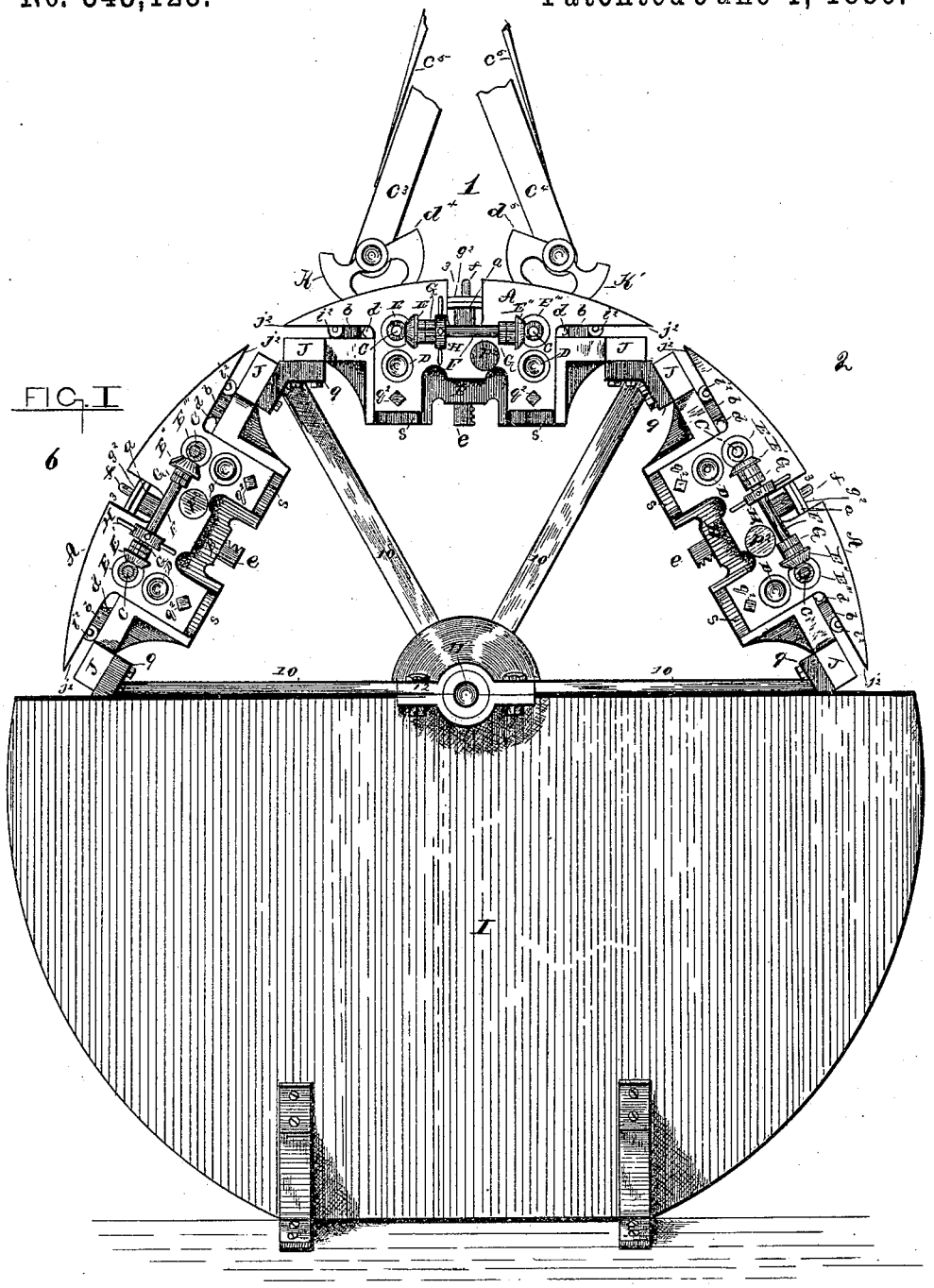
(No Model.) 3 Sheets—Sheet 1.

J. W. GRAY.

SPRING BENDING MACHINE.

No. 343,123. Patented June 1, 1886.

FIG. I



Witnesses.
William A. Foskit.
Timothy Callahan.

Inventor:
James W. Gray.
By Geo. D. Phillips.

