J. H. BICKLEY.

APPARATUS FOR FORMING SHEET METAL.

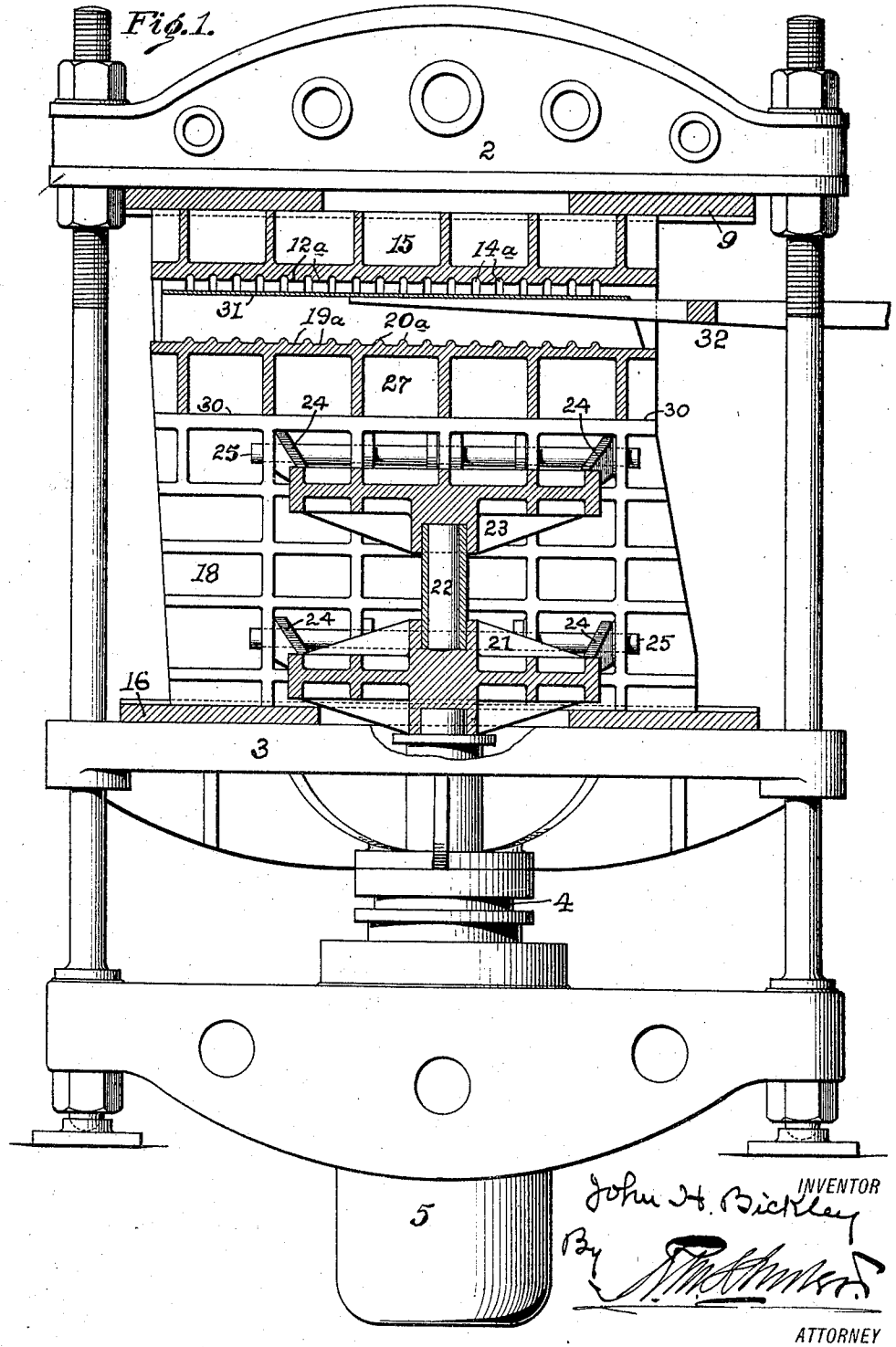
APPLICATION FILED NOV. 23, 1918.

1,306,166.

