Sept. 4, 1962 W. VOGT 3,052,392

WIRE FORMING MACHINE

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FIG. 1

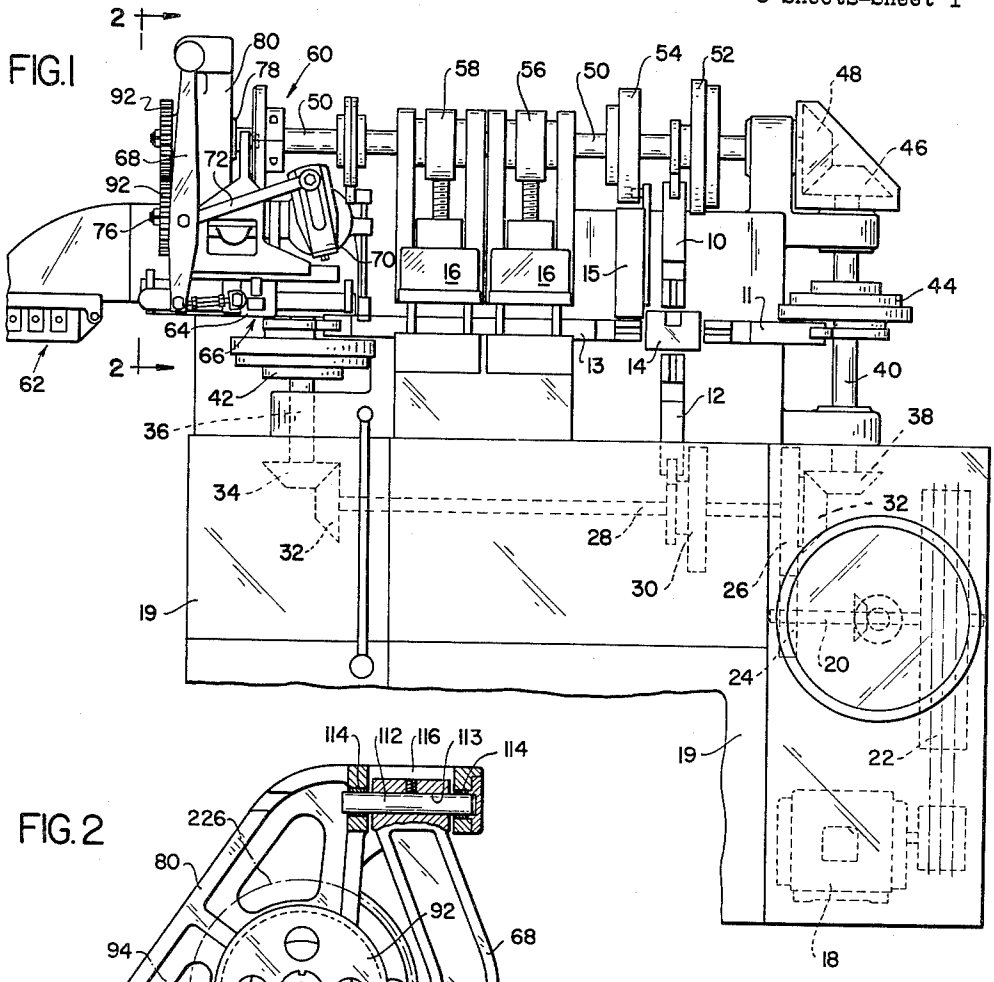


FIG. 2

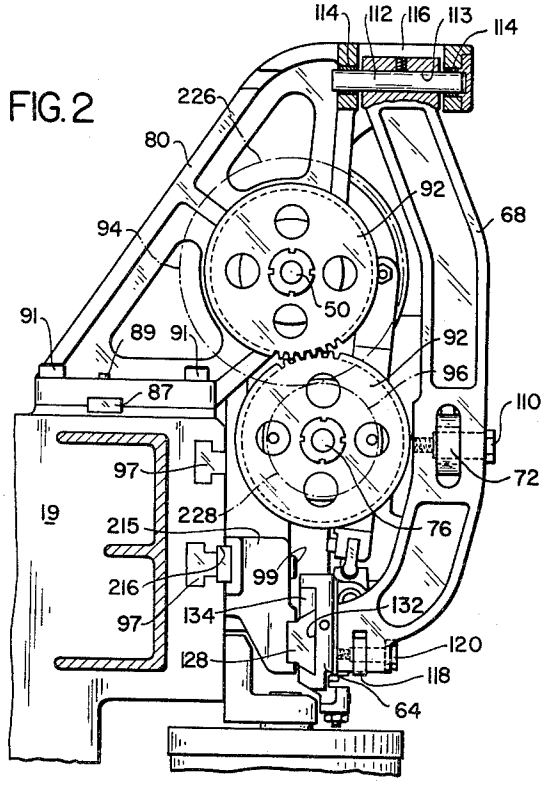
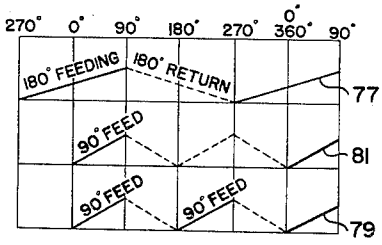


