July 21, 1936. A. L. KITSELMAN 2,048,341

WIRE NETTING LOOM

Filed Dec. 17, 1934 5 Sheets-Sheet 1

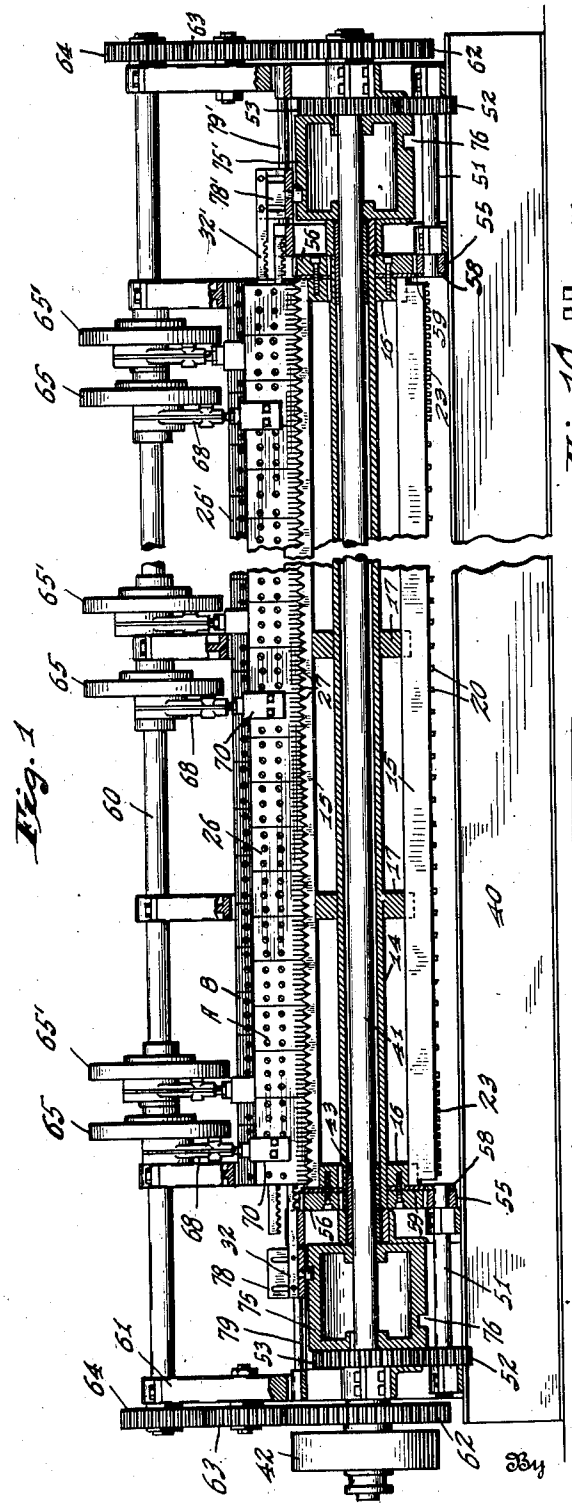


Fig. 1.

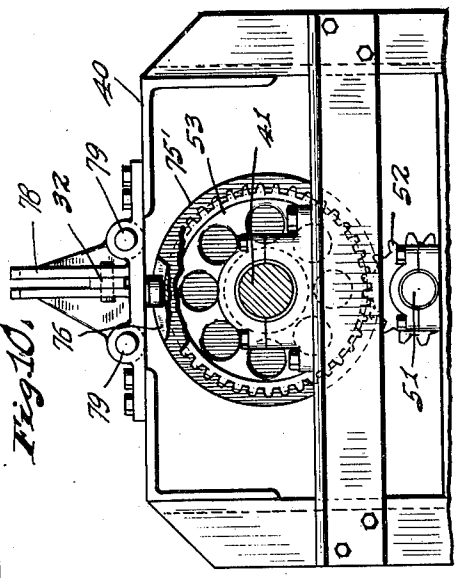


Fig. 10.

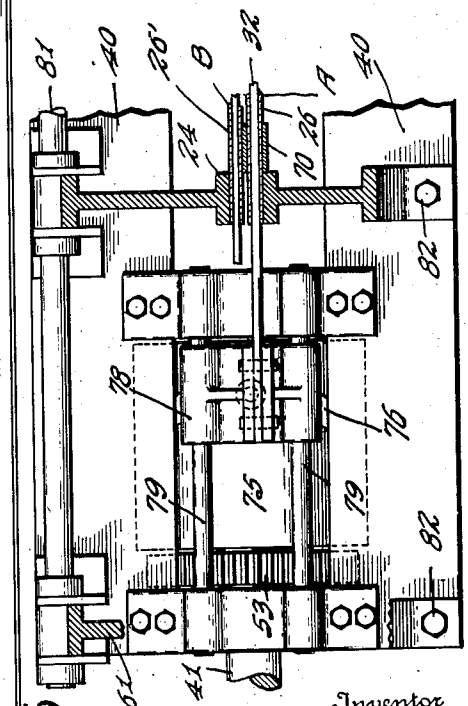


Fig. 9.

