Apr. 13, 1937
157,291	Germany	Oct. 25, 1939
258,731	Great Britain	Sept. 30, 1926