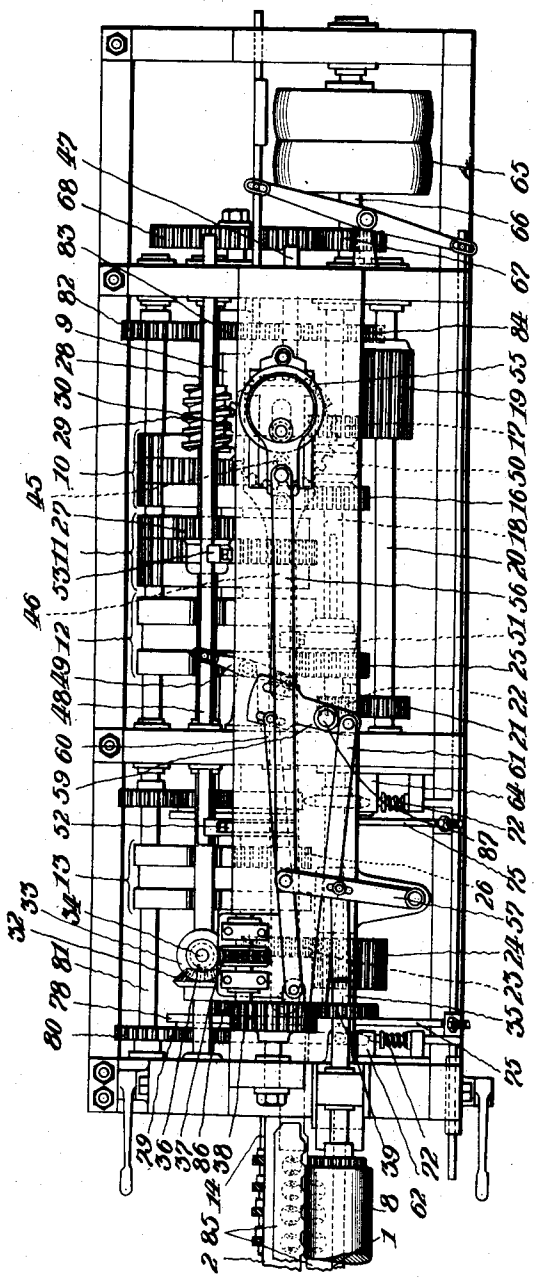
Dec. 9, 1930. S. KAKUDA 1,784,188

OPERATING MECHANISM FOR NET MAKING MACHINES

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Fig. 1.



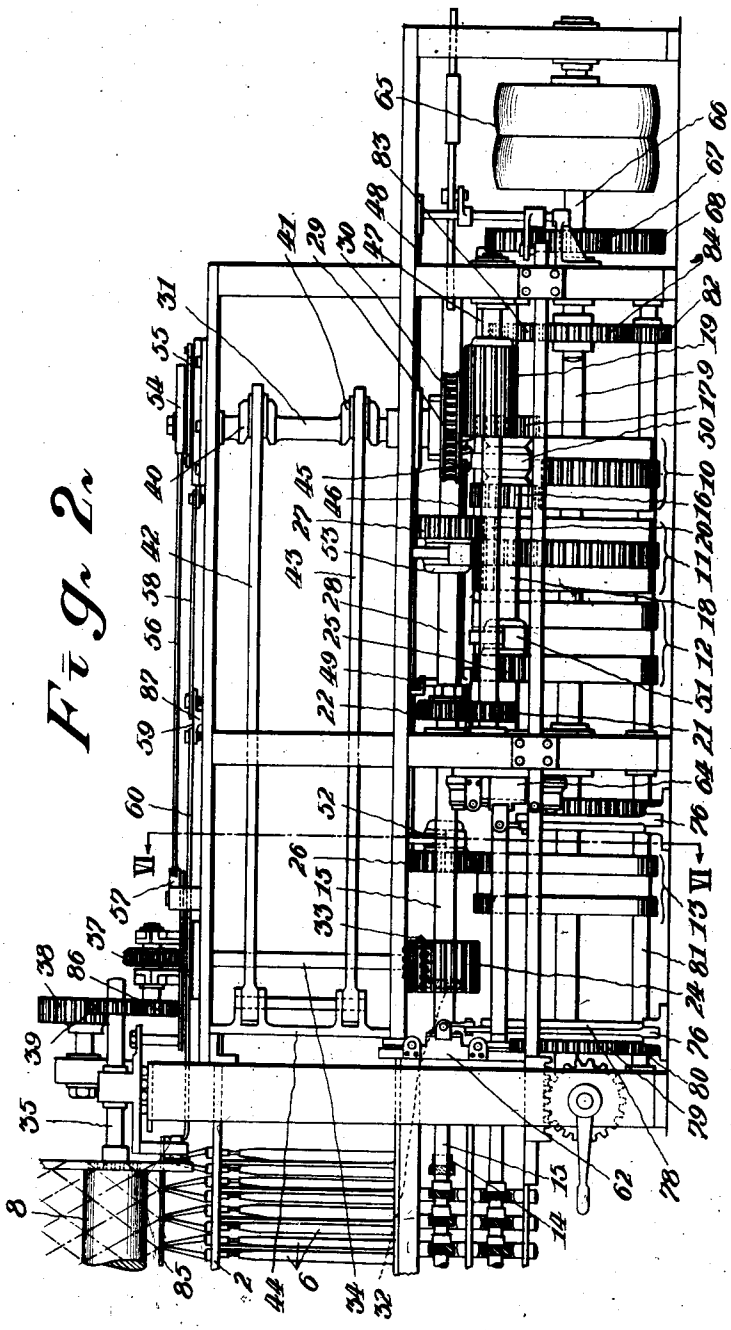
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Fig. 2.



