

[54] **APPARATUS FOR FASTENING THE
END COILS OF BORDER SPRINGS OF
A SPRING CONSTRUCTION TO AN
ELONGATE WIRE**

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245/10

[56]

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2,885,693	5/1959	Wuest.....	5/260
3,362,439	1/1968	Foreman	140/113
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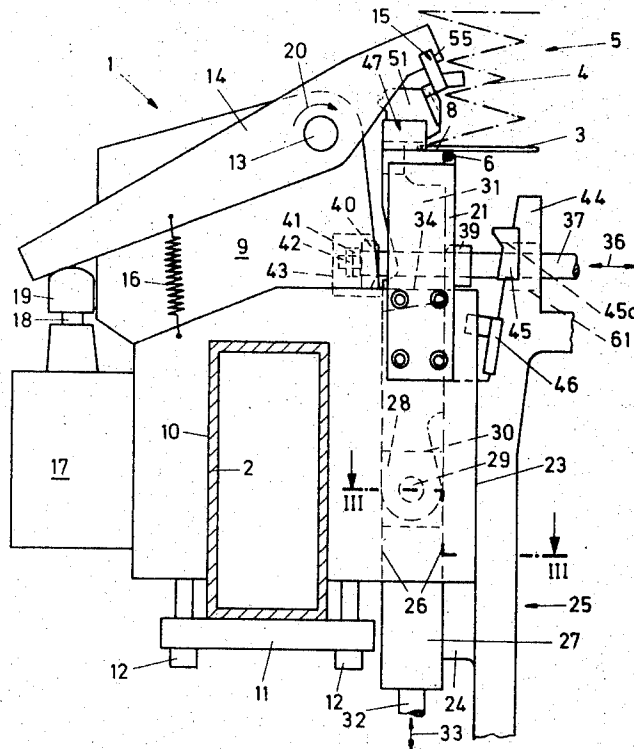
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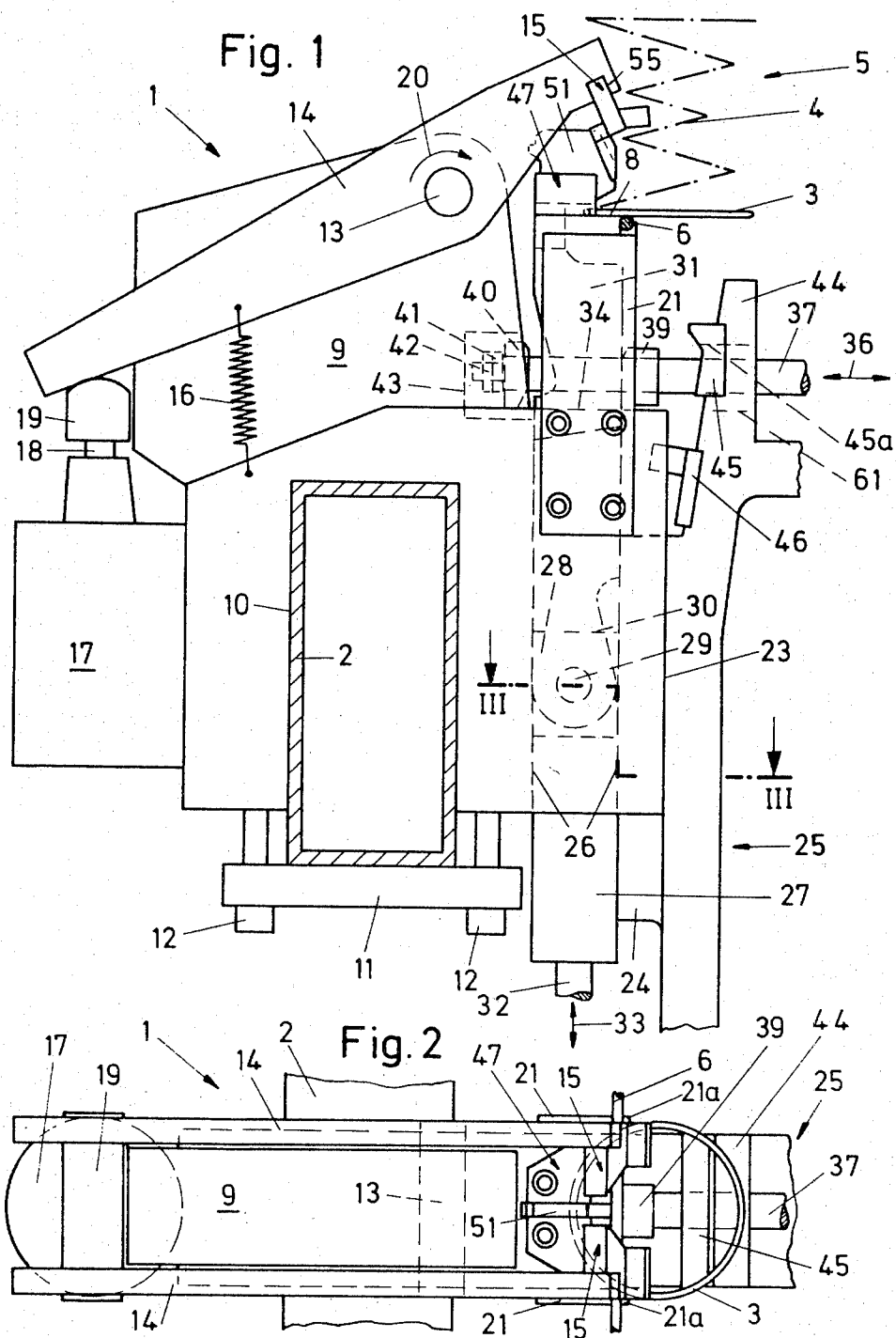
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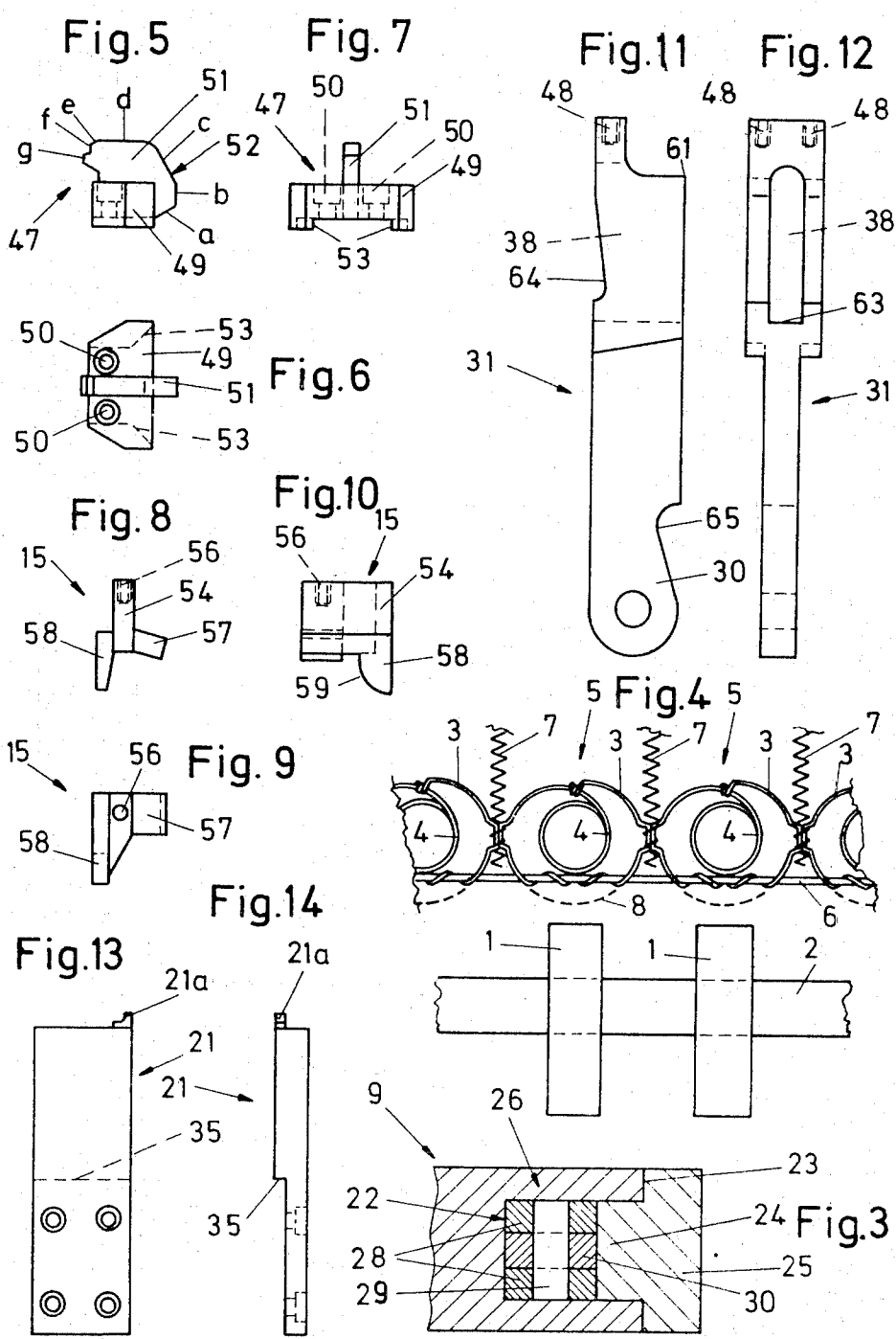
ABSTRACT

