No. 660,664. Patented Oct. 30, 1900.

W. E. S. STRONG.

METAL BENDING MACHINE.

(Application filed Oct. 23, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 2.

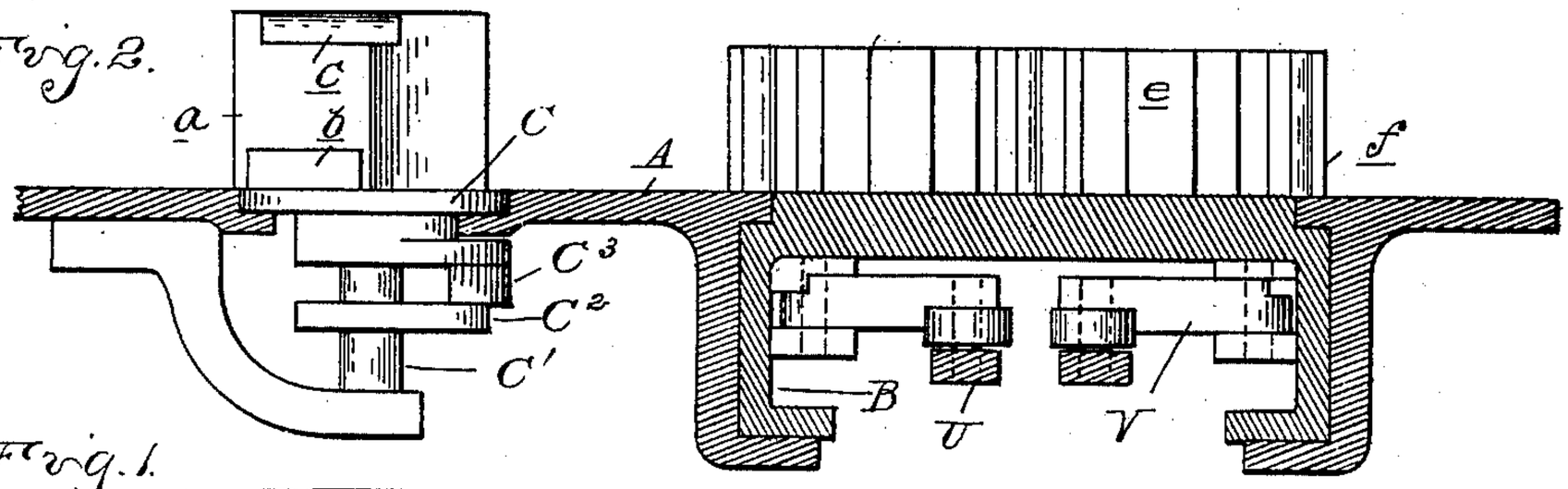

Fig. 1.

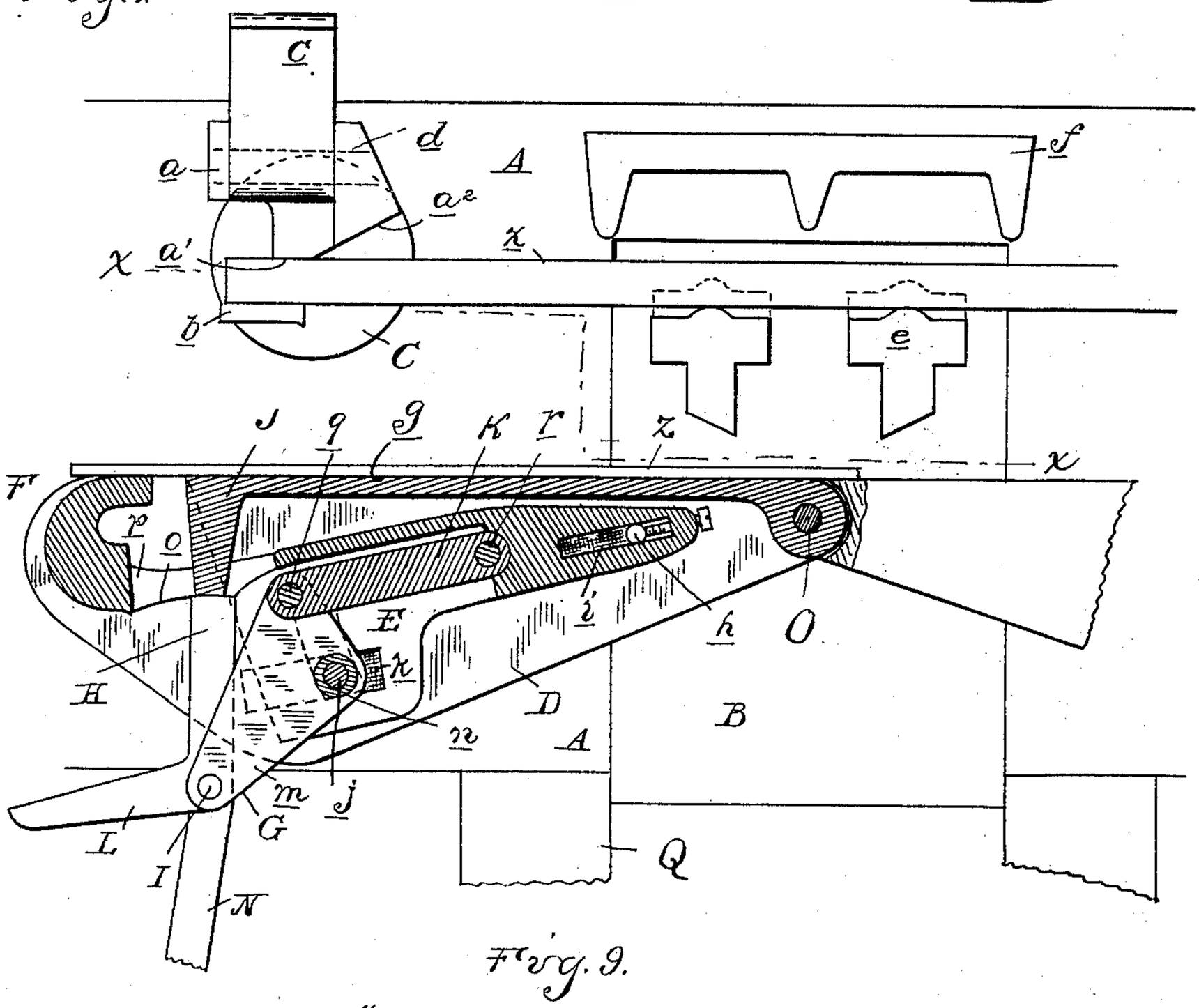

Fig. 3.