(No Model.) 3 Sheets—Sheet 2.

J. W. GRAY.

SPRING BENDING MACHINE.

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FIG. II.

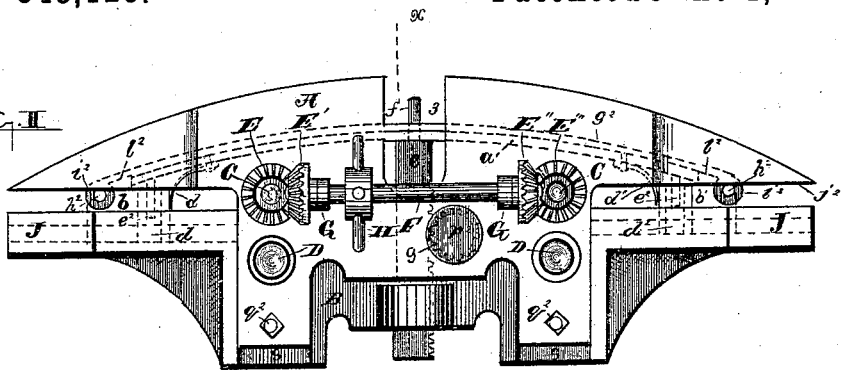


FIG. III.

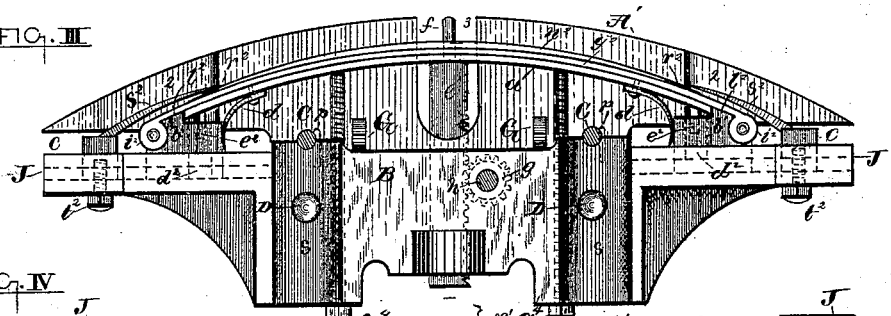


FIG. IV.

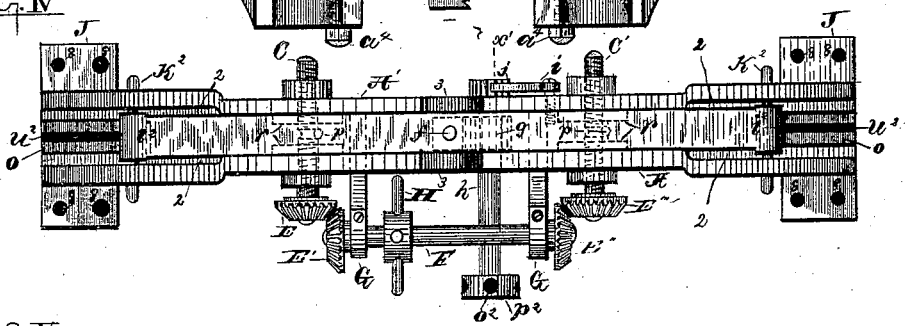


FIG. V.

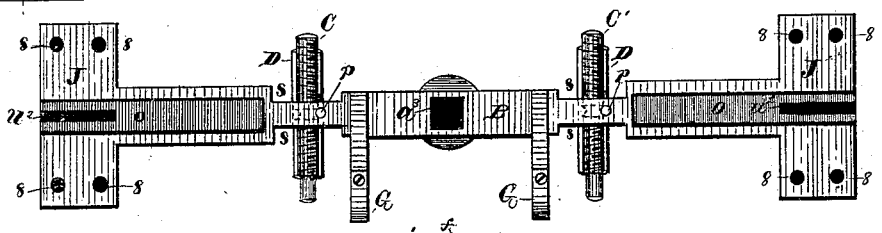


FIG. VI.