FIG. 3



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FIG. 4

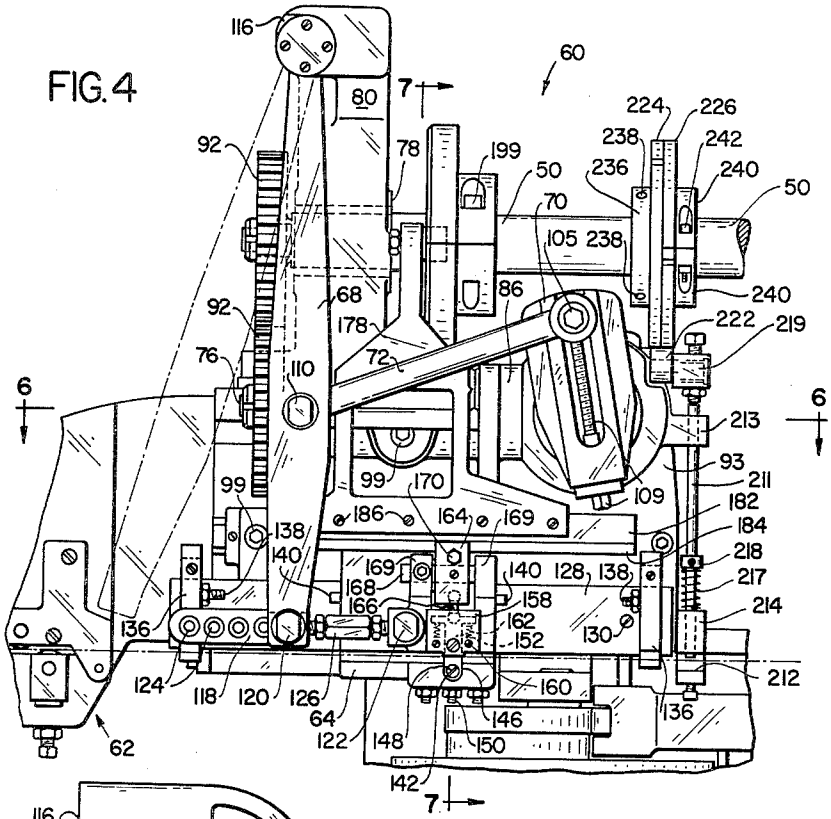


FIG. 5

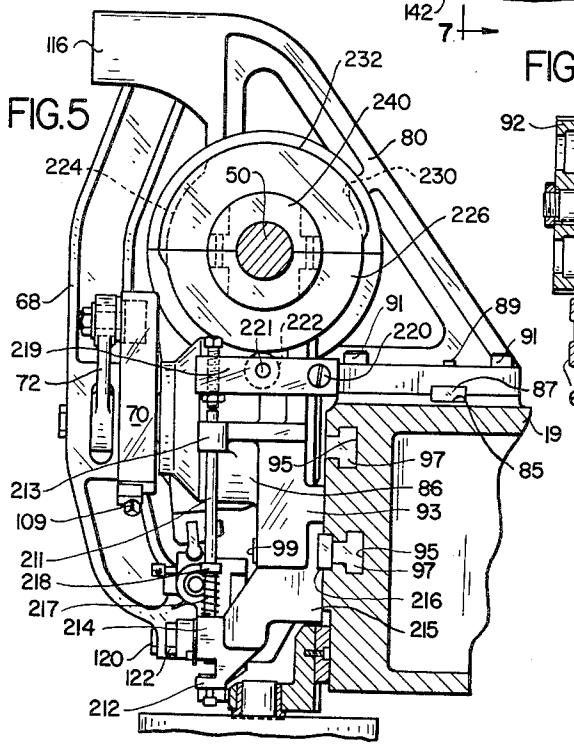
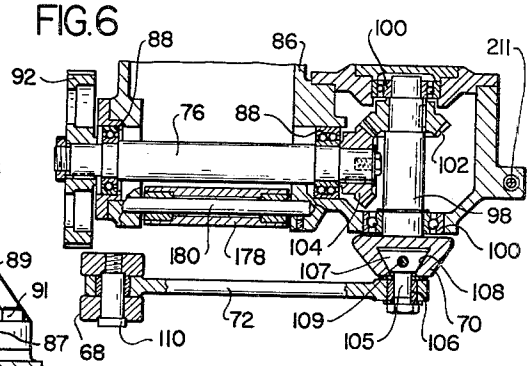


FIG. 6



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WIRE FORMING MACHINE

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FIG. 7

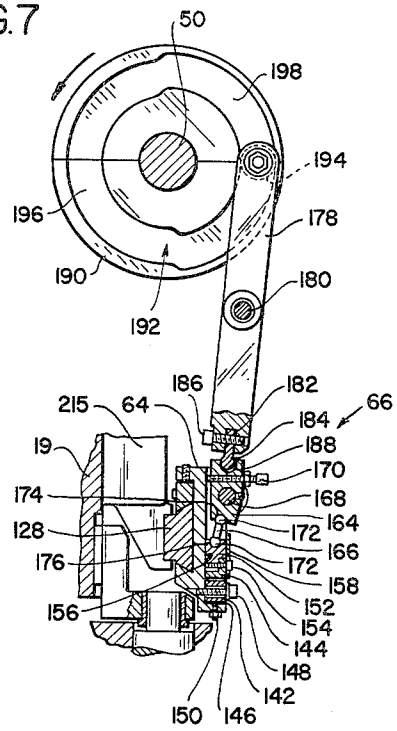


FIG. 9

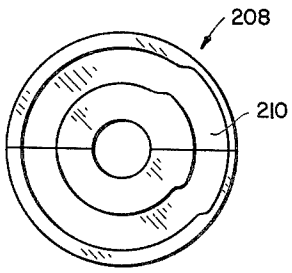


FIG. 8

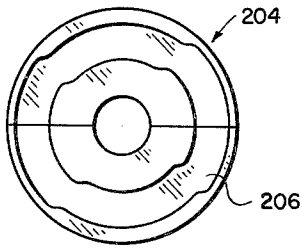


FIG. 10

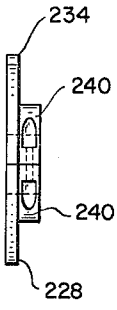
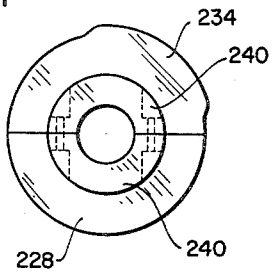


FIG. 11



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United States Patent Office 3,052,392 Patented Sept. 4, 1962

3,052,392

WIRE FORMING MACHINE

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Filed Mar. 4, 1959, Ser. No. 797,158
6 Claims. (Cl. 226—165)

This invention relates to a cyclically operable machine for bending and otherwise forming various types of wire and, more particularly, to an improved automatic feed mechanism particularly adapted for use therewith.

Wire forming machines have been equipped with various types of automatic wire feeding mechanisms in the past. In the design of such mechanisms, it has been a conventional practice to provide for a mode of operation wherein feeding of a desired length of wire to the machine forming mechanism is accomplished during 180° of each 360° machine cycle, forming of the wire being accomplished during the remaining 180° of each cycle. It will be apparent that in the case of certain wire forming operations, substantial advantages are to be obtained from the provision of a wire feeding mechanism adapted to feed wire within fractional parts of a machine cycle less than 180°. For example, certain relatively complex wire forming operations may be accomplished much more readily within the 270° of forming time afforded by a 90° wire feeding operation than within the 180° of forming time afforded by a 180° wire feeding operation.

The present invention has as its general object the provision of an improved automatic feed mechanism particularly adapted for use with a cyclically operable wire forming machine, which mechanism is operable selectively to feed a length of wire to a forming mechanism in the machine within any one of two or more different fractional parts of the machine cycle, and which mechanism is constructed and arranged so that conversion from one mode of operation thereof to another may be accomplished readily and with a minimum loss in operating time of the wire forming machine.

The drawings show a preferred embodiment of the invention and such embodiment will be described, but it will be understood that various changes may be made from the construction disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a front view of a wire forming machine equipped with the improved automatic feed mechanism of the present invention.

FIG. 2 is an enlarged left-hand side elevation of the feed mechanism.

FIG. 3 is a chart depicting the several modes of operation of the feed mechanism.

FIG. 4 is an enlarged front view in elevation of the feed mechanism.

FIG. 5 is an enlarged right-hand side elevation thereof.

FIG. 6 is a longitudinal transverse section of a portion of the feed mechanism taken as indicated by the lines 6—6 in FIG. 4.

FIG. 7 is a fragmentary vertical transverse section of the feed mechanism taken as indicated by the lines 7—7 in FIG. 4.

FIG. 8 is a side elevation of an actuating cam for a wire gripping device included in the feed mechanism.

FIG. 9 is a side elevation of another actuating cam for the wire gripping device.

