C. H. HOWARD.

PAPER REINFORCING MACHINE.

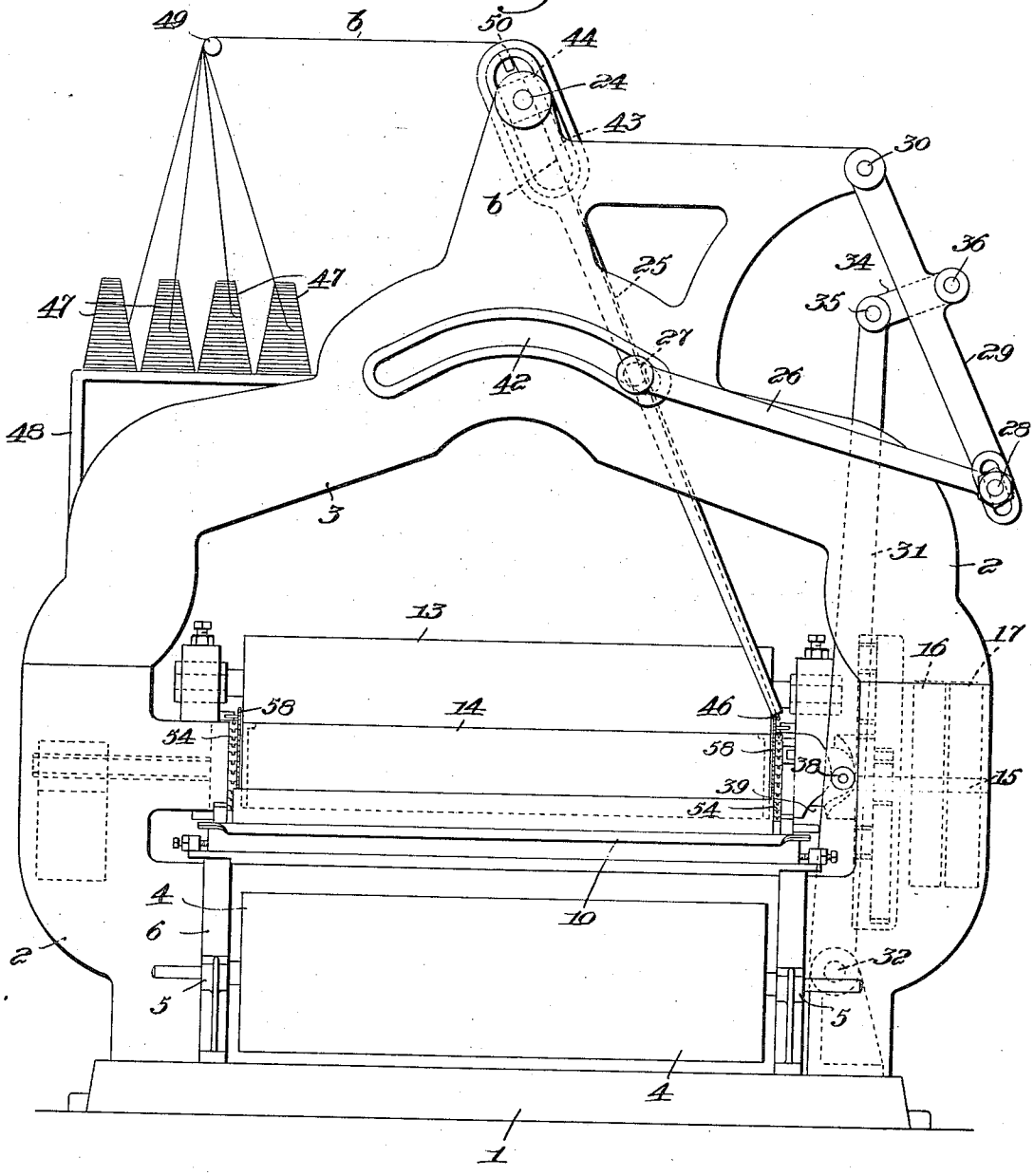
APPLICATION FILED DEC. 23, 1914.

1,211,851.

Patented Jan. 9, 1917.

3 SHEETS—SHEET 1.

Fig. 1.



