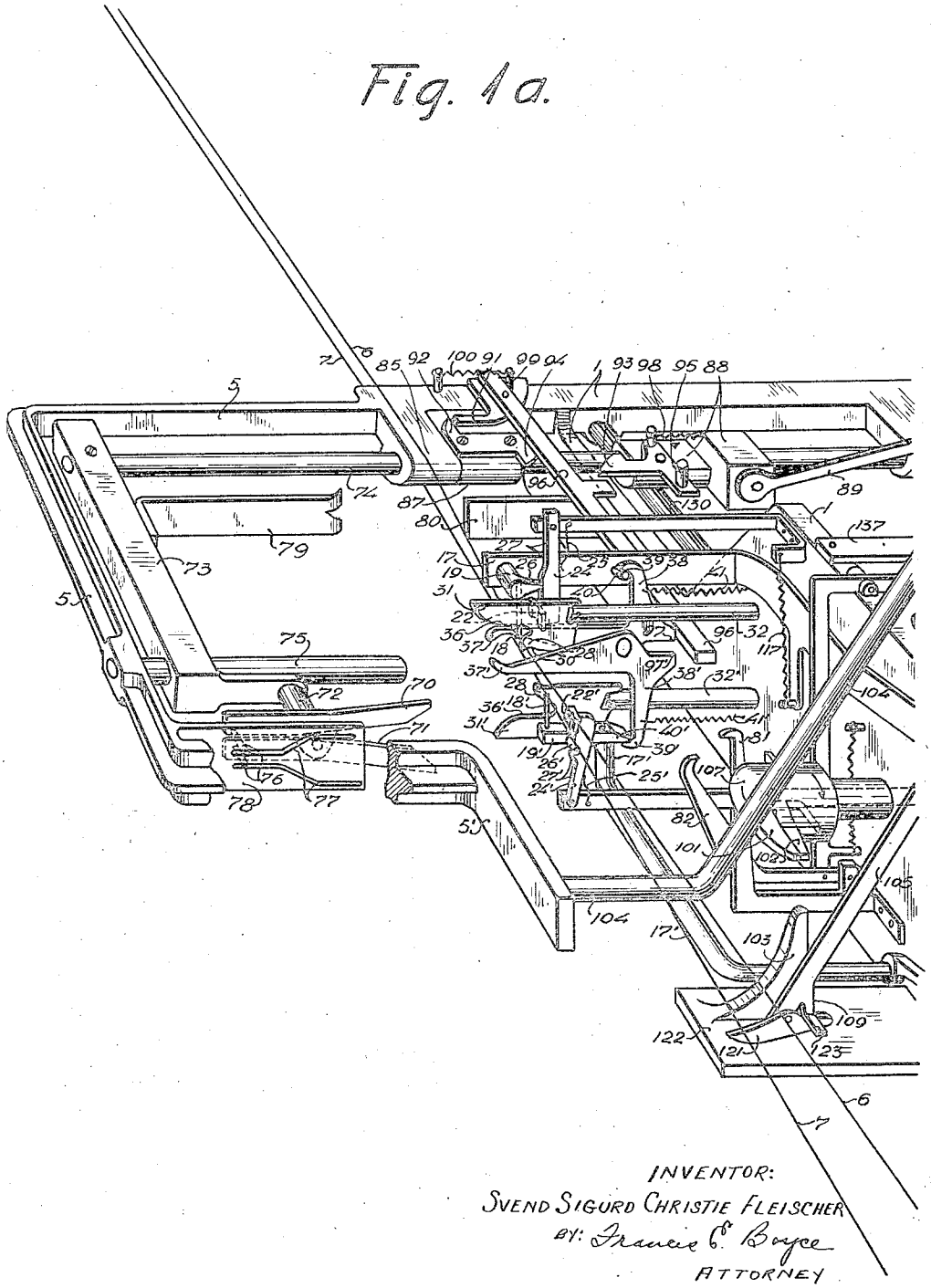
April 28, 1936. S. S. C. FLEISCHER 2,039,157

WARP TYING MACHINE

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Fig. 1a.



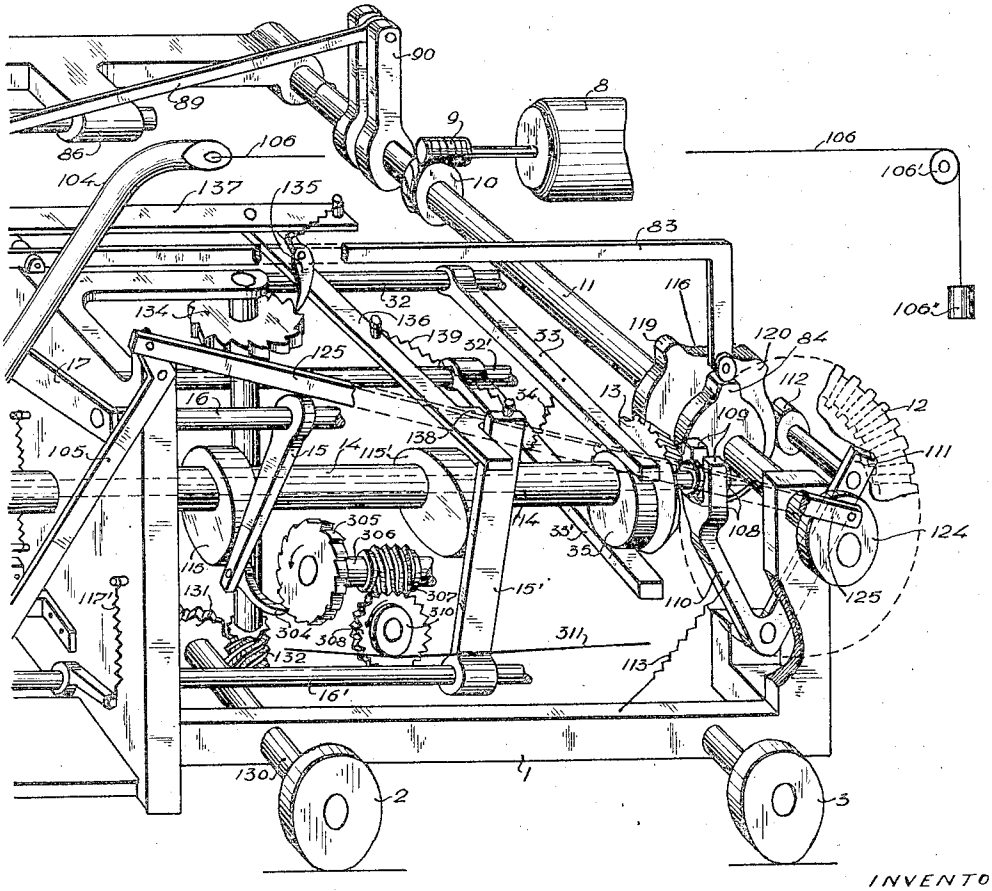
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WARP TYING MACHINE

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Fig. 1b.



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Fig. 10.

