

April 16, 1968

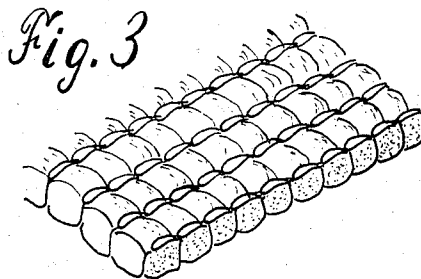
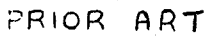
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3,377,821

APPARATUS FOR REINFORCING FIBROUS MATERIAL

Filed Oct. 14, 1966

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4

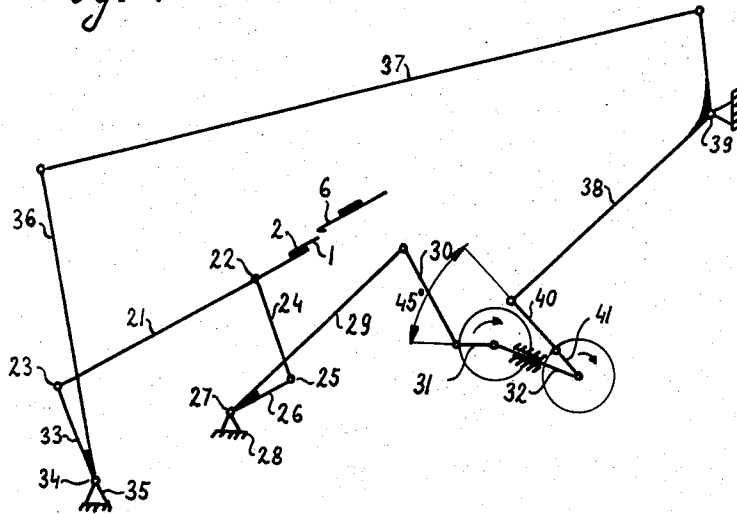
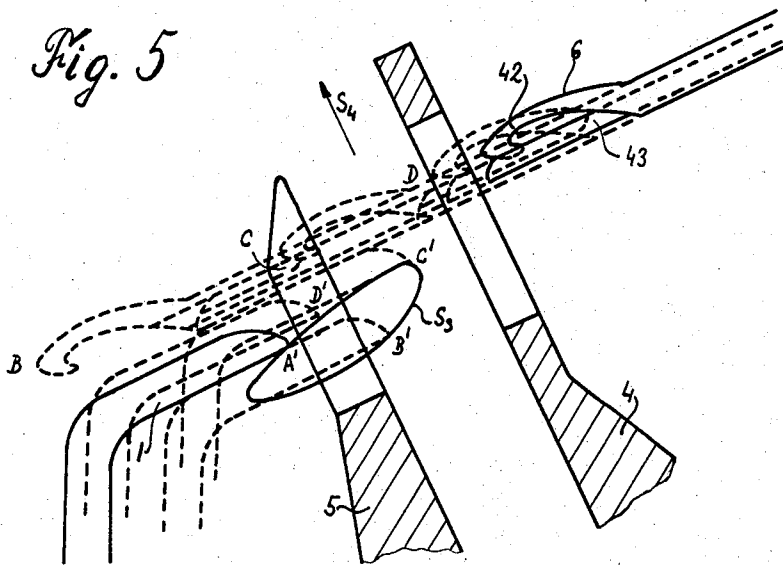


Fig. 5



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APPARATUS FOR REINFORCING FIBROUS MATERIAL

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Filed Oct. 14, 1966, Ser. No. 586,778
5 Claims. (Cl. 66—85)

The present invention relates to the manufacture of textile sheets.

In particular, the present invention relates to the manufacture of textile sheets from flat bodies of unconnected fibers in which the fibers themselves are formed into chain stitches interconnecting the body of fibers so that the resulting textile sheet of unconnected fibers does not have any binding yarns.

During the manufacture of sheets of this type, the body of unconnected fibers is advanced in a given direction while latched needles and sinker plates coact to form loops of chain stitches from the fibers themselves.

It is a primary object of the present invention to provide an apparatus for driving the sinker plates of a machine of this type in a manner which will greatly improve the apparatus and the resulting product, as compared to conventional apparatus and products of this type.

In general, the manufacture of textile sheets from a body of unconnected fibers without any binding yarns is basically well known and has been known for a long time. The principle of the construction of such a sheet is that during the continuous advancing of a sheet of fleece of the above type, a system of hooked needles pass through the flat body of unconnected fibers and during their return movement pull out of the body of fibers a certain number of the fibers themselves, which are thus pulled through and beyond the body of fibers. From these fibers which are acted upon by the needles, a chain stitch binding is formed to fix the unconnected body of fibers together so as to form a unitary textile sheet therefrom.