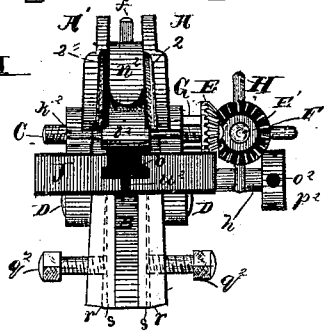
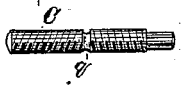


FIG. VII.



Witnesses.
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(No Model.) 3 Sheets—Sheet 3.

J. W. GRAY.

SPRING BENDING MACHINE.

No. 343,123. Patented June 1, 1886.

FIG. VIII

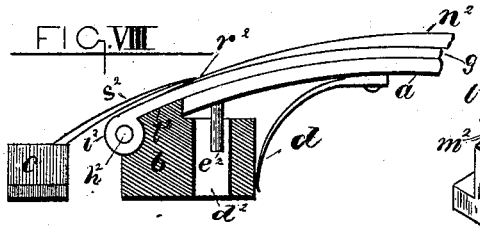

FIG. IX

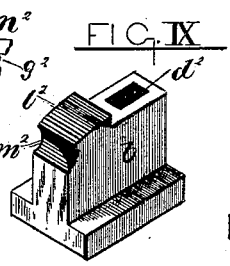

FIG. X

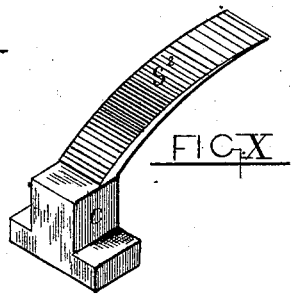

FIG. XI

FIG. XII

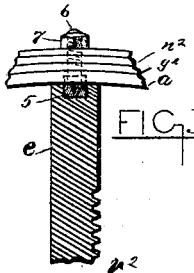

FIG. XIII

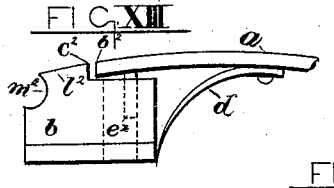

FIG. XIV

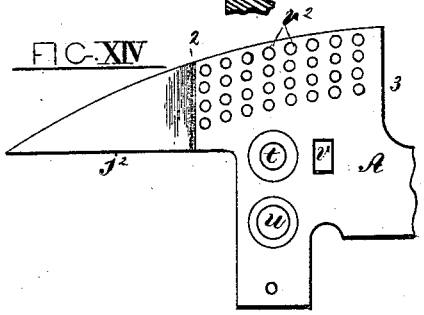

FIG. XV

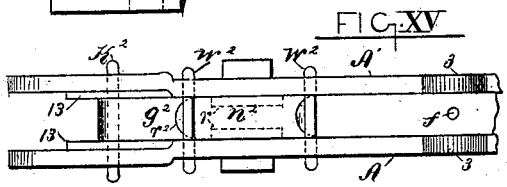

FIG. XVI

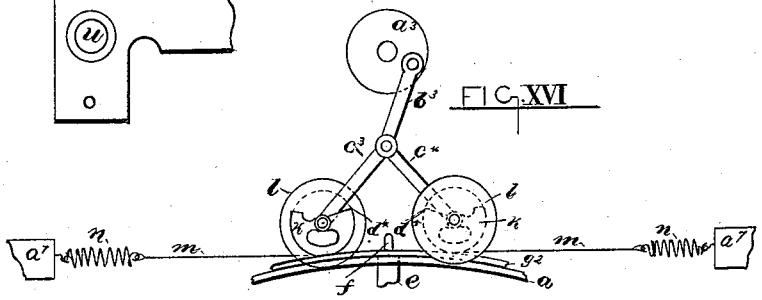

FIG. XVII

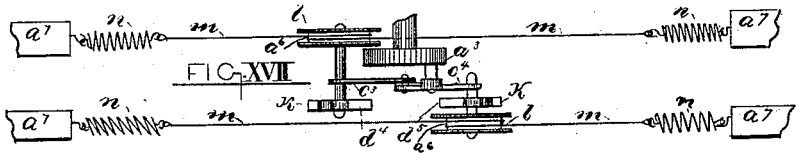

FIG. XVIII

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Timothy Callahan.

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By Geo. D. Phillips

UNITED STATES PATENT OFFICE.