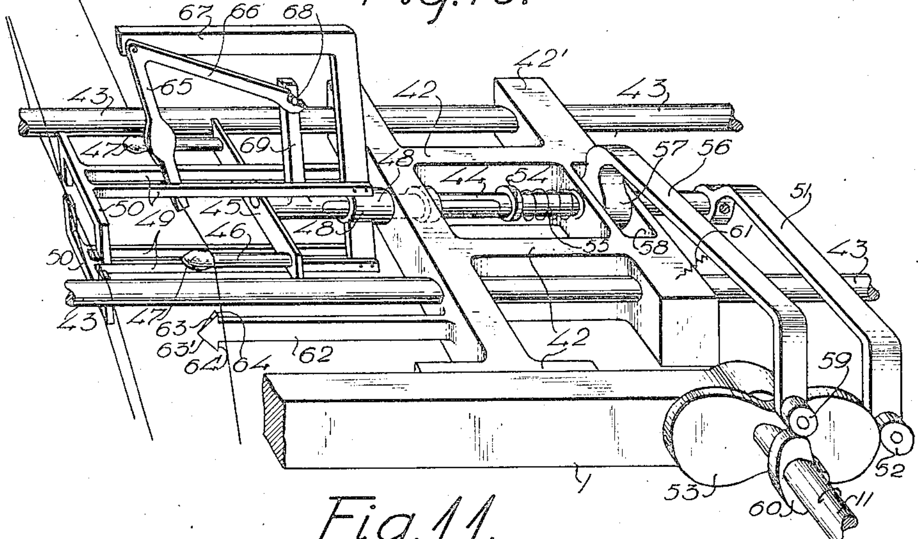


Fig. 11.

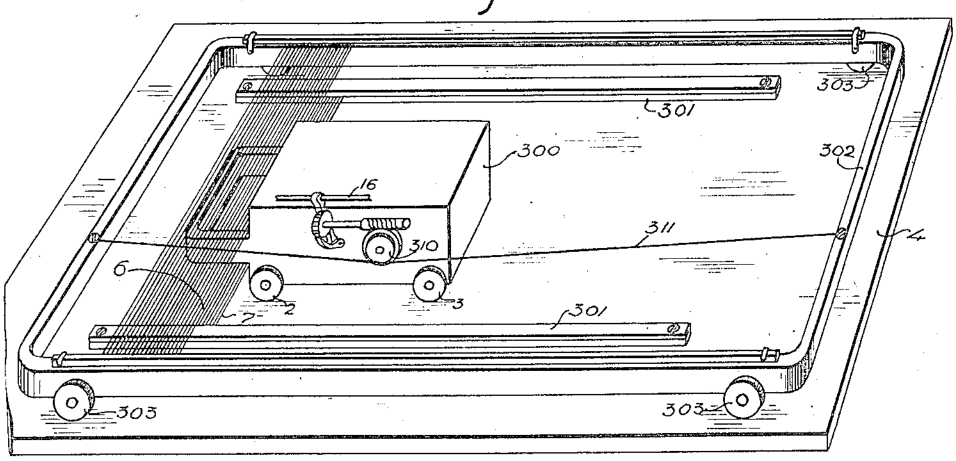


Fig. 2.

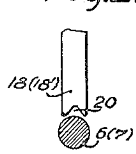


Fig. 4.

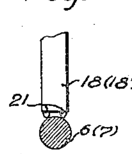


Fig. 6.

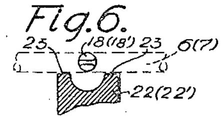


Fig. 7.

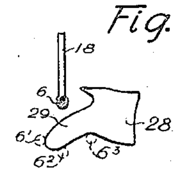


Fig. 9.

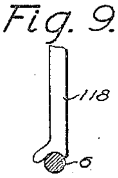


Fig. 8.

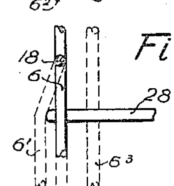


Fig. 3.

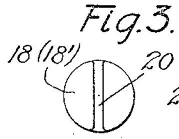
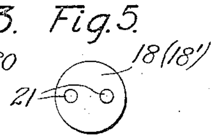


Fig. 5.



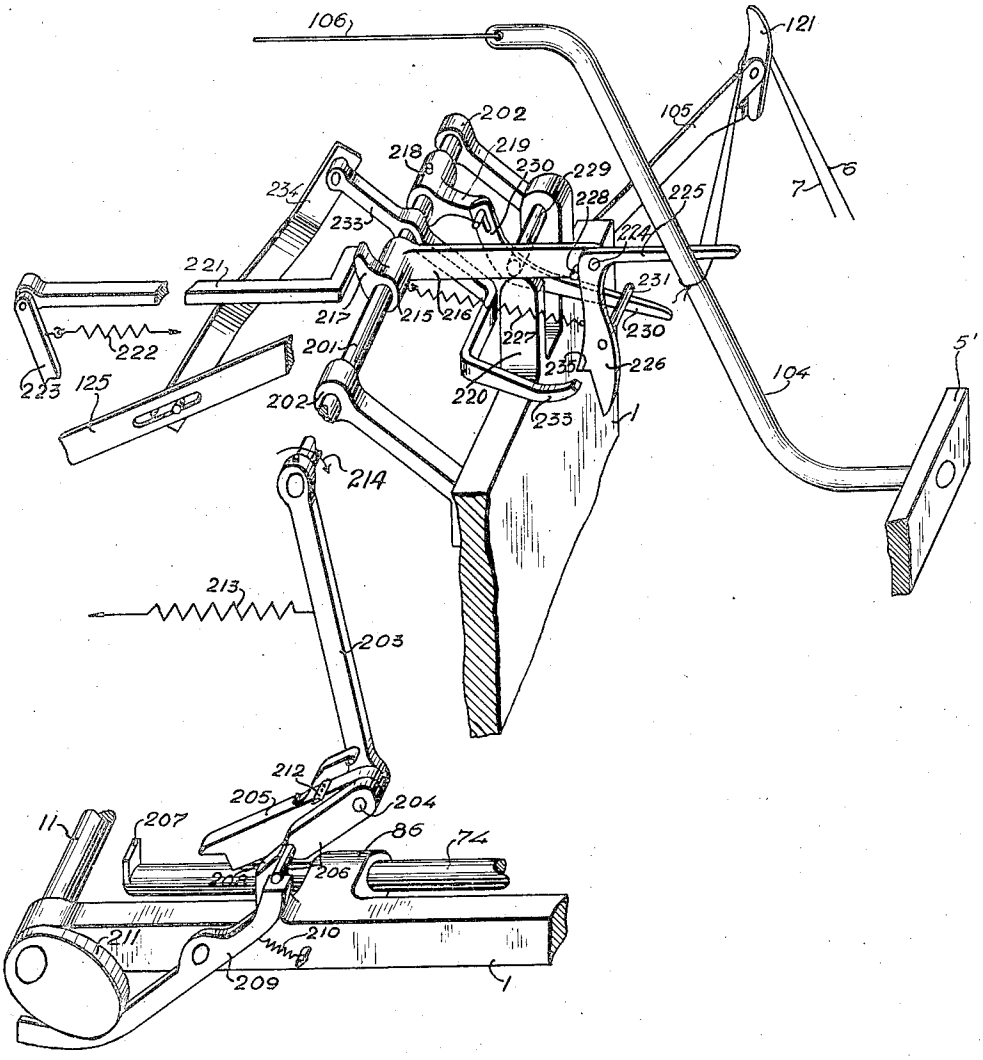
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WARP TYING MACHINE

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Fig. 12.



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Patented Apr. 28, 1936 2,039,157

UNITED STATES PATENT OFFICE

2,039,157

WARP-TYING MACHINE

Svend Sigurd Christie Fleischer, Charlottenlund, near Copenhagen, Denmark

Application May 26, 1933, Serial No. 673,044
In Germany June 2, 1932

44 Claims. (Cl. 28—49)

The present invention relates to a fully automatic tying machine for tying together in pairs the threads from the edge of two single layers or sheets of threads suitably stretched out relatively to one another, an operation to be performed whenever the warp beam for a loom is to be shifted.

