Feb. 18, 1958 J. G. LORD 2,823,792

WIRE FEEDING APPARATUS

Filed April 5, 1956 3 Sheets-Sheet 1

FIG. 1.

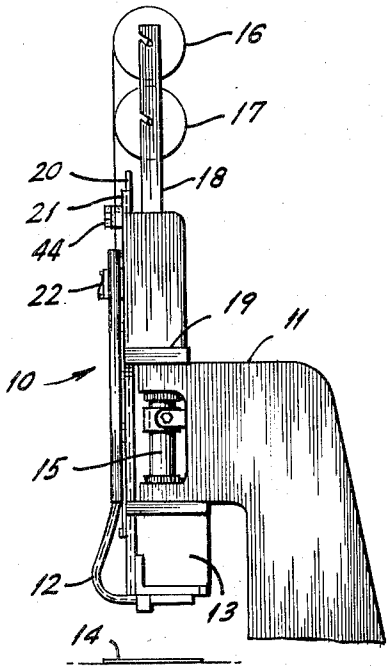
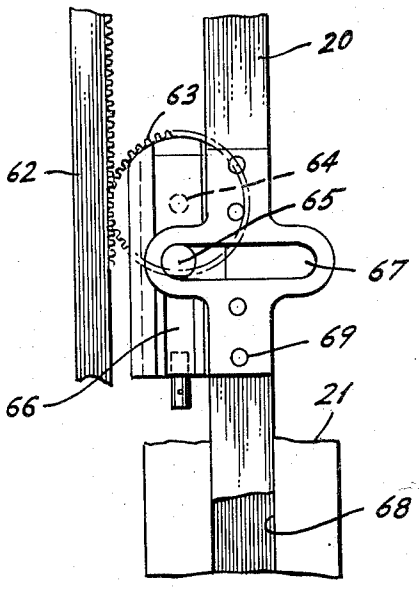


FIG. 5.



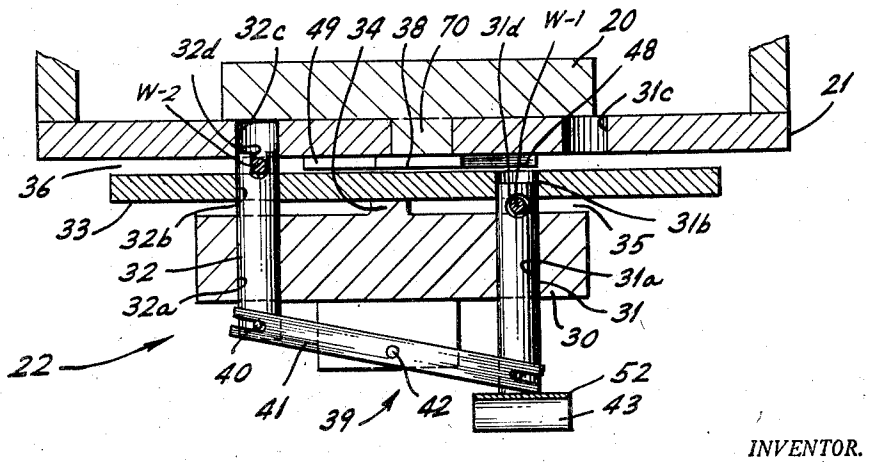


FIG. 4.

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WIRE FEEDING APPARATUS

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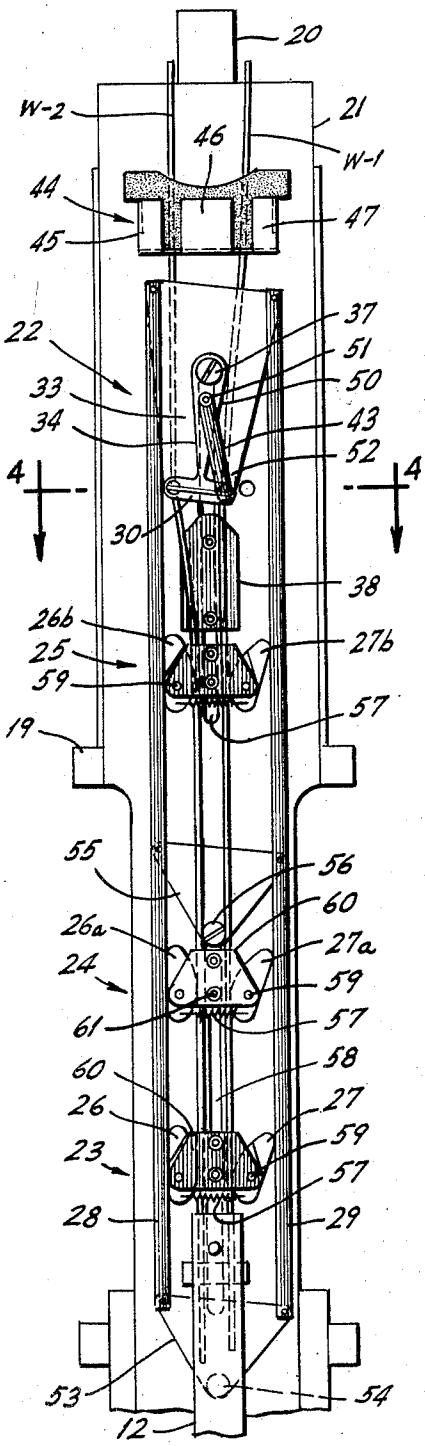