JAMES W. GRAY, OF BRIDGEPORT, CONNECTICUT, ASSIGNOR OF ONE-THIRD TO CYRUS M. SHELTON, OF SAME PLACE.

SPRING-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 343,123, dated June 1, 1886.

Application filed July 16, 1885. Serial No. 171,747. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. GRAY, a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Spring Bending or Forming Machines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

The object of my invention is to provide a machine for forming the various leaves of vehicle-springs, giving them the required degree of curvature and tempering them while in this condition.

My invention consists of a forming-bar adapted by means of the proper mechanism to assume any degree of curvature required, upon which the first or primary leaf of the spring is bent, each leaf operating as a former for the next succeeding one, combined with movable side plates or clamping-jaws, said jaws having a lateral adjustment and adapted to be thrown out of their perpendicular, so as to grip each leaf of the spring as soon as it is formed, holding the same in position until cooled.

It further consists in facilitating and simplifying the process of forming and tempering the leaves of the spring and greatly reducing the cost of manufacture by the arrangement of a series of devices, each complete in itself, consisting of the forming-bar to give shape to the spring, clamping-jaws for the same, and means for operating them, each one of said devices constituting, as it were, the segment of a circle, each and all of said segments adapted to revolve about a common center, a cooling-bath connected therewith, and by the circular arrangement of the segments the spring is carried endwise into said bath.

My invention consists of other improvements, which, together with those above mentioned, are more fully described in the following specification, a better understanding of which may be obtained by referring to the accompanying drawings.

Figure I represents a view of a side elevation of the circular arrangement of the forming devices and bath-tub combined. Fig. II represents a side elevation of one of the segments of the circle, consisting of the forming-bar, clamping-jaws, and means for operating them. Fig. III represents a view of the same, with one of the clamping-jaws removed. Fig. IV represents a plan view of Fig. II. Fig. V represents a plan view of the center piece or frame. Fig. VI represents an end elevation of Fig. II. Fig. VII represents a detail view of one of the clamping-jaw screws. Figs. VIII, IX, X, XI, XII, and XIII represent detail views. Fig. XIV represents a side elevation and section of one of the clamping-jaws through dotted line *x* of Fig. II. Fig. XV represents a plan and section of both jaws through dotted line *x'* of Fig. IV. Fig. XVI represents a side elevation of the rolls and mechanism pertaining thereto. Fig. XVII represents a plan view of the same. Fig. XVIII is a modification of one of the rolls.

The construction and operation of my device are as follows:

A A' are the clamping-jaws; B, frame or center piece supporting the same; C C', right-and-left screws to operate clamping-jaws; D D', laterally-projecting studs for the jaws; E E' E'' E''', bevel-gears for operating right-and-left screws; F, shaft for gears; G G', bearings for said shaft; H, spindle-wheel; *a*, forming-bar; *b*, end supports for same; *d*, end springs; *e*, central supports; *f*, center pin for the springs; *g*, pinion to operate central support; *h*, spindle for pinion; *i*, retaining-pawl; *j*, ratchet; *k*, forming-rolls; *l*, time-rolls; *m*, controlling-wires; *n*, springs for same.

I will now proceed to describe the operation of forming the various leaves of the spring, and also the construction and manner of operating the mechanism to accomplish this result.

The center piece or frame, B, serves as a support for the clamping-jaws and mechanism for operating them, also for the forming-bar and the parts belonging thereto; *o*, longitudi-

