

S. I. ARMBRUSTER.
WIRE WORKING MACHINE.
APPLICATION FILED SEPT. 27, 1907.

911,931.

Patented Feb. 9, 1909.

6 SHEETS—SHEET 1.

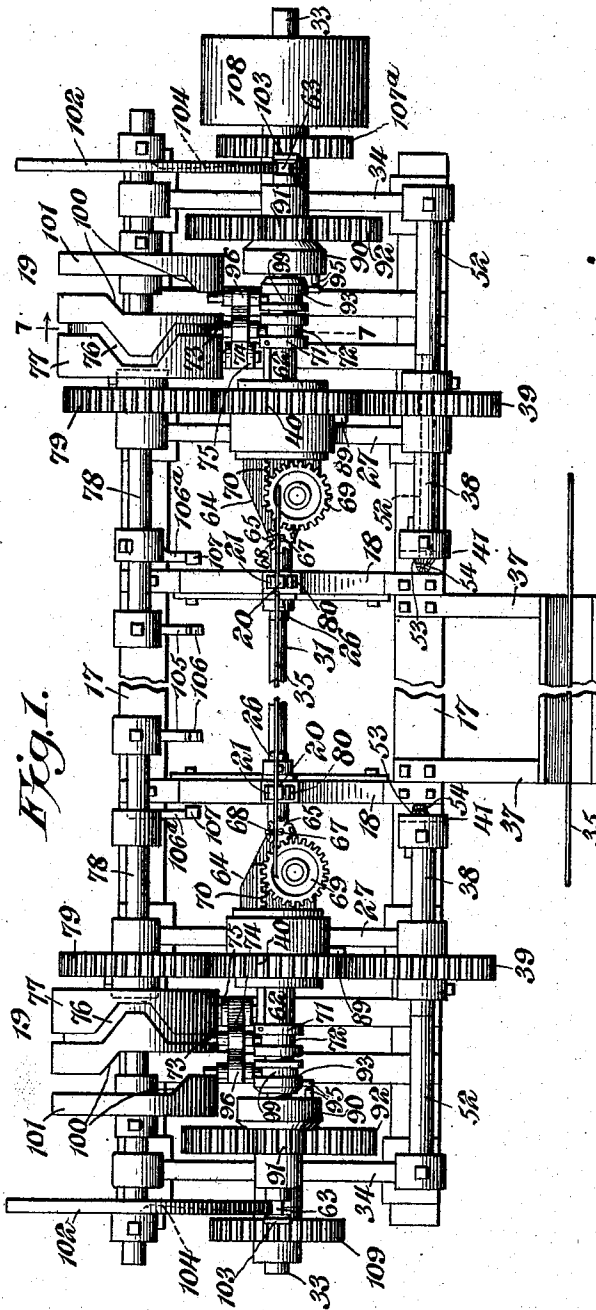


Fig. 1.

Fig. 15.

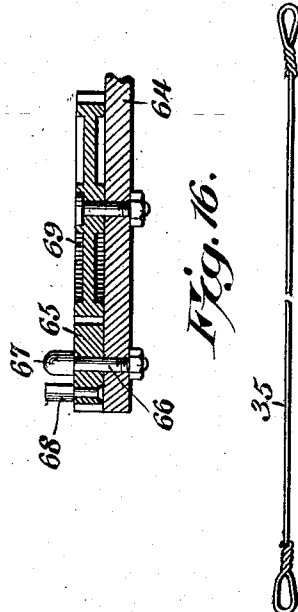
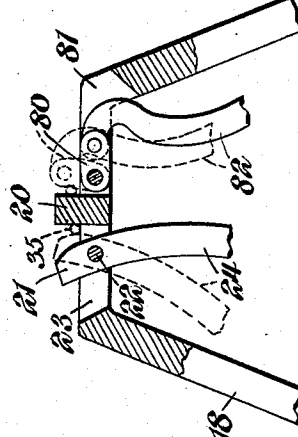


Fig. 16.

Fig. 14.



Witnesses
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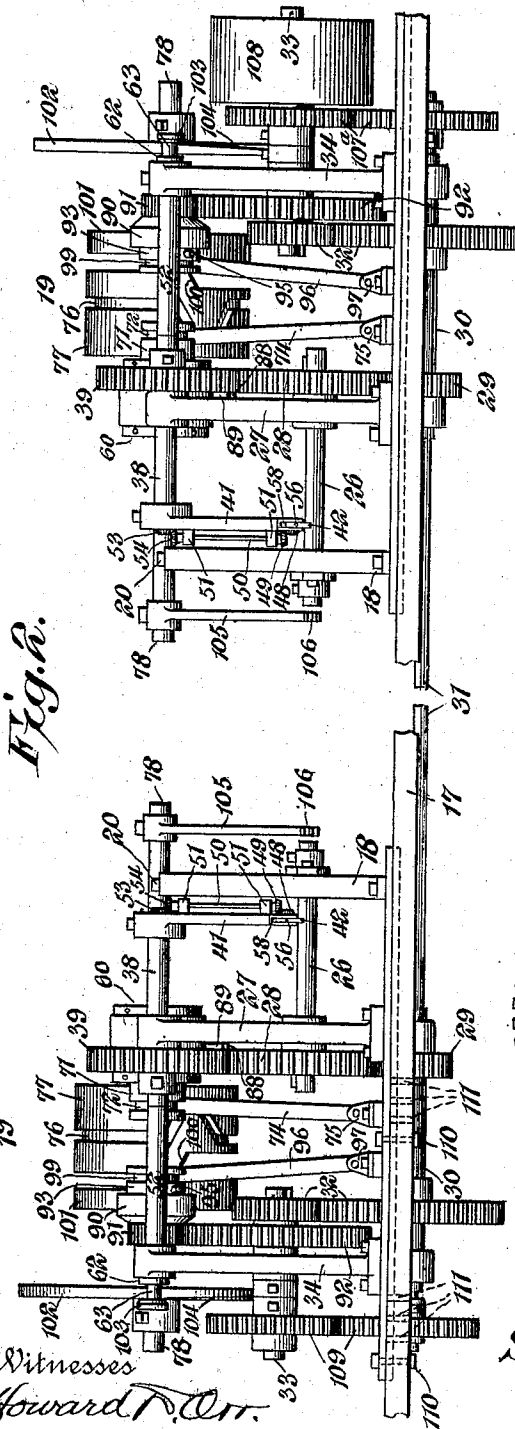


Fig. 2.

Fig. 9.

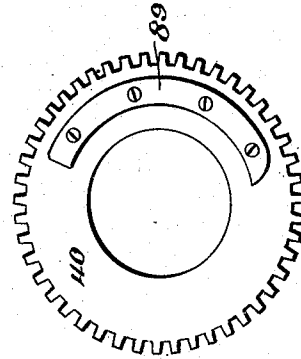
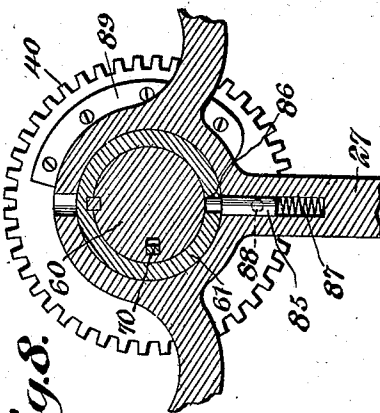


Fig. 8.



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6 SHEETS—SHEET 3.