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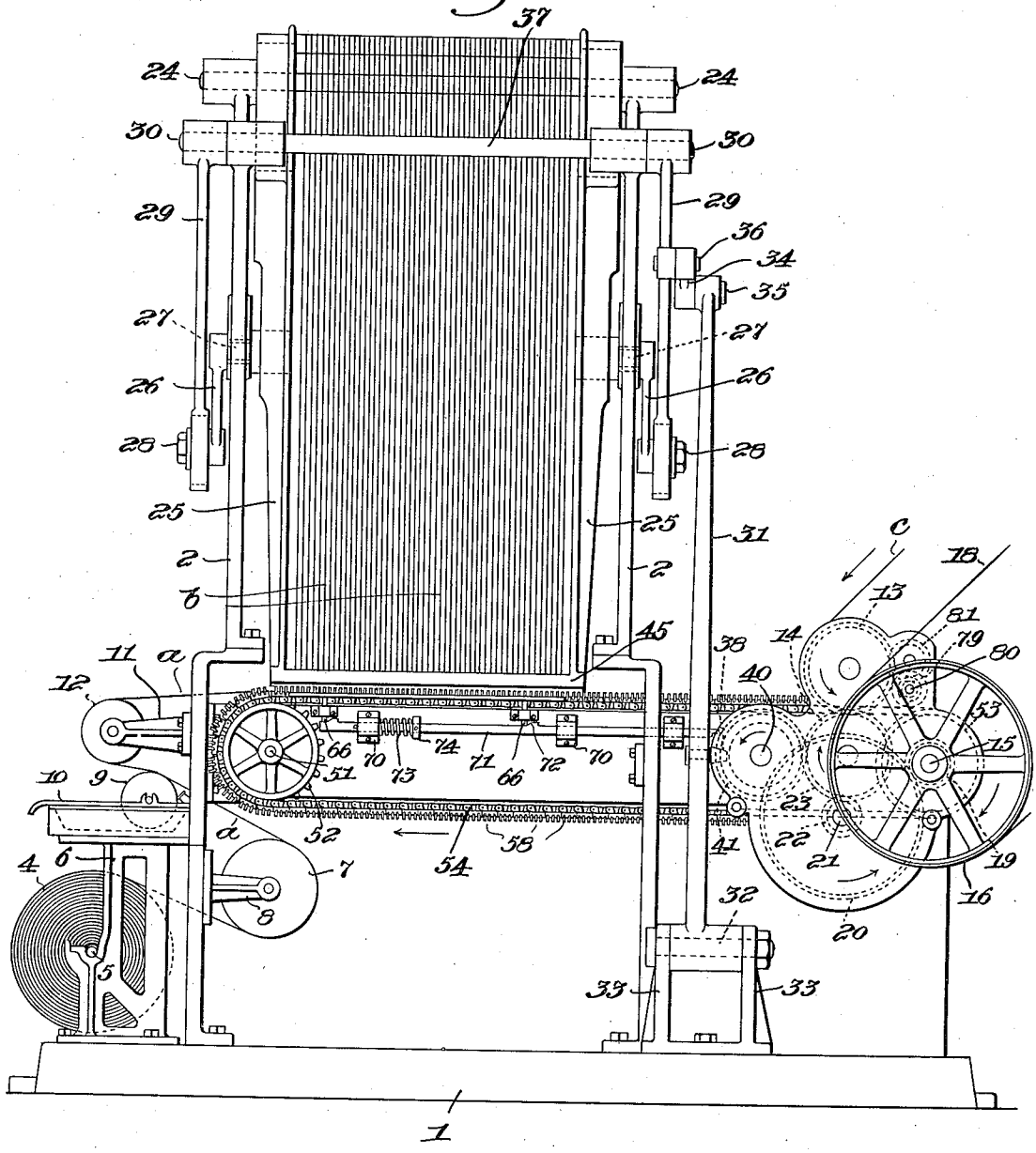
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

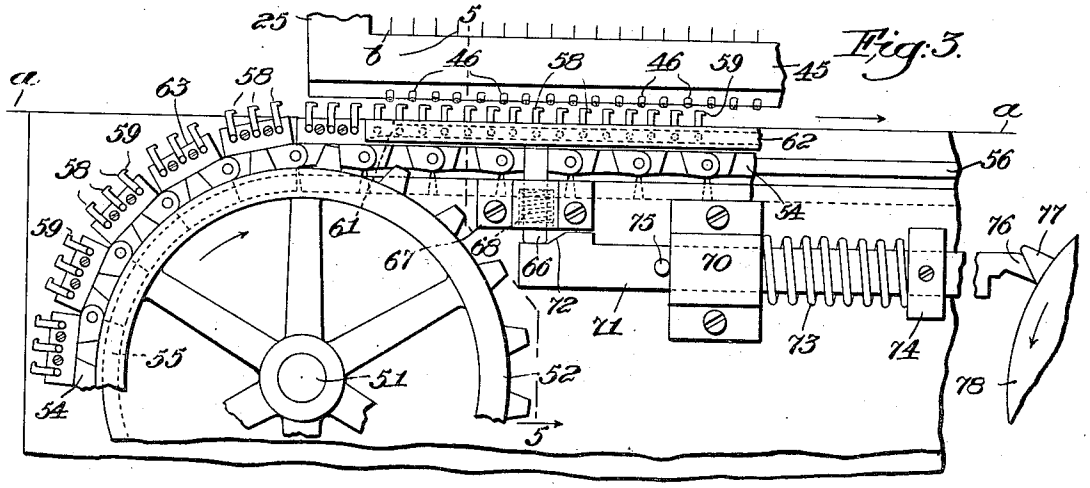


Fig. 4.

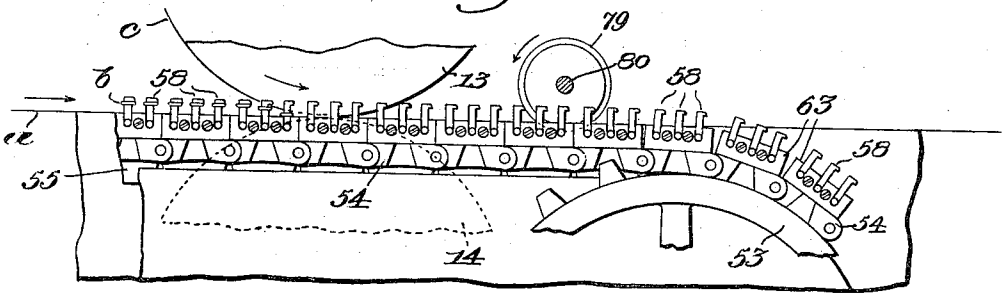


Fig. 5.