FIG. 10 is a front elevation of an actuating cam for a wire holding device included in the feed mechanism.

FIG. 11 is a side elevation of the actuating cam of FIG. 10.

The wire forming machine to be described is adapted to accommodate wire of various types. That is, both the wire forming and wire feeding mechanisms of the machine are adapted to handle wire having various cross-sectional shapes. Accordingly, the term wire is used throughout the description and the claims which follow in its broad sense and refers to a thread or slender rod of metal of any cross-sectional shape, such as round, square, triangular, flat or irregular.

The wire forming machine shown in FIG. 1 is of the four-slide type, the forming mechanism thereof comprising four slides 10, 11, 12 and 13 disposed in a hub-spoke arrangement about a central form 14. The several slides are preferably movable in a vertical plane, as shown, and forming tools are provided on the contiguous ends thereof. Suitable cams move the several slides inwardly in timed relation with each other, the tools thereon cooperating with the central form 14 to provide a wire product of a desired shape and form. Also included in the forming mechanism is a cam actuated vertical cut-off device 15 which is disposed at the left of the slide 10.

Two cam or eccentric actuated vertical presses 16, 16 are shown as being included in the forming mechanism of the machine, but the provision of such presses is optional. The presses when provided may be used cooperatively with the several slides 10, 11, 12 and 13 or they may be used independently of said slides. Said presses are most advantageously used in the forming of flat stock.

The forming mechanism of the wire forming machine is operable in fixed cycles. While the details of the operating means therefor may be widely varied, the forming machine is shown as including an electric motor 18 which supplies power for operating the forming mechanism. The motor 18 is supported on a main frame 19 of the machine and turns a counter shaft 20 through a belt drive indicated generally at 22. The counter shaft 20 is suitably journaled in the machine frame 19 and carries at one end a gear 24 which drives a gear 26 secured on a lower horizontal longitudinally extending camshaft 28. The camshaft 28 also carries a cam which is indicated generally at 30 and which actuates the lower vertically movable slide 12.

At the ends of the lower horizontal camshaft 28, there are fixedly mounted bevel gears 32, 32. The bevel gears 32, 32 respectively drive a bevel gear 34 secured on the lower end of a left-hand vertical camshaft 36 and a bevel gear 38 secured on the lower end of a right-hand vertical camshaft 40. The left and right-hand vertical camshafts 36 and 40 are suitably journaled in the main frame 19 of the machine and each of said shafts carries a cam, said cams being indicated generally at 42 and 44 respectively. The cam 42 on the left-hand vertical shaft 36 actuates the left-hand horizontally movable forming slide 13 and the cam 44 on the right-hand vertical shaft 40 is similarly operatively associated with the right-hand horizontally movable forming slide 11.

At the upper end of the right-hand shaft 40, there is secured a bevel gear 46. The gear 46 drives a bevel gear 48 secured at the right-hand end of an upper horizontal longitudinally extending camshaft 50. The camshaft 50 carries two cams, indicated generally at 52 and 54, which respectively actuate the upper vertically movable forming slide 10 and the cut-off device 15. When there are two vertical forming presses 16, 16 included in the machine forming mechanism, there are two additional cams or two eccentrics 56 and 58 on said shaft 50 for operating the presses.

The upper horizontal longitudinally extending camshaft 50 also serves as a rotary driving means for the improved

automatic feed mechanism to which the present invention more particularly relates. The said mechanism is shown mounted on the main frame 19 at the left-hand end portion of the forming machine and is indicated generally by the reference numeral 60. As will be described more fully hereinafter, all of the component parts of the feed mechanism 60 are supported on a secondary or feed mechanism frame which includes two principal frame members each adapted to be detachably connected to the main frame 19 of the wire forming machine. As a result of the manner in which the mechanism parts are supported on the two frame members, said mechanism may be readily removed from or incorporated in the wire forming machine as a unitary assembly or in two parts.

The provision of a feed mechanism adapted to be readily removed from or incorporated in the forming machine is particularly advantageous when the forming presses 16, 16 are included in the machine. When said presses are included in the forming machine, they may be detachably mounted on the machine frame so as to be readily removed from the machine by effecting relative longitudinal movement thereof toward the left-hand end of the machine. Thus, removal of the feed mechanism 60 may be a prerequisite to removal of the presses 16, 16. It will be apparent that when feed mechanism removal is a prerequisite to press removal, the provision of a feed mechanism which may be quickly and easily removed from and re-incorporated in the forming machine will substantially reduce the losses in machine operating time which are occasioned by the removal or incorporation of the forming presses.

The automatic feed mechanism 60 draws a continuous strand of wire through a wire straightener, indicated generally at 62, and feeds the wire longitudinally toward the aforedescribed forming mechanism. Generally, the feed mechanism 60 comprises a longitudinally reciprocable slide 64 which carries a wire gripping device 66. The gripping device 66 is operable to feed the wire a predetermined distance into the wire forming mechanism during some or all forward movements of the slide . During rearward movements of the slide, the gripping device 66 is inoperable and it releases the wire and passes idly thereover. Also included in the feed mechanism and connected with the slide 64 in driving relationship is a means for converting rotary motion to reciprocatory motion. In the preferred embodiment of the invention shown, the motion converting means comprises a lever 68 which is connected with and drives the reciprocable slide 64. The lever 68 is oscillated by a crank 70 which drives said lever through a connecting rod 72. The crank 70 is rotatably driven by the upper horizontal camshaft 50 in a manner described hereinbelow and each rotation of said crank effects one complete forward and rearward reciprocation of the slide 64.

In accordance with the invention, the feed mechanism 60 includes a first rotatable shaft which is connected with the wire forming mechanism to make one rotation during each machine cycle. As previously mentioned, the camshaft 50 drives the feed mechanism 60 in the embodiment of the invention shown and as will be observed in FIG. 1 the shaft 50 is extended longitudinally leftwardly from the forming mechanism of the machine and constitutes said first rotatable shaft of the feed mechanism. Obviously, the shaft 50 could be connected in end-to-end driving relationship with a separate shaft included in the feed mechanism 60 in an equivalent alternative construction.

A second rotatable shaft 76 included in the feed mechanism 60 is driven by the first rotatable shaft 50 and is disposed adjacent the motion converting means comprising the oscillable lever 68, the crank 70 and the connecting rod 72. The second shaft 76 is connected with and drives the motion converting means and, more specifically, said second shaft drives the crank 70 of said motion converting means at a one-to-one ratio.

In further accord with the present invention, the driving connection between the first and second shafts 50 and 76 is effected by change gears. The change gears are adapted to selectively effect one rotation or an integral plurality of rotations of the second shaft during each rotation of the first shaft or during each machine cycle. Since the crank 70 is driven by the second shaft 76 at a one-to-one ratio and since one rotation of said crank effects one complete reciprocation of the slide 64, it will be seen that when the shaft 76 is rotated once during each machine cycle the slide 64 will be reciprocated once. Similarly, when an integral plurality of rotations of the second shaft 76 are effected during each machine cycle, a like plurality of slide reciprocations will be effected during each machine cycle.