Patented June 10, 1919.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

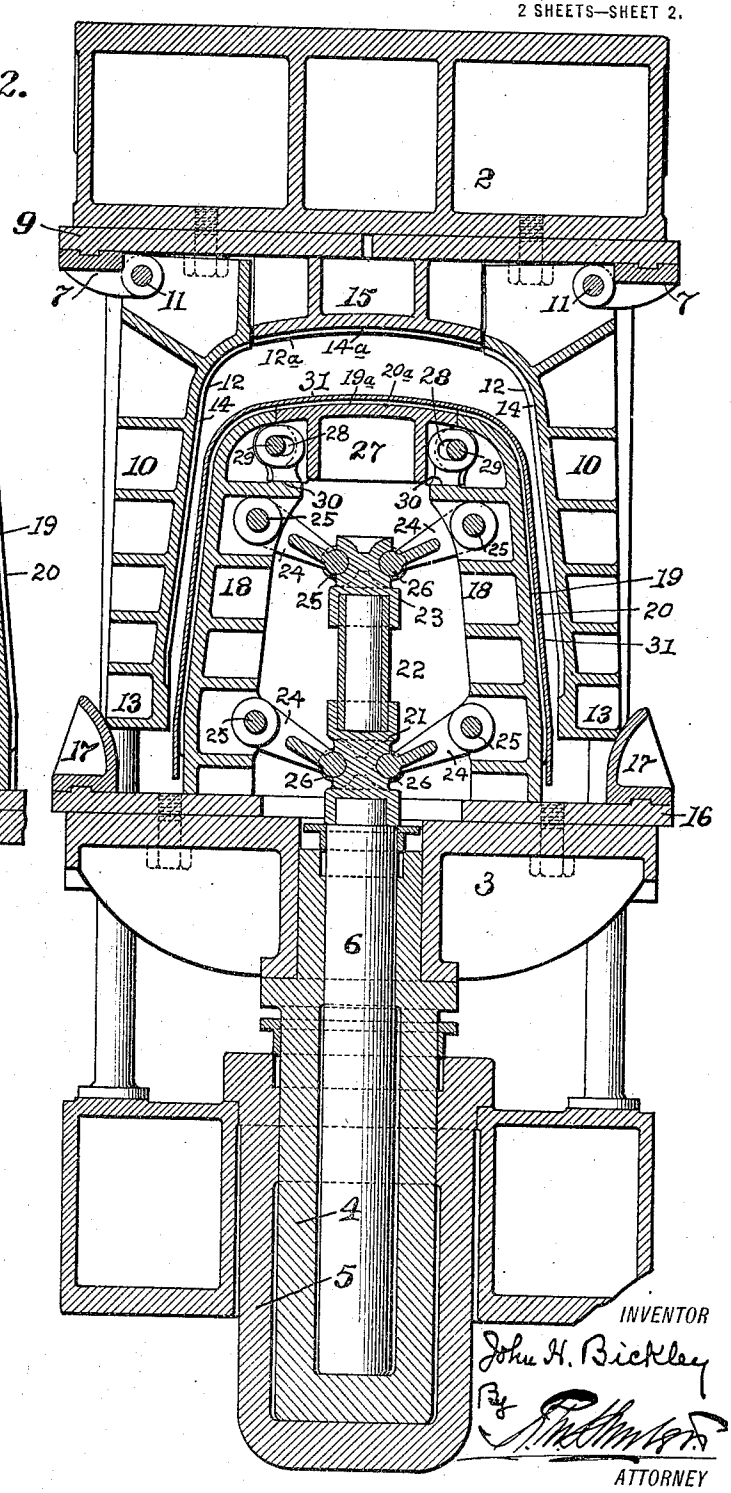
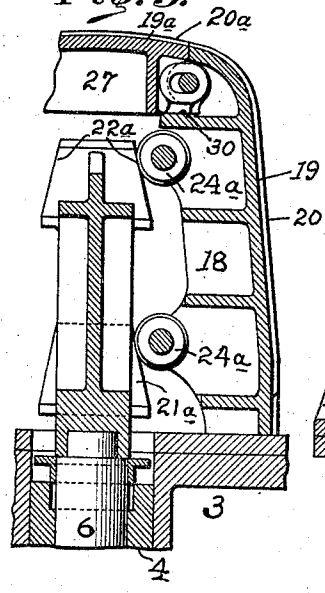


Fig. 3.