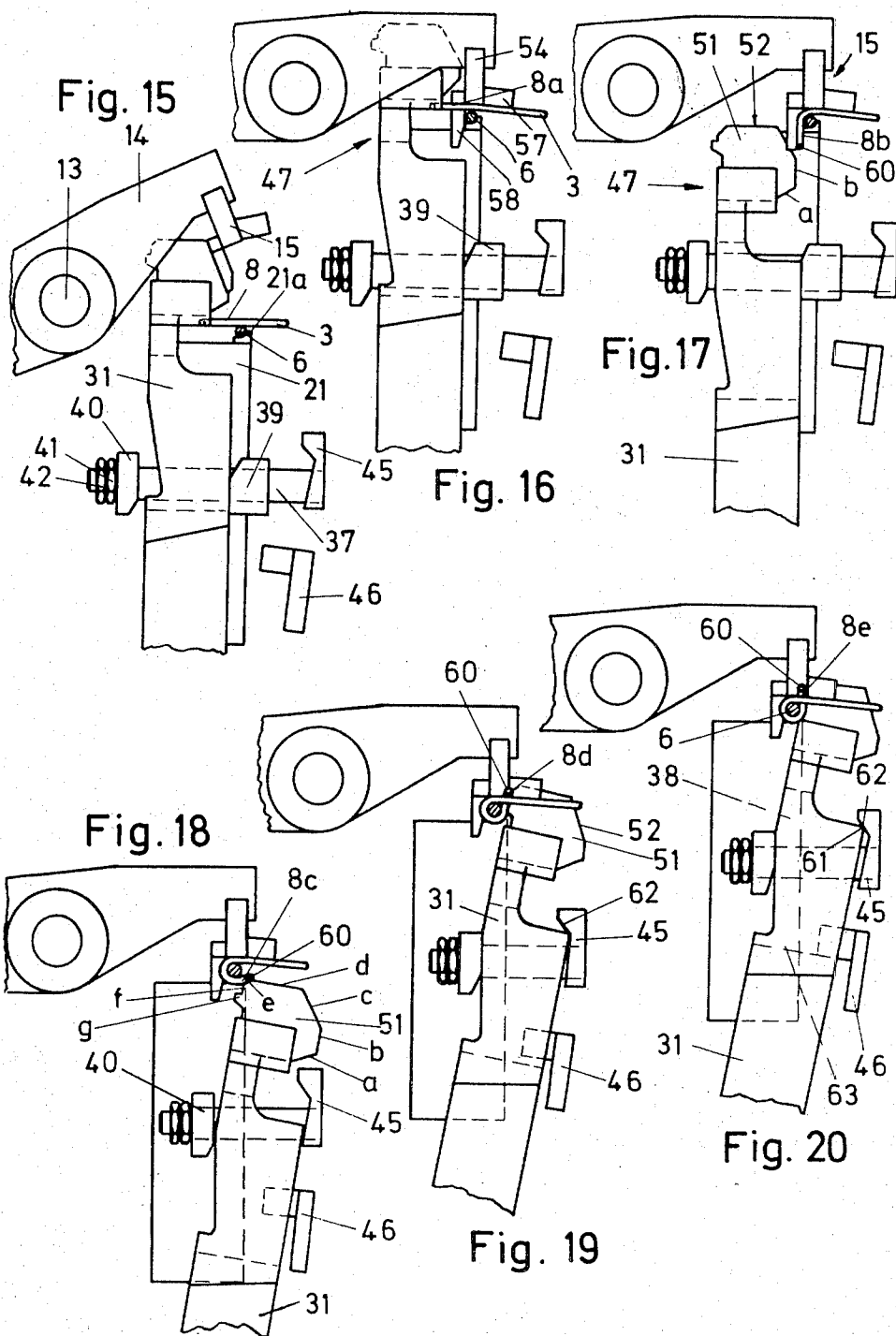
The end coils of border springs of a spring construction are clamped by clamping jaws against a common elongate wire with the end coils overhanging the wire. A bending head attached to a pivotal and reciprocable arm undergoes a sequence of movements to produce bending of the overhanging ends of the coils around the wire.

