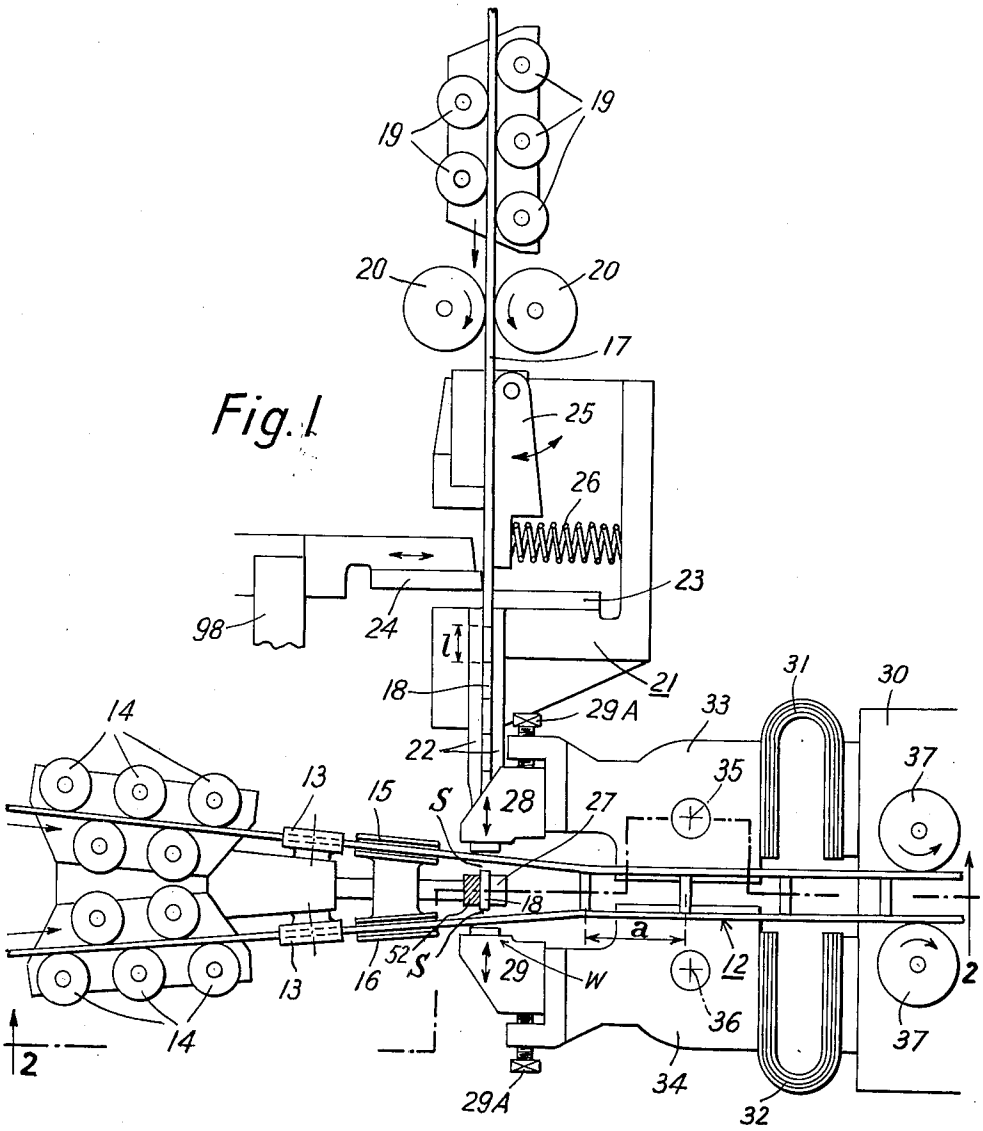
Oct. 2, 1962 K. EISENBURGER ET AL 3,056,883