FIG. 2.

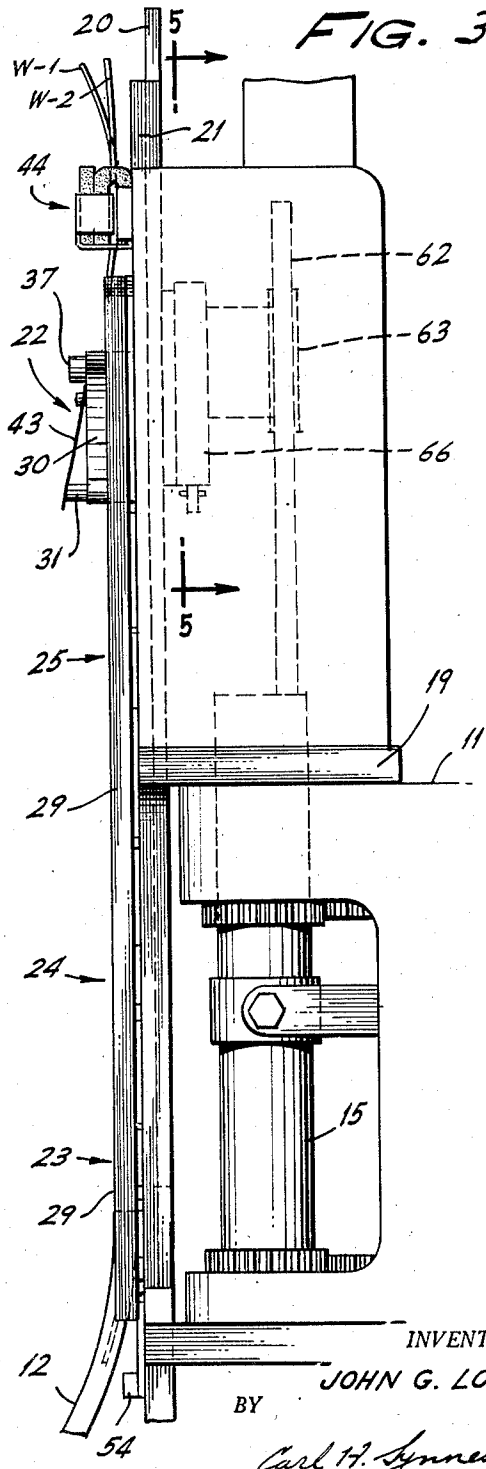


FIG. 3.

