An apparatus for shaping bars of reinforced concrete (3) comprises means for automatically loading the bars (19) adapted to pick up the bars (3) to be shaped from support slots (12a, 13a, 14a) and to unload them on two automated bending machines (4).
The present invention relates to apparatus for shaping bars, particularly bars of reinforced concrete, of the type comprising an elongated bed for supporting bars and a first and a second bending machines movable relative to each other along a direction parallel to the bed, adjacent to one side thereof, each bending machine having a bending device comprising a driven rotatable horizontal disk with a central pin and an offset pin and a fixed support element.

An apparatus of the above indicated type is described and shown for example in Italian patent application No. 53304-B/87 filed on 11 May 1987 and laid open to public inspection on 11 November 1988. This apparatus has been produced and marketed by the applicant for a long time.

In this known apparatus, the bars to be shaped are fed above the bed and then subsequently picked up therefrom and positioned with their end portions resting on the horizontal rotatable disks of the two bending machines. The position in the longitudinal direction of the bar to be shaped with respect to the two bending machines is determined by the abutment of one end of the bar against a fixed stop element provided on one of the two bending machines. The two machines are located at a distance from each other corresponding to the position of the bends to be carried out on the bar. In the case for example of a bar which is to have a single bend at 90 degrees at each one of its end portions, the two machines are positioned so that when the bar is laid down on the two rotatable disks of the bending machines, the two central pins of these disks are located at the bending regions. The two disks are then activated simultaneously so as to carry out the two end bendings by the offset pins, whereas the portion of the bar adjacent to each end portion is prevented from moving by the central pin and said support element, which are in contact with the bar on opposite sides thereof and at two regions thereof which are spaced apart from each other. In case the bar must be subjected to a second operation for a 90 degrees bend at some distance from the first one, so as to assume a C-shaped configuration at each end thereof, the two machines are located at the corresponding distance (once the rotatable disks are returned to their starting positions) and the two disks are again activated to carry out the second bend. In the apparatus produced and marketed by the applicant, the whole cycle of operations which has been described above is automated with the aid of a computer which automatically controls the displacement of the bending machines and the rotation of their rotatable disks as a function of a predetermined program, corresponding to the specific geometry of the shaped bar which is to be obtained.

According to the most conventional technique, the bars to be shaped were picked up from the bed and positioned above the bending machines manually. This required some effort and lost of time for the operators. In the apparatus described and shown in the above identified patent application, the bed is provided with a plurality of liftable supports which raise the bars received on the bed with respect to the plane thereof. These supports had the configuration of brackets projecting transversally to the bed in the direction of the side thereof facing the bending machines. When the supports were lifted, the operator could then obtain the positioning of the bar above the bending machines by causing the bar to roll on said supports until it fell down on the bending machine. Thus, the effort necessary for lifting the bar was avoided by the operators. When more bars had to be bent, these had to be loaded individually, one after the other, on the bending machines, by causing them to roll on said supports. This operation required a lost of time, reducing the productivity of the machine. A further drawback of the known apparatus described above took place when a same bar had to be subjected to different bends having their concavities facing opposite sides. In this case it was necessary, upon performing the bend or the bends in a same direction, to raise the bar manually from the bending machines and to rotate it over 180 degrees around its axis and then to position it again to perform the bend in the opposite direction. Again, said operations caused a decrease in productivity of the machine.

The object of the present invention is that of providing an apparatus which keeps all the advantages of the known apparatus described above and which at the same time is able to solve all the above mentioned inconveniences satisfactorily.

In view of achieving this object, the invention provides an apparatus for shaping bars, particularly bars of reinforced concrete, comprising:

- an elongated bed for supporting the bars,
  a first and a second bending machines movable relative to each other along a direction parallel to the bed, adjacent to one side thereof, each bending machine having a bending device including a driven rotatable horizontal disk, having a central pin and an offset pin, and a fixed support element,

characterized in that said apparatus further comprises:

- support means for supporting the bars arranged on the side of the bed facing the two bending machines at a height not greater than the upper planar surface of the bed and defining bar containing slots, opened upwardly, able to receive more bars superimposed on each other in a vertical plane parallel to the longitudinal direction of the
According to a further feature of the invention, one of said support brackets is also provided with an abutment plane for the ends of the bars, which defines a reference plane for the proper positioning of the bars along the longitudinal direction. The positioning of the bracket carrying this plane is also automatically controlled by the computer, with the aid of a position sensing device. In this manner, it is possible to eliminate the reference plane provided, according to the prior art, on one of the two bending machines and no manual measuring operations are necessary any longer to position said reference plane properly.

