Sept. 4, 1951 C. D. BROWN ET AL 2,566,922

COMBING MECHANISM FOR CROSS-LAYING MACHINES

Filed April 8, 1947 4 Sheets-Sheet 1

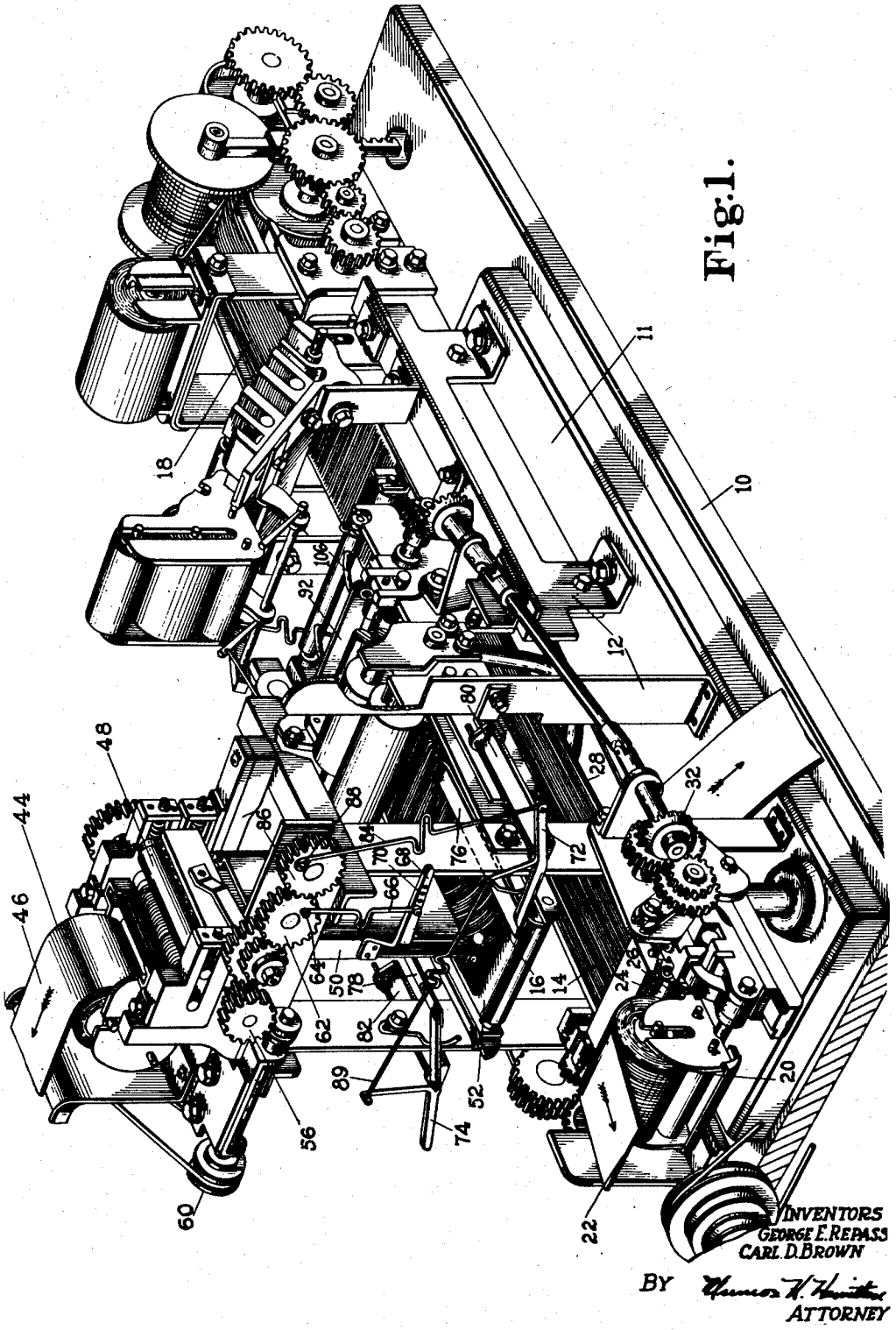


Fig.1.