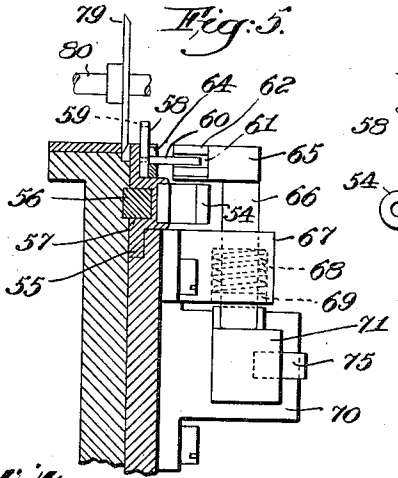


Fig. 6.

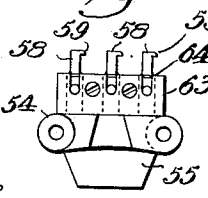
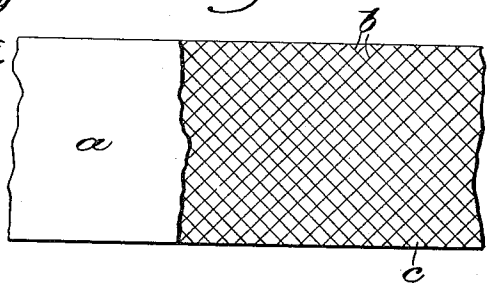


Fig. 7.



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UNITED STATES PATENT OFFICE.

CHARLES H. HOWARD, OF SAUGUS, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO PATRICK TRACY JACKSON, JR., OF CAMBRIDGE, MASSACHUSETTS.

PAPER-REINFORCING MACHINE.

1,211,851. Specification of Letters Patent. Patented Jan. 9, 1917.

Application filed December 23, 1914. Serial No. 878,700.

To all whom it may concern:

Be it known that I, CHARLES H. HOWARD, a citizen of the United States, residing at Saugus, county of Essex, and State of Massachusetts, have invented an Improvement in Paper-Reinforcing Machines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The invention to be hereinafter described relates to machines for reinforcing fabrics, such as paper or like sheet material, and more particularly to that type wherein the fabric is strengthened by a series of threads, strands, cords, tapes, or the like, extending diagonally of the fabric.

It has heretofore been proposed to strengthen paper in sheet form by a series of longitudinal and transverse threads, and machines have been suggested for this purpose. It has also been proposed to incorporate threads with such paper material by laying such threads back and forth transversely of the paper as the latter was fed longitudinally, thus providing the surface of the paper material or incorporating with paper pulp as it was run into sheet form, with continuous threads extending diagonally thereof, and such form of reinforced paper have been recognized in the art as possessing many advantages in the present application thereof. The mechanical production of such reinforced fabric, however, has not responded to the recognized advantages of and the demand for the fabric itself. This has been due in some cases to the high cost of manufacture incident to the character of machines employed for introducing the diagonally-extending threads, the necessary slow and intermittent operation thereof or the non-uniformity of the resulting product, and in other cases by the character of the fabric produced.

With these generally-stated facts in mind, the aims and purposes of the present invention are to provide a machine for the economic and commercial production of a fabric, such as paper or the like, having strengthened or reinforcing threads, cords, strands, tapes, or the like, extending diagonally of the fabric. It is within the contemplation of the present invention that such reinforced fabric may be formed by laying a series of threads, cords, or the like diagonally upon the surface of such fabric and securing them in place by a proper adhesive, which may or may not be a waterproof compound; and, if desired, the said threads, cords, or the like, may be inclosed between two plies of such fabric or paper; or they may be incorporated with the paper as it comes from the paper-making machine.

A further object of the present invention is to provide a machine of the above-mentioned character, which will be simple in construction, efficient in operation, and wherein the mechanical parts are so combined and organized that rapidity of operation and uniformity of product may be secured.

In carrying the invention into practical effect, the sheet material to be reinforced, which may for convenience, be hereinafter termed "the paper", is fed longitudinally through the machine either from a paper-making machine or other supply, such as a roll, and the reinforcing threads, cords, tapes, or the like, which for brevity, may be hereinafter referred to as "reinforcing threads", are taken from a source of supply and carried back and forth transversely of and opposite the surface of the paper as it is fed, adjacent the longitudinal edge portions of which it is looped about carriers or fingers which move longitudinally along with the paper and finally deliver the diagonally-extending threads to the surface of the paper, where it is secured by a proper adhesive, all of which will more fully appear from the following description and accompanying drawings of one form of the invention. It will be understood, of course, that the particular means herein shown and described may be variously modified within the true scope of the invention as defined by the claims.