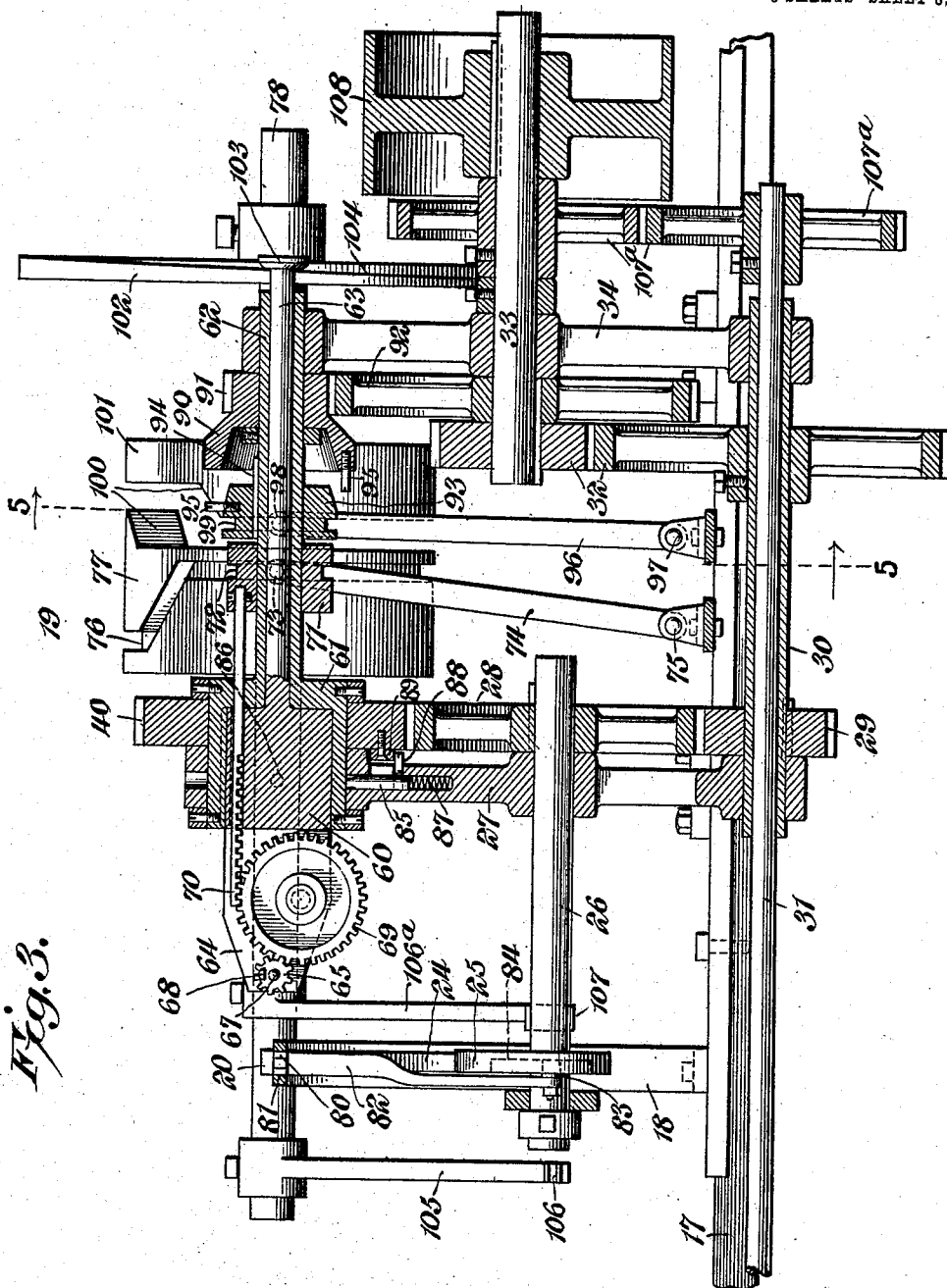


Fig. 3.

Witnesses

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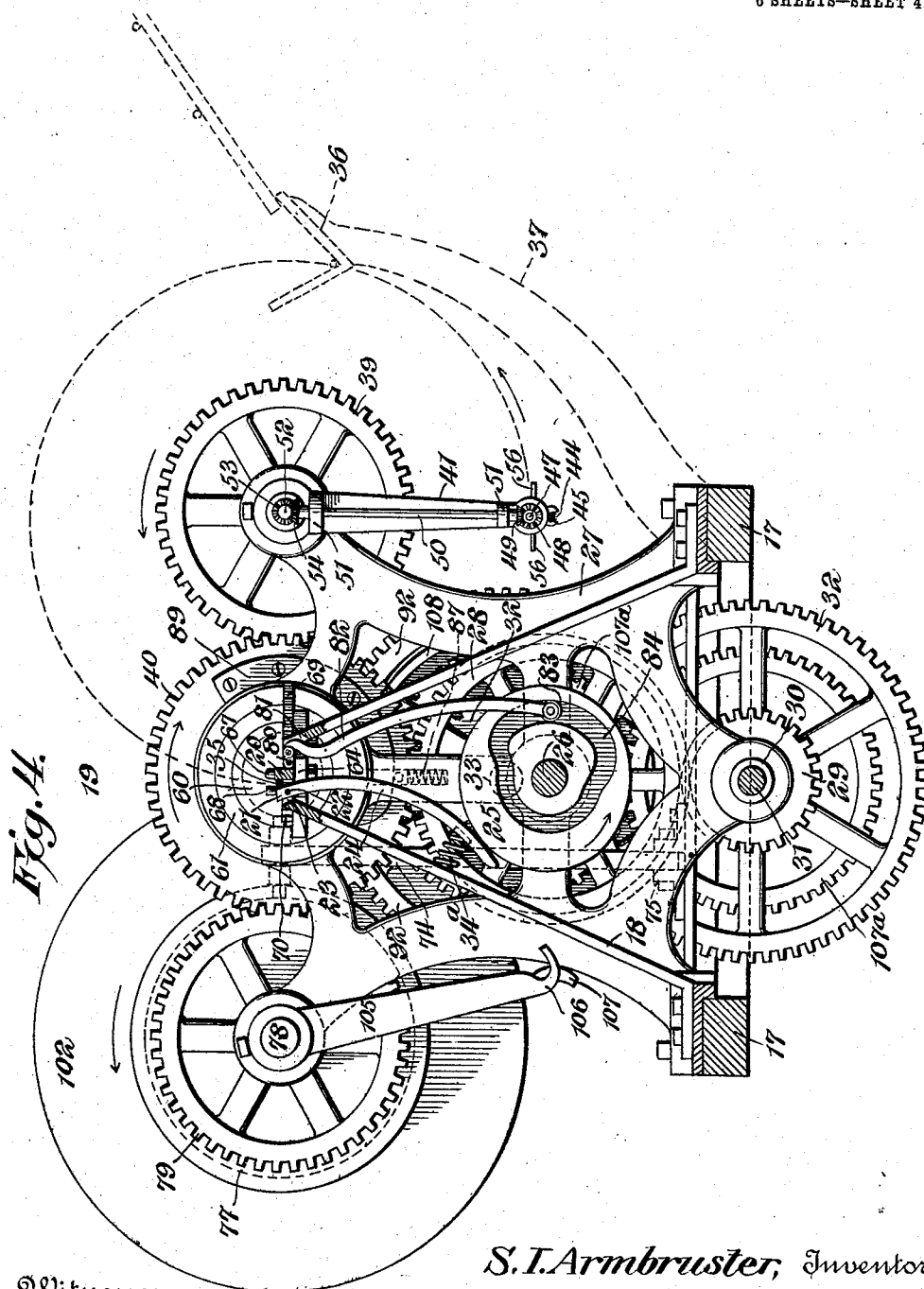
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6 SHEETS—SHEET 4.