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WIRE FEEDING APPARATUS

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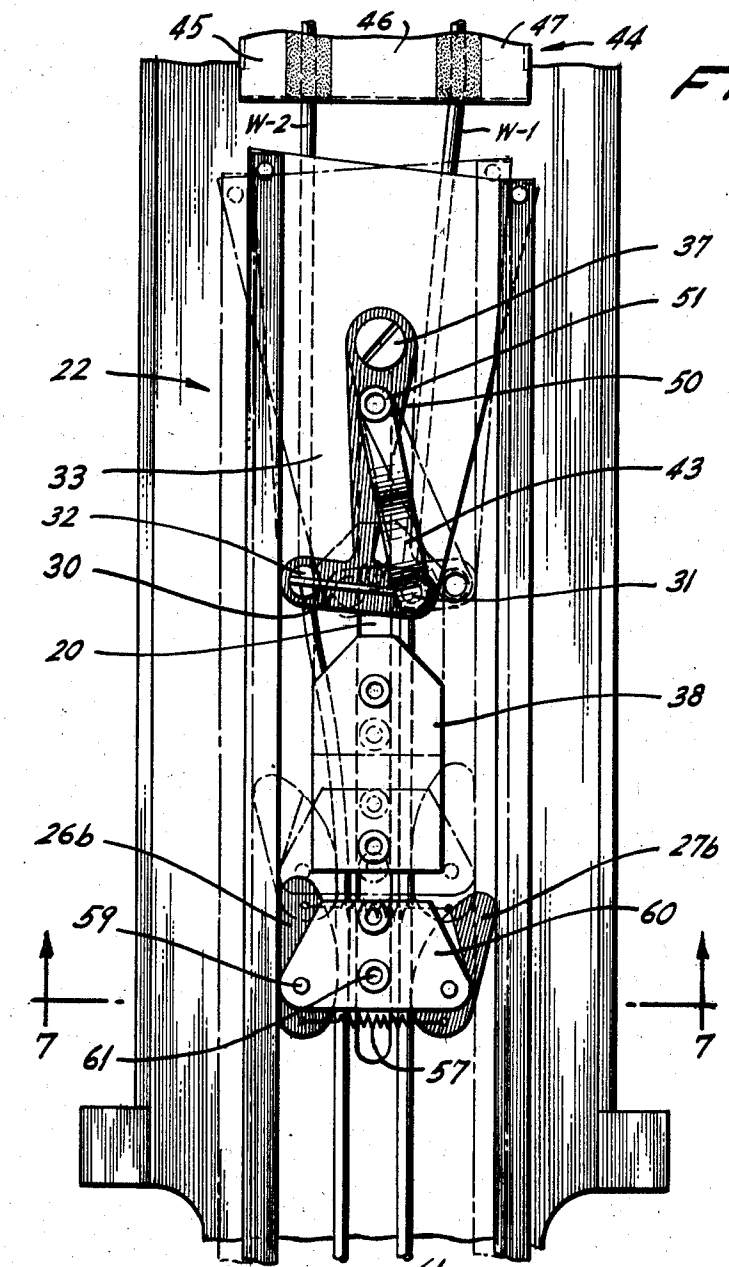


FIG. 6.

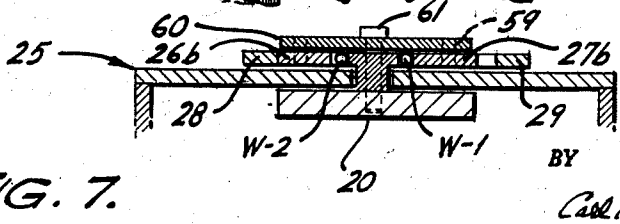


FIG. 7.

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WIRE FEEDING APPARATUS

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Application April 5, 1956, Serial No. 576,434

17 Claims. (Cl. 203—65)

This invention relates to wire feeding apparatus.

In such apparatus, successive lengths of wire are moved from a zone of supply to a zone of discharge, either intermittently or continuously but practically always in a constant or continual or regulated movement, for purposes of fabrication of electrical devices or for various other purposes. In the zone of supply the wire may be stored on reels; and after passing into or beyond the zone of discharge the wire may be severed into parts, and may be shaped or otherwise treated or used.

A main purpose of the present apparatus is to protect the wire discharge and utilization zone from difficulties potentially arising in the wire supply zone. It is often desirable and sometimes necessary to provide such protection and thus to make sure that the feeding process will proceed at its predetermined or constant rate. Desirably the wire feeding process is undisturbed even by the running out of the wire on a reel and the occurrence of a break in the wire on a reel, and it is a specific purpose of the invention to make the feeding operation independent of such incidents.

One of the cases where this is important is the automatic mass fabrication of electrical wiring panels, wherein wire may be utilized very rapidly, so that the running out of a reel may occur quite frequently. The invention will be described as applied in such fabrication, although it will be understood that the invention is capable of many other applications.

It is a specific object of the invention to feed wire material so as to allow predetermined fabrication in the wire discharge zone, undisturbed by discontinuities of wire in the supply zone. A still more specific object is to feed wire by a cycle of strokes from one of a pair of reels, and to automatically shift the feeding operation from one reel to another, in case of a discontinuity in the wire, particularly, to shift the feeding operation so as to miss none of said strokes.

The objects have been achieved by a novel combination of movable and stationary wire engaging elements. Briefly described, a preferred form of the apparatus is formed as a vertical unit comprising, as an uppermost element, a pair of reels of wire; therebelow, a wire continuity sensing device such as a pair of mechanical wire feelers; next, a pair of wire clamping and feeding units vertically reciprocable below the reels and controlled by the sensing element so that only one of the units actually clamps and feeds a wire and that only on each downward stroke of the pair of units; and, as a lowermost element, a wire discharge means. The wire sensing and wire clamping devices are adapted, upon the running out of wire on one reel, to promptly shift the wire feeding to the other clamping unit and thereby to the other reel. The exact manner in which this is achieved will be understood from the description which follows.