From the foregoing, it will be apparent that if the wire gripping device 66 which is carried by the slide 64 is caused to grip the wire in properly timed relation with the reciprocable movement of said slide, wire feeding to the machine forming mechanism may be effected selectively within any one of several different fractional parts of the machine cycle. If, for example, the shafts 50 and 76 are connected by change gears which effect one reciprocation of the slide 64 during each machine cycle and if the gripping device 66 effects wire feeding during all forward slide movements, a 180° wire feeding operation, as indicated by the line 77 on the chart of FIG. 3, will be provided. If, on the other hand, the first and second shafts 50 and 76 are connected by change gears which effect two slide reciprocations during each machine cycle and if the wire gripping device effects wire feeding during all forward slide movements, wire will be fed to the machine forming mechanism during each of two spaced apart 90° portions of each machine cycle. The line 79 on the chart of FIG. 3 depicts this mode of feed mechanism operation. In an additional example, assume that two slide reciprocations are effected during each machine cycle but that the gripping device 66 effects wire feeding during every other forward slide movement rather than during all forward slide movements. It will be seen that, in this instance, the single 90° feed operation indicated by the line 81 on the chart of FIG. 3 will be provided.

While the great majority of wire forming operations may be accomplished readily and efficiently with either the mode of feed mechanism operation represented by the chart line 77 or the mode of operation represented by the chart line 81, said two modes of operation being therefore considered of primary importance, the mode of operation represented by the chart line 79 is particularly well suited to a limited number of special forming operations and is therefore of substantial importance. Thus, although the invention is not so limited, the automatic feed mechanism which is shown in the drawings and which constitutes the presently preferred embodiment of the invention is adapted to be operable selectively in accordance with any one of the three different operational modes described above. Change gears are provided for effecting one or two rotations of the second shaft 76 during each rotation of the first shaft 50. Actuating means for the wire gripping device 66 is also provided and said means is operable selectively to cause the gripping device to effect wire feeding in each of the manners described above. As will become apparent from the detailed description which follows, the change gears and actuating means are constructed and adapted to cooperate with the other feed mechanism components in a manner which permits conversion from one mode of feed mechanism operation to another to be readily accomplished. As a result, the losses in operating time of the forming machine which are occasioned by such conversions are reduced to a minimum and substantial cost savings are obtained.

The shaft 50 is journaled near its left-hand end in a bearing 78 in a first frame member 80 of the feed mechanism with its left-hand end portion exposed at the left of said bearing and frame member. The frame member

80 in which the shaft 50 is supported in the bearing 78 is detachably connected to and supported on the main machine frame 19. As best illustrated in FIG. 5, a longitudinally extending groove 85 formed in an upwardly exposed surface of the main frame 19 slidably receives a guide bar 87 which is secured to the frame member 80 by suitable screws 89, 89. Additional screws 91, 91 rigidly connect the frame member 80 to the upwardly exposed surface of the main machine frame 19. When it is desired to detach the frame member 80 from the machine frame 19, the screws 91, 91 are removed and relative longitudinal movement between said member and frame is effected to slide the guide bar 87 leftwardly and out of the groove 85.

The second rotatable shaft 76 is disposed in parallel relationship with the first shaft 50 in accordance with the invention. Thus, when said first shaft extends longitudinally in a horizontal plane, as shown, said second shaft is similarly disposed. As shown, the second shaft 76 is supported in a housing 86 by ball bearing units 88, 88, best illustrated in FIG. 6. The left-hand end portion of the shaft is exposed adjacent the exposed left-hand end portion of the first shaft 50.

The housing 86 in which the second shaft 76 is supported is formed integrally on a second frame member 93 of the feed mechanism. The member 93 is detachably connected to and supported on the machine frame 19, the connection of said frame member with the machine frame 19 being similar to that of the member 80 with said machine frame. As best illustrated in FIG. 5, two longitudinally extending T-shaped grooves 95, 95 formed in a vertical surface of the machine frame 19 respectively receive two T-shaped guide bars 97, 97 which are secured to the member 93 by suitable screws 99, 99. One or more of the screws 99, 99 may be extended through its associated guide bar and into the machine frame 19 for rigidly connecting the member 93 to said machine frame. When it is desired to detach the frame member 93 from the machine frame 19, said one or more screws is retracted from the machine frame and relative longitudinal movement is effected between the member 93 and the frame 19 to slide the bars 97, 97 leftwardly and out of the grooves 95, 95.

The manner in which the driving connection between the first and second shafts 50 and 76 is effected by change gears may be varied widely within the scope of the invention. There may, for example, be several gears mounted on each of the shafts 50 and 76 and a shifting means may be provided whereby sets of gears may be engaged selectively to provide different driving ratios. The presently preferred practice, however, is to provide several sets of gears each of which sets comprises two gears adapted to be detachably mounted respectively on the adjacent exposed ends of the first and second shafts 50 and 76. The sets of gears are respectively adapted to effect different driving ratios between the shafts 50 and 76. To effect a desired driving ratio between said shafts, two suitable gears are mounted respectively on the exposed ends thereof. When it is desired to effect a different driving ratio between the shafts, the two gears are detached from the ends thereof and are replaced by another set of two gears adapted to provide said different driving ratio.

As mentioned above, two sets of change gears respectively having one-to-one and two-to-one driving ratios are provided in the feed mechanism shown in the drawings. First and second companion spur gears 92, 92 which constitute the first set of change gears are shown mounted respectively on the adjacent exposed ends of the shafts 50 and 76. The gears 92, 92 effect one rotation of the second shaft 76 during each rotation of the first shaft 50 and are utilized when the mode of feed mechanism operation depicted by the line 77 on the chart of FIG. 3 is desired. The second set of change gears comprises third and fourth companion spur gears which effect two rotations of the second shaft 76 during each rotation of the first shaft 50 when they are mounted respectively on the exposed ends of the shafts 50 and 76 in place of the gears 92, 92. Said third and fourth gears are shown in FIG. 2 of the drawings as broken line circles 94 and 96, the said circles indicating the peripheries of the gears when they are mounted respectively on said shafts. The third and fourth gears are mounted on the shafts 50 and 76 when it is desired that the feed mechanism operate in accordance with the line 79 or in accordance with the line 81 on the chart of FIG. 3.

The connection between the second rotatable shaft 76 and the crank 70 of the aforementioned motion converting means is preferably effected as described hereinbelow with particular reference to FIG. 6. At its right-hand end the shaft 76 is adapted to rotatably drive a transversely extending crankshaft 98 through a bevel gear connection. The crankshaft 98 extends in a horizontal plane and is journaled in ball bearing units 100, 100 which are supported in the housing 86. On one end of the crankshaft 98 there is mounted a bevel gear 102 which is driven by a bevel gear 104 carried on the right-hand end of the second shaft 76. The crank 70 is formed integrally at the other end of the crankshaft 98 and extends therefrom radially in a vertical plane.

