

Oct. 16, 1934.

A. J. BATES

1,977,299

MANUFACTURE OF GRATING

Filed Jan. 30, 1931

2 Sheets-Sheet 1

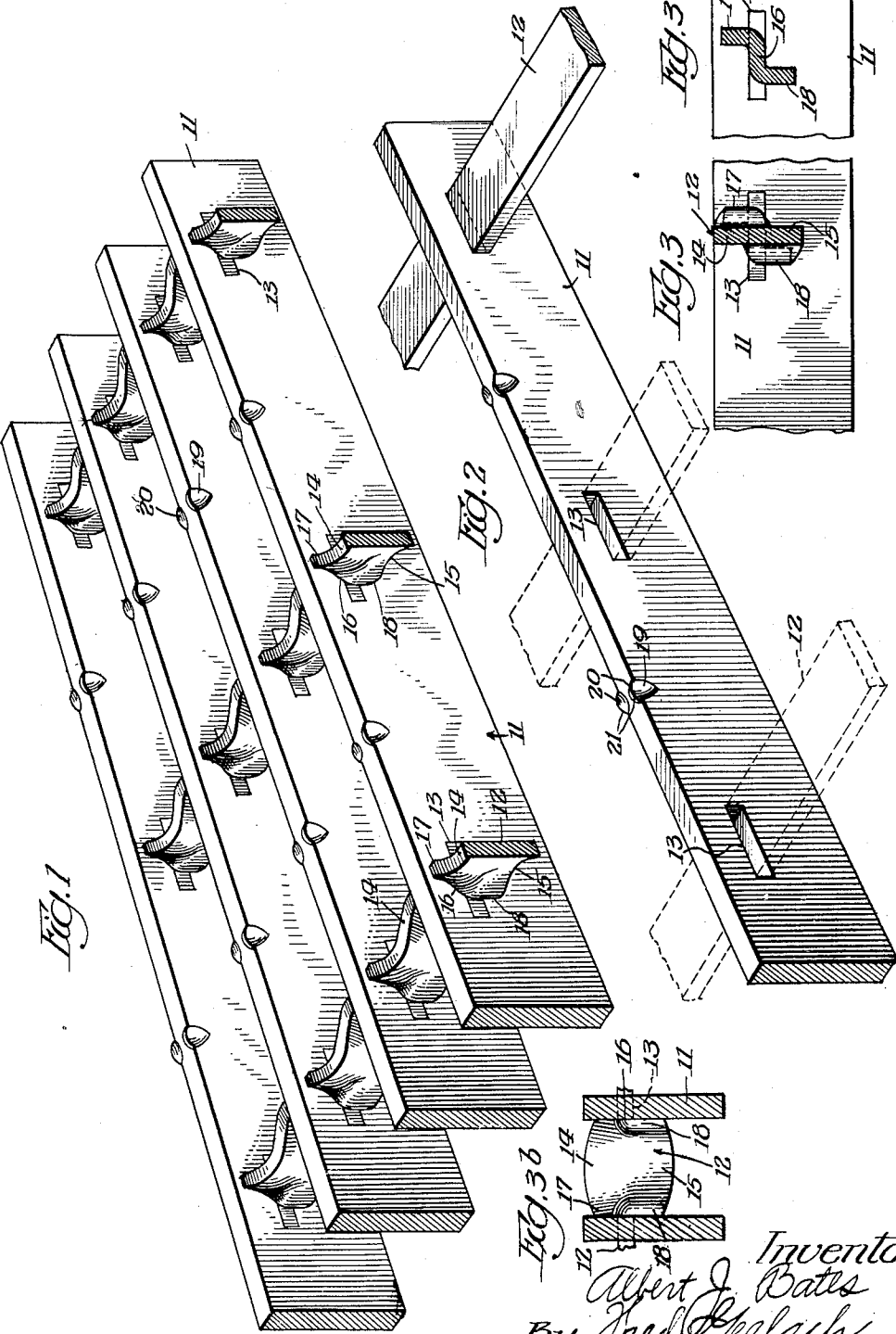


Fig. 3b

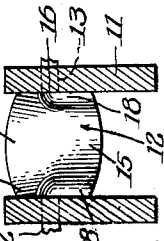


Fig. 3a

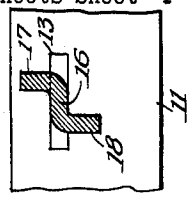
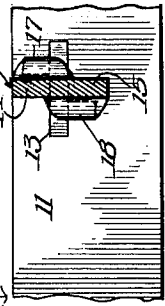