In the drawing appended hereto:

Figure 1 is a side view of apparatus embodying the invention.

Figures 2 and 3 are, respectively, front and side views of a part of the apparatus of Figure 1, on a larger scale.

Figure 4 is an additionally enlarged sectional detail view taken along line 4—4 in Figure 2.

Figure 5 is a detail view taken along line 5—5 in Figure 3.

Figure 6 is an enlarged fragmentary front view of an upper part of the structure shown in Figure 2, and

Figure 7 is a sectional view taken along line 7—7 in Figure 6.

Referring first to Figure 1: the wire feeder **10** is shown as being mounted on the ram guide **11** of a machine for wire insertion or stapling in panel fabrication or the like, the latter machine being shown only in fragmentary and general outline, since, per se, it forms no part of the present invention. A discharge duct **12** of the wire feeder is adapted to guide an elongated wire from that feeder into a cutting and inserting tool **13** forming part of the machine and adapted to sever successive wire portions from the elongated wire and to insert them in electrical circuit panels **14**. Said panels are transferred into the vicinity of the tool **13**, for such insertion, by suitable transfer apparatus, not shown. Power for the operation of the wire feeder **10** and tool **13** may be furnished by one and the same structure, for instance, by a ram **15** vertically moving in the ram guide **11** in response to mechanical, pneumatic or other operating forces. The operation of the feeder **10**, in turn, causes the elongated wire to be unrolled from one or the other of a pair of reels **16**, **17**. These reels may be mounted on the top of the ram guide **11**, for instance by a vertical holder structure **18**, whereas the feeder tool **10** may be mounted on the front of the same ram guide by clamping connector means **19**.

In Figures 2 and 3 the tool **10** is shown as comprising a long, vertical slider **20**, vertically reciprocable in an even longer, stationary holder or base structure **21**. Pivotally mounted on an upper front part of the holder **21** there is a sensing unit **22**. Mounted on a lower front part of the slider **20** and vertically movable with the same there is a wire clamping and feeding unit **23**. The apparatus may also comprise additional wire clamp and/or feeder means, such as a stationary clamp unit **24**, interposed between the units **22**, **23** and an additional vertically slidable clamp unit **25**, between the units **22**, **24**.

The first-mentioned clamp and feeding unit **23**, as best shown in Figure 2, comprises a pair of wire clamps **26**, **27**, symmetrical and adjacent to the vertical axis of the device; and each additional clamp and feeding unit **24**, **25** comprises a similarly constructed and similarly arranged pair of clamps **26***a*, **27***a* and **26***b*, **27***b*. Each series of wire clamps on one side of the axis, for instance the series of clamps **26**, **26***a*, **26***b*, is adapted to engage or release a wire W–1 or W–2, vertically extending from one of the reels **16**, **17**. A pair of vertical clamp control links **28**, **29** are provided, one on each side of the vertical axis of the device. This linkage is controlled by the sensing unit **22** and is adapted to control the different clamps, so that at all times one series of clamps on one side of the axis, is in potentially wire clamping position and the other series then is in wire releasing position. Power for moving the linkage **28**, **29**, under the control of the sensing unit **22**, and for thereby setting the clamping means **26***a*, **27***a*, etc., may be furnished by the ram **15** and the slider **20** (Figure 5), as will be explained hereinafter.

The sensing device **22** is shown in general in Figures 2 and 3 and with greater particularity in Figures 4, 6 and 7. It comprises a housing **30** (Figures 4 and 6) with a pair of horizontal, parallel pistons **31**, **32** slidable therein, side by side, in directions normal to the front of the

holder 21. This housing is rigidly secured to, but slightly spaced from, a vertical support and rocker plate 33, by a rib 34, providing a narrow, vertical channel area 35, parallel to and disposed between the plate 33 and housing 30, for insertion and general guidance of one wire, W–1. The support and rocker plate 33 is similarly spaced from the holder plate 21 by a narrow, vertical channel area 36, for insertion and general guidance of the second wire, W–2. The rocker plate is pivoted to the holder plate by a horizontal pin 37, which is mounted parallel to the pistons 31, 32 and disposed above the same, on the vertical center line or axis of the apparatus. By a swinging or rocking motion of the plate 33, about the pin 37, either piston 31 or 32 may be brought to an area close to said vertical axis, and the other piston is thereby brought to an area relatively remote from that axis.