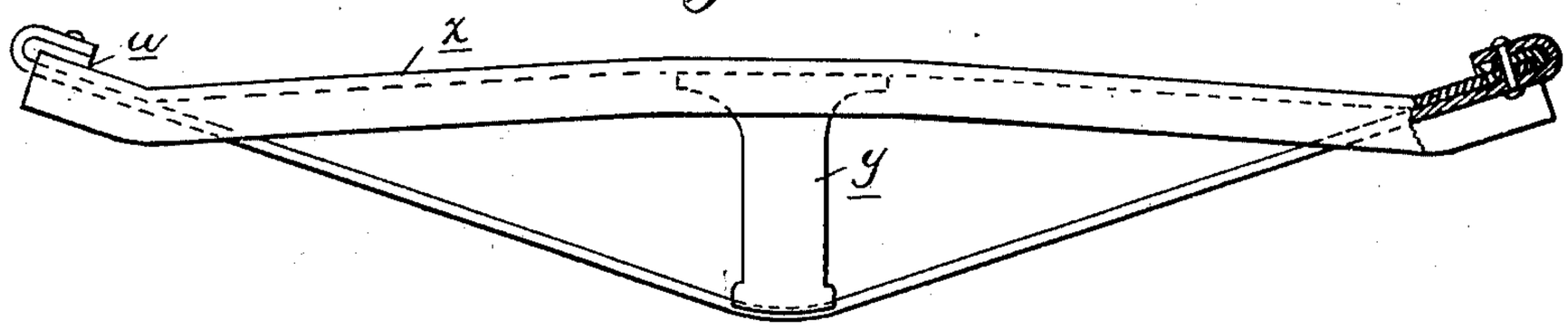

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Fig. 3.

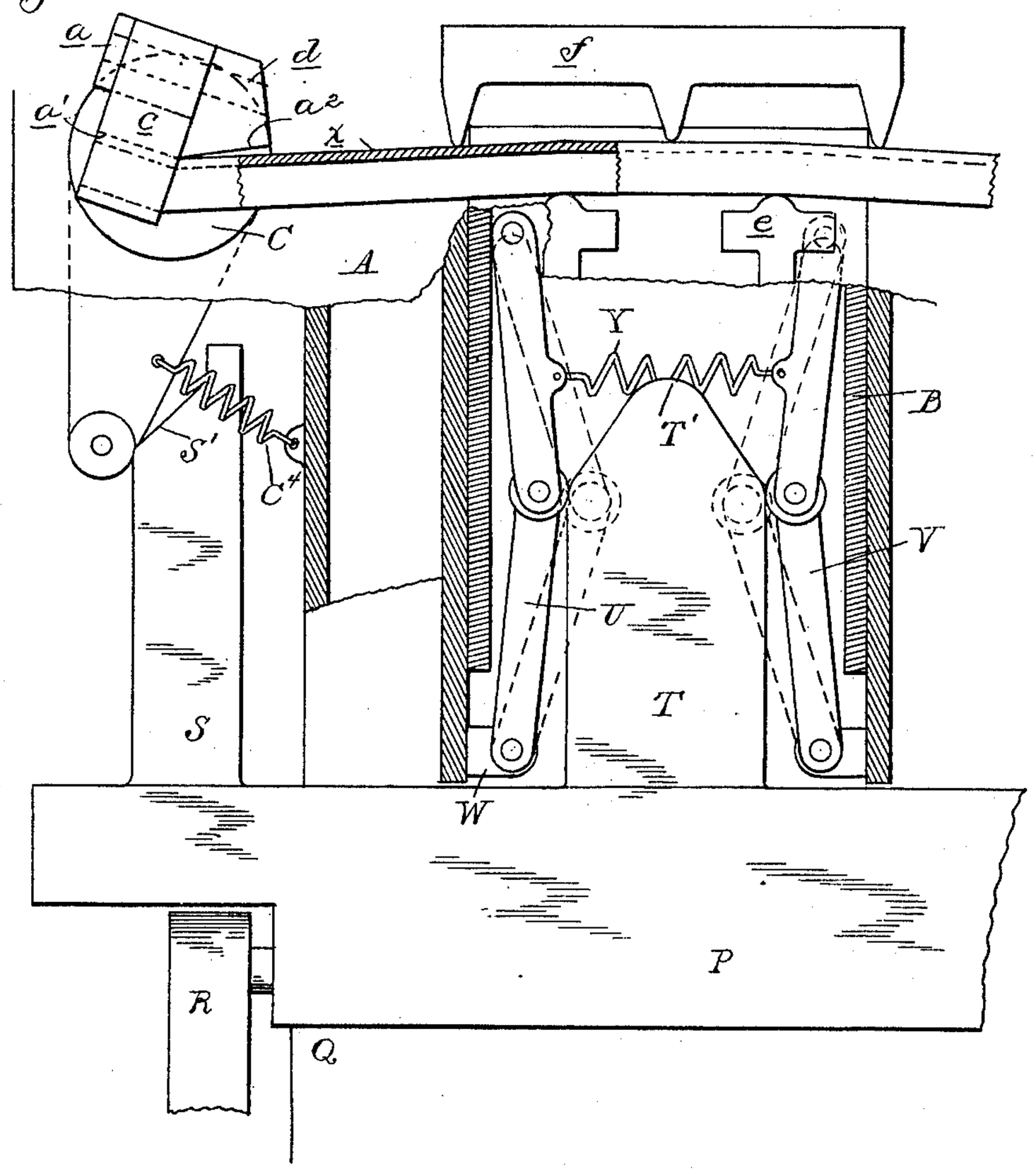
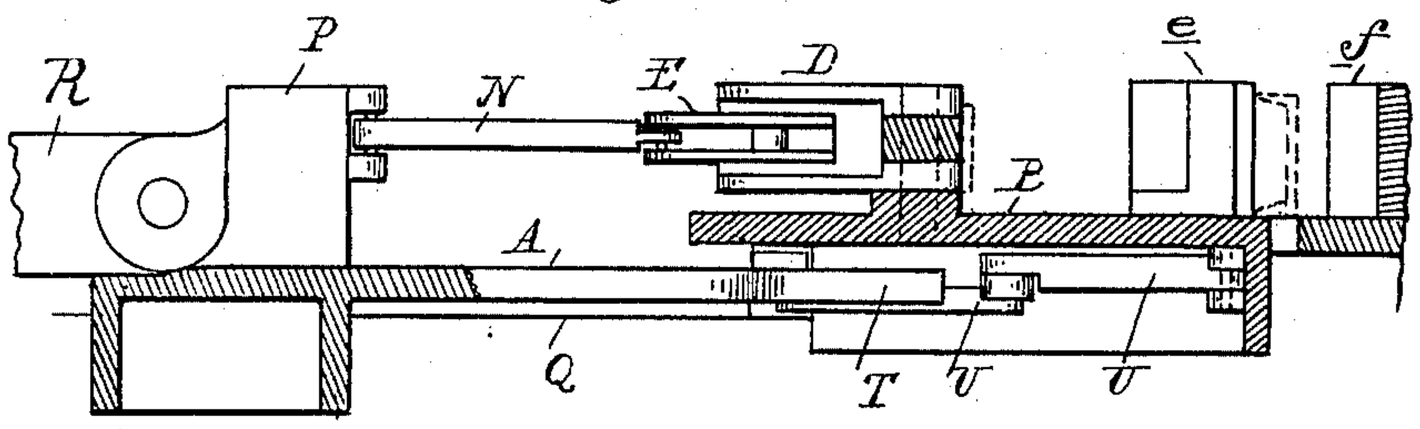