With known constructions of the above type, the needles, after passing through the fleece, are either turned about their own axes, so as to facilitate the return movement of the needles back through the body of fibers and to enable them to engage the largest possible number of fibers so as to form the loops of the chain stitching, or at that side of the body of fibers where the chain stitching binding is formed the needles coact with tiltable hooks which engage the fibers.

There are also known machines where the pulling of the fibers out of the flat fleece so as to form the chain-stitch binding is brought about by a system of hollow latch needles which coact with a system of sinker plates which have the purpose of pressing into the open needles the largest possible number of fibers from the fleece sheet. Thus, these sinker plates press into the sheet of fleece in a direction toward the stitch-forming needles.

Up to the present time, sinker plates of this latter type have been controlled to carry out either a swinging movement along a path which forms part of a circle or a return movement on a wave-shaped path.

The primary disadvantage of these types of movements for the sinker plates is that in both cases the sinker plates, after pressing the fibers into the hook portions of the needles, return to their original positions along the same paths which they moved along during their working strokes, with the result in that during their return strokes they move in a direction opposite to the advancing direction of the fleece sheet. Therefore, in an undesired manner, additional fibers are displaced out of the fleece and are pulled to that side of the fleece from which during the subsequent operations fibers are to be taken to be introduced into the needles, this latter side conventionally being the front side which is visible.

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A further disadvantage of that type of sinker plate which moves along an arc of a circle resides in the fact that such a sinker plate engages the sheet at a location spaced from the location where the needles pass there-through and at the side of the sheet which is visible so that an impression is left at this side of the sheet and the material is weakened.

With respect to that type of known construction where the sinker plates move back and forth along a path of wavy configuration, the structure presents the disadvantage of being extremely complex and being very difficult to manufacture and adjust with the required accuracy. For controlling the structure which carries the sinker plate, and which can have a width of more than 2 meters, at least four cams are required, and in addition with this type of construction it is difficult to maintain the operating surfaces clean and there is a great sensitivity to vibrations since the sinker plate controlling structure is urged in only one direction by a spring which maintains the control structure in engagement with a roller moving along a guide of curved configuration. In addition, with this type of construction, in order to achieve the high operating speed required of modern machines, it is essential to use extremely strong return springs. In order to maintain the required pressure on the guide roller when using the strong return springs, it is necessary to increase the width of the guide roller, as well as the size and weight of the structure which carries such a roller and the structure which supports the sinker plates. As a result of this increase in the size and weight of the components, there is an undesirable increase in the kinetic energy of the moving components, particularly those which turn about a given axis, and thus relatively strong springs are required.

It is, therefore, an object of the present invention to provide an apparatus which will avoid all of the above drawbacks.

According to the present invention, the support means which carries the sinker plates is moved by a pair of lever means actuated by a pair of crank means which are driven about a common axis but which are angularly displaced one with respect to the other to provide from the combined movements derived from the pair of lever means forward and return strokes of the sinker plates along a convex, closed, relatively flat curve which provides for the return stroke of the sinker plates a path which is perpendicular with respect to the plane occupied by the body of fibers, so that as a result the sinker plates not only prevent displacement of fibers away from the needles into which the fibers have been pressed but in addition the sinker plates will not damage the outer surface of the fleece. The phase displacement of the pair of lever means resulting from the angular relationship of the pair of crank means with respect to each other is on the order of 45°.

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a schematic representation of that type of known structure where the sinker plate drive moves along an arc of a circle;

FIG. 2 is a schematic representation of that type of construction where the drive for the sinker plates displaces them forwardly and rearwardly along the same path of wave-shaped configuration;

FIG. 3 schematically represents a part of the fabric sheet produced with the structure of the invention;

FIG. 4 is a schematic representation of the structure of the present invention; and

FIG. 5 is an enlarged, fragmentary, partly sectional illustration of the latch needles and the manner in which the sinker plates cooperate therewith in accordance with

the present invention, FIG. 5 also illustrating the path described by each sinker plate during a cycle of operations.