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APPARATUS FOR FORMING SHEET METAL.

1,306,166. Specification of Letters Patent. Patented June 10, 1919.

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To all whom it may concern:

Be it known that I, JOHN H. BICKLEY, citizen of the United States, and resident of Reading, county of Berks, and State of Pennsylvania, have invented an Improvement in Apparatus for Forming Sheet Metal, of which the following is a specification.

The object of my invention is to provide suitable dies for use in a hydraulic or other press, which shall be adapted to shape and corrugate large fire box sheets for locomotive boilers.

My invention is especially designed for forming the corrugated fire box sheet which constitutes the sides and crown of the fire box exemplified in Letters Patent No. 1,106,908 and granted to William H. Wood on August 11, 1914, the same consisting of an arch shaped sheet having corrugations arranged transversely across the crown and down the sides to a short distance from the bottom.

My invention consists of adjustable male and female die structures, each composed of die sections suitably coupled and adapted to be operated in a commercial hydraulic press having a movable platen and an auxiliary plunger operating from below the platen.

The outer or female die structure comprises side and crown die sections, the former to swing about upper hinge supports, the swinging movements of the side sections coöperating in producing the transverse corrugations and definitely shaping the sheet. The inner or male die structure comprises a dome shaped construction composed of transversely movable side sections and a crown or dome top section carried by the side sections and movable vertically with them, said sections having their outer surfaces shaped to coöperate with the outer or female die structure to provide transverse corrugations; and in which moreover, the side sections are operated by devices, such as toggles or their equivalent, which simultaneously move them relatively apart during formative operation.

My invention also comprises details of construction which, together with the features above specified, will be better understood by reference to the drawing, in which: Figure 1 is front elevation of a press with my improved dies thereon in section; Fig. 2 is a side elevation of the press showing the dies thereon in transverse section; and Fig. 3 is a sectional view showing a modification of the means for operating side sections of the male die structure.

The hydraulic press which is best suited to operate my improved dies comprises the usual stationary head 2 and movable platen 3, movable to and from the head by a plunger 4 working in a hydraulic cylinder 5. Aside from the main plunger 4, there is an auxiliary plunger 6 working within the plunger 4 and adapted to come into play after the main plunger has performed its function and come to rest; in the present instance the auxiliary plunger operating the means for spreading the side sections of the male die structure, as hereinafter described.

The female die structure consists of the plate 9 to which a top die section 15 is secured and two side die sections 10 which are hinged to the plate 9. As shown, the outer and upper portions of these sections 10 are hinged at 11 to plates 7 which are secured to the top plate 9. The top section 15 and side sections 10 form an arch like structure providing the inner walls 12 and 12ª having transverse grooves 14 and 14ª, said grooves terminating a short distance above the lower edges of the side sections. The inner surface of the side sections curve laterally to form a continuation of the curved surface of the top section (Fig. 2). The side sections 10 have capacity for a slight swinging movement, which is greatest at their lower parts; and this movement is imparted by the cam portions 17 secured to the lower plate 16 bolted to the platen 3 of the press. When the platen is moved upward by the plunger 4, the cams 17 move the side die sections 10 inwardly and hold them in proper position to take the side thrust in the formative process.

The male die structure consists of the side die sections 18 and a top crown or dome section 27, which latter is coupled with the side sections by longitudinal pins 29 secured to its sides and extending through slotted parts 28 on the upper portions of the side sections 18. The lower parts of the side sections rest directly upon the plate 16 and said sections may be moved apart or together over said plate as a support. The outer surfaces 19 of the die sections 18 are provided with ribs 20 and similarly, the outer surface 19ª