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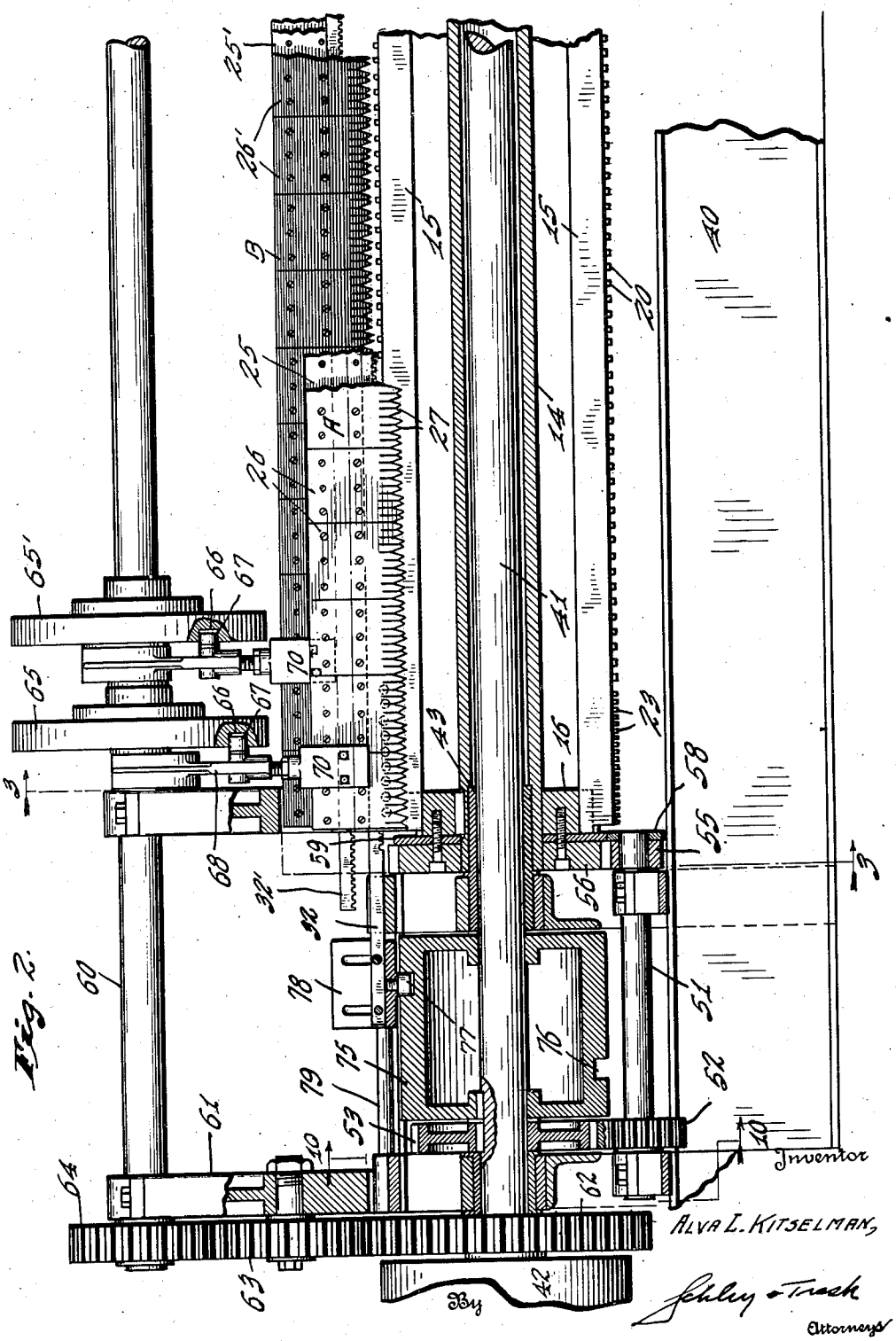


Fig. 2.

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Fig. 11.

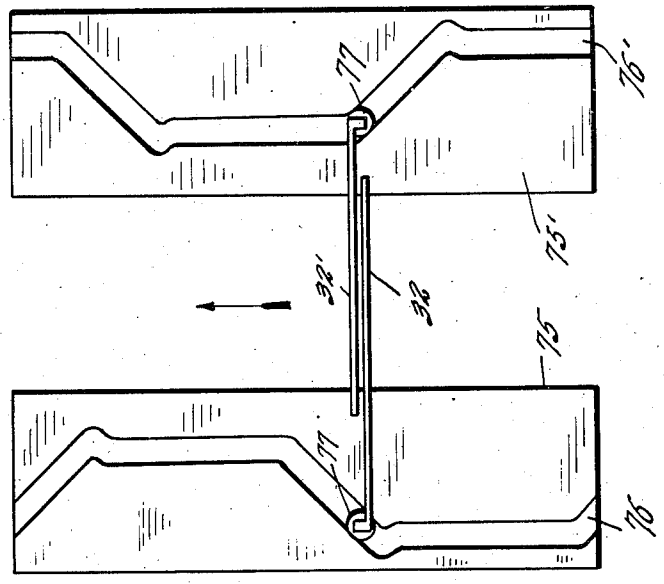
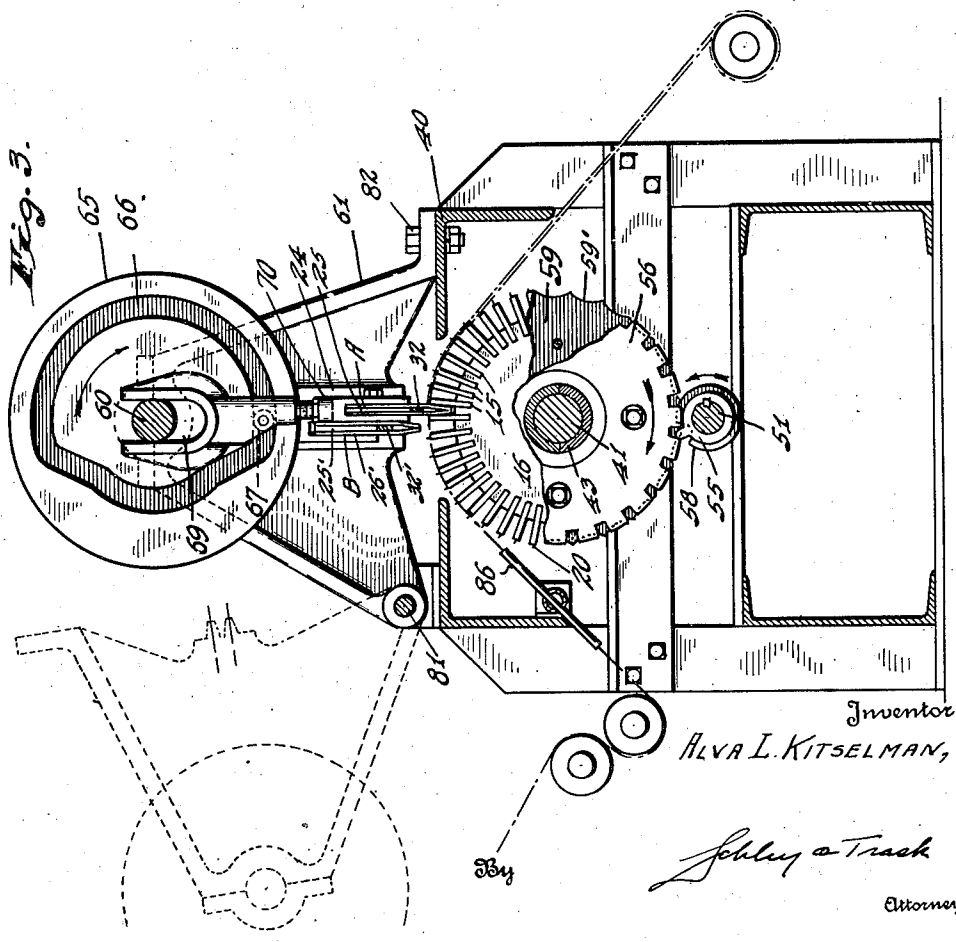


