Nov. 17, 1953 E. O. KLEMM 2,659,409

WIRE BENDING MACHINE

Filed Sept. 26, 1949 5 Sheets-Sheet 1

Fig 2

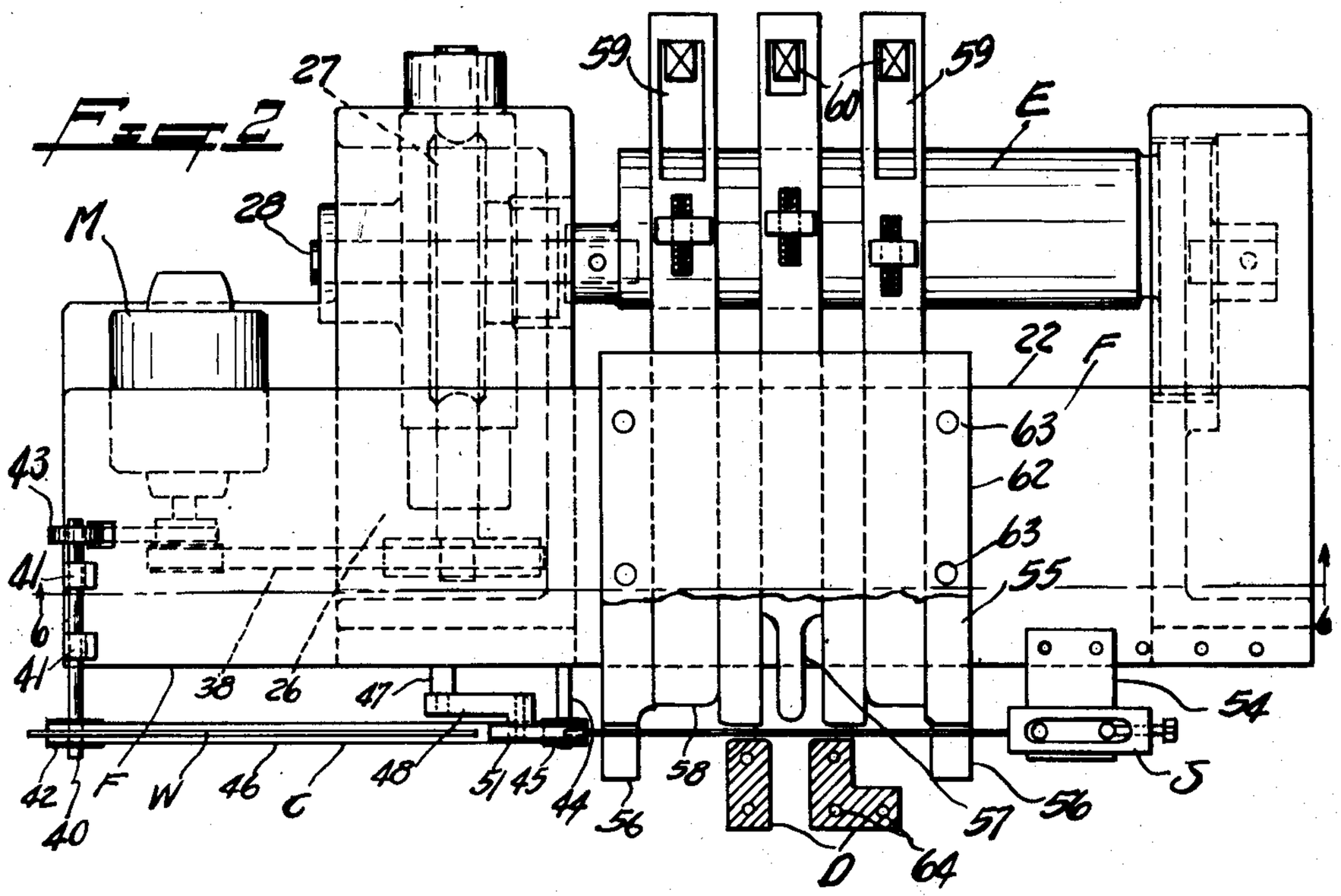

Fig 1

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WIRE