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OPERATING MECHANISM FOR NET MAKING MACHINES

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Fig. 3.

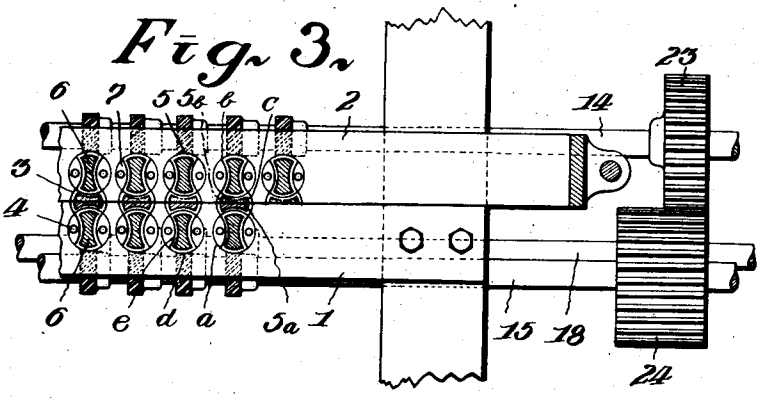
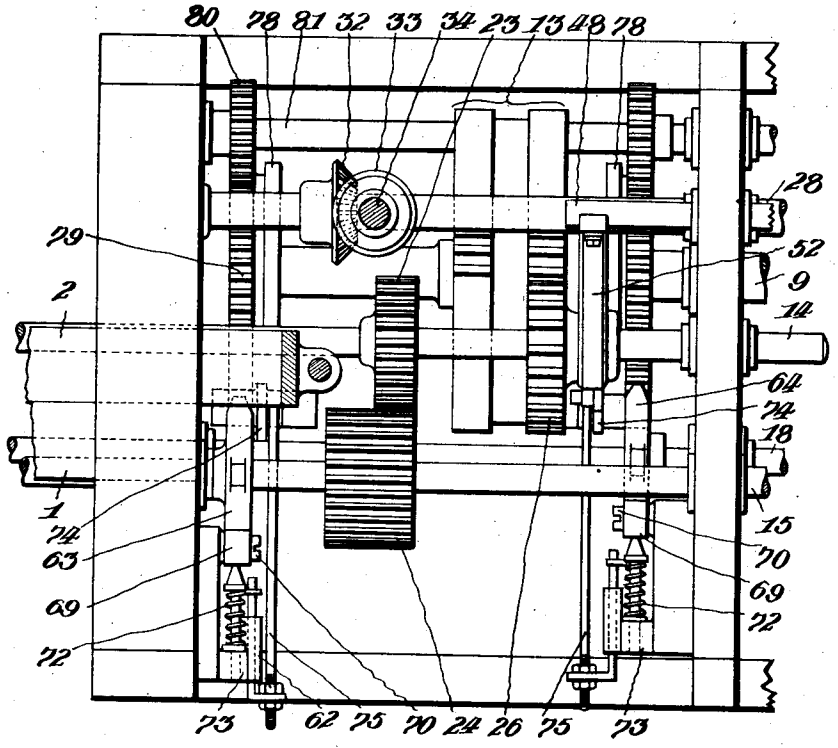


Fig. 4.