Fig. 3.



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WIRE NETTING LOOM

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Fig. 4.

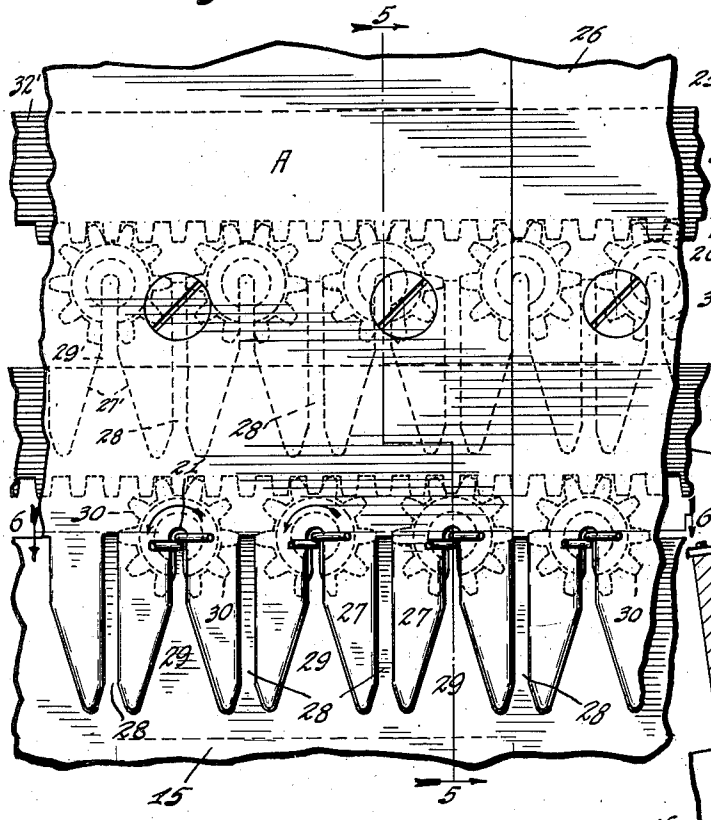


Fig. 5.

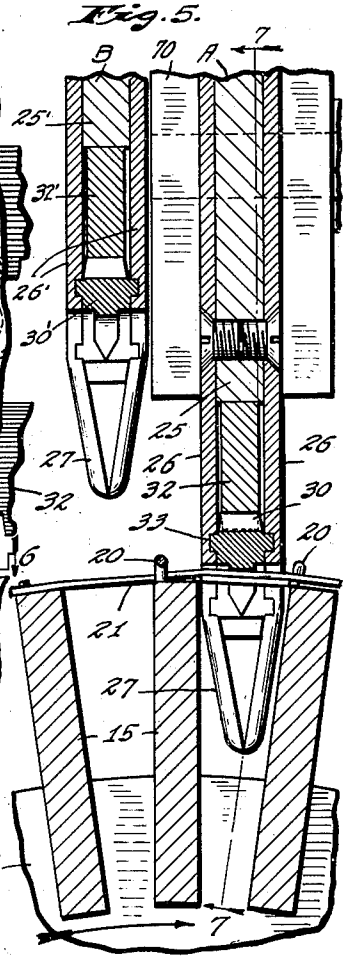
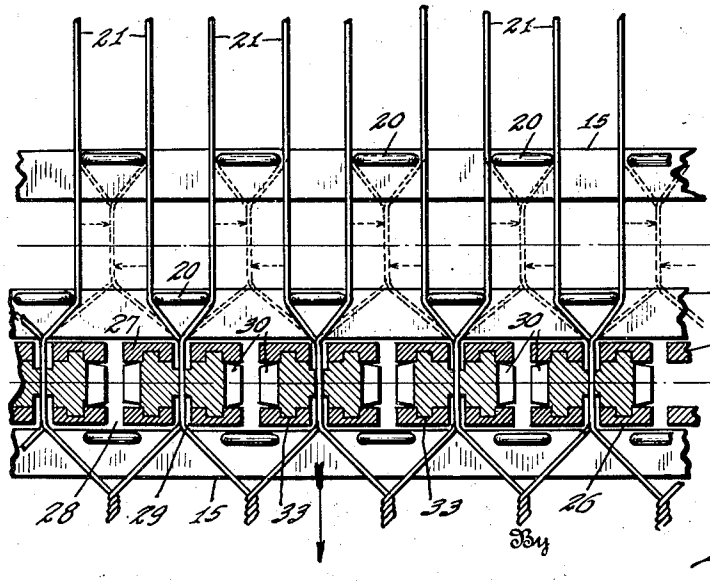


Fig. 6.