INVENTORS
GEORGE E. REPASS
CARL D. BROWN

BY Thomas H. Hamilton
ATTORNEY

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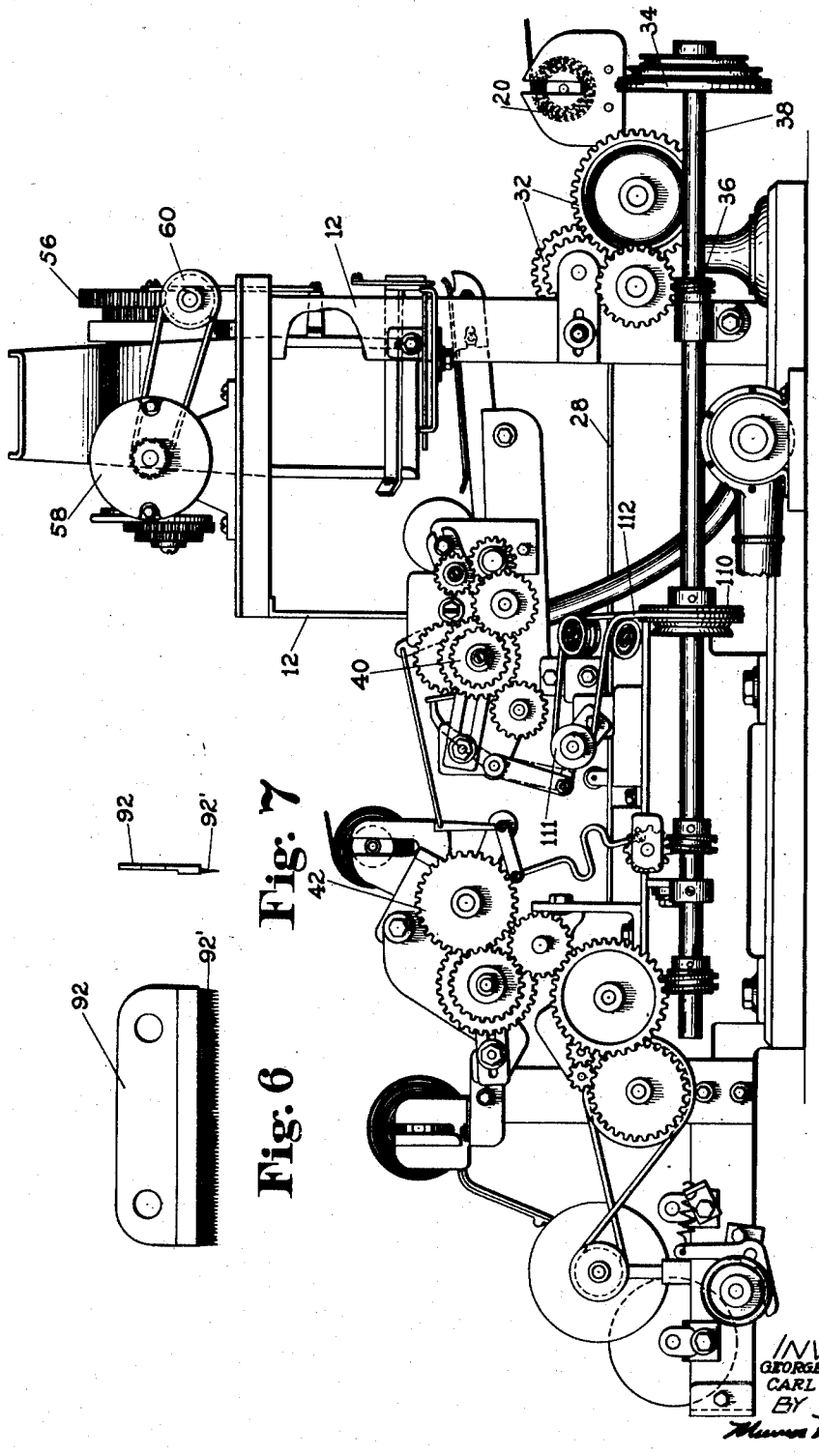


Fig. 2.