The machine according to the invention comprises, in combination, an isolating mechanism and an approaching mechanism for separating the edge thread in each of the two layers of threads and for approaching the two isolated threads to one another, in such a manner that they can then be picked up at one and the same time, a combined inserting and cutting mechanism for conveying and cutting off the pair of threads isolated, a combined tying and suspending mechanism for tying together the two threads of the pair of threads isolated and cut, and for suspending the tied threads, a mechanism for step-wise feeding forward of the tying machine itself, gradually as the threads are being tied together in pairs, a mechanism for automatic regulation of the position of one sheet of threads relatively to the other one and relatively to the tying machine itself, and a controlling mechanism for stopping the machine automatically, if a pair of threads be not tied together in proper manner, or if a thread might break during the tying.

One construction of a machine built in accordance with the invention is illustrated on the drawings by way of example, but several of the devices and individual parts used in this machine may also be used as independent apparatuses or in machines the construction of which is otherwise wholly or partly different from the machine shown here, and similarly members or mechanisms performing separate functions in the construction shown may be united into one single member or one single mechanism performing all of the functions concerned, or vice versa.

Figs. 1*a* and 1*b* show a diagrammatic perspective view of the machine,

Figs. 2–9 show details of the thread-isolating mechanism of the machine,

Fig. 10 is a diagrammatic perspective view of a special thread-isolating mechanism for sheets of threads with crosses.

Figure 11 is a perspective view showing the tying machine itself on its base, and the two sheets of threads in their frame.

Figure 12 shows the controlling mechanism in perspective view from the right hand side of the machine.

The various parts of the machine are supported on and in a frame **1**, which in its turn is resting on four wheels **2** and **3**, on which the machine can be moved forward on a suitable base **4**. The frame forms at the front a front frame **5**, which only at one side of the machine is connected to the remaining frame **1** of the machine, and which is fed forward between the two sheets of threads when the machine is moved forward, the said two sheets of threads being in Fig. 1*a* represented by the two edge threads **6** and **7**.

The machine is suitably driven by an electromotor **8** disposed on the frame of the machine and driving, through a suitable gear **9**, **10**, a transverse shaft **11** (the main shaft) which through a gear **12**, **13** drives a longitudinally shaft **14** (the tying shaft) at twice the rotary speed. From these two shafts the greater part of the motions performed by the various parts of the machine are derived.

In the construction shown in Figs. 1*a* and 1*b* the isolating mechanism and the approaching mechanism are combined into one single isolating and approaching mechanism consisting of two mainly symmetrical systems of devices, viz, an upper one and a lower one, each consisting of a bell-crank lever **15**, **16**, **17** or **15'**, **16'**, **17'** respectively, actuated by a spring **117** (**117'**) or by a weight or otherwise, one arm **15** (**15'**) of the said lever being set into oscillation by an eccentric, a polygonal disc, a cam disc or the like **115** (**115'**) on the tying shaft **14** or by a shaft rotated synchronously therewith, while the other arm **17** (**17'**) supports a member directed downward or respectively upward, the thread-actuating member **18** (**18'**), which by the oscillation of the bell-crank lever about its shaft **16** (**16'**) effects the separation of the edge thread from the thread sheet concerned as well as the approach of the thread thus isolated to the isolated thread from the other sheet of threads.

The thread-actuating member **18** (**18'**) in the combined isolating and approaching mechanism is shown, greatly magnified, in two different constructions in Figs. 2–5. The member consists of a slender pin, the feeler needle, which is similarly marked **18** (**18'**) and is attached in a suitable holder **19** (**19'**) on the lever arm **17** (**17'**) or in some other manner, and has a small cross-section corresponding to the diameter of the threads treated, and is fitted with incisions **20**, Figs. 2 and 3, or projections **21**, Figs. 4 and 5, for the thread alone in or on the end surface of the pin and of such small dimensions, and arranged in such a manner, that only one thread at a time can be carried along by the needle during the

downward or, respectively, upward motion of the same. As it will be understood the threads in the two sheets of threads are suitably extending transversely to the direction of motion of the machine. The plane in which the oscillation of the feeler needle takes place is perpendicular to this direction and consequently parallel to the individual threads, and the shaft 16 (16') about which this oscillation is performed is situated in such a manner, relatively to the sheet of threads concerned, that the direction from the point of engagement of the feeler needle on the edge thread to the axis of rotation forms such an angle with the thread that the pin, while moving the thread, will slide appreciably along the same.

In order to make sure that the edge thread 6 (7) shall not come behind the path of the feeler needle 18 (18') but, on the contrary, will be in the most favorable position relatively to the feeler needle, when the latter is moved towards the sheet of threads, there is provided, on the frame of the machine, a thread tappet 22 (22') which as shown in Fig. 6 at a slight distance from either side of the path of the needle presents an edge 23 facing the sheet of threads concerned, which two edges during the motion of the needle towards the sheet of threads are situated in a plane parallel to the plane in which the needle is moving, and are situated in such a manner relatively to the axis of the needle that the needle with certainty will catch the edge thread in the sheet of threads, provided that the machine has been fed forward so far towards the latter that the thread will rest against the edges of the tappet. The thread tappet may be stationary but is suitably supported by a pivoted arm 24 (24'), which by means of a spring 25 (25') is held forward towards a guide pin 26 (26') on the holder 19 (19') or some other part moved together with the feeler needle 18 (18'), and which is fitted with a guide surface 27 (27') of such a shape that the thread tappet, when the needle 18 (18') has reached, or just has passed, the sheet of threads, will be swung back from the latter and then, when the needle again passes the thread sheet in the opposite direction, will be swung forward against the latter. The feeler needle and the thread tappet may be united into one single member.

Somewhat to the side of and near the end of the path of the needle 18 (18') a thread hook 28 (28') is provided, in which the thread 6 (7) carried along by the needle 18 (18') is delivered, in the manner illustrated by Figs. 7 and 8, as far as the upper thread is concerned, Fig. 7 showing the thread hook 28 and the needle 18 viewed from the side, while Fig. 8 shows the thread hook and the thread in top view. As it is seen, the thread hook 28 is fitted with a nose 29, fixed or movable, which projects slightly in front of the path of the thread 6 carried along by the needle 18. The ridge of the nose slopes obliquely outward in the direction of motion of the thread, and the bottom side thereof is mainly parallel to the ridge and forms together with the bottom side of the remainder of the hook a notch 30 situated behind the path along which the thread is approached to the hook. When the thread 6, while guided by the needle 18, reaches the ridge of the nose 29, then the thread carried further along by the needle will be forced beyond the point of the nose—the position 6^1 (Figs. 7 and 8)—and will then slip down below the latter to the position 6^2 and, maybe, some distance further down. When the needle 18 is then again moved upward, the thread will be caught by the nose 29, and during the continued upward motion of the needle the thread, while tightened, will slide along the bottom side of the nose and up into the notch 30, where it will remain—the position 6^3—outside of the path of the needle 18.

The two thread hooks 28 and 28' are slightly offset sideways relatively to one another, but their hooks 30, (30') are approximately at the same level and opposite one another, in such a manner that the threads 6 and 7 delivered in the hooks will be moved practically quite close to one another.