The crank 70 is shown as having attached thereto one end of the connecting rod 72, the other end of said rod being attached to the lever 68 which reciprocally moves the slide 64. A crankpin 105 is journaled in a suitable bearing 106 at one end of the rod 72 and has a dove-tailed enlargement 107 formed integrally at an end portion thereof. The dove-tailed enlargement 107 of the pin 105 is slidably held in a complementary dove-tailed slot 108 which extends lengthwise in the crank 70. An adjusting bolt 109, best shown in FIG. 4, secures the crankpin 105 in selected positions along the slot 108. Thus, said one end of the connecting rod 72 may be connected to the crank 70 at selected positions of eccentricity relative to the axis of the crankshaft 98. The other end of the connecting rod 72 is pivotally connected between the ends of the lever 68 by a pin 110.

As best illustrated in FIG. 2, the lever 68 is suspended from a pivot pin 112 for oscillation in a vertical plane. The pin 112 extends through a suitable opening 113 in the upper end of the lever 68 and has its ends journaled respectively in bearings 114, 114. The bearings 114, 114 are supported in an overhanging portion 116 of the frame member 80. The lower end of the lever 68 is connected to the reciprocable slide 64 by an adjusting link 118.

As best illustrated in FIG. 4, the adjusting link 118 is pivotally connected to the lever 68 and the slide 64. Pivot pins 120 and 122 respectively connect the link 118 to said lever and slide. Several openings 124, 124 in the link 118 are each adapted to receive the pin 120 to permit a rough adjustment of the distance between the lower end of the lever 68 and the slide 64. Fine adjustments of said distance may be achieved by means of a variable length coupling 126 which forms a part of said adjusting link.

The construction of the reciprocable slide 64 and the manner in which the operative connection thereof with other feed mechanism components is effected may be varied widely. As shown, the slide 64 is supported for longitudinal movement toward and away from the machine forming mechanism on a longitudinally extending dove-tailed guide and support bar 128. The guide and support bar 128 is secured to a lower portion of the feed mechanism frame member 93 by suitable screws 130, 130, only one of which is shown. As best illustrated in FIG. 2, a dove-tailed recess 132 formed in a rear portion of the slide 64, which recess is partially defined by a removable slide member 134, receives and approximately fits the guide and support bar 128. At each end portion of the bar 128, there is provided a longitudinally adjustable stop 136. Each of the stops 136, 136 carries

a pin 138 which extends longitudinally therefrom. The pins 138, 138 engage similar pins 140, 140 which project longitudinally respectively from opposite sides of the slide 64 to limit the travel of said slide along the guide and support bar 128.

From the foregoing, it will be seen that the length of the forward and rearward movements or strokes of the slide 64 will be determined by the eccentricity of the end of the rod 72 relative to the axis of the crankshaft 98 and by the relative positions of the adjustable stops 136, 136 along the support and guide bar 128. The reference or starting point for the slide movements or strokes, on the other hand, will be determined by the adjusted length of the link 118.

The wire gripping device 66 which is carried by the reciprocable slide 64 and the actuating means for said device may take various forms within the scope of the invention. There may be provided, for example, a relatively simple device comprising a pair of pivotally supported gripping jaws or blocks and the actuating means may comprise suitable springs or the like for biasing the jaws or blocks in one direction about their pivots so that they engage and feed wire when moved therealong in one direction and so that they slide idly over the wire when moved therealong in an opposite direction. It will be apparent that when a wire gripping device and actuating means of such type is provided, wire feeding will be effected during all forward slide movements.

In accordance with presently preferred practice, there is provided a somewhat more complex wire gripping device and actuating means whereby a high degree of wire gripping and releasing efficiency is achieved. In addition, the wire gripping device and actuating means are adapted to selectively effect wire feeding during all forward slide movements or during every other forward slide movement.

The actuating means comprises, in preferred form, three cam means which are useable selectively. Said three cam means may be operated in various manners, but are preferably each adapted to be detachably mounted on and driven by the first rotatable shaft 50 independently of the second rotatable shaft 76. Each of the three cam means, when mounted on the shaft 50, cooperates with additional components of the actuating means to cause the wire gripping device to grip and release the wire in timed relation with movement of the slide 50. When it is desired to convert from one mode of feed mechanism operation to another, one cam means is removed from the shaft 50 and another cam means is mounted on said shaft.

As best illustrated in FIGS. 4 and 7, the gripping device 66 comprises, in preferred form, a fixed lower wire gripping member 142 and a transversely movable upper wire gripping member 144. The fixed wire gripping member 142 is secured in a suitable recess 146 formed in a lower portion of the slide 64 by a screw 148 which extends therethrough and into said slide lower portion and by an abutment bolt 150.

The movable wire gripping member 144 is fixedly mounted on the body of a small T-shaped slide member 152 by means of a retaining screw 154. The T-shaped slide member 152 is guided for vertical movement between the walls of a recess 156 formed in the slide 64 and a cover plate 158 secured to the slide 64 by the screws 160, 160. Two small springs 162, 162 disposed behind the cover plate 158 respectively engage oppositely extending arms of the T-shaped slide member 152 and bias the said member and the gripping member 144 mounted thereon upwardly and away from the wire.

First and second components of the actuating means which cooperate with each of the several cam means are a toggle lever 164 and a floating toggle link 166. The toggle lever 164 is shown pivotally supported for oscillation in a vertical plane on a pin 168. The pin 168 extends through the lever 164 and has its ends journaled in suitable bosses 169, 169 on the slide 64. A screw 170 which is adapted to be turned manually extends through the toggle lever 164 and engages the slide 64 to limit oscillation of said lever about its pivot in the counterclockwise direction.

The floating toggle link 166 connects the toggle lever 164 with the T-shaped slide member 152. Partially spherical enlargements 172, 172 formed at opposite ends of the link 166 are respectively received in a detent 174 formed in the bottom surface of the toggle lever 164 and in a detent 176 formed in the top surface of the T-shaped member 152. It will be seen that oscillation of the toggle lever 164 about its pivot 168 will cause the slide member 152 and the gripping member 144 to be reciprocated in a vertical plane by the floating link 166. The gripping member 144 is thus caused to grip and release wire extending across the fixed member 142. It will be further seen that downward and wire gripping movement of the member 144 will be limited by the screw 170 which limits counterclockwise movement of the toggle lever 164 about the pin 168.

Another component of the preferred actuating means is a lever 178 which is oscillated in a vertical plane by the above referred to cam means and which, in turn, oscillates the toggle lever 164. The lever 178 is fulcrummed on a pin 180 which is supported at its ends in the housing 86 as best illustrated in FIG. 6. A longitudinally extending bar 182 which has a bead 184 formed along its lower edge is attached to the lower end of the lever 178 by suitable screws 186, 186. Formed in the upwardly exposed portion of the toggle lever 164 is a longitudinally extending groove 188 adapted to receive and fit the bead 184. The bar 182 is of sufficient length to insure that the bead 184 thereon will remain in engagement with the walls of the toggle lever groove 188 throughout the movement of the slide 64.