11 Claims, 20 Drawing Figures









APPARATUS FOR FASTENING THE END COILS OF BORDER SPRINGS OF A SPRING CONSTRUCTION TO AN ELONGATE WIRE

BRIEF SUMMARY OF THE INVENTION

The invention relates to the attachment of the end coils of border springs of a spring construction to a common elongate wire.

In U.S. Pat. No. 2,885,693, there is described a spring construction in which the upper and lower, end or terminal coils of border springs are fastened to an edge wire in such a manner that a portion of the terminal coil is bent around the edge wire. This Patent does not disclose how the bending operation is accomplished in practice. However, apparatus is known that for the above purpose, wherein, first, one terminal coil of the border spring is clamped in place at the wire, and subsequently a portion of the terminal coil is bent around the wire by means of a plurality of bending tools which are mounted on respective levers operated in consecutive order. This apparatus is very complicated and requires considerable space. It is not possible to arrange a plurality of such apparatuses next to each other in order to utilize them for bending the terminal coils of the adjacent border springs. Therefore, the prior apparatus consists of a single bending means, to which the terminal coils to be fastened are brought one after another.

It is an object of the invention to provide a substantially simpler apparatus with at least one bending head of such compact construction that it is possible to arrange a plurality of bending heads in adjacent relation to simultaneously fasten all the border springs positioned on one side of the spring construction to the upper and lower edge wires.

The invention contemplates an apparatus for fastening an edge wire at the border springs of a spring construction, with at least one bending head which clamps one terminal coil of the border spring in place at the edge wire and bends the portion of the terminal coil protruding beyond the edge wire around the wire.