BENDING MACHINE

Filed Sept. 26, 1949 5 Sheets-Sheet 2

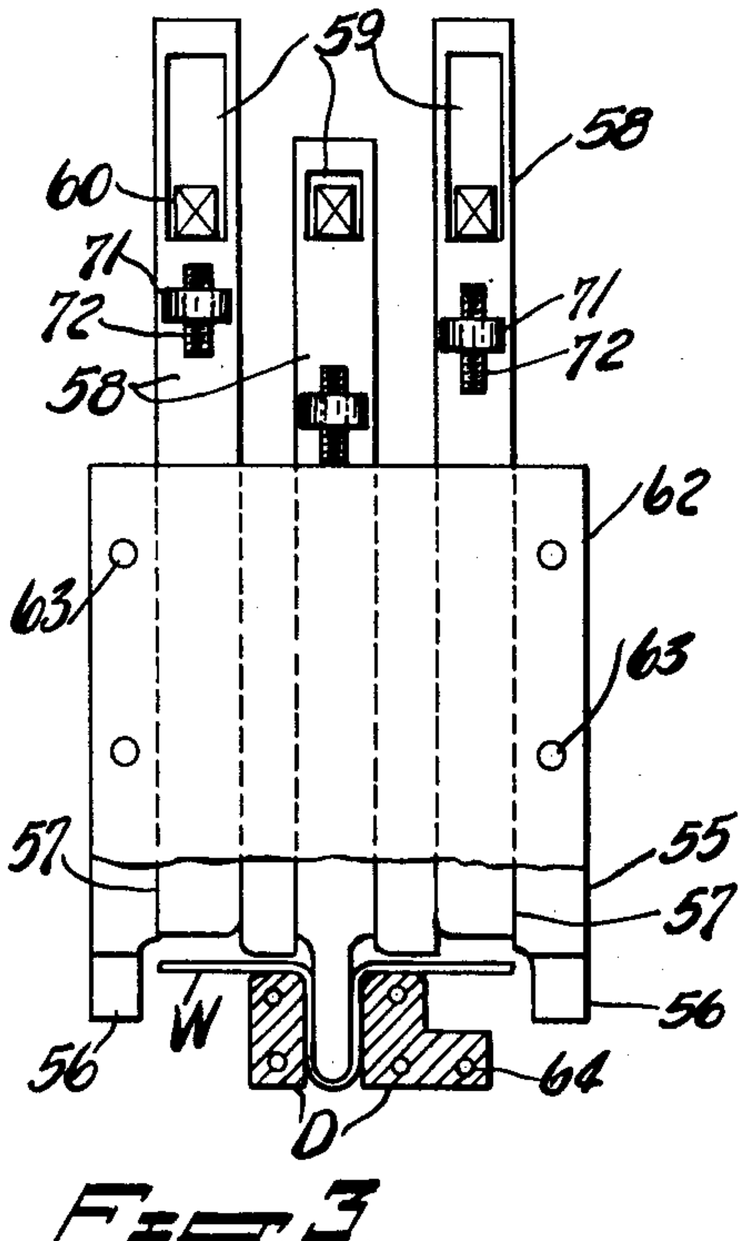

Fig. 3

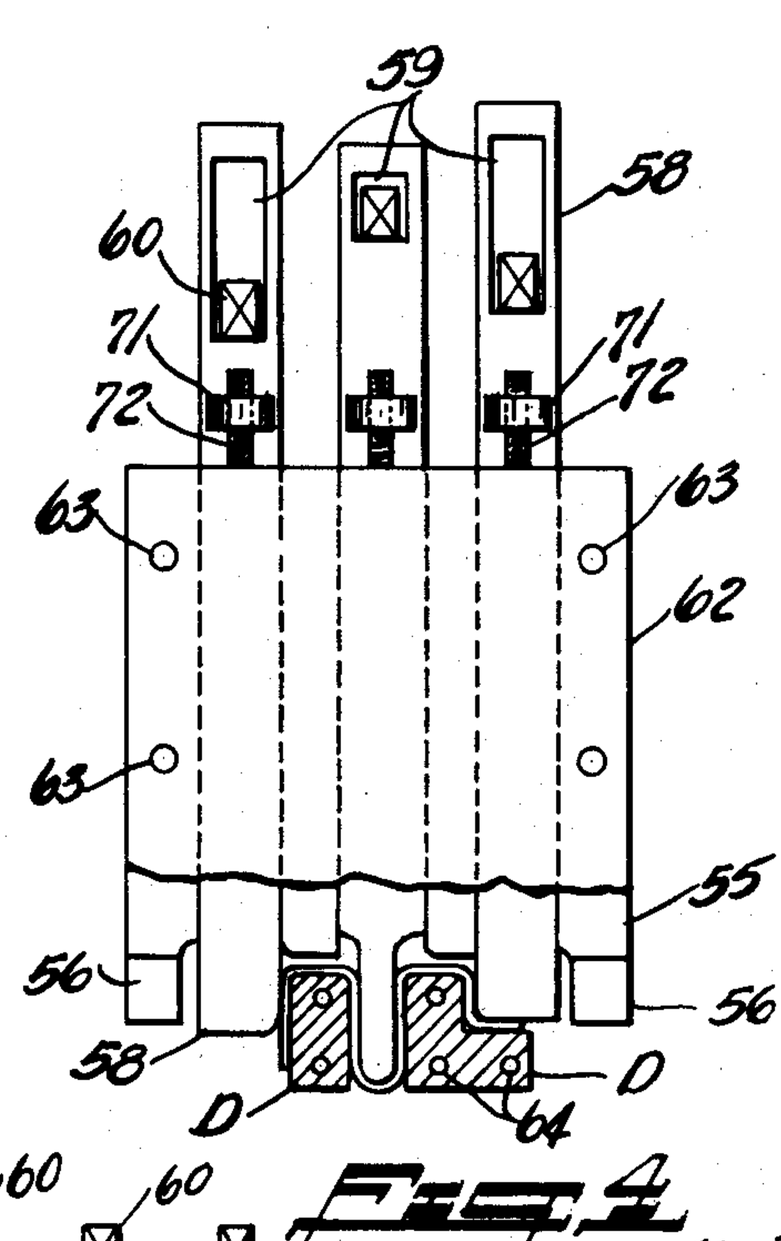

Fig. 4

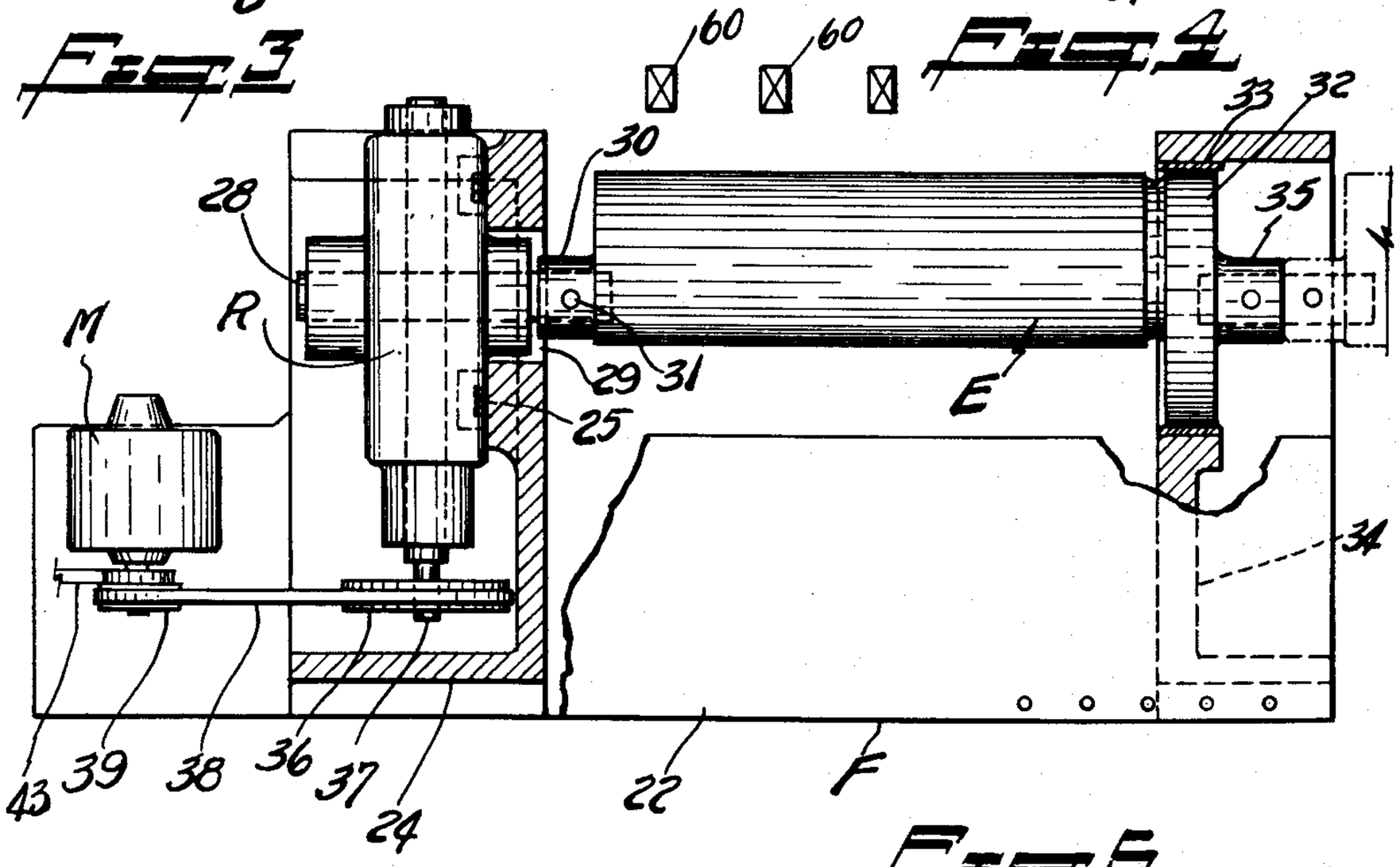