Fig. 3



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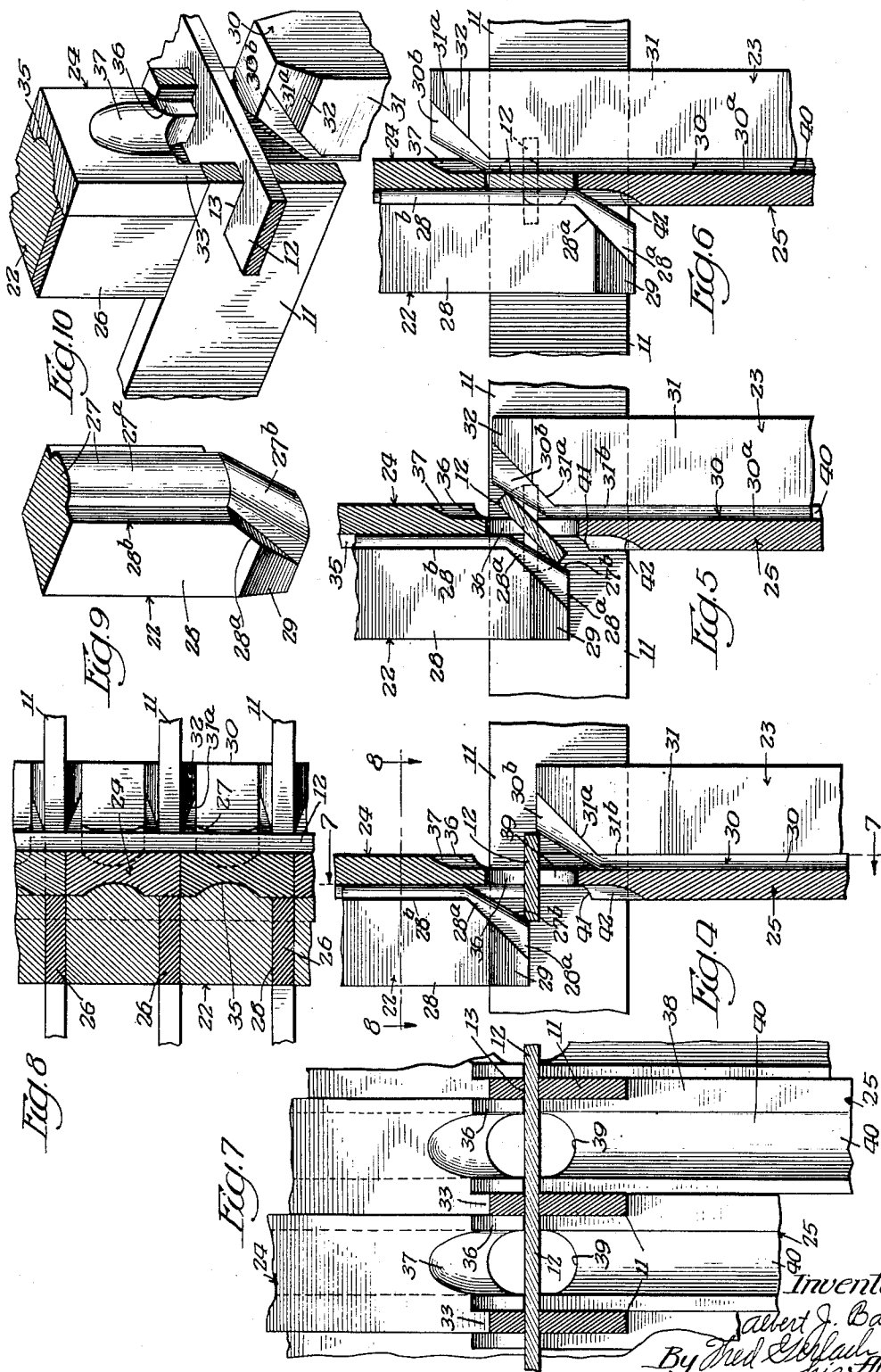
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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MANUFACTURE OF GRATING

Albert J. Bates, Chicago, Ill.