of the section 27 is provided with ribs 20ª, the ribs 19ª and 20ª in alinement and coacting with the grooves 14 and 14ª of the female die structure. The preferred means for moving the side sections 18 are shown as toggles and comprise a plurality of links 24 hinged at their outer ends to the longitudinal shafts 25 secured to the side sections and having their inner ends hingedly socketed at 26 in the heads 21 and 22 spaced apart by the post 23 and all moved vertically by the auxiliary plunger 6 of the press. As shown in Fig. 2, the plunger 6 being down and the toggle links 24 inclined upward at their outer ends, it follows that when the male die structure has reached its upward movement, the upward movement of the plunger 6 and heads 21 and 22 will cause the side sections 18 to be moved laterally away from each other and into close formative relation with the side die sections of the outer or female die structure. As shown, the top crown or dome section 27 bridges across the space between the side sections 18 and rests directly upon guide surfaces 30, so that when the side sections are moved upward by the platen 3 and into formative relation with the female die structure, this crown or dome section is definitely moved into formative relation with the die section 15.

In general shape, the die structures are relatively long and open at their opposite ends, it being understood that they are only intended to operate upon a sheet bent into arch form and which would constitute the sides and crown of a fire box of a locomotive boiler. In practice, the sheet steel to be corrugated is first bent into arch form, then heated and finally subjected to the formative action of my improved dies, which give to its surface the desired shape and corrugations.

The operation may be summarized as follows: The arch shaped sheet of steel being heated, it is suspended upon a suitable tool 32 and introduced longitudinally into the arch shaped space between the male and female die structures, as shown at 31 in Fig. 1. The tool is then removed and the sheet 31 is allowed to rest upon the male die. The plunger 4 is put into operation, raising the platen 3 and with it the male die structure and sheet 31. As the platen rises, the cams 17 press upon the lower ends 13 of the side die structures 10 and swing them into formative position, and then hold them in such position during the completion of the formative process. When the platen rises, it carries upward the male die structure and this action presses the crown of the sheet between the die sections 15 and 27, producing both formative and corrugated effects, which also extend downward to some extent on the side portions of the sheet. The next action is produced by the auxiliary plunger 6, which raises the heads 21 and 22 and thereby rock the toggle links 24 to force the side sections 18 of the male die structure apart and into close formative relation with the side sections 10 of the female die structure, thereby forming and corrugating the side portions of the sheet. During this operation, the die sections 18 rest positively upon the platen 3, sliding outwardly upon it and between it and the crown or dome section 27, the latter being at the same time positively and forcibly held against the sheet 31 and the upper sections of the female die structure. After the sheet has been shaped, the plunger 6 is lowered to loosen the side sections 18 from side sections 10; then the platen 3 is lowered and with it the male die and the sheet. This last action lowers the cams 17 and thereby permits the side sections 10 to swing outward to position shown in Fig. 2, whereby the sheet may be removed.

In the modification shown in Fig. 3, the toggles are replaced by wedge action, the plunger 6 carrying at its upper end the two wedge heads 21ª and 22ª, these acting upon roller surfaces 24ª extending inwardly from the side die sections 18 of the male die. The action is similar to that produced by the toggles, but the friction is somewhat greater and therefore I prefer to employ the toggle device, first described.

The die sections are shown as castings, well braced with ribbed backing and therefore both light and strong; but I do not confine myself to the details in this respect, as the construction of the several sections of the die structures may be modified to suit variations in the shapes of the sheets to be corrugated and the strength which may be required according to the thickness of the sheet operated upon.

I have described my invention in the form which I believe is best suited to commercial practice, but it is to be understood that the means for supporting and automatically adjusting the die sections, during rise in the formative process, may be modified without departing from the general nature of the invention; and therefore, I do not confine myself to the details, as they may be varied within the scope of the claims without being a departure from the spirit of the invention.

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

1. In apparatus for shaping arch shaped sheets, an arch shaped female die structure formed of a stationary crown section and two side sections jointedly attached relatively to the stationary section and having their upper working faces shaped to alinement with the working face of the stationary section, combined with a male die structure comprising a movable plate having

means for causing the side sections of the female die structure to be moved toward each other and a dome like structure having side die sections supported by the plate and adjustable whereby they may be moved apart to coöperate with the side sections of the female die structure and also having a dome top die section bridging the space between the side die sections and adapted to fit the crown section of the female die structure, and means for forcibly acting upon the side die sections of the male die structure to move them apart during the formative operation.