Fig. 5

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WIRE BENDING MACHINE

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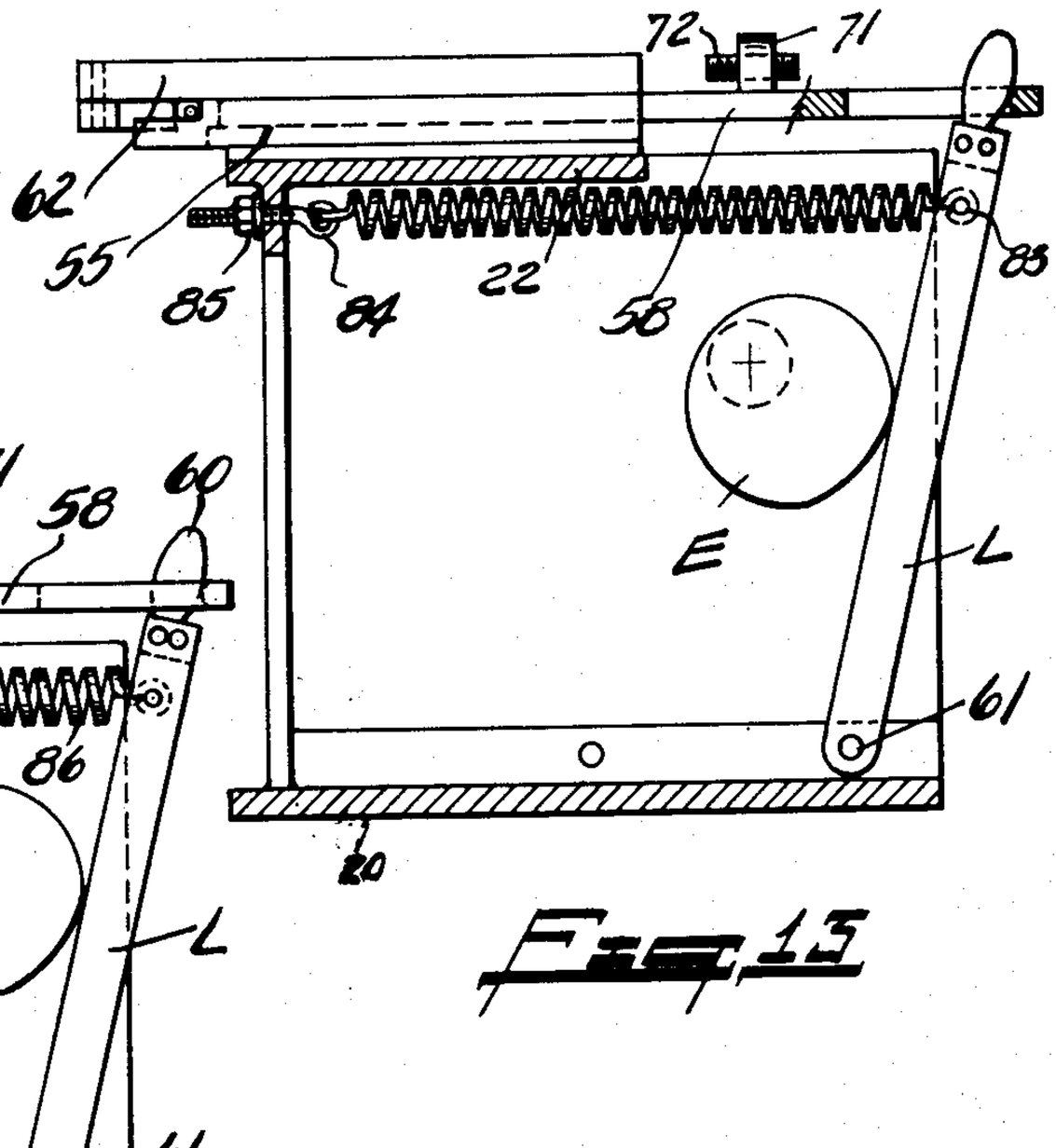