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WIRE NETTING LOOM

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Fig. 8.

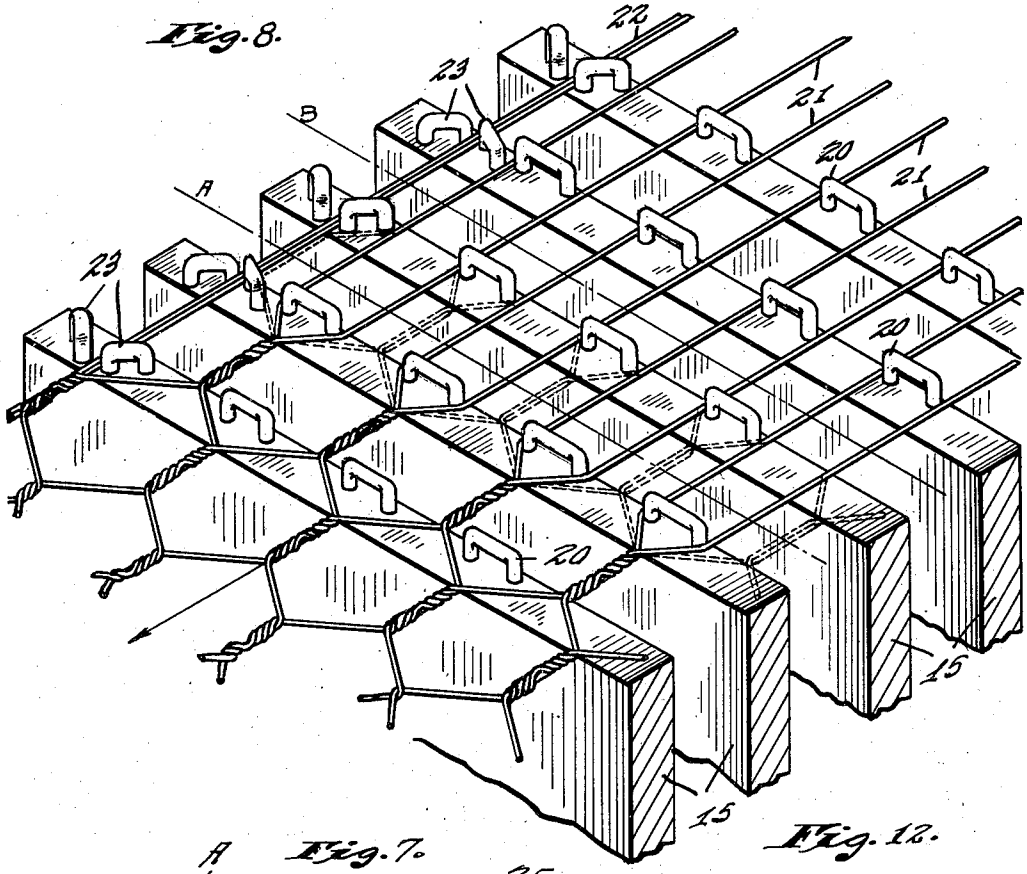


Fig. 7.

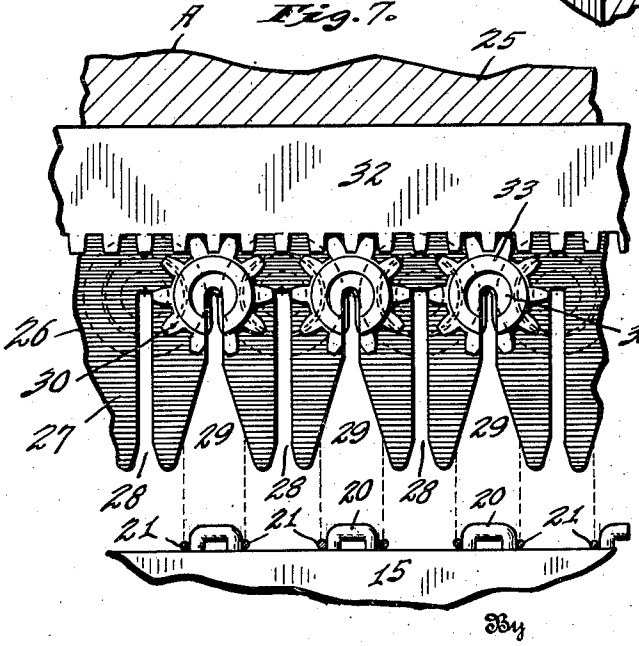
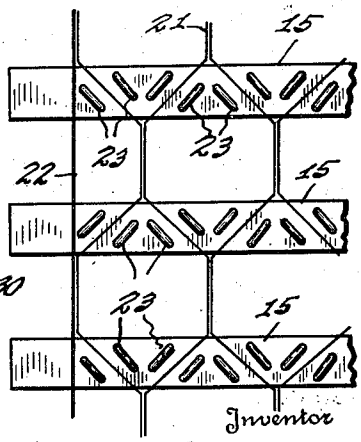


Fig. 12.