PROCESS AND APPARATUS FOR THE PRODUCTION OF INTEGRAL REINFORCING STRUCTURES FOR REINFORCED CONCRETE AND THE LIKE

Filed Dec. 13, 1960

4 Sheets-Sheet 1

Fig. 1



INVENTORS:
KUNO EISENBURGER
HANS GÖTT
JOSEF RITTER

BY Michael S. Striker
their ATTORNEY

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4 Sheets-Sheet 2

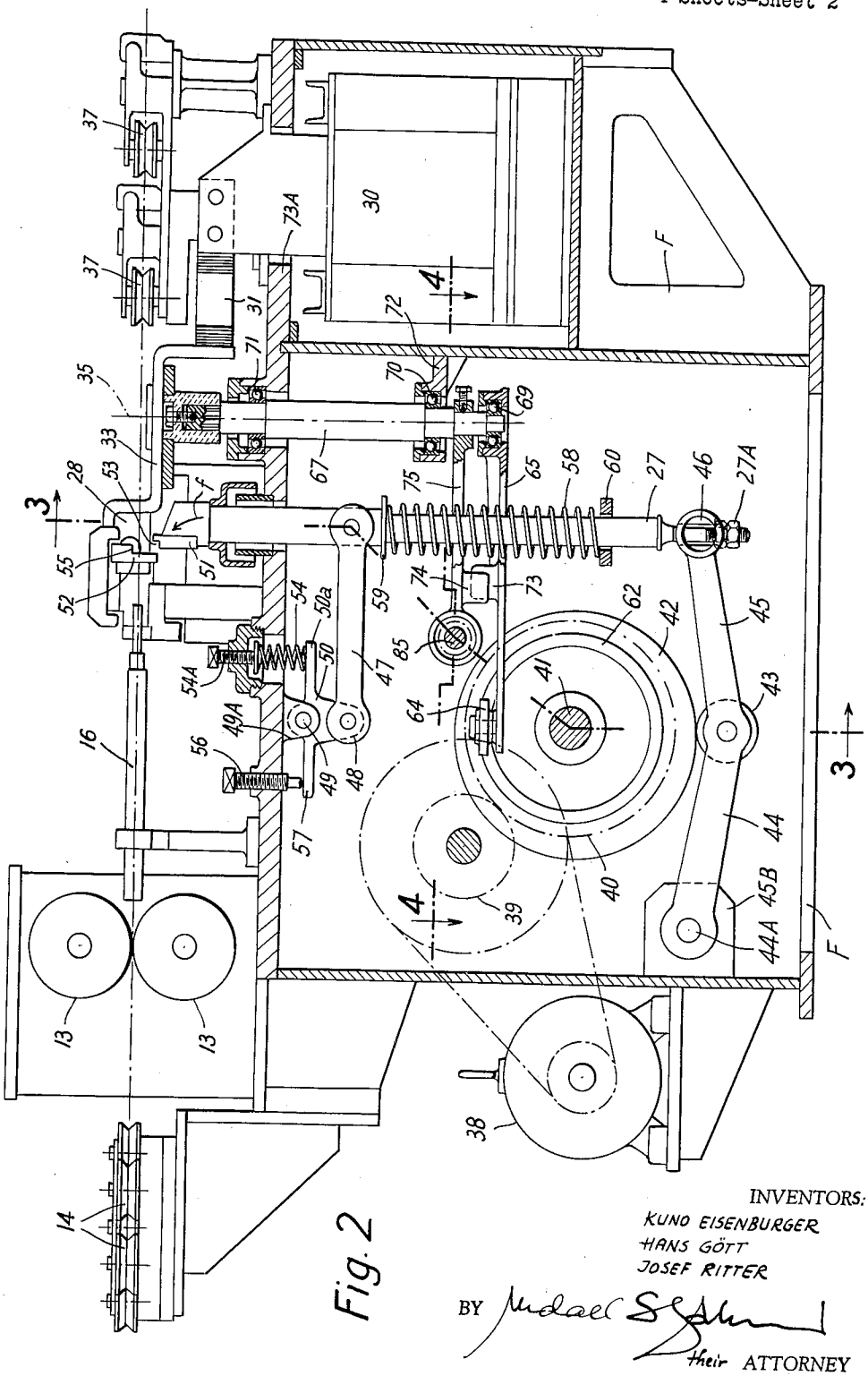


Fig. 2

INVENTORS:
KUNO EISENBURGER
HANS GÖTT
JOSEF RITTER

BY Michael S. Striker
their ATTORNEY

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4 Sheets-Sheet 3

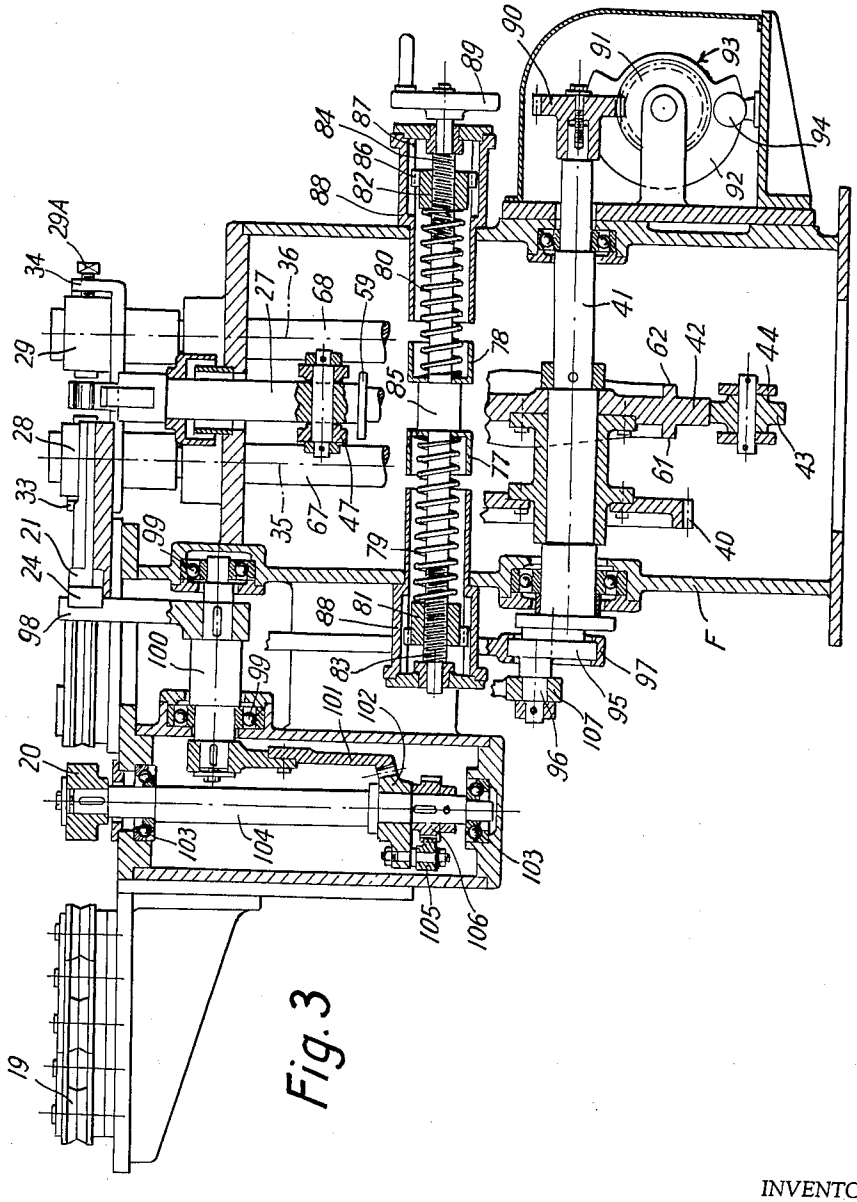


Fig. 3

INVENTORS:
KUNO EISENBURGER
HANS GÖTT
JOSEF RITTER

BY

their ATTORNEY

Oct. 2, 1962 K. EISENBURGER ET AL 3,056,883

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4 Sheets-Sheet 4

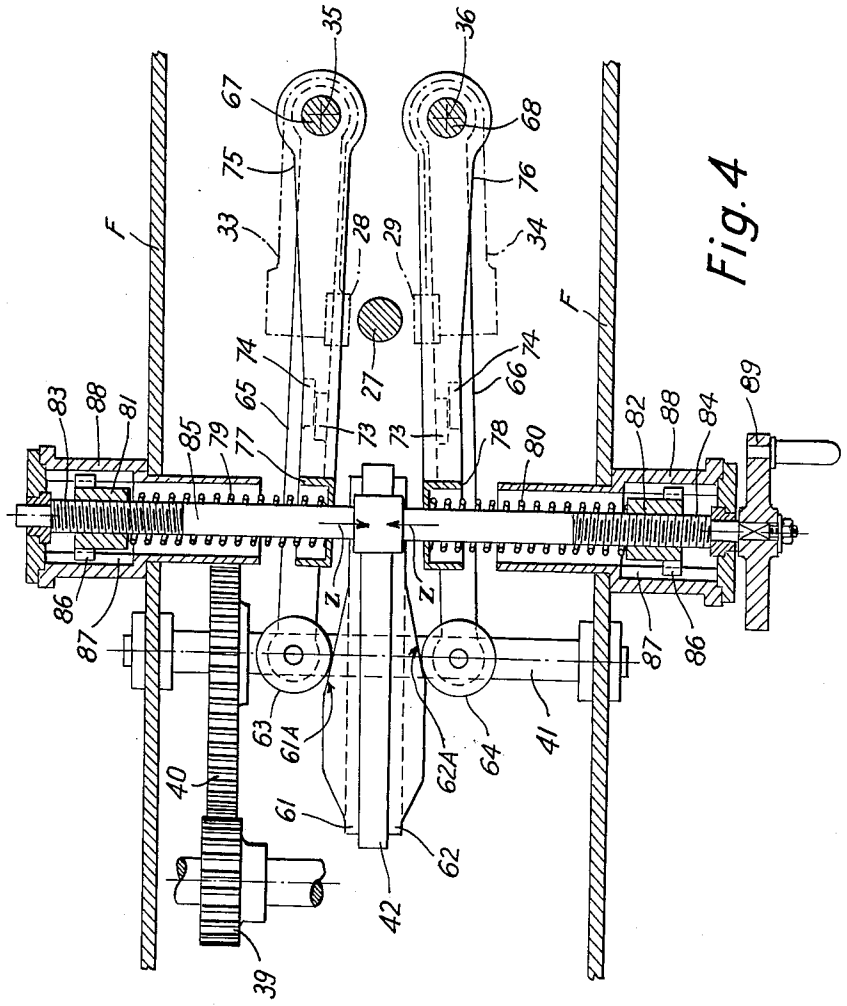


Fig. 4

INVENTORS:

KUNO EISENBURGER
HANS GÖTT
JOSEF RITTER

BY

their ATTORNEY

United States Patent Office

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PROCESS AND APPARATUS FOR THE PRODUCTION OF INTEGRAL REINFORCING STRUCTURES FOR REINFORCED CONCRETE AND THE LIKE

Kuno Eisenburger, Gut Hummelhof, Hans Gött, Graz, and Josef Ritter, Graz-Kroisbach, Austria, assignors to Evg Entwicklungs- u. Verwertungs-Gesellschaft m.b.H., Styria, Austria

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13 Claims. (Cl. 219—79)

The present invention relates to a process and to an apparatus for the production of integral reinforcing structures for reinforced concrete and the like, and more particularly to the production of reinforcing structures which consist of parallel members and of transverse webs which are interwelded at intervals to the parallel members.

It is already known to strengthen concrete by reinforcements consisting of ladder-like structures. For example, U.S. Patent No. 2,916,910, granted on December 15, 1959, discloses a structure comprising two longitudinal rod-like members of steel and transverse webs of softer steel which are interwelded to the longitudinal members at spaced intervals so as to form a ladder-like reinforcing structure. The metallic material of the longitudinal members has a very high yield point whereas the material of the webs contains a smaller percentage of such alloying substances which improve its yield strength, particularly carbon and manganese. The webs preferably consist of a soft, non-hardenable steel which insures the formation of good bonds with the longitudinal members.

A serious problem which arises in the production of such reinforcing structures is that, during the welding step, the length of the webs is reduced so that the distance between the longitudinal members of a finished reinforcing structure is less than the length of a web prior to its connection to the longitudinal members. Thus, it is rather difficult to introduce new webs between the longitudinal members which form part of a completed reinforcing structure.

An important object of the present invention is to provide a process and an apparatus for the production of reinforcing structures of the above outlined characteristics which render it possible to produce such reinforcing structures in a more economical way, with little loss in time, and which insure that the webs may be moved consecutively into proper position for welding to the longitudinal members without requiring undue deformation of the already completed reinforcing structure.