Fig. 13

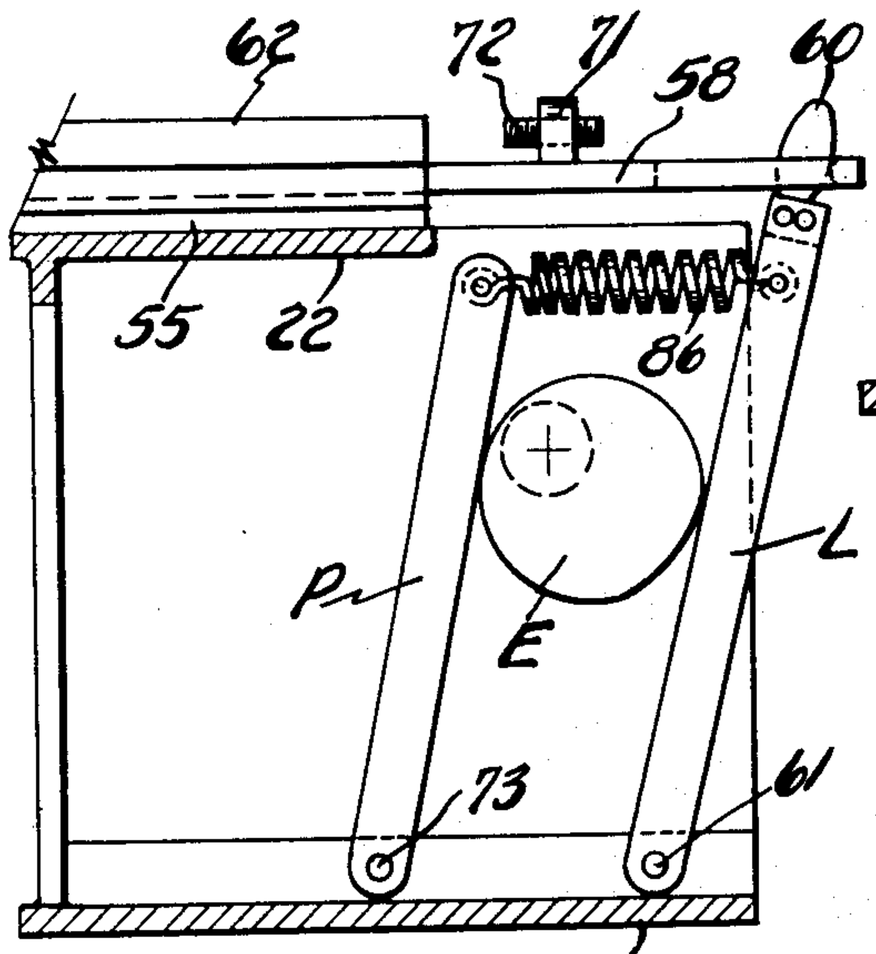

Fig. 14

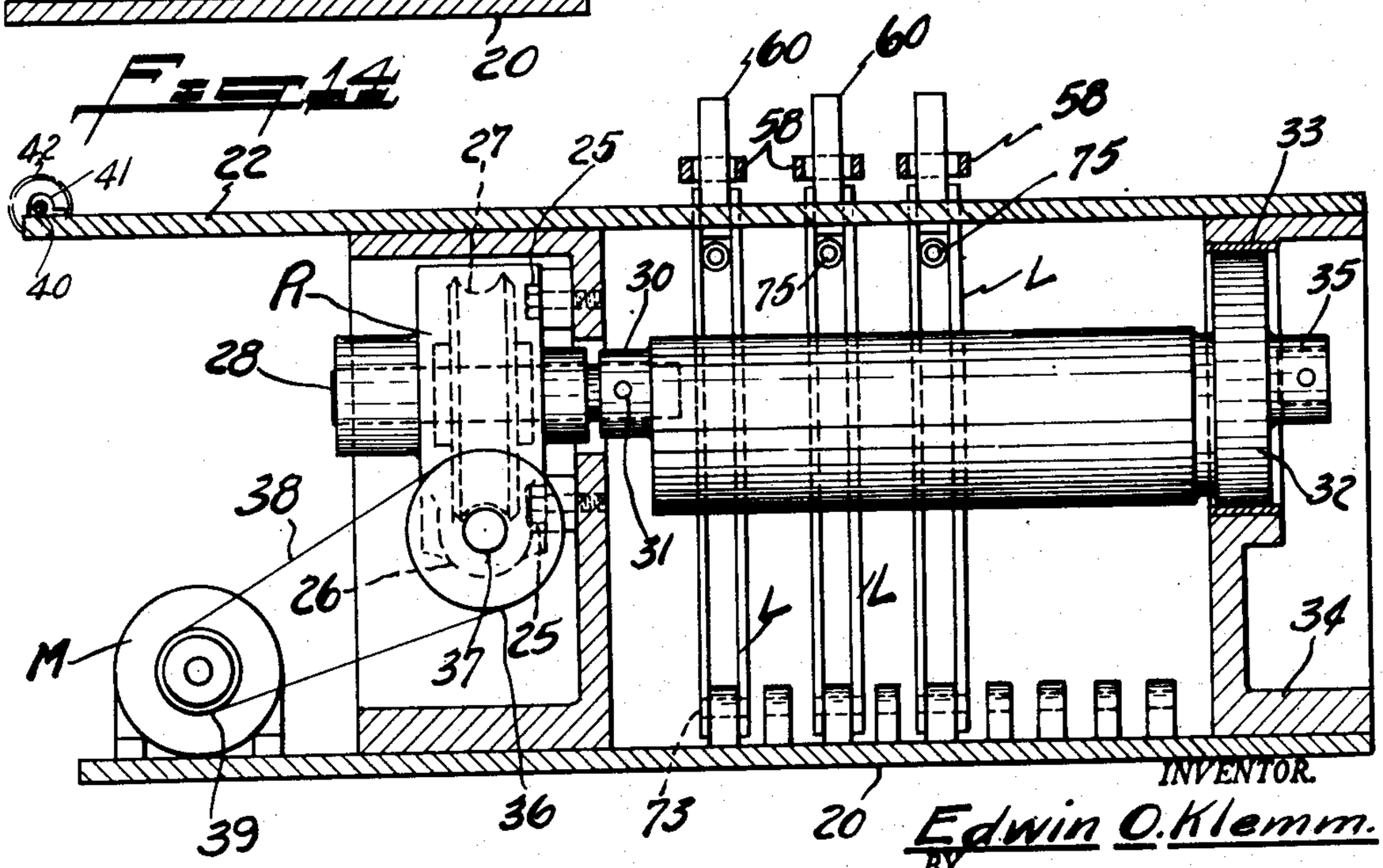

Fig. 6

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WIRE BENDING MACHINE

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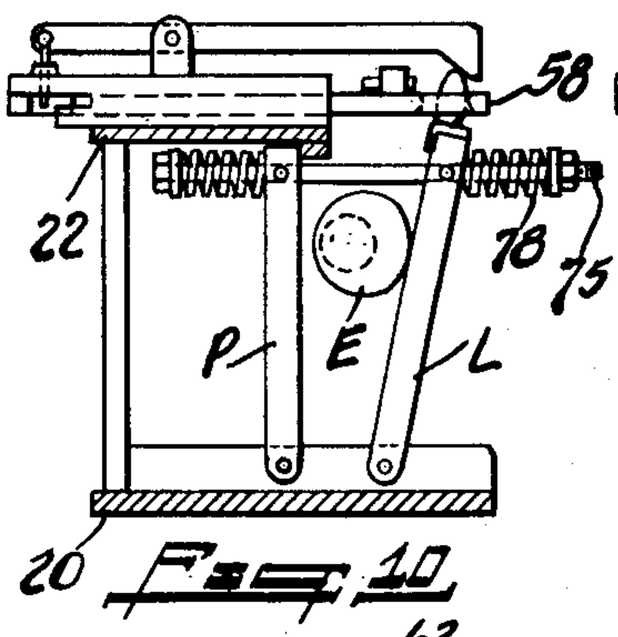