The thread hook 28 (28') may be rigidly attached to the frame of the machine but may also, as shown in Fig. 1*a*, be made integral with an oscillating thread-adjuster 31 (31'), which is firmly attached to a shaft 32 (32') having an arm 33 (33') fixed thereto and actuated by a spring 34 holding the said arm in contact with the edge of an eccentric 35 fixed on the shaft 14, so that the shaft 32 (32') will receive the desired oscillating motion. The thread-adjuster 31 (31') itself is formed by a plate, the edge 36 (36') of which is parallel to the sheet of threads and faces downward or upward, respectively, and rests against the top side, respectively the bottom side, of the sheet of threads concerned while exerting a light pressure against the same. Owing to the oscillating motion of the shaft 32 (32') the said edge 36 (36') of the thread-adjuster will slide along the threads, alternately in one and the other direction, and with an alternating pressure.

The thread-adjuster 31 (31'), however, may also be rigidly attached to the frame, in which case it only slides transversely to the threads, namely during the step-wise forward motion of the machine. Even in this case the thread-adjusters and the thread hook 28 (28')—similarly fixed—may of course be combined into one single member.

When the edge thread caught on the end of the feeler needle 18 (18') is carried along with the latter for delivery in the thread hook 28 (28') it strikes, on its way, a tilting arm 37 (37') forming one arm of a bell-crank lever 37, 38 (37', 38') also called the thread swipe, the other arm of which 38 (38') forms a hook 39 (39') adapted to co-operate with a locking lug 40 (40') on the lever arm 17 (17') which supports the holder 19 (19') for the feeler needle 18 (18'). The thread swipe 37, 38 (37', 38') is actuated by a spring 41 (41'), which normally holds the hook 39 (39') out of engagement with the locking lug 40 (40') but, when the tilting arm 37 (37') by the caught thread 6 (7) is carried along in the direction against the thread hook 28 (28'), then the hook 39 (39') is brought into the path of the locking lug 40 (40') and prevents thereby the lever 17 (17') from swinging backward more than a quite short distance under the action of its spring 117 (117') after the needle 18 (18') has delivered the thread into the thread hook 28 (28'). As long as the thread rests in the said hook, the tilting arm remains actuated, and the lever 17 (17') will therefore remain locked, so that the other arm 15 (15') thereof will not any more be pressed against its eccentric 115 (115') by the spring 117 (117'), but will only at intervals be actuated by the top of the latter, so that after this the feeler needle 18 (18') will only perform quite small motions at the end of its path, without being moved so far backward in this path that the end of the needle moves past the sheet of threads

concerned. The needle will therefore until completion of the tying operation be unable to catch any new thread, and during its small motions at the end of its path the needle will therefore all the time go free of the thread resting in the notch of the thread hook, which thread as mentioned above is situated behind the said path. The two isolating and approaching devices are thus locked separately, gradually as each has caught a thread and has transferred the same to the thread hook.

If an absolute certainty is desired for the threads in a sheet of threads to follow after each other in a certain definite order, it is known to use crosses in the sheet of threads. Such a cross is arranged, as it is well known, between two so-called cross beams, over which the threads are directed in such a manner that a thread is directed below one beam and over the other one, the next thread on the contrary over the first beam and under the second one. The third thread is directed like the first one, and the fourth one like the second one etc.

If the tying machine here referred to is to work with such a sheet of threads with crosses, the cross beams are disposed parallel to the direction of the forward motion of the machine, and a special mechanism, see below, is used for isolating the edge wire in such a sheet of threads, at the same time the above described combined isolating and approaching mechanism for the sheet of threads concerned becomes a pure approaching mechanism, as the edge threads are isolated by other means, and the above described mechanism therefore, as far as the sheet of threads here considered is concerned, has only to transfer the isolated thread to the thread hook. The corresponding part of the mechanism described may therefore also in certain respects be modified, and especially the thread-actuating member may here be given another construction, viz. as a simple presser foot **118** as shown in Fig. 9, instead of the feeler needle **18** shown in Figs. 2–5, and similarly the thread-adjuster **31** and, maybe, also the thread tappet **22** may here be dispensed with entirely.

The special mechanism for isolation of the edge thread in sheets of threads with crosses consists, as shown in Fig. 10, of a frame **42** with certain members attached therein and thereon, the said frame being constructed in such a manner that when the mechanism is to be used the frame can be arranged to slide on the cross beams **43** and be attached on the side of the frame **1** of the main machine and thus be moved forward by the latter. The mechanism contains a rocker shaft **44** adapted to slide in the frame **42** and ending at the front in a cross-head **45** supporting at each end an arm **46** pointing forward and fitted with a club-shaped head **47** with a diameter (height) somewhat smaller than the cross beams. On the shaft **44** a sleeve **48** is provided in which the shaft can slide but not rotate, and which itself is unable to slide relatively to the frame **42** but is rotatable relatively thereto together with the shaft. The said sleeve **48** is fitted with arms **49** pointing forward in the direction of the shaft and carrying at the front end each a part, the lower and upper part respectively, of a rectangular frame **50**, the end pieces of which are cut away for a short distance at the centre. The shaft **44** is withdrawn into the frame **42** by means of suitable driving devices, for instance as shown, an arm **51** attached to the end of the shaft and fitted with a roller **52** running on the edge of a cam disc **53** with two humps on the main shaft **11**, and when the disc **53** allows such a motion, and the shaft is not locked, the shaft is again moved forward by a suitable returning spring **55**, for instance as shown a helical spring inserted on the shaft **44** between a fixed sleeve **54** and the rear part **42'** of the frame **42**. The oscillation of the shaft is similarly effected by suitable driving devices, for instance as shown an arm **56**, which with a head **57**, in which the shaft can slide but not rotate, is guided in a slot **58** in the rear part **42'** of the frame, and which is running, by means of a roller **59**, on the edge of a cam disc **60** on the shaft **11**, and is actuated by a spring **61**, which maintains the arm with its roller pressed against the edge of the said disc. At the beginning of the forward motion of the shaft **44**, the shaft is rocked from one extreme position to the other one, whereby the club-shaped members **47** similarly alter their positions, from the upper one to the lower one, or vice versa. While the shaft **44** is being pushed forward, the club-shaped members **47** enter between the crossing threads in front of the rectangular frame **50, 50**, and actuate the one set of threads, which hereby are lifted slightly at one side and, at the other side, are forced slightly downward, gradually as the members move forward, for which reason the said members, when subsequently moved backward, will tend to carry along in rearward direction the threads situated behind the club-shaped heads. These threads, however, form mutually a lock for one another, all with exception of the rearmost (outermost) thread, which they therefore carry along, while the second one from the rear and, thereby all the threads in front thereof are held back in front of the frame **50, 50** on account of the last but one of the threads striking the end pieces of the frame. When the extreme thread in this manner has been isolated and with the club-shaped heads **47** has been moved all the way back to the position shown in Fig. 10, then at the beginning of the next forward motion the club-shaped carrier arms **46** with the said heads **47** will again be swung and now into their opposite extreme position. Hereby they liberate themselves from the isolated thread, which now, while trying to join the other threads, is caught on a holding hook **62** fixed on the frame **42**, which hook is fitted at the front with an oblique face **63 (63')**, along which the thread has been lifted (lowered) up (down) behind the tooth **64 (64')** of the hook, when it was carried back by the heads **47**. At the same time the thread, while being carried back, has actuated the suitably weighted and downward directed arm **65** of a bell-crank lever **65, 66** suspended in a frame **67** on the sleeve **48**, the other arm **66** of which lever is thereby forced upward into the path of a pin **68** at the top of a post **69** on the sliding shaft **44**, which is thereby prevented from being pushed forward again by the spring **55**, as long as the isolated thread remains unbroken and, therefore, maintains the bell-crank lever **65, 66** in the locking position indicated. When the thread is situated behind the tooth **64** (or **64'**) of the holding hook, it will at the same time be in position ready to be caught by the approaching member of the main machine, the feeler needle **18** or the presser foot **118**, which then directs the thread down into the thread hook **28**, from where then, when also the

other thread hook has been supplied with a thread, but from another sheet of threads, the two threads together are transferred to the tying mechanism and at the same time are cut off. When the isolated "cross thread" has thus been cut off, the bell-crank lever 65, 66 is released when subsequently the shaft 44 has been moved entirely back again, and the spring can then again move the shaft 44 all the way forward.