Fig. 7

Fig. 6

INVENTORS
GEORGE E. REPASS
CARL D. BROWN
BY
Marcus B. Hamilton
ATTORNEY

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COMBING MECHANISM FOR CROSS-LAYING MACHINES

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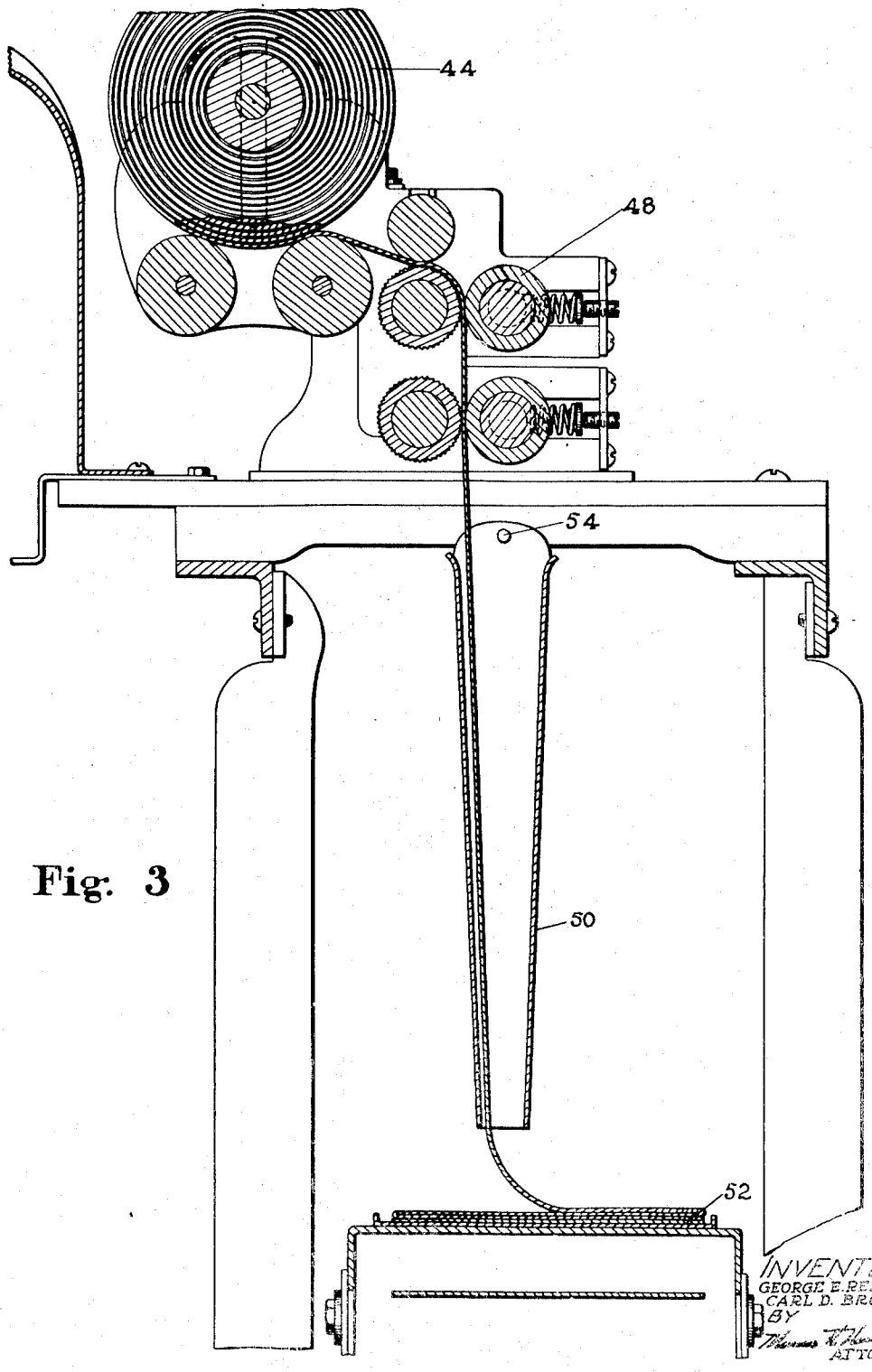