nal slot in the frame to admit the end supports, the same moving freely therein. The right-and-left hand screws C pass transversely through frame B, revolving freely therein. They are held in position by the pins *p*, driven into the frame and engaging with groove *q* of the screw. (See Fig. VII.) The large studs D are situated transversely in frame B and are secured firmly thereon and support the clamping-jaws A A′. The brackets G, supporting shaft F, project transversely from frame B through slots *v* of the clamping-jaws. (See Fig. XIV.) The clamping-jaws A have the projecting lugs *r* (see Figs. IV and XV) on their inner face, which engage with recesses *s* of frame B, as seen at Fig. V. In clamping-jaw A, (see Fig. XIV) the holes *t* for screws C, and *u* for studs D, *v* for brackets G are all made sufficiently large to allow free play to the said jaw. On the end of right-and-left screws C and shaft F are the bevel-gears E. Corresponding right-and-left-threaded holes are provided in jaws A A′, for the screws C C.′ The hand-wheel H on shaft F operates the gears and gives the required lateral or tilting movement to the clamping-jaws. The forming-bar *a* is made sufficiently strong to withstand the necessary pressure, and yet flexible enough to assume any degree of curvature required. Said bar is supported and controlled at its center by support *e*, pin *f* of said support loosely fitting a hole in the center of forming bar and leaves of the spring. The ends b^2 of the bar *a* are supported in the end blocks, *b*. In Fig. XIII will be seen a side elevation of one of said blocks and section of bar *a* before the primary leaf of the spring is formed thereon. It will be observed that the end b^2 of the bar falls short of the shoulder c^2 of block *b*. This space is allowed for the contraction of the primary leaf. The elongated slot d^2 of block *b* (see Fig. IX) is intended for the downward-projecting pin e^2 of the bar, Fig. XII. Said pin, as shown, is brought to the extreme end of slot d^2, and held th re by spring *d*, also attached to bar *a*.

In the operation of bending the primary leaf g^2, Fig. II, it is placed on the bar *a*, and rolls *k* (see Fig. XVI) are brought in contact with said leaf, and by the action of said rolls (a full description as to the manner of operating said rolls will hereinafter appear) the hot leaf will be made to conform to the exact shape of bar *a*, and when in this position the hole h^2 of the head i^2 will be on a line with the under surface, j^2, of jaws A A′, and while said leaf is in this position the pins k^2 are passed through the eye, engaging with surface j^2, effectually preventing the head lifting from its position. The operator, by manipulating the wheel H, will cause the upper part of the jaws to tilt inward, as seen at Fig. VI, so as to clamp the leaf g^2 its entire length and effectually hold it in position until cooled. The upper portion, l^2, of block *b*, Fig. VIII, is the same height as the end of the bar *a*, and is in effect a continuation of the same. This gives a bearing to that portion of leaf g^2 projecting beyond the bar *a*. To accommodate different lengths of springs, longer or shorter forming-bars are used. Cooling leaf g^2 causes the same to contract, and this action, by means of head i^2 in contact with recess m^2 of block *b*, (see Fig. IX,) will draw blocks *b b* toward each other. The elongated slot d^2 and space between shoulder c^2 and end b^2 of bar *a* will assist to bring about this result. The spring *d* will serve to keep leaf g^2 firmly against the blocks *b*, and yet preserve a certain amount of elasticity in the several parts. As the next leaf, n^2, Fig. III, will require a different degree of curvature, support *e*, operating in square hole a^3, (see Fig. V,) is raised, as before stated, by pinion *g*, which is operated by inserting a pin or handle in holes o^2 of head p^2 of spindle *h*. Said leaf is made to conform to the shape of the primary leaf, g^2. The clamping-jaws are brought up as before, and said leaf cooled. The set-screws q^2, which are screwed into and project through jaws A, abut against frame B, and serve to give the required angle to said jaws, so that when the right-and-left screws C act on the jaws the set-screws will cause them to be closed at the top, as seen at Fig. VI. This feature which the jaws possess of being thrown out of their perpendicular, enables the hot leaf only to be clamped. A further support to the bar *a* may be added when long springs are required to be formed by using screws a^4, as seen at Fig. III, which project through frame B. Any number of these may be employed.

There is a possibility of the thin ends r^2 of leaf n^2 (see Fig. VIII) lifting after the forming-rolls have passed over it. To counteract this, block *c*, having spring s^2, may be used to hold them down until clamping-jaws A are brought to bear. Blocks *c* move freely in the same recess as blocks *b*, and when brought in position are firmly held there by screws t^2, Fig. III. Slot u^2 is provided for said screw. This spring would, no doubt, also serve to hold the end of primary leaf. Other means may be used to accomplish this result—such as perforations v^2 in the jaws A A′ (see Fig. XIV) and pins w^2, Fig. XV, to pass through said jaws and over the spring, and as there can be several of these holes and situated close together, no matter what curvature is given to the spring some of the holes will line with the leaf. Said holes will be sufficiently large so as not to interfere with the tilting of the jaws.