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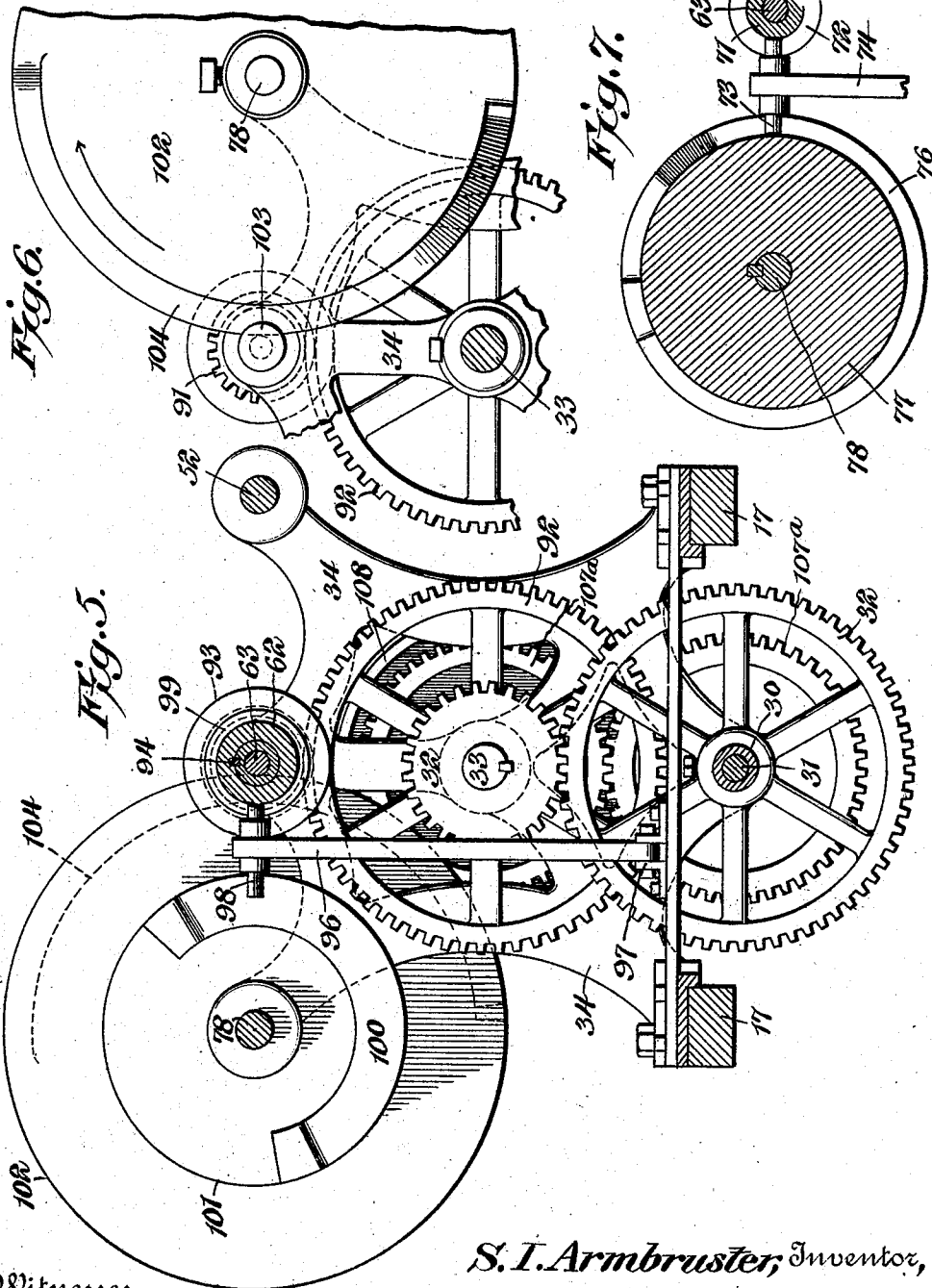
Attorney

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6 SHEETS—SHEET 5.



Witnesses
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R. H. Foster

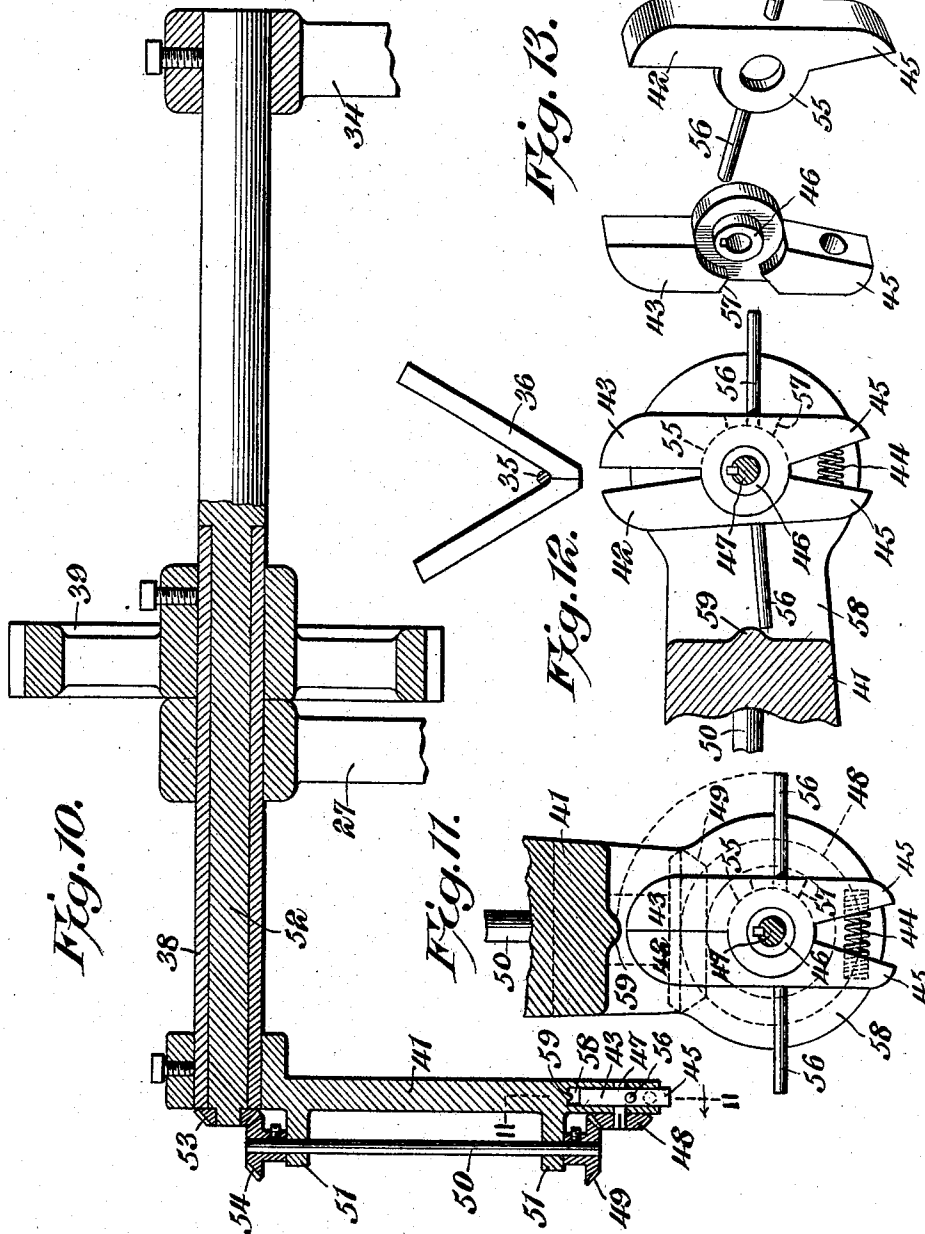
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S. I. ARMBRUSTER.
WIRE WORKING MACHINE.
APPLICATION FILED SEPT. 27, 1907.

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6 SHEETS—SHEET 6.



Witnesses
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UNITED STATES PATENT OFFICE.

STEPHEN I. ARMBRUSTER, OF PLYMOUTH, OHIO.

WIRE-WORKING MACHINE.

No. 911,931.

Specification of Letters Patent.

Patented Feb. 9, 1909.

Application filed September 27, 1907. Serial No. 394,882.

To all whom it may concern:

Be it known that I, STEPHEN I. ARMBRUSTER, a citizen of the United States, residing at Plymouth, in the county of Richland and State of Ohio, have invented a new and useful Wire-Working Machine, of which the following is a specification.

The present invention relates to means for operating on wires, and more particularly for producing terminal loops thereon.

The principal object of the invention is to provide a comparatively simple, thoroughly practicable, and highly efficient machine, which will have a large output, and will form loops in either or both ends of a wire, said machine being readily adjustable to wires of different lengths and various diameters.

The machine is particularly adapted for producing terminal loops on piano wires, wires for brick machines, ties for hay and other bales, and in fact for any looped wire.

An embodiment of the invention that is at present considered the preferable one is illustrated in the accompanying drawings, but it will be evident from an inspection of the claims hereto appended, that the invention is not limited solely to the particular construction disclosed.