Fig. 10

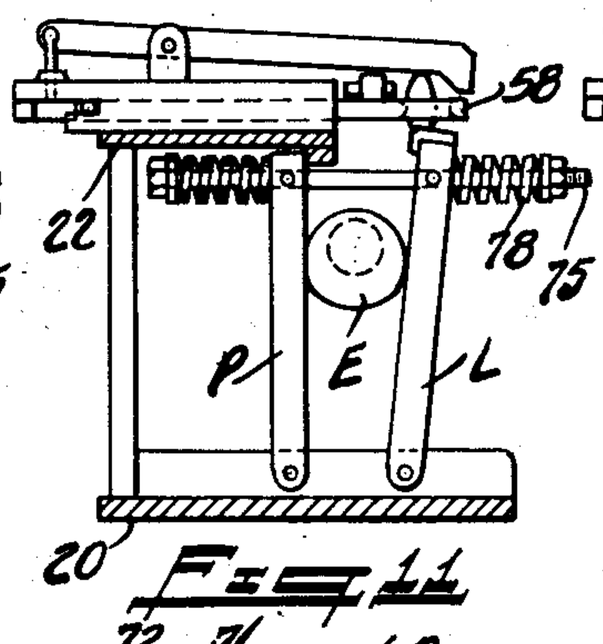

Fig. 11

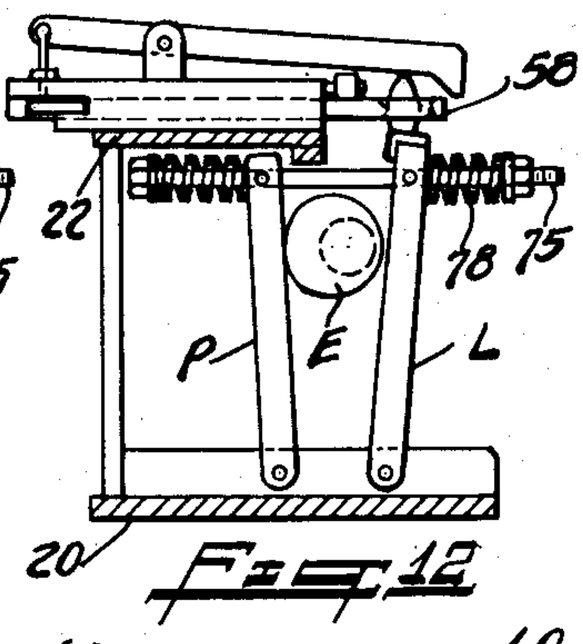

Fig. 12

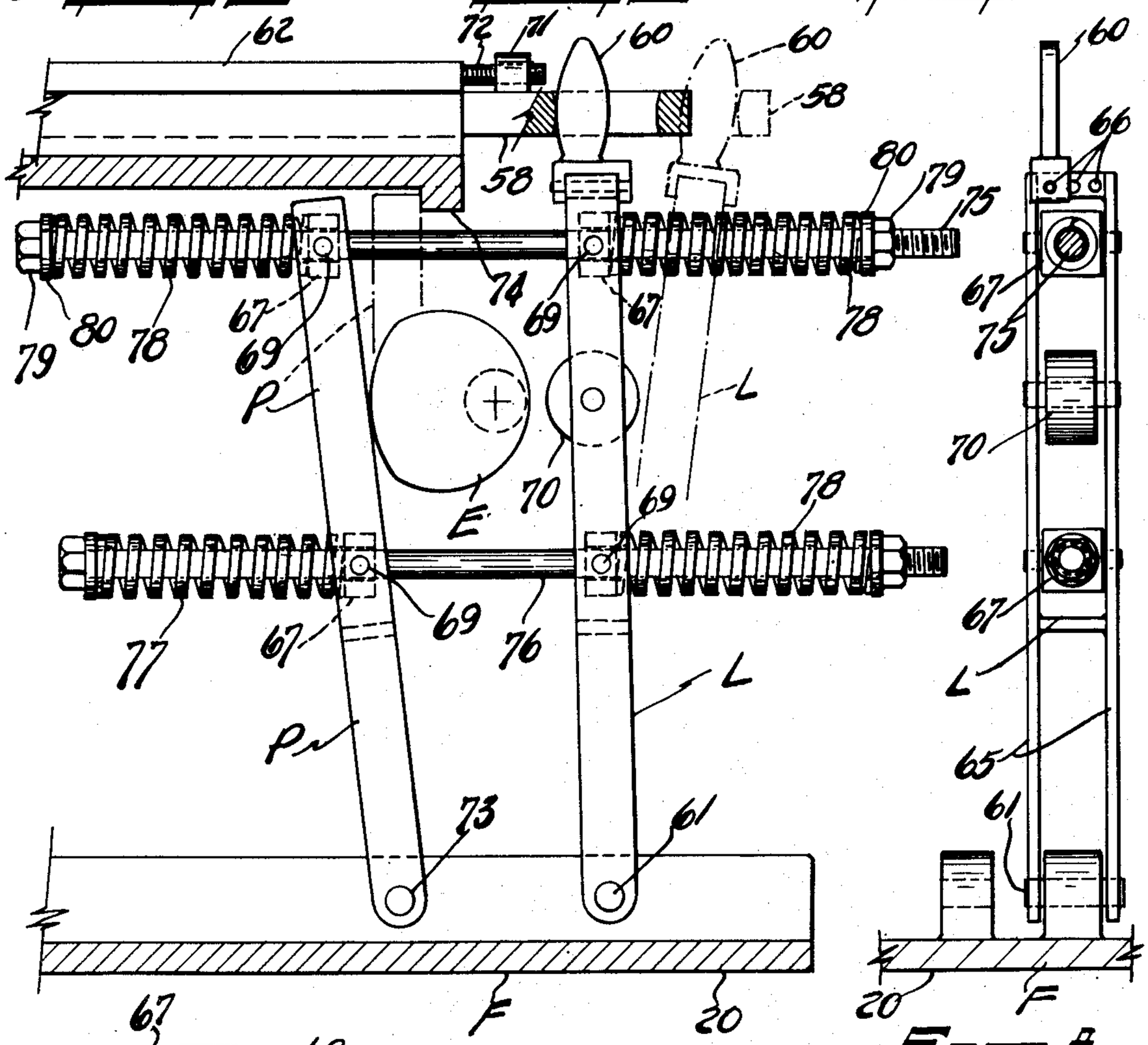

Fig. 8

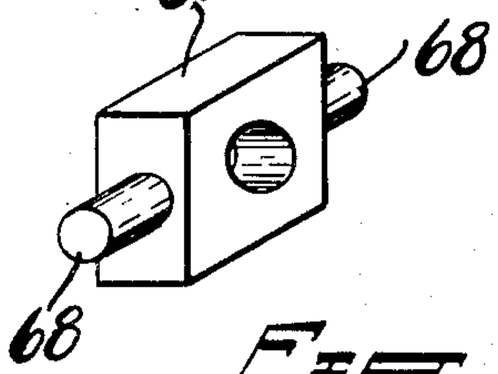

Fig. 9

Fig. 7

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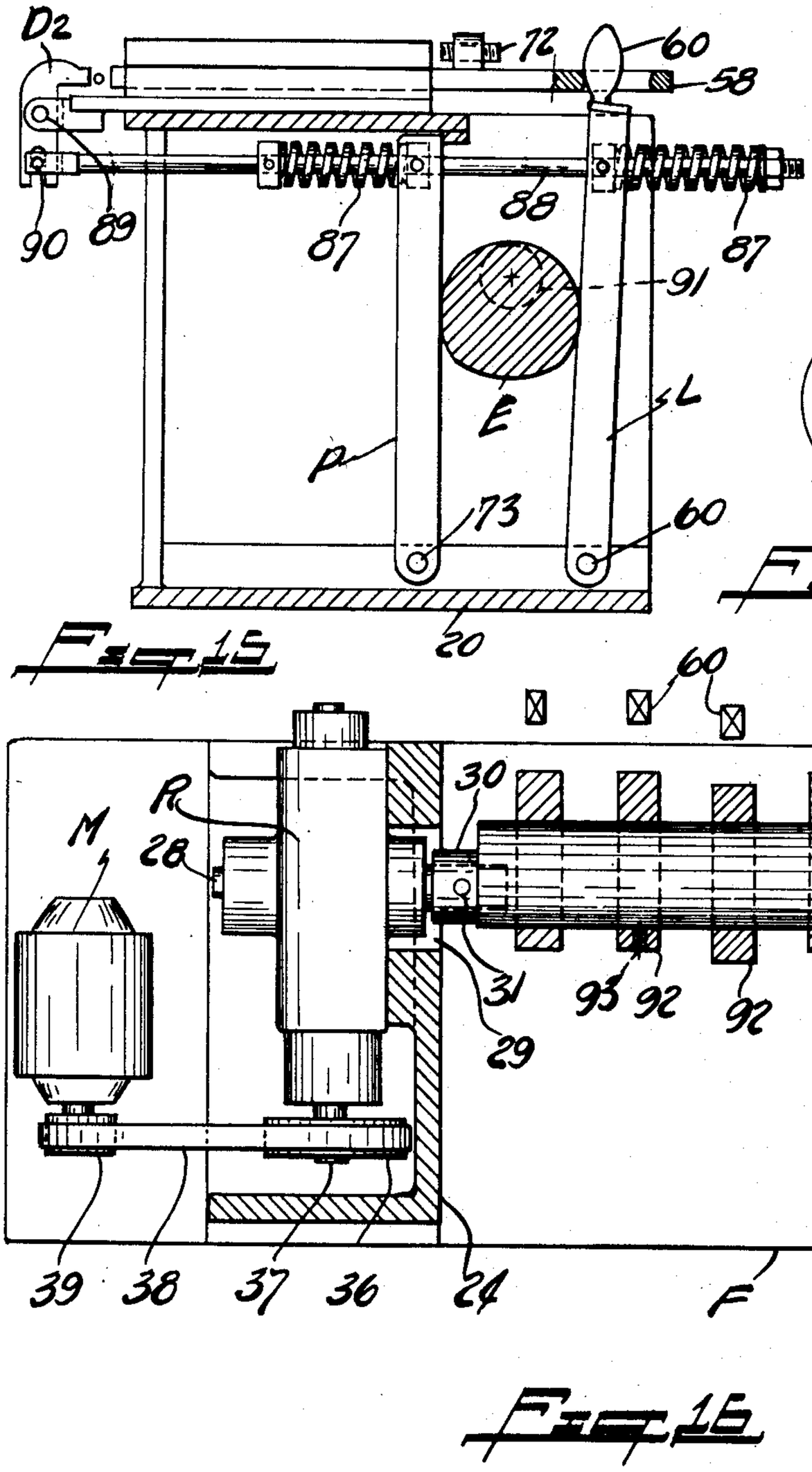

