C. H. HOWARD.

PAPER REINFORCING MACHINE.

APPLICATION FILED JAN. 8, 1915. RENEWED APR. 14, 1916.

1,211,852. Patented Jan. 9, 1917.

4 SHEETS—SHEET 1.

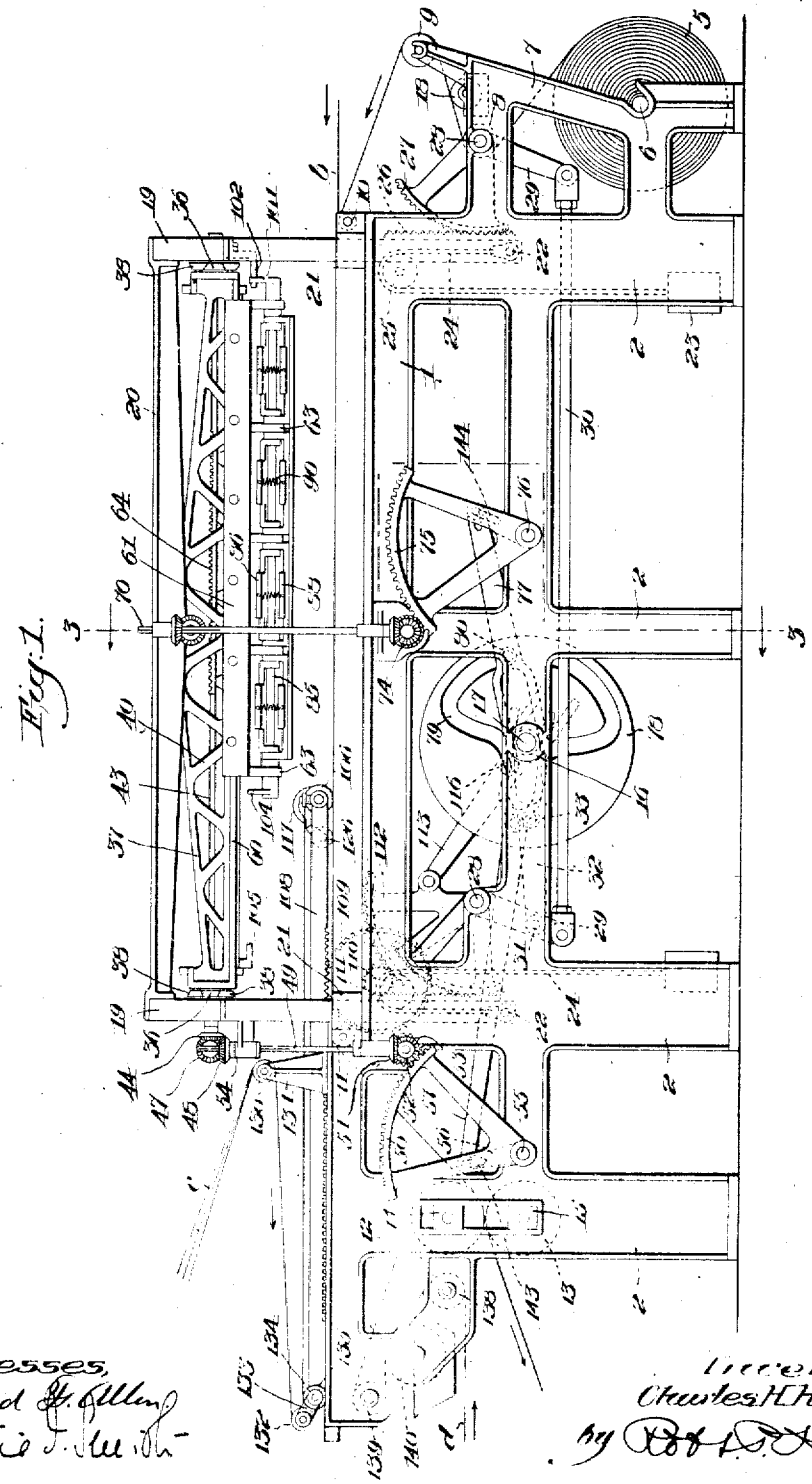

Fig. 1.

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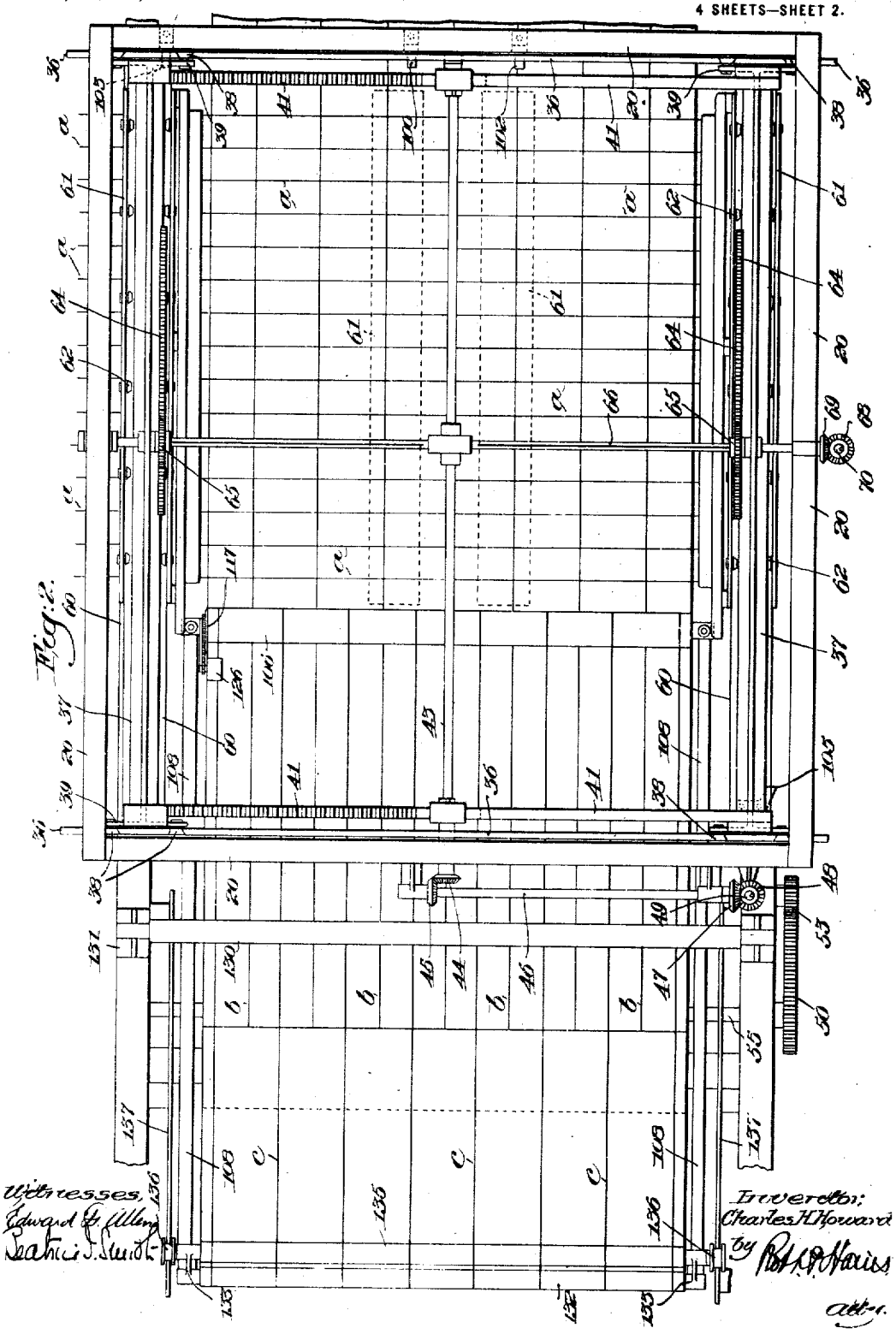

Fig. 2.