As shown in Figure 4, a system of rigidly aligned apertures, with sliding fit for pistons 31, 32, is provided, comprising apertures 31*a*, 32*a* in the housing 30 and apertures 31*b*, 32*b* in the rocker plate 33; and apertures with similar fit but at slightly greater horizontal distance from one another are provided in the holder 21, at 31*c*, 32*c*. All of these six apertures have horizontal axes normal to the front of the holder 21. As further shown, one of the cylinders, 31, has a small drill hole, 31*d*, with sliding fit for wire W–1, vertically and centrally extending through the cylinder body, adjacent the rear end of the cylinder. The other cylinder, 32, has instead of such a drill hole, a slot 32*d* of similar width, with sliding fit for wire W–2, which slot is adjacent to and open to the rear end of this cylinder. By these arrangements the two pistons 31, 32 serve: (1) as guides establishing exact positions of wires W–1, W–2 in channels 35, 36; (2) as potential, alternate locks or holders for the rocking plate 33; and (3) as potential followers for a reciprocating cam member 38 which is secured to the slider 20 and can be moved thereby into and through the channel 36 in vertical strokes. In addition, one piston, 31, serves (4) as a feeler, adapted to sense continuity and discontinuity of its wire W–1.

For this latter or fourth purpose, the feeler piston 31, with the wire W–1 therein, is normally urged backwardly by a spring and see-saw mechanism 39 installed in front of housing 30 (Figures 4 and 6). This mechanism comprises a pin 40 on the front end of each piston; a lever 41 with slotted ends, engaging the pins 40; a central pivot 42 for the lever 41, on the housing 30; and a leaf type load spring 43, adapted to urge the feeler piston 31 and wire W–1 and the adjacent end of the lever 41 rearwardly, and thereby also to urge the other piston 32 forwardly.

Before the operation of these parts is described it may be noted that, as shown in Figures 2 and 3, an additional guide structure 44 for the wires W–1, W–2 may be secured to the top of the holder plate 21; and that the clamp devices 23, 24 and/or 25 are so positioned, on lower parts of the holder and of the slider vertically moving therein, that they cooperate with the guide structure 44 in holding both wires W–1, W–2 in approximately vertical positions adjacent to the vertical axis of the device, against the forces tending to displace the wire laterally as it unrolls from one of the reels 16, 17 (Figure 1). Desirably the guide structure 44 is resilient, for instance by incorporating therein a pair of felt pads, lying in planes parallel to the holder 21 (Figure 3) and clamped together in surface contact with one another by a system of spaced, vertically extending flat spring fingers 45, 46, 47 (Figure 3).

Referring to Figures 4 and 6 together, it will be noticed that the so-oriented wires W–1, W–2 extend downwardly into and through their respective channels 35, 36 and guide apertures 31*d*, 32*d*; that in the position shown, the right hand or feeler piston 31 is forwardly withdrawn and the left hand piston 32 is laterally withdrawn—toward the left—from interference with the cam and slider member 38; and the piston 32 locks the plate 33 to the

holder 21, in such position that the link 29 allows the clamps 23, etc. to feed wire W–1 to the discharge means 12 through the agency of the aforementioned right hand clamp members 27, 27*a* and 27*b*.

If and when, incident to such feeding, a break in wire W–1 arrives at 31*d*, the spring 43 becomes free to snap the sensing mechanism into a new and reversed setting. This snap action establishes a new, rearward position of feeler piston 31 and forward position of piston 32. As a further result, the slider cam member 38 can now and will engage the feeler piston 31 and thereby rock the support plate 33 into a new and reversed position, thereby in turn reversing the positions of the links 28, 29 and of the wire clamps 23, 24 and 25. These latter reversals of position are achieved upon the next upward stroke of the slider cam member 38, which has a bevelled right shoulder 48, adapted to drive the now rearwardly displaced right hand piston 31 from its relatively central position further toward the right. Thereupon the piston-actuating leaf spring 43 may move the piston 31 rearwardly by a small further distance and into a new locking position, wherein the piston is inserted in hole 31*c* in the holder plate 21, thereby locking the support plate 33 against any reverse rocking which might otherwise be caused by machine vibration or by inadvertent manual operation or the like. It will thus be seen that the plate 33 is automatically rockable only during an instant, upon the arrival of a break of wire W–1 in feeler hole 31*d*.

It is possible, however, to return the plate 33 to the original position, by disengaging spring 43 and manually depressing piston 32 rearwardly, so that this piston now interferes with a second bevelled cam surface 49 at the top of the slider plate 38. In order to facilitate such disengaging, the spring 43 is preferably formed as a flat leaf (Figure 2), having one end pivoted to an upper portion 50 of the rib 34 by a pin 51. The other end 52 of the leaf spring may engage the piston 31 by a suitably curved surface so that it can be withdrawn easily, with a wiping action, by manually turning the spring about its pivot pin 51.