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Patented July 21, 1936 2,048,341

UNITED STATES PATENT OFFICE

2,048,341

WIRE NETTING LOOM

Alva L. Kitselman, Muncie, Ind., assignor to Indiana Steel & Wire Company, Muncie, Ind., a corporation of Indiana

Application December 17, 1934, Serial No. 757,859

13 Claims. (Cl. 140—6)

My invention relates to wire fabric weaving machines and especially to machines of the kind suitable for the formation of that type of fencing known as poultry netting. The particular embodiment of my invention illustrated and described in detail in this application is intended for the production of poultry netting of hexagonal mesh. Such netting is formed of generally longitudinally extending wires which, at intervals, are brought together in pairs and twisted or locked togther, the locks being arranged in transverse rows across the fabric with the locks of each row staggered relatively to the locks of the adjacent rows.

In prior-art wire-weaving machines of which I am aware, the wires of which the fabric is to be composed are fed to a carrier in the form of a drum or endless conveyor comprising an endless series of rows of lock-forming devices, the wires being shuttled back and forth to form the desired mesh, usually through the medium of guides which reciprocate transversely of the wires and in the common plane thereof.

It is the primary object of my invention to simplify the construction of wire-fabric forming machines by doing away with the endless series of rows of lock-forming devices which move with the fabric and by substituting therefor a limited number of rows of lock-forming devices to which the wires forming the fabric are progressively presented. A further object of my invention is to produce a machine in which the formed fabric can be readily stripped from the parts which support it, thus avoiding the distortion of the mesh which frequently occurs when relatively great force is necessary in stripping the fabric. A further object of my invention is to provide an effective and durable mounting for the twisting gears which are employed to form the locks in the fabric. Still another object of my invention is to produce a machine in which wear on the twisting gears will be equalized and their working life thereby prolonged.

In carrying out my invention, I dispose the wires of which the fabric is formed on the face of a movable carrier, which conveniently is an intermittently rotatable drum on the surface of which the wires are located by means of outwardly projecting lugs. Reels containing the stock wires are disposed in rear of the machine and are fed forwardly through the machine, the completed fabric being rolled on a suitable spool or mandrel at the front of the machine.

In the movement of the wires through the machine, they are progressively presented to two lock-forming heads which extend transversely of the wires and which are spaced apart a distance equal to the longitudinal distance between adjacent rows of locks in the finished fabric. These heads are mounted for independent reciprocation perpendicularly to the common plane of the wires and carry rows of fingers having inclined surfaces disposed to engage the wires and gather them together in pairs as the heads move toward the carrier. Each head includes a row of twisting gears positioned to receive respectively the pairs of wires gathered by the associated fingers, the gears in one row being staggered relatively to those of the other row.

The timing of the machine is such that the front head comes into operation first and at least partially completes the locks it forms before the rear head forms its locks. After each head has formed its locks it is moved out of association with the wires, the wire-carrier or drum is indexed forwardly to carry the two rows of locks just formed past the heads; and the cycle of operations is repeated.

The wire-guiding lugs on the face of the carrier or drum are so positioned that the gathering fingers of the heads will free the wires of the completed mesh from contact with the lugs; and thus there is no friction between the wires and lugs which otherwise would oppose ready stripping of the fabric from the carrier.

The accompanying drawings illustrate my invention: Fig. 1 is a front elevation of the complete machine with parts thereof broken away and showing in vertical section through the axis of the drum on which the fabric is formed; Fig. 2 is a fragmental view similar to Fig. 1, but on an enlarged scale; Fig. 3 is a vertical section on the line 3—3 of Fig. 2; Fig. 4 is a fragmental front elevation illustrating on an enlarged scale details of the wire-gathering fingers and twisting gears; Fig. 5 is a vertical section on the line 5—5 of Fig. 4; Fig. 6 is a horizontal section on the line 6—6 of Fig. 4; Fig. 7 is a fragmental vertical section on the line 7—7 of Fig. 5; Fig. 8 illustrates an isometric development of a portion of the drum on which the fabric is formed; Fig. 9 is a fragmental top plan view of the machine with parts thereof broken away; Fig. 10 is a vertical section on the line 10—10 of Fig. 2; Fig. 11 is a development of cams forming part of the mechanism by which the twisting gears are operated; and Fig. 12 is a development of a portion of the surface of the wire-carrying drum.

In the following detailed description of the embodiment of my invention illustrated in the ac-

companying drawings I shall in the main describe first those parts of the machine which operate directly on the wire in the formation of the fabric.

The rotatable drum on which the wire fabric is produced has a long sleeve-like hub 14 supporting an annular series of longitudinally extending bars 15 the outer surfaces of which provide support for the fabric and the wire of which it is formed. Conveniently, the bars 15 are mounted in angularly spaced notches in the peripheries of two disks 16 which are keyed to the sleeve or hub 14 near the ends thereof. The bars 15 have a length equal at least to the width of the widest fabric which the machine is to produce and, for the sake of rigidity, may be supported at intermediate points by auxiliary notched disks 17 which are mounted on the hub 14.

Each of the bars 15 is provided with a longitudinally extending series of upwardly projecting wire-guiding lugs 20 between which the mesh wires 21 for the fabric are fed as they enter into association with the drum. Conveniently, although not necessarily, the lugs 20 take the form of U-shaped staples the legs of which have a press fit within holes drilled in the outer surface of bars 15. As is clear from Fig. 3, the lugs 20 on adjacent bars 15 are arranged in staggered relation, and the length of each lug is somewhat less than the spacing between adjacent lugs so that the mesh wires 21 are substantially equally spaced.

The border wires 22 at the edges of the fabric are held in proper lateral position by means of special border-wire lugs 23 which are generally similar to the lugs 20 but which have different dimensions and spacing. Adjacent border-wire lugs 23 are spaced apart only a sufficient distance to receive the wires which are to be disposed between them, and their over-all dimension longitudinally of the bar 15 on which they are mounted is approximately half that of the corresponding dimension of the lugs 20, so that at each edge of the fabric the distance between the border-wire or border-wires 22 and the adjacent mesh wire 21 is approximately half that of the distance between two adjacent mesh wires.