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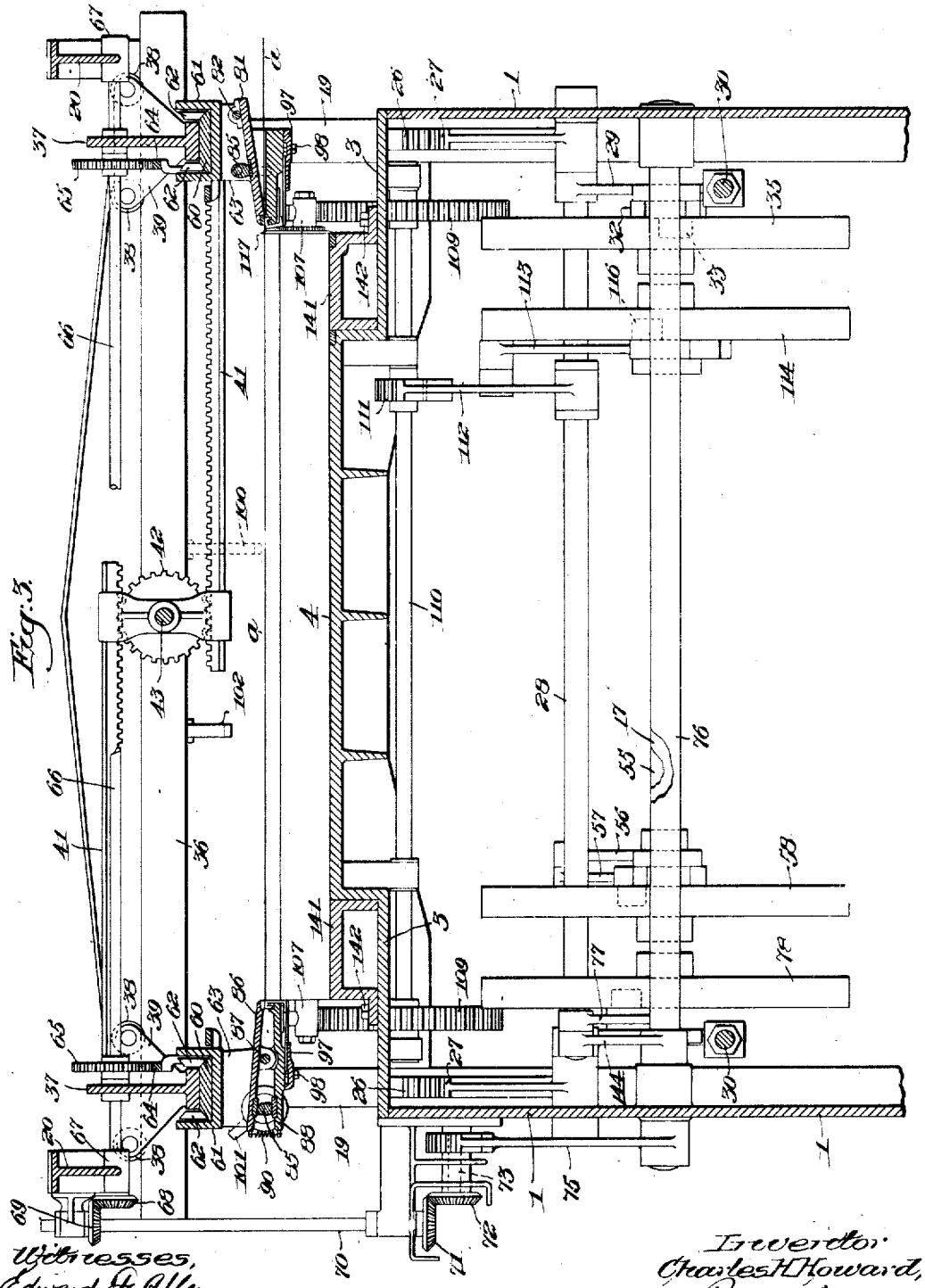

Fig. 3.

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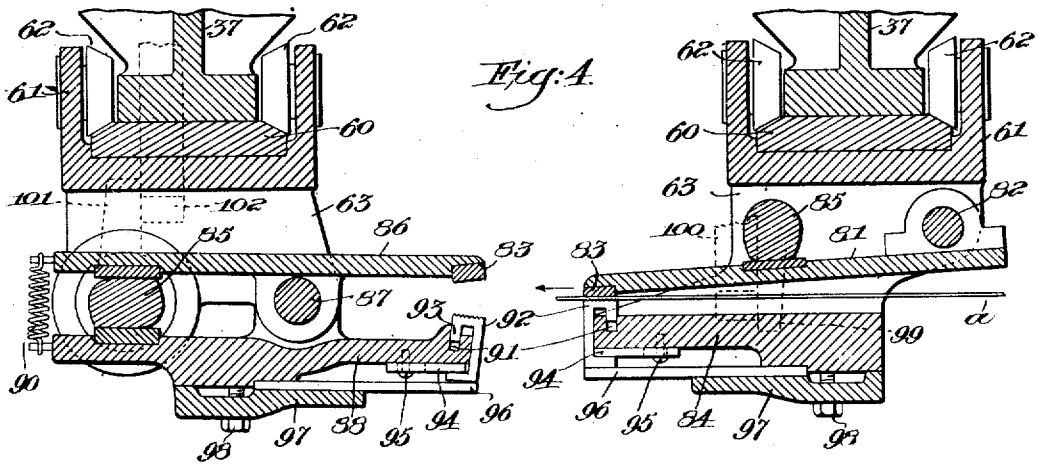