The apparatus is preferably provided with a plurality of bending heads which are fixed on a common support in releasable fashion in order to be able to adjust their spacing in correspondence with the diameter of the coils of the springs.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a bending head of apparatus according to the invention;

FIG. 2 is a top plan view of the apparatus of FIG. 1;

FIG. 3 is partial cross-section taken along line III—III of FIG. 1;

FIG. 4 is a schematic top view of the apparatus and a spring construction showing a fastened edge wire to the border springs;

FIG. 5 is a side elevational view of a bending and positional tool of the apparatus;

FIG. 6 is a top plan view of the tool of FIG. 5;

FIG. 7 is a front elevational view of the tool of FIG. 6;

FIG. 8 is a side elevational view of a clamping jaw of the apparatus;

FIG. 9 is a top plan view of the jaw of FIG. 8;

FIG. 10 is a front elevational view of the jaw of FIG. 8;

FIG. 11 is a side elevational view of a swivel arm of the apparatus;

FIG. 12 is a front elevational view of the arm in FIG. 11;

FIG. 13 is a side elevational view of a supporting plate of the apparatus;

FIG. 14 is a front elevational view of the plate of FIG. 13; and

FIGS. 15 to 20 are side elevational views of the apparatus showing the positions of the bending head in six stages of the working cycle.

DETAILED DESCRIPTION

FIGS. 1-3 show the construction of a bending head 1 and in FIG. 4 are seen a plurality of bending heads mounted in regular spaced relation on a support 2. FIG. 4 also shows the lower end or terminal coils 3 of two adjacent border springs 4 of a spring construction 5, which coils have been fastened to an edge wire 6 by means of the opposed bending heads 1. Adjacent terminal coils 3 are interconnected to one another and are connected to terminal coils of further border springs by means of spiral wires 7. These wires 7 also serve the purpose of connecting, in a known manner, the terminal coils of other springs of the same kind which form the spring construction. As seen in FIG. 4, the head 1 is shown as a block which is retracted from the operating position.

When the spring construction 5 and the edge wire 6 are introduced into the fastening device in order to be connected together, this is always effected in such a manner that they assume positions in which each of the approximately circular terminal coils 3 is provided with a portion 8 (shown in dotted lines in FIG. 4) which protrudes beyond the edge wire 6 in the corresponding bending head 1 as seen in FIG. 1. The overhanging portion 8 is then bent around the wire 6 by means of the bending head 1, wherein the portion 8 passes through the positions 8a to 8e as shown in FIGS. 15 to 20. In the last position in FIG. 20 the portion 8e firmly encloses the wire 6.

In order to be able to describe the operation of bending the portion 8 of the terminal coil around the wire, the construction of the bending head 1 will next be described in greater detail.

The bending head 1 comprises a carriage 9 made, for instance, of grey cast iron, and the carriage is provided with a rectangular cavity 10 in which the support 2 is received. A plate 11 is fastened to the lower part of the carriage 9 by means of screws 12 and releasably locks the carriage 9 to the support 2. A pivot 13 is supported in the upper part of the carriage and extends parallel to the support 2. A lever composed of two mutually parallel legs 14 is pivotably supported at both ends of the pivot 13 protruding from the carriage. Mounted on the shorter, rectangular arms of the legs 14 are clamping jaws 15 in symmetrical arrangement as shown in FIG. 2. The longer arm of each leg 14 is pulled downwardly by a tension spring 16 attached to the carriage 9. A piston is supported for vertical displacement in a pneumatic cylinder 17 secured to the carriage 9 by means of suitable attachment means, such as plates and screws (not shown). A piston rod 18 supports a bearing member 19 at the upper end thereof, and the bearing member is disposed beneath both legs 14 (as seen at

the left side of FIG. 1) so that the lever is pivotably moved in the direction of the arrow 20, if the pneumatic cylinder 17 is actuated.