Another object of the invention is to provide a process for the production of ladder-like reinforcing structures for concrete and the like according to which the intervals between the adjacent webs may be varied as desired and according to which the shortening of welded webs does not impede the introduction and welding of subsequently connected webs with the longitudinal members.

A further object of the invention is to provide an apparatus for the production of ladder-like reinforcing structures for concrete and the like which is constructed and assembled in such a way that the production of reinforcing structures may be carried out in a fully automatic way and wherein all moving parts may be actuated by a single control arrangement of simple construction.

An additional object of the instant invention is to provide an apparatus of the just outlined characteristics wherein the welding instrumentalities utilized for bonding the ends of successively introduced transverse webs to the longitudinal members may simultaneously perform additional functions, particularly to move the longitudinal members into actual abutment with the ends of successively introduced webs.

Still another object of the invention is to provide an apparatus of the above described type which is capable of producing reinforcing structures with differently spaced webs and with differently spaced longitudinal members.

With the above objects in view, the invention resides in the provision of a process for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members which comprises the steps of disposing the longitudinal members in two converging paths located in a common plane, introducing a web between the longitudinal members at a point where the distance between the longitudinal members exceeds the length of the web so that the web is located in the plane of the longitudinal members, moving the longitudinal members into abutment with the ends of the web, and welding the ends of the web to the longitudinal members.

In accordance with a preferred embodiment of the invention, the instrumentalities utilized for welding the ends of the webs with the longitudinal members are utilized for deflecting the longitudinal members from their respective paths into abutment with the webs so that the welding instrumentalities actually perform a welding and a simultaneous compressing action.

The apparatus for the practice of our process comprises a spot welding machine which includes two spaced electrodes adapted to be moved toward and away from each other, guideways for leading the longitudinal members in a pair of coplanar paths intermediate the electrodes, a feeding device which delivers webs into the common plane of the longitudinal members at a point intermediate the electrodes, and means for moving the electrodes into deflecting engagement with the longitudinal members so that the longitudinal members are caused to move into abutment with the ends of a web and are simultaneously welded thereto.