With the known construction, which is illustrated in FIG. 1, the sinker plates 1 are carried by a support means 2 and move along a path which forms part of a circle. The fleece 3 is in the form of a body of unconnected fibers which is advanced upwardly by known feeding structure, and the fleece 3 passes between a knock-over comb 4 and a supporting comb 5, these combs coacting to provide the flat body of unconnected fibers. The hollow latch needles 6 pass through the body of fleece in the manner shown schematically in FIG. 1. The supporting structure 2 for the sinker plates 1 is in this case carried by a two-armed lever 7 which is supported for turning movement by a stationary pivot structure 8 providing for the lever 7 an axis of turning which is normal to the plane of FIG. 1. A pull rod 9 is operatively connected with the lever 7 and is controlled in such a way that the sinker plates 1, which press the fibers of the fleece into the hooks of the hollow latch needles, carry out a return swinging movement in the direction of the arrow S_1 .

In the known construction shown in FIG. 2, the stitching mechanism has the same basic elements 1-6, but in this case the support 2 for the sinker plates is carried by an arm 10 which engages the roller 11 and which by way of a pivot pin 12 is turnably connected with a lever 13 which turns about a pivot pin 14 fixedly carried by the machine frame. The arm 10 is urged downwardly by the tension spring 15, so that it urges the roller 11 onto the curved roller guide 16 carried by the machine frame. A stationary pivot 17, also fixed to the machine frame, supports for turning movement a lever 18, between the ends of the latter, so that the lever 18 has a pair of arms, and the pull rod 19 is operatively connected with one of these arms to provide for the sinker plates a return movement as indicated by the arrow S_3 when the rod 19 is moved in the direction of the arrow S_2 . The movement of the rod 19 is transmitted through the other arm of the lever 18 and a link 20 to the lever 13 which turns about the pin 14 as a result of this motion transmission. The resulting drive provides for the sinker plates 1 the movement along a path having the curvature of the arrow S_3 and determined by the configuration of the roller guide 16.

The disadvantages of these known structures which are shown in FIGS. 1 and 2 have been set forth above.

The structure of the present invention is indicated in FIG. 4, as well as in FIG. 5. With this construction, the sinker plates 1 are carried by the supporting structure 2 which has a width of more than 2 meters. This supporting structure includes not only the bed 2 which directly carries the row of sinker plates but also several parallel arms 21 one of which is indicated in FIG. 4, these arms 21 forming extensions of the bed 2. The arms 21 are provided with pivotal connections 22 and 23.

The pivotal connections 22 serve to interconnect the supporting structure 21 with one of the lever means of the present invention. This one lever means includes a link 24 turnably connected at 22 to the sinker plate support means 21, 2 and pivotally connected at its opposite end, by means of a pivot pin 25, to an arm 26 of a lever which is supported for turning movement on a pivot structure 27 formed by a shaft which extends throughout the width of the machine and which is supported by bearings 28 so as to carry out angular movements back and forth about its axis, the lever arm 26 being fixed to the shaft 27. The lever which includes the arm 26 also has an arm 29 which forms with the arm 26 a lever of this particular lever means, which includes not only the links 24 extending between and interconnecting the lever 26, 29 with the support means 21, 2, but also another link 30 which extends between and is pivotally interconnected with the arm 29 and a crank means 31, so that in this way by way of link 30 the lever 26, 29 is connected to the crank means 31 and by way of the link 24 this latter lever 26, 29 is connected with the support means 21, 2.

The crank means 31 is in the form of a crank arm fixed to and projecting radially from a drive means formed by a rotary shaft 32 which rotates about its axis and which is driven in any suitable manner.

The pivot pins 23 serve to connect the support means 21, 2 to the other lever means of the invention, and this latter lever means includes one lever having the arms 33 and 36 which form a single lever structure and which are supported on a rotary shaft 34 which is fixed to the lever 33, 36, and which is supported for turning movement by bearings 35, this shaft 34 together with the lever 33, 36 carrying out swinging movements back and forth about the axis of the shaft 34. This shaft 34 also extends throughout the width of the machine and is parallel to the shaft 27, both of these shafts 27 and 34 being parallel to the axis of the drive shaft 32, this latter shaft turning about its own axis.

This second lever means of the invention includes an elongated connecting rod 37 pivotally connected at its left end, as viewed in FIG. 4, to the arm 36 of the lever 33, 36 and at its right end to a bell crank 38 supported for turning movement by a shaft 39 which is parallel to the shafts 27 and 34 and which is supported for swinging movement about its axis by any suitable bearings, so that the bell crank 38 also can carry out swinging movements back and forth about the axis of the shaft 39 which forms a pivot for the bell crank 38. This second lever means of the invention further includes a link 40 which extends between and is pivotally connected to the bell crank 38, on the one hand, and a second crank means 41, on the other hand, this second crank means being in the form of a crank arm fixed to and extending radially from the drive shaft 32 so as to turn with the latter at the same speed as the crank means 31.