Fig. 3

INVENTORS
GEORGE E. REPASS
CARL D. BROWN
BY
ATTORNEY

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COMBING MECHANISM FOR CROSS-LAYING MACHINES

Filed April 8, 1947 4 Sheets-Sheet 4

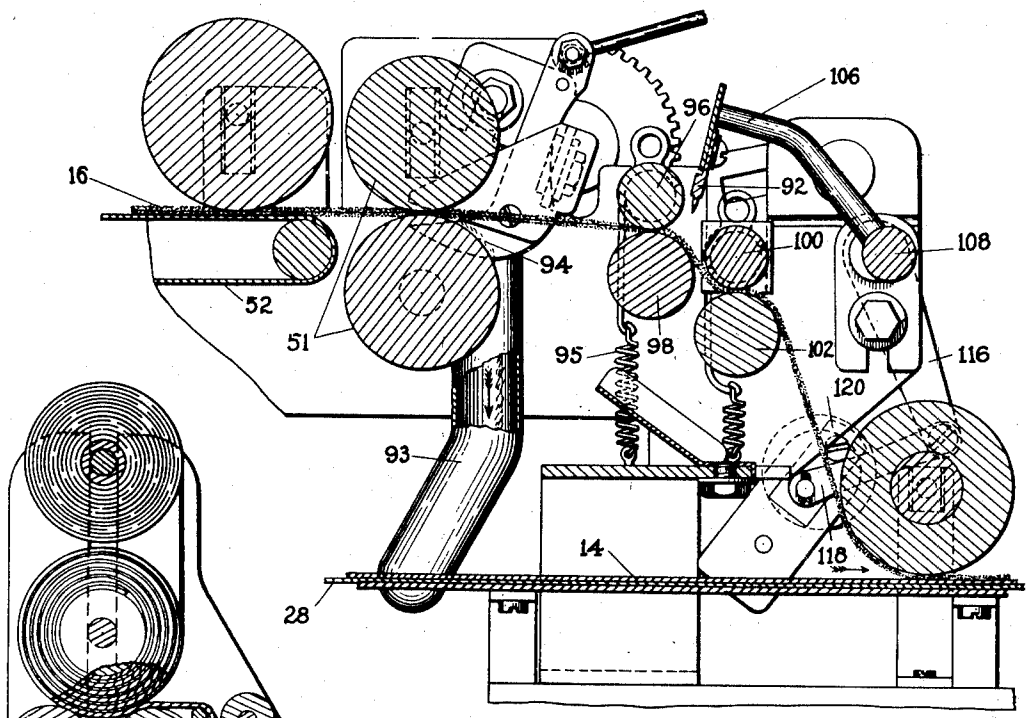


Fig. 4

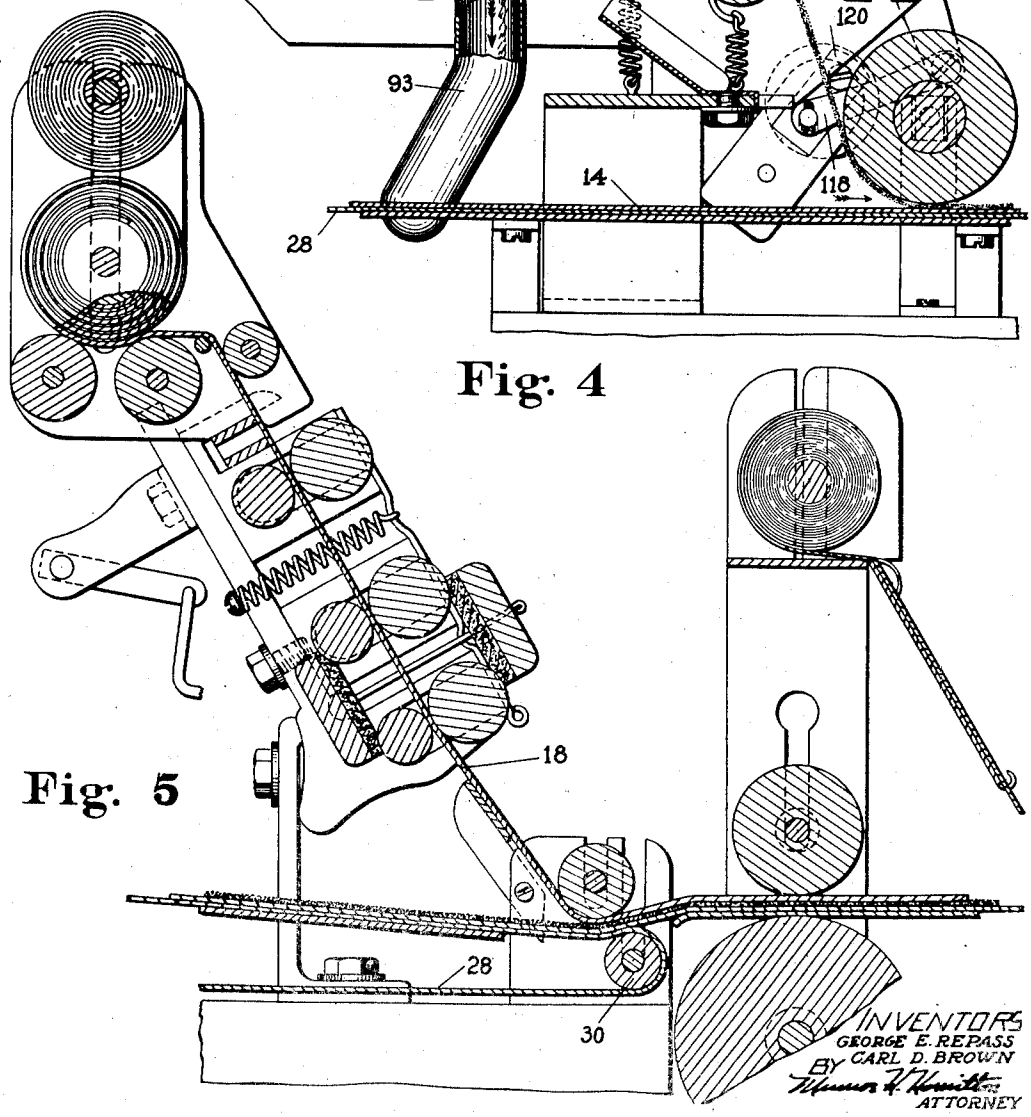


Fig. 5

INVENTORS
GEORGE E. REPASS
BY CARL D. BROWN
ATTORNEY

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UNITED STATES PATENT OFFICE

2,566,922

COMBING MECHANISM FOR CROSS-LAYING MACHINES

Carl D. Brown and George E. Repass, Hopedale, Mass., assignors to Draper Corporation, Hopedale, Mass., a corporation of Maine

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9 Claims. (Cl. 19—161)

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This invention relates to a method and apparatus for making fibrous sheet material. More particularly the invention is concerned with a method of forming a cross-laid fibrous web in which the constituent fibres are arranged more desirably in relation to one another in order materially to enhance the useful properties of such webs and with apparatus for carrying into effect that method.