In the drawings: Figure 1 is a top plan view of the machine, the central portion being broken away. Fig. 2 is a side elevation of the same. Fig. 3 is a vertical longitudinal sectional view on an enlarged scale through one of the wire looping and twisting mechanisms. Fig. 4 is a cross sectional view through the same. Fig. 5 is also a cross sectional view on the line 5—5 of Fig. 3. Fig. 6 is a detail view illustrating the means for controlling the longitudinal movement of the twisting mechanism. Fig. 7 is a detail sectional view on the line 7—7 of Fig. 1. Fig. 8 is a detail sectional view showing the locking means for the twisting mechanism. Fig. 9 is a detail view of the idler and the actuating means for the lock of the twisting mechanism. Fig. 10 is a detail sectional view illustrating the structure of one of the feeding devices. Fig. 11 is a detail sectional view on the line 11—11 of Fig. 10. Fig. 12 is also a sectional view illustrating the operation of the wire holding clamp when in a position to receive a wire. Fig. 13 is a detail perspective view of the clamp with the jaws disassociated. Fig. 14 is a detail sectional view of the clamping mechanism that is associated with one of the wire looping and

twisting devices. Fig. 15 is a detail sectional view through one of said looping and twisting devices. Fig. 16 is a view showing a wire as produced by the machine.

Similar reference numerals designate corresponding parts in all the figures of the drawings.

In the embodiment disclosed, a supporting frame is employed, which includes spaced tracks or bars 17 bridged by suitable cross pieces 18 and supported in any suitable manner.

Two wire looping and twisting mechanisms are mounted on the end portions of the frame, and are designated generally by the reference numeral 19. As these mechanisms are duplicates, but one will be described in detail. Their inner ends are spaced apart, as clearly shown in Figs. 1 and 2, and the wires to be operated upon are held between them. The holding means is in the form of sets of clamps mounted on the central cross pieces 18, and as shown in Figs. 4 and 14, said cross pieces have upstanding stationary clamping jaws 20. Coacting with one side of each jaw is a swinging jaw 21 pivoted, as shown at 22 in an opening 23 in the cross piece and having a depending arm 24. This arm rides against the eccentric edge of a rotatable cam 25 secured to a shaft 26 that is journaled in a supporting bracket 27 mounted on the frame. The shaft 26 has a gear wheel 28 secured to its outer end, and in mesh with a pinion 29 fast upon a tubular shaft 30 that is mounted on a shaft 31 connecting the two wire looping and twisting mechanisms, as hereinafter set forth. The tubular shaft 30 has a gear connection 32 with a main driving shaft 33 journaled in another supporting bracket 34 that is mounted on the frame. It will thus be evident that upon the rotation of the shaft 26 and cam 25, the arm will be swung so that the jaw 21 will be moved toward and from the stationary jaw 20, the bearing of said arm against the cam being maintained by a spring 34^a, shown in Fig. 4. The clamps thus described are adapted to receive and hold the wires during the looping and twisting operations, one of said wires being shown in position in Fig. 1, and designated 35.

For the purpose of feeding the wires, the following mechanism is preferably employed. A trough 36 is mounted on suitable arms 37 at one side of the machine, and the wires having first been cut the desired length, are suc-

cessively fed to the trough by any suitable means (not shown). Mounted on each set of brackets 27 and 34 at one side of the machine, is a shaft 38 that has a gear connection 39 with an idler 40 journaled on the looping and twisting mechanism, as hereinafter described, this idler 40 being in mesh with the gear 28 of the shaft 26, and consequently being continuously rotated. Each of the shafts 38 carries at its inner end an arm 41, and these arms, as shown in Figs. 1 and 2, are spaced apart. The free ends of the arms operate beyond the ends of the trough, and outside the clamps above described. They carry at their free ends wire engaging and transferring clamps, each of which consists of relatively swinging jaws 42 and 43 normally pressed together by a spring 44 located between projecting tails 45. The clamps are always maintained in vertical positions regardless of the rotation of the arms carrying them, and to this end, one of the jaws 43 of each clamp has a hub 46 fixed to a spindle 47 that has a beveled gear wheel 48 in mesh with another gear wheel 49 carried by a shaft 50 that is journaled longitudinally of the arm 41 in ears 51 projecting from one side of said arm, as shown in Figs. 4 and 10. The shaft 38, which carries the arm 41, as illustrated in said Fig. 10, is tubular, and is journaled on a stationary axle 52. This axle carries at its inner end a stationary gear wheel 53 that is in mesh with another gear 54 carried by the inner end of the shaft 50. The result is that during the rotation of the shaft 41, the gear 54 will be revolved by its engagement with the stationary gear 53. Consequently the gears 49 and 48 will be rotated, and because of this arrangement, the clamp carried by the arm will always remain in vertical position. This will be evident by a comparison of Figs. 11 and 12. As already stated, one of the jaws 43 is thus geared, the other jaw 42 swings and therefore has an ear 55 journaled on the hub 46. This jaw furthermore has oppositely extending fingers 56, one of which extends through a slot 57 in the jaw 43, and these fingers are located in the bifurcation 58 in the end of the arm in which the clamp is placed. A lug 59 or projection formed upon the arm and located in the bifurcation in the path of movement of the ends of the fingers 56, is thus arranged to strike said fingers, and as a consequence, the jaw 43 will be swung to open position twice on every revolution of the arm. The arrangement is such that as the arm swings upwardly past the end of the wire holding trough 36, one of the fingers will be engaged by the projection, and as it rides over the same, the jaw 42 will be forced open against the action of the spring 44, and consequently the jaws are passed on opposite sides of the ends of the wire placed in the trough. After such passage, the finger 56 having passed the

projection 59, the spring 44 can react to close the jaws and therefore the wire will be clamped between the same. The two arms and their clamps rotating simultaneously, will thus engage the ends of the wire and carry said wire from the trough to the clamps, as described. As the free ends of the arms pass downwardly, the opposite fingers 56 will strike the upper sides of the projections 59. Therefore the jaws 42 will again be swung to open position just as the wire 35 is deposited in the clamps 20—21, and as the jaws thus release the wire, the jaws 21 are clamped thereupon and secure said wire in position to be operated upon by the looping and twisting mechanisms.

As already stated, the looping and twisting mechanisms are duplicates, so that a description of one is believed to be sufficient for both. Referring now particularly to Fig. 3, it will be observed that a twister head 60 is employed that is located in a shell 61, said shell being journaled in the bracket 27 and having an inwardly extending sleeve 62 journaled in the bracket 34. The sleeve includes a stem 63 secured to the head 60. On the shell is loosely journaled the idler 40, already described. The head 60 carries an outstanding supporting plate 64, and journaled thereon, is a looping device, in the form of a pinion 65, shown in detail in Fig. 15. This pinion is journaled on a central removable stud bolt or pin 66 having a head 67 projecting beyond the pinion, and said pinion also has a bending pin 68 secured thereto and spaced from the stud 67. A gear wheel 69 is in mesh with the pinion 65, and a reciprocatory rack 70, slidably mounted in the head 60 and shell 61, meshes with the gear wheel 69. A grooved collar 71 slidably mounted on the sleeve 62, is secured to the rack 70, and has an annular groove 72 in which is engaged one end of a cross pin 73 carried by the upper end of a swinging arm 74, said arm having its lower end pivoted, as shown at 75 in the bracket. The other end of the cross pin, as shown in Figs. 1 and 7 is engaged in a cam groove 76 formed in the periphery of a wheel 77 that is mounted on a shaft 78. This shaft as shown in Fig. 1, is journaled on the opposite side of the frame to the shaft 38, and is driven from the idler 40 by a gear wheel 79 fixed to the shaft 78, and in mesh with said idler. It will thus be evident that during every rotation of the shaft 78, the arm 74 will be swung back and forth once, thus causing the gear wheel 69 to partially rotate and effecting a half rotation of the pinion 65. The normal position of the pinion is illustrated in Fig. 1, and it will therefore be evident that when a wire 35 is deposited in the clamps, the terminal portion of this wire will be located between the stud 67 and the pin 68. Therefore when the pinion 65 is rotated, the terminal portion of

said wire will be looped and the end thereof will be brought against the opposite side of the stationary jaw 20 to that with which the jaw 21 coöperates. Another clamp is there-
 5 fore employed that coacts with said opposite side of the jaw 20 to hold the end of the wire after it has been looped, and this clamp is shown more particularly in Figs. 4 and 14. A jaw 80 is pivoted in an opening 81 in the
 10 cross piece 18 of the frame, and is movable into and out of said opening and consequently into and out of the path of movement of the terminal of the wire. The free end of this jaw 80 is connected to an arm 82,
 15 the lower end of which has a roller 83 operating in a cam groove 84 in the wheel or eccentric 25. The cam groove 84 is so arranged with respect to the other mechanism that after the looping mechanism takes place and
 20 the terminal of the wire has been bent against the side of the stationary jaw 20, the jaw 80 will be raised, as indicated in dotted lines in Fig. 14, and said terminal will be clamped, the looping operation being thus
 25 completed.