Both sheets of threads—the bottom one as well as the top one—can be fitted with crosses, each with two cross beams 43. The frame of the thread-isolating mechanism is then suitably adapted to slide on all four cross beams, and the mechanism itself is in the main simply doubled.

From the thread hooks 28 and 28' the isolated pair of threads 6, 7 is transferred to the tying mechanism by means of a combined inserting and cutting-off mechanism consisting of a pair of tongs 70, 71, adapted to slide between the two sheets of threads, the jaws 70 and 71 of the said tongs being pivoted on a pin 72 on a carriage member 73 attached on the front end of a rod 74 adapted to slide in the frame of the machine and guided by a guide pin 75 in the front frame 5. The forward directed jaws of the tongs are each fitted with a guide pin 76, engaging a groove or slot 77 in a guide plate 78 on the front frame, which grooves or slots 77 are of such a shape that the jaws 70 and 71 of the tongs, when the latter have been moved sufficiently far to the rear, will close together about the pair of threads resting in the thread hooks 30 and 30' and being, immediately thereafter cut off by a rearward directed knife 79 provided on the carriage 73 and co-operating with a stationary knife 80, after which the threads are conveyed further to the rear and are delivered into tongs 81, 82 with upward directed jaws 81 and 82 provided in the path of the threads and co-operating with the tying mechanism. The rear one 81 of the said jaws is stationary, while the front one 82 is rotatable, and, at the time when the threads are brought forward by the movable tongs 70, 71, so far open that the threads can be directed over the said movable jaw 82 and into the tongs, which then take hold of the threads, grip them firmly and pull them rearward from the movable tongs, which are then again moved forward in the direction of the operating motion of the machine, while opening themselves at the same time owing to the co-operation of the guide pins 76 with the slots 77. The movable jaw 82 of the stationary tongs 81, 82 is guided by a spring-actuated lever 83, which is pivoted to the frame of the machine, and the motion of which is derived from a cam disc 84 on the shaft 11, and the pivot point of the said jaw is situated so far behind the jaw surface of the fixed jaw that the movable jaw, while opening itself, will sink so far relatively to the fixed jaw that the pair of threads carried along by the movable tongs 70, 71 can be moved horizontally into the stationary tongs and, nevertheless, be caught by the movable jaw, when the latter closes itself. The sliding rod 74, which together with the part 73 forms a sliding carriage 73, 74, supports between its two bearings 85 and 86 in the machine frame a fixed and a sliding sleeve 87 and 88, respectively, the latter one of which is connected by means of a connecting rod 89 to a crank pin 90 on the constantly rotating shaft 11, while the sleeve 87 fixed on the shaft, depending on both of the thread hooks 28, 28' of the machine having or having not received a thread, will be locked automatically either to the machine frame 1 by means of a spring-actuated pawl 91 on the frame in co-operation with a stationary hook 92 on the sleeve, or to the sliding sleeve 88 by means of a snatch hook 93 provided thereon in co-operation with another fixed hook 94 on the fixed sleeve 87. Normally the sliding rod 74 is locked to the fixed frame 1 of the machine, and this locking is maintained as long as the thread-actuating members 18, 18' might not yet have isolated and brought together a pair of threads, so that the said threads while resting in the thread hooks 28, 28' will be ready to be caught by the movable tongs 70, 71 when the latter are returned in the machine. In order to secure the maintenance of the said locking of the sliding rod 74 until this moment, the following arrangement is made: the snatch hook 93 is fitted with a pin 95, which when the movable sleeve is moved forward towards the fixed sleeve comes into contact with a locking rod 96, which is pivoted on the pawl 91, and which normally by striking a heel 97, 97' towards the rear on each of the rocker arms 37, 37' is prevented from yielding to this pressure, which therefore will have for its consequence that the snatch hook 93, while actuated by its spring 98, is forced towards the rear, and is held free of engagement with the hook 94, in such a manner that the sleeve can again freely be moved back on the shaft without carrying along the fixed sleeve 87 and, thereby, the sliding rod 74. When on the other hand both rocker arms 37 and 37', actuated each by one of the threads of an isolated pair of threads, have locked each the corresponding one of the levers 17 and 17' of the thread-actuating members, then both of the said two heels 97 and 97' will be brought out of the path of the locking rod 96, leaving sufficient space between them for the said rod, as shown in Fig. 1*a*. Under these conditions the locking rod 96 will therefore, when the sliding sleeve 88 the next time is moved forward, yield to the pressure from the pin 95 on the snatch hook 93 and, in co-operation with a stop 99 on the pawl 91, turn the same out of engagement with the hook 92 on the fixed sleeve 87, while at the same time tightening the spring 100 of the said pawl, and the snatch hook 93, the spring 98 of which is more powerful than the spring 100, will now, because the locking rod 96 yields, not be turned to the rear, but when moved forward it will jump into engagement with the hook 94 on the fixed sleeve 87 and therefore, when subsequently the sliding sleeve 88 is moved rearward by the connecting rod 89, the said snatch hook, when returning, will carry along the fixed sleeve 87, which is now released from the frame of the machine and, thereby, also the sliding rod 74 and the carriage member 73 connected thereto. This rearward motion of the carriage 73, 74 has, as mentioned before, the consequence that the tongs 70, 71 will grip the isolated pair of threads, and that the knives 79, 80 immediately will cut off the threads during the transfer of the latter to the fixed tongs 81, 82 of the tying machine. By the cutting off of the threads the rocker arms 37, 37' will be liberated, and while actuated by their springs 40, 41' they will return into their normal position, in which they each with their heel 97, 97' form a lock for the locking rod 96, which at that moment during the return motion of the carriage again, owing to the action of the pawl spring 100, will have entered into its normal position. When the car-

riage 73, 74 and, thereby, the sleeves 87 and 88 then again are moved forward, the hook 92 on the fixed sleeve 87 will force its way past the pawl 91, which then at once under the action of its spring 100 enters into engagement with the said hook 92, and thus once more locks the fixed sleeve 87 to the frame, while the snatch hook 93 on the sliding sleeve 88 now again by the locking rod 96 will be forced to the rear and out of engagement with the hook 94 on the fixed sleeve all, however, provided that the thread-actuating mechanism, which operates twice as fast as the inserting mechanism may not previously have separated and drawn together a new pair of threads, in which latter case the locking rod 96 can again be turned forward, so that the pawl 91 will be maintained out and the snatch hook 93 be maintained in, for which reason the carriage 73, 74 once more will return.