When fibres, for example, in the form of cotton slivers, are passed through drawing rolls, there is obtained a thin web of material which may be quickly and cheaply produced. It has been proposed to utilize this inexpensive material in various ways and especially as a retaining web for carrying adhesives or other materials with which it may be coated or impregnated. Such applications have not been entirely successful, due in large part to lack of strength in the web. Such weakness makes it difficult to handle the material before or during treatment, while the impregnated product oftentimes does not have as great resistance to stretch and breaking as may be desired for some purposes.

Attempts have been made along several lines to increase the strength of such webs. Thus the use of a plurality of layers to form a laminated body has been tried with some success and in this connection it has been suggested that one or more layers be so arranged that fibres of adjacent layers extend angularly across one another in order that the composite web may present greater strength in two dimensions.

In resorting to the use of cross lengths of drawn fibre, however, there is an increase in irregularity and non-uniformity of thickness of the composite web, especially where adjacent sections of cross-laid layers of fibre are arranged in overlapping relation. The overlapping portions tend to produce unsightly ridges and various other irregularities.

In many cases these imperfections are sufficiently noticeable to affect the sale of the product and are especially troublesome in that they detract from the appearance of the finally impregnated product.

An object of the invention is to improve methods of forming inexpensive multi-layer webs with a view to increasing the strength characteristics of such materials, while at the same time preserving to a much greater extent uniformity of thickness and smooth appearance. It is further a specific object of the invention to improve methods of applying cross lengths of fibre in order to avoid objectionable variation in thickness resulting from applying such cross lengths in overlapping relation to one another. Other objects will appear in the course of the following detailed description of the invention.

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With the foregoing considerations in mind, we have devised a method and apparatus for materially modifying the arrangement of fibres in cross-laid stock. The procedure may be conveniently and generally referred to as "combing" and consists in passing a plurality of sharp pointed elements in and out of overlapping webs of drawn fibres in a special way to overcome the above mentioned objectionable results of the prior art. An important aspect of the invention therefore resides in combing fibres in overlapping web portions in order to obtain displacement of some fibres relative to others in a manner to obtain a more uniform overall distribution and alinement thereof in the composite web. Other objects and novel features will appear from the following description of the invention.

In the accompanying drawings:

Fig. 1 is a perspective view of the cross-laying machine of the invention;

Fig. 2 is a side elevational view;

Fig. 3 is a view in side elevation and partial cross section illustrating cross-laying mechanism;

Fig. 4 is a vertical cross section further illustrating combing mechanism;

Fig. 5 is another vertical cross section;

Fig. 6 is a detail perspective view of a comb element; and

Fig. 7 is an end elevation of the comb element.

The invention generally comprises building up a plurality of layers of drafted fibres and at one or more points during the assembly of the layers subjecting them to a combing operation. This latter step consists essentially in rapidly moving a plurality of spaced-apart sharp-pointed elements transversely in and out of the fibres of two or more adjacent layers which are in motion and which are held under a light tension. A satisfactory means of holding the moving composite web under tension is afforded by two spaced-apart set of rolls, the second set of which rotates at a faster speed than the first.

The combing mechanism operates on that portion of the composite web which is passing between the two sets of rolls. As the web leaves the first set of rolls it is rapidly pierced and released by the teeth of the comb mechanism reciprocating at high speed. This action, together with a slightly inclined position of the comb, produces a light drawing effect which stretches the web

away from the first set of rolls and spreads out thickened fibre areas. At the same time the tension maintained by the second set of rolls tends to take up any slack coming from some of the fibres being stretched out more than others. In effect, therefore, the comb acts as a distributing member by means of which the fibre arrangement of web portions passing thereunder may be rendered more uniform or otherwise more desirably controlled. Also of importance is the ability of the reciprocating comb mechanism to produce a continuous vibration or shaking effect on the web. From this force and the action of the sharp-pointed elements, there is induced a combined drawing out and cohering action by which fibres of one layer are more closely intermingled and locked together with fibres of an adjacent layer, thus interlocking the webs as well as improving their appearance.

A principal example of fibre stock is cotton slivers as already noted. The invention is particularly directed to treating this material and is, for the sake of convenience, described with reference especially to handling such fibres, although it is intended that the invention may be practiced with various other well-known fibres such as those of wool, rayon, and the like.

To secure as much attenuation and straightening of these fibres as possible, we find that it is preferable to subject the cotton slivers to a preliminary drawing operation, using conventional type drawing rolls and winding the roughly drawn stock upon a drum. Then a plurality of webs thus obtained are again separately drawn, brought together and combed.