Adjacent to the wire discharge means 12 at the lower end of the device (Figures 2, 3), a second rocking plate 53 is pivoted to the holder 21 by a pin 54, in a manner similar to that used at 33 and 37; and this second plate is interconnected with the upper rocking plate 33 by the aforementioned links 28, 29, so as to enforce parallel, vertical positions and coordinated motions of the two links, on the two sides of the several superposed clamp units 23, 24, 25. In order to minimize bending of the links, each link may also be hinged to one corner of an intermediate rocking plate 55, similarly pivoted at 56. By means of such linkage, the rocking motion of the upper rocking plate 33 is uniformly transferred to the clamp units 23 to 25, for coordinated action in engaging and releasing wires W–1, W–2.

Each moving clamp member 26, 27, 26*b*, 27*b* (Figures 6 and 7) is so shaped and arranged that it engages its respective wire closely, during downward or feed strokes, and practically releases it during upward or return strokes of the slider; and each clamp member, whether it be moving or stationary is further caused to disengage its respective wire regardless of upward or downward movement of the slider, when the adjacent link 28 or 29 is moved toward the vertical axis of the apparatus. For this purpose each clamp member of a pair 26, 27, or 26*a*, 27*a*, or 26*b*, 27*b* may be swingable in a vertical plane adjacent and parallel to the holder plate 21, between the links 28, 29 (Figure 6), and may be loaded by a coil extension spring 57 to urge the corresponding wire W–1 or W–2, against a rib 58 vertically extending between the clamp members of the pair (Figure 7); and each clamp member may simply be approximately oval shaped, as shown, with a lower wire-engaging cam surface facing the rib 58 and curving about and downwardly away from a clamp member pivot pin 59, in parabolic or

similar form. There may be an upper, outwardly facing, link-engaging cam surface on each clamp member, which may be approximately straight, as shown. The pivot pins 59 of each clamp unit are held by a plate 60, which is mounted on the rib 58 by screws 61.

By way of a brief resume, the combined sensing means 22 and clamp means 26, 27, etc. may be called a system of one-way wire clutches with selective, alternating release, adapting it to apply a cycle of feed strokes to one or another of several wires, and further adapting it to avoid interruption or disturbance of the cycle in case that the supply of a wire is interrupted.

This cycle is further adjustable as to the length of the strokes, by means shown in Figure 5. The machine ram 15 has a vertical rack 62 secured thereto, in mesh with a pinion 63 which is journalled at 64 so that vertical reciprocation of the ram causes angular reciprocation of the pinion. The pinion has an eccentric pin 65, mounted at an adjustable distance from the bearing 64 by a slide and groove mechanism 66; said pin engaging a yoke 67 which is vertically guided in a slot 68 of the holder 21. By such a transmission, as is well known to the art, yoke reciprocations of variable length can be derived from ram strokes of given length. The movements of the yoke 67, as best shown in Figures 3 and 5, are transferred to the slider 20, which may be attached to the yoke by screws 69. The slider moves behind the holder 21 but has extension means 70 (Figure 4) forwardly extending through a vertical slot in this holder, for attachment of the cam or deflector plate 38; and the slider has similar extension means for attachment of the movable clamp units 23, 25 (Figure 2).

In order to prepare for the operation of the apparatus the operator installs two reels of wire 16, 17 on the support 18 (Figure 1) and threads both wires W–1 and W–2 from these respective reels through the guide 44, then, respectively, through channels 35, 36 and piston apertures 31*d*, 32*d* in sensing unit 22 (Figure 4), and then through the respective sides of clamp units 25, 24, 23 (Figure 2), in that sequence. He then turns the top portions of the rocking plates 33, 55, 53 into the right-hand position shown in Figure 2 and at the same time he makes sure that the leaf spring 43 is also on the right hand side as shown, applying backward pressure to piston 31 (Figures 3, 4, 6). He then starts the reciprocation of ram 15, by starting or connecting an actuating motor, not shown.