In the drawings; Figure 1 is an end elevation of a machine containing the present invention; Fig. 2 is a side elevation thereof; Fig. 3 is an enlarged detached detail in side elevation, showing more particularly the diagonal thread presenting means, the thread carrier, and the means for raising

the fingers to engage the threads presented by the said means; Fig. 4 is a similar view showing the threads passing into the bite between the compression or calender rolls and forced down upon the fingers to place the threads upon the surface of the paper, and the cutter; Fig. 5 is a section on the line 5—5, Fig. 4, showing more particularly the finger raising and lowering means, and the cutter; Fig. 6 is a detail showing one of the links of the carrier and its fingers; and Fig. 7 shows the diagonal arrangement of the threads upon the paper.

The main framework for supporting the operating parts of the machine may be of any desired character suitable for the intended purpose, and as shown, comprises the base portion 1 from which rise the side frames 2 and such side frames may be appropriately connected as by the overhead arch 3, but so far as these features of construction are concerned, they form no essential part of the present invention, and may be variously modified.

The present invention contemplates that the fabric or paper to be reinforced shall be fed longitudinally through the machine, and may be taken from any source of supply, such as a paper-making machine, or it may be drawn from a roll in a continuous web or sheet form, and fed longitudinally. In the present form of the invention, the paper or web *a* is taken from a roll 4, Fig. 2, which is itself supported upon suitable bearings 5 carried by brackets 6 rising from the base 1 of the main supporting frame. In order that the paper thus drawn from the roll 4 may be properly guided as it is fed, it is passed about a guide roll 7, Fig. 1, appropriately supported in a bracket 8 and from such point it passes over a gumming roll 9 which may dip into a tank 10 and have applied to one surface of the fabric or paper, a proper adhesive, either of waterproof character or not, as may be desired. If the fabric or paper has been previously gummed and dried, then the roll 9 may apply moisture to the gummed surface.

Mounted in a bracket 11, Fig. 2, secured to the machine frame, is the guide roll 12 the top surface of which is in appropriate position to guide the fabric or paper *a* in the desired direction, which in the present instance of the invention is in a plane longitudinally of the machine, and in proper relation to the parts which are to place thereon and secure thereto the series of diagonal threads.

Mounted at the opposite end of the machine are the two pressure or calender rolls 13, 14, Fig. 2, which may be appropriately forced into contact, as usual in this character of rolls, to assist in feeding the paper longitudinally and for forcing the diagonal threads into intimate contact with the adhesive surface of the fabric or web, as will more fully appear.

Mounted upon the driving shaft 15, Figs. 1 and 2, are the fast and loose pulleys 16 and 17, which may be connected with a suitable belt 18, Fig. 2, for imparting motion to the driving shaft 15, in a manner well understood. The calender rolls 13, 14, may be driven from the main shaft 15 by appropriate gearing connection, as indicated in Fig. 1, wherein there is mounted on the driving shaft 15, a gear 19 which meshes with an idler 20 mounted on a shaft 21, and having a gear 22 operatively engaged by a gear 23 secured to the shaft of the lower calender roll 14, the construction being such that the lower calender roll 14 will be driven in appropriate direction clockwise, as indicated in Fig. 2, and by gearing connection with the upper calender roll, drive it contra-clockwise, as indicated by the arrows in Fig. 2, to thereby act upon the material passed between the rolls.

From the construction thus far described, it will be seen that the fabric or paper *a* passes from the guide roll 12 substantially in a single plane longitudinally of the machine, and between the calender rolls 13 and 14.

As hereinbefore noted, one of the purposes of the present invention is to take reinforcing threads from a source of supply and carry them back and forth transversely of the fabric or paper to be reinforced and engage loops of such threads by carriers moving longitudinally with the fabric or paper while holding said threads diagonally of the fabric or paper, and such characteristics of the invention will now be described as embodied in one convenient and practical form.

Mounted for oscillatory movement about the axis of the shaft 24, Fig. 1, is the thread presenting frame 25, which may be appropriately oscillated by suitable means, to carry the reinforcing threads *b* transversely of the fabric or paper. In the present form of the invention, such means comprises links 26 one at each side of the machine, as indicated in Fig. 2, pivotally connected at 27 to the thread presenting frame 25 and adjustably connected at 28 to the swinging arm 29, Fig. 1, pivoted to a suitable bracket projecting from the machine frame, as at 30. Mounted for oscillatory movement about an axis at the lower portion of the machine is the actuator 31, Fig. 1, pivotally mounted at 32 upon suitable brackets 33 and operatively connected to the swinging arm 29 by a link 34 which may be pivotally connected to the actuator 31 at 35 and to the swinging arm 29 at 36, Fig. 1.

In order that the thread presenting frame 25 may be more steadily moved in its oscillatory path back and forth, the swinging arms 29 may be duplicated at each side of

the machine, as also may the links 26, and the swinging arms 29 may further be appropriately mounted upon a suitable rock shaft 37, Fig. 2.