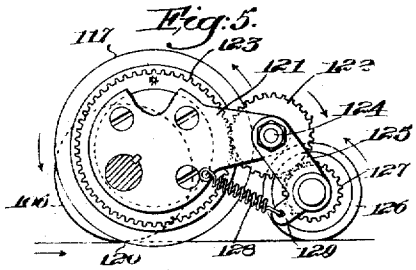

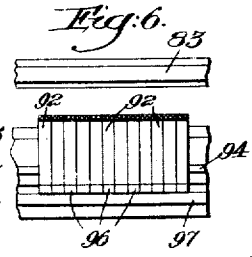

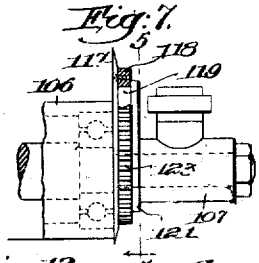

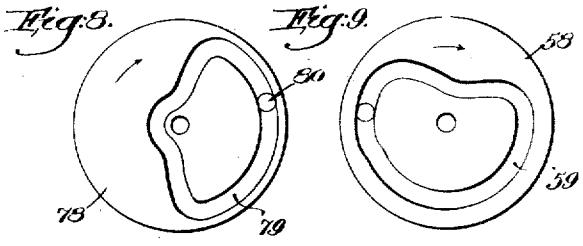

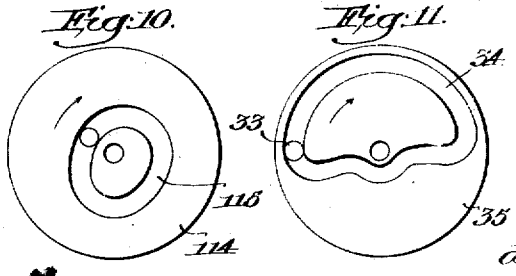

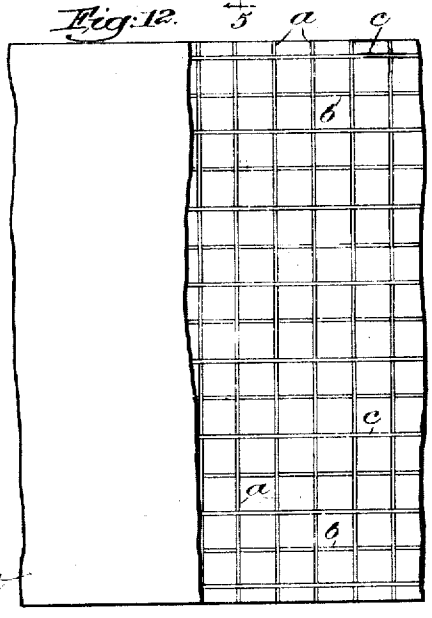

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UNITED STATES PATENT OFFICE.

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

PAPER-REINFORCING MACHINE.

1,211,852. Specification of Letters Patent. Patented Jan. 9, 1917.

Application filed January 8, 1915, Serial No. 1,208. Renewed April 14, 1916. Serial No. 91,262.

To all whom it may concern:

Be it known that I, CHARLES H. HOWARD, a citizen of the United States, and resident of 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 by adhesively securing thereto a series of reinforcing elements, such as threads, tapes, cords, or the like.

As well understood by those skilled in the art, the main difficulty encountered in the accomplishment of the desired reinforced fabric is the proper introduction and application of the reinforcing elements that extend transversely of the fabric to be reinforced, and while various attempts have heretofore been made to introduce such transverse reinforcing elements, the mechanical difficulties have not been satisfactorily overcome with due regard for economic production. Where such transverse reinforcing elements have been introduced singly or in succession, the operation has necessarily been slow, and often said elements have not been properly retained in transverse position until sufficiently incorporated with the fabric to insure permanency of their transverse disposition; and where the transverse reinforcing elements have been introduced in plural series, they have extended continuously in serpentine or diagonal relation to the fabric itself.

The aims and purposes of the present invention are to provide a machine for expeditiously and effectively placing the reinforcing elements in plural numbers transversely of the fabric to be reinforced and to maintain such transverse relation thereto until the said elements and fabric have become sufficiently united to insure permanency and proper transverse relation.

Another important feature of the present invention consists in the grippers which are so constructed and arranged that a plurality of reinforcing elements may be grasped and held by the gripper jaws and carried into transverse relation with the fabric, even should the elements themselves vary in size.

A further important feature consists in the means for severing the reinforcing elements along or parallel to the edge of the fabric to be reinforced.

The above and other features of the invention will best be made clear from the following description and accompanying drawings of one form or embodiment of means for carrying the invention into practical effect, it being understood that the particulars and details thereof may be variously modified within the true scope of the invention, as defined by the claims.

In the drawings, Figure 1 is a side elevation of a machine embodying features of the present invention; Fig. 2 is a plan view thereof with some of the parts broken away or omitted; Fig. 3 is a cross-section of the machine on the line 3—3, Fig. 1; Fig. 4 is an enlarged sectional detail showing more particularly the gripper construction; Fig. 5 is an enlarged side elevation of the pressure roller and cutter showing the latter acting upon the reinforcing elements at the nip of the pressure roller and one form of means for operating the cutter; Fig. 6 is a fragmentary detail looking in the direction of the arrow, Fig. 4, at the face of one of the grippers; Fig. 7 is a side elevation of one end of the pressure roller and showing the cutter associated therewith; Figs. 8, 9, 10 and 11 are face views of certain cams to be described, showing in a general way the configuration of the cam path; and Fig. 12 is a plan view of a piece of fabric having both longitudinal and transverse reinforcing elements adhesively secured thereto, and with an overlying or covering fabric.

The reinforcing elements may be threads, yarn, tapes, cords, wires, or the like, but for the purposes of brevity and identification, these will be hereinafter referred to generally as threads. The present machine is primarily intended for reinforcing paper, but obviously the material to be reinforced may be either paper or any other fabric.

The machine frame may be, of any suitable character, but as herein shown, it com-

poses side frames 1 sustained upon appropriate supports 2, and transversely braced as circumstances may dictate. Extending inwardly from the top of the side frames 1 are flanges 3, Fig. 3, between which is supported the table 4 over which the paper is fed longitudinally through the machine.

The present invention contemplates that the paper to be reinforced may be taken from a source of supply and that such source of supply may be furnished by a paper-making machine from which the paper may be fed directly into the machine of the present invention, or it may, as indicated in the present exploitation of the invention, be in the form of a roll of paper 5, sustained upon suitable supports 6 mounted in the brackets 7 projecting at one end of the machine frame.

From the roll 5, the paper may appropriately pass about suitable guiding rolls such as 8 and 9 to a roll 10 at one end of the table 4, and then be moved longitudinally over the top of the table 4 to another guide roll 11 at the opposite end of the table, whence the paper web may be directed through the calender or other rolls 12 and 13, mounted in suitable bearings 14 and 15 in one of the uprights 2 of the machine frame. In order that the thickness of the material passing between the calender rolls 12 and 13 may be properly accommodated, one or both of these rolls may be made adjustable in its bearings, as indicated in Fig. 1, and these calender rolls may, as usual, be properly driven to draw or feed the paper longitudinally through the machine from the source of supply. Obviously, other means for guiding and directing the paper and feeding it longitudinally, may be employed.

Rotatably sustained in suitable bearings 16, Fig. 1, is the cam shaft 17 which may be driven from any suitable source of power, and as the mechanical devices to this end are well understood by those skilled in the art, further illustration or amplification will be unnecessary.

The present form of the invention contemplates that the means for introducing the transverse threads in plural number transversely of the paper to be reinforced, shall comprise grippers which shall take such threads from a source of supply, carry a plurality thereof simultaneously into a plane opposite the surface of the paper, then move such threads into contacting relation with the paper to be reinforced, and then move longitudinally with the paper while still holding the transverse threads against the surface thereof until such threads have become sufficiently incorporated with the paper to retain their proper transverse disposition with respect thereto; whereupon, the said transverse threads are released from the grippers. In order that the threads may thus become incorporated with or permanently secured to the paper to be reinforced, the surface of said paper is preferably provided with an adhesive. This adhesive may be applied to the paper as it is drawn from the source of supply, as by means of a roll 18, Fig. 1, or if the paper has previously been gummed, it may be dampened by such roll, so that when the transverse threads are brought into contact with the surface of the paper and are moved by the grippers longitudinally with the paper, they become permanently united thereto while still held by the grippers in their proper transverse relation to the paper.