The first cam means is mounted on the first shaft 50 when the mode of feed mechanism operation depicted by the line 77 on the chart of FIG. 3 is desired. Said cam means is illustrated in FIG. 7 and comprises a disc cam 190 having an annular groove 192 formed in a radial face thereof. The annular groove 192 receives a cam roller 194 which is rotatably supported on the upper end of the lever 178. Two radially offset 180° sections 196 and 198 of the cam groove 192 cause the cam roller 194 to be reciprocated horizontally as the cam rotates with the shaft 50. The horizontal reciprocation of the cam roller 194, in turn, effects oscillation of the lever 178 about its pivot and this movement is transmitted by the toggle lever 164, the floating toggle link 166, and the slide member 152 to the upper wire gripping member 144.

In FIG. 7 the cam 190 is shown angularly positioned so that the cam roller 194 carried by the lever 178 is disposed in the groove section 198 of larger radius. The positions of the lever 178, the toggle lever 164, the floating link 166, and the T-shaped slide member 152 thus effected maintain the movable gripping member 144 in its downward and wire gripping position. When the cam 190 is rotated so that the roller 194 enters the groove section 196, said levers, link and member are moved to cause the gripping member 144 to release the wire. The angular position of the cam 190 on the shaft 50 is established so that the wire will be gripped substantially simultaneously with the commencement of each forward movement of the slide 64 and released substantially simultaneously with the commencement of each rearward slide movement. Thus, it will be seen that the cam 190 will cause the gripping device 66 to effect wire feeding during all forward movements of the slide 64 when said slide is reciprocated once during each machine cycle.

In order that the cam 190 may be readily mounted on the shaft 50 and readily detached therefrom, said cam

is preferably formed in two half-sections. As best illustrated in FIG. 4, each cam half-section is provided with a hub half-section and the hub half-sections are adapted to be bolted together on the shaft 50. One of a pair of similar bolts 199, 199 provided for holding the cam half-sections together on the shaft 50 is shown in FIG. 4.

When it is desired to effect feed mechanism operation in accordance with the line 79 on the chart of FIG. 3, the two-to-one ratio gears 94 and 96 are mounted respectively on the adjacent exposed ends of the shafts 50 and 76 and the cam 190 is replaced on the shaft 50 by the second cam means. Said second cam means comprises a disc cam 204 illustrated in FIG. 8. The cam 204 is of half-section construction similar to the construction of the cam 190. An annular groove 206 formed in said cam is similar to the groove 192 in the actuating cam 190 but is radially offset at 90° intervals, opposite quadrants of said cam groove being at equal radial distances. It will be seen that as the cam 204 is rotated by the shaft 50, it will alternately effect gripping and releasing operation of the wire gripping device 66 at 90° intervals. Thus, wire feeding will be effected during all forward movements of the slide 64 and the two-part 180° feed operation will be provided.

The third cam means comprises a disc cam 208 which is similar in construction to the cams 190 and 204. The cam 208 is illustrated in FIG. 9 and is adapted to be mounted on the shaft 50 when the gears 94 and 96 are mounted respectively on the exposed ends of the shafts 50 and 76 to effect the mode of feed mechanism operation depicted by the line 81 on the chart of FIG. 3. An annular groove 210 formed in the face of the cam 208 is radially enlarged through 90°. It will be seen that the radially enlarged 90° portion of the cam groove will effect wire gripping action of the gripping device 66 during every other forward slide movement or during one forward slide movement during each machine cycle.

As shown, the feed mechanism 60 also includes a wire holding device and actuating means therefor, the provision of said device and actuating means, however, being optional. When the wire holding device and the actuating means are provided, the actuating means is preferably driven by the first rotatable shaft 50 and is adapted to operate the holding device to prevent wire movement when wire feeding is not in process. Thus, if the wire gripping device 66 fails to properly release the wire upon completion of a wire feeding stroke of the slide 64, the wire is nevertheless held stationary during rearward movement of the slide and the desired forming operation may be effectively performed.

A plunger 211 of the wire holding device is adapted to selectively engage the wire at its lower end and urge the same against a bearing plate 212 so as to positively prevent wire movement. The plunger 211 is movable vertically in upper and lower guides 213 and 214 as best illustrated in FIG. 4. The upper guide 213 is formed on the housing 86 and the lower guide 214 is formed on a longitudinally elongated frame member 215. The member 215 is disposed in a longitudinal slot 216 formed in the lower portion of the frame member 93, as best illustrated in FIGS. 2 and 5. The frame member 215 is secured to the frame member 93 by two of the aforementioned screws 99, 99.

A spring 217 which embraces a lower portion of the plunger 211 is seated at its lower end on the lower guide 214. The upper end of the spring 217 engages a collar 218 which is fixedly secured on the plunger 211 whereby to bias the plunger upwardly and out of engagement with wire extending across the bearing plate 212.

The actuating means for the wire holding device preferably comprises cam means adapted to be mounted on the first shaft 50 and operable to impart vertical movement to the plunger 211 in timed relation with movement of the reciprocable slide 64 and with the operation of the wire gripping device 66. As shown, the plunger 211 is

connected at its upper end with one end of a lever 219. The other end of the lever 219 is pivotally connected to an upper portion of the frame member 93 by a pin 220 as best illustrated in FIG. 5. Between the ends of the lever 219, a pin 221 supports a cam roller 222. The cam roller 222 is displaced vertically by the cam means mounted on the shaft 50 and the lever 219 is thereby oscillated about the pin 220. Oscillation of the lever 219 about its pivot causes the plunger 211 to be moved vertically into and out of engagement with wire extending across the bearing plate 212.

The cam means for actuating the hold down device may take various forms within the scope of the invention, but said means preferably comprises first, second and third disc cams 224, 226 and 228. Each of the disc cams is provided with a cam surface at its circumference for engaging the cam roller 222 supported on the lever 219. The first cam 224 is shown mounted on the shaft 50 in the drawings. As best illustrated in FIG. 5, said cam has a 90° radially enlarged portion 230 formed at its circumference for urging the cam roller 222 downwardly and causing the plunger 211 to engage and hold the wire. The second cam 226 is also shown mounted on the first rotatable shaft 50 in the drawings and is disposed adjacent the cam 224 so that the roller 222 is engaged by the circumferential surfaces of both of said cams. A 180° radially enlarged portion 232 is formed at the circumference of the cam 226 for urging the cam roller 222 downwardly and causing the plunger 211 to engage and hold the wire. The third actuating cam 228 for the wire holding device is shown in FIGS. 10 and 11 of the drawings separate from the feed mechanism. The cam 228 is provided with a 90° radially enlarged portion 234 at its circumference as is the first cam 224.

It is presently contemplated that the first actuating cam 224 for the wire holding device will be mounted on the shaft 50 throughout operation of the feed mechanism. The second and third cams 226 and 228, on the other hand, will be mounted selectively on the shaft 50 for actuating the holding device in cooperation with said first cam. Thus, the first cam 224 is of unitary construction while the second and third cams 226 and 228 are each constructed in two half-sections so that they may be readily mounted on the shaft 50 and removed therefrom.