As already described, the head 60 and supporting ear or plate 64 for the looping device is rotatable, and by this means, the
 30 twisting operation is secured. During the looping operation, however, the said head is stationary, and in order to effectively prevent its rotation, a lock is employed in the form of a reciprocatory bolt 85, which is
 35 slidably mounted in the bracket 27, as shown in Figs. 3 and 8, and engages in an opening in a socket 86 formed in the shell 61. A spring 87 bears against the bolt, and normally urges it into said socket. The bolt,
 40 however, has an outstanding pin 88, and this pin projects into the path of movement of a cam track 89 secured to one side of the idler
 45 40, as shown in Figs. 3 and 9. Consequently upon every rotation of the idler 40, the pin will be withdrawn so as to permit the rotation of the head and shell to permit the
 50 twisting operation. The means for effecting this twisting operation is preferably constructed in the following manner. A clutch member 90 is loosely journaled on the sleeve
 55 62, and has a pinion 91 in mesh with a gear wheel 92 fixed to the main driving shaft 33. Consequently the clutch member 90 is always in rotation, and operates independently of the sleeve 62. A coöperating clutch
 60 member 93 is feathered on the sleeve 62, as shown at 94, and is movable into and out of coaction with the clutch member 90. When out of coaction, the sleeve 62 and the various parts carried thereby, is of course stationary,
 65 but if said clutch member 93 is moved into coaction with the clutch member 90, then the sleeve 62 and associated parts are necessarily rotated. These clutch members, preferably have beveled friction faces, as shown,
 but they are also provided with positive en-

gaging devices in the form of projecting pins 95. In order to secure the automatic operation of the clutch, a swinging arm 96 is employed pivoted at its lower end, as shown at 97. The upper end of this arm, as illus-
 70 trated in Figs. 1 and 5 has a cross pin 98, one end of which is engaged in an annular groove 99 in the clutch member 93, the other end coöperating with the cam edges 100 of the wheel 77 and the adjacent wheel 101 carried
 75 by the shaft 78, on which said wheel 77 is mounted. Therefore upon each rotation of the shaft 78, the arm 96 will be swung carrying the clutch member 93 into coaction with the clutch member 90, and causing the rota-
 80 tion of the head 60 and associated mechanism, thus twisting the sides of the wire loop together. In order to compensate for the shortening of the loop due to this twisting action, the head 60 and stem 63 have a move-
 85 ment longitudinally of their axis of rotation, and this movement is controlled by a wheel 102 which bears against a head 103 formed upon the outer projecting end of the stem 63, the wheel having a cam portion 104, which
 90 permits the inward longitudinal movement of the stem 63.

After the loops and twists have been made, the wires are in condition to be removed from the machine. Therefore the following
 95 devices are employed. The shafts 78 project toward each other, but are entirely independent, as shown in Fig. 1. They have fixed to their inner ends arms 105 provided with terminal hooks 106, and as these arms
 100 swing upwardly, they engage the wires just as the clamping jaws 21 and 80 open. The shafts 78 are furthermore provided with other arms 106^a having terminal heads 107 that engage the loops and serve to detach
 105 them from the looping and twisting mechanisms. Therefore the wires being detached by said heads 107, the arms 105 carry the completed articles away from the machine and deposit them on the opposite side to the
 110 feeding mechanism.

As already described, the looping and twisting mechanisms are duplicates, but are entirely independent of each other save for the connecting shaft 31. This shaft at one
 115 end of the machine is geared, as shown at 107^a to one of the driving shafts 33 and this driving shaft is provided with a driving pulley 108 by means of which power is transmitted to the machine. The other end of
 120 the shaft is geared as shown in Fig. 2 at 109 to the corresponding driving shaft 33, and thus power is transmitted to the corresponding mechanism. It will be observed that the looping and twisting devices are located in op-
 125 position to each other, and in order that the machine may be operated on wires of different lengths, one set of mechanisms is adjustable toward and from the other. To this end, it is slidable upon the spaced tracks or
 130

beams 17 and the bolts 110, which secure it in place, can be passed through any of the series of openings 111 formed in said tracks or beams. Moreover the machine is readily adapted to operate on wires of different diameters, the only change necessary being the substitution of different sized studs 67 on the looping devices in order to secure more or less distance between said studs 67 and the cooperating pins 68.

The operation of the machine may be briefly outlined as follows. Under normal conditions, the parts are as illustrated in Fig. 1. If therefore a wire is placed in the trough 36 and the machine is in operation, the clamps on the ends of the arms 41 will pick up said wire from the trough and deposit it in the clamps 20—21 with the terminal portions of said wire located between the studs 67 and 68 of the looping devices. When the wire has been so deposited, the jaws 21 will be operated to hold the wire, and immediately the racks 70 will operate to loop the terminals of the wire. As soon as this takes place, the jaws 80 are raised to clamp the terminals and thereupon the bolts 85 are withdrawn from the twisting heads while the clutch members 93 are moved into coaction with the clutch members 90. Inasmuch as the looping studs 67 and pins 68 are still engaged with the loops just produced, it will be evident that said loops will be rotated, and as their ends are held by the jaws 20, 21 and 80, the sides of said loop will be twisted together. During this twisting operation, the loops will contract, due to the take up of the wire, and to compensate for this the cam portions 104 of the wheels 102 will permit the heads 103, and consequently the heads 60 to move inwardly longitudinally of their axes of rotation. The twisting operation being completed, the clutch members 93 are automatically disassociated from the clutch members 90 so that the rotation of the looping and twisting devices is stopped. At the same time, the jaws 21 and 80 open and the arms 105 and 106^a engaging the finished wire, remove the same from the machine.

From the foregoing, it is thought that the construction, operation, and many advantages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is:—

1. In a machine of the character set forth, the combination with wire working mechanism, of a wire holding device, means for

transferring a wire from the holding device to the working mechanism and leaving it in the latter, means for moving the transferring means from the holding device to the working mechanism, and returning it to said holding device, and mechanism for operating the wire working mechanism between the deposits of the wires therein by the transferring means and holding said mechanism stationary during said deposits.

2. In a machine of the character set forth, the combination with wire working mechanism, of a wire holding device, rotary means for transferring a wire from the holding device to the working mechanism and leaving it in the latter, means for continuously rotating the transferring means, and mechanism for operating the wire working mechanism between the deposits of the wires therein by the transferring means, said operating mechanism holding the working mechanism stationary during the deposits of the wires.

3. In a machine of the character set forth, the combination with wire working mechanism, of a wire holding trough spaced therefrom, and rotary transferring arms having wire engaging devices that move upwardly at the ends of the trough to elevate wires therefrom, said devices moving downwardly past the wire working mechanism to deposit and leave the wires therein.

4. In a machine of the character set forth, the combination with wire working mechanism including the clamp, of wire holding means spaced therefrom, and rotary transferring arms having wire engaging devices that move upwardly at the wire holding means to elevate the wires therefrom and move downwardly past the clamp to deposit and leave the wires in said clamp.

5. In a machine of the character set forth, the combination with wire working mechanism, of a clamp for holding a wire while being operated upon by said wire working mechanism, wire holding means, rotary transferring arms for carrying the wires from the holding means to the clamp and leaving it in the latter, said arms having wire engaging devices that move upwardly at the holding means to elevate wires therefrom and move downwardly past the clamp to deposit the wires therein, means for continuously rotating the arms, and means for operating the wire working mechanism between the deposits of the wires in the clamps, said means being inactive during the deposits of the wires.

6. In a machine of the character set forth, the combination with wire working mechanism, of a clamp for holding a wire stationary while operated upon by said mechanism, and movable means for carrying a wire and depositing it in the clamp and in position to be operated upon by the working mechanism, said means releasing and leaving the wire in

the clamp and then moving onward beyond said clamping means.