As one means for carrying this feature of the invention into practical effect, the grippers are preferably mounted for movement in rectilinear paths transversely of and longitudinally with the paper, and have in addition to such movements, a movement toward and from the plane of the paper. A good, practical form of this feature of the invention will now be described.

Mounted for rising and lowering movement with respect to the machine frame, is the gripper frame, comprising, in the present form of the invention, the standards 19, and connecting longitudinal and transverse braces 20, Figs. 1 and 2. The standards 19 extend through suitable guideways 21, as indicated in Fig. 1, and at their lower ends are connected at 22 with a counter-weight 23 by suitable means, such as the flexible chain or strap 24, the construction being such that the counter-weights 23 serve to counterbalance the weight of the gripper frame and the parts carried thereby, as will hereinafter more fully appear. The chain or flexible connection 24 preferably passes over suitable guide pulleys 25. Rising and falling movement of the gripper frame may be imparted by any suitable means, but in the present form of the invention, said means comprises a rack-bar 26 secured to or formed upon each of the standards 19 and engaged with a co-acting rack segment 27, secured to the transverse shafts 28, and having arms 29 which are appropriately connected by a rod 30 for imparting to the rack segments 27 appropriate movement in unison, substantially as indicated in Fig. 1.

In order to impart to the rack segments 27 the desired rocking movement, one of the arms 29, connected to the shaft 28, (that to the left in Fig. 1), has jointed thereto at 31, Fig. 1, an operating arm 32 provided with a roll 33, for engagement with the cam path 34 of the cam 35, Fig. 11, mounted on the shaft 17, the construction being such that upon rotation of the cam shaft 17 and, perforce, the cam 35, the gripper frame will

be raised and lowered, according to the dictates of the cam path, as will be readily understood.

Secured to the gripper frame and preferably extending between the standards 19 at the opposite sides of the said frame, are the two trackways 36, Figs. 1, 2, and 3, on which are mounted the transversely-movable gripper carrier frames 37. These gripper carrier frames each comprise a longitudinally-supporting member having at its end portions, suitable rolls 38, Fig. 1, for engaging the upper and lower portions of the trackways 36, the construction being such that each of the gripper carrier frames is capable of movement transversely of the machine on the trackways 36 carried by the gripper frame.

As a preferred form of this feature of the invention, each of the gripper carrier frames 37 has at its end portion, the brackets 39, Fig. 3, the upper portions of which carry the upper rollers 38 and the under portions of which carry the under rollers 38, so that the trackways 36, which extend transversely of the machine frame, are embraced by the rollers 38 which thereby serve to give to the gripper carrier frames, stability and accuracy of rectilinear movement, as will presently appear. Since the gripper carrier frames 37 each sustain the gripper carriers to be hereinafter described, said frames are preferably made of sufficient strength to perform their desired functions; and as a good, practical form, said frames are preferably constructed as indicated in Fig. 1, that is, with the web portions 40, although, as will be clearly evident to those skilled in the art, this feature of the construction may be varied to suit the conditions of use.

The present invention contemplates that the gripper carrier frames which, as will be presently described, carry the gripper carriers, shall have movement in rectilinear paths transversely of the machine, and suitable means may be provided to effect such transverse movement. In the illustrated form of the invention, each of the gripper carrier frames 37 has secured thereto, a rack bar 41, Figs. 2 and 3, which extends transversely of the machine frame into engagement with a rack pinion 42, preferably near the median portion of the machine frame; and appropriate movement is imparted to the rack pinion 42 to effect the transverse movement of the gripper carrier frames. In the present form of the invention, there are two of the rack pinions 42, one at each end of the shaft 43, which extends longitudinally of the machine frame, as indicated in Figs. 2 and 3, and is supported in bearings movable with the gripper frame, and in the present instance, these bearings may be appropriately formed in the transversely-extending portions 20 of the gripper frame, substantially as indicated in Fig. 2.

Secured at one end of the shaft 43, Figs. 1 and 2, is a beveled gear 44 which is operatively engaged with a corresponding gear 45 secured to a shaft 46 extending toward one side of the machine frame, the outer end of said shaft being operatively engaged by the beveled gears 47, 48, with an upright shaft 49 which may be driven through suitable gearing connection as indicated in Fig. 1, from a segment rack 50, such gearing connection in the present form of the invention being constituted by the beveled gears 51, 52, and the rack gear 53. In order that operative engagement may be continued through the gears 47 and 48 as the gripper frame is raised and lowered, the beveled gear 48 is mounted for movement with the gripper frame by means of a bracket 54, Fig. 1, and is splined to the upright shaft 49.

The rack segment 50 is mounted upon the shaft 55, Fig. 1, from which projects an arm 56 jointed to an arm 57 which receives reciprocating motion from the cam 58, Fig. 9, having a cam path 59 and mounted upon the cam shaft 17. In order to guide the arm 57 in its reciprocating movement by its operating cam, the substantial form of which is shown in Fig. 9, the said arm 57 has its end bifurcated as indicated in Fig. 1, to engage about the hub of the cam 59, but as such detail of construction is well understood by those skilled in the art, further elucidation is unnecessary.

From the construction thus far described, it will be apparent that upon rotation of the cam shaft 17, the gripper frame will be raised and lowered with respect to the support or table 4 and the gripper carrier frames will be moved transversely of the machine toward and from each other through the described mechanism, or other form of operating means.

Each of the gripper carrier frames 37, there being preferably two, one at each side of the machine, is provided with a longitudinally-extending track 60, Figs. 1 and 4, for supporting the gripper carriers with capacity for movement longitudinally of the machine frame. Each of the gripper carriers comprises a support 61, the upturned flanges of which support a series of carrier rollers 62, Figs. 2 and 4, which rest and move upon longitudinal trackways 60.

The gripper carrier or support 61 preferably sustains a series of gripper jaws which are appropriately operated at desired times for taking a plurality of threads from a source of supply and carrying them transversely of the machine above the support or table 4. In the present illustration of the invention, the gripper carrier is shown by

Fig. 1 as supporting four separate grippers, each of which comprises a pair of gripper jaws adapted to hold between them a plurality of threads. Depending from the gripper carrier or support 61 are the arms 63, Figs. 1 and 4, which afford appropriate means for supporting the grippers as well as the operating means therefor, as will more fully appear.

In the illustrated form of the invention, the threads *a* are taken from a source of supply at one side of the machine and carried by the grippers at that side of the machine toward the median line, where the grippers at the opposite side of the machine grasp the ends of the transverse threads and complete the transverse movement thereof.