Certain other features of our apparatus reside in the provision of means for stepwise advancing the longitudinal members through distances corresponding to the desired spacing between the adjacent webs in a completed reinforcing structure, and in the provision of means for operating the feeding device, the electrodes and the advancing means in a predetermined rhythm.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of a specific embodiment when read in connection with the accompanying drawings, in which:

FIG. 1 is a somewhat schematic fragmentary top plan view of an apparatus for the production of ladder-like reinforcing structures in accordance with our invention;

FIG. 2 is a longitudinal vertical section through the apparatus as seen in the direction of arrows from the line 2—2 of FIG. 1;

FIG. 3 is a transverse vertical section through the apparatus as seen in the direction of arrows from the line 3—3 of FIG. 2; and

FIG. 4 is an enlarged fragmentary view of a detail as seen in the direction of arrows from the line 4—4 of FIG. 2.

Referring now in greater detail to the drawings, and first to FIG. 1, there is shown a spot-welding apparatus for the production of a ladder-like reinforcing structure generally indicated by the reference numeral **12**. This reinforcing structure consists of two parallel longitudinal members **10**, **11**, preferably assuming the form of steel rods, and of preferably uniformly spaced transverse webs **18**. The ends of the webs **18** are successively connected to the longitudinal members **10**, **11** at a welding station W to which the longitudinal members are advanced in step-by-step fashion in a pair of converging paths and where a

rod- or ram-shaped feeding device 27 intermittently introduces webs 18 of predetermined length into the common horizontal plane of the longitudinal members.

Before reaching the welding station W, the members 10, 11 pass between a series of straightening rolls 14 and are thereupon engaged by pairwise arranged advancing rolls 13 (see FIG. 2). On their way to the welding station, the longitudinal members (hereinafter called rods) respectively advance through converging guideways 15, 16 so that they reach the welding station while advancing in two mutually inclined coplanar paths.

The webs 18 are cut from an elongated metallic stock 17 which is advanced to the welding station W in a horizontal plane and in a direction preferably perpendicular to the path of the reinforcing structure 12. The stock 17 passes between a series of straightening rolls 19 and is then entrained by two advancing rolls 20 which move it between the cutters 23, 24 of a cutting device 21. As will be explained in more detail in connection with FIG. 3, the intermittently reciprocable cutter 24 is operated in the working rhythm of the apparatus and cooperates with the fixed cutter 23 to sever the stock 17 as the latter's forward end emerges from a swingable channel 25 of adjustable width which is under the bias of a helical expansion spring 26 permanently urging the forward end of the stock into abutment with the reciprocable cutter 24. The individual webs 18 formed at the cutting station occupied by the device 21 are of equal length and are caused to advance through a conveying trough 22 toward the welding station.

The novel apparatus comprises means for intermittently arresting the rods 10, 11 at such intervals that the spacing *a* between the adjacent webs 18 of the reinforcing structure 12 remains the same. Whenever the advancing rolls 13 for the rods 10, 11 are brought to a halt, a new web 18 heretofore located beneath the common horizontal plane of the rods is automatically lifted into this plane by the feeding device 27 at a point where the spacing between the converging rods exceeds the length *l* of the web. As is clearly shown in FIG. 1, the ends of a web 18 which is already moved into the plane of the rods 10, 11 define with the adjacent rods two narrow gaps S both located intermediate the ends of two reciprocable welding electrodes 28, 29 so that, by moving the electrodes toward each other, the rods are caused to move into abutment with the ends of the newly introduced web 18 and are simultaneously welded thereto.

The electrodes 28, 29 are respectively mounted on two carriers 33, 34 which are swingable about two spaced vertical axes coinciding with the axes of pivot axles 35, 36. These pivot axles are perpendicular to the common plane of the rods 10, 11. The carrier 33 is fixed to a flexible conductor 31 and the latter is electrically connected with one pole of a welding transformer 30 which is mounted in the frame of the apparatus and which is adapted to deliver current to the electrode 28 for a short period of time when this electrode comes into actual contact with the adjacent rod 10. The other carrier 34 is connected to the other pole of the transformer 30 by a second flexible conductor 32. As shown in FIG. 1, the electrode 29 is adjustable in its carrier 34, e.g. by means of a threaded spindle 29A which enables an operator to move the electrode 29 in a direction toward the rod 11 when the electrode is worn out after extended periods of actual use. The mounting of the other electrode 28 in its carrier 33 is analogous. Such adjustability of the electrodes 28, 29 insures that their distance in operative position, i.e. when in actual contact with the rods 10, 11, may be controlled with utmost precision. The force exerted by the electrodes 28, 29 against the rods 10, 11 is sufficient to deflect these rods into substantial parallelism at the welding station W so that the finished reinforcing structure 12 assumes the form of a ladder with parallel side walls and with uniformly spaced rungs which are perpendicular to the side walls and are integrally connected therewith. The arrangement is such that the transformer 30 delivers electric current as soon as the rods 10, 11 are moved into actual contact with the ends of the web 18 at the welding station W. Upon completion of a welding step, the electrodes 28, 29 are pivoted about the respective pivot axles 35, 36 in a direction away from each other so that the rods 10, 11 may be advanced through the distance *a*, whereupon a new web 18 is introduced by the feeding device 27 and the welding operation is repeated in the above described manner. The reinforcing structure 12 is advanced by a pair of rolls 37 whose drive is controlled in such a way that the intervals between the successive webs 18 remain unchanged unless the operator desires to start the production of a different reinforcing structure.

FIG. 1 illustrates the apparatus in a position in which a new web 18 is already introduced between the converging rods 10, 11 but before the rods are actually bonded to the newly introduced web. It will be noted that the rods converge toward and all the way to the last web or rung 18 of the completed reinforcing structure 12 and that the compressive force of the electrodes 28, 29 must be sufficient to deflect the rods into substantial parallelism with each other so that the width of the reinforcing structure upon completion of the welding step equals the width of the space between the advancing rolls 37. Since the distance between the converging rods 10, 11 at the welding station W still exceeds the length of the web 18 when the electrodes 28, 29 are moved apart, the rods need not be forced away from each other to permit the insertion of a new web despite the fact that the length of the last web 18 forming part of the reinforcing structure 12 is less than the length of the newly introduced web before the latter is actually welded to the rods.