Fig. 15

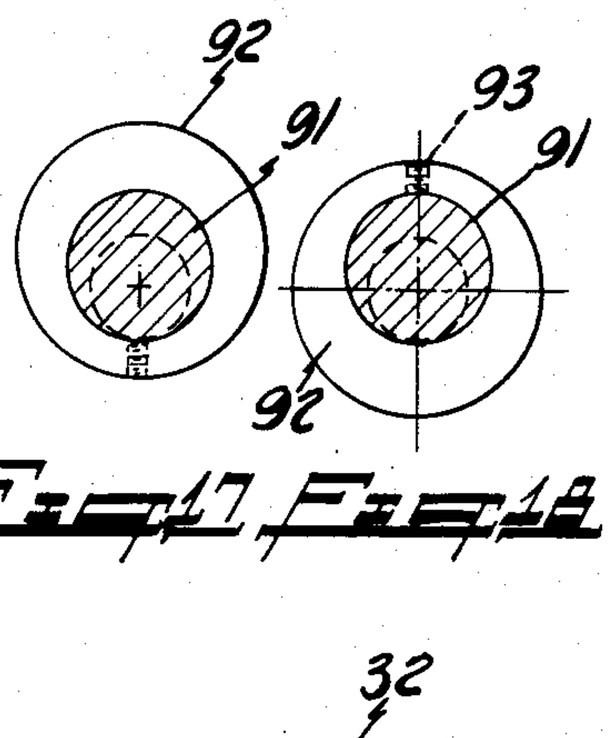

Fig. 17 Fig. 18

Fig. 16

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Patented Nov. 17, 1953

2,659,409

UNITED STATES PATENT OFFICE

2,659,409

WIRE BENDING MACHINE

Edwin O. Klemm, Saginaw, Mich., assignor, by mesne assignments, to Saginaw Wire Products, Inc., Saginaw, Mich., a corporation of Michigan

Application September 26, 1949, Serial No. 117,891

7 Claims. (Cl. 153—21)

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This invention relates to machines for bending wire into various shapes for use in the automobile industry and other places where high production of wire shapes and quick changeover from the manufacture of one wire shape to another are both necessary and economical.

One of the prime objects of my invention is to design a power-actuated wire bending machine in which the wire may be readily bent to the most complicated form or shape without stretching or fracturing the wire at the point of bend.

A further object is to design a wire bending machine which bends in a smooth, natural manner, the bends being progressively formed so that the metal displacement caused by the bend is free and natural, thus torsional stresses and distortions are avoided, and undue bending, inaccuracies, and resultant scrappage minimized.

A further object of my invention is to provide a machine which incorporates spring-actuated slides associated with the dies in such a manner, that longer lengths of wire may be bent merely by bringing additional spring-actuated lever units into play, it being understood that any number of such lever units may be incorporated, and that the number of elements in action can be easily, quickly and readily varied.

Another object is to provide a bending machine in which the bending dies may be easily and securely mounted in position and in a minimum length of time, consequently making it more economical to change over from one wire shape to another, thus eliminating stock piling of wire shapes and conserving valuable storage space at present used for this purpose.

As is well-known in the art, the process of forming the heavy wires used in modern industry to the complicated shapes required, comprises a sequence of separate forming operations such as is necessary to accomplish free, easy, and non-distorting bending. The precise timing necessary has heretofore been provided by complicated, expensive and non-flexible cam mechanisms, and when it was necessary to produce a different wire shape, several hours were required, by a skilled mechanic, to effect the changeover, inasmuch as it was necessary to change cams or individually adjust each of the various cams. This was both expensive and time-consuming, and as a result, it has been customary to stock pile various wire shapes to eliminate too frequent changeovers, which, of course, necessitates storage space and adds to the inventory on hand.

All of this I have overcome in my new machine in which the bending mechanism incorporates

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simple, non-cam-sequence-timing means which can be easily and quickly mounted and demounted, and in which the wire is rapidly fed to the dies.

A further object of my invention is to provide a machine of the type described in which the necessary pressure to accomplish a bending result is easily obtained by the simple variation of the pre-loading of my individual spring units; and further provide means whereby the forward travel of the spring powered unit may be arrested at any predetermined point in its path of travel, thus greatly simplifying the bending die design.

Further objects and advantages of my invention will become apparent as the specification progresses, reference being had to the accompanying drawings in which I have shown several embodiments of my invention, it being apparent that changes may be made in the form, size, and arrangement of the various parts, without departing from the spirit of the invention or the scope of the appended claims.

In the drawings:

Fig. 1 is a side elevational view of my wire-bending machine.

Fig. 2 is a top, plan view, parts of the assembly being broken away to more clearly show the invention.

Fig. 3 is a fragmentary, plan view similar to Fig. 2 and showing the die and slides with the wires in the process of being formed to shape.

Fig. 4 is a similar view showing the progressive bending of the wire.

Fig. 5 is a fragmentary, part-sectional plan view showing the eccentric driving mechanism.

Fig. 6 is a longitudinal, sectional view of the wire bending machine taken on the line 6—6 of Fig. 2.

Fig. 7 is an enlarged, fragmentary, sectional view of the slide-actuating levers, slides, etc., the broken lines indicating the range of movement of said levers.

Fig. 8 is a fragmentary, part-sectional, end-elevational view of one of the levers.

Fig. 9 is a perspective view of one of the swivel bearings such as used in the levers.

Fig. 10 is a reduced, schematic, part-sectional, side-elevational view of the structure shown in Fig. 1 with the dies in place.