In order to adapt the machine for the manufacture of fabric of different widths, each of the bars 15 may have a plurality of sets of the special border-wire lugs 23, as shown in Figs. 2 and 12. By disposing the border-wire lugs 23 obliquely with adjacent lugs inclined oppositely, they will not interfere with the formation of the mesh in fabric wide enough to extend into the region which the border-wire lugs occupy.

In the operation of the machine, the drum formed by the bars 15 is rotated intermittently by mechanism which will be hereinafter set forth to feed the wires 21 and 22 into association with the wire-weaving mechanism. The weaving mechanism operates to deflect each wire laterally of itself, first in one direction and then in the other, each deflection gathering adjacent wires together in pairs which, by the operation of the usual slotted twisting gears, are twisted to lock them together.

The weaving mechanism comprises a front head A and a rear head B disposed in parallel relation above the drum and adapted to reciprocate toward and away from the drum in suitable guideways 24, as shown in Fig. 3. These heads are substantially identical in construction and are perhaps best illustrated in Figs. 4 to 7, inclusive.

The head A includes a bar 25 which serves as a base or frame-member for the support of the mechanism of the head A. On opposite sides of the bar 25 there are secured plates 26 which extend downwardly beyond the bar and are provided at their lower edges with spaced fingers 27. The fingers 27 are arranged in pairs, adjacent pairs of fingers being separated by slots 28 and the two fingers of each pair being separated by slots 29. Between each pair of fingers 27 on the front plate 26 and the corresponding pair of fingers on the rear plate 26 there is rotatably mounted a twisting gear 30 having a slot which, in the normal position of the gear, is in alinement with the slots 29 of the associated fingers. The slot 29 separating the two fingers of each pair and the slots in the gear 30 have a width slightly larger than the diameter of the wires of which the fabric is formed but less than twice the diameter of such wires, so that two wires entering the slot in any of the gears 30 will be compelled to occupy a superposed relationship, as is clear from Fig. 4. Referring to Fig. 7, it will be apparent that each of the slots 29 is flared at its lower end to embrace a pair of adjacent mesh wires 21 on the face of the drum. Therefore, when the head A is lowered to bring its fingers 27 into engagement with the parallel wires 21, such wires will be gathered in pairs, superposed, and directed into the slots of the gears 30. The border-wires 22 are disposed on the drum in alinement with slots 29 of the front head, and are therefore not deflected when the head is lowered.

The gears 30 associated with the bar 25 are arranged in a horizontal row below the bar, and between such row of gears and the bar 25 there is mounted a rack 32 by longitudinal movement of which all the gears 30 may be rotated. Each of the gears 30 is conveniently mounted between the plates 26 through the medium of annular flanges 33 provided on the end faces of the gear and received in annular grooves in the inner faces of the plates 26.

The head B is the same in construction as the head A, including a bar 25' and plates 26' similar to the bar 25 and plates 26. The lower edges of the plates 26' are provided with slots 28' and 29' defining fingers 27' corresponding to the fingers 27, and between the plates 26' there are mounted twisting gears 30' adapted to be rotated by a rack 32'. The gears 30' of the head B are arranged similarly to the gears 30 except that they are staggered relatively to the gears 30. The fingers 27' on the plates 26' are correspondingly staggered so that each slot 29' is in alinement with a slot 28 and each slot 28' with a slot 29.

In the operation of the machine, after the wire-supporting drum has been indexed to bring parallel stretches of wires 21 and 22 beneath the heads A and B, the front head A is lowered to cause the fingers 27 associated with it to enter between the wires on the face of the drum. As previously set forth, the lowering of the fingers causes the wires 21 to be brought together in pairs and the wires of each pair to be led into the slot of one of the twisting gears 30, as is clear from Figs. 4 to 6. After the head A has reached the end of its downward stroke, the rack 32 is moved longitudinally of itself to rotate all the gears 30 and to twist the two wires of each pair together to form a lock.

The head B follows the head A in its downward stroke. As the fingers 27' of the head B

enter between the wires 21, they deflect such wires laterally as indicated in dotted-lines in Fig. 6 to bring them together in pairs and to lead the pairs of superposed wires into the slots in the gears 30'. After the head B has reached the end of its downward stroke, the rack 32' is operated to rotate the gears 30' and twist the pairs of wires respectively disposed within them. The heads are then elevated, the drum is indexed, and the cycle of operations repeated.

Mechanism for effecting the movement of parts necessary in performing the cycle of operations above set forth will now be described. As shown in Figs. 1 and 2, the main frame 40 of the machine rotatably supports a drive shaft 41 adapted, as by means of a pulley 42 rigid with it, to be connected to any suitable source of power. Conveniently, the drive shaft 41 is located concentrically with the drum on which the fabric is formed and serves as a support for such drum. To this end, the hub 14 of the drum may be provided with bushings 43 which receive the shaft 41.

For the purpose of relieving torsional strains on the drum, the indexing mechanism for driving it is preferably duplicated at each side of the machine. Each set of such indexing mechanism includes a shaft 51 having rigid with it a gear 52 which meshes with a gear 53 on the drive shaft 41. The indexing mechanism is perhaps best illustrated in Fig. 3 and includes intermittent gearing comprising a single-toothed gear 55 which is rigid with the shaft 51 and which meshes with a gear 56 secured to the adjacent bar-supporting disk 16 of the drum. Also rigid with the shaft 51 is an interrupted locking disk 58 which, during the period the drum is at rest, is received in one of a series of arcuate grooves 59' in a co-operating lock disk 59 which is rigid with the drum.