The shortest distance between the electrodes 28, 29 during a welding operation determines the ultimate width of the reinforcing structure 12. The deformation of the longitudinal members 10, 11 and of the ends of the transverse web 18 is continued as long as the electrodes continue their movement toward each other, i.e. as long as the heat-softened zones of contact between the components 10, 11 and 18 are caused to move toward and to be bonded to each other. The subsequent stepwise advance of the reinforcing structure can occur simultaneously with or subsequent to the movement of electrodes 28, 29 away from each other. During such stepwise advance of the reinforcing structure 12, the guideways 15, 16 again cause the rods 10, 11 to move toward the welding station in two converging paths so that the feeding device 27 may conveniently introduce a new web 18 therebetween. Since the length *l* of the webs 18 is the same, each web again defines two narrow gaps S with the adjacent portions of the rods 10, 11 until the electrodes are caused to swing about the pivot axles 35, 36 so as to move the rods into actual abutment with the new web 18.

The various driving, reciprocating and control means for insuring the movements of advancing rolls 13, 20, of the reciprocable cutter 24, of the advancing rolls 37, of the welding electrodes 28, 29 and of the feeding device 27 in a predetermined rhythm are shown in FIGS. 2 to 4. Referring first to FIG. 2, there is shown a main drive motor 38 which is secured to the apparatus frame F and which rotates a main shaft 41 by means of a gear transmission 39, 40. The main drive shaft 41 carries a cam plate or disk 42 whose periphery and lobes respectively impart movements to the feeding device 27 and to the electrode carriers 33, 34. The periphery of the rotary disk 42 forms a cam track for a roller follower 43 which moves the feeding device 27 in one direction. This follower 43 is rotatably mounted on a one-armed lever 44 which is provided with a rigid extension 45 having at its free end a motion transmitting sleeve 46 in direct engagement with the lowermost end portion 27A of the feeding device 27. The lever 44 is pivotable about an axle 44A which is received in a bracket 45B secured to the frame F. At a point vertically spaced from the sleeve 46, the

feeding device 27 is articulately connected with one end of a second lever 47 whose other end is articulately fixed to the downwardly extending arm 48 of a three-armed lever 50. The lever 50 is pivotable about a horizontal pivot axle 49 which is carried by a bracket 49A depending from the top plate or cover 73A of the frame F. When the feeding device 27 assumes its lowermost position, i.e. when the follower 43 is in contact with the highest point of the cam track on the periphery of the disk 42, the lever 47 assumes a substantially horizontal position. However, when the sleeve 46 permits the spring-biased feeding device 27 to move in upward direction, the lever 47 begins to pivot in anticlockwise direction, as viewed in FIG. 2, and causes the upper end of the feeding device to move in a direction to the left because the three-armed lever 50 momentarily retains its position so that the left-hand end of the lever 47 must pivot about the downwardly extending arm 48. The upper end of the feeding device 27 is provided with a plate-like head 51 which is then caused to move against the adjacent face of a fixed guide plate 52 in a direction indicated in FIG. 2 by the arrow *f*. The guide plate 52 is fixed to the cover 73A and extends into the space between the converging portions of the rods 10, 11 intermediate the electrodes 28, 29 (see FIG. 1). Its face which cooperates with the head 51 of the feeding device 27 is perpendicular to the common plane of the rods 10, 11 and is turned to the right, as viewed in FIG. 1. The head 51 is formed with a transversely extending recess 53 which receives the foremost web 18 from the conveying trough 22. The depth of the recess 53 is somewhat less than the diameter of a web 18 so that the latter projects slightly from the head 51 to engage with the face of the guide plate 52 and to prevent the upper end of the upwardly moving feeding device 27 from continuing its angular movement in the direction of the arrow *f* so that the lever 47 causes a pivotal movement of the three-armed lever 50 in counterclockwise direction, as viewed in FIG. 2. Thus, instead of pivoting about the arm 48, the lever 47 now turns about the pivot axle 49 together with the three-armed lever 50 and causes the latter's arm 50A to compress a resilient element in the form of an adjustable helical expansion spring 54, the latter permanently biasing the third arm 57 of the lever 50 into abutment with an adjustable stop 56 which is screwed into the cover 73A of the frame F. The bias of the spring 54 is adjustable by a screw 54A. Such mounting of the three-armed lever 50 insures that a web 18 which is momentarily received between the face of the fixed guide plate 52 and the head 51 of the feeding device 27 when the latter assumes its uppermost position is resiliently retained in the plane of the rods 10, 11 by being yieldably biased against the face of the guide plate 52 and is ready to be welded to the rods as soon as the electrodes 28, 29 are caused to move toward each other. It is preferred to provide the guide plate 52 with a projection 55 which engages the upper side of a web 18 when the latter is introduced between the rods 10, 11 at the welding station W so that the web is controlled by the face of the guide plate 52, by the projection 55 of this guide plate, and by the walls of the recess 53 in the head 51 of the feeding device 27. This insures that the web is properly held before its ends are engaged by the adjacent portions of the deflected rods 10, 11.

The adjustable stop 56 determines the spacing between the fixed plate 52 and the head 51 when the feeding device 27 returns to its lowermost position. This stop controls the angular position of the three-armed lever 50 with respect to its pivot axle 49, i.e. it provides a stop for the arm 57 when the lever 50 is pivoted under the bias of the spring 54. In the lowermost position of the feeding device 27, the lever 47 maintains the head 51 at such a distance from the fixed plate 52 that a new web 18 can be advanced into the recess 53 under the action of advancing rolls 20 which move the elongated stock 17 toward the conveying trough 22. The webs received in the trough 22 cause the foremost web to advance into the recess 53 in a fully automatic way because the movements of the rolls 20 and of the feeding device 27 are synchronized so that the recess 53 is in the path of the foremost web 18 as soon as the feeding device reaches its lower end position.