The first cam 224 has an integrally formed hub 236 which is suitably bored to receive a plurality of set screws 238, 238, two of which screws are shown. By means of said screws, the cam may be secured in a selected angular position on the shaft 50 for rotation therewith. The half-sections of the second and third cams 226 and 228 are adapted to be bolted together on the shaft 50 and thus secured thereto in a selected angular position for rotation therewith. Countersunk openings in a hub half-section 240 formed integrally on each of said cam half-sections receive bolts 242, 242, one of which is shown.

The first and second actuating cams 224 and 226 which are shown in the drawings mounted in adjacent relationship on the shaft 50 may be adapted to actuate the wire holding device for the 180° wire feeding operation shown by the operation chart line 77 or for the 90° wire feeding operation shown by the line 81 on said chart. When the change gears 92, 92 and the gripping device actuating cam 190 are operatively connected with the other feed mechanism components to provide the 180° wire feeding operation, the first and second cams 224 and 226 are respectively angularly positioned on the shaft 50 so that the radial enlargements 230 and 232 thereon are superimposed when viewed along the axis of the cams. Said cams are shown so related in FIG. 5. It will be apparent that when the cams 224 and 226 are positioned in such manner, they will actuate the plunger 211 of the wire holding device to hold the wire during one-half of each rotation of the shaft 50 and to permit free wire movement during the remaining half-portion of each rotation of said shaft.

When the change gears 94 and 96 and the gripping device actuating cam 208 are operatively connected with the other feed mechanism components to provide the 90° wire feeding operation, the cams 224 and 226 are angularly positioned respectively on the shaft 50 so that their radially enlarged portions 230 and 232 are arranged in end-to-end relationship. The plunger 211 will then be urged downwardly to hold the wire during the 270° portion of each rotation of the shaft 50 on each machine cycle when wire feeding is not in process.

When it is desired that the holding device be actuated to hold the wire during two spaced apart 90° portions of the machine cycle, as required by the wire feeding operation provided by the change gears 94 and 96 and the gripping device actuating cam 204, the second cam 226 is removed from the shaft 50 and replaced thereon by the third cam 228. The cams 224 and 228 are angularly positioned respectively on the shaft 50 so that their 90° radially enlarged portions are diametrically opposite each other. It will be seen that with the cams so related, the plunger 211 of the wire holding device will be actuated to hold the wire during the two 90° portions of each cycle when feeding thereof is not in process and to permit the free movement of the wire during the two 90° portions of each cycle when feeding thereof is in process.

From the foregoing it will be apparent that with the improved feed mechanism of the present invention, a conversion from one mode of mechanism operation to another may be accomplished readily and with a minimum loss of forming machine operating time. It is expected that the 180° and the 90° wire feeding operations will be used most frequently. To convert from one of these operational modes to the other, the change gears are interchanged, the gripping device actuating cams 190 and 208 are interchanged and the angular position of one of the holding device actuating cams 224 or 226 is suitably adjusted on the shaft 50. When the third mode of feed mechanism operation (two spaced apart 90° wire feeding operations) is involved in a conversion, the holding device actuating cams 226 and 228 must be interchanged as an additional step. This, however, is not found burdensome from a time or convenience standpoint particularly in view of the infrequent demand for this mode of operation.

The method of removal of the feed mechanism from the forming machine is suggested by the above description. To remove the mechanism in two parts the two principal members 80 and 93 of the feed mechanism frame which support all of the component parts of said mechanism are detached and removed from the main machine frame separately. To remove the frame member 80, the change gears are removed from the shafts 50 and 76, the lever 68 is disconnected from said frame member as by removing the pin 112, and the screws 91, 91 are retracted from the machine frame. The member 80 and its connected parts is then removed from the machine by effecting relative longitudinal movement between said member and the main frame 19 of the machine.

After removal of the frame member 80 and its connected parts, the frame member 93 may be removed from the forming machine by retracting the screws 99, 99 from the machine frame 19 and sliding said member leftwardly to remove the longitudinal T-shaped bars 97, 97 from the slots 95, 95 in said machine frame. It will be noted that when the frame member 93 is so removed, the roller 194 will slide leftwardly out of the groove in the gripping device actuating cam which is mounted on the shaft 50. The said cam and the holding device cam mounted on the shaft 50 may be readily removed from said shaft as described above.

Alternatively the feed mechanism may be removed from the forming machine as a unitary assembly, the two frame members 80 and 93 being removed from the machine simultaneously with the parts respectively supported by each member operatively connected thereto as shown in the drawings. Since the parts are more easily handled, however, the two-part method of removal of the mechanism is preferred.

The invention claimed is:

1. A wire forming machine comprising a mechanism operable in fixed cycles and adapted for forming wire, a first longitudinally extending rotatable shaft having one end connected with the wire forming mechanism to make one rotation during each cycle and having the other end exposed, a second longitudinally extending rotatable shaft parallel with said first shaft and having an end exposed adjacent the exposed end of said first shaft, change gears of the spur type for connecting said first and second shafts in exposed positions at said adjacent exposed shaft ends and adapted selectively to effect either one rotation or an integral plurality of rotations of said second shaft during each rotation of said first shaft, a transversely extending rotatable shaft having a bevel gear connection with said second shaft and rotating once during each rotation of said second shaft, a crank connected to and driven by said transversely extending shaft, a pivotally supported lever connected with said crank and oscillated thereby, a longitudinally reciprocable slide connected with and driven by said lever and making one forward and rearward reciprocation during each rotation of said second shaft whereby to make one reciprocation or an integral plurality of reciprocations during each cycle, a wire gripping device carried by said slide and inoperable during each rearward slide movement, and actuating means driven by said first shaft for causing said gripping device to be operable to effect wire feeding during at least one forward slide movement within each cycle.

2. A wire forming machine comprising a mechanism operable in fixed cycles and adapted for forming wire, a first longitudinally extending rotatable shaft having one end connected with the wire forming mechanism so as to make one rotation during each cycle thereof and having the other end exposed, a second longitudinally extending rotatable shaft parallel with said first shaft and having an end exposed adjacent the exposed end of said first shaft, change gears for connecting said shafts comprising first and second companion spur gears adapted to be detachably mounted respectively in exposed positions on the adjacent exposed ends of said shafts to effect one rotation of said second shaft for each rotation of said first shaft, said change gears also comprising third and fourth companion spur gears adapted to be detachably mounted respectively on the adjacent exposed ends of said shafts in place of said first and second gears to effect two rotations of said second shaft for each rotation of said first shaft, a transversely extending rotatable shaft having a bevel gear connection with said second shaft and rotating once during each rotation of said second shaft, a crank connected to and driven in a longitudinal plane by said transversely extending shaft, a pivotally supported lever connected with said crank and oscillated in a longitudinal plane thereby, a longitudinally reciprocable slide connected with and driven by said lever and making one forward and rearward reciprocation during each rotation of said second shaft whereby to make one or two reciprocations during each cycle, a wire gripping device carried by said slide and inoperable during each rearward slide movement, and actuating means driven by said first shaft for causing said gripping device to be operable during one forward slide movement within each machine cycle whereby to effect wire feeding within a 180° or a 90° portion of each cycle.