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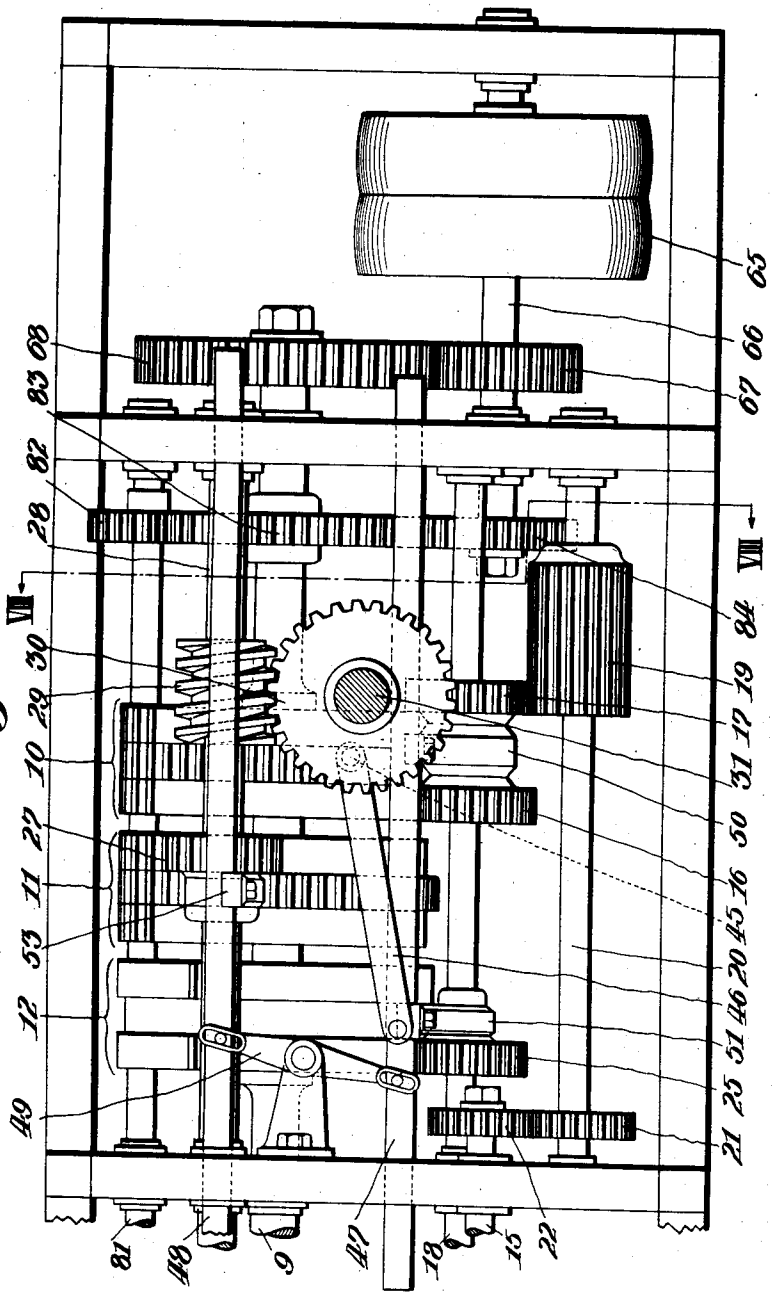
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Fig. 5.