7. In a machine of the character set forth, wire working mechanism, a clamp for holding the wire stationary while operated upon by said wire working mechanism, a carrier movable transversely to the clamp and past the clamp adapted to carry a length of wire to the clamp in position to be operated upon by the wire clamping mechanism, and means for simultaneously releasing the wire from the carrier, closing said clamp upon the wire and moving the carrier onward, leaving the wire in the clamp.

8. In a mechanism of the character set forth, the combination with wire looping and twisting mechanism, of a magazine adapted to hold lengths of untwisted wire, a fixed clamp for holding a length of wire while being operated upon by said mechanism, a carrier movable transversely to and past said fixed clamp, said carrier having thereon a transferring clamp adapted to grasp a length of wire at the magazine, carry it to the holding clamp and deposit it therein, means simultaneously closing said holding clamp upon the wire and releasing the carrier clamp, and means for moving said carrier onward past the fixed clamping means.

9. In a machine of the character set forth, the combination with wire working mechanism, of wire holding means, a transferring clamp for carrying the wire from the holding means to the wire working mechanism, and means for automatically effecting the movement of the clamp to grasp the wire at the holding means and release it at the working mechanism.

10. In a machine of the character set forth, the combination with wire looping and twisting mechanism, of wire holding means, a transferring clamp for carrying the wires transversely of their lengths from the holding means to the wire working mechanism, and means for automatically effecting the movement of the clamp to grasp the wire at the holding means and release it at the working mechanism.

11. In a machine of the character set forth, the combination with wire working mechanism, of mechanism for feeding wires thereto including a rotary support, and a clamp rotatably mounted on the support.

12. In a machine of the character set forth, the combination with wire looping mechanism, of mechanism for feeding wires thereto including a rotary support, a clamp rotatably mounted on the support, and means for maintaining the clamp in a predetermined position to the perpendicular regardless of the movement of the support.

13. In a machine of the character set forth, the combination with wire working mechanism, of mechanism for feeding wires thereto including a rotary arm, a clamp ro-

tatably mounted on the free end of the arm, and means mounted on the arm and engaging the clamp for maintaining said clamp in a predetermined position to the perpendicular regardless of the rotation of the arm.

14. In a machine of the character set forth, the combination with wire working mechanism, of a movable support, a feeding clamp movably mounted on the support, means for automatically operating the clamp to grasp the wire, means for moving the support to carry the wire to the wire working mechanism, and means for automatically operating the clamp to release said wire at said wire working mechanism.

15. In a machine of the character set forth, the combination with wire working mechanism, of wire supporting means, a wire transferring device operating between the supporting means and wire working mechanism and including a clamp, means for automatically operating the clamp to grasp a wire at the supporting means, and means for operating the clamp to release the wire and leave it at the working mechanism.

16. In a machine of the character set forth, the combination with wire working mechanism, of wire supporting means, a wire transferring device operating between the supporting means and wire working mechanism and including a clamp comprising relatively movable jaws, means for automatically operating the clamp to close the jaws at the supporting means, and means for operating the clamp to open the jaws in order to release the wire and leave it at the working mechanism.

17. In a machine of the character set forth, the combination with wire working mechanism, of a clamp for holding a wire while being operated upon by said mechanism, a wire feeding device including a wire clamp for carrying a wire into said holding clamp, and means for opening the second wire clamp when a wire is placed therein by the first clamp.

18. In a machine of the character set forth, the combination with wire working mechanism, of a clamp for holding a wire while being clamped upon by said mechanism, a wire feeding device including a wire clamp for carrying a wire into said holding clamp, means for opening the second wire clamp when a wire is placed therein by the first clamp, and means for closing said first clamp when a wire is placed therein by the second clamp.

19. In a machine of the character set forth, the combination with wire working mechanism, of a rotatable arm, a feeding clamp mounted on the free end of the arm and comprising relatively swinging jaws, means for automatically closing the jaws to grasp a wire when the arm is in one position, means for rotating the arm to carry the wire

to the wire working mechanism, and means for automatically opening the jaws to release the wire and permit its delivery to the wire working mechanism.

5 20. In a machine of the character set forth, the combination with wire working mechanism, of a shiftable feeding device movable into and out of coaction therewith, a feeding clamp mounted on the device, 10 means for automatically operating the clamp to grasp a wire when the device is in one position, means for moving the feeding device to carry the wire to the wire working mechanism, and means for automatically operating 15 the clamp to release the wire and permit its delivery to the wire working mechanism.

21. In a machine of the character set forth, the combination with wire working mechanism, of clamps for holding a wire in 20 position to be operated upon by the wire working mechanism, a wire support located at one side of the working mechanism, transferring devices movable between the support and the clamps, feeding clamps mounted on 25 the transferring devices, means for automatically closing the clamps upon a wire at the support and automatically opening the same at the holding clamps to deliver a wire into the latter, and means for closing the latter 30 clamps when a wire is therein.

22. In a machine of the character set forth, the combination with wire working mechanism, of a wire holder, a rotary support operating transversely thereof, relatively 35 movable jaws mounted on the support, and means for automatically effecting the closing of the jaws on the movement of the support past the wire holder and the opening of said jaws on the movement of the support past the 40 wire working mechanism.

23. In a machine of the character set forth, the combination with wire working mechanism, of a rotary arm, a clamp rotatably mounted on the arm and comprising 45 relatively movable jaws, and means for operating said jaws.

24. In a machine of the character set forth, the combination with wire working mechanism, of a rotary supporting arm, a 50 clamp rotatably mounted on the arm and comprising relatively movable jaws, means for maintaining the jaws in a predetermined position to the perpendicular during the rotation of the arm, and means for operating the 55 jaws.

25. In a machine of the character set forth, the combination with work holding mechanism, of a rotatable supporting arm, a clamp mounted on the arm and comprising 60 relatively movable jaws, and means carried solely by the arm for operating the jaws during the movement of the arm.

26. In a machine of the character set forth, the combination with wire working 65 mechanism, of a rotatable supporting arm, a

wire carrying clamp mounted on the arm and comprising relatively swinging jaws, one of said jaws having oppositely outstanding fingers, and a projection on the arm that successively engages the fingers to effect the 70 operation of the jaws.

27. In a machine of the character set forth, the combination with wire working mechanism, of a rotatable supporting arm, a clamp rotatably mounted on the arm, and 75 comprising relatively movable jaws, means for maintaining the clamp in a predetermined position to the perpendicular during the rotation of the arm, said means comprising a shaft on the arm that is geared to the clamp, 80 and means for effecting the rotation of the shaft.

28. In a machine of the character set forth, the combination with wire working mechanism, of a rotatable supporting arm, 85 a wire holding clamp rotatably mounted on the free end of the arm and having a gear wheel, a shaft journaled on the arm and having a wheel in mesh with the gear wheel, a tubular shaft supporting the arm, a fixed 90 axle supporting the tubular shaft, and gear connections between said fixed axle and the shaft that is journaled on the arm.

29. In a machine of the character set forth, the combination with wire working 95 mechanism, of mechanism for feeding wires thereto including a fixed axle, a tubular shaft journaled on the axle, an arm carried by the tubular shaft, a clamp rotatably mounted on the free end of the arm and comprising 100 relatively swinging jaws, one of which is provided with oppositely extending fingers, a spring for normally holding the jaws closed, a projection carried by the arm, and located in the path of movement of the fingers to 105 swing the jaws to an open position, and gear connections between the clamp and the fixed axle for maintaining the clamp in a vertical position during the complete rotation of the arm. 110

30. In a machine of the character set forth, the combination with wire looping and twisting mechanism, of a wire holding trough, a rotatable arm having its axis of rotation located between the trough and the looping 115 and twisting mechanism, a clamp mounted on the free end of the arm and movable past the end of the trough and past the looping and twisting mechanism, means for operating the clamp to clamp a wire in the trough and 120 carry said wire to the looping and twisting mechanism, and means for operating the clamp to release said wire and deposit it in said looping and twisting mechanism.

31. In a machine of the character set 125 forth, the combination with wire working mechanism, of feeding means therefor including a rotatable support, a wire clamp rotatably mounted on the support, and co-acting devices carried by the support and 130

clamp and rotatable therewith for effecting the movement of the clamp.

32. In a machine of the character set forth, the combination with wire working mechanism, of feeding means therefor including a rotatable support, a holding device rotatably mounted on the support, and means for maintaining the holding device in a predetermined position to the perpendicular during the rotation of the support.