As each succeeding leaf is added, a different degree of curvature is needed, which is obtained, as before stated, by the rack and pinion. The advantage of the rack and pinion over a screw is that it can be moved rapidly and the required curvature more quickly obtained.

To accommodate springs having a projecting-head, (see Fig. IV,) the offset 2 is provided in each end of the jaws A A′; but with spring having no such lateral projection said offset may be filled up level with the inner face of the jaws by pieces 13, as seen at Fig. XV. Said

pieces are readily inserted and removed when required.

In place of the pin *f*, in support *e* to hold the spring, the square hole or socket 4, (see Fig. XI,) may be formed in the end of said support to receive the head 5 of bolt *b*. (See Fig. XII.) Said bolt is intended to secure the various leaves of the spring together. A corresponding square hole is provided in bar *a*. Part of bolt-head 5 will be in said bar and part in support *e*, and when the spring is completed and all the leaves in position the nut 7 secures them in place. The spring is removed from the jaws by means of slots 13, and all danger of the leaves being misplaced is avoided.

The T-shaped ends J (see Fig. V) of frame B, having holes 8, are bolted to lugs 9 of arms 10, Fig. I. Said arms are connected with shaft 11 in box 12 of the bath-tub I. There are six segments to the circle. Part only of the number are shown—three without and three supposed to be within the bath.

In operating the device a leaf is rolled, for instance, on segment 1, and set by means of clamping-jaws, as heretofore mentioned, and the circle revolved until said segment is in the position occupied by segment 6. This will bring segment 2 under the rolls, when the same operation of forming another leaf will be gone through with, as in segment 1. In the meantime the leaf previously rolled in segment 1 will have cooled just sufficient to enter the bath and receive the proper temper. The next turn of the circle will carry segment 1 into the bath, and so on indefinitely. The bath-tub is supposed to contain oil, which will give a more uniform temper to the spring than water, which is now extensively used. A spring chilled in water is more liable to break than one tempered in oil. One advantage of the bath-tub is the springs can remain in the bath until thoroughly cooled. As shown, there will be three in the bath at one time. The number of segments comprising the circle may be increased or reduced as desired. When a segment emerges from the bath, the jaws A are loosened, another leaf placed in position, and the same operation performed as before. This arrangement of the circle has the advantage of employing one or more workmen at the same set of formers—one putting on and taking off the springs, the other forming them. It also causes the springs to be carried into the bath endwise. To one conversant with the art of tempering this is very important, as the spring is less liable to warp or alter in shape when hardened in this way. In fact it is the only proper manner in which to harden long pieces to prevent springing.

In the matter of rolls, any form of rolls or manner of operating them may be employed. In Figs. XVI and XVII is represented a simple arrangement for timing the rolls, which will give good results. The rolls *k k* are operated by the crank-plate a^3, connected to said plate by arms b^3 c^3 c^4. This will give them the required motion; but it is important that each roll should be correctly timed one with the other, so that the retracting-springs c^5 (see Fig. I) shall bring the points d^4 and d^5 of the rolls up to the pin *f* at the same time to be in readiness to begin the outward movement together. The rectracting-springs c^5 (a section only of which is shown in Fig. I) are attached to some convenient point adjacent, but not shown. These springs, for want of space, are omitted from Figs. XVI and XVII. The correct timing of the rolls is accomplished by means of the time-rolls *l l* and wires *m*. (See Figs. XVI and XVII.) Said rolls are in reality flanged drums, the body a^6 being of the same diameter as rolls *k*. The wires *m*, for which chains may be substituted, are wound once around said drums and the ends attached to the adjacent points a^7. The springs *n* are placed intermediate between to give sufficient elasticity to the wires *m* when the rolls *k* are passing over the spring. The drums *l* rolling as it were on wires *m* and being connected to and operated by the same crank-plate, they will by the above arrangement revolve in the same time as rolls *k*. The wires *m* and springs *n* enable the drums *l* to describe the same circle as the rolls when passing over the spring, as before stated. The rolls *k*, instead of being solid, as seen at Figs. XVI and XVII, may be flanged, as shown at Fig. XVIII. This will enable them to pass over the beading which is formed on plates of some kinds of springs.

Other arrangements differing from those shown, equally simple and effective, may be used without departing from the spirit of my invention.