The tying and suspending mechanism consists, besides of the before mentioned fixed tongs 81, 82, mainly of a rotary pair of tongs 101, 102, various guide members 103 and 104 for the threads and a lifting arm 105 and a suspension cord 106.

The rotary tongs 101, 102 form a head, the tying head 107, rounded at the front and with a mainly radially directed beak 101, 102, consisting of a fixed upper beak 101 and a bottom beak 102 movable in a direction parallel to the upper beak. The upper beak 101 is integral with the head 107 attached to the front end of the shaft 14, which is hollow and encircles a shaft 114 adapted to slide therein and supporting at front the bottom beak 102, while the said shaft 114 at the rear and outside of the rear end of the shaft 14 is coupled to the shaft 11, in such a manner that the last mentioned shaft by its rotation imparts to the sliding shaft 114 a reciprocating motion serving to open and close the beak twice in rather quick succession during two revolutions of the beak. This coupling may suitably be arranged as follows. Between two guide flanges 108 to the rear on the sliding shaft 114 the latter is engaged by a fork 109 at the end of one arm 110 of a bell-crank lever 110, 111, the other arm 111 of which supports a roller 112, which a spring 113 tends to press against a cam disc 116 on the shaft 11, which disc is fitted with two quite steep and short projections 119, 120, offset about 90° relatively to one another.

Out of the thread-guiding members 103 and 104, the former one 103 forms a simple stop provided for the bottom thread 7 on the frame of the machine, while the other one 104 as a continuation of the free side branch 5' of the front frame forms an obliquely upward and rearward directed guide rod for the upper thread 6, which along the said rod by the lifting arm 105 is lifted up on the top side of a suspension string 106 stretched horizontally from the top of the said guide rod and passing suitably over a fixed pulley 106' and fitted at its free end with a weight 106'', in such a manner that the horizontal part of the string is automatically elongated, gradually as the machine moves forward.

The lifting arm 105 is a lever with very unequal arms attached to the frame of the machine, the long arm of the said lever supporting at its extreme end a pivoted shoe 121, which by striking the pair of threads during the downward swing of the arm is tilted rearward, so that the arm can go free of the threads, but which after having passed the threads and at last by striking a certain part 122 of the frame of the machine is again swung forward and, thereby, below the threads, so that the latter, when the lifting arm is then again swung upward, are taken along by the said arm, supported at the start by the pivoted shoe 121, which by striking a lug 123 or the like is prevented from yielding to the pressure from the threads. The motion of the lifting arm is derived from the shaft 11, which for this purpose supports a crank disc 124, which by means of a connecting rod 125 is connected to the end of the shorter arm of the lifting lever 105.

The tying and suspending mechanism acts in the following manner:

The two threads 6 and 7 inserted in and held by the fixed tongs 81, 82 have been caused to occupy a mainly horizontal position obliquely above the tying head during the insertion into the tongs and by striking, respectively, the guide rod 104 and the stop 103. During its rotation in the direction indicated by the arrow 126 in Fig. 1*a*, the beak 101, 102 is provisionally maintained closed and moves upward past the fixed tongs, then upward in front of the pair of threads and finally, after half a revolution and owing to the above mentioned oblique position of the threads, the beak dives down behind the threads. During the course of one revolution a loop will hereby be formed around the root of the beak, the tying head being shaped and dimensioned in such a manner that the long parts of the pair of threads will not at any moment, during the formation of the loop and subsequently the knot, be able to pinch the short ends of the threads against the faces of the tying head. Towards the end of the said revolution the first cam on the disc 116 will cause the beak to open, in such a manner that the beak is now moved up with the lower and upper beak on either side of the pair of threads still gripped in the stationary tongs, and at the next moment the beak closes itself firmly together about the pair of threads under the pressure of the spring 113, the result being that the thread ends now during the continued rotation of the tying head are pulled out from the stationary tongs, which soon thereafter open themselves in readiness to receive the next pair of threads. The beak continues its rotation upward while holding the thread ends. In the meanwhile the pair of threads, with one thread on either side of the guide rod 104, are lifted higher and higher by the elevating lever 105, which causes the loop to slide off the beak, whereby a knot is formed, as the thread ends are still held by the beak, and during the further action of the lifting arms on the threads and the present downward rotation of the beak the knot will gradually be tightened more and more, until the beak finally, slightly below the horizontal position, opens itself again owing to the cam 120 co-operating with the roller 112, after which the lifting arm moves the now tied threads further upward in order finally to deliver them with the knot astride on the suspension string 106, and then to lower itself into the position shown in Fig. 1*a*. Immediately after having released the ends of the tied pair of threads, the beak closes itself again, so that it is closed when it now again passes the fixed tongs in which a new pair of threads will ordinarily already have been received.

As the edge threads, in order that the machine may be able to operate, must all the time occupy a certain definite position relatively to the path of the thread-actuating members, and

as the sheets of threads are stationary, the machine must be arranged in such a manner that it will move automatically step-wise forward, gradually as the threads are being tied together in pairs.

The feeding-forward mechanism provided for this purpose is arranged as follows:

Two of the wheels of the machine—preferably the front wheels **2**, (only one of which is shown in Fig. 1*b*), are attached to a common shaft **130** journalled in the frame of the machine and supporting a worm wheel **131**, which is in engagement with a worm **132** on a vertical shaft **133** journalled in the frame and supporting at the top a pawl wheel **134** driven by a spring-actuated pawl **135** on a driving rod **136**, one end of which is pivotally connected to an arm **137** pivoted to the frame of the machine, and the other end of which is fitted with a tappet **138** for the bottom side of the before mentioned driving arm **15'** for the lower thread-actuating member, which arm **15'** is actuated by the eccentric **115'** and maintained pressed against the said tappet by means of a spring **139**.

When the eccentric **115'** forces the arm **15'** away from the shaft **14**, the said arm will take the driving rod **136** along by means of the spring, and the pawl **135** will thereby drive the pawl wheel one tooth forward, which again causes a certain small rotation of the shaft **130** and, thereby, of the wheels **2**, which thus move the entire machine one tooth forward. When the eccentric has rotated further on, and the spring **117'** has again returned the arm **15'** towards the shaft **14**, then the said arm, by resting against the tappet **138** will move the driving rod back, and the pawl will thereby be moved behind the next tooth of the pawl wheel. If on the contrary, although the angular motion of the eccentric allows this to be done, the arm **15'** is not returned all the way towards the shaft **14**—namely on account of the lower thread-actuating member having been locked by the hook **39** co-operating with the lug **40'**, after the said thread-actuating member has isolated the edge thread from the lower sheet of threads, and has delivered the same to the lower thread hook **28'**—then the driving rod **136** will on the contrary not be moved fully back, so that the pawl can catch a new tooth, which means that no new forward motion of the machine will be effected until the lower thread-actuating member has again been released by the transfer of a pair of threads to the tying mechanism.

Supposing the threads in the two sheets to be of the same thickness, the machine will normally advance at the same rate of speed in the two sheets. In practice, however, the threads in the two sheets of threads cannot be stretched so uniformly that the sheets will have the same tightness throughout, and therefore or in consequence of one thread-actuating member failing perhaps more frequently than the other one, the machine may possibly not at each step forward be moved sufficiently close to both of the edge threads. If the lower edge thread be too far away, after the upper thread-actuating member has deposited its thread in the thread book, the machine will accordingly continue its step-wise forward motion, until also the lower thread-actuating member has caught a thread and has deposited the same in the lower thread hook. If, on the other hand, the edge thread in the upper sheet is too far away, the forward motion of the machine will cease as soon as the lower thread-actuating member has caught its thread and delivered the same in the thread hook, and the upper thread-actuating member will then continue to work in vain, without being able to catch any thread, until the machine by means of a special regulating mechanism succeeds in drawing closer the upper sheet of threads, which then must be movable.