Two supporting plates 21 are fastened on both sides of the carriage 9 by means of screws (not shown), and mounted on the surface of the plates are seats 21a for receiving the edge wire 6. The carriage 9 is provided with a large rectangular groove 22, as shown in FIG. 3, which extends centrally at the right edge 23. In the lower portion of groove 22 there is introduced a rib 24 of an auxiliary carriage 25, which is fixedly attached to the carriage 9 by means of screws (not shown). A short guide 26 for a sliding member 27 is formed in groove 22 between the rib 24 and the bottom of groove 22. The sliding member 27 has an upper fork end 28 attached to the lower end 30 of a swivel arm 31 by means of a pivot 29. The lower end of sliding member 27 is attached to the upper end of a vertical piston rod 32, which is reciprocally movable in the directions of the arrows 33 in FIG. 1 by means of a double-acting pneumatic cylinder (not shown) which is fastened to the auxiliary carriage 25.

The carriage 9 is provided at its right side with a shoulder 34 (FIG. 1) and on each of the opposing edges of the shoulder 34 rests a ledge 35 (see FIGS. 13 and 14) of a supporting plate 21. The portions of the supporting plates below ledge 35 overlie the side surfaces of the carriage 9.

The swivel arm 31 which is vertically movable as a result of its connection to the sliding member 27, can be rotated about the pivot 29 by means of a piston rod 37 which is horizontally displaceable in opposite direction as shown by arrows 36. For this purpose, a second double-acting, pneumatic cylinder (not shown) is attached to the auxiliary carriage 25. The piston rod 37 extends through a slot 38 (see FIGS. 11 and 12) in the swivel arm 31, and the rod 37 is provided with two stops 39 and 40. The stop 40 is secured in position by means of a nut 41 and a jam nut 42. A recess 43 in the carriage 9 accommodates the left end of the piston rod 37 with the stop 40 and the nuts 41 and 42. The auxiliary support 25 has an upwardly extending portion 44 which tapers away from the carriage 9 in an upwardly direction as seen in FIG. 1. Two stops 45 and 46 are mounted on the side surface of portion 44 facing the carrier 9.

A bending and positioning tool 47 is attached to the upper end of the swivel arm 31 by means of two screws engaging in the tapped holes 48 (see FIGS. 11 and 12) and two recesses 50 are provided in a base plate 49 of the tool 47 for the heads of the screws. A cam 51 is rigidly connected to the base plate 49 in the center thereof. This cam will hereafter be referred to as a "bending cam", as its profiled edge 52 serves to contact the portion 8 of the terminal coil in order to bend it around the edge wire 6. Two positioning cams 53 protrude at the lower side of the base plate 49 and converge symmetrically toward the central plane of base plate 49 as seen in FIG. 6.

One of the symmetrical clamping jaws 15 which are fastened to the legs 14, is shown in greater detail in FIGS. 8 to 10. The jaw 15 is provided with a clamp plate 54, which extends in a groove 55 (see FIG. 1) in the respective leg 14 and the plate 54 is fastened in the leg by means of a screw, which engage a tapped hole 56

provided in the upper narrow side of the plate 54. At the lower portion of plate 54, a bending shoulder 57 extends from one of its sides, said shoulder protruding in slightly downwardly inclined direction. At the other side of the lower portion of plate 54 is a guide shoulder 58, said shoulder projecting downwardly and having a rounded side 59.

The operation of the bending head will now be explained in greater detail with reference to FIGS. 15 to 20.