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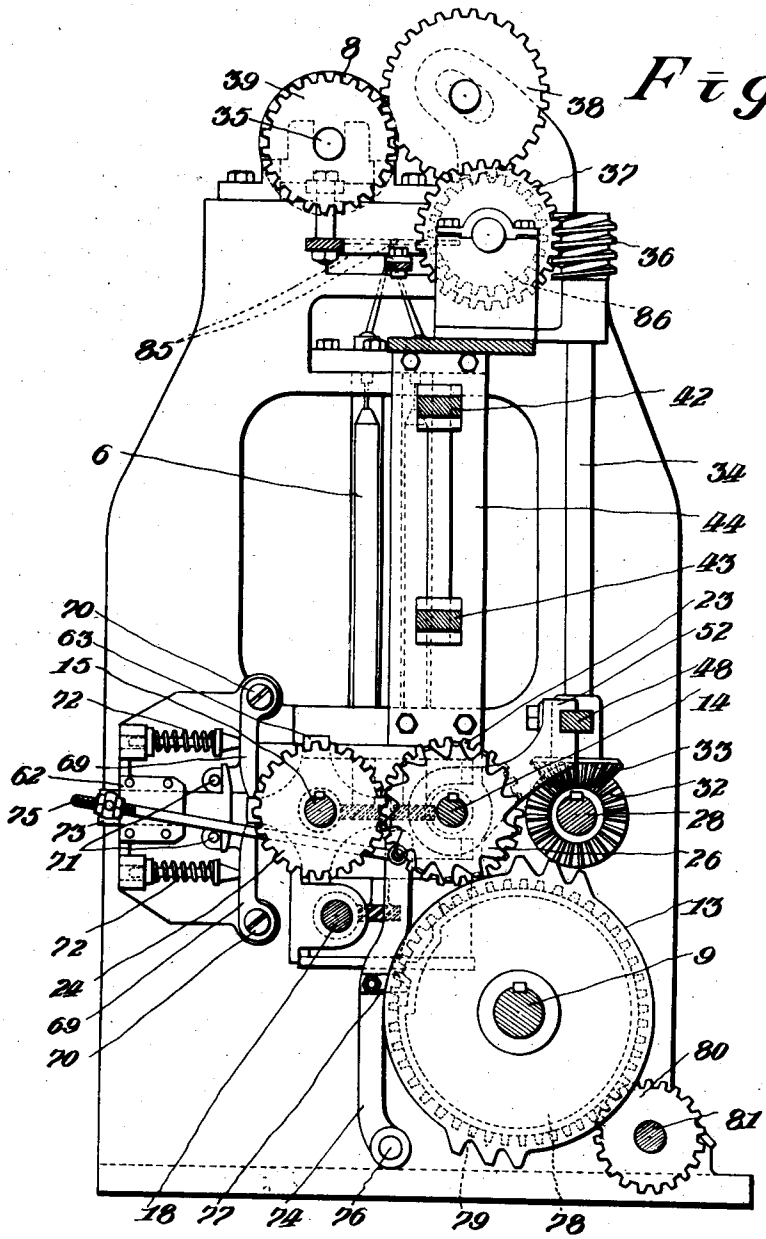
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Fig. 6.



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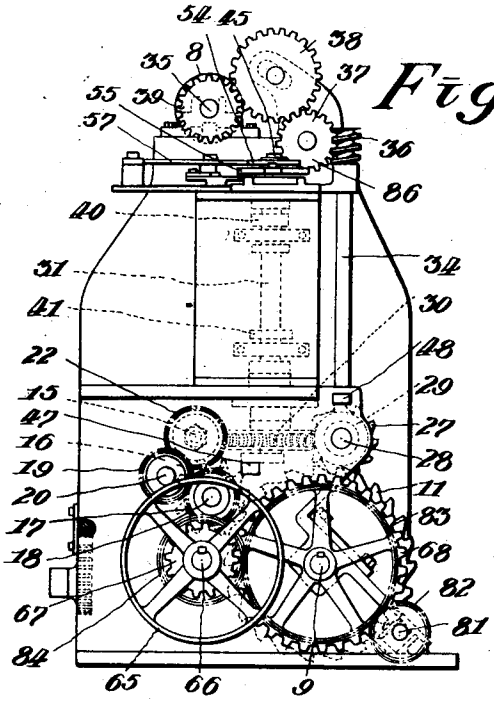


Fig. 7.

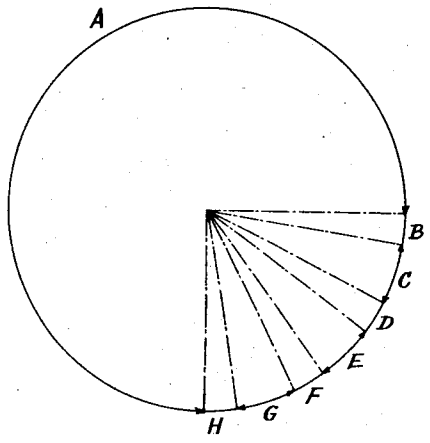


Fig. 9.