2. The apparatus specified and defined in claim 1, when further characterized by having the means for forcibly acting upon the side die sections of the male die structure consisting of vertically movable heads and toggle links extending from said heads to the side die sections, whereby an upward movement of the heads will cause the toggles to rock and impart an outward movement to the side die sections.

3. The apparatus specified in claim 1, when distinguished by having the side die sections of the female die structure hinged at their upper and outer portions, and by having the means for causing the side sections of the female die structure to be moved toward each other made of cam devices movable with the plate and having cam faces which directly act upon the lower ends of the said side sections.

4. The apparatus specified in claim 1, when the dome top section of the male die structure rests upon and is adjustably connected with the upper portions of the side die sections of the male die structure.

5. The apparatus defined in claim 1, when further combined with a press having a stationary frame for supporting the female die structure, a movable platen for movably supporting the male die structure and moving it to and from the female die structure, and auxiliary power devices for imparting motion to the means for forcibly acting upon the side die sections of the male die structure whereby said action may take place after the male and female die sections have been brought into formative relation

6. The apparatus specified in claim 1, when the operating inner surfaces of the female die structure are provided with grooves and the operating outer surfaces of the male die structure are provided with corresponding ribs which are received in the grooves when shaping the metal sheet.

7. In apparatus for shaping arch shaped sheets, an arch shaped female die structure formed of a stationary crown section and two side sections jointedly attached relatively to the stationary section and having their upper working faces shaped to alinement with the working face of the stationary section, combined with a male die structure comprising a movable plate having means for causing the side sections of the female die structure to be moved toward each other and a dome like structure having side die sections supported by the plate and adjustable whereby they may be moved apart to coöperate with the side sections of the female die structure and also having a dome top die section bridging the space between the side die sections and adapted to fit the crown section of the female die structure, and means for forcibly acting upon the side die sections of the male die structure to move them apart during the formative operation, the said male and female die structures being relatively provided with co-acting ribs and grooves and said ribs and grooves extending transversely of the die structures whereby corrugations will be formed transversely of the length of the arch shaped sheet.

8. In apparatus for shaping arch shaped sheets, an arch shaped female die structure formed of a stationary crown section and two side sections jointedly attached relatively to the stationary section and having their upper working faces shaped to alinement with the working face of the stationary section, combined with a male die structure comprising a movable plate having means for causing the side sections of the female die structure to be moved toward each other and a dome like structure having side die sections supported by the plate and adjustable whereby they may be moved apart to coöperate with the side sections of the female die structure and also having a dome top die section bridging the space between the side die sections and adapted to fit the crown section of the female die structure, and means for forcibly acting upon the side die sections of the male die structure to move them apart during the formative operation, the operating opposed surfaces of the male and female die structures being relatively provided with ribs and grooves arranged transversely of the length of the die structures and extending continuously over their operating surfaces and terminating at a short distance from the bottom of their side sections and co-acting to produce corrugations transversely of the length of the arch shaped sheet terminating a short distance above the bottom edges.

9. In apparatus for shaping arch shaped sheets, a female die structure having an arch shape and composed of a longitudinal central crown section and two side sections hinged at their upper ends and forming an adjustable union with the crown section, combined with a male die structure of dome like shape and composed of two side die sections adjustable to and from each other and a longitudinal top dome section bridging the

space between the side sections and supported by them, said sections of the female and male die structures having grooves and ribs, means for moving the two side sections of the female die structure toward each other and means for moving the two side sections of the male die structure away from each other.

10. In apparatus for shaping arch shaped sheets, a female die structure having an arch shape and composed of a longitudinal central crown section and two side sections hinged at their upper ends and forming an adjustable union with the crown section, combined with a male die structure of dome like shape and composed of two side die sections adjustable to and from each other and a longitudinal top dome section bridging the space between the side sections and supported by them, said sections of the female and male die structures having grooves and ribs, means for moving the two side sections of the female die structure toward each other, means for moving the two side sections of the male die structure away from each other, and means for moving the two die structures relatively toward and from each other, the last mentioned means and the means for moving the side die sections of the female die structure coöperating during the same period and alternately with action of the means for moving the side sections of the male die structure.

In testimony of which invention I hereunto set my hand.

JOHN H. BICKLEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."