The feeding device 27 carries a collar 59 which serves as to stop for the upper end of a helical expansion spring 58 whose function is to permanently bias the feeding device in upward direction, i.e. in a direction counter to that in which the sleeve 46 tends to move the feeding device under the action of the follower 43. The lower end of the spring 58 bears against a guide bracket 60 which is fixed to the frame F. The feeding device 27 passes through the cover 73A with sufficient play to be movable in the direction of the arrow *f*, i.e. to move laterally under the action of the levers 47 and 50.

By proper selection of the cam track for the follower 43, the feeding device 27 reaches its uppermost position at a moment when the web 18 is located in the plane of the rods 10, 11. The spring 58 performs an additional function, namely, it maintains the follower 43 in permanent contact with the cam track of the disk 42.

It will be seen that the lever 44, 45 and the spring 58 together constitute means for reciprocating the feeding device 27 between two spaced positions in the first of which (under the action of the spring 58) the head 51 is located intermediate the electrodes 28, 29 to press a web 18 against the face of the fixed guide plate 52, and in the second of which (under the action of the lever 44, 45) the head 51 is ready to receive a new web 18 which is advanced into its recess 53 by the rolls 20. The spring 54, the lever 50, and the lever 47 act as a means for yieldably biasing a web 18 which is momentarily received in the recess 53 against the face of the guide plate 52.

The pivotal movements of the electrodes 28, 29 about their respective pivot axles 35, 36 toward and away from each other are derived from the lobes 61, 62 on the end faces of the cam disk 42. These lobes are arranged in mirror reverse with respect to a symmetry plane which passes through and is perpendicular to the axis of the cam disk 42. The means for transmitting movements from the lobes 61, 62 to the respective electrode carriers 33, 34 comprises two roller followers 63, 64 which are respectively mounted for rotation on a first pair of one-armed levers 65, 66. The levers 65, 66 are respectively mounted on and are pivotable about the lower ends of two spaced vertical shafts 67, 68 each of which carries a suitable antifriction bearing 69. Each of the shafts 67, 68 is rotatable in an antifriction bearing 70 provided in a horizontal plate-like extension 72 of the frame F and in a second bearing 71 which is mounted in the cover 73A. The upper end portions of the shafts 67, 68 constitute the pivot axles 35, 36 which are respectively fixed to the carriers 33, 34.

The means for imparting pivotal movements to the electrodes 28, 29 further comprises a second pair of levers 75, 76 which are rigidly fixed to the shafts 67, 68, respectively, and which carry motion transmitting elements 74 cooperating with complementary motion transmitting elements 73 on the levers 65, 66, respectively, as is best shown in FIG. 4. The free ends of the levers 75, 76 are respectively connected with spring plates or retainers 77, 78 which are slidable along a spindle 85, and the spring plates 77, 78 are under the bias of adjustable resilient elements in the form of helical expansion springs 79, 80, respectively, which are mounted on the spindle 85 and which tend to move the spring plates 77, 78 so that the motion transmitting elements 73 are maintained in abutment with the complementary motion transmitting elements 74. The bias of the springs 79, 80 is adjustable by a pair of nuts 81, 82, respectively, which mesh with threaded end portions 83, 84 of the spindle 85, and the pitch of threads on the end portion 83 is opposite to that of threads on the end portion 84. The nuts 81, 82 are

provided with radial projections or noses 86 which are slidable in longitudinal grooves 87 formed in two spaced sleeves 88 each of which is fixed to the frame F. Thus, if the spindle 85 is rotated by a handwheel 89 in clockwise or anticlockwise direction, the bias of the springs 79, 80 may be increased or reduced so that the free ends of the levers 75, 76 are urged with a greater or lesser force toward each other. As is clearly shown in FIG. 4, the springs 79, 80 control the compressing force which the electrodes 28, 29 exert against the rods 10, 11 in order to deflect the latter toward each other and into abutment with the ends of a web 18. In addition, the springs 79, 80 maintain the followers 63, 64 in engagement with the cam lobes 61, 62.

The main drive shaft 41 is drivingly connected with a shutter disk 92, e.g. by means of helical gears 90, 91 (see FIG. 3), so that the disk 92 may control the flow of electric current to the electrodes 28, 29. This control is brought about by photoelectric means. As shown in FIG. 3, the disk 92 is formed with a sector-shaped cutout 93 so that a light source 94 located at one side of the disk 92 can illuminate a photoelectric cell which is located at the other side of this disk whenever the cutout 93 travels between the cell and the light source 94. The photoelectric cell controls a relay, not shown, which in turn electrically connects the transformer 30 with the electrodes 28, 29 so that a welding current may flow to the welding station W when the cutout 93 exposes the light source 94.

At its end distant from the helical gears 90, 91, the main drive shaft 41 carries an eccentric 95 and a crank pin 96. The strap 97 of the eccentric 95 is drivingly connected with a swingable lever 98 (see FIG. 3) by means of a link train, not shown, and this lever is fixed to a shaft 100 which is rotatably mounted in bearings 99 carried by the apparatus frame F, the lever 98 serving as a means for reciprocating the cutter 24 of the cutting device 21. As shown in FIG. 3, the upper end of the lever 98 engages with the cutter 24 and, when pivoted about the axis of the shaft 100, it moves the cutter 24 in a direction which is perpendicular to the plane of the drawing.

The shaft 100 is rigid with the lever 98 and carries a segmental bevel gear 101 which meshes with a second segmental bevel gear 102, the latter being mounted on a vertical shaft 104 which is rotatable in bearings 103 carried by the apparatus frame F. Thus, the gear 102 is angularly displaced whenever the shaft 100 is caused to perform an angular movement with the lever 98. This gear 102 carries a pawl 105 which cooperates with a ratchet wheel 106 fixed to the shaft 104 so that the latter is turned through a predetermined angle when the shaft 100 is turned in one direction by the lever 98. The shaft 104 also carries one of the advancing rolls 20 so that these rolls shift the stock 17 through a distance *l* in a direction toward the cutters 23, 24.

The crank pin 96 of the main drive shaft 41 operates a connecting rod 107 which, through a suitable gearing (not shown), drives the advancing rolls 13 for the rods 10, 11 as well as the advancing rolls 37 for the reinforcing structure 12 so that the finished product is moved stepwise in a direction away from the welding station W.