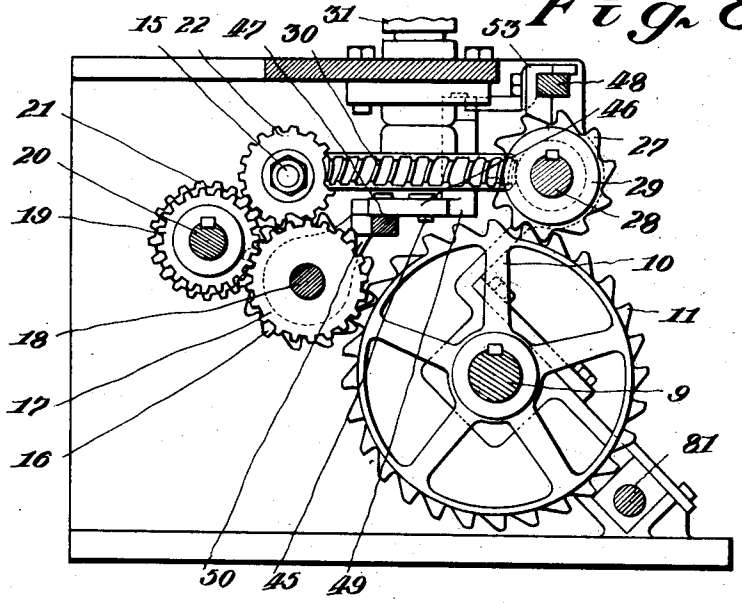


Fig. 8.

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UNITED STATES PATENT OFFICE

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OPERATING MECHANISM FOR NET-MAKING MACHINES

Application filed May 2, 1927. Serial No. 188,291.

This invention relates to improvements in operating mechanisms for net-making machines, in which the knotless netting fabric, such as may be used for fishing and other purposes, is made, and for its object to provide an operating mechanism adapted for mechanically taking up the several steps required to form a netting fabric of the knotless type.

The operating mechanism according to the present invention is mainly designed for the use in well known net-making machines of such a kind in which is employed a working platform composed of an upper and lower platform, each of which platforms consists of a stationary plate, a reciprocating plate positioned substantially flush and in close contact with the said stationary plate, both plates being provided with a series of working grooves connected by an intermediate groove extending across the said two plates, the intertwisting operation of strands of twine being accomplished by the rotation of the strand carriers delivered upon the first named grooves whilst the interlocking operation of the strands upon the second named grooves, means being provided whereby the reciprocating plate is shifted during the course of the intertwisting operation.

In order that this invention may be clearly understood, reference may be had to the appended explanatory sheets of drawings upon which:—

Fig. 1 is a plan view of the mechanism, with the working platform partly broken away.

Fig. 2 is a side view.

Fig. 3 is an enlarged plan view of the working platform partly broken away.

Fig. 4 is an enlarged plan view showing the parts of the connecting gears between two intertwisting shafts and reversing gears for the same.

Fig. 5 is an enlarged plan view showing a mechanism for shifting toothed wheels.

Fig. 6 is an enlarged end view, looking in the direction of the arrow on line VI—VI in Fig. 2.

Fig. 7 is an enlarged end view, looking from top of Fig. 2.

Fig. 8 is an enlarged end view, looking in the direction of the arrow on line VIII—VIII in Fig. 5.

Fig. 9 is a diagram illustrating the cycle of operations of the machine.

A net-making machine of the kind referred to above is provided with a working platform comprising an upper and lower platform. The upper platform is formed in two parts, namely, a fixed portion which is termed the "stationary plate" indicated by 1, and a movable portion which is termed "reciprocating plate" indicated by 2, as shown in Figs. 1 and 3. Both the plates are provided with a series of grooves 3 in which the spools or strand carriers or working heads 4 are to be operated. The working groove 3 consists of three circular channels *a*, *b* and *c* which are arranged in proximity to each other and extend transversely across the plates in several rows, so as to provide circular corrugated grooves therein, the intermediate channel *c* extending to both the stationary plate 1 and reciprocating plate 2. Within each group of the said three channels which constitute the working grooves, as mentioned above, is inserted a cam roller 5 having convex surface *d* and concave surface *e*. The cam roller is supported by a supporting arm 6, Fig. 1, extending downwardly to the lower platform, so that when all rollers are positioned within the respective grooves the concave walls of the intermediate rollers will be engaged by the corresponding convex walls of the other two rollers. The construction of the lower platform is identical with that of the said upper platform. In order to permit free movement of the reciprocating plate 2, the intermediate cam rollers are made in two halves, as indicated by 5*a* and 5*b*. In this case only the half 5*a*, dealing with the grooves belonging to the stationary plate, is secured to the supporting arm 6 whilst the other half 5*b*, dealing with the grooves belonging to the reciprocating plate, is loosely carried by the supporting arm 6 in any suitable manner such as by resting it upon a projection (not shown) formed upon the end of the arm 6. In each of the two side working grooves and within the empty spaces between the upper concave surface of the