The arrangement is as follows (see Figs. 1*a*, 1*b* and 11). While the lower sheet of threads is stretched in a frame **301**, which is firmly connected to the base **4** on which the step-wise forward motion of the machine is effected, the upper sheet is stretched in a movable frame **302**, which encircles the machine itself (marked **300** in Fig. 11) and is resting on wheels **303** running on the above mentioned fixed base **4**.

The mechanism for moving the upper sheet of threads, relatively to the fixed sheet and to the machine itself, is mainly arranged in the same manner as the feeder apparatus described above, but its operation is dependent on the upper thread-actuating member, and the shaft rotated step-wise by the mechanism does not support the running wheels themselves but a cord pulley, on which a cord is laid, the two ends of which are attached each to one end of the movable frame.

The detailed arrangement of the device is as follows. On the free end of the driving arm **15** for the upper thread-actuating member a spring-actuated pawl **304** is provided, which co-operates with a pawl-wheel **305** and, by the full swing of the driving arm, causes the said wheel to rotate step-wise. The pawl wheel **305** is attached to a shaft **306**, which by means of a worm **307** drives a worm wheel **308** attached on a shaft **309**, which also supports, rigidly attached thereto, a cord pulley **310**, about which a cord **311** is tightly laid, the two ends thereof being attached each to one end of the movable frame **302**.

It is now seen that if the upper thread-actuating member is operating, while the lower one is standing still after having isolated the edge thread from the lower sheet, then the machine will remain stationary on the base, but by means of the mechanism described it will pull towards itself the movable frame **302** with the upper sheet of threads stretched therein, until the edge thread of the said sheet has come directly below the thread-actuating member, and is then caught by the latter and moved down into the thread hook, in such a manner that a pair of threads have now been isolated and moved to the tying mechanism.

In the opposite case, if the upper thread-actuating member is standing still, while the lower one is operating, then the machine will be moved step-wise forward on its base **4** towards the rear edge of the lower sheet of threads, and the movable frame with the upper sheet of threads will then partake in this motion, as the cord pulley **310** is unable to move.

If finally both thread-actuating members, whenever they are moved towards the sheets of threads, each isolate an edge thread, the machine will every time be moved one step forward on its fixed base, and will thereby with its lower thread-actuating member come opposite the next edge thread in the lower stationary sheet. The upper sheet of threads would partake in this motion of the machine, if the upper thread-actuating member did not also operate, but as it does operate the consequence will be that the upper sheet is pulled one step back at the same time as it is moved one step forward, so that it will really remain stationary relatively to the

lower sheet of threads, and therefore the upper thread-actuating member will come opposite a new edge thread at the same time as the lower one.

The machine will thus under all conditions, in fully automatic manner, work through the sheets, notwithstanding any irregularities occurring in the same.

In order to control the tying mechanism, after the same has received a pair of threads, so that it will properly tie the two threads together, the machine is fitted with a controlling mechanism for stopping automatically the entire machine, if the knot be not in order, or one or both of the threads be broken during the tying operation.

One construction of such a mechanism is shown in Fig. 12, showing the mechanism in perspective view from the right-hand side of the machine.

201 is a shaft extending transversely above the machine shown in Fig. 1*a* and 1*b* and journalled in bearings 202 on the frame 1 of the machine and supporting at its right end a crank pin 203, 204, which is fitted with two rearward directed pawls 205 and 206 alongside of one another, the inner pawl 205 co-operating with a lug 207 on the sliding rod 74 belonging to the thread-inserting mechanism, while the outer pawl co-operates with a lug 208 on the frame 1 of the machine, and is actuated periodically by one end of a lever 209, the other end of which by means of a spring 210 is maintained in contact with the edge of a cam disc 211 on the above mentioned shaft 11 of the machine.

The inner pawl 205 projects with a lateral pin 212 over the outer pawl 206, which freely can sink relatively to the inner one, but only can be lifted slightly before the said lateral pin 212 carries the inner pawl along during the further upward motion. The said small vertical play of the outer pawl 206 is sufficient to enable the said pawl to be lifted over the lug 208 without actuating the inner pawl. The lever 209 lifts the outer pawl considerably higher and lifts thereby, owing to the lateral pin 212, the inner pawl out of engagement with the lug 207 on the sliding rod 74.

After the inserting mechanism has delivered a pair of threads in the tying mechanism, the sliding rod 74 will go forward again and, owing to the pin 207, it will carry the inner pawl 205 along into the position shown in Fig. 12. This motion is also shared by the outer pawl 206 which thereby, by means of a sloping face on the lug 208, is lifted over the latter and then drops down behind the same so as to lock both pawls in their foremost position, in which position they then remain, even if the sliding rod be returned, until they are both released by the lever 209. As soon as the pawls are thus released, the crank pin 203, 204 will swing rearward owing to the pressure of a spring 213, and will carry along the pawls and rotate the shaft 201 in the direction indicated by the arrow 214.

The shaft 201 supports partly a sleeve 215 free to rotate but not to slide and fitted with an arm 216 pointing forward and a lug 217 facing obliquely rearward and upward, and partly a sleeve 218 fixed on the shaft and fitted with a short arm 219 pointing forward.

In its normal position (as shown) the arm 216 is supported by a fixed tappet 220, against which it is maintained pressed by a presser bar 221 resting against the rear side of the lug 217, the said bar being forced in the direction towards the lug by a spring 222 and being connected to a disengaging lever 223 for uncoupling the motor of the machine, maybe in the shape of a contact arm for breaking the circuit of the current driving the motor. The arm 216 supports at its front end a thread-feeling member in the shape of a bell-crank lever 225, 226 pivoted about a horizontal pin 224 and actuated by a spring 227 so as to occupy normally the position shown in Fig. 12 with one arm 225 pointing forward and the other arm 226 pointing downward, resting on a stop 228 on the arm 216, but adapted in two different manners to be turned away from this position against the pressure of the spring 227, viz. either on account of the two tied threads 6 and 7 being lifted up by the arm 105 along the guide rod 104 on either side of the latter and coming into contact with the forward directed arm 225 of the bell-crank lever (the thread-feeler arm) and turning the same in backward direction so as to be able, finally, to slip past the end thereof and be delivered on to the outstretched supporting thread 106, after which the bell-crank lever, while actuated by this spring, 227, swings back to its normal position, or on account of a lever 230 pivoted about a fixed pin 229 and connected at its rear end to the above mentioned fixed arm 219 on the shaft 201 and having its front end situated below a lateral pin 231 on the downward arm 226 of the bell-crank lever and having its front end lifted so as to force forward the downward arm 226 of the bell-crank lever, when the pawls 205 and 206 are released and the shaft 201 is then rotated by the spring 213 in the direction of the arrow 214.

Further, a two-armed lever 233 is pivoted about the shaft 201, and the rear end of the said lever is connected by suitable intermediate members 234 to the driving rod 125 for the elevating arm 105 serving to lift the tied threads, and the said lever performs thus a periodic oscillation synchronously with the said lifting arm, which as explained above performs one oscillation up and down for each revolution of the main shaft 11 of the machine.