When the grippers have carried the threads transversely of the machine, the present invention provides that the gripper frame shall be lowered to place the series of threads held by the grippers in contact with the adhesive surface of the paper to be reinforced, and in order that the threads thus held by the grippers shall remain in proper transverse relation to the fabric as it is fed, the present invention further contemplates means for giving to the grippers a longitudinal movement along with the fabric as it is fed, while still holding the transverse threads. As one form of means to this end, each of the gripper carriers is provided with a longitudinally-extending rack 64, which is adapted to be engaged by suitable gears 65 splined to the transversely-extending shaft 66, said gears being preferably connected for transverse movement with the gripper carrier frames 37 as said frames are moved transversely of the machine. The shaft 66 is carried in appropriate bearings 67 supported by the longitudinal frame pieces 20 of the gripper frame, as indicated in Fig. 3, and carries at one end thereof, a beveled gear 68, Fig. 3, operatively engaged with a corresponding gear 69 splined to the upright shaft 70, the lower end of which carries a beveled gear 71 operatively engaged with a corresponding gear 72 mounted in bearings 73 and having secured to the shaft thereof a gear 74 adapted to be operated by a segment rack 75, Fig. 1, the construction being such that upon oscillatory movement of the segment rack 75, rotative movement in proper direction will be imparted to the beveled gear 72 and through the driving connections, to the transverse shaft 66, whereby movement longitudinally of the machine will be imparted to the gripper carriers and grippers at each side thereof.

The segment rack 75 may be operated in any suitable manner, but as shown, is mounted at 76 to the machine frame, Fig. 1, and has operatively connected thereto an arm 77 actuated by a cam 78, Fig. 8, mounted on the cam shaft 17, said cam 78 being provided with an appropriate cam path 79 for engagement by a roll 80 carried by the arm 77. The arm 77, as hereinbefore described for the cam actuated arm 32, may have its end portion bifurcated to straddle and be guided by the hub of its actuating cam 78.

From the construction thus far described, it will be apparent that the grippers for placing a plurality of threads transversely of the fabric or paper to be reinforced, are given movements transversely of the machine to place the threads in such transverse relation to the fabric or paper, and then toward the plane of the fabric or paper to be reinforced in order to place the threads in contact with the adhesive surface of the fabric or paper, and that the grippers, while still holding the threads at each side of the machine, move longitudinally with the fabric or paper; and while certain detailed means have hereinbefore been described for carrying these features of the invention into practical effect, it will be understood that the invention is not circumscribed by these details, and that they may be varied indefinitely.

It is appropriate at this time to describe the grippers and the operating means for opening and closing the gripper jaws at appropriate times. The grippers at each side of the machine might appropriately be formed in corresponding manner, but in the present invention, it is contemplated that the grippers at the thread supply side of the machine, which will hereinafter be designated the "delivery grippers or jaws," shall be specifically different from the grippers at the opposite side of the machine, which grippers will hereinafter be known as the "taking grippers or jaws."

The delivery grippers comprise an upper jaw 81, Fig. 4, pivotally mounted on the portion 63 of the gripper carrier at 82, and having a facing 83 at its free end. This facing may be of appropriate material for properly acting upon the texture of the threads supplied. The lower jaw of the delivery grippers comprises a fixed member 84 and the upper jaw is moved about its pivotal mounting by a cam rod 85 to clamp and unclamp the threads between the jaws.

The taking grippers, that is the grippers at the opposite side of the machine, comprise the upper jaws 86, Fig. 4, pivotally mounted at 87 to the extensions 63 from the gripper carrier. The lower jaw of the taking grippers may be a fixed member 88 and between the non-active portion of the jaws, is the operating cam bar 85 for closing the jaws, while a spring 90 connected to the non-active ends of the jaws serves to open them when permitted to do so by the cam operating bar 85.

An important feature of the present invention with respect to the grippers, con-

sists in so constructing the jaws of the grippers that a plurality of threads may be grasped and held between the jaws of the grippers, even though the dimensions or size of the threads themselves may vary. As one means to this end, one of the jaws of each gripper is provided with a series of independently-movable thread-engaging members, each member being intended to engage one thread between itself and the opposite jaw. As illustrated in Fig. 4, the lower jaw of each of the grippers is provided at its end portion with a recess 91 and a tooth 92 having a portion 93 to engage said recess, and normally held in operative position on the jaw by a plate or holder 94 which may be secured to the jaw by a suitable set screw 95. The depth of the recess 91 in the jaw is somewhat greater than the length of the projecting portion 93 of the tooth which engages said recess, so that the teeth 92 may move transversely or toward and from the opposite jaw to a limited extent. The teeth 92, as indicated in Fig. 6, are arranged side-by-side along the acting end portion of one of the jaws, and are preferably of a size as indicated in Fig. 6, to engage a single thread or other reinforcing element between itself and the facing piece 83 of the opposite jaw. It is desirable that the teeth 92, while being independently movable toward and from the upper jaw to accommodate different sizes of threads, shall, nevertheless, be normally held yieldingly in initial position, and to this end the series of teeth 92 are acted upon by spring means for normally holding them in the position indicated in Fig. 4. In the form of the invention illustrated in the drawing, the said spring means comprises a series of spring fingers 96, preferably one for each of the teeth 92, as indicated in Fig. 6, and said spring fingers 96 may be clamped to the jaw with which the teeth are associated by means of a clamping piece 97, the end portion of which overlaps to some extent, the non-active end of the spring fingers 96, with the result that the spring action of said fingers is rendered sufficiently stable and energetic to insure secure clamping of the threads between the teeth and opposite jaw of the grippers when the jaws are closed together. The clamping piece 97 may be secured to the jaw of the gripper by any suitable means, such as the clamping bolt 98, Fig. 4.

From the construction described, it will be apparent that when any of the jaws of the grippers are closed upon the threads *a*, the independently movable and yielding teeth 92 will enable the jaws to hold between them a plurality of threads, even though the said threads vary in size. It will be noted, also, from Fig. 4, that the threads at the delivery side of the machine preferably pass through or between the jaws of the delivery grippers and that the jaws of the taking grippers engage the projecting end portions of the threads *a* offered by the delivery grippers.

When the delivery grippers move from the side of the machine toward the median line, the reinforcing threads should be clamped between the jaws of the grippers with the ends projecting as in Fig. 4, and the taking grippers as they approach the delivery grippers, should have the jaws open to receive the projecting ends of the threads. When the grippers have met or practically met near the median portion of the machine, the jaws of the taking grippers should close upon the threads and the jaws of the delivery grippers should open, whereupon the delivery and taking grippers will move toward their respective sides of the machine to carry the threads transversely. It is likewise desirable that when the delivery grippers have reached the outer side portion of the machine, the jaws thereof may be clamped upon the threads in order that the threads at both sides of the machine may be held by the gripping jaws as these jaws are moved longitudinally with the fabric or paper to be reinforced. When the grippers have moved the desired longitudinal extent to insure the incorporation of the threads with the adhesive surface of the paper or fabric, the threads should be released from their jaw control. These various conditions and the means for effecting them will now be described.