Fig. 1.



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(Application filed Oct. 23, 1899.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 4.

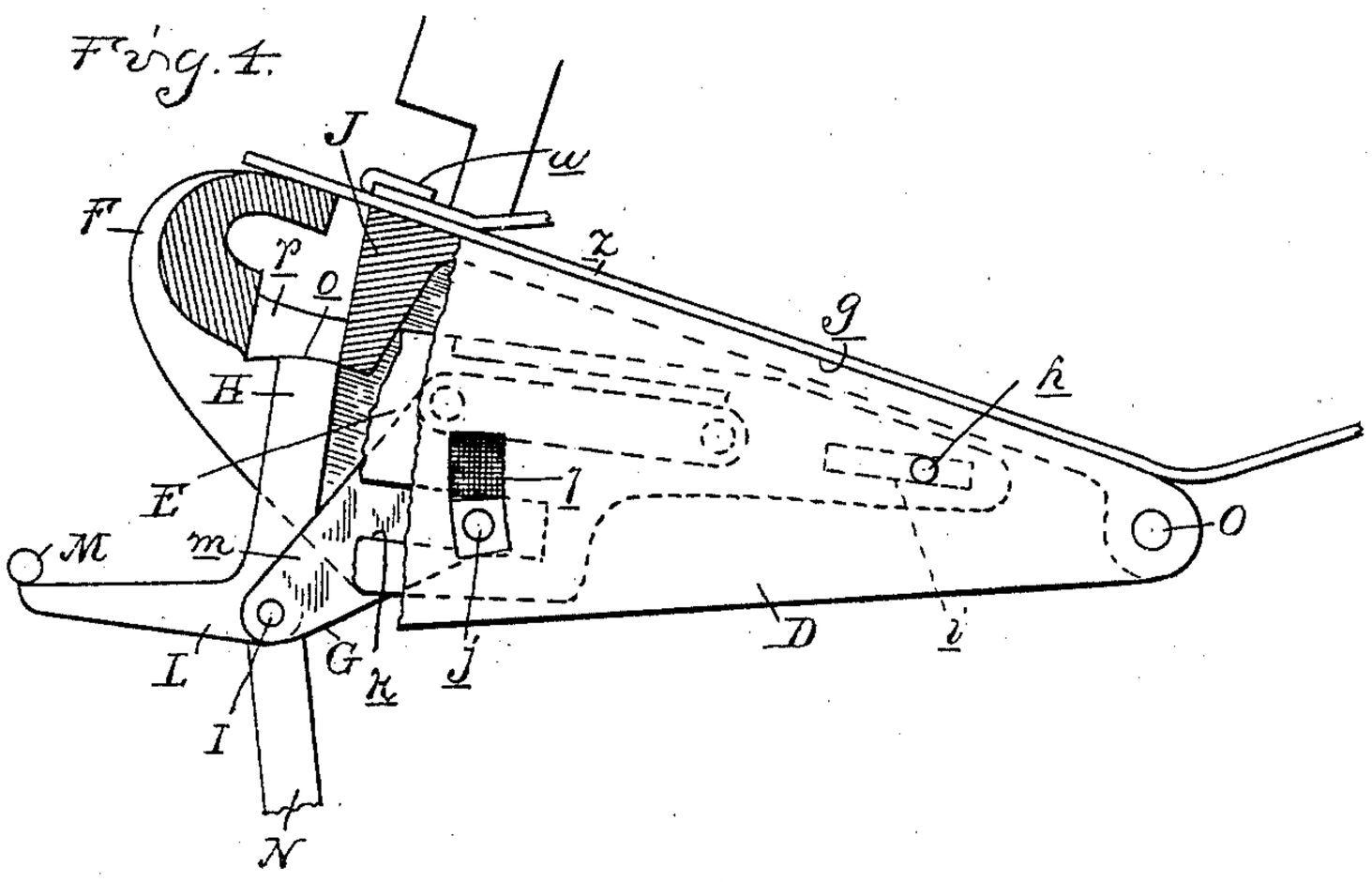


Fig. 5.