The necessary movement may be imparted to the actuator 31 to swing the thread presenting frame in its path of movement by any desired form of means, but in the present embodiment of the invention, the actuator 31 is provided with a pin carrying a roller 38, Figs. 1 and 2, operatively engaged with a cam 39 mounted on the shaft 40, Fig. 2, and the said shaft 40 carries an appropriate gear 41 adapted to operatively engage the gear 23 which operates the lower calender roll 14, substantially as indicated in Fig. 2, the construction being such that upon rotative movement being imparted to the driving shaft 15, the thread presenting frame 25 will have imparted thereto the desired movements back and forth transversely of the fabric. Inasmuch as it is desirable to have the threads carried transversely of the fabric in substantially a single plane, the parts 27 of the thread presenting frame 25 extend through appropriate slotted guides 42, Fig. 1, formed in the arches 3, at the front and rear portions of the machine frame; and the thread presenting frame 25 has its pivotal end portion provided with the elongated slot 43 for embracing the block 44 mounted on the axis 24 of the presenting frame 25, the construction being such that as the presenting frame 25 is moved back and forth transversely of the fabric, it is given the desired movements for carrying the thread substantially in a single plane from one side of the fabric to the other. Obviously, various changes may be made in the presenting mechanism and the details thereof, but the above has been found to be a good, practical form of this feature of the invention.

The presenting frame 25 comprises the side bars as shown, and the lower arm 45, Fig. 2, which is provided with a series of tubular guides 46 through which the reinforcing threads may be passed, substantially as indicated in Figs. 1, 2 and 3.

The reinforcing threads are preferably taken from a stationary source of supply which, in the present form of the invention, is illustrated as comprising a series of thread carrier spools or cones 47, mounted upon suitable spindles extending upward from a bracket frame 48. From the spools 47 the threads are carried upward above a guide 49 and from there preferably pass to the guide tubes 46 on the lower bar 45 of the presenting frame. The reinforcing threads *b* may be variously directed to the guide tubes 46, but in the present form of the invention they are shown as passing over a guide opening 50 in the upper part of the presenting frame 25 and thence downward to the guide tubes 46, as will be readily understood from Figs. 1 and 2.

One of the purposes of the present invention is to effect the economical and mechanical production of a fabric or paper reinforced by diagonal threads; and it has been found that this end is best accomplished by imparting to the fabric or paper, a continuous feed movement, as hereinbefore noted, and to take from a source of supply, a plurality of threads and carry them back and forth transversely of the fabric or paper as it is moved, but out of contact therewith, and at the edge portions of the fabric or paper to engage the threads over carriers which move longitudinally in rectilinear path with the paper continuously as it is fed. Thus, the carriers at the opposite edge portions of the paper, or at the sides of the machine, hold the threads presented thereto by the presenting mechanism in a direction diagonal to the fabric or paper, and while so holding the diagonal threads, such carriers move longitudinally with the fabric or paper and preferably maintain the diagonal threads in a plane out of contact with the surface of the paper for a predetermined portion of their longitudinal movement, whereupon the diagonal threads are moved into contact with the fabric or paper.

Variously formed carriers may suggest themselves to those skilled in the art, but in the present form of the invention, they are preferably designed as chain links carrying fingers which may be movable relatively to the links to engage the reinforcing threads, and then lower the loops thereof out of the path of the thread presenting mechanism, as will now be more fully explained in detail.

Mounted on the shaft 51, Fig. 2, at one end of the machine, is a wheel 52 which may be appropriately formed as a sprocket wheel, as indicated in Fig. 3. Similarly mounted on the driving shaft 15, is another sprocket wheel 53, Figs. 2 and 4. Between and about these sprocket wheels extends the sprocket chain 54, one of the links of which is shown detached in Fig. 6, and as comprising the portions 55 which, while passing around these sprocket wheels 52 and 53, engage between the teeth of the sprocket and then traverse longitudinally of the machine in a rectilinear path, substantially as indicated by Figs. 2, 3 and 4. In the stretch of the sprocket chain between the sprocket wheels, the sprocket chain may be guided to maintain the length of the chain between the said sprocket wheels in the desired plane, and as one means to this end, the links of the sprocket chain may run upon the guide bar 56, Fig. 5, said links being preferably formed with appropriate recessed portions 57 in one face thereof, to engage the said guide bar 56, substantially as indicated in Fig. 5. Of

course, other characteristic guiding means may be employed to maintain the sprocket chain in its desired path of movement.

Each of the links of the sprocket chain carries a series of fingers 58, three fingers being provided for each link of the chain in the illustrated form of the invention, but obviously, the number of fingers might be varied and either more or fewer be employed. This will be determined, of course, by the distance apart it is desired to place the diagonal threads, or by the character of the work to be produced. Each of the fingers 58 has a projecting portion 59 at the top, preferably formed as an overhang, or hook, and preferably facing in the direction of travel of the sprocket chain.

Projecting from each of the fingers 58, is a pin 60, adapted to engage the guideway 61, Fig. 5, in a finger controller 62. The fingers 58 are capable of movement in a direction longitudinally thereof in the links of the chain, and to this end the upper portion 63 of each link is slotted, as at 64, substantially as indicated in Figs. 5 and 6.