33. In a machine of the character set forth, the combination with wire working mechanism, of feeding means therefor including a rotatable support, a wire holding device rotatably mounted on the support, means for rotating the support, and means for rotating the holding device on the support at a speed that will maintain said holding device in a predetermined position to the perpendicular during the rotation of the support.

34. In a machine of the character set forth, the combination with mechanisms for separately looping and twisting both ends of a wire, of a wire holder located at one side of the mechanisms, and rotary carrying arms operating transversely of the holder and having wire clamping devices that automatically engage the wires placed in the holder and transfer them with their ends in cooperating relation to the looping and twisting mechanisms.

35. In a machine of the character set forth, the combination with wire working mechanism, of feeding means therefor including a rotatable support, a wire holding device rotatably mounted on the support and comprising relatively movable clamping jaws, means for rotating the support, means for rotating the holding device on the support at a speed that will maintain said holding device in a predetermined position to the perpendicular during the rotation of the support, and means carried by the support for effecting the opening and closing of the jaws during the rotation of said support.

36. In a machine of the character set forth, the combination with wire looping and twisting mechanism, of a clamp for holding the wires, said clamp comprising a stationary jaw and a swinging jaw having an arm, a rotary cam operating against the arm for swinging the same, and means for delivering wires into the clamp.

37. In a machine of the character set forth, the combination with wire looping and twisting mechanism, of a clamp for holding the wires, said clamp comprising a stationary jaw and a swinging jaw having an arm, a rotary cam operating against the arm for swinging the jaw, a wire holder, and rotary arms having wire clamping devices for carrying the wires from the holder to the first mentioned clamp.

38. In a machine of the character set forth, wire looping mechanism comprising a pair of

associated wire-engaging clamps, a wire looping device associated with the clamps, and mechanism for first operating one of the clamps to secure the wire against movement, afterwards operating the looping device, and after the looping operation operating the other clamp to secure the loop.

39. In a machine of the character set forth, the combination with wire looping mechanism, of mechanism for actuating the same including a reciprocatory device, a rotary cam located alongside the device, a movable support, and oppositely extending fingers carried by the support, one of the fingers being engaged with the cam, the other engaging the reciprocatory device to operate the same.

40. In a machine of the character set forth, wire looping mechanism including a rotary looping device, a reciprocatory rack geared to the looping device, a swinging arm connected to the rack, and a cam for swinging the arm.

41. In a machine of the character set forth, wire looping mechanism comprising a gear wheel having a wire receiving seat, means for depositing a wire in the seat, a reciprocatory rack geared to the wheel, a swinging arm having oppositely outstanding fingers, one of which is engaged with the rack, and a rotary cam engaging the other finger to effect the swinging movement of the arm.

42. In a machine of the character set forth, wire looping mechanism comprising a gear wheel having a central removable pin, and another pin spaced from the central pin, means for partially rotating the gear wheel and returning it, a clamp located adjacent to the gear wheel, and means for depositing a wire in the clamp and between the pins.

43. In a machine of the character set forth, wire looping mechanism comprising a gear wheel having a central removable pin and another pin spaced from the central pin, means for partially rotating the gear wheel and returning it, a clamp located adjacent to the gear wheel, and means for depositing a wire in the clamp and between the pins, said means comprising rotary arms, clamping devices carried by the arms, and means for opening the clamping devices as they pass the first mentioned clamp.

44. In a machine of the character set forth, the combination with a plurality of clamping devices, of means for successively operating the clamping devices, and means for bending a wire engaged by one device after the operation of said device to a position to be clamped by the other device prior to the operation of said other device.

45. In a machine of the character set forth, the combination with an intermediate clamping jaw, of outer clamping jaws cooperating with opposite sides of the same, means for delivering a wire between one of the outer

jaws and the intermediate jaw, and means for looping the wire and carrying the same to a position to be held between said intermediate jaw and the other outer jaw.

5 46. In a machine of the character set forth, the combination with wire holding means, of a clamping device including a support, and a jaw movable into and out of projecting relation with respect to the support, means for bending a wire placed in the
10 holding means over the movable jaw, and means for operating the jaw to clamp the wire after it has been so bent.

47. In a machine of the character set forth, the combination with a wire bending device, of means for operating the same, a clamp including a jaw movable into and out of the path of movement of a wire bent by said device, means for maintaining the jaw
20 out of said path of movement during the bending operation, and means for operating the jaw to clamp the wire after said bending operation.

48. In a machine of the character set forth, the combination with a clamp, of means for feeding a wire into said clamp, a second clamp, means for operating the first clamp, means for afterwards operating the second clamp, means for bending the wire
30 held by the first clamp into the second clamp, and mechanism for operating the bending means after the operation of the first clamp and prior to the operation of the second clamp.

49. In a machine of the character set forth, the combination with a clamp, of means for feeding a wire thereto, a second clamp comprising a support, a jaw movable into and out of the support, means for swinging the jaw, and means for bending a wire
40 held by the first clamp to a position to be secured by the jaw of the second clamp while said jaw is in the support.

50. In a machine of the character set forth, the combination with a support having a stationary jaw, of a movable jaw coöperating with one side of the stationary jaw, another jaw movable into and out of the support and coöperating with the opposite
50 side of the stationary jaw, means for feeding a wire to a position to be secured by the first movable jaw, means for bending said wire to a position to be engaged by the second movable jaw, and actuating means for successively moving the jaws.

51. In a machine of the character set forth, the combination with rotary twisting mechanism including a shaft, of relatively rotatable clutch elements, one of which is
60 fixed against rotation to the shaft, a cam device located alongside the clutch elements, and a supporting device carrying oppositely extending fingers, one of which engages the cam device, the other engaging one of the
65 clutch elements.

52. In a machine of the character set forth, the combination with rotary twisting mechanism, including a shaft, of relatively rotatable clutch elements associated therewith, a cam device located alongside the
70 shaft, a swinging supporting arm operating between the cam device and shaft, and oppositely extending fingers carried by the arm and respectively engaging the cam device and one of the clutch elements.

53. In a machine of the character set forth, the combination with a rotary twisting device, of a rotary driving device connected thereto, a clutch element secured to one, a
80 coacting clutch element slidable on the other, a cam located alongside the clutch elements, a swinging arm, and oppositely extending fingers carried by the arm, one of said fingers engaging the cam, the other engaging the slidable clutch element.

54. In a machine of the character set forth, the combination with rotary twisting mechanism capable of a movement longitudinally of its axis of rotation, of means for rotating the mechanism, and means mounted
90 independently of said twisting mechanism and continuously movable during the twisting operation to permit of the said longitudinal movement of the twisting mechanism to compensate for the shortening of the wire
95 during the twisting operation but preventing any longitudinal movement of the twisting mechanism beyond what is necessary to compensate for the shortening of the wire.

55. In a machine of the character set forth, the combination with rotary twisting mechanism having a longitudinal movement, of means for rotating the same, and rotary means having its axis of rotation disposed at
100 one side of the axis of the twisting mechanism engaging the same to control said longitudinal movement, but permit a sufficient longitudinal movement of the twisting mechanism to compensate for the shortening of the wire during the twisting operation.

56. In a machine of the character set forth, the combination with a rotary twister capable of a movement during its rotary movement to compensate for the shortening
110 of the wire due to the twisting operation, of means for rotating the twister, and a cam device for controlling the said movement of the twister during its rotation.

57. In a machine of the character set forth, the combination with a rotary twister movable longitudinally of its axis of rotation and having a bearing head, of means for rotating the twister, and a rotary wheel bearing against the head and having a cam surface that permits the twister to move longitudi-
125 nally of its axis.

58. In a machine of the character set forth, the combination with a twister including a shaft having a twisting head at one end and a bearing head at the other end, of means
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for rotating the twister, a cam wheel journaled at one side of the shaft, said cam wheel having a bearing against the bearing head and a cam track that rides against the same to permit the longitudinal movement of the shaft, and means for simultaneously rotating the shaft and wheel.

59. In a machine of the character set forth, the combination with a looped clamping device, of a rotary twister having a movement toward and from the clamping device, a rotary cam for controlling said movement of the twister, and means for rotating the twister.