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3 Claims. (Cl. 29—160)

The invention has reference to the manufacture of grating and its primary object is to provide an improved method of making grating.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Fig. 1 is a perspective of a grating made in accordance with the present method;

Fig. 2 is a perspective, illustrating the manner in which the tie bars of the grating are threaded or inserted through the slots in the master bars, before they are operated upon to develop their locking proclivities;

Fig. 3 is a cross section of one of the tie bars taken midway between two of the master bars and showing the central part of the tie bar portion between the two master bars after bending thereof into its vertical or right angle position and the ends of said portion turned upwards and downwards and shaped to form shoulders which abut directly against the sides of the master bars and prevent the master bars from rolling relatively to the tie bars;

Fig. 3a is a cross section of one of the tie bars taken approximately one-sixteenth of an inch from one of the master bars and illustrating the construction and arrangement of the shoulders;

Fig. 3b is a section taken on the line 3b—3b of Fig. 3;

Fig. 4 is a view, partly in section and partly in side elevation, showing the dies which serve to bend or twist at right angles the portions of the tie bars between the master bars and to form the shoulders at the ends of the twisted portions, before shift thereof to effect the bending and shearing of the tie bars, and also showing the dies which engage and hold the end parts of the portions of the tie bars between the master bars during operation of the bending and shearing dies;

Fig. 5 is a view, showing the bending and shearing dies after they have been advanced or shifted sufficiently to effect a preliminary twisting of the tie bars and bring the cutting parts into a position wherein they engage the edges of the tie bars and are in readiness to coact with the sides of the master bars and effect shearing for the purpose of forming the shoulders;

Fig. 6 is a view, showing the bending and shearing dies after they have been advanced or shifted to effect a complete bending or twisting of the tie bars and to form shoulders at the

ends of the twisted tie bar portions which serve rigidly to lock the master bars in place;

Fig. 7 is a vertical transverse sectional view taken on the line 7—7 of Fig. 4 and illustrating in detail the construction of the holding dies and the manner in which such dies operate to prevent distortion of the master and tie bars during the bending and shearing operation;

Fig. 8 is a horizontal section taken on the line 8—8 of Fig. 4 and illustrating the cross sectional construction of the dies;

Fig. 9 is a perspective of one of the combined bending and shearing dies; and

Fig. 10 is a perspective, showing the bending and shearing dies before the twisting and shearing of the tie bars.

The method which forms the subject matter of the invention contemplates the fabrication or manufacture of a grating which comprises a series of master bars 11 and a series of transversely extending tie bars 12. The master bars are formed of any suitable metal, such as steel, and are of substantially uniform height and thickness. They are arranged in side-by-side and parallel relation and so that the upper edges thereof are in alignment and are spaced equal distances apart as illustrated in Fig. 1. The tie bars 12 are formed of strips of steel and are rectangular in cross section. They serve to hold the master bars 11 in connected relation and extend through groups or sets of aligned slots 13 in the master bars. The slots 13 conform to the cross sectional shape of the tie bars and extend longitudinally with respect to the master bars. In fabricating the grating, the tie bars 12 are first threaded or inserted through the slots 13 as illustrated in Fig. 2. Thereafter, the portions of the bars between the master bars undergo reformation as hereinafter described, so that the central parts thereof, that is, the parts midway between the master bars, extend substantially at right angles or perpendicularly with respect to the portions within the slots. The portions of the tie bars between the master bars comprise upper parts 14 and lower parts 15. The upper parts are curved in one direction and the lower parts are curved in the opposite direction. As a result of this arrangement, the grating as a whole is of an ornamental character and is exceedingly attractive and pleasing to the eye. In addition to the upper and lower parts 14 and 15, the portions of the tie bars between the master bars comprise connecting parts 16, upper shoulders 17 and lower shoulders 18. The connecting parts 16 are lo-