The normal path of travel of the tops of the fingers 58 is in a plane slightly below the plane of transverse movement of the delivery portion of the presenting mechanism; and in order that the fingers 58 may properly engage the threads presented by the presenting mechanism, means are provided to lift a series of fingers corresponding in numbers to the number of parts or guide tubes 46 of the thread presenting mechanism as such guide tubes pass outwardly beyond the line of travel of the fingers, and then lower said fingers after they have engaged the threads, and as the tubular guides 46 pass inwardly or toward the opposite edge of the fabric or paper. Since the thread presenting guide tubes 46 move back and forth in a substantially straight path, and have no longitudinal movement with the thread carriers at each side of the machine, and since the latter have such continuous traveling movement with the fabric or paper as it is fed, the fingers are enabled to unerringly engage the threads as the guide tubes 46 pass outwardly and hold said threads under the hooked end portion 59 of the fingers as the said guide tubes 46 pass inwardly at the other side of the respective fingers. Any usual or desired character of means may be appropriately employed to give the characteristic rising and falling movement to the carrier fingers, but in the present form of the invention, the said means is shown as a controller 62 preferably formed as a longitudinally-extending bar 65, Fig. 5, having the groove 61 therein, adapted to engage the pins 60 projecting from the fingers. The bar 65 has projecting downwardly therefrom, the foot pieces 66, Figs. 2, 3 and 5. These foot pieces 66 preferably pass through appropriate guides 67, and are normally under the influence of a spring 68, acting to depress said foot pieces 66 and, perforce, hold the bar 65 in its lowered position. To this end, the spring 68 is appropriately contained in a socket formed in the guide 67, as indicated in Fig. 5, and has one end bearing against the upper wall of the socket and the lower end upon a collar 69, Fig. 5, secured to the foot piece 66, the construction being such that the foot piece and the controller bar 65 will be normally held in lowered position, substantially as indicated in Figs. 3 and 5.

Slidably mounted in appropriate guides 70, Figs. 2 and 3, is a bar 71 having cam portions 72 adapted to engage the lower ends of the foot pieces 66 when said bars are moved longitudinally in one direction, to the left, Figs. 2 and 3. Surrounding the bar 71 is a spring 73, one end of which bears against a face portion of the guide bracket 70, and the other end against a collar 74 secured to the rod 71, as indicated in Fig. 3, the construction being such that the bar or rod 71 is normally held with the cam portions 72 out of engagement with the foot pieces 66, a pin 75 acting as a stop to hold the parts in the position stated.

In order to impart to the bars 71 a longitudinal movement to raise quickly and then lower the carrier fingers 58 for the purposes hereinbefore described, the end portion of the bar 71 is provided with an inclined toe 76, which is in the path of movement of a cam trip 77 carried by a wheel 78 appropriately mounted upon the shaft 40, the construction being such that as the wheel 78, which may be designated as a cam wheel, rotates contra-clockwise in the illustrated form of the invention, the trip cam 77 will engage the inclined toe 76 and move the cam bar 71 longitudinally to the left, Figs. 2 and 3, thereby lifting the foot pieces 66 and through the bar 65 and its groove 61 which is engaged with the pin 60 of the fingers, also lift said fingers. It will be noted that the cam trip 77 acts only momentarily to move the bar 71 to the left and then at once passes the toe 76 and permits the bar to move under the action of the spring 73 in the reverse direction, the construction being such that the carrier fingers are quickly raised momentarily and then depressed to engage and hold the reinforcing threads presented by the presenting mechanism, substantially as indicated at the left, Fig. 4.

The loops of reinforcing threads *b* being now engaged by the carrier fingers 58, the presenting mechanism carries the tubes 46 toward the opposite side of the machine, the threads *b* at such time extending through such tubes. The carrier fingers thus holding the threads, substantially as indicated at the right, Fig. 4, maintains them in a plane

somewhat above the surface of the fabric or paper, and extending in a direction diagonally thereto, and while thus holding the reinforcing threads, the carriers move longitudinally with the paper as it is fed. As the paper and the diagonal threads thus move together and reach the nip between the calender rolls 13 and 14, these rolls act upon the diagonal threads *b* as indicated in Fig. 4, to depress the loops upon the carrier fingers 58, and thus lower and compress the threads upon the adhesive surface of the fabric or paper. As the diagonal threads and fabric or paper *a* thus pass between the calender rolls 13 and 14 it may be desirable to introduce another layer of paper or fabric above the diagonal threads and to this end such other layer of paper *c*, Fig. 2, may be taken from a suitable source of supply and passed above the upper calender roll 13 as indicated in Fig. 2. After the diagonal threads have thus been incorporated with the fabric *a*, either with or without the superposed fabric *c*, the diagonal threads and the fabric or paper pass from between the calender rolls, and the loops of thread still held by the carrier fingers, are now to be cut. To this end, a suitable cutter is mounted to act upon the threads after they have been passed between the calender rolls; and as a convenient form of such cutter, it is shown in the present invention as comprising a cutting disk 79, Figs. 2, 4, and 5, appropriately mounted upon a shaft 80 which may derive rotative movement from the upper calender roll 13 through the gearing connection 81, substantially as indicated in Fig. 2.

From the construction described, it will be noted that the reinforcing threads are taken from a source of supply, preferably from a series of spools supported on a stationary part of the machine frame or other appropriate structure, and carried back and forth above the surface of the fabric or paper to be reinforced, while said web or paper is continuously being fed longitudinally through the machine. It will also be apparent that the present invention contemplates a carrier, one at each side of the machine, which is continuously moved with the fabric as it is fed, and is provided with a series of fingers for engaging the reinforcing threads presented by the presenting mechanism and holding them in a diagonal direction with respect to the longitudinal dimensions of the fabric or paper, and preferably, though not necessarily out of contact therewith; and that as the diagonally-arranged threads, while still held by the carrier in the stated position with respect to the fabric or paper, and the fabric or paper move together, means, such as the calender rolls, are provided to move the threads and the fabric or paper into intimate contact; and further, that after the threads and the fabric or paper have thus beeen brought together and incorporated, the loops of thread held by the carrier fingers, are cut, thereby not only releasing the diagonally-arranged threads from the fingers, but interrupting the continuity of such diagonal threads. This feature of thus interrupting the continuity of the diagonally-arranged threads, serves to prevent any great length of fabric being destroyed or injured, should one of the diagonal threads be drawn from the fabric or paper during use.