Secured to the cam bar 85, of the delivery grippers, is an actuating finger 99, Fig. 4, which, when the jaws of the delivery grippers are closed, occupies substantially the dotted line position as indicated in said figure. As the delivery jaws move toward the median line of the machine into the dotted line position shown by Fig. 2, the actuating finger 99 meets the opening stop 100 secured to a fixed part of the gripper frame, as indicated in Fig. 2, thereby turning the cam bar 85 and releasing the hold of the jaws upon the threads *a*. Likewise, projecting from the cam bar 85 of the taking grippers is a finger 101, Figs. 1 and 4, which, when in dotted line position as indicated in said Fig. 4, permits the jaws of the grippers to be opened by the spring 90, which is their condition as the taking grippers move to meet the delivery grippers at the median portion of the machine, as indicated by dotted lines in Fig. 2. As the delivery and taking grippers come together near the median portion of the machine, the finger 101 of the taking grippers meets a closing stop 102 secured to the gripper frame, thereby turning the cam bar 85 of the taking grippers and clamping the ends of the threads *a* between them, whereupon the taking and

delivering grippers separate toward the side portion of the machine, the taking grippers pulling the reinforcing threads through the now unclamped jaws of the delivery grippers. As the delivery grippers reach their side portion of the machine, the finger 99 of the cam bar 85 meets a jaw closing stop 103 secured to the gripper frame, thereby closing the gripper jaws of the delivery gripper upon the thread. Through the means hereinbefore described, or other equivalent devices, the gripper jaws are carried downward at this time to place the threads upon the adhesive surface of the fabric or paper, and then move longitudinally with the paper while still holding the threads. It is necessary, however, to release the threads from the grippers after they have performed their function; and to this end, the cam bar 85 of the taking grippers has an opening finger 104, Fig. 1, which, as the gripper carrier moves the grippers longitudinally of the machine, Fig. 1, meets the opening stop 105 secured to the gripper carrier frame, thereby releasing the ends of the reinforcing threads from the taking grippers. The threads are released from the delivery grippers, however, by cutting the threads along the edge of the fabric to be reinforced, leaving portions of the threads *a* projecting from the closed jaws of the delivery grippers, as indicated in Fig. 4.

So far as certain features of the invention are concerned, any appropriate means might be employed to sever the threads from the delivery grippers, but the present instance of the invention contemplates that the severing means shall be so constructed and arranged as to act upon and cut the threads by a severing cut, along the edge of the fabric or paper to which they have been applied, while such threads are held upon the paper. It may be desirable as the threads are severed or released from the grippers, that they be pressed into intimate contact with the adhesive surface of the paper by a rolling pressure. To this end, the present invention contemplates the provision of a pressure roller 106, Figs. 1, 2, 5 and 7, extending transversely of the table 4 and having end portions carried by bearings 107 mounted on the rack bars 108, Figs. 1 and 2. The rack bars 108 at each side of the machine, are operatively engaged by the gear 109 mounted on the transverse shaft 110, Figs. 1 and 3. Mounted on the shaft 110 is a gear or pinion 111 which is in operative engagement with a toothed rack 112 loosely mounted on the transverse shaft 28 at the left, Fig. 1. The rack segment 112 is oscillated upon the shaft 28 at desired times by means of an operating arm 113, Figs. 1 and 3, having suitable connection with an operating cam 114, Figs. 3 and 10, provided with a suitable cam path 115 adapted to engage a roller or pin 116 projecting from the arm 113, the construction being such that upon rotation of the cam shaft 17, the proper oscillatory movement will be imparted to the segment rack 112 to move the rack bars 108, and, perforce, the pressure roll 106 longitudinally of the fabric and the transverse threads which have been laid thereon. The operating arm 113, like the similar arms for operating the segment racks hereinbefore described, may have suitable bifurcated ends for the guidance of said bar during its reciprocating movements.

Eccentrically mounted with respect to the pressure roll 106 is the rotary cutter 117, Figs. 1 and 5. This cutter is preferably secured to a ring 118 which bears upon a circular trackway 119 carried by the bearing 107 eccentric with relation to the pressure roll 106, the construction being such that the cutting part 120, Fig. 5, of the rotary cutter, is substantially at the nip of the roll 106, where it bears upon the fabric or paper and the transverse threads, the result being that the threads themselves while being cut, are held from displacement.

It is desirable that the rotary cutter be given rotary movement as the roller and cutter are moved longitudinally of the fabric or paper; and to this end the bearing 107 has projecting therefrom, an arm 121, Figs. 5 and 7, carrying a pinion 122 in operative engagement with a pinion 123 secured for rotative movement with the cutter 117. Pivotally mounted at 124, Fig. 5, is an arm 125 carrying at its free end suitable bearings for a roll 126 which projects over the table and fabric or paper resting thereon, substantially as indicated in Fig. 2. Mounted for rotative movement with the roll 126 is a pinion 127 meshing with the pinion 122, the construction being such that as the rack bars 108 move the pressure roller 106 and the cutter longitudinally of the fabric or paper, on which the transverse threads have been laid, the roll 126 gives positive rotating cutting movement to the cutter 117 which performs the cutting action at the nip of the roller or where it bears upon the paper and threads. In order to impart to the roll 126 sufficient frictional turning movement as the roll moves over the paper, a spring 128 may be connected to the end portion 129 of the arm 125 to exert a downward pressure upon said roll, as will be evident from Fig. 5.

It may sometimes be desirable to place longitudinal threads or reinforcing elements on the surface of the paper as well as the transverse reinforcing elements; and the present invention, by Fig. 1, shows longitudinal threads *b* entering the machine at the right, Fig. 1, and extending longitudinally of the fabric to be reinforced. These longitudinal threads, of course, will lie be-

neath the transverse threads *a*, and it may be desirable that other longitudinal threads be superposed upon the transverse threads alternately with the threads *b;* and to this end, as indicated in Fig. 1, the longitudinal threads *c* are shown as being taken from a source of supply and carried about a guide roll 130, Figs. 1 and 2, supported in brackets 131, and then about a guide roll 132 mounted on proper supporting arms 133 and carried by the end portions 134 of the rack bars 108. The end portions of the rack bars 108 may likewise be provided with a roll 135 over which the longitudinal threads *c* may be passed, as indicated in Figs. 1 and 2, and the said roll may have at its end portions, the guiding pulleys 136 movable upon the trackways 137, the construction being such that as the rack bars 108 move the pressure roller 106 longitudinally of the fabric or paper, the longitudinal threads *c* which may alternate transversely of the fabric or paper with the longitudinal threads *b*, may be properly laid upon or over the transverse reinforcing threads *a*, and the entire reinforcing thread structure be firmly embedded into the adhesive surface of the paper.

The character of the adhesive which may be applied to the surface of the paper varies under different conditions of intended use. Some adhesives dry more rapidly than others; especially is this difference marked with respect to waterproof adhesives. It may therefore be desirable where a quick-setting adhesive is employed, to move the pressure roll 106 longitudinally over the reinforcing threads and the paper as soon as the transverse reinforcing threads have been properly laid upon the paper by the grippers. The present invention therefore contemplates this characteristic action and notes that such action or a more retarded movement of the roller 106 over the reinforcing threads and paper may be secured merely by a change in the form of the cam groove 115 in the cam 114.