Fig. 11 is a similar view showing an advanced position of the slide-actuating means.

Fig. 12 is another similar view showing the position of the die unit, slide and actuating mechanism at completion of the bending stroke.

Fig. 13 is also a fragmentary, longitudinal, sec-

tional, side-elevational view showing a modified design.

Fig. 14 is a view similar to Fig. 13 showing still another modification.

Fig. 15 is a similar sectional, elevational view showing a modified construction.

Fig. 16 is a sectional, plan view similar to Fig. 5 showing the eccentric collars adjustably mounted on the eccentric.

Fig. 17 is a transverse, sectional view through one of the eccentric collars.

Fig. 18 is a similar sectional view illustrating the adjustment of the eccentric collars on the main body of the eccentric.

Referring now more particularly to Figs. 1 to 12 of the accompanying drawings in which the letter F indicates a main frame having a base **20**, and a top plate **22** as usual. A transverse partition **24** spans the main frame (see Fig. 5 of the drawings), and a speed reducer R is mounted thereon by means of bolts **25**, said reducer comprising a worm **26** drivingly engaging a worm wheel **27** which is mounted on the shaft **28**, one end of said shaft projecting through an opening **29** provided in the frame and being secured in a boss **30** which forms a part of the eccentric E by means of a pin **31**.

An enlarged section **32** is provided on the opposite end of the eccentric E and is mounted in a bearing **33** provided in the partition **34**, a hub **35** being cast integral with the eccentric and is suitably bored to accommodate another shaft member (shown in broken lines), should it be desired to add additional units thereto.

A sheave **36** is provided on the one end of the worm shaft **37**, and a belt **38** drivingly connects the sheave **36** with a sheave **39** provided on the motor M, which motor can be connected to any suitable source of power.

A shaft **40** is journaled in bearings **41** provided on the face of the frame, and a sheave **42** is provided thereon, said shaft being driven from the motor M by means of belt **43**. A horizontally disposed shaft **44** is journaled on the face of the top plate **22** and a sheave **45** is provided thereon, a belt **46** drivingly connecting shafts **40** and **44** and forming a conveyor C which carries the cut lengths of wire W to the bending dies.

A vertically disposed bar member **47** is provided on the side wall of the main frame, and a horizontally extending arm **48** is pivotally connected thereto by means of pin **49**, the free end of said arm being formed with a depending leg section **50** to which a shoe **51** is rockably connected by means of a pin **52**, the lower face of the shoe being beveled as at **53** for guiding the wire W as it is carried on the conveyor C.

An adjustable stop unit S is mounted on a plate **54** secured to the top face of the main frame in horizontal alignment with the conveyor C, and limits the inward travel of the wire, this stop being of conventional design, and I do not deem it necessary to describe the construction or operation thereof.

A bed plate **55** is mounted on the upper face of the main frame, and is formed with spaced-apart projecting sections **56** forming a support for the work, said plate being grooved as at **57** to slidably accommodate a plurality of die bar slides **58**, these slides being actuated in a manner to be presently described, one end of each slide being shaped to form the curvature to which the wire is to be bent, the opposite end being formed with a slotted opening **59** of predetermined length to accommodate the shoe **60** of a die bar actuating

lever L, the lower end of said lever being pivotally connected to the base **20** by means of a pin **61**.

A plate **62** forms a cover for the die bar slide **58** and is secured in position by means of bolts **63**, one edge of said plate overhanging the end of the bed plate and forming dies D are secured to the lower face thereof by means of bolts **64** or the like.

The die bar actuating levers L are formed as clearly shown in Figs. 7 and 8 of the drawings, each lever comprising spaced-apart bars **65** having an extension shoe **60** adjustably connected to its upper end by means of bolts **66** or the like, and a swivel bearing **67** is revolvably mounted therebetween. Laterally projecting pins **68** are provided on the bearing **67**, and are journaled in suitable openings **69** provided in the bars **65** at a point intermediate their length, and a cam follower roller **70** is revolvably mounted on the lever L in position for engagement by the eccentric E as the machine is driven.

The die bar slides **58** are actuated by the extension shoes **60** which project into the openings **59**, the edges of the shoes being curved as shown to minimize thrust and wear, and the stroke of each slide is governed by the eccentric E and the length of the slot in each slide.

A raised boss **71** is provided on the upper face of each of the die bar slides **58**, and an adjustable stop member **72** is threaded therein, the end of the stop engaging the edge of the plate **62** to limit forward travel of said slide as the machine is operated.

A shorter lever P is pivotally secured to the base **20** by means of pin **73** and is located on the side of the eccentric E opposite to lever L. Swivel bearings **67** are mounted on the lever P the same as on lever L, the upper end of lever P engaging a stop **74** provided on the lower face of the top plate **22** to limit return travel of said lever P.

Threaded rods **75** and **76** are slidably mounted in the swivel bearings **67**, and springs **77** and **78** are interposed between the swivel bearings and a nut and washer assembly **79** and **80**, which is provided on the threaded ends of the rods, these springs being preloaded by means of the nut **79** and can be tensioned as desired, said springs normally tending to force the levers L and P towards each other and into engagement with the face of the eccentric at all times, and while in Figs. 7 and 12 of the drawings I have shown two sets of rods and springs, it will be understood that it is a matter of choice, depending on the size of the work and power required and that one pair can be used when desired.

The actuating levers and openings in the draw bar slides **58** and stops are of prime importance. The eccentric E is the timer; it governs the start of the forward travel of the actuating levers L and P; the variation in the lengths of the individual slots or openings in the die bar slides **58** controls the sequence and starting time of the slides when acted upon by the stored energy in the preloaded springs of the levers. The forward movement of the slides **58** is stopped when the stops **72** engage the edge of the plate **62**, and the levers stop simultaneously therewith, and it will be obvious that the full energy of the preloaded springs has not been fully expended.

The eccentric E also returns the levers to original starting position, the upper end of the lever P engaging the stop **74** on the plate **22** and limiting the return movement thereof. The pressure exerted is yieldable, providing more even, accurate and uniform bending, eliminating break-

age, and providing a safety factor not present in machines of this type at present on the market.

The sequence of operation of the machine is as follows: When the motor M is energized, the conveyor C feeds a pre-cut length of wire W over the projecting supports 56 which form a part of the bed plate of the die and against stop S, the wire being disposed between the ends of the die bar slides and the face of the bending die blocks D, and as the eccentric E is driven, the levers L and P are swung about pivot points 61 and 73, moving forwardly from broken line position shown in Fig. 7 of the drawings and forcing the ends of the die bar slides 58 into engagement with the work W, compressing the springs 77 and 78, and completing a bending stroke, so that there is no tendency to crack the wire or create an inherent twist or distortion after it is formed to shape.

The slides 58 move in predetermined sequence so that the forming is progressive, and when all slides have reached the limit of their forward travel, the stops 72 will be in engagement with the plate 62, and with this arrangement certain slides may be holding bent portions in true alignment and position, while other slides are in turn making other unusual bends; there are no sharp hammer blows as the spring loaded levers provide a yielding pressure.