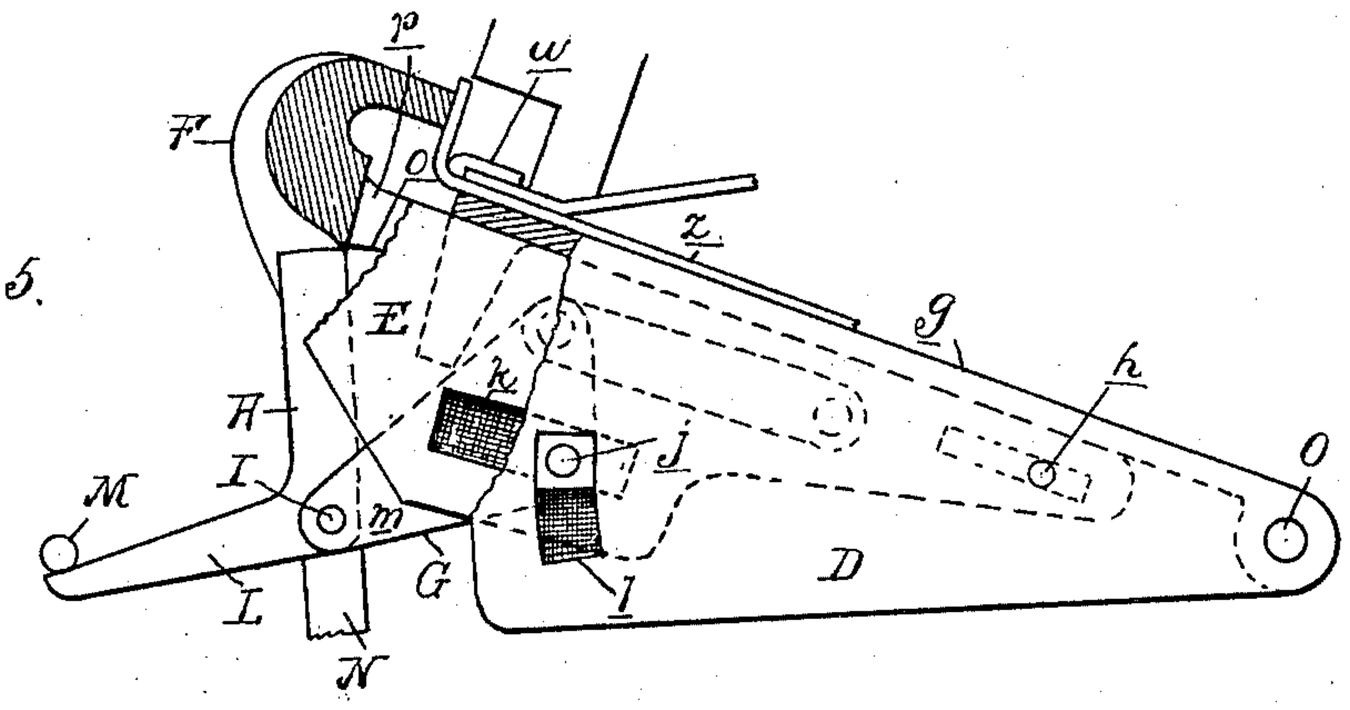
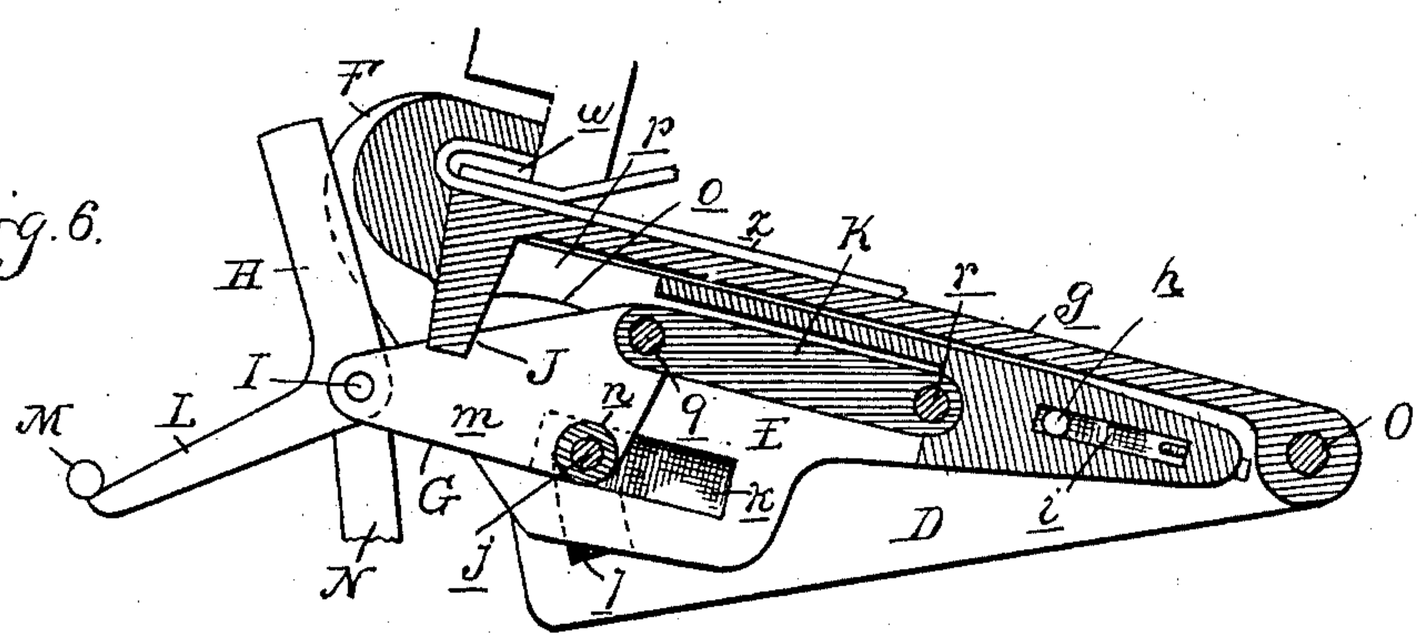


Fig. 6.



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(No Model.) 4 Sheets—Sheet 4.

Fig. 8.