It may be desirable in some cases to superpose upon the reinforced fabric taken from the original source of supply such as the roll 5, Fig. 1, another fabric or web of paper. The present invention embraces within its contemplation, means to this end, as indicated at the left, Fig. 1, wherein a web or strip of paper *d* is shown as being drawn from a source of supply in the direction of the arrow, passed around suitable guide rolls 138 and 139, Fig. 1, and over an adhesive-applying roller 140, said web *d* being there conducted about the upper calender roll 12 into superposed relation with the underlying fabric, and the reinforcing threads thereon.

It sometimes is expedient to adapt the machine for the treatment of different widths of paper or fabric to be reinforced; and to this end the support or table 4 is made adjustable in width, so as to accommodate the desired width of fabric or paper being passed thereover. In the present form of the invention, the table 4 may be adjusted in width by means of the filler pieces 141, Fig. 3, at each side thereof, said filler pieces being appropriately secured to the flanges 3 of the machine frame by suitable bolts 142 or otherwise. When the table is changed in width, the length of the pressure roll 106 will be such as to adapt such roll to the treatment of the prescribed width of paper. This may be effected by the substitution of longer or shorter rolls.

When the paper is varied in width, the present machine provides means for varying the transverse travel of the grippers to correspond thereto; and to this end, the actuating arm 57, Fig. 1, is connected to the rack segment 50 by means of a pin and adjusting slot connection 143. Similarly, the longitudinal movement of the grippers along with the fabric while still holding the transverse threads may be changed in accordance with the demands of use, and the present machine provides this variation in the longitudinal travel by means of the slotted connection 144 between the rack segment 75 and its actuating arm 77.

Changes in various parts, and modification of the actuating means may be made within the scope of the present invention, but the described means has been found to be practically effective, and a good, practical embodiment of the invention.

What is claimed is:—

1. In a machine for reinforcing fabrics, the combination of means for feeding a fabric longitudinally, gripper means for taking a plurality of threads from a source of supply and placing them transversely to the surface of the fabric to be reinforced, means for moving said gripper means toward the surface plane of the fabric to place the threads in contact with the fabric, and means for moving the gripper means with the fabric while still holding the transverse threads.

2. In a machine for reinforcing fabrics, the combination of means for feeding a fabric longitudinally, a plurality of grippers, means for causing said grippers to simultaneously carry a series of threads transversely of the fabric, means for moving the grippers toward the plane of the fabrics, and means for moving the grippers longitudinally.

3. In a machine of the character described, the combination of means for supporting and feeding a fabric longitudinally, grippers, means for causing said grippers to simultaneously carry a plurality of threads transversely of the fabric, means for moving the grippers toward the plane of the fabric to place the transverse threads held by the

grippers into contact with the surface of the fabric, and means for moving the grippers longitudinally with and at the same speed as the fabric while still holding the transverse threads.

4. In a machine for reinforcing fabrics, the combination of means for feeding a fabric longitudinally, grippers, and means for moving said grippers in three directions, first, transversely of the fabric; second, toward the fabric; and third, longitudinally in the same direction as the fabric.

5. In a machine for reinforcing fabrics, the combination of means for feeding a fabric longitudinally, gripper means for taking a plurality of threads from a source of supply and placing them transversely to the surface of the fabric to be reinforced, means for moving said gripper means toward the surface plane of the fabric to place the threads in contact with the fabric, means for moving the gripper means with the fabric while still holding the transverse threads, and means to release the transverse threads from the grippers.

6. In a machine for reinforcing fabrics, the combination of means for feeding a fabric longitudinally, a plurality of gripper means for causing said grippers to simultaneously carry a series of threads transversely of the fabric, means for moving the grippers toward the plane of the fabric, means for moving the grippers longitudinally with the fabric while still holding the transverse threads, and means for releasing the transverse threads from the grippers after said threads have been laid upon the surface of the fabric.

7. In a machine for reinforcing paper, the combination of means for feeding paper longitudinally, grippers for engaging transverse threads, means for causing said grippers to move a plurality of threads simultaneously transversely of and into a plane above the paper, means for moving the grippers downward to place the transverse threads into contact with the paper, and means for moving the grippers longitudinally with the paper as it is fed while still holding the transverse threads, and means operative during the longitudinal movement of the grippers to release the transverse threads from the grippers.

8. In a fabric reinforcing machine, the combination of a support, means for continuously feeding paper longitudinally over said support, a series of grippers for engaging transverse threads, means for moving the series of grippers transversely over said support to place the transverse threads in contact with the fabric being fed over said support, and means for simultaneously moving the series of grippers longitudinally with the fabric while still holding the transverse threads.

9. In a paper reinforcing machine, the combination of paper feeding devices, gripper means comprising a plurality of gripper sections, means for simultaneously moving said sections transversely of the paper to place a plurality of threads transversely of and opposite to the paper, means for simultaneously moving the gripper sections toward the plane of the paper to place transverse threads held by any of the sections upon the surface thereof, and means for simultaneously moving the gripper section longitudinally with the paper.

10. In a machine for reinforcing fabrics, the combination of means for feeding a fabric, grippers, means causing said grippers to engage and carry threads transversely of said fabric, means for moving the grippers toward the plane of the fabric to place the transverse threads upon the surface thereof, means for moving the grippers longitudinally with the fabric while holding the transverse threads, a roller, and means for moving the roller over the fabric and transverse threads.

11. In a paper reinforcing machine, the combination of means for feeding longitudinally a paper strip having an adhesive surface, grippers at each side of the machine, means for moving the grippers toward and away from each other to carry a plurality of threads transversely of the machine, means for moving the grippers toward the plane of the paper to carry the transverse threads into contact therewith, means for moving the grippers at each side of the machine longitudinally with the paper while still holding the transverse threads in contact therewith.

12. In a machine for reinforcing fabrics, the combination of means for feeding a fabric, grippers, means causing said grippers to engage and carry threads transversely of said fabric, means for moving the grippers toward the plane of the fabric to place the transverse threads upon the surface thereof, means for moving the grippers longitudinally with the fabric while holding the transverse threads, a roller for pressing the threads and fabric together, and means for moving the roller over the fabric and transverse threads while said threads are held by the grippers.

13. In a machine for reinforcing fabrics, the combination of means for feeding a fabric, grippers, means causing said grippers to engage and carry threads transversely of said fabric, means for moving the grippers toward the plane of the fabric to place the transverse threads upon the surface thereof, means for moving the grippers longitudinally with the fabric while holding the transverse threads, a roller for pressing the threads and fabric together, and means for moving the roller over the

fabric and threads in a direction opposite to the longitudinal movement of the grippers while holding said threads.

14. In a machine for reinforcing fabrics, the combination of means for feeding a fabric, grippers, means causing said grippers to engage and carry threads transversely of said fabric, means for moving the grippers toward the plane of the fabric to place the transverse threads upon the surface thereof, means for moving the grippers longitudinally with the fabric while holding the transverse threads, a roller for pressing the threads and fabric together, means for moving the roller over the fabric and threads in a direction opposite to the longitudinal movement of the grippers while holding said threads, and means for releasing the threads from the grippers.

15. In a paper reinforcing machine, the combination of means for feeding longitudinally a paper strip having an adhesive surface, a plurality of grippers at each side of the machine, means for moving said grippers toward and from each other to simultaneously place a series of threads transversely of the paper in a plane above the said adhesive surface, means for lowering the grippers at each side of the machine to place the transverse threads against the adhesive surface, means for moving the grippers longitudinally with the paper while holding the threads against the adhesive surface thereof, and means for superposing another strip of paper upon the first-named strip and threads.