The apparatus operates as follows:

At the start of a working cycle, the followers 63, 64 of the levers 65, 66, respectively, begin to move along the outwardly diverging portions 61A, 62A of the respective lobes 61, 62 on the cam disk 42 (see FIG. 4) so that the cooperating pairs of motion transmitting elements 73, 74 bring about angular displacements of the levers 75, 76 in directions counter to the arrows Z, i.e. counter to the bias of the springs 79, 80, respectively. Consequently, the electrodes 28, 29 are moved away from each other and away from the outer sides of the rods 10, 11 at the welding station W.

As soon as the electrodes 28, 29 are moved to the position of FIG. 1, the crank pin 96 shifts the connecting rod 107 in a direction to turn the advancing rolls 13 and to thereby move the rods 10, 11 through a distance *a* in a direction toward the welding station W. The rods 10, 11 are led through the converging guideways 15, 16, respectively, so that they assume the positions of FIG. 1 in which they are sufficiently spaced from each other to permit the introduction of a web 18 therebetween. At the same time, the eccentric 95 swings the lever 98 about the axis of the shaft 100, so that the shaft 100 and the segmental bevel gears 101, 102 are angularly displaced which brings about an angular displacement of the shaft 104 under the action of the ratchet-and-pawl assembly 105, 106. The shaft 104 then turns the advancing rolls 20 to move the stock 17 through a distance *l* toward the cutters 23, 24. Such movement of the stock 17 causes the foremost web 18 to advance from the conveying trough 22 into the recess 53 provided in the head 51 of the feeding device 27, this recess being located below the level of the welding station W (i.e. below the common plane of the rods 10, 11).

At this stage of the operation, the follower 43 comes into engagement with such a portion of the peripheral cam track on the disk 42 which is closer to the main drive shaft 41 than the remaining portion of this track so that the spring 58 is free to move the feeding device 27 in upward direction in order to lift the foremost web 18, already located in the recess 53, into the plane of the rods 10, 11. As explained hereinabove, the web 18 is held in requisite position by the walls of the recess 53, by the projection 55, and by the adjacent face of the fixed guide plate 52.

As soon as the web 18 is properly located in the plane of the rods 10, 11 at the welding station W, the followers 63, 64 come into engagement with differently inclined portions of the cam lobes 61, 62 so that the levers 75, 76 are free to yield to the bias of the respective springs 79, 80 and move the electrodes 28, 29 toward and into deflecting engagement with the rods 10, 11. The rods are deflected into abutment with the ends of the web 18 which latter is held in proper position between the fixed guide plate 52 and the head 51 of the feeding device 27.

In the next stage, the cam disk 42 deflects the composite lever 44, 45 in downward direction, as viewed in FIG. 1, so that the sleeve 46 acts against the lower end portion 27A of the feeding device 27 and entrains the latter in downward direction whereby the head 51 is separated from the web 18. Of course, the compressing force of the electrodes 28, 29 under the bias of the springs 79, 80 is sufficient to insure that the web 18 does not change its position while the head 51 is disconnected therefrom. As soon as the web 18 momentarily located at the station W is released by the head 51, the sector-shaped cutout 93 in the shutter disk 92 exposes the light source 94 so that the current is free to flow from the transformer 30 to the electrodes 28, 29 to bring about a welding action which is completed when the shutter disk 92 again assumes a position in which it screens the light source 94 from the photoelectric cell.

As the main drive shaft 41 continues its rotary movement, the eccentric 95 swings the lever 98 into the latter's starting position which causes the cutter 24 to perform a cutting stroke and to cut a new web 18 from the forward end portion of the stock 17. As the lever 98 swings in the opposite direction, the cutter 24 returns to its idle position and is ready for the next cutting operation. The crank pin 96 then acts on the connecting rod 107 to move the latter in the opposite direction, but such movement of the connecting rod has no effect on the angular position of the advancing rolls 13.

The working cycle is completed when the electrodes 28, 29 are disconnected from the transformer 30. The main drive shaft 41 has completed a full revolution and, as it starts the next revolution, the electrodes are again moved away from each other to begin the next working cycle in the same manner as described above.

The apparatus may be modified by advancing the webs 18 in the plane of and in the direction of convergence of the rods 10, 11 i.e. in a direction from the left to the right as viewed in FIG. 1. In such instances, the feeding device 27 is reciprocable in a horizontal plane and the position of the guide plate 52 is somewhat changed so that its web-engaging face is turned to the left, as viewed in FIG. 1.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; and means for moving said electrodes toward each other at intervals alternating with said first mentioned intervals so that the electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web.

2. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; carrier means for each electrode, said carrier means pivotable about two spaced parallel axes; welding transformer means; flexible conductor means for connecting said transformer means with each of said electrodes; a pair of converging guideways for guiding the longitudinal members intermediate said electrodes in a common plane which is perpendicular to said axes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; and means for pivoting said carrier means about the respective axes at intervals alternating with said first mentioned intervals and for thereby moving said electrodes toward each other so that the electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web.

3. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; fixed guide plate means disposed intermediate said electrodes and having a face perpendicular to said plane; feeding means for moving the webs at space time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes, said feeding means comprising a head having a web-receiving recess, means for reciprocating said head with respect to said face in directions substantially perpendicular to said plane, and resilient means for biasing said head toward said face whereby a web received in said recess is yieldably biased into abutment with said face between the longitudinal members; and means for moving said electrodes toward each other at intervals alternating with said first mentioned intervals so that the electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web.

4. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; fixed guide plate means disposed intermediate said electrodes and having a face perpendicular to said plane; feeding means for moving the webs into said common plane between said longitudinal members and intermediate said electrodes, said feeding means comprising a head having a web-receiving recess, means for reciprocating said head at spaced time intervals with respect to said face in directions substantially perpendicular to said plane between a first position in which said head is located intermediate said electrodes and a second position in which the head is spaced from said plane, and resilient means for yieldably biasing said head toward said face in said first position of the head whereby a web received in said recess is yieldably biased into abutment with said face between the longitudinal members; advancing means for introducing a web into said recess when said head is in said second position; and means for moving said electrodes toward each other at intervals alternating with said first mentioned intervals so that electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web.

5. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs into said common plane between said longitudinal members and intermediate said electrodes, said feeding means comprising a ram having a head reciprocable in two opposite directions substantially perpendicularly to said plane between a first position intermediate said electrodes and a second position in which the head is spaced from said plane; means for reciprocating said ram at spaced time intervals and comprising a rotary cam disk, pivotable lever means operatively connected with said ram for moving the same in one of said directions, follower means connected with said lever means and engaging with said cam disk for pivoting said lever means when the cam disk rotates, resilient means for permanently biasing said ram in the other of said directions, and guide plate means located intermediate said electrode means and having a face adjacent to said head when the latter is moved to said first position so that a web may be retained between said face and said head; and means for moving said electrodes toward each other at intervals alternating with said first mentioned intervals so that the electrodes deflect the longitudinal members

into abutment with and weld the same to the ends of a web.

6. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs into said common plane between said longitudinal members and intermediate said electrodes, said feeding means comprising a ram having a head reciprocable in two opposite directions substantially perpendicularly to said plane between a first position intermediate said electrodes and a second position in which the head is spaced from said plane, means for reciprocating said ram at spaced time intervals and comprising a rotary cam disk, pivotable lever means operatively connected with said ram for moving the same in one of said directions, follower means connected with said lever means and engaging with said cam disk for pivoting said lever means when the cam disk rotates, resilient means for permanently biasing said ram in the other of said directions, guide plate means located intermediate said electrodes and having a face adjacent to said head when the latter is moved to said first position so that a web may be retained between said face and said head, and spring-biased second lever means for permanently urging said head toward said face and for yieldably retaining a web between said head and said face; and means for moving said electrodes toward each other at intervals alternating with said first mentioned intervals so that the electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web.

7. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; and means for pivoting said electrodes toward and away from each other at intervals alternating with said first mentioned intervals so that, when pivoted toward each other, the electrodes deflect the longitudinal members into abutment with an weld the same to the ends of a web, said pivoting means comprising a rotary cam disk, a first pair of levers each comprising follower means cooperating with said cam disk for pivoting the levers when said cam disk rotates, a carrier for each of said electrodes, a shaft connected with each of said carriers, said shafts parallel with each other and perpendicular to said plane and each rotatably supporting one of said levers, a second pair of levers each rigidly fixed to one of said shafts, motion transmitting elements provided on said first and second pairs of levers for pivoting said second pair of levers and said shafts when said first pair of levers is pivoted by said cam disk and for thereby pivoting said electrodes, and resilient means for permanently biasing said first pair of levers in directions to maintain said follower means in engagement with said cam disk.

8. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; and means for pivoting said electrodes toward and away from each other at intervals alternating with said first mentioned intervals so that, when pivoted toward each other, the electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web, said pivoting means comprising a rotary cam disk having a pair of symmetrically arranged lobes, a first pair of levers each comprising follower means respectively cooperating with said lobes for pivoting the levers when said cam disk rotates, a carrier for each of said electrodes, a shaft connected with each of said carriers, said shafts parallel with each other and perpendicular to said plane and each rotatably supporting one of said levers, a second pair of levers each rigidly fixed to one of said shafts, motion transmitting elements provided on said first and second pairs of levers for pivoting said second pair of levers and said shafts when said first pair of levers is pivoted by said cam disk, and for thereby pivoting said electrodes, and resilient means for permanently biasing said first pair of levers in directions to maintain said follower means in engagement with said cam disk.

9. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; means for moving said electrodes toward and away from each other at intervals alternating with said first mentioned intervals so that, when moved toward each other, said electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web; and means for advancing the longitudinal members in said plane at intervals alternating with said last mentioned intervals and for supplying webs to said feeding means at intervals alternating with said first mentioned intervals.

10. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; means for moving said electrodes toward and away from each other at intervals alternating with said first mentioned intervals so that, when moved toward each other, said electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web; means for advancing the longitudinal members in said plane at intervals alternating

with said last mentioned intervals and for supplying webs to said feeding means at intervals alternating with said first mentioned intervals; and means for adjusting the position of said electrodes with respect to said moving means.

11. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; means for moving said electrodes toward and away from each other at intervals alternating with said first mentioned intervals so that, when moved toward each other, said electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web; means for advancing the longitudinal members in said plane at intervals alternating with said last mentioned intervals; and means for supplying webs to said feeding means at intervals alternating with said first mentioned intervals, said supplying means comprising means for advancing an elongated stock toward said feeding means, cutter means for reducing the stock into webs of equal length, and means for conveying the webs to said feeding means.

12. A spot-welding apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal rod-like metallic members and of spaced transversely extending rod-like metallic webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common horizontal plane intermediate said electrodes so that the spacing between the longitudinal members intermediate said electrodes exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes; means for moving said electrodes toward and away from each other at intervals alternating with said first mentioned intervals so that,

when moved toward each other, said electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web; and means for advancing the longitudinal members in said plane at intervals alternating with said last mentioned intervals and for supplying webs to said feeding means at intervals alternating with said first mentioned intervals.

13. An apparatus for the production of integral reinforcing structures of the type consisting of two parallel longitudinal members and of spaced transversely extending webs having ends welded to the longitudinal members, said apparatus comprising, in combination, a pair of spaced welding electrodes; a pair of converging guideways for guiding the longitudinal members in a common plane intermediate said electrodes so that the spacing between the longitudinal members exceeds at least slightly the length of a web; feeding means for moving the webs at spaced time intervals from a position externally of said common plane into said common plane between said longitudinal members and intermediate said electrodes, said feeding means comprising a ram having a web-supporting head reciprocable in two opposite directions substantially perpendicularly to said plane between a first position intermediate said electrodes and a second position spaced from said plane, means for reciprocating said ram comprising a rotary main shaft, first cam means mounted on and rotatable with said shaft, follower means engaging with said cam means and operatively connected with said ram for reciprocating the latter in response to rotation of said cam means, and resilient means for biasing said follower means into engagement with said cam means; and means for moving said electrodes toward each other at intervals alternating with said first mentioned intervals so that the electrodes deflect the longitudinal members into abutment with and weld the same to the ends of a web supported by the head of said ram, said reciprocating means comprising second cam means mounted on and rotatable with said main shaft, and second follower means engaging with said second cam means and operatively connected with said electrodes for reciprocating the same in response to rotation of said second cam means.

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