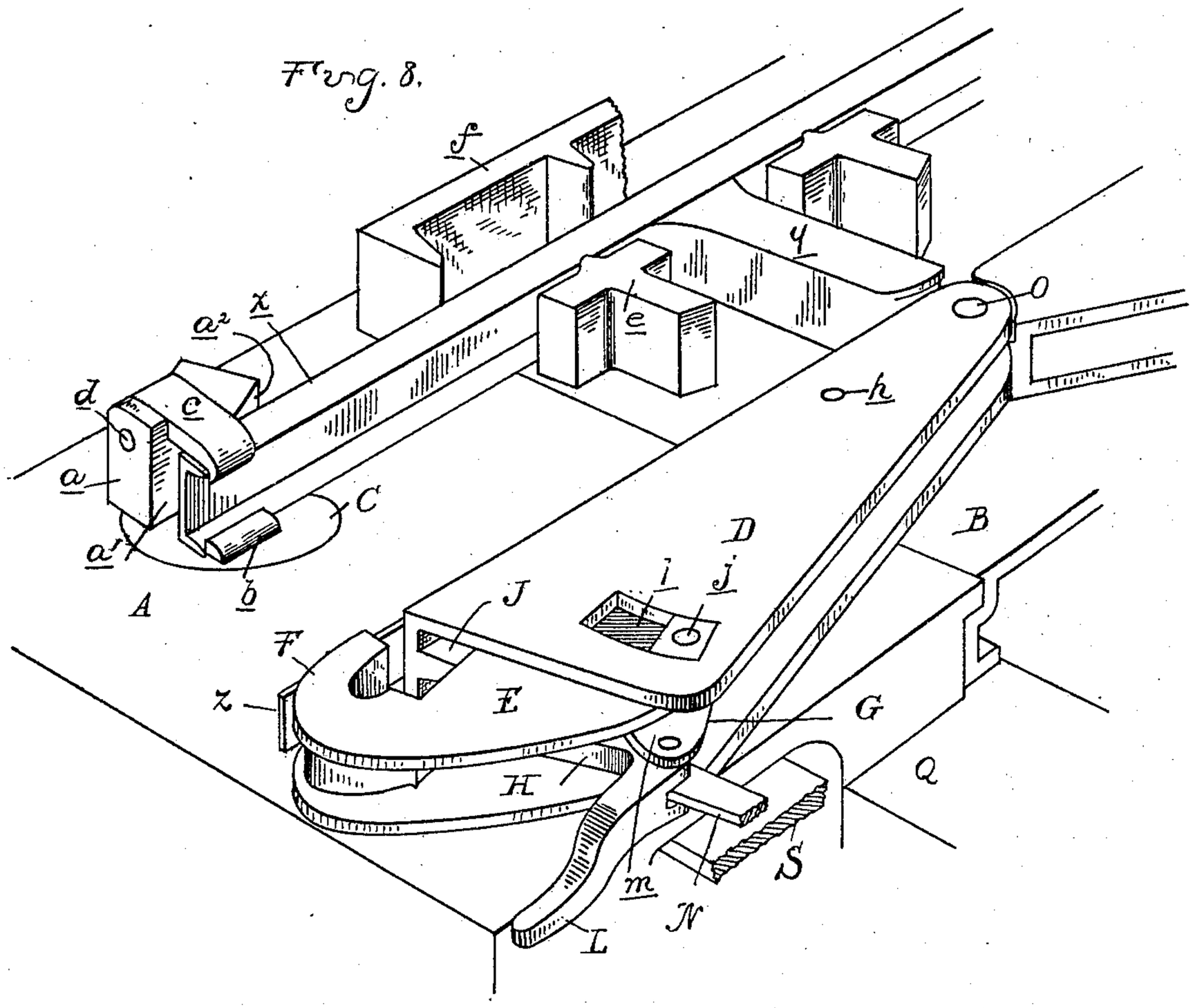
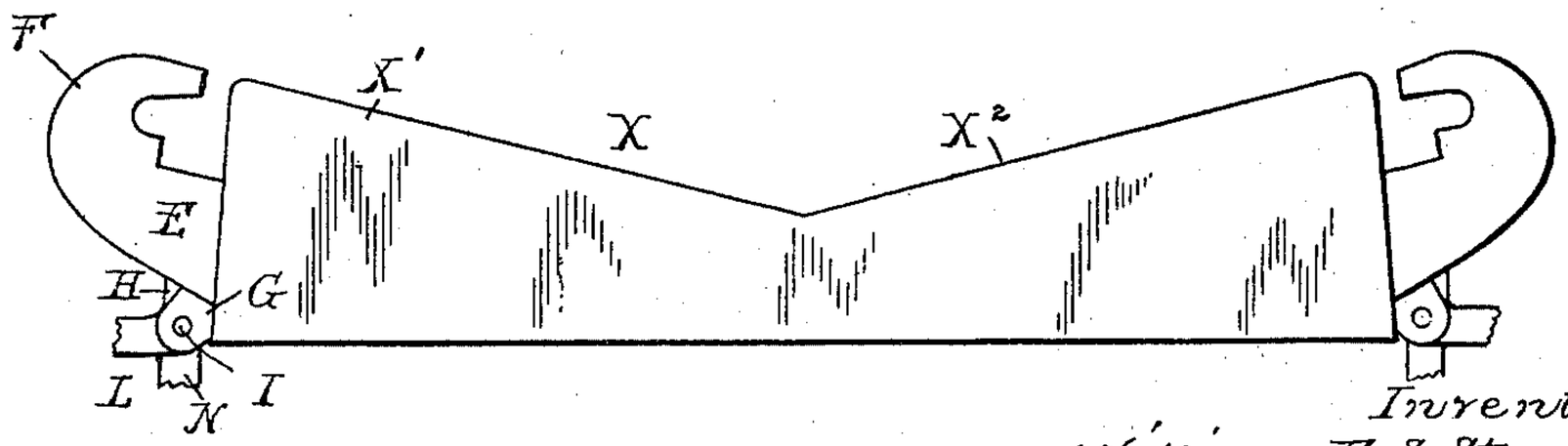


Fig. 10.



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UNITED STATES PATENT OFFICE.

WILLIAM E. S. STRONG, OF DETROIT, MICHIGAN.

METAL-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 660,664, dated October 30, 1900.