16. In a fabric reinforcing machine, means for feeding a fabric longitudinally, means for carrying a plurality of threads transversely of the fabric and then longitudinally with the fabric, a cutter for severing the threads at one edge of the fabric, and means actuated by relative movement of the fabric and cutter for operating the cutter.

17. In a fabric reinforcing machine, means for feeding the fabric longitudinally, means for placing a series of threads transversely of the fabric, a cutter, means for moving the cutter longitudinally along the edge of said fabric, and means actuated by such movement of the cutter for operating the same.

18. In a fabric reinforcing machine, means for feeding the fabric longitudinally, means for placing a series of threads transversely of the fabric, a roller for pressing the threads against the fabric, a rotary cutter acting upon the threads while held against the fabric by said roller, and means for moving the roller and cutter longitudinally of the fabric.

19. In a fabric reinforcing machine, means for feeding the fabric longitudinally, means for placing a series of threads transversely of the fabric, a roller for pressing the fabric and threads together, a rotary cutter mounted for cutting the threads substantially at the nip of the roller, and means for moving the roller and cutter longitudinally of the fabric.

20. In a fabric reinforcing machine, means for feeding the fabric longitudinally, means for placing a series of threads transversely of the fabric, a roller acting to press the fabric and threads together, a rotary cutter to cut the threads substantially at the nip of the roller, means for moving the roller and cutter longitudinally of the fabric, and means for rotating the cutter.

21. In a machine for reinforcing fabrics by transverse threads, the combination of fabric feeding means, and grippers for placing a plurality of threads transversely of the fabric, said grippers each comprising a pair of jaws one member of which has a series of thread engaging portions independently movable toward and from the opposed jaw to enable a plurality of threads of varying sizes to be held by the jaws, and means for operating the jaws.

22. In a machine of the character described, a pair of gripper jaws for engaging and clamping a series of threads, one of said jaws having a series of independently movable thread engaging portions, yielding means for holding said thread engaging portions in normal position and permitting said portions to yield independently to accommodate threads of varying sizes to be held between said jaws, and means for operating said jaws.

23. In a machine for reinforcing fabrics, a pair of gripper jaws for engaging a plurality of threads between them, one of said jaws having a series of independently movable thread engaging teeth arranged side-by-side, means for detachably holding said independently movable teeth on said jaw, and means for operating the jaws.

24. In a machine for reinforcing fabrics, a pair of gripper jaws for engaging a plurality of threads between them, one of said jaws having a series of teeth arranged side-by-side, yielding means acting independently upon each tooth and permitting it to yield in a direction toward and from the opposite jaw to adapt the jaws to hold a series of threads of different sizes, and means for operating the jaws.

25. In a machine for reinforcing fabrics, a pair of gripper jaws for engaging a plurality of threads between them, one of said jaws having a series of thread engaging teeth arranged side-by-side, yielding means for holding said teeth in normal position relative to said jaw and permitting each tooth to move independently of the others of the series in accordance with the size of the thread, and means for limiting movement of the teeth.

26. In a machine of the character de-

scribed, a pair of gripper jaws to engage a plurality of threads between them, one of said jaws having a recessed end portion, a series of thread engaging teeth arranged side-by-side on said jaw and having a recess engaging portion of less length than the depth of the recess, yielding means normally holding said teeth projected toward the opposite jaw and permitting them to yield independently in accordance with the size of the threads as the jaws are closed.

27. In a machine of the class described, the combination of means for moving a transverse thread receiver, gripper means for taking a plurality of threads from a source of supply and placing them transversely to the receiver, means for moving the gripper means toward the receiver to transfer the transverse threads thereto, and means for moving the gripper means with the receiver while still holding the transverse threads.

28. In a machine of the character described, the combination of means for moving a transverse thread receiver longitudinally, gripper means for taking a series of threads from a source of supply and distending them in parallel relation transversely of the thread receiver, means for moving the gripper means toward the thread receiver and in the direction of movement of the thread receiver to transfer the threads thereto.

29. In a machine of the character described, the combination of means for moving a thread receiver continuously, gripper means for delivering a series of transverse threads to said receiver, and means for moving the gripper means transversely of the receiver, toward the receiver, and in the direction of movement of the receiver to transfer the threads thereto.

30. In a machine of the character described, the combination of a series of grippers, means for moving the series of grippers transversely of the machine to simultaneously carry a series of threads from a source of supply into a transverse position, a transverse thread receiver, means for moving said receiver longitudinally of the machine, means for moving the series of grippers toward the receiver, and means for moving the grippers in the direction of movement of the receiver to transfer the threads thereto.

31. In a machine of the character described, the combination of means for moving a thread receiver continuously, gripper means for delivering a series of transverse threads to said receiver, means for moving the gripper means transversely of the receiver, toward the receiver, and in the direction of movement of the receiver to transfer the threads thereto, and means for freeing the transverse threads from the grippers after they have been delivered to the receiver.

32. In a machine of the character described, the combination of gripper means at each side of the machine, means for moving the gripper means toward and from each other to place a series of threads transversely of the machine, a transverse thread receiver, means for moving the gripper means toward the thread receiver and also in the direction of movement of the receiver to deliver the transverse threads thereto.

33. In a machine of the character described, gripper means for carrying a series of threads transversely of the machine, said gripper means comprising a pair of jaws one of which has a series of independently movable thread engaging portions to enable threads of different dimensions to be held between the jaws, and means for operating the gripper means.

34. In a machine of the character described, the combination of a main frame, a gripper carrying frame, means for moving the gripper carrying frame relative to the main frame, grippers carried by the gripper frame, means for moving the grippers transversely of the gripper carrying frame for taking threads from a source of supply and placing transversely of the gripper carrying frame, a transverse thread receiver, means for moving it longitudinally, and means for moving the grippers in the direction of receiver movement to transfer the threads thereto.

35. In a machine of the character described, the combination of a series of grippers each adapted to engage a plurality of threads, a transverse thread receiver, means for moving it continuously, means for operating the series of grippers for taking threads from a source of supply and placing them transversely of the receiver, means for moving the series of grippers toward the transverse thread receiver, and means for moving the series of grippers in the direction of receiver movement to transferring the threads to said receiver.

36. In a machine of the character described, gripper means for moving a plurality of threads transversely of material to be reinforced comprising jaws, one of which has relatively movable portions cooperating with the other for clamping threads of different thicknesses, and means for operating said jaws.

37. In a machine of the character described, gripper means for moving a plurality of threads transversely of material to be reinforced comprising jaws, one of which has yieldable relatively movable portions cooperating with the other for clamping threads of different thicknesses, and means for operating said jaws.

38. In a machine of the character de-

scribed, gripper means for moving a plurality of threads transversely of material to be reinforced comprising jaws having elements movable relatively to said jaws for clamping threads of different thicknesses, and means for operating said jaws.

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

CHARLES H. HOWARD.

Witnesses:
EDWARD D. ALLEN,
BEATRICE I. SMITH.