All right-hand clamp members 27, 27*a*, 27*b* are then in potentially wire-clamping position, under the actuation of their springs 57, while all left-hand clamp members 26, 26*a*, 26*b* are in wire-releasing position, being held upright by the right-hand link 28, against the pull of the springs 57 (full-line positions in Figure 6). Therefore, the first downward ram and slider stroke, which now occurs (from broken-line position to full-line position in Figure 6), results in a feeding stroke of the right-hand wire W–1, moving said wire into the discharge device 12 (Figure 2), whereas the left-hand wire W–2 is stationary. Upon the upward return stroke (from full-line position to broken-line position in Figure 6), the slider plate 38 passes on the side of the leftwardly and rearwardly displaced piston 32 and in back of the forwardly displaced, rearwardly loaded piston 31. Thus the plate 38 explores the continuity of the wire W–1 passing through the hole 32d in the feeler piston 32 (Figure 4). It continues to do so on successive upward and downward strokes (Figure 6), as determined by the cycle of the insertion machine and ram 15 (Figures 1 and 5).

Upon the arrival of any discontinuity—that is, upon the arrival of the end of wire W–1 or of any break therein, in said hole 31d (Figure 4)—the feeler piston 31 becomes free to be moved back by the backwardly loaded spring 43. Upon the next following upward stroke of the slider plate 38, the right-hand bevel surface 48, as mentioned, encounters the foot portion of the right-hand or feeler piston 31, which has now been shifted backwardly, and moves that piston and thereby the entire lower portion of the rocking plate 33 toward the right and the upper part to the left (broken-line position in Figure 6). As a result (Figure 2) the left-hand link 28 now allows the spring-actuated left-hand clamps 26, 26*a*, 26*b*, to engage the left-hand wire W–2 while the right-hand link 29 engages the upper parts and thereby disengages the lower parts of the clamps 27, 27*a*, 27*b* on the right-hand wire W–1. Thus the next downward slider stroke now results in downward feeding of the left wire W–2.

This next downward stroke, after the wire engagement shifting operation, follows without interruption of the normal operating cycle of the ram 15 and connected parts. No wire feeding stroke of the normal program is missed, incident to the shift from wire W–1 to wire W–2. This applies regardless of the exact correlation between the cycles of the sensing slider plate 38 and the occurrence of the discontinuity in wire W–1. The discontinuity always arrives in the sensing device during a wire feed stroke, that is, during a downstroke of the slider plate. The completion of the downstroke may require only a fraction of a second, but the pistons 31, 32 are perfectly able within such a short interval to reverse their position, under the snap-acting force of the spring 43. As soon as the left-hand piston foot has moved into the position where it can be struck, such striking occurs upon the next upstroke of the slider, thereby providing timely and complete preparation for the next downstroke of the slider in which the new wire W–2 must be and is engaged.

It may be noted that the described mechanism is adapted to shift the feed automatically from one wire W–1 to another W–2; it is not adapted to automatically reverse the shift. This arrangement is preferred, since automatic return to the discontinuous wire W–1 would ordinarily be undesirable even if the other wire W–2 has also reached a point of discontinuity. Thus the present mechanism is arranged for a sequence of manual and automatic actions. An alarm may of course be sounded and/or indicated by well known means, not shown, whenever an automatic wire shift occurs, thereby alerting the operator to promptly install a new reel and to perform the necessary manual preparation for the next proper, automatic wire shifting action so that no complete disabling of both wire feeding subassemblies will occur.

While only a single embodiment of the invention has been described, it should be understood that the details thereof are not to be construed as limitative of the invention, except insofar as set forth in the following claims.

I claim:

1. In apparatus for feeding wire at a predetermined rate, a supply structure adapted to supply a plurality of wires; transfer means adapted to gradually remove one of said wires from said supply structure, at said rate; and control means adapted, in response to a discontinuity in the wire which is being removed in this manner, so to reset the transfer means that it thereafter gradually removes another of said wires from said supply structure, at said rate; the transfer means being adapted to move back and forth in intermittent feed strokes with intervening returning strokes, to grip one of said wires during each feed stroke and to release all wires during each return stroke.

2. Apparatus as described in claim 1 wherein the control means is adapted to reset the transfer means during a return stroke, so that wire is fed on each feed stroke without interruption by discontinuity of a wire.

3. Apparatus as described in claim 1 wherein the supply structure comprises a pair of wire supply means and the transfer means comprises a pair of transfer devices, each transfer device being associated with one of the supply means.

4. Apparatus for feeding wire in a predetermined and continued succession of feed strokes, comprising supply

means providing a plurality of wires; discharge means spaced from the supply means and adapted to discharge any one of said wires; reciprocatory wire transfer apparatus positioned in an area between said means, adapted to perform successive cycles of feed strokes and return strokes, between said means, and further adapted to engage, grip and move, upon each feed stroke only, one of said wires and one of them only; and a sensing apparatus also positioned in the area between said means, adapted, in response to the arrival in said area of any discontinuity in the wire then being moved, to reset the transfer apparatus so that the latter releases said one wire and on subsequent feed strokes engages, grips and moves another of said wires.