rollers and the walls of the respective grooves, is inserted a working head 7, of a shape substantially complementary to that of the said empty spaces, and adapted to carry a strand carrier. With the arrangement of the parts as described above, each pair of the strands are intertwisted by rotation of the two side rollers and consequential rotation of each pair of the working heads 7. Thus, after each pair of the strands has been intertwisted through a certain length, all the working heads are stopped in a position to deliver from the two inner side working heads to the intermediate grooves. Then the strands from each pair of the working heads delivered to the intermediate grooves are crossed with each other by the operation of interchanging the position of the said working heads by turning the intermediate rollers 180 degrees in one direction, for instance, in a clockwise direction while the side rollers are at rest. Then the reciprocating plate 2 is moved through a distance corresponding to the pitch of the working grooves, or the side rollers are turned through an angle of 360 degrees in the reverse direction to that of the rotation during the intertwisting operation, that is in a counterclockwise direction. This will cause each pair of the strands on the working heads delivered to the side grooves to be intertwisted one turn. The intermediate rollers will be then turned again 180 degrees in the same direction as before namely in a clockwise direction. This will cause each pair of the strands to resume its original position, each pair of the strands on the working heads delivered to the intermediate grooves being crossed with each other, and upon resuming the intertwisting operation of the strands by rotating the side rollers, the interlocking of the strands will be completed. After each completion of the interlocking of the strands, the reciprocating plate 2 will be moved a distance corresponding to the pitch of the working grooves and the operation as described above will be repeated. The net as formed is taken up by means of a take-up roller 8 shown in Figs. 1 and 2.

The invention provides mechanism, simple and efficient to effect the above described operations in which a driving shaft 9, driven from a prime mover through suitable means, for instance, a pulley 65, a shaft 66 and toothed wheels 67, 68 carries partly toothed gear sets 10, 11, 12 and 13 fixed thereto, each of which sets consists of three partly toothed wheels assembled together as shown in Figs. 1, 2 and 5.

The gear set 10 serves for rotating shafts 14 and 15 termed "intertwisting shaft" for rotating the side rollers only during the intertwisting operation of the strands, otherwise they impart no rotation to the said intertwisting shafts, and for that purpose are provided with teeth which mesh only during the intertwisting operation of the strands with a toothed wheel 16 fixed to or integral with another toothed wheel 17, from which it is separated by an offset member as shown in Figs. 1, 2 and 5. The toothed wheel 16 is carried by a shaft 18 termed "interchanging shaft", for example by means of a sliding key and a long key-way, in a manner such as to permit a sliding movement longitudinally of the gear set 10 by means of a shifter 50 as hereinafter described, the toothed wheel 16 engaging with the said gear set 10 whilst the toothed wheel 17 engages with another toothed wheel 19 fixed on one end of a shaft 20. Fixed on the other end of the shaft 20 is a toothed wheel 21 which meshes with a change toothed wheel 22 fixed on one end of the intertwisting shaft 15, the change toothed wheel 22 being adapted to regulate the numbers of the intertwisting of the strands. The other intertwisting shaft 14 is connected with the intertwisting shaft 15 through means of toothed wheels 23 and 24 fixed to the respective shafts and meshing with each other, as shown in Figs. 1, 2, 3, 4 and 5. With such an arrangement, the intertwisting shafts 14 and 15 will be rotated in time from the driving shaft 9, and consequently the side rollers will be rotated to effect the intertwisting operation of the strands. The connections between the intertwisting shafts and the side rollers are omitted from the drawings and are not further described as they form no part of the present invention.

The gear set 12 serves for rotating the interchanging shaft 18 to turn the intermediate rollers 180 degrees in a direction for effecting crossing of each pair of the strands on the working heads in the intermediate grooves while the intertwisting shafts are at rest after the strands have been intertwisted through a certain length, and again for rotating the said interchanging shaft to turn the said intermediate rollers 180 degrees to cross each pair of the strands on the working heads in the intermediate grooves, while the intertwisting shafts are at rest after the turning of the side rollers through 360 degrees in the reverse direction for interlocking the crossed strands with the other strand adjacent each of them, by intertwisting each pair of the strands through one turn, and accordingly are only partly toothed so as to mesh with a toothed wheel 25 intermittently in time to accomplish the above said operation. The toothed wheel 25 is carried by the interchanging shaft 18, for example by means of a sliding key and a long key-way, in a manner such as to permit a sliding movement longitudinally of the said gear set 12 by means of a shifter 51 as hereinafter described, as shown in Figs. 1, 2 and 5. The interchanging shaft 18 is connected to the intermediate rollers in a manner such as to be rotated with the same, while the connections are omitted from the draw-

ings and are not further described as they form no part of the present invention.