cated at the ends of the portions of the tie bars and serve to connect such portions to the portions of the tie bars within the slots 13. As clearly illustrated in Fig. 3a of the drawings, the parts 16 are not processed in any way and extend horizontally. The portions of the tie bars within the slots 13 of the master bars completely fill the aforesaid slots and hence serve to prevent displacement of the tie bars longitudinally with respect to the master bars. The upper shoulders 17 are located at the ends of the upper parts 14 of the tie bars and are disconnected with respect to the contiguous end parts of the portions of the tie bars within the slots 13. Inasmuch as they are formed as hereinafter described, by shearing the edges of the tie bars against the master bars, they extend substantially at right angles to the aforesaid portions of the tie bars within the slots in the master bars and abut directly against the sides of the master bars in order to render the grating rigid and prevent the master bars from rolling or shifting laterally one relatively to the others. The lower shoulders 18 are located at the ends of the lower parts 15 and abut against the sides of the master bars so as to assist the shoulders 17 in preventing roll of the master bars. They are disconnected with respect to the contiguous ends of the portions of the tie bars within the slots 13 and extend downwardly at substantially right angles to such portions of the tie bars. A distinctive and novel feature of the invention resides in the fact that the shoulders 17 and 18 are formed by shearing the edges of the tie bars after the tie bars have been threaded or inserted through the slots in the master bar. The shearing is accomplished by dies which are described hereafter and cooperate with the master bars to effect an inward shearing of the edges of the tie bars adjacent the master bars and are so formed that the shoulders are bent perpendicularly with respect to the tie bar portions within the slots and engage frictionally the sides of the master bars. By utilizing the shoulders 17 and 18 at the ends of the twisted or bent portions of the tie bars between the master bars, the master bars are rigidly held in connected relation. In addition, the grating as a whole is strengthened and made extremely rigid. This is attributable to the fact that the shoulders 17 and 18 which abut directly against the sides of the master bars prevent bending of the tie bars when weight is applied to the grating. By virtue of the fact that the portions of the tie bars between the master bars are twisted or bent into place and the upper and lower parts 17 and 18 are curved as a result of the bending operation, the shoulders 17 are offset with respect to the shoulders 18 and are positioned at one side of the central part of the twisted tie bar portions. The slots 13 are preferably arranged so that the upper parts 14 of the tie bars are flush with the top or upper edges of the master bars.

To prevent people's feet from skidding or slipping on the grating, the sides of the master bars are indented, as at 19, in order to force the metal upwardly and form projections 20 at the top or upper edges of the master bars. These projections are arranged in pairs and are preferably positioned between the tie bars 12. They embody comparatively sharp edges 21 above the top edges of the master bars and tend to present a ruffled surface at the top of the

grating which effectively precludes slippage or skidding.

Twisting or bending of the portions of the tie bars between the master bars is effected by means of sets of dies. Each of these sets consists of an upper combined bending and shearing die 22, a lower combined bending and shearing die 23, an upper holding die 24 and a lower holding die 25. By way of a preliminary explanation, the various dies are associated with a power-operated machine (not shown) which is designed for volume production and consists of an upper vertically reciprocating head for the dies 22 and a lower vertically reciprocating head for the dies 23. The two heads are reciprocated to and from each other and are so arranged and timed that the dies of the heads are brought into substantial registry (see Fig. 6). The dies 22 and 23 operate during movement of the heads towards each other, to engage opposite edges of the tie bars and are so constructed and shaped that they shear and bend the portions of the tie bars between the master bars into the design or shape heretofore described.

The upper combined bending and shearing dies 22 are arranged in rows and are held in spaced relation by metallic plates or strips 26. The latter, together with the upper combined bending and shearing dies 22 are mounted in the upper die-carrying head of the machine and are reciprocated vertically. The grating is held in a suitable retainer (not shown) beneath the upper head and above the lower head, after it has been assembled in a preliminary manner by inserting the tie bars 12 through the elongated slots 13 in the master bars. The combined bending and shearing dies 22 are adapted to be shifted downwardly between the master bars in order to effect downward deflection or bending of the tie bars 12. Each of the upper combined bending and shearing dies 22 is formed of a single block of metal and consists of a bender 27 and a pair of shearers 28. The shearers are located at the sides of the bender 27 and operate as hereinafter described to shear the ends of the subjacent tie bar portions in order to form the lower shoulders 18. The bender 27 consists of a vertically extending upper part 27^a and a lower part 27^b. The latter extends downwardly and outwardly with respect to the upper part 27^a, is convex and serves, during downward movement of the die 22, to bend or deflect downwardly the subjacent tie bar portion so as to form the lower part 15 of such portion. The upper part 27^a of the bender 27 is convex and operates toward the end of the downward stroke of the die 22 to swing the subjacent tie bar portion into a position wherein it is disposed at substantially right angles with respect to the tie bar portions within the slots 13. During the initial part of the downward stroke of the die 22, the lower part 27 of the bender engages the subjacent tie bar portion in the manner illustrated in Fig. 4. As the die is shifted downwardly from the position illustrated in Fig. 4, the lower part 27^b of the bender 27 engages slidably the contiguous part of the subjacent tie bar portion and deflects it downwardly in the manner illustrated in Fig. 5. As the die 22 approaches the end of its downward stroke, the upper part 27^a of the bender is brought into contact with the bent or deflected part of the subjacent tie bar portion and serves to bend or deflect the latter into a right angle position as illustrated in Fig. 6. The shearers