Application filed October 23, 1899. Serial No. 734,509. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. S. STRONG, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Metal-Bending Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to bending-machines more particularly designed for shaping metallic bars forming the component members of trusses—such, for instance, as car-bolsters. Such constructions are usually formed of a compression member, preferably a channel or **I** beam, a central strut, and a tension member extending from the ends of said compression member and over the end of said strut. The compression member is usually cambered, and its opposite ends are bent to lie parallel with the tension member, which latter is provided with return-bends or hooks engaging with said bent ends of the compression member.

It is the object of my invention to obtain a machine in which both the compression and tension members may be formed and also assembled in proper relation to each other and the central strut, the whole being accomplished in a single operation of the machine.

To this end my invention consists, first, in the means employed for bending the ends of the compression member; further, in the mechanism by which the beam is cambered, and, further, in the devices employed for bending the tension member around the strut and in forming return-bends at its opposite ends engaging with the ends of the compression member.

The invention further consists in the peculiar construction, arrangement, and combination of parts, as more fully hereinafter described and claimed.

In the drawings, Figure 1 is a plan of a portion of the machine, showing one of the forming-arms in horizontal section. Fig. 2 is a vertical cross-section on line *x x*, Fig. 1. Fig. 3 is a plan similar to Fig. 1, but broken away to illustrate the mechanism beneath the bed. Figs. 4, 5, and 6 are sectional plans of the bending-arm shown in Fig. 1, illustrating the same in different positions of its operation. Fig. 7 is a longitudinal section through the machine. Fig. 8 is a perspective view of the forming devices in their initial position, and Fig. 9 is a plan of the complete truss formed by the machine. Fig. 10 is a plan of a modified construction of forming member.

A is a bed suitably formed to support the various operating parts of the machine. Centrally of this bed and slidingly secured in bearings therein is a movable bed B, and upon opposite sides of this movable bed are arranged rotary heads C, (only one being illustrated in the drawings.)

The heads C are spaced a sufficient distance apart to support the ends of the compression-bar (shown at *x*) and are provided with lugs or abutments *a* and *b*, forming jaws for engaging the ends of said bar, said lugs being arranged upon one side of the axis of each head.

In the drawings I have illustrated the bar *x* as a channel-beam, and for such a member the lug *a* on the rotary head is arranged with one face *a'* thereof, against which the web of the channel is adapted to bear, this face *a'* being substantially arranged in the axial plane of the head C. The lug *b* is arranged in a position to engage with the lower flange of the beam, and to engage with the corresponding upper flange a hook *c* is provided, which is pivotally secured at *d* to the lug or abutment *a*.

In the initial position of the parts thus far described the hooks *c* are turned back, so as to permit of the channel-beam being placed in position on the heads C and with the faces *a'* of the two heads arranged in the same plane and bearing against the web of the channel-beam. In this position the lugs *b* also bear against the edge of the lower flange of said channel-beam, and when the hooks *c* are turned down they will engage with the corresponding upper flange. It will thus be understood that a rotation of the head C will cause the bending of the ends of said channel-beam, the angle of the bend being the axes of the rotary heads. To hold the central portion of the channel-beam while its ends are being bent and also to form the camber in said beam, the sliding bed B is provided with

the lugs or abutments *e*, which in the initial position of the machine are substantially in line with the lugs *b* and are adapted to bear against the flanges of the beam in the central portion thereof. These lugs *e* are spaced from each other to permit of placing the strut *y* of the truss between them and in engagement with the channel-beam.

f indicates stationary abutments secured to the bed A in rear of the beam and the abutments *e*. In front of the beam and a sufficient distance therefrom to clear the strut *y* are arranged the devices for bending the tension member *z*. These consist of two like forming-arms D, extending upon opposite sides of the center of the bed and pivotally secured at adjacent ends to the sliding bed B. Each of these arms is provided with a flat vertical face *g*, and in the initial position of said arms these faces are preferably in the same plane extending parallel to the beam and adapted to bear against the straight bar of which the tension member is formed. The arm D is preferably hollow, and within the recess therein is arranged an arm E, which extends out through the end of the arm D and is provided at its outer end with a hook-shaped forming-head F. The arm E is connected to the arm D in such a manner as to be capable of a lateral and also a longitudinal movement in relation thereto. As illustrated in the drawings, this connection consists of a pivot-pin *h* in the arm D, engaging with a slotted bearing *i* at the inner end of the arm E. Near the outer end of the arm D is arranged the second pivot-pin *j*, which has a cross sliding engagement with the arms E and D. This is secured by providing the arm E with the longitudinal slot *k* and the arm D with the transverse slots *l*, the latter being preferably formed in the arc of a circle drawn from the center of the pin *h*. The arm E is also centrally recessed, and within this recess is arranged the arm G, secured upon the pivot-pin *j*. This arm is bifurcated, being preferably formed by two parallel plates *m*, secured together by the sleeve *n*. Between the plates *m* is arranged an arm H, pivotally secured at I to said plates and extending inwardly therefrom. The inner end of this arm H is adapted to bear against a segmental bearing-face *o* on the arm E and also in the initial position of the parts against the lug J on the arm D, this lug extending through a slot *p* in the arm E. The plates *m* extend laterally from the pivot *n* and embrace a link K, to which they are pivotally secured at *q*, the opposite end of this link being pivotally secured at *r* to the arm E. The arm H is provided with a laterally-extending arm L, adapted at a certain point in the movement of the parts to engage with a lug M on the stationary bed A for the purpose that will be hereinafter described.

N is a link or push-bar, secured to the arms H and G by the pivot-pin I.

With the construction and arrangement of parts just described whenever movement is imparted to the push-rod N it will cause the arm H to bear against the lug J and to thereby swing the arm D around its pivot O, carrying with it the arm E and other parts in connection therewith. As soon, however, as the arm L comes into engagement with the lug M the latter will cause the turning of said arms L and H upon the pivot I, disengaging the latter from the lug J, as shown in Fig. 4, after which a further movement of the push-bar N will cause the swinging of the arm E only, the arm D remaining stationary. This swinging of the arm E is permitted by the pivotal connection *h* between it and the arm D and also by the slots *l* in the arm D, which allow the pivot-pin *j* to travel in a segmental course in said slots. Thus during the travel of the arm E the relative position of the arm G thereto remains the same. During this swinging movement of the arm E the arm L remains in engagement with the lug M, and thus causes the arm L and arm H to swing around the pivot I until said arm H is finally disengaged from the segmental bearing *o*, as illustrated in Fig. 5. If then a still further movement is imparted to the push-bar N, it will cause the swinging of the arm G around the pivot *j*, causing the lateral extension of said arm to push against the link K and cause the longitudinal sliding movement of the arm E. This longitudinal sliding is permitted by the slots *i* and *k* in the arm E, while the fulcrum-pin *j* is prevented from movement by its engagement with the transverse slots *l* in the arm D.