The machine illustrated in the drawings is designed to handle rolled webs of fibre obtained from the preliminary drafting noted above. In a preferred form of the invention three layers of drawn fibre are utilized although it is intended that a greater number of layers may be employed where desired. A bottom layer is first furnished and disposed upon a moving conveyor belt. The belt carries this bottom layer along to a point where it receives an intermediate layer made up of a plurality of cross lengths arranged in overlapping relation with respect to one another and disposed transversely of the bottom layer.

The cross lengths may be furnished in either separated lengths or in the form of connected layers obtained by folding the drawn stock over upon itself and sweeping it from side to side to build up a required thickness. Before the cross lengths are brought into contact with the longitudinally extending bottom layer of fibre, the combing operation of the invention may be carried out to rearrange the fibres and cause them to assume a more orderly position or in any case to fall into a definite pattern.

The bottom layer carrying the combed overlapping cross lengths of fibres is carried along by the conveyor belt to a further point at which a top layer of drawn fibre may be applied. Thereafter the composite web is acted upon by shearing mechanism which clips the folded ends of the cross lengths just prior to the web passing through calender rolls. From the calender rolls the web may be wound upon itself on a drum in readiness for impregnating or other subsequent operations or use.

With this general description in mind, the mechanism shown in the drawings may be considered in greater detail. Attention is directed to Fig. 1 in which is illustrated a base 10 on which is mounted a supporting frame made up of

a block 11 and a number of legs or upright members such as 12. In this frame at separated points are received three web furnishing units which deliver a bottom layer or web 14, an intermediate layer composed of a plurality of cross lengths 16, and a top layer 18.

The web furnishing unit for the bottom layer appears at the extreme left-hand side of Fig. 1 and includes a roll of cotton fibre 20 which may consist of cotton slivers or a partially drafted web obtained from cotton slivers. To facilitate ready separation of the web from the roll 20, I may desire to employ a paper backing 22 which can be rolled up on some conventional winding equipment such as a roller (not shown), at the time the web of cotton fibre is drawn away.

As the web leaves the roll 20, it passes through a set of drafting rolls, two of which, 24 and 26, may be seen in Fig. 1. These rolls may be of conventional type and function to draw and straighten out the fibres of the web to provide the bottom layer 14 already noted. A conveyor belt 28 advances the bottom layer 14 along past a point where the intermediate layer of cross lengths 16 is laid on.

The roll of cotton 20, the drawing rolls and a set of rolls 30, Fig. 5, which carry the conveyor belt 28 are all driven by a set of gears 32 of conventional nature, which are in turn actuated by a belt-driven pulley 34 through a worm 36 mounted on a shaft 38 as may be more clearly seen in Fig. 2.

The second web-furnishing unit is supported on the frame in an elevated position as illustrated at the upper left-hand side of Fig. 1, and includes a roll of cotton 44 with a paper backing 46 similar to that already described. A second set of drawing rolls 48 receive and draft a web of fibre from the roll 44. As the drafted stock passes away from the drawing rolls, it is allowed to fall away and be directed downwardly through a swinging guide member 50, on to a second conveyor belt 52, as may be seen from an inspection of Figs. 1 and 3. The guide 50 consists of a tapered chute which is pivoted at 54 (Fig. 3) and which extends downwardly to a point just above the conveyor belt 52.

The roll of fibre 44 and the drawing rolls 48 are driven by a set of gears generally indicated by numeral 56. These gears receive motive power from a motor 58 applied through a belt-driven pulley 60, as shown in Fig. 2. In mesh with the gearing 56 is a gear 62 which carries a pin 64 to which is secured a rod 66, the lower end of which is connected to an arm fixed on the guide 50. As the gear 62 is rotated the guide 50 is oscillated on its pivot 54 through a distance which is determined by the spacing of the rod 66 along the arm 68 as provided by the openings 70.

When the drafted web is passing through the guide 50, therefore, it is folded back and forth upon itself to provide a plurality of cross lengths of fibre overlapping upon one another and thus furnishing a substantial overall thickness. In order to position the folded edges of the cross lengths in substantial alinement along the conveyor belt 52, we have provided adjacent the opposite edges of the conveyor belt two rocker arms 72 and 74, each of which supports thin metal blades 76 and 78. The blades are caused to engage and temporarily hold the folded edges of stock just after they are laid in place in each instance. The rocker arms may be conveniently supported in brackets 80 and 82 as shown, and the arm 72 is moved up and down by means of

a rod 84. The latter member connects the rocker arm 72 with a pin 88 on a gear 86 in mesh with gear 62 (Fig. 1). A cross link 89 interconnects the pivoting structures and imparts movement from one to the other.