It will be obvious from the characteristics of the invention as hereinbefore described, that the resulting fabric will have incorporated therewith, a series of diagonally-arranged threads and that some of these threads will overlie and others underlie each other; and it will also be understood that while the threads may be incorporated with the fabric or paper by a simple adhesive, such adhesive may be of water-proof character to impart water-resisting power to the resulting fabric. Also, various changes may be made in the details of the invention, without departing from the true scope thereof, as defined by the claims.

What is claimed is:—

1. The combination of means for feeding material to be reinforced, thread presenting means for taking a plurality of threads from a source of supply and carrying them back and forth transversely to the path of said material, devices at the terminals of the back and forth travel of the thread presenting means for engaging the reinforcing threads, and means for severing the threads where they change direction to interrupt the continuity of the diagonally disposed threads.

2. In a machine for reinforcing a fabric by diagonally-extending threads, the combination of means for continuously feeding a fabric longitudinally, thread presenting means for taking a plurality of threads from a source of supply and carrying them back and forth transversely of the fabric, rectilinearly movable thread carriers at each side of the machine to engage loops of thread presented by the presenting means and hold said threads diagonally of the fabric, means for moving the thread carriers rectilinearly with the fabric while holding the threads diagonally thereto, and means for cutting the loops held by the carriers.

3. In a machine of the character described, the combination of means for feeding a fabric, means for drawing reinforcing filaments from a source of supply and carrying them back and forth transversely of the fabric, means for engaging loops of the filaments drawn from the supply by the said drawing means and presenting them diagonally to the fabric to be reinforced, and

means for severing the loops of thread that the continuity thereof diagonally back and forth of the fabric may be interrupted.

4. In a machine for reinforcing a fabric by diagonally-extending threads, the combination of a source of thread supply, means for feeding the fabric continuously, thread presenting means for taking a plurality of threads from said supply and carrying them back and forth transversely of said fabric, a thread carrier at each side of the machine for engaging loops of thread and holding said threads diagonally of but out of contact with the fabric, means for moving the carriers longitudinally with the fabric as it is fed while still holding the diagonal threads out of contact therewith, means for forcing the diagonal threads into contact with the fabric, and means for cutting the loops of thread held by the carriers.

5. In a machine of the character described, the combination of means for feeding a fabric, means for drawing threads from a source of supply and carrying them back and forth in transverse relation to the fabric, a thread carrier for engaging loops of the diagonal reinforcing threads and placing the threads upon the fabric, and means for cutting the loops of diagonal threads after the threads have been placed upon the fabric.

6. In a machine for reinforcing fabrics, the combination of means for feeding a fabric continuously, thread presenting means for taking threads from a source of supply and placing them transversely of the fabric, a thread carrier for engaging the threads presented by the presenting means and holding them in a plane out of contact with the fabric, means for continuously moving the carrier along with the fabric while still holding the threads out of contact therewith, means acting upon the fabric and threads held by the carriers for forcing them into contact as they are being thus moved, and means for cutting the loops of thread held by the carrier after the threads and fabric have been placed in contact.

7. In a machine for reinforcing fabrics by diagonally-extending threads, means for continuously feeding the fabric longitudinally, means for carrying threads back and forth transversely of the fabric as it is continuously fed, thread carriers moving longitudinally with fabric at each side thereof to engage the threads as they are carried back and forth transversely and hold them diagonally of the fabric, calender rolls for forcing the diagonal threads and fabric into contact while still held by the thread carriers, and means for then cutting the threads from carriers.

8. In a paper reinforcing machine, the combination of means for feeding a web of paper longitudinally, a stationary source of thread supply, thread presenting means for taking threads from said stationary supply and carrying them back and forth transversely of the paper, a carrier at each side of the machine having thread engaging fingers, means for moving said carriers longitudinally with the paper while the fingers hold the threads diagonally of the paper, means to depress the threads on the fingers to place the threads in contact with the paper, and thread severing means for cutting the threads held by the fingers.

9. In a paper reinforcing machine, the combination of thread presenting means for taking threads from a source of supply and moving them back and forth transversely of the machine, a thread carrier at each side of the machine provided with thread engaging fingers, means for moving said carriers in a plane extending longitudinally of the machine to cause the fingers to engage loops of threads presented by the presenting means, paper feeding means for continuously feeding paper longitudinally between the thread carriers, and means for placing the threads in contact with the paper and then cutting the thread loops.

10. In a paper reinforcing machine, the combination of thread presenting means for taking threads from a source of supply and moving them back and forth transversely of the machine, a thread carrier at each side of the machine provided with thread engaging fingers, means for moving said carriers in a plane extending longitudinally of the machine to cause the fingers to engage loops of threads presented by the presenting means, paper feeding means for continuously feeding paper longitudinally of the machine below the thread presenting means and between the thread carriers, means for moving the threads downward on the said fingers to place the threads in contact with the paper, and a cutter at each side of the machine for cutting the diagonal threads.