Further features and advantages of the invention will become apparent from the following description with reference to the annexed drawings, given purely by way of non-limiting example, in which:

- figure 1 is a diagrammatic perspective view of an apparatus according to the present invention,
- figure 2 is a diagrammatic front view of a detail of the apparatus of figure 1,
- figure 3 is a diagram which shows the principle of operation of the detail shown in figure 2,
- figure 4 is a diagrammatic plan view of a bending machine used in the apparatus of figure 1, and
- figures 5A, 5B, 5C, 5D and 5E are diagrammatic plan views which show an operating cycle of the apparatus according to the invention.

In figure 1, reference numeral 1 generally designates a bed having an upper planar surface 2 which is for receiving a plurality of bars 3. According to the usual technique, the surface 2 may be provided with rollers to make the longitudinal advancing movement of the bars 3 on the bed when they are fed thereto. These details are not shown in the annexed drawings since they may be of any known type and do not fall within the scope of the present invention. The deletion of these details from the drawings also renders the latter more easy to understand.

Adjacent to one side of the bed 1 there are provided two bending machines 4 both movable on rails 5 along a linear direction parallel to the longitudinal direction of bed 1. The embodiment shown relates to the case in which both bending machines 4 are movable. However, the invention is theoretically applicable even to the case in which one of the two bending machines is fixed, since what is essential is the possibility to adjust the distance between the two machines 3.

Similarly to the details of construction of the bed 1, also those of the bending machines 4; the rails 5, the motor means which drive movement of
the machines 4 along rails 5 and the motor means which drive the movable members of each bending machine 4 are not illustrated in the annexed drawings since they may be of any known type and do not fall, taken alone, within the scope of the present invention. However, reference is made in this regard to the previous patent application of the applicant which has been identified in the foregoing. For this reason, in the following the structure of each bending machine 4 will be illustrated only along its general lines. As shown, each bending machine 4 comprises an upper planar surface 6 on which there is arranged a driven rotatable horizontal disk 7 having a central pin 8 and an offset pin 9, as well as a flat support element 10 which is able to assume two different operating positions, both adjustable, on the upper planar surface 6, as it will be described in detail in the following.

On the side 11 of bed 1 facing towards the bending machines 4 there are provided two pairs of support brackets 12, 13 adjustable in position along the longitudinal direction of the bed and a support bracket 14 fixed to the bed at the central region thereof. All said support brackets have vertical slots 12a, 13a, 14a opened upwardly, aligned with each other and adapted to receive and support one or more bars 3 superimposed on each other in a vertical plane parallel to the longitudinal direction of the bed. The upper surfaces of brackets 12, 13, 14 are arranged in the same plane, or in a plane lowered with respect to the upper planar surface 2 of the bed, so that bars 3 may be loaded in the slots 12a, 13a, and 14a by making them roll on the planar surface 2 until they fall down within said slots. This may be done manually or by an automatic pushing device of any known type (not shown). The support brackets 12 and 13 are adjustable in position to adapt to different possible lengths of bar 3, whereas one of the two brackets 13, and precisely that arranged closer to the corresponding end of bed 1 is also provided with a reference plate 13b transverse to the longitudinal direction of the bed 1, which is to define a reference for one end of the bars, so to allow the proper positioning along the longitudinal direction of the bars on the support brackets.

With reference to figure 1 and figure 2, each bending machine 4 is provided, on its side facing the other bending machine 4 with a support structure 15, fixed to the frame of the bending machine and provided with rails (not shown) for a carriage 16 movable with respect to the support structure 15 along a horizontal direction transverse to the longitudinal direction of bed 1.

With reference to figure 2, the movement of carriage 16 is driven by a chain 17 (shown only diagrammatically in figure 2) which is controlled by an electric motor. Similarly to what takes place in the known apparatus which is presently being produced and marketed by the applicant, the electric motors which driven all the movements of the various parts of the apparatus are controlled by a computer on the basis of a predetermined program which is defined as a function of the particular geometry to be given to the shaped bar. This applies of course also to the electric motor (not shown) which drives the chain 17. Naturally, in order to allow automatic control of the positioning of the various movable parts, there are provided angular position sensing devices which are able to supply an electronic control unit with the information on the position reached by each movable part.