The speed at which the folded cross lengths are delivered to the belt 52 may be varied by suitable choice of gearing and similarly the speed of movement of the conveyor belt may be varied. One desirable arrangement, for example, consists in running the conveyor belt at a speed corresponding to that of belt 28 and then adjusting the rate of furnishing cross lengths to secure a desired degree of thickness of intermediate layer. It will be observed that with this particular manner of operating the mechanism described, the cross lengths will fall along a somewhat diagonal path extending from one side to the other of the conveyor belt 52. At the same time the fibres of one cross length overlap a part only of the fibres of an adjacent cross length, thus leaving relatively thick and relatively thin areas.

From the conveyor belt 52, the intermediate layer 16 is carried between two calendar rolls 51 (Fig. 4), and simultaneously is passed through shears 94 which may be arranged to clip the folded ends of the cross lengths. A suction tube 93 carries away the clipped ends. The layer 16 then passes through two spaced-apart sets of rolls. The first set is made up of rolls 96 and 98 with the latter roll being of greater diameter as shown. These rolls are resiliently urged together by a spring 95. The second set of rolls, made up of members 100 and 102, is spaced away from the first set a short distance and in addition is located at a lower level so that the layer of cross lengths 16 in passing from the nip of the first set of rolls to the nip of the second set follows a downward path as indicated. The speed of the second set of rolls is adjusted so that it exceeds slightly the speed of the first set and thus produces a light tension on the layer 16. It will be noted that by directing the layer downwardly as described, it remains in contact with roll 98 for a very brief interval after it passes the nip point, thus providing for a relatively greater supporting area than would be the case if the web were drawn directly away from the nip point.

Those portions of layer 16 leaving the rolls 96 and 98 pass under and are immediately engaged by a rapidly reciprocating comb member 92, as indicated in Fig. 4. The comb element is shown in greater detail in Figs. 6 and 7, and consists of a flat metal base along one side of which are supported a plurality of spaced-apart sharp-pointed elements or teeth 92'. The base is supported between two arms 106 in an angularly extending position directly above the web as it leaves rolls 96 and 98. The arms are secured to a shaft 108 which is caused to oscillate rapidly through a limited arc of rotation by means of an arm 116, link 118 and an eccentric or crank 120 to which said link is connected and by which it is reciprocated. Motive power is furnished by the shaft 38 carrying a pulley 110 and belt 112 which operates pulleys 111 through a quarter-turn drive (Fig. 2). Crank 120 is rotated by this pulley 110.

The teeth 92' preferably pass through the fibrous layer 16 at a point just after this material moves out of contact with the periphery of roll 98. The inclined position of the comb allows the teeth to engage the layer 16 at an angle less than ninety degrees, and there is thus obtained a slight drawing action from the rapidly repeated strokes of the comb. The result is to force apart

the fibres along the web, thus affording a means of spreading out relatively thick masses of fibres and rearranging them to some extent. This desirable result is further aided by the action of the second set of rolls which moves faster than the first set, and thus exerts a light tension on the web while it is engaged by the comb.

As the comb redistributes the fibres, there may be produced a slight amount of slack which is almost immediately taken up by the second set of rolls. It may be seen that the two sets of rolls and the comb therefore cooperate, first to pull some fibres away from others and then to spread them out. This operation has been found to be exceedingly effective in removing ridges from overlapping cross lengths of fibre. At the same time there is a definite tendency for the fibres to become alined lengthwise of the comb or transversely of the first layer 14, which has been found to provide a more uniform arrangement of fibres and to produce a definite pattern or texture, improving the appearance of the finished stock.

When treating separately an intermediate web or layer made up of the cross lengths as described, the combed material is passed along and fed on the first layer 14, as indicated in Fig. 4. From here the conveyor belt 28 moves the two layers up to a point where a top layer 18 is applied. Fig. 5 illustrates a supply roll and drafting unit, similar to those already described, for furnishing the top layer 18 and requires no further description here. The finished web is then passed between calender rolls and wound upon itself in readiness for impregnating operations or other use.

We may also desire to carry out the combing operation at other points in the assembly of layers of fibre. For example the comb element may be arranged to engage with the intermediate layer of fibre after it has been disposed upon the bottom, or in some instances combing may be carried out both before and after the intermediate layer is laid on the bottom layer. Still another arrangement consists in applying the comb element to all three layers of the composite web described above or to a web which includes a greater number of layers. The application of the comb to a plurality of layers is especially effective in cohering these layers together as well as improving their appearance.

Various novel pattern effects may be secured by the use of the comb element. For instance by changing the angle of movement of the composite web and then combing, distinctive diagonal weaves and other formations may be made. The comb element may be employed in various ways such as in a bank or a series of rows following upon one another and supported on a suitable base. By selecting a suitable size of comb elements, it is possible to form holes in the web which may be utilized to facilitate introduction of impregnating materials in the web. Other modifications may also be resorted to.

While we have described the invention in connection also cross-laid material formed from three layers of drawn cotton fibres, it is intended that the combing methods of the invention may be applied to other fibrous webs having other arrangements of layers and formed of various types of fibres.