The return stroke is neither violent nor jerky; it is controlled by the rotation of the eccentric which engages the rollers 70 to eliminate friction and provide smooth operation.

In Fig. 13 of the drawings I have shown a simplified arrangement in which but one lever L is provided, the slides, die mounting, feeding and driving mechanism being exactly the same as shown in Fig. 1 with the exception that but one spring 82 is provided for each lever, one end being anchored direct to the lever L by means of the pin 83, the opposite end being anchored to an eye bolt 84 mounted in the side wall of the frame, and which is adjustable by means of nut 85. With this arrangement, the energy in excess of the pre-load is stored up when the slide is in its fully retracted position, and when the eccentric is actuated, the springs force the slides forwardly into engagement with the work, and when the bending operation is completed, the eccentric again forces the lever back to original starting point.

Fig. 14 shows still another modification in which pairs of levers are employed similar to Fig. 7. In this design, a spring 86 is connected to the levers L and P, and as the eccentric E is driven, the springs 86 force the slides 58 forwardly into engagement with the work, and also return the slides in the same manner.

Figs. 15 to 17 inclusive show another modification in which the spring arrangement 87 is similar to that shown in Fig. 7, except that but one pair of springs is provided for each pair of levers. A die D2 is rockably mounted on a horizontally disposed extension 89 of the bed plate 55 by means of the pin 90, and the lower end of the die is pivotally connected to the forked extension D3 of the die by means of the pin 90A. This arrangement simultaneously moves the slides 58 and rocks the dies D2 about the pivot point 90, so that bending and punching operations can be performed as desired.

Fig. 16 shows a variation of the eccentric construction previously described, a smaller eccentric drum 91 being provided, and eccentric collars 92 are circumferentially adjustable thereon

by means of setscrews 93. This permits the starting sequence to be varied and the adjustment is simple and easy.

When it is desired to change over to bend a wire different than that presently being run on the machine, it is merely necessary to remove the forming dies and die bar slide assembly, replace them with dies and slides of required design, and the changeover is complete. The change can be easily made and in a minimum length of time.

From the foregoing description, it will be apparent that I have perfected a simple, practical and relatively inexpensive bending machine for bending wire into any desired shape or configuration.

What I claim is:

1. In a wire bending machine, the combination comprising a main frame, a bed plate mounted thereon, die bar slides reciprocably mounted in said bed plate, said slides each having single slots of varied length with relation to one another extending in the direction of travel of said bar slides, forming dies on said frame spaced from the ends of the slides and in alignment therewith, work support means for supporting the work between said die bar slides and forming dies, actuating levers pivotally mounted on said frame, the one end of each of said actuating levers being freely accommodated in the slot of a die bar slide and of a size with relation to the length of the slot as to be movable therein predetermined distance in the direction of travel of said die bar slide before actuating said slide, so that each slide is moved in timed relation with respect to the other slides, and driving means associated with said levers for forcing the slide engaging ends of said levers through a definite path of travel to move said slides into and out of engagement with the work.

2. In a wire bending machine, the combination comprising a main frame, a horizontally disposed bed plate mounted thereon, transversely disposed die bar slides reciprocably mounted in said bed plate, forming dies on said frame spaced from the ends of the die bar slides and in alignment therewith, work support means supporting the work between said slides and forming dies, said slides being formed with slots of varying length extending in the direction of travel of the slides, longitudinally spaced, upwardly extending actuating levers pivotally mounted on said frame with their upper ends freely accommodated in said slots, the levers being of a size with relation to the length of the slots as to be transversely movable in said slots of varied length before actuating said die bar slides, so that each die bar slide is moved in timed relation with respect to the other die bar slides, and driving means for forcing the upper ends of said levers simultaneously through a path of travel to move said slides into and out of engagement with the work.

3. In a wire bending machine, the combination comprising a main frame, a bed plate mounted thereon, die bar slides reciprocably mounted in said bed plate, forming dies on said frame spaced from the ends of the slides and in alignment therewith, work support means for supporting the work between said die bar slides and forming dies, actuating levers pivotally mounted on said frame for moving said slides into and out of engagement with the work, each lever having an end associated with a die bar slide in a manner to permit travel with relation thereto before positively actuating its die bar slide a varied distance with respect to the distance traveled by the other ac-

tuating levers before positively engaging their slides to enable each slide to be moved in timed relation with respect to the movement of the other slides, and driving means simultaneously driving said levers through the same defined path of travel.

4. In a wire bending machine, a frame, a bed plate mounted thereon, die bar slides reciprocable in said bed plate, said slides being formed with elongated slots of varied length extending in the direction of travel of said slides, forming dies spaced from the ends of said slides and in horizontal alignment therewith, actuating levers pivoted on said frame, the one end of each of said levers being freely accommodated in a slot in a slide and of a size with relation to the length of said slot as to be movable therein in the direction of travel of said slide before actuating said slide, so that each slide is actuated in timed relation with respect to the other slides, spring means normally urging said levers in a direction to drive said slides into engagement with the work, and driven eccentric means controlling the spring forced bending stroke of said levers and returning said levers to spring loaded position.

5. In a wire bending machine, a frame, a bed plate mounted thereon, die bar slides reciprocable in said bed plate, said slides being formed with elongated openings of varied length extending in the direction of travel of said slides, forming dies spaced from the ends of said slides and in alignment therewith, units of spaced-apart levers pivoted on said frame, the one end of a lever in each unit being freely accommodated in one of said slide openings and of a size with relation to the length of said opening as to be movable in the direction of travel of the slides before actuating the bar slide, at least one rod slidably connecting the levers of each lever unit and extending beyond the levers at both ends, spring means mounted on said rods between each lever and the end of the rod for normally urging said slide engaging lever in a direction to drive said slides into bending engagement with the work, stop means limiting the return travel of the non-slide-engaging levers, and driven eccentric means controlling the release of said slide-engaging levers during the bending stroke and returning said slide-engaging levers against the compression of said springs to original spring-loaded position.

6. In a wire bending machine for actuating a die bar slide having a slotted opening therein, an actuating lever pivotally mounted on said machine with its one end freely accommodated in said opening, a booster lever pivotally mounted on said machine, at least one rod slidably connecting said actuating lever and said booster lever, spring means on said rod adjacent said actuating lever normally urging said actuating lever in a direction to move said die bar slide into engagement with the work, booster spring means on said rod adjacent said booster lever, eccentric means for controlling the spring forced travel of said actuating lever and returning said actuating lever against the compressive force of said spring means and booster spring to spring-loaded position.

7. In a wire bending machine, a mechanism for actuating a die bar slide provided with means for limiting its bending stroke, comprising a pair of levers pivotally mounted on said machine, the rear lever being arranged to engage said die bar slide and move it into bending engagement with the work, swivel bearings on said levers, at least one horizontally disposed rod slidably disposed in said bearings and extending beyond said bearings, pre-loaded springs mounted on said rod and interposed between the levers and the ends of the rods, a stop on said machine for limiting the return stroke of said front lever, a driven eccentric means mounted between said levers and actuating said rear lever to return it to original position and compress said springs and to also actuate said front lever to complete the bending stroke.

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