The gear set 13 serves to rotate the intertwisting shafts 14 and 15 for turning the side rollers 360 degrees in the reverse direction to that of the rotation of the said rollers in the intertwisting operation, and accordingly is only partly toothed upon the end portions, the intermediate member being blank, in order to effect the above operation in time, and engaging with a toothed wheel 26 which is carried by the intertwisting shaft 14, for example by means of a sliding key and a long key-way, in a manner such as to permit a sliding movement longitudinally of the gear set 13 by means of a shifter 52 as hereinafter described, as shown in Figs. 1, 2 and 4.

The gear set 11 serves to effect the transverse movement of the reciprocating plate 2 through a distance corresponding to the pitch of the working grooves 3, in the intertwisting operation after completion of each interlocking operation of the strands, and also serves to move the take-up roller 8 and a reed 85, where the same is employed in the machine, and accordingly is so toothed as to impart the traversing movement to the said reciprocating plate, take-up roller and reed to cooperate with the intertwisting operation of the strands. The operation of the said gear set may be effected directly from the gear set 10, as the operation must be in synchronism with the intertwisting operation of the strands, but the separate gear sets are preferably employed in this construction. The gear set 11 engages with a toothed wheel 27 which is carried by a shaft 28, for example by means of a sliding key and a long keyway, in a manner such as to permit a sliding movement longitudinally of the gear set 11 by means of a shifter 53 as hereinafter described. Fixed to the shaft 28 is a worm 29 which meshes with a worm wheel 30 fixed to one end of a crank shaft 31, and also mounted upon said shaft 28 is a bevel wheel 32 which meshes with a bevel wheel 33 fixed to one end of a shaft 34. The shaft 34 is connected to the shaft 35 of the take-up roller 8 through the medium of a worm 36, worm wheel 37, toothed wheel 86, change toothed wheel 38 whereby the speed of rotation of the take-up roller 8 may be changed according to the size of the mesh of the net, said toothed wheel engaging a toothed wheel 39 fixed on the said shaft 35, as shown in Figs. 1, 2, 4, 5, 6 and 7. Thus it will be obvious that the take-up roller 8 will be rotated at a proper speed in time from the gear set 11. The crank shaft 31 is provided with two cranks 40 and 41 to the end of which respectively one end of connecting rods 42 and 43 is connected. The other ends of the said connecting rods are connected with a member 44 connecting the reciprocating plate 2 in the upper working platform with the reciprocating plate in the lower working platform, whereby the said reciprocating plates will be moved a distance corresponding to the pitch of the working grooves 3 in time as described hereinbefore, from the gear set 11, as shown in Fig. 2.

Eccentrically fixed to the worm wheel 30 is a pin 45, to which is connected one end of a link 46, the other end of said link being pivotally connected with a shaft 47, as shown in Fig. 5. The shaft 47 is connected to a shaft 48 by means of a pivoted lever 49, and carries fixed thereto a shifter 50 for the toothed wheel 16 controlling the intertwisting operation and a shifter 51 for the toothed wheel 25 controlling the rotation of the interchanging shaft 18. The shaft 48 carries fixed thereto a shifter 52 for the toothed wheel 26 controlling the reversing of the direction of rotation of the intertwisting shaft 14 and a shifter 53 for the toothed wheel 27 as shown in Figs. 2, 4 and 5. With such an arrangement, the toothed wheels 16, 25, 26 and 27 will be shifted in time as described hereinbefore.

The crank shaft 31 is provided with eccentrics 54 and 55 at the outer end. The eccentric 54 is adapted to move the take-up roller 8 in time, as already described, by means of a rod 56 and a pivoted lever 57 to which the said rod 56 and the rod 35 of the take-up roller 8 are connected. The eccentric 55 is adapted to move the reed 85, where same is provided over the upper working platform, in time by means of a rod 58, and a swinging lever 59 pivoted at 87 and connected with the rod 58 at its one arm and rods 60 and 61 connecting two arms of the lever 59 with two plate members of the reed 85 respectively, as shown in Figs. 1 and 2.