The downward directed arm 226 of the bell-crank lever 225, 226 is fitted with a lug, projection or the like 235, which is situated in the path of the front end of the lever 233, when the bell-crank lever occupies its normal position, but on the contrary is out of the reach of the lever 233, when the bell-crank lever in one of the two above mentioned manners is swung out from its normal position. It should be noted that the arrangement is made in such a manner, with regard to the relative occurrence of the moments for the various motions, that the period of oscillation of the lever 233 co-incides with the period in which the tied pair of threads, if any such be carried along by the elevating arm 105, actuate the forward pointing arm of the bell-crank lever 225, 226, and that the front end of the lever 230 will be lifted if the elevating arm 105 ascends empty, because no new pair of threads have been transferred to the tying mechanism, as the pawls 205 and 206 in that case will be allowed to swing all the way to the rear after having been released, while in the opposite case (if a new pair of threads have already been delivered to the tying mechanism) the said pawls will be stopped, during their rearward motion, by the lug 207 on the sliding rod, which is now advancing after having finished its return motion, and will be carried along by the said rod for renewed locking, so that the bell-crank lever will now again stand in

its normal position at the moment when the elevating arm 105 arrives with its tied pair of threads. If the pawls have been allowed to swing all the way back, they will remain standing there, and the bell-crank lever 225, 226 will therefore remain out of the reach of the lever 233, until the inserting mechanism has again been coupled in, and has delivered a new pair of threads to the tying mechanism. The lug 207 of the sliding rod has namely then at the same time been moved to the rear of the pawl 205, and will now during its forward motion carry the pawls along for a renewed locking.

Only in the case that the tying mechanism certainly has received a new pair of threads, but the elevating arm nevertheless ascends empty, or ascends with slack threads, either because the threads have not been properly knitted together, or because one or both of the threads have been broken, the bell-crank lever 225, 226 will stand in its normal position at the moment when the front end of the lever 233 ascends, but as soon as this is the case the consequence will also be that the said lever, by the cooperation of its front end with the lug of projection 235, will force the arm 216 upward, the result being that the lug 217 will be turned away below the presser bar 221, which then under the influence of the spring 222 slides in the direction towards the shaft 201 and carries along the disengaging lever or contact arm 223, and thus causes the motor to stop.

If the machine is to be started again, after the pair of threads, which are now easily accessible, have been brought in order by hand, it is only necessary by a forward directed pressure on the crank arm 233 to move the pawls 205, 206, into the locking position, to turn the bell-crank lever 225, 226 free of the lever 233 and to swing the arm 216 down against its tappet 220 and, against the pressure of the spring 222, to move the presser bar 221 behind the lug 217. The machine will then start at once, and will continue its operation in the normal manner.

The patent protection is not to be limited to the construction shown and described, but is also to cover any such modifications or substitutions as may not essentially alter the character of the functions performed by the machine, and the protection is also to apply to the individual arrangements or mechanisms when used singly or in other combinations, maybe in combination with other known or novel arrangements or mechanisms.

Having thus described my invention, what I claim is:—

1. In a tying machine of the kind described, a pair of feeler needles adapted for end engagement with the respective threads to be tied, means to oscillate said needles transversely of sheets of warped threads and in the plane of the edge threads, a locking mechanism for the needles actuated by the moved thread, a knotting mechanism associated with said needles, and means to advance said needles and knotting mechanism across the sheets of warped threads.

2. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the paths of said needles, means to swingingly support said tappets on said frame, stop means to limit movement of the tappets in one direction, and spring means yieldingly holding said tappets against said stop means.

3. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the paths of said needles, means to swingingly support said tappets on said frame stop means to limit movement of the tappets in one direction, spring means yieldingly holding said tappets against said stop means, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, and a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same.

4. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests.

5. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the paths of said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for

said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests.

6. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the paths of said needles, means to swingingly support said tappets on said frame stop means to limit movement of the tappets in one direction, spring means yieldingly holding said tappets against said stop means, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests.

7. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, and a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same.

8. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and hold the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, and a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same.

9. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests.

10. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and hold the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from

acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests.

11. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the said thread rests.

12. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposing directions transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

13. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of, sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in said thread rests.

14. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and hold the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in said thread rests.

15. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

16. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single

thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and hold the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said rests, cutting the same and transferring it to next named means, a holding and knottting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads engaged thereby has been transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

17. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the paths of said needles, means to swingingly support said tappets on said frame, stop means to limit movement of the tappets in one direction, spring means yieldingly holding said tappets against said stop means, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, and means for suspending the pairs of threads successively as they are knotted.

18. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, and means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, and means for suspending the pairs of threads successively as they are knotted.

19. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and position the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, and means for suspending the pairs of threads successively as they are knotted.

20. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and motion limiting means for said needles associated with said thread rests, and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

21. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and posi-

tion successive threads of said sheets in the paths of said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

22. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads, and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the path of said needles, means to swingingly support said tappets on said frame, stop means to limit movement of the tappets in one direction, spring means yieldingly holding said tappets against said stop means, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

23. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

24. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and position the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

25. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

26. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads

moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

27. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

28. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and position the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

29. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to the next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

30. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and hold the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby have been transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation,

said trip device including an operating member engageable by thread in the thread rests.

31. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the path of said needles, means to swingingly support said tappets on said frame, stop means to limit movement of the tappets in one direction, spring means yieldingly holding said tappets against said stop means, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted.

32. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, and means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking-off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted.

33. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and position the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, and means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted.

34. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

35. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the paths of said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and motion

limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

36. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads, and in the plane of the edge threads, thread tappets carried by said frame adjacent said needles to engage and position successive threads of said sheets in the path of said needles, means to swingingly support said tappets on said frame, stop means to limit movement of the tappets in one direction, spring means yieldingly holding said tappets against said stop means, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

37. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

38. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and position the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests.

39. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

40. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, trans-

versely of sheets of warp threads and in the plane of the edge threads, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

41. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles vertically mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles vertically in opposite direrctions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

42. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and position the separated single threads in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

43. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stopped if a knot proves to be not correctly knotted, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

44. In a device for tying pairs of threads from respective warp sheets, a frame, pawl and ratchet means to move said frame in step-by-step motion across said sheets, a pair of feeler needles mounted on said frame for longitudinal movement and having end faces provided with single thread engaging means, means on the frame for oscillating said needles in opposite directions, transversely of sheets of warp threads and in the plane of the edge threads, means carried by said frame engaging the warp sheets to separate a single thread at the edge of each sheet nearer the frame from the remainder of the threads of the sheet whereby to permit the separated threads to be engaged by said needles, thread tappets carried by said frame adjacent the needles to engage and hold the separated single threads

in the paths of the needles, means for receiving the threads moved forth by the needles, said means forming temporary rests for said threads out of the path of the needles, a mechanism for taking off the pair of threads from said thread rests, cutting the same and transferring it to next named means, a holding and knotting mechanism for receiving the pair of threads from said taking-off and transferring mechanism and knotting the same, means for suspending the pairs of threads successively as they are knotted, means for testing the knots successively as they are being suspended, causing the machine to be stoppped if a knot proves to be not correctly knotted, motion limiting means for said needles associated with said thread rests and engageable by threads moved into the same to restrain the needles from acting on other threads until the pair of threads lastly engaged thereby has been transferred from said thread rests, and a trip device for the pawl and ratchet means for restraining the latter from operation, said trip device including an operating member engageable by thread in the thread rests.

SVEND SIGURD CHRISTIE FLEISCHER.