FIG. 15 corresponds to the starting position as shown in FIGS. 1 to 3, in which position the piston rod 18 is in its lowermost position and the piston rod 37 is in its leftmost extreme position. The swivel arm 31 abuts against the stop 39 under the influence of a spring (not shown). Sufficient space is available between the clamping jaws 15 and both of the supporting plates 21, firmly connected to the carriage, for placing edge wire 6 on the clamping seats 21a and subsequently laying one terminal coil 3 of a border spring 4 on the wire 6 such that the portion 8 overhangs beyond the wire 6. By moving the piston rod 18 upwardly, the arms 14 of the lever are tilted in clockwise direction, so that, as shown in FIG. 16, the terminal coil 3 is clamped against the edge wire 6 between the lower end surfaces of both clamping plates 54 and the clamping seats 21a. Simultaneously, the bending shoulders 57 produce a slight bend of the portion 8 in relation to the main part of the terminal coil 3 immediately adjacent to the edge wire 6 as shown at 8a in FIG. 16. Prior to the clamping of coil 3 on wire 6, the guide shoulders 58 extend between the edge wire 6 and the portion 8 and shift the portion 8 by means of their rounded sides 59 against both converging positioning cams 53 of the tool 47 so that the portion 8 will always have exactly the overlap and position needed for following the bending operations.

Next, a downward movement of the vertical piston rod 32 is effected and, consequently, the sliding member 27, and the swivel arm 31 with the tool 47 fastened thereto are moved downwardly. Hereby, the extreme end 60 of the portion 8 first contacts a surface *a* inclined to the right and upwardly, and then a vertical surface *b* of the profiled edge 52 of the bending cam 51. As a result of the pressure exerted by the surfaces *a* and *b* of the profiled edge, the portion 8 assumes the shape at 8b as shown in FIG. 17. In course of a subsequent movement of the horizontal piston rod 37, the swivel arm 31 is abutted by the stop 40, and is pivoted in the clockwise direction until it reaches the stop 45 rigidly connected to the carriage. An opening 45a (FIG. 1) provided in the end portion 44 of the auxiliary carriage 25 and in the stop 45 permits the stop 39 to be freely moved towards the right. During the pivotal movement of the arm 31, the end 60 first contacts a surface *c* inclined upwardly and to the left, and then a surface *d* of the profiled edge 52. The surface *d* is horizontal in the starting position, but is slightly inclined upwardly and to the left as a result of the pivotal movement of the arm 31. As a result of this operation, the portion 8 is bent to the shape as shown at 8c in FIG. 18.

Next, the vertical piston rod 32 is displaced upwards whereby the tilted arm 31 is also moved upwardly, so that the end 60 contacts a surface *e* which is inclined to the left and downwardly, and then a short, vertical surface *f* of the profiled edge 52, so that it rests on a

protruding portion *g*. Thus, the portion 8 is bent to the form *8d* as shown in FIG. 19, this occurring shortly before the end of the upward movement of the arm 31. During the last, short portion of said upward movement, a protruding edge 61 of the arm 31 slides along an upper, inwardly inclined sliding surface 62 of the stop 45, whereby the arm 31 is subject to a small tilting movement in the counterclockwise direction, to bend the portion 8 over the edge wire 6 and complete the operation as seen at *8e* in FIG. 20. The upward movement of the arm 31 is limited by the stop 46, which projects into the slot 38 of the arm 31 and contacts the edge 63 at the lower end thereof. Two shallow recesses 64, 65 which are seen in FIG. 11, are provided in the contour of the arm 31, solely for the purpose of avoiding obstruction of the sliding and tilting movements of the arm 31 by the stop 40, and by the rib 24 of the auxiliary carriage.

It is emphasized, that the bending cam 51, and the swivel arm 31 both move constantly in their common plane, which is perpendicular to the edge wire 6, during the various movements of the swivel arm 31, so that the bending head 1 occupies very little space in the longitudinal direction of the edge wire 6.

After the portion 8 of the terminal coil 3 has been very quickly and very firmly attached to the edge wire 6 in the above manner, the air pressure is released from the cylinder 17 which holds the lever with legs 14 in the clamping position (FIGS. 16 to 20), whereby the lever is returned to its starting position (FIGS. 1 and 15) by means of the springs 16. Simultaneously, the initial position of the swivel arm 31 is obtained by returning the piston rods 32 and 37 to their original positions and the bending head 1 is now ready for the next bending cycle.