From the above description it will be understood that all the movements of the parts in connection with the swinging arms D are accomplished by the longitudinal movement of the push-bar N. To cause the movement of this bar, as well as to operate the rotary heads C and the sliding bed B, the machine is provided with the following mechanism:

P is a sliding cross-head secured upon ways or guides Q, forming an extension of the bed A and parallel with the guides of the sliding bed B. This cross-head is given a reciprocating movement by suitable connection, such as the links R, to a crank or other source of power. (Not shown.) To this cross-head P are pivotally secured the push-rods N, and the cross-head is also provided with forwardly-extending arms S and T, adapted to respectively operate the rotary heads C and the sliding bed B through mechanism which will now be described.

The heads C are provided with shanks C′, extending down into a recess within the bed, and to these shanks are secured the rock-arms C^2, said rock-arms being preferably bifurcated and carrying at their outer ends the antifriction-rolls C^3. These rolls in the initial position of the parts extend into the path of the arms S, which latter are provided with cam-faces S′, adapted in the forward movement of the cross-head P to bear against the rolls C^3 and to rock the arms C^2, thereby

causing a partial rotation of the head C. The sliding bed B has arranged in the recesses therein two pairs of toggle-levers U and V, one end of each pair of levers being pivoted to the sliding bed B, while the opposite ends are pivoted to lugs or bearings W on the stationary bed A. The connecting or elbow ends of said toggle-levers extend in the initial position of parts in proximity to each other and in the path of the arm T, which is provided with a tapering or wedge-shaped nose T′, adapted in the forward movement of said arm to spread the pairs of toggles and by straightening them out cause the forward movement of the sliding bed B.

The construction and the relative movement of the parts being as above described, the complete operation of the machine in forming a truss is as follows: The operator first places the channel-bar *x*, which is to form the compression member of the truss, with its ends in engagement with the lugs *a b* on the rotary heads C, after which he turns down the hooks *c* into engagement with the upper flanges of said channel-beam in the manner before described. It will be noticed from Fig. 1 of the drawings that the beam in this position has its ends extending a short distance beyond the vertical faces *a′* of the lugs *a*, and it will also be noticed that the lugs *a* are provided with an inclined surface a^2, which in connection with the surface *a′* forms an angle in the axial line of the head C. The strut *y* is also placed in position with its base bearing against the channel-beam and its outer end extending in proximity to the adjacent ends of the forming-arms D. There is, however, sufficient space between the outer end of the strut *y* and said forming-arms to permit of the insertion of the tension member *z*, the latter being preferably a flat bar and of a width slightly less than the width of the web of the channel-beam. As will also be observed from an examination of Fig. 1, the hooked head F of the arm E is arranged in its initial position with its outer face in line with the vertical face *g* of the arm D, and the ends of the tension member *z* extend sufficiently beyond the arms D to overlap said hooked heads F. If motion be now imparted to the cross-head P, it will cause a forward movement of the push-bar N and the arms S and T. The latter will cause the spreading of the toggles and forward movement of the sliding head B, as before described, which will cause the lugs or abutments *e* to press against the flanges of the channel-beam *x* and carry the central portion of the latter rearward until it bears against the stationary abutments *f*. The effect of this movement is to camber the beam. Simultaneously with or successively to the movement of the sliding head B the arms S will come into engagement with the antifriction-rolls C^3 of the rock-arm C^2, which will cause a partial rotation of the heads C. This rotation is sufficient to bend the ends of the channel-beam *x* to the proper angle—that is, where they will be parallel with the tension member when the latter is formed and connected thereto. During the bending of the channel-beam the movement of the cross-head P will carry forward with it the push-rods N, which will bear upon the arms H and cause the swinging of the arms D in the manner before described. This swinging of the arms D will bend the tension member *z* around the end of the strut *y* and to the proper angle, so as to bring its outer ends against the inner face of the bent ends of the channel-beam. When this position has been reached, the lug M will trip the arm L, so as to disengage the arm H from the lug *f*, thus arresting the movement of the arms D, but continuing the movement of the arm E. The latter will cause the hooked arm F to bear against the projecting end of the tension member *z* and bend them across the ends of the channel-beam, as shown in Fig. 5. When this movement is completed, the arm H will be disengaged from the segmental bearing *o* and the arm G will be caused to swing around the pivots *j*. This arm G, it will be observed, constitutes in effect the bell-crank lever fulcrumed at *j*, and its short arm is connected at *q* to the link K, so that the forward movement of the push-bar N will cause the longitudinal sliding movement of the arm E. This will carry the head F inward, causing the projecting end thereof to bear against the bent portion of the bar *z*, turning it over the end of the channel-beam and pressing it into contact with the rear face thereof. In order to strengthen the end of the channel-beam, as well as to avoid forming too sharp a bend in the bar *z*, I preferably reinforce the ends of the beam by blocks or plates *w*, which are riveted or otherwise secured to the channel-beam and are preferably provided with rounded ends, as shown in Figs. 4, 5, and 6 of the drawings. Thus in the forward movement of the cross-head P the complete operation of bending both the compression and tension members of the truss is performed and the assemblage of these parts in connection with the strut. The return movement of the cross-head will cause the reverse movement of the parts; but to avoid bending back the ends of the channel-beam the heads C are not positively rotated in the reverse direction, but are provided with a spring C^4, which after the complete truss has been removed will return the arms C^2 and heads C to their initial positions. The toggles U and V may also be returned by a spring, such as Y.

Although I have described my machine as arranged for forming a truss of particular design, it is obvious that suitable adjustments may be provided by which the various angles of bends may be changed. Thus within certain limits a truss of any desired design may be formed.