60. In a machine of the character set forth, the combination with a tubular shaft, of twisting mechanism mounted thereon and including a stem longitudinally movable in the shaft, means for rotating the shaft, and means engaging the stem for controlling the longitudinal movement of the same in the shaft to compensate for the shortening of the wire during the twisting operation.

61. In a machine of the character set forth, the combination with a tubular shaft, of twisting mechanism mounted thereon and including a head projecting beyond one end of the shaft and having a stem that is longitudinally movable in said shaft, means for rotating the shaft including clutch mechanism mounted on said shaft, and a cam device engaging the stem for controlling its longitudinal movement.

62. In a machine of the character set forth, the combination with a wire holding clamp, of a second clamp, a rotatable support, a looping device mounted on the support for bending a wire in the first clamp into the second clamp, means for operating the looping device, and means for rotating the support after the operation of the looping device.

63. In a machine of the character set forth, the combination with a clamp, of means for operating the clamp to secure a wire therein with the ends projecting therefrom, a rotatable supporting head, a looping device rotatably mounted on the head and engaging the wire held by the clamp, a second clamp, means for operating the looping device to bend the wire into said second clamp, means for actuating the second clamp, and means for rotating the supporting head to twist the loop thus produced.

64. In a machine of the character set forth, the combination with cooperating clamps located side by side, of a rotary head, a rotary looping device carried by the head, means for depositing a wire in one of the clamps and in the looping device, means for rotating the looping device, said device bending the wire into the other clamp, means for operating said second clamp to secure the wire, and means for rotating the head to twist the loop thus produced.

65. In a machine of the character set forth, the combination with a rotatable support, of a wire looping device rotatably mounted on the support, means for rotating the looping device on the support, means for locking the support against movement during the operation of the looping device, means journaled upon the support for actuating the locking means, and means for rotating the support after the operation of the looping device.

66. In a machine of the character set forth, the combination with a rotatable support, of a wire looping device rotatably mounted on the support, means for rotating the looping device on the support, a lock for holding the support against movement during the operation of the looping device, means for rotating the support after the operation of the looping device, and mechanism for automatically unlocking the support after the looping operation to permit the rotation of the support, said mechanism including an idler loosely journaled on the support and having its axis substantially coincident with the axis of said support, and a device operated by the idler and operating the lock.

67. In a machine of the character set forth, the combination with a rotatable support constituting twisting means, of a wire looping device rotatably mounted on the support, means for rotating the looping device on the support, a spring pressed bolt engaging the support for holding it against movement during the operation of the looping device, means for periodically moving the bolt to release the support, and means for rotating said support when released.

68. In a machine of the character set forth, the combination with wire clamping means, of a rotatable twister head associated therewith, a looping device rotatably mounted on the head and associated with the wire clamping means, mechanism for rotating the looping device on the twister head, a spring pressed bolt that engages the head to prevent its rotation, means for rotating the head, and an idler gear having a cam track that engages the bolt to release the head and permit its rotation.

69. In a machine of the character set forth, the combination with a clamping device, of means for feeding wires successively thereto, said means including spaced rotating arms and automatically operating wire clamps rotatably mounted on the arms, a second clamp, a rotatable head associated with the clamps, a rotatable looping device mounted on the head, means for rotating said device including a reciprocatory rack, a cam for actuating the rack, said looping device bending a wire secured in the first clamp to a position to be secured by the second clamp, means for actuating the second clamp, a locking bolt for securing the head against rotation during the operation of the

looping device, means for rotating the head including a driving member and a clutch for securing the driving member and head together, automatic mechanism for operating the clutch, and means for withdrawing the bolt from the head when the clutch is thrown into operation.

70. In a machine of the character set forth, the combination with means for holding lengths of untwisted wire, of means continuously rotating for raising said wire lengths from the holding means, carrying a length of wire to the wire working mechanism, depositing and leaving the wire in the working mechanism and moving backward to the wire length holding means, and means that engages and removes the wire from the working mechanism after the wire has been twisted, said removing means being independent of the depositing means.

71. In a machine of the character set forth, the combination with wire working mechanism, of means that moves downwardly to deliver a wire thereto and leave it therein, and other means that moves upwardly to engage the wire so left, and carry it away from the wire working mechanism.

72. In a machine of the character set forth, the combination with wire working mechanism including a holding clamp, of means that moves in one direction past the clamp to deliver a wire thereto and leave it therein, and other means that moves in an opposite direction past the clamp to engage the wire so left and carry it away from the clamp.

73. In a machine of the character set forth, the combination with wire looping and twisting mechanism, of one means that delivers wire successively to the looping and twisting mechanism, another means operating between the delivery of the wires by the first means to remove the same from said mechanism, and means for operating the wire looping and twisting mechanism between the delivery and removal of each wire.

74. In a machine of the character set forth, the combination with mechanism for forming terminal loops on wires, of means for removing said wires from the mechanism comprising a rotary arm that disengages the loops from the mechanism, and a wire carrying arm that coöperates with the disengaging arm and having a wire holding hook that engages the wire when the same is disengaged by the first arm.

75. In a machine of the character set forth, the combination with wire working mechanism including a looping and twisting device, of a shaft located alongside the device, a rotary arm carried by the shaft and constituting means for removing the twisted loop from the device, and a rotary wire engaging arm coacting with the wire carrying arm and also secured to the shaft.

76. In a machine of the character set forth,

the combination with wire working mechanism including a wire holder, of a rotary arm having means for delivering wire to and leaving it in the holder, and a separate rotary arm that carries the wire delivered by the first arm out of and away from the holder.

77. In a machine of the character set forth, the combination with wire working mechanism including a wire holder, of a rotary arm located and operating on one side of the wire working means and constituting means for delivering a wire to and leaving it in the holder, and a rotary arm located and operating on the opposite side of the wire working means for engaging and carrying the wire so left away from the holder.

78. In a machine of the character set forth, the combination with a support, of a wire clamp located thereon, wire looping and twisting mechanisms associated with the clamp, a rotary shaft disposed on one side of the twisting means, a rotary feeding arm secured to the shaft and having wire clamping mechanism that delivers wires successively to the first mentioned clamp, a rotary shaft located on the opposite side of the wire looping and twisting mechanism, and a delivery arm secured to the latter shaft and removing the wire from the first mentioned clamp.

79. In a machine of the character set forth, the combination with a supporting frame, of a clamp mounted thereon, means for periodically opening and closing the clamp, wire looping and twisting mechanism journaled on the frame and coöperating with the clamp, an idler gear rotatably mounted on the looping and twisting mechanism, means for rotating the idler gear, a shaft located at one side of the looping and twisting mechanism and driven by the idler gear, a wire holding trough located alongside the shaft, an arm secured to the shaft, a clamp carried by the shaft, means for operating the clamp to grasp the wire in the trough and transport it to the first mentioned clamp, means for releasing the clamp of the arm to deliver the wire into said first mentioned clamp, means for operating the looping and twisting mechanism to produce a loop in said wire while in the first mentioned clamp, another shaft located on the opposite side of the wire looping and twisting mechanism to the first mentioned shaft and driven by the idler gear, and releasing and carrying arms secured to the latter shaft for disengaging the wire from the looping and twisting mechanism and the first mentioned clamp and delivering the same from the machine.

80. In a machine of the character set forth, the combination with spaced wire looping and twisting mechanisms, of clamping means located between said mechanisms, rotatable arms having their axis of movement at one side of the clamping means for delivering wires to said clamping means, and

rotatable arms having their axis of movement on the opposite sides of the clamping means for removing the wires from the same.

5 81. In a machine of the character set forth, the combination with a supporting frame including spaced tracks, of a wire looping and twisting mechanism mounted on the frame, another wire looping and twisting mechanism mounted on the spaced tracks
10 and adjustable toward and from the first mentioned mechanism, means for securing the latter mechanism at different distances from the first mentioned mechanism, and wire clamping means located between the
15 mechanisms for holding wires with their terminals in position to be looped and twisted by said mechanisms.

82. In a machine of the character set forth, the combination with a clamp engaging the main body of a length of wire, of 20 means for looping the end of the wire projecting from the clamp, means other than said clamp for securing the end of the wire after the loop has been formed, and mechanism for rotating the looping means to 25 twist the loop so secured.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

STEPHEN I. ARMBRUSTER.

Witnesses:

JEROME E. ARMBRUSTER,
ALOIS F. ARMBRUSTER.