I hereby reserve the right to make subsequent applications for devices and combination of devices herein shown or described, but not claimed.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a machine for bending and forming springs, the combination, with a forming-bar and means to give to said bar the proper degree of curvature required, and means provided to form or shape the spring to said bar, of adjustable side plates or clamping-jaws, said jaws operated by suitable mechanism, and adapted thereby to move laterally or be tilted or thrown out of their perpendicular, so as to clamp and hold the spring rigidly after it has been formed, substantially as described.

2. In a machine for bending springs, the combination, with a forming-bar adapted to receive the proper degree of curvature by means of a rack-operating central support, and means provided to bend the spring to the shape of said forming-bar, of laterally-movable clamping-jaws and means for operating said jaws so that they may be tilted or thrown out of their perpendicular, so as to clamp and hold the spring rigidly after it has been formed, substantially as set forth.

3. In a spring-bending machine, the combination, substantially as described and set

forth with a forming-bar and mechanism for forming the spring on said bar, a perpendicular rack operating central support for said bar, laterally-adjustable tilting clamping-jaws for the spring, of adjustable end blocks, adapted to support the ends of said forming-bar and primary leaf of the spring and provide for the contraction of the same.

4. The combination, with a forming-bar, adapted to receive the proper degree of curvature by means of a rack operating central support, and means provided to bend or form the spring to said bar, longitudinally-adjustable end blocks to support the ends of said forming-bar and the primary leaf of the spring, adjustable tilting side plates or clamping-jaws, and means for operating them, of a frame to support said jaws, forming-bar, and end blocks, substantially as set forth.

5. The combination, with frame B, having laterally-projecting studs D D, rigidly secured thereto and adapted to support clamping-jaws A A′, of the right-and-left-hand screws to secure the lateral movement of said jaws, set-screws q^2 in said jaws to give the proper angle for the tilting of the same, gears E, to operate said right-and-left screws, all arranged substantially as described and set forth.

6. The combination, with clamping-jaws A A′ and forming-bar a, of pins k^2, for holding the primary leaf of the spring rigidly to said forming-bar, substantially as shown.

7. The clamping-jaws A A′, having offsets 2 in the ends of said jaws for springs, having laterally-projecting heads and pieces 13, to fill said recesses flush with the inner face of said jaws when required, substantially as set forth.

8. The central support, e, having socket 4, adapted to receive the bolt-head, in combination with forming-bar and springs, substantially as described.

9. The combination, substantially as shown, of the forming-bar a, having downward-projecting pin e^2, spring d, with the adjustable end blocks, b, having circular face l^2, to support the end of the primary leaf, elongated slot d^2, to receive pin e^2 of said forming-bar.

10. The combination, with frame B, having longitudinal slot o, of the spring-blocks c, having springs s^2, said blocks arranged to move in said slots, and means provided to secure them in the proper position, so that the springs in said blocks will be brought to bear on the ends of the springs after they have been formed, substantially as described.

11. The clamping-jaws A A′, having perforations v^2 transversely through said jaws, pins w^2, to engage with said perforations and hold down the leaves of the spring until the jaws are brought to bear, substantially as described.

12. The combination, substantially as shown and described, of a series of devices, each complete in itself, each one of said devices having a forming plate or bar, and means provided to give to said bar the proper degree of curvature required, and means adjacent to said devices for forming the various leaves of the spring to said forming-bar, clamping-jaws for holding the spring after it has been formed, and means for operating said jaws, each and all of said devices arranged so as to revolve about a common center.

13. The combination of a series of devices arranged to revolve about a common center, each complete in itself, each of said devices having a forming-bar, and means provided to give to said bar the proper degree of curvature required, and means adjacent to said devices for forming the various leaves of the spring to said forming-bar, clamping-jaws for holding the spring after it has been formed, and means for operating said jaws, of a cooling-bath connected therewith, and the springs so arranged about the revolving circle so as to be carried endwise into said bath, substantially as shown and set forth.

14. The combination of the forming-rolls k, time rolls or drums l, controlling-wires m, springs n, substantially as described, and for the purpose set forth.

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

JAMES W. GRAY.

Witnesses:

LOUIS K. GOULD,

CYRUS M. SHELTON.