The respective pneumatic cylinders of all bending heads arranged on the support 2 are actuated by a common pneumatic controlling device at the same time, so that the terminal coils 3 of all border springs 4 provided on one side of the spring construction 5 are simultaneously attached to the edge wire 6 in a single operation. The width of the bending heads 1 is smaller than the diameter of the terminal coils 3 of all springs 4. In order to adapt the apparatus for springs with different diameters of terminal coils, the mutual spacing of the bending heads 1 is varied on the support 2, and the clamping jaws 15, and the tools 47 of these bending heads 1 are replaced by others, if the positioning cams 53 and the guide shoulders 58 do not correspond to the new diameter.

It is, however, also possible to provide a fastening apparatus with only a single bending head, and to fasten single border springs to the edge wire in consecutive order. However, this option is suitable only in exceptional cases, when the apparatus is only used rarely and the initial cost is to be kept as low as possible.

What is claimed is:

1. Apparatus for fastening an elongate wire to the end coils of border springs of a spring construction, said apparatus comprising means for clamping a border spring against a wire in a position in which the border spring has an end coil with a free edge overhanging said wire, bending means for bending the free edge of said end coil of the border spring around said wire, said bending means including a bending head with a bend-

ing cam having a plurality of cam surfaces, and means for displacing said bending head relative to said border spring in a plane perpendicular to said wire to produce successive contact of said cam surfaces with said free edge of the end coil of the border spring to bend said free edge around said wire.

2. Apparatus as claimed in claim 1 wherein said means for displacing said bending head comprises a swivel arm having opposite ends, said bending head being secured to one of said ends of the swivel arm, and a reciprocable member pivotably connected to the other end of said swivel arm such that said swivel arm can be linearly displaced with concurrent pivotal movement.

3. Apparatus as claimed in claim 2 comprising means connected to said swivel arm at a location displaced from the pivotal connection of the swivel arm and said reciprocable member for pivoting said swivel arm about said pivotal connection.

4. Apparatus as claimed in claim 1 wherein said bending means includes a pair of symmetrical converging guide members for engaging the overhanging edge of the end coil of the border spring to guide the same to a pre-determined position on said wire.

5. Apparatus as claimed in claim 1 wherein said bending means further comprises a pivotal lever, said clamping means including a clamping jaw carried by said lever for pressing said end coil of the border spring against said wire.

6. Apparatus as claimed in claim 5 wherein said lever comprises a pair of parallel legs, said clamping means including a second clamping jaw, one jaw being mounted on each leg, and a positioning member on each jaw opposed to said guide members for pressing the end coil of the border spring against said guide members before the end coil is clamped against said wire.

7. Apparatus as claimed in claim 6 comprising a main carriage supporting said pivotal lever, an auxiliary carriage secured to said main carriage, a first stop member on said auxiliary carriage positioned to limit pivotal movement of said swivel arm in one direction, and a second stop member on said auxiliary carriage positioned to limit linear displacement of said swivel arm in one direction.

8. Apparatus as claimed in claim 7 wherein said linear displacement of said swivel arm is up and down and the pivotal movement of said swivel arm is toward and away from said carriage, said swivel arm being successively displaced downwardly, then pivoted away from said carriage, then upwardly in pivoted position, and finally pivoted back towards said carriage.

9. Apparatus as claimed in claim 8 wherein said first stop member has an upper inclined sliding surface facing said swivel arm, said swivel arm including a portion engageable with said sliding surface during the end of the upward movement of said swivel arm to cause the swivel arm to undergo said pivoted movement back towards said carriage.

10. Apparatus as claimed in claim 1 wherein said bending means includes at least one additional bending head spaced from the first head for simultaneous fastening of a plurality of border springs to said wire.

11. Apparatus as claimed in claim 10 comprising a common support on which said bending heads are

releasably attached to permit adjustment of the spacing between the heads to correspond to the diameter of the border springs.

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