Thus, the structure of the invention includes a single drive means formed by the rotary drive shaft 32 and a pair of crank means 31 and 41 which are operatively connected with the pair of lever means described above, this pair of lever means in turn being operatively connected with the support means which carries the sinker plates 1. The pair of crank means 31 and 41 are angularly displaced one with respect to the other about the axis of rotation of the drive shaft 32, and in the illustrated example the angular displacement between the cranks 31 and 41 is on the order of 45° , so that there is a phase displacement of 45° between the pair of lever means of the invention with the lever means 24-30 having with respect to the lever means 35-39 a retarded phase displacement causing the latter lever means to move through its cycle of operations 45° in advance of the movement of the lever means 24-30 through its corresponding cycle of operations. Thus, the angular oscillation of the shaft 27 about its axis is phase-displaced by this angle of 45° behind the corresponding angular oscillation of the shaft 34 about its axis. The result is that the movements provided through this pair of lever means of the invention for the sinker plates 1 by the action of the pair of lever means on the support means 21, 2 produces for the sinker plates a movement according to which each sinker plate will describe the path S_3 shown in FIG. 5, this path having the configuration of a convex, closed, relatively flat curve. The sinker plates coact with the known latch needles 6 which have the hook portions 42 and the axially shiftable latches 43.

The structure described above and shown in FIG. 4 operates as follows:

While the pair of crank means 31 and 41 carry out their phase-displaced movement with the rotary drive shaft 32, the pair of lever means of the invention are actuated by the pair of crank means to oscillate the shafts 27 and 34 about their axes in such a way that during the axial return movement of the hollow latch needles 6, the tips of the sinker plates 1 move along the convex, closed, flat curve S_3 as shown in FIG. 5. The crank 31, by way of the link 30 and arm 29 of the lever 26, 29

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provides for the shaft 27 a return movement in the bearings 28, and the rotary return movement of the shaft 27 is transmitted by the links 24 to the arms 21.

The crank 41 provides by way of the link 40 a swinging movement of the bell crank 38 with the shaft 39 about the axis of the latter. The bell crank 38 transmits its swinging motion to the arm 36 of the lever 36, 33 by way of the connecting rod 37, and thus the lever 33, 36 swings together with the shaft 34 about the axis of the latter, and this movement is directly transmitted to the support means 21 by way of the pivotal connections 23 between the arms 21 and the arms 33 of the levers 33, 36. It is to be understood, of course, that the parallel arms 21 are distributed along the bed 2 which carries the sinker plates 1 and a link 24 and lever arm 33 are connected with each of the several arms 21 in the manner shown in FIG. 4, the several arms 33 being fixed to and distributed along the shaft 34 while the several links 24 are pivotally connected with and are distributed along the shaft 25.

Thus, with the above structure of the invention, the arms 21, and the bed 2 therewith, will carry out with the sinker plates 1 a combined movement derived from the opposed, phase-displaced pair of crank means 31 and 41, and the resulting movement of the tips of the sinker plates 1 provides for each sinker plate a movement where its tip will describe the closed, flat, convex curve S_3 shown in FIG. 5.

The individual phases of this curved path of movement for the tip of each sinker plate are combined with the axial movement of the needles 6 in the following manner:

Before the needles 6 pass through the fleece 3, which is fed between the combs 4 and 5 in the direction of the arrow S_4 , the hollow latch needles are in the position A and their latches 43 are in a known way retracted into the hollow interiors of the needles. The tips of the sinker plates 1 at this time are at the position A', so that they are closely adjacent to and just beneath or behind the supporting comb 5.

During the next operating phase the hollow latch needles 6 pierce through the fleece 3 and reach their outermost positions B while the tips of the sinker plates 1, which move along the curve S_3 , initially move away from the supporting comb 5 and then approach the latter along the lower part of the curve S_3 , passing between the teeth of the comb 5 and reaching the position B' when the needles reach their end positions B. When the tips of the sinker plates have reached their position B', they already are pressed partly into the body of fibers 3 but have not yet carried out any pressing of fibers into the needles.

The hollow latch needles 6 are now retracted in a known way from their outermost end position B back to the position C where the hooks 42 of the needles begin to gather fibers from the fleece 3 into themselves, at the upper surface of the supporting comb 5. The tips of the sinker plates 1 at the same time move from the position B' into the position C', toward the hollow latch needles 6, and during this part of their movement the sinker plates displace a given number of fibers out of the fleece 3 into the still open hooks 42 of the hollow latch needles 6.