5. Apparatus as described in claim 4 wherein the sensing apparatus comprises feeler means adapted to contact the engaged wire, to move in response to discontinuity of such wire and thereby to reset the transfer apparatus.

6. Apparatus as described in claim 4, wherein the wire transfer means also comprises reciprocatory cam means, adapted to cyclically explore the position of the feeler means and adapted in response to such position to reverse the engaging and disengaging of said wires.

7. Apparatus for feeding wire from any of several supply means to a single discharge means, comprising a base structure extending between said means; a transfer member adapted to move back and forth along the base structure, between said means; selective one-way wire clutch means on the transfer member, adapted to engage one and only one of the wires from the several supply means and to move it toward the discharge means on each forward movement of the transfer member and to release it on each return movement thereof; and a wire continuity sensing and transfer shifting device, adapted to reset the clutch means upon the occurrence of a discontinuity in the wire being fed to the discharge means; the clutch means being adapted when so reset to completely release said wire and upon the subsequent forward movements to engage a wire from another one and only one of said supply means and to move it toward the discharge means.

8. Apparatus as described in claim 7 wherein the continuity sensing and transfer shifting means is installed on the base structure and engages the wire clutch means by a wiping cam action.

9. Apparatus as described in claim 8, comprising additional wire clutch means, also installed on the base structure and also adapted to be reset by the continuity sensing and transfer shifting device.

10. Wire feeding apparatus comprising a pair of supply means for supplying wire; a discharge device adapted to discharge wire from either of said supply means; a pair of wire gripping units, each adapted to engage one and only one of the wires from the two supply means and to move it in a direction from the supply means to the discharge device; transfer switching means adapted to activate one of the wire gripping units and to inactivate the other; and a check unit adapted to respond to a discontinuity in the wire engaged by one of the wire gripping units and correspondingly to control the transfer switching means to activate the other wire gripping unit.

11. Apparatus as described in claim 10 wherein the check unit comprises a pair of mechanical members, adapted to contact the wires, to explore continuity thereof, and upon the arrival of a discontinuity to contact a portion of the transfer switching means so that the latter reverses the activation and inactivation of the gripping units.

12. Apparatus as described in claim 11, additionally comprising linkage interconnecting the two members for see-saw motion; and spring means adapted to activate one of the members and to inactivate the other as to said contacting.

13. Apparatus as described in claim 12, additionally comprising a support structure mounted between the supply means and the discharge device and supporting the pair of members, their interconnecting linkage and their spring means; said support structure being adapted to be moved by the transfer switching means in response to a change in position of either of said members and by such movement to control the activation of the wire gripping unit.

14. Wire feeding apparatus comprising a pair of sources of wire; a discharge device adapted to discharge wire from either source; a sensing device adapted to discover and signal discontinuity in such a wire; and wire transfer means adapted in response to one such signalling to automatically disengage one of said wires and engage the other for feeding it to the discharge device, said wire transfer means being further adapted in response to a subsequent such signalling to discontinue feeding either wire until the sensing device is manually reset; the sensing device comprising a pair of mechanical elements and linkage interconnecting the same in the manner of an equal-armed lever, spring means adapted to bias said linkage in either of two directions, and means for manually resetting the spring means so as to bias the linkage in the opposite direction.

15. Apparatus for feeding wire in a succession of feed strokes, comprising supply means for supplying a plurality of wires; discharge means adapted to discharge any one of said wires; a system of wire transfer clamps, said system being adapted to perform successive feed strokes and return strokes and each clamp having a cam surface adapting it on each feed stroke to engage one of said wires and to move it in a direction from said supply means to said discharge means and on each return stroke to disengage the wire; a feeler device disposed between said supply means and discharge means and adapted to respond to any discontinuity in the wire being moved to the discharge means; and wire transfer shifting means adapted on such response to reset the wire transfer clamps so that the latter permanently release said one wire and on subsequent feed strokes engage another of said wires to move it in said direction.

16. Apparatus as described in claim 15 wherein each clamp has another cam surface, adapted to be engaged by the transfer shifting means for the resetting of the clamps.

17. Apparatus as described in claim 16 comprising power means adapted to perform successive power strokes of predetermined length, and adjustable transmission means adapted to derive said feed and return strokes from such power strokes and to adjust the length of said feed and power strokes; each clamp of the system performing said feed and return strokes being adapted to engage the transfer shifting means with a wiping cam action.

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