In the case of the horizontally movable carriage 16, for example, there is provided an encoder associated with the wheel 18 engaged by the chain 17. On carriage 16 there is mounted a vertically movable slide 19 which has on its upper part a slot 20 opened upwardly which is for receiving the bars to be picked up and positioned on the bending machines. For locking the bars in slots 20, there is provided a horizontally movable jaw 21, driven by a hydraulic cylinder 22 diagrammatically shown in figure 2 in any know way. When bars 3 have been placed in slots 12a, 13a and 14a shown in figure 1 of support brackets 12, 13, 14, the two slides 19 associated with the two bending machines 4 take their slots 20 immediately below bars 3, respectively in regions between the two brackets 12 and the two brackets 13. As a result of an upward movement of slide 19, the bars are picked up by slots 19, which therefore act as gripping members, and are locked therein by jaws 21. Once the bars have been received in slots 20, slides 19 are lifted so that bars 3 move out of the slots of brackets 12, 13, 14 and carriages 16 move away from the bed carrying the picked bars exactly over the two bending machines 4 at the vertical longitudinal plane limited on one side by the two central pins 8 of the bending machines and on the other side by the two planar support members 10. At this moment, slides 19 may lower so that the bars are placed on the rotatable disks 7.

Figure 3 diagrammatically shows the path followed by slide 19 in an operating cycle. Position 1 is the position assumed immediately before that the bars are picked up from the support brackets 12, 13, 14. Position 2 is that reached as a result of the lifting movement of slide 19 by which the latter picks up the bars from support brackets 12, 13, 14. Position 3 is that assumed as a result of the movement along a direction transverse to the longitudinal direction of the bars and position 4 is that for unloading the bars above the bending machines.

With reference to figure 4, which shows a plan view of a bending machine 4, the fixed support
element 10 is displaceable along a direction 50 so that it can assume two different operating positions located on opposite sides with respect to a plane including the axes of the two rotatable disks 7 of the two bending machines 4. In this manner, the bending machines may be arranged to carry out bendings in both directions without requiring a rotation of the bars around their axes over 180 degrees once a bending in one direction has been carried out, in order to carry out a bending in the opposite direction. This feature, which will become even more apparent from the following description with reference to figures 5A-5E, which show a bar bending cycle, becomes extremely advantageous when one wishes to bend simultaneously many bars superimposed on each other. It is to be noted that each of said two operating positions is adjustable to allow adaptation to different diameters of the fixed pin.

As clearly shown in figures 5A-5D, in order to obtain a shaped bar as shown in figure 5E, an originally linear bar (or more bars superimposed on each other) is/are arranged on the two bending machines 4 which are activated to carry out the first end bends, at 90 degrees, at the end portions 3a. Once this operation has been carried out, the rotatable disks 7 are brought again in their starting position and the bending machines 4 are moved closer in the position shown in figure 5B to carry out a second bend and 90 degrees of a second portion 3b adjacent to each end portion 3a. In figure 5C there is indicated a third bend which is carried out in the same direction at two further portions 3c of the bar adjacent to the portions 3b and displaced towards the center of the bar with respect to portion 3b. At this moment, in order to carry out the last two bends in the opposite direction, the gripping members formed by slides 19 are again activated to pick up the bar or bars 3 from the rotatable disks 7 and to lift them over the latter. Once the bars have been lifted, the support elements 10 are positioned in positions symmetrical with respect to said plane including the axes of the two rotatable disks and the latter are arranged in the positions adapted to carry out the bend in the opposite direction, as shown in figure 5D. Therefore, in the apparatus according to the invention, shapes of the type shown in figure 5E, which have bends in the two opposite directions, do not require the operator to rotate the bar around its axis over 180 degrees once the bends in a same direction have been carried out, before carrying out the bends in the opposite direction. As clearly illustrated in figure 1, the preferred embodiment of the invention which is described herein, also comprises a third slide 19 which is exactly similar to slides 19 associated with the two bending machines 4, but is guided on a support structure 30 fixed to the bed 11 in a central position with respect to the length thereof.