We claim:

1. In a method of forming a cross-laid fibrous web, the steps of conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the fibers therein and depositing in overlying relationship thereto a second layer of fibers

so that the fibers therein are disposed transversely to the direction of the fibers of the first layer, and rearranging the fibers in the second layer as they are deposited upon the first layer to even out thick and thin portions by applying tension to the layer, and, while it is under tension, rapidly moving a plurality of pointed elements into and out of the fibrous material.

2. In a method of forming a cross-laid fibrous web, the steps of conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the fibers therein and depositing in overlying relationship thereto a second layer of fibers disposed transversely to the direction of movement of the first layer, applying tension to the second layer before depositing it on the first, and, while it is under tension, rearranging the fibers by rapidly moving a plurality of pointed elements into and out of the said layer.

3. In a method of forming a cross-laid fibrous web, the steps of conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the fibers therein and depositing in overlying relationship thereto a second layer of fibers so that the fibers therein are disposed transversely to the direction of movement of the first layer, extending said second layer of fibers thereby to tension the layer before depositing it on the first layer, and, while it is under tension, rearranging the fibers in the layer to even out thick and thin portions by rapidly moving a comb-like element disposed lengthwise of the direction of the fibers in the layer into and out of the said layer.

4. In a method of forming a cross-laid fibrous web, the steps of conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the fibers therein and depositing in overlying relationship thereto a second layer of fibers so that the fibers therein are disposed transversely to the direction of movement of the first layer, extending said second layer of fibers thereby to tension the layer before depositing it on the first layer, and, while it is under tension, rearranging the fibers in the layer to even out thick and thin portions by rapidly moving a comb-like element disposed lengthwise of the fibers in the layer into and out of the said layer and also in a direction corresponding to the path of travel of the layer and in the direction in which it is moving.

5. In a method of forming a cross-laid fibrous web, the steps of conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the fibers therein and depositing in overlying relationship thereto a second layer of fibers so that the fibers therein are disposed transversely to the direction of movement of the first layer, applying tension to the second layer before depositing it on the first, and, while it is under tension, rearranging the fibers therein by rapidly moving a plurality of pointed elements into and out of the said layer while said elements are inclined toward and in the direction of travel of the layer.

6. In a machine for forming a cross-laid fibrous web having means for conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the said fibers and other means functioning transversely to the first conveying means for depositing a second layer of fibers on the first layer with the fibers in said second layer disposed transversely of the fibers in the first layer, means for evening out thick and thin portions of the fibers of one layer which includes means for gripping and extending said second layer of fibers toward the first layer, a plurality of pointed elements and a support therefor so positioned as to permit the elements to be moved into and out of the layer, and means for so moving said support and elements at a relatively rapid rate as the layer is extended and moved past the said evening means.

7. In a machine for forming a cross-laid fibrous web having means for conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the said fibers and other means functioning transversely to the first conveying means for depositing a second layer of fibers on the first layer with the fibers in said second layer disposed transversely of the fibers in the first layer, means for evening out thick and thin portions of the second layer which includes means for gripping and extending the layer to tension it and a comb-like element disposed transversely of the layer at a point where the fibers tend to be separated by the applied tension, and means for rapidly moving the comb-like element into and out of the layer as it is extended toward the said first layer.

8. In a machine for forming a cross-laid fibrous web having means for conveying a first layer of aligned fibers in a direction longitudinally of the layer and of the said fibers and other means functioning transversely to the first conveying means for depositing a second layer of fibers on the first layer with the fibers in said second layer disposed transversely of the fibers in the first layer, means for evening out thick and thin portions of the second layer which includes pairs of driven rollers between which the layer is extended to impose tension thereon, a comb disposed across the path of the layer between said pairs of rollers and means for swinging said comb to perforate the web in rapid strokes so directed that comb teeth penetrate the layer and also have a component of motion lengthwise of the layer toward the direction in which it is moving.

9. Mechanism is defined in claim 8 wherein said pairs of rollers are arranged so that the second pair is spaced laterally from and lower than the first pair whereby the layer in passing from the first to the second rollers is supported upon a considerable portion of the surface of the lowermost roller of the first pair.

CARL D. BROWN.
GEORGE E. REPASS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
Re. 440	Arnold et al.	Mar. 17, 1857
65,456	Faite	Jan. 4, 1867
778,351	Crepy et al.	Dec. 27, 1904
1,351,678	Nuckols	Aug. 31, 1920
1,715,443	Appleby	June 4, 1929
1,795,351	Stell	Mar. 10, 1931
1,939,525	Schmitt	Dec. 12, 1933
2,107,818	Elzer	Feb. 8, 1938
2,127,410	Knowles	Aug. 16, 1938
2,323,300	Abbott	July 6, 1943
2,434,887	Repass et al.	Jan. 20, 1948

FOREIGN PATENTS

Number	Country	Date
11,883	Great Britain	of 1899