11. In a paper reinforcing machine, the combination of paper feeding means, thread presenting mechanism for carrying threads back and forth transversely of the paper, a thread carrier at each side of the machine guided for movement in a rectilinear path substantially parallel to the paper, fingers mounted on the carriers to engage loops of the threads presented by the thread presenting mechanism and hold the threads diagonally of the paper, means for moving said carriers and fingers in said rectilinear path along with the paper as it is fed, and means for bringing the diagonal threads held by said fingers into contact with the paper after the latter and carriers have moved together a predetermined distance and means for thereafter cutting the thread loops.

12. In a paper reinforcing machine, paper feeding means, thread presenting mechanism for carrying a plurality of threads

back and forth transversely of the paper, a thread carrier movable longitudinally and comprising a flexible chain, thread engaging means mounted on said chain to engage and form loops in the threads as they are carried back and forth by the presenting mechanism and to hold the threads diagonally of the paper and means for cutting the thread loops to interrupt the continuity in the diagonal threads.

13. In a paper reinforcing machine, a thread carrier at each side of the machine for engaging and holding threads diagonally of the paper, said carrier comprising a flexible chain, a series of fingers mounted on said chain for rising and falling movement with respect thereto, means for causing a portion of the chain to move in a single plane longitudinally of the machine, and means for raising and lowering said fingers as the said portion of the chain is so moved to cause the fingers to engage threads positioned above the chain.

14. In a paper reinforcing machine, the combination of paper feeding means, thread presenting mechanism for taking a plurality of threads from a source of supply and carrying them back and forth above the paper as it is fed, a carrier at each side of the machine having a series of thread engaging fingers to engage thread loops as the threads are presented by the presenting mechanism and to hold said plurality of threads in a plane above and diagonally to the line of travel of the paper, means for moving the carriers longitudinally with the paper as it is fed, and means for severing the thread loops held by the fingers.

15. In a paper reinforcing machine, a thread carrier comprising a flexible chain, means for supporting and actuating the chain to cause a portion thereof to move in a plane longitudinally of the machine, a series of thread engaging fingers carried by the chain, and means for raising and lowering said fingers to engage and hold thread loops as the fingers travel in said plane longitudinally of the machine.

16. In a paper reinforcing machine, the combination of paper feeding means, thread presenting mechanism for carrying a plurality of threads back and forth transversely of the paper, a thread carrier at each side of the machine for engaging a plurality of threads as they are delivered by the presenting mechanism and holding them diagonally of the paper, means for moving the carriers longitudinally with the paper as it is fed while still holding the threads diagonally thereto, and means for cutting the threads at each side of the machine.

17. In a paper reinforcing machine, the combination of paper feeding means, thread presenting mechanism for carrying a plurality of threads back and forth transversely of the paper, a thread carrier at each side of the machine for engaging a plurality of threads as they are delivered by the presenting mechanism and holding them diagonally of the paper, means for moving the carriers longitudinally with the paper as it is fed while still holding the threads diagonally thereto, means for forcing the diagonal threads and paper together, and means for cutting the threads at each side of the machine.

18. In a paper reinforcing machine, the combination of paper feeding means, thread presenting mechanism comprising a swinging frame carrying a series of guides for a plurality of reinforcing threads led therethrough from a source of supply, a thread carrier adjacent the terminals of the swinging frame movement, a series of thread engaging fingers mounted on said carriers to engage threads as they are moved past said fingers by the presenting mechanism, and means for moving said carriers in rectilinear paths longitudinally along with the paper while holding the threads diagonal thereto.

19. In a paper reinforcing machine, the combination of paper feeding means, thread presenting mechanism comprising a swinging frame carrying a series of guides for a plurality of reinforcing threads led therethrough from a source of supply, means for directing the swinging movement of said frame to cause the thread guides to move in substantially a single plane, a thread carrier adjacent the terminals of the swinging frame movement, a series of thread engaging fingers mounted on said carriers to engage threads as they are moved past said fingers by the presenting mechanism, and means for moving said carriers in rectilinear paths longitudinally along with the paper while holding the threads diagonal thereto.

20. In a machine of the character described, the combination of a transverse thread receiving element, thread presenting means for taking a plurality of threads from a source of supply and carrying them back and forth transversely of said element, means for moving the receiving element continuously in a longitudinal direction, and means for relatively moving the said presenting means and said thread receiving element in a direction of approach to transfer the threads to the receiving element while it is being moved longitudinally, and means for severing the reinforcing threads adjacent the edge of the receiving element to interrupt their continuity.

21. In a machine of the character described, the combination of a transverse thread receiving element, thread presenting means for taking a plurality of threads from a source of supply and carrying them back and forth transversely of said element,

means for moving the receiving element continuously in a longitudinal direction, and means for moving the receiving element toward the presenting means to transfer the diagonally arranged threads from the presenting means to said receiving element, and means for thereafter cutting the threads.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES H. HOWARD.

Witnesses:

BEATRICE I. SMITH,

EDWARD F. ALLEN.