3. A wire forming machine comprising a mechanism operable in fixed cycles and adapted for forming wire, a first longitudinally extending rotatable shaft having one end connected with the wire forming mechanism to make one rotation during each cycle and having the other end exposed, a second longitudinally extending shaft parallel with said first shaft and having an end exposed adjacent the exposed end of said first shaft, change gears of the

spur type for connecting said first and second shafts in exposed positions at said adjacent exposed shaft ends and adapted selectviely to effect either one rotation or an integral plurality of rotations of said second shaft during each rotation of said first shaft, a transversely extending rotatable shaft having a bevel gear connection with said second shaft and rotating once during each rotation of said second shaft, a crank connected to and driven in a longitudinal plane by said transversely extending shaft, a pivotally supported lever connected with said crank and oscillated in a longitudinal plane thereby, a longitudinally reciprocable slide connected with and driven by said lever and making one forward and rearward reciprocation during each rotation of said second shaft whereby to make one reciprocation or an integral plurality of reciprocations during each cycle, a wire gripping device carried by said slide and inoperable during each rearward slide movement, actuating means driven by said first shaft for causing said gripping device to be operable to effect wire feeding during at least one forward slide movement within each cycle, a wire holding device, and actuating means driven by said first shaft for causing said wire holding device to be operable to prevent wire movement when wire feeding is not in process.

4. A wire forming machine comprising a mechanism operable in fixed cycles and adapted for forming wire, a first longitudinal rotatable shaft having one end connected with the wire forming mechanism to make one rotation during each cycle and having the other end exposed, a second longitudinal rotatable shaft parallel with said first shaft and having an end exposed adjacent the exposed end of said first shaft, change gears of the spur type for connecting said first and second shafts in exposed positions at said adjacent exposed shaft ends and adapted selectively to effect either one or two rotations of said second shaft during each rotation of said first shaft, a transversely extending rotatable shaft having a bevel gear connection with said second shaft and rotating once during each rotation of said second shaft, a crank connected to and driven in a longitudinal plane by said transversely extending shaft, a pivotally supported lever connected with said crank and oscillated in a longitudinal plane thereby, a longitudinally reciprocable slide connected with and driven by said lever and making one forward and rearward reciprocation during each rotation of said second shaft whereby to make one or two reciprocations during each cycle, a wire gripping device carried by said slide and inoperable during each rearward slide movement, and actuating means for said wire gripping device comprising a first cam means adapted to be detachably mounted on said first shaft and to cause said gripping device to be operable to effect wire feeding during all forward slide movements when said slide is reciprocated once during each cycle, said actuating means also comprising a second cam means adapted to be detachably mounted on said first shaft and to cause said gripping device to be operable to effect wire feeding during all forward slide movements when said slide is reciprocated twice during each cycle, and said means also comprising a third cam means adapted to be detachably mounted on said first shaft and to cause said gripping device to be operable to effect wire feeding during alternate forward slide movements when said slide is reciprocated twice during each cycle.

5. A wire forming machine comprising a mechanism operable in fixed cycles and adapted for forming wire, a main machine frame supporting said wire forming mechanism, a secondary frame detachably connected to and supported on said main frame, a first longitudinal rotatable shaft having one end connected to said wire forming mechanism so as to make one rotation during each cycle and having the other end exposed, a second longitudinal rotatable shaft supported on said secondary frame parallel with said first shaft and having an end exposed adjacent the exposed end of said first shaft, change gears of the spur type for connecting said first and second shafts in exposed positions at said adjacent exposed shaft ends and adapted selectively to effect either one rotation or an integral plurality of rotations of said second shaft during each rotation of said first shaft, a transversely extending rotatable shaft on said secondary frame having a bevel gear connection with said second shaft and rotating once during each rotation of said second shaft, a crank connected to and driven in a longitudinal plane by said transversely extending shaft, a pivotally supported lever on said secondary frame connected with said crank and oscillated in a longitudinal plane thereby, a longitudinally reciprocable slide on said secondary frame connected with and driven by said lever and making one forward and rearward reciprocation during each rotation of said second shaft whereby to make one reciprocation or an integral plurality of reciprocations during each cycle, a wire gripping device carried by said slide and inoperable during each rearward slide movement, and actuating means supported on said secondary frame and driven by said first shaft for causing said gripping device to be operable to effect wire feeding during at least one forward slide movement within each cycle.

6. A wire forming machine comprising a mechanism operable in fixed cycles and adapted for forming wire, a first longitudinally extending rotatable shaft having one end connected with the wire forming mechanism so as to make one rotation during each cycle thereof and having the other end exposed, a second longitudinally extending rotatable shaft parallel with said first shaft and having an end exposed adjacent the exposed end of said first shaft, change gears for connecting said shafts comprising first and second companion spur gears adapted to be detachably mounted respectively in exposed positions on the adjacent exposed ends of said shafts to effect one rotation of said second shaft for each rotation of said first shaft, said change gears also comprising third and fourth companion spur gears adapted to be detachably mounted respectively on the adjacent exposed ends of said first and second shafts in place of said first and second gears to effect two rotations of said second shaft for each rotation of said first shaft, a transversely extending rotatable shaft having a bevel gear connection with said second shaft and rotating once during each rotation of said second shaft, a crank connected to and driven in a longitudinal plane by said transversely extending shaft, a pivotally supported lever connected with said crank and oscillated in a longitudinal plane thereby, a longitudinally reciprocable slide conected with and driven by said lever and making one forward and rearward reciprocation during each rotation of said second shaft whereby to make one or two reciprocations during each cycle, a wire gripping device carried by said slide and inoperable during each rearward slide movement, and actuating means for said wire gripping device comprising a first cam means adapted to be detachably mounted on said first shaft and to cause said gripping device to be operable to effect wire feeding during all forward slide movements when said slide is reciprocated once during each cycle, said actuating means also comprising a second cam means adapted to be detachably mounted on said first shaft in place of said first cam means and to cause said gripping device to be operable to effect wire feeding during all forward slide movements when said slide is reciprocated twice during each cycle, and said actuating means also comprising a third cam means adapted to be detachably mounted on said first shaft in place of said first or second cam means and to cause said gripping device to be operable to effect wire feeding during alternate forward slide movements when said slide is reciprocated twice during each cycle.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

470,591	Norton	Mar. 8, 1892
519,924	Norton	May 15, 1894
1,097,652	Lewis	May 26, 1914
1,382,379	Olson	June 21, 1921
1,880,939	Emmons	Oct. 4, 1932
1,883,513	Borton	Oct. 18, 1932
2,009,726	Bouillon	July 30, 1935
2,884,119	Powers	Apr. 28, 1959

FOREIGN PATENTS

917,242	Germany	Aug. 30, 1954