28 at the sides of the bender 27 are provided at the lower ends thereof with shearing edges 28^a. The latter are inclined downwardly and outwardly and are located adjacent to and outwardly of the lower part 27^b of the bender 27. During downward movement of the die 22, the shearing edges 28^a of the shearers 28 slide against the contiguous faces of the master bars 11 and sever the ends of the subjacent tie bar portion from the tie bar portions within the slots 13 to form the shoulders 18 at the ends of the lower part 15. In addition to the shearing edges 28^a, the shearers 28 are provided with vertically extending edges 28^b. The latter are located at the sides of the upper part 27^a of the bender and operate, as illustrated in Figure 6, to bend the shoulders 18 into their right angle position. The lower ends of the edges 28^b terminate adjacent the lower end of the upper part 27^a of the bender 27. The lower ends of the shearers 28 are tapered, as at 29, so as to facilitate passage of the die 22 between the master bars. During downward movement of the die 22, the lower part 27^b of the bender 27, as previously pointed out, deflects downwardly the contiguous part of the subjacent tie bar portion. After a partial bending or deflection, the shearing edges 28^a of the shearers cut or shear the contiguous end parts of the subjacent tie bar portion so as to form the lower shoulders 18. As the die 22 reaches the end of its downward stroke, the upper part 27^a of the bender and the edges 28^b of the shearers effect complete deflection of the subjacent tie bar part and bring the lower shoulders 18, as illustrated in Fig. 6, into the right angle position. By virtue of the fact that the shearers 28 engage slidably the master bars and the shearing is accomplished with the aid of the master bars, the shoulders 18 abut directly against the sides of the master bars and thus, after deflection thereof into place, effectively hold the master bars against rolling. Inasmuch as the parts 27^a and 27^b of the bender are convex, the lower part 18 of the subjacent tie bar portion is curved.

The lower combined bending and shearing dies 23 are arranged in rows and are held in spaced relation similarly to the upper dies 22. They are offset with respect to the upper dies 22 and are mounted in the lower head of the machine. Upward bending of the portions of the tie bars between the master bars is accomplished by the dies 23. The latter are similar in construction to the dies 22. Each of the lower combined bending and shearing dies 23 comprises a bender 30 and a pair of shearers 31. The bender comprises a vertically extending lower part 30^a and an upper part 30^b. The latter is inclined upwardly and outwardly and operates, during upward movement to bend and deflect upwardly the contiguous part of the subjacent tie bar portion. The lower part 30^a of the bender 30 engages the tie bar portion after the upper part 30^b and completes the deflection so as to form the upper part 14. The two shearers 31 are located at opposite sides of the bender 30 and embody shearing edges 31^a and vertically extending edges 31^b. The shearing edges operate, during upward movement of the die 23, to shear the contiguous end parts of the subjacent tie bar portion to form the shoulders 17. The edges 31^b, after formation of the shoulders 17 by the shearing edges 31^a, engage the shoulders and shift them

upwardly so that they extend at right angles to the tie bar portions within the slots 13. The upper ends of the shearers 31 are tapered as at 32 so as to facilitate passage of the lower die between the master bars. The parts 30^a and 30^b of the bender are convex.

The upper holding dies 24 are associated with the upper combined bending and shearing dies 22 and are arranged in rows. They are positioned adjacent the benders 27, are shifted downwardly into their operative position before shift of the upper combined bending and shearing dies 22 and serve to prevent rupture or tearing of the metal during operation of said dies 22. Each of the holding dies 24 is formed of a single strip or plate of metal and is provided at one side thereof with a lug or projection 33. The latter projects laterally and is adapted to lap and abut against the upper edge of the subjacent master bar so as to prevent rupture of the metal when the lower combined bending and shearing dies 23 are shifted upwardly to bend or deflect upwardly the parts of the tie bar portions which form the upper parts 14. The lower ends of the upper holding dies 24 fit between the master bars and are adapted to abut directly against the upper faces of the tie bars as illustrated in Figs. 4, 7 and 10. Semicircular openings 34 are formed in the lower ends of the dies 24 so as to accommodate the upper parts 14 of the portions of the tie bars between the master bars when such parts are shifted upwardly into their right angle position by the lower combined bending and shearing dies 23. The faces of the dies 24 that are opposite to the benders 27 of the upper combined bending and shearing dies 22 are grooved longitudinally as at 35 in order to accommodate the aforesaid benders. The opposite faces of the holding dies 24 have cut away portions 36 and recesses 37. The cutaway portions 36 are positioned adjacent the openings 34 and receive the upper shoulders 17 when the latter are shifted upwardly into a vertical position by the action of the edges 31^b of the shearers of the dies 23. The recesses 37 conform to the curvature of the benders of the lower combined bending and shearing dies and receive the lower parts 30^a of said benders at the end of the upward stroke of the dies 23.