The mechanism which reciprocates the heads A and B is operated by a shaft 60 which is supported above the heads through the medium of a suitable sub-frame 61 from the main frame 40 of the machine. To avoid excessive torsional strains on the shaft 60, it is convenient to drive it at both ends by gearing located at opposite sides of the machine. Each set of such gearing includes a gear 62 rigid with the shaft 41, and idler gear 63 meshing with the gear 62 and rotatably supported from the sub-frame 61, and a gear 64 rigid with the shaft 60 and meshing with the idler 63.

Vertical reciprocation of the heads A and B is conveniently secured by means, respectively, of face cams 65 and 65' mounted on the shaft 60. Each of these cams is provided with a cam-slot 66 which receives a cam-following roller 67 mounted on a vertically reciprocable arm 68. The upper end of each of the arms 68 is conveniently guided by being provided with a slot 69 embracing the shaft 60, while the lower end of each arm is secured to its associated head preferably through the medium of a yoke 70 which embraces and is secured to the associated head and which may be adjustably connected to the arm 68 in order to regulate the stroke of the associated head. The cams 65 and 65' may be duplicated at intervals along the shaft 60 to prevent excessive bending strains on the bars 25 and 25'.

The two racks 32 and 32', which operate the twisting gears, are actuated by drum cams 75 and 75', respectively, rigidly mounted on the shaft 41 beyond the ends of the drum at opposite sides of the machine. The mechanism by means of which these two cams respectively control movements of their associated racks are the same, and only one need therefore be described in detail.

The cam 75, shown in section in Fig. 2 and developed in Fig. 11, has a cam-slot 76 which receives a roller 77 mounted on a cam follower 78. The cam follower 78 is mounted for sliding movement parallel with the shaft 41 by means of two parallel guide rods 79 supported from the frame 40 of the machine. The rack 32 projects axially beyond the drum into association with the cam follower 78 with which it has a pin-and-slot connection to provide for the vertical movement of the rack 32 which occurs in the reciprocation of the head A.

The cam 75' is operatively connected to the rack 32' by the cam-follower 78' which is slidable on guide rods 79'.

The gearing interconnecting the shaft 41 with the shafts 51 and 60 is in each instance two-to-one gearing, and the shafts 51 and 60 therefore rotate at twice the speed of the shaft 41. The cams 75 and 75', as is evident from Fig. 11, are arranged to produce one complete reciprocation of each of the racks 32 and 32' for every revolution of the shaft 41 and to provide at the end of each stroke of each rack a dwell during which the heads A and B are reciprocated and the drum indexed. With this method of operation, the twisting gears of each set rotate oppositely in performing two successive twisting operations, thus distributing wear on the teeth of the twisting gears and racks.

I prefer to rotate the gears 30 for either two or three revolutions in each twisting operation, depending on the size of the mesh to be made, but because no means is provided for controlling the order in which each pair of gathered wires enters the slot in the gear which is to twist them, some of the locks will be twisted a half-turn less than others. To prevent the elasticity of the wires from causing them to bind in the slots of the gears when the heads are raised, the gears 30 and 30' rotate for a short distance, say about 90°, past their normal position at the completion of the twisting operation and are then backed up to normal position before the heads are lifted.

For the purpose of affording ready access to the weaving mechanism to make necessary inspections and repairs, the sub-frame 61 is conveniently pivotally attached to the main frame 40 of the machine by means of a hinge pin 81, as illustrated in Fig. 3. Bolts 82 normally serve to maintain the sub-frame 61 in operative position; but upon removal of the bolts, and upon disconnection of the racks 32 and 32' from the cam followers 78 and 78', the sub-frame and the parts its carries can be swung about the axis of the hinge pin 81, as to the dotted-line position illustrated in Fig. 3.

In operating the machine described, wire-reels (not shown) containing a sufficient number of wires 21 and 22 to make a fabric of the desired width are set up in rear of the machine, and the wires are led between idle rollers 85 to the drum on which the fabric is formed. After leaving the rollers 85 and before entering into association with the drum, the wires pass through guide tubes 86 which are supported from the frame 40 of the machine and which are spaced apart the necessary distance to dispose the wires in proper spaced relation on the face of the drum.

When the machine is first set up to produce fabric of a given width, the ends of the wires emerging from the guide tubes 86 may be secured to the drum by manually twisting them together

in pairs to embrace the wire-guiding lugs on one of the bars 15, and the drum is then rotated until the ends of the wires have passed the heads A and B; or, if desired, the ends of the wires may be led manually across the face of the drum to a point beyond the heads A and B. After the ends of the wires have been brought forwardly past the heads, power-operation of the machine is started.

As previously indicated, the front head A descends first and forms a row of locks extending transversely of the wires; and then the head B comes into operation to form a second set of locks. From inspection of Figs. 6 and 8 it will be apparent that as each head forms a row of locks, the two wires of each lock will be drawn tightly against the lug 20 immediately in rear of such lock. It will also be apparent that the operation of gathering the wires into pairs to form each lock will free the wires from contact with the sides of the lug 20 immediately ahead of such lock. This latter action releases the wires from any gripping engagement with the lugs and eliminates the necessity of the application of any great force in removing the finished fabric from the drum. While the wire is thus freed from gripping engagement with lugs in front of the rear head B, the wire still embraces tightly the lugs 20 on the bar 15 immediately in rear of the rear head B, thus insuring that there can be no retrograde movement of the wires relative to the drum when the drum is indexed forwardly.

I claim as my invention:

1. In a machine for making wire fabric, a frame, a rotatable drum mounted in said frame and provided with an annular series of angularly spaced rows of outwardly projecting wire-locating lugs, the lugs in each row being staggered relatively to the lugs in the adjacent rows, means for feeding a plurality of parallel wires to said drum, two heads extending longitudinally of said drum and supported from said frame for independent reciprocation radially of said drum, two rows of slotted twisting gears supported respectively in said heads, the gears of one row being staggered relatively to the gears of the other row, each of said heads being provided with a row of wire-deflecting fingers having inclined surfaces adapted in the reciprocation of the associated head to engage the wires on the face of the drum and to bring the wires in pairs into the slots of the twisting gears, mechanism for rotating the twisting gears, and means for reciprocating said heads, operating said gear-rotating mechanism, and advancing said drum in timed relation.