With the aforesaid construction and arrangement, it will be seen that the movements of the intertwisting shaft and the interchanging shaft must be exactly synchronized, otherwise the netting operation will be impossible, or the mechanism will be out of order, or the proper formation of the net will not be obtained. Brake devices 62 and 64, therefore, are provided for the intertwisting shaft 15 and the interchanging shaft 18 respectively, in order to secure the stoppage of the intertwisting shafts and the interchanging shaft at the desired moment, as shown in Figs. 1, 2, 4 and 6. For example, the brake device 62 for the intertwisting shaft 15 comprises a substantially cruciform disc 63 fixed to the intertwisting shaft 15, pawls 69, 69 pivoted at 70, 70 and having lugs 71, 71 adjacent the respective inner end, spring 72, 72 for pressing the pawls against the brake disc 63 and a bar 73 having a T-head engaging with the lugs 71, 71 as shown in Fig. 6. Said bar 73 is connected, at its outer end, with the upper end of a pivoted lever 74 through a connecting link 75. The lever 74 is pivoted at the lower end 76 and has a projection 77 fixed thereto,

which projection is adapted to engage with a cam wheel 78 fixed to or integral with a toothed wheel 79 loosely carried by the driving shaft 9 and driven by a toothed wheel 80 engaging with the same as shown in Figs. 1, 2 and 6. The toothed wheel 80 is fixed on one end of a shaft 81 which is driven from the pulley 65 through a toothed wheel 82 fixed on the other end of the shaft 81, a toothed wheel 83 loosely carried by the driving shaft 9 and a toothed wheel 84 fixed to one end of the shaft 66 of the pulley 65, as shown in Figs. 1, 2 and 5. With such an arrangement, during the intertwisting operation the projection 77 on the pivoted lever 74 will engage with the circumference the cam roller 78 and be pressed outwardly, and consequently the pawls 69, 69 will be pulled outwardly against the spring 72, 72 by the bar 73 to disengage pawls with the brake disc 63, and in the interlocking operation the projection 77 will come in the depression in the cam roller 78, and consequently the pawls will be released and engage with two sides of one of the projected ends of the brake disc, due to the tension of the springs 72, to arrest the rotation of the intertwisting shaft 15. The brake device 64 is identical with the brake device 62, and serves to secure the stoppage of the rotation of the interchanging shaft 18.

With the foregoing arrangement, the cycle of operation of the machine during one revolution of the driving shaft will be as follows: With reference to Fig. 9, at an angle A the intertwisting operation takes place to intertwist each pair of the strands, the side rollers being turned, at an angle B all the rollers stop, at an angle C the interchanging operation takes place, the intermediate rollers being turned 180 degrees, at angle D all the rollers stop, at an angle E the interlocking operation takes place, the side rollers being turned through an angle of 360 degrees in the reverse direction to that of the rotation during the intertwisting operation, at an angle F all the rollers stop, at an angle G the interlocking operation is completed, the intermediate rollers being turned again 180 degrees in the same direction as before and at an angle H all the rollers stop before the intertwisting operation at the angle A.

I claim:

1. In an operating mechanism for net-making machines, the combination of a driving shaft, a plurality of toothed wheels fixed to the driving shaft, each of the toothed wheels being formed in several parts and only partially provided with teeth, intertwisting and interchanging shafts, a plurality of slidable toothed wheels secured to the intertwisting and interchanging shafts so as to permit longitudinal sliding movement along the partly toothed wheels, each of the toothed wheels engageable with the respective partly toothed wheels, a shifting device for said slidable toothed wheels, means for operating said shifting device from one of said partly toothed wheels on said driving shaft to control the timed intermittent rotation and reversal of the intertwisting shafts, toothed wheels connecting one intertwisting shaft to another intertwisting shaft whereby to form the net.

2. An operating mechanism for net-making machines according to claim 1, including a crank shaft with two cranks driven from one of the partly toothed wheels and two excentrics fixed to the crank shaft whereby movements of the intertwisting shaft and the interchanging shaft are synchronized with the movements of the reciprocating plates, in the upper and lower working platform and movement of the take-up roller and reed is effected.

3. An operating mechanism according to claim 1, a brake device adapted to secure the timed stoppage of the rotation of the intertwisting shafts and the interchanging shafts to form the net.

In testimony whereof I affix my signature.

SAIBEI KAKUDA.