My machine may also be readily adapted to form trusses in which the tension member is

straight and the compression member bowed, it being only necessary to secure a greater relative travel of the sliding bed B, so as to produce a corresponding greater bend in the compression member and to dispense with the angular movement of the arms D, which latter may be accomplished by suitably adjusting the position of the stop M. Again, the tension members may be bent on compression members already cambered by dispensing with movement of the sliding bed B, locking the arms D in a position forming a straight line and using only the forward and inward movement of the hooks F to form the return-bends.

In Fig. 10 I show a construction in which the swinging forming-arms D are dispensed with and in place thereof a sliding head X is used. This head has the angularly-arranged faces x' and x^2, adapted to bend the tension member of the truss, while the ends of said members are bent around the ends of the compression member, as in the other construction. I do not, however, consider this form of machine as desirable as the one previously described.

What I claim as my invention is—

1. A machine for forming return-bends in metallic bars comprising a bed, a hook-shaped forming-head, having a transverse and longitudinal movement upon said bed and means for holding the bar to be bent with a free end projecting across the transverse path of said forming-head and in alinement with said hook in the longitudinal movement of said head.

2. In a machine for bending metallic bars the combination with a bed of a swinging arm thereon, a hook-shaped forming-head carried by said arm, means for holding the bar to be bent in the path of said swinging arm to be bent thereby and means for moving said hooked forming-head transversely and longitudinally in relation to said arm to form a return-bend in said bar.

3. In a machine for bending and assembling metallic bars, the combination with a bed, of a rotary head journaled therein having upwardly-extending jaws, a swinging forming-arm upon said bed, a hook-shaped forming-head carried by said forming-arm, means for holding two separated bars, with the free end of one in engagement with the jaws of said rotary head and the other extending in the path of said swinging arm, means for rotating said head to bend the end of the bar in engagement therewith, means for swinging said arm to carry the other bar into contact with said bent portion and with its end projecting therebeyond and means for moving said hook-shaped forming-head first laterally against said projecting end and then longitudinally to form a return-bend around the end of said bent bar.

4. In a machine for bending metallic bars the combination with a bed of a forming member thereon, a traveling connection between said bed and member guided to move in one direction in relation to said bed and having a cross sliding engagement with the forming member, a push-bar bearing upon said forming member, adapted to move the same and said sliding connection upon said bed, means for disengaging said bar from said member and a lever fulcrumed to said connection and connected to said forming member and push-bar adapted upon the further movement of the latter to impart a cross movement to said forming member transversely.

5. In a machine for bending metallic bars the combination with the bed of a rotary head journaled therein having arranged upon one side of its axis separated upwardly-projecting jaws, means upon the bed and arranged upon the opposite side of the axis of said head, for holding the bar to be bent with a free end projecting into engagement with said jaws and means for rotating said head to bend the engaged portion of said bar.

6. In a machine for bending metallic bars the combination with a bed of two rotary heads journaled therein having upwardly-projecting separated jaws arranged upon opposite sides of the axes of said heads and forming grooves or channels normally in alinement with each other adapted to receive the bar to be bent and means for rotating said heads to form a double bend in said bar.

7. In a machine for bending metallic bars the combination with the bed, of two rotary heads journaled therein having upwardly-projecting separated jaws arranged upon opposite sides of the axes of said heads, and forming normally-alined grooves or channels for receiving the bar to be bent, an abutment in said bed for bearing against the side of said bar centrally between said heads, means for rotating said heads to form a double bend in said bar, and means for moving said central abutment laterally to camber said bar between the heads.

8. In a machine for bending metallic bars the rotary bending-head C having the jaws or abutments a and b arranged on one side of the axis the former being of a height greater than the width of the bar to be bent and the abutment b being of a lesser height and adapted to engage with the lower edge of the bar, and a hook c pivoted to the lug a adapted to be turned over to engage with the upper edge of said bar.

9. In a machine for bending metallic bars the combination with a bed of a swinging forming-arm thereon, a second arm carried by said forming-arm having an independent swinging and longitudinal sliding movement thereon, a hook-shaped forming-head at the free end of said carried arm and beyond the end of said forming-arm, a push-bar having bearings upon both of said arms adapted to swing the same together, means for disengaging said push-bar first from said main arm to permit of the independent swing of said carried arm and forming-head, and subsequently from said carried arm, and a connection between

said push-bar and carried arm adapted in the continued movement of the former to move said carried arm and hooked head longitudinally.

10. In a machine for bending metallic bars the combination with a bed, of the hollow swinging forming-arm D thereon, the hollow swinging arm E within the arm D and having the hook-shaped forming-head F projecting beyond the free end thereof, the pin *j* passing through cross-slots formed respectively longitudinally of the arm E and transversely of the arm D, the bell-crank lever G pivoted upon the pin *j* within the recess of the arm E, the link K connecting one arm of said bell-crank with the arm E, the arm H connected to the other end of said bell-crank and bearing upon the segmental bearings *o* on the arm E, the lug J on the arm D passing through a slot in the segmental bearing *o*, the trip-arm L and the push-rod B substantially as and for the purpose described.

11. In a machine for bending metallic bars the combination of a traveling forming member, a return-bend-forming device carried thereby and common actuating mechanism for operating said forming member and return-bend-forming device.

12. In a machine for bending metallic bars the combination of a swinging forming-arm, a return-bend-forming device carried by the free end of said arm and a common actuating connection for operating said forming-arm and return-bend-forming device.

13. In a machine for bending metallic bars the combination of a traveling forming member and a hook-shaped forming-head carried thereby adapted to have a relative transverse and longitudinal movement in relation to said forming member.

14. In a machine for bending metallic bars the combination of a traveling forming member, a hook-shaped forming-head carried thereby and a common actuating connection for successively operating said forming member and moving said hook-shaped head transversely and horizontally in relation thereto.

15. In a machine for forming metallic bars, the combination with a bed, of a work-holder thereon and a hook-shaped forming-head having a lateral and longitudinal movement upon said bed, the path of the former movement extending across the work and the latter longitudinally thereof.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM E. S. STRONG.

Witnesses:

JAMES WHITTEMORE,

M. B. O'DOGHERTY.