2. In a machine for making wire fabric, a frame, a rotatable drum mounted in said frame and provided with an annular series of angularly spaced rows of outwardly projecting wire-locating lugs, the lugs in each row being staggered relatively to the lugs in the adjacent rows, means for feeding a plurality of parallel wires to said drum, a head extending longitudinally of said drum and supported from said frame for reciprocation radially of the drum, a row of slotted twisting gears mounted in said head, said head being provided with a row of wire-deflecting fingers having inclined surfaces adapted in the reciprocation of the associated head to engage the wires on the face of the drum and to bring the wires in pairs into the slots of the twisting gears, mechanism for rotating the twisting gears, and means for reciprocating said head, operating said gear-rotating mechanism, and advancing said drum in timed relation.

3. In a machine for making wire fabric, a frame, a wire support movably mounted in said frame, means for feeding a plurality of wires to said support, said support being provided with a plurality of wire-guiding lugs arranged in rows extending transversely of the wires, a head extending transversely of said wires and supported from said frame for reciprocation toward and away from said wire support, a row of slotted twisting gears mounted in said head, said head being provided with a row of wire-deflecting fingers having inclined surfaces adapted in the reciprocation of the head to engage said wires and to bring them in pairs into the slots of the twisting gears, mechanism for rotating the twisting gears, and means for reciprocating said head, operating said gear-rotating mechanism, and advancing said wire support in timed relation.

4. In a machine for making wire fabric, a frame, a wire support movably mounted in said frame, means for feeding a plurality of wires to said support, said support being provided with a plurality of wire-guiding lugs arranged in rows extending transversely of the wires, a head extending transversely of said wires and supported from said frame for reciprocation toward and away from said wire support, a row of slotted twisting gears mounted in said head, means operable in the reciprocation of said head for bringing said wires in pairs into the slots of the twisting gears, mechanism for rotating the twisting gears, and means for reciprocating said head, operating said gear-rotating mechanism, and advancing said wire support in timed relation.

5. In a machine for making wire fabric, means for supporting a plurality of wires in spaced relation, a reciprocable head, a row of slotted twisting gears mounted in said head, means for reciprocating said head to bring said gears into and out of association with said wires, and means operable in the reciprocation of said head for bringing the wires in pairs into the slots of the twisting gears.

6. In a machine for making wire-fabric, a movable support for a plurality of spaced wires, wire-weaving mechanism reciprocably mounted for movement into and out of association with said wires, and means for reciprocating said wire-weaving mechanism and for advancing said support in timed relationship.

7. In a machine for making wire-fabric, a movable support for a plurality of spaced wires, a set of lock-forming devices arranged in a row extending transversely of said wires, a second set of lock-forming devices arranged in a row parallel to said first set and disposed beyond said first set in the direction of movement of said support, the lock-forming devices of said second set being staggered relatively to those of the first set, means for intermittently advancing said support, and means operable when said support is at rest for causing a lock-forming operation of said second set of devices and then a lock-forming operation of said first set of devices.

8. In a machine for forming wire-fabric, a support for a pair of spaced wires which are to be locked together, a reciprocable head movable in a plane generally perpendicular to that of said wires, a slotted twisting gear rotatably supported in said head, and a pair of gathering fingers mounted on said head and having inclined surfaces disposed to engage said wires and to guide them both into the slot of said twisting gear as said head moves toward said wires in its reciprocation.

9. In a machine for forming wire-fabric, a slotted twisting gear, said gear being provided on its end faces with annular flanges, and a pair of supports for said twisting gear located at the ends thereof and having annular grooves providing a bearing for both the inner and outer surfaces of said flanges.

10. In a machine for making wire-fabric, a frame, a movable support for a plurality of spaced wires, wire-weaving mechanism mounted for reciprocation in said frame into and out of association with said wires, said support being movable in said frame to carry said wires progressively past said wire-weaving mechanism, and means for reciprocating said wire-weaving mechanism and advancing said support in timed relationship

11. In a machine for forming wire-fabric, a support for a pair of spaced wires which are to be locked together, a reciprocable head movable in a plane generally perpendicular to that of said wires, a lock-forming device supported in said head, and a pair of gathering fingers mounted on said head and having inclined surfaces disposed to engage said wires and to bring them together into said lock-forming device as said head moves toward said wires in its reciprocation.

12. In a machine for forming wire-fabric, a support for a plurality of wires, said support being provided with a series of rows of abutments each projecting outwardly from said carrier between two adjacent wires and the abutments of each row being staggered relatively to the abutments of adjacent rows, rows of lock-forming devices each disposed between adjacent rows of abutments with their lock-forming devices in staggered relation, each of said lock-forming devices being adapted to form a lock in two adjacent wires, the abutments of each row being so disposed and of such width relative to the disposition of the lock-forming devices on opposite sides of the row that in the formation of the locks the wires are freed from engagement with the sides of the abutments.

13. In a machine for making wire fabric, a frame, a wire support movably mounted in said frame, means for feeding a plurality of wires to said support, said support being provided with a plurality of wire-guiding lugs arranged in rows extending transversely of the wires, a head extending transversely of said wires and supported from said frame for reciprocation toward and away from said wire support, a row of lock forming devices mounted in said head, means operable in the reciprocation of said head for bringing said wires in pairs into association with said lock-forming devices, mechanism for actuating the lock-forming devices, and means for reciprocating said head, operating the mechanism actuating said lock-forming devices, and advancing said wire support in timed relation.

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