The lower holding dies 25 are associated with the lower combined bending and shearing dies 23 and are similar in construction to the upper holding dies 24. They are formed of metallic strips or plates and are provided at the sides thereof with lateral projections or lugs 38. The latter are adapted to engage the lower edges of the master bars of the grating and cooperate with the projections 33 of the upper holding members 24 to hold the master bars in place during shift of the dies 22 and 23. The upper ends of the lower holding dies fit between the master bars and engage the lower faces of the tie bars as illustrated in Figs. 4 and 7. In order to accommodate the lower parts 15 of the portions of the tie bars between the master bars when such parts are deflected by the benders of the upper dies 22, openings 39 are formed in the upper ends of the lower holding dies. These openings, like the openings 34 of the upper holding dies, are semicircular in conformation. The faces of the lower holding dies that are opposite to the dies 23 are grooved longitudinally as at 40 so as to receive slidably the lower part 30^a of the benders 30. The opposed faces of the

lower holding dies are provided with cut away portions 41 and recesses 42. The cut away portions, as indicated in Fig. 6, are located at opposite sides of the openings 39 and receive the shoulders 18 when the latter are shifted downwardly by the edges 28^b of the shearers 28. The recesses 42 receive the upper portions 27^a of the benders 27 when the upper combined bending and shearing dies reach the end of their downward stroke. The lower holding dies 25 are slidable relatively to the lower combined bending and shearing dies 23 and are adapted to be shifted into their operative position before shift of the dies 23 to effect upward bending or deflection of the portions of the tie bars between the master bars.

In bending or deflecting the portions of the tie bars between the master bars, the upper and lower holding dies are first shifted into their operative position. The upper and lower dies 22 and 23 are then shifted towards each other so as to effect the desired bending of the tie bar portions between the master bars and form the shoulders 17 and 18 which abut directly against the sides of the master bars and serve, as previously pointed out, to prevent rolling of the master bars one relatively to the others. During the downward stroke of the upper combined bending and shearing dies 22, the contiguous parts of the tie bar portions between the master bars are deflected downwardly into the openings 39 of the lower holding dies and at the same time, the end parts are sheared from the contiguous parts of the tie bar portions within the slots 13 so as to form the shoulders 18. During upstroke of the lower combined bending and shearing dies, the opposite parts of the tie bar portions between the master bars are deflected upwardly into the openings 36 of the upper holding dies and at the same time, the shoulders 17 are formed. Upon release of the dies 22, 23, 24 and 25, the grating is ready for use.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended

claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. That improvement in the manufacture of grating which consists in first inserting tie bars through sets of aligned slots in a group of laterally spaced master bars, and then shearing the ends of the portions of the tie bars between the master bars inwardly from the side edges and against the sides of the master bars and bending or deflecting them to form shoulders that lap the side faces of the master bars and hold the master bars against displacement relatively to the tie bars.

2. That improvement in the manufacture of grating which consists in first inserting tie bars through sets of aligned slots in a group of laterally spaced master bars, and then shearing the ends of the portions of the tie bars between the master bars inwardly from the side edges and against the side faces of the master bars and bending them in opposite directions to form pairs of oppositely extending shoulders that lap the side faces of the master bars and hold the master bars against displacement relatively to the tie bars.

3. That improvement in the manufacture of grating which consists in first inserting tie bars through sets of aligned slots in a group of laterally spaced master bars, and then deflecting the central parts of the portions of the tie bars between the master bars into an angular position with respect to the portions of the tie bars within the slots of the master bars and simultaneously shearing the ends of said first mentioned portions inwardly from the side edges and against the side faces of the master bars and bending or deflecting them adjacent the sheared parts in opposite directions to form shoulders that lap the side faces of the master bars and hold the master bars against displacement relatively to the tie bars.

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