As it is clearly apparent from the foregoing description, the apparatus according to the invention allows an automatic and rapid loading of the bars to be shaped on the bending machines without requiring the manual intervention of the apparatus and nullifying the dead times which are typical of the known apparatus. In particular, while the bending machines are operating, it is possible to provide a series of superimposed bars in the slots of support brackets 12, 13, 14, so that such bars may be picked up all simultaneously by the gripping members 19, thus increasing greatly the productivity of the machine. As it has been shown, the apparatus is also able to perform bendings in opposite directions on a same bar without requiring the intervention of the operator and without requiring a rotation of the bar around its axis during the operating cycle.

Naturally, while the principle of the invention remains the same, the details of construction and the embodiments may widely vary with respect to what has been described and shown purely by way of example, without departing from the scope of the present invention.

Claims

1. Apparatus for shaping bars, particularly bars of reinforced concrete (3), comprising:
   an elongated bed (1) for supporting the bars (3),
   a first and a second bending machines (4) movable relative to each other along a direction parallel to the longitudinal direction of the bed (1), adjacent to one side (11) thereof, each bending machine (4) having a bending device comprising a driven rotatable horizontal disk (7), having a central pin (8) and an offset pin (9), and a fixed support element (10),
   characterized in that said apparatus further comprises:
   bar supporting means arranged on the side of the bed (1) facing towards the two bending machines (4) at a height not above the planar surface of the bed (1) and defining bar containing slots (12a, 13a, 14a), opened upwardly, adapted to contain more bars (3) superimposed on each other in a vertical plane parallel to the longitudinal direction of the bed, and
   means for automatically loading the bars on the bending machines (4), comprising at least one gripping member (19) displaceable between a position for picking up the bars (3) from said supporting means (12a, 13a, 14a) and a position for unloading the bars (3) on the bending machines (4).
2. Apparatus according to claim 1, characterized in that the support element (10) provided on each bending machine (4) is able to assume two different operating positions located on opposite sides with respect to a plane including the axes of the two rotatable disks (7) of the bending machines, each operating position being on its turn adjustable in the direction transverse to said plane.

3. Apparatus according to claim 1, characterized in that said supporting means comprise at least two support brackets (12, 13) adjustable in position along the longitudinal direction of the bed (1) and having respective slots (12a, 13a), which are to receive and support the bars, said support brackets (12, 13) having their upper surfaces located not above the upper planar surface of the bed (2), so that the bars (3) may be loaded within said slots (12a, 13a) by making them roll on the upper planar surface (2) of the bed (1).

4. Apparatus according to claim 3, characterized in that said supporting means comprises two pairs of support brackets (12, 13) adjustable in position and a support bracket (14) fixed to the bed (1) in a central position with respect to its longitudinal direction.

5. Apparatus according to claim 4, characterized in that one of said supporting brackets (12, 13) which are arranged adjacent to one end of the bed (1) is provided with a reference plate (13b) transverse to the longitudinal direction of the bed which is to act as a stop element for one end of the bars thus defining a reference for the proper positioning of the latter along the longitudinal direction.

6. Apparatus according to claim 1, characterized in that it comprises a gripping member (19) associated with each bending machine (4) said gripping member being comprised of a slide (19) vertically movable on a carriage (16) which is horizontally movable with respect to a support structure (15) which is fixed to the bed (1), said slide (19) being provided at its upper part with a vertical slot (20) opened upwardly which is for receiving and supporting the bars (3) and provided with a jaw (21) for locking the bars in said slot (20).

7. Apparatus according to claim 6, characterized in that a further gripping member is supported by a support structure (30) fixed to the bed (1) in a central position with respect to its longitudinal direction, said further gripping member being also comprised of a slide (19) vertically movable with respect to a carriage (16) guided horizontally on said fixed support structure (30), said slide (19) being also provided at its upper part with a slot (20) opened upwardly and provided with a locking jaw (21).
## DOCUMENTS CONSIDERED TO BE RELEVANT

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<tr>
<th>Category</th>
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**TECHNICAL FIELDS SEARCHED (Int.Cl6)**

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The present search report has been drawn up for all claims.

**THE HAGUE**

**Date of completion of the search**: 27 January 1995

**Examiner**: Peeters, L

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**CATEGORY OF CITED DOCUMENTS**

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