The needles 6 are now retracted back out of the fleece 3 so that they are displaced away from the position C, where the hooks 42 are still open and collect fibers, into the position D where the hooks 42 which are filled with fibers move away from the fleece 3 and are closed by the latch rods 43. During this phase of the operation the sinker plates 1 move from the position C' into the position D', and when moving beyond the position D', the sinker plates leave the fleece 3. The path of movement C'-D' described by each sinker plate 1 is, as indicated in FIG. 5, parallel with the direction of movement of the needles 6 when they pass through the fleece, while being perpendicular to the plane occupied by the fleece 3, so that during this phase of their movement the sinker plates 1 not only prevent fibers which had been gathered into the hooks 42 of the

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needles 6 from moving out of these still-open hooks 42, but also at the same time the sinker plates move away from the fleece 3 in a direction which is perpendicular to the plane occupied by the fleece 3, so that the sinker plates do not move in a direction opposite to the direction of movement S_4 of the fleece 3, will not provide any undesirable pulling of fibers out of the fleece 3, and do not damage the upper surface of the fleece 3, which is the normal visible front surface thereof. Thus, the disadvantages of the known structures, which provide the latter defects by their drive of the sinker plates, are avoided with the structure of the invention.

During the movement of the hollow latch needles 6 from the position D back to their starting position A, the latches 43 close the hooks 42 and in a known way during the feeding of the fleece 3 in the direction of the arrow S_4 the old loops are knocked off, and in this way the known chain-stitch formations 44 (FIG. 3) are provided at that side of the fleece from where the needles 6 press into the fleece. At the same time, the tips of the sinker plates 1 move from the position D' into the position A', so that one operating cycle is completed, and this entire cycle is then carried out repeatedly.

Therefore, as is apparent from FIG. 3, the fleece 3 is provided at its rear surface with the rows of chain stitches 44 which bind the fibers together so that the textile sheet illustrated in FIG. 3 results.

We claim:

1. In a machine for forming flat textile sheets of unconnected fibers, which have no binding yarns, from a flat body of unconnected fibers which is advanced in a plane in which the body of unconnected fibers is located while latched needles reciprocate through the body of unconnected fibers and coact with sinker plates to form, from part of the unconnected fibers, chain stitches holding the unconnected fibers together to form the flat sheet, support means supporting said sinker plates, a single rotary drive means turnable about a given axis, a pair of crank means fixed to said drive means for rotation therewith about said axis and being angularly displaced one with respect to the other about said axis, and a pair of lever means operatively connected to said pair of crank means to be actuated thereby and operatively connected with said support means for transmitting movement of said crank means to said support means, said pair of lever means acting on said support means to provide for said sinker plates a path of movement where each plate describes a relatively flat, closed, convex curve while said pair of lever means act on said support means to displace said sinker plates along forward and return strokes with the path of movement of said sinker plates during said return strokes thereof being perpendicular to the plane of the body of fibers so that said sinker plates prevent displacement of fibers from the needles and also do not damage the surface of the body of fibers.

2. The combination of claim 1 and wherein one of said lever means includes a lever turnable about an axis parallel to the axis of rotation of said drive means and a pair of links one of which interconnects said lever with said support means and the other of which interconnects said lever with one of said crank means, and the other of said lever means including a pair of levers respectively turnable about a pair of axes which are parallel to the axis of rotation of said drive means, one of the latter pair of levers being pivotally connected to said support means, and said other lever means including an elongated connecting rod extending between and pivotally interconnecting the pair of levers of said other lever means, and a link extending between and interconnecting the other of said crank means with the other lever of said pair of levers of said other lever means, so that the pair of lever means provide combined movements for said support means which together give said sinker plates said path of movement.

3. The combination of claim 2 and wherein said sinker

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plates during their return strokes move perpendicularly with respect to the direction of movement of the body of unconnected fibers.

4. The combination of claim 2 and wherein the angular displacement of said pair of crank means one with respect to the other is on the order of 45°.

5. The combination of claim 1 and wherein one of said lever means includes a lever turnable about an axis parallel to the axis of rotation of said drive means and a pair of links one of which extends between and is pivotally connected with said lever and said support means and the other of which extends between and is pivotally connected with said lever and one of said crank means, the other of said lever means including a lever and a bell crank both of which are turnable respectively about axes parallel to said axis of rotation of said drive means, said lever of said other lever means being pivotally connected directly to said support means at a location more distant from said sinker plates than the connection of said one link of said one lever means to said support means, and

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said other lever means including an elongated connecting rod extending between and pivotally connected to said lever and bell crank of said other lever means, said other lever means including a link extending between and pivotally interconnecting with said bell crank and the other of said crank means.

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