(No Model.) 4 Sheets—Sheet 1.

J. N. RICE.

SPRING BENDING MACHINE.

No. 399,160. Patented Mar. 5, 1889.

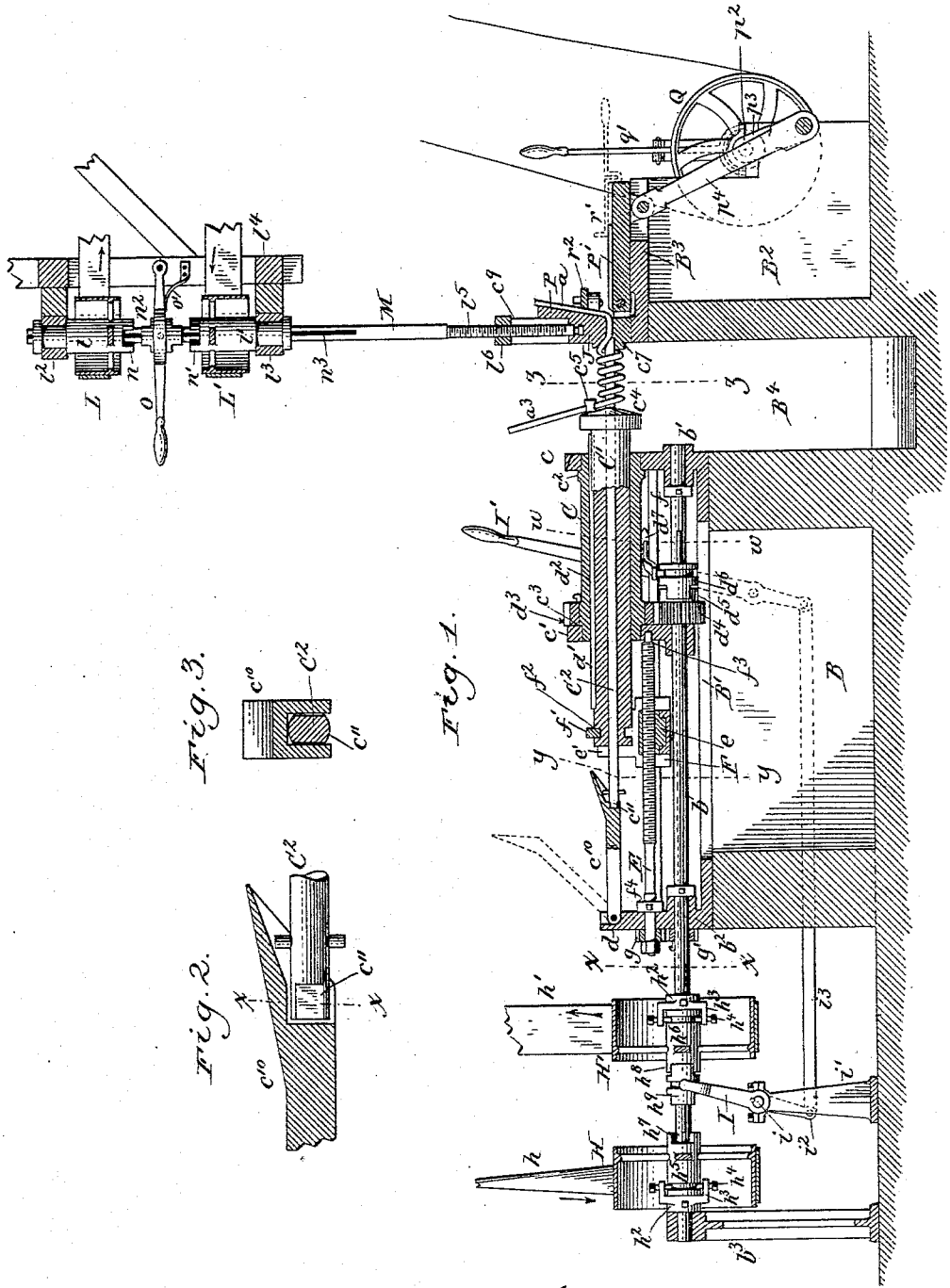


Fig. 1.

Fig. 3.

Fig. 2.

Witnesses.
Chas. J. Buchheit
Theo. L. Popp.

James N. Rice Inventor.
By Wilhelm Bonner.
Attorneys

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 2.

J. N. RICE.

SPRING BENDING MACHINE.

No. 399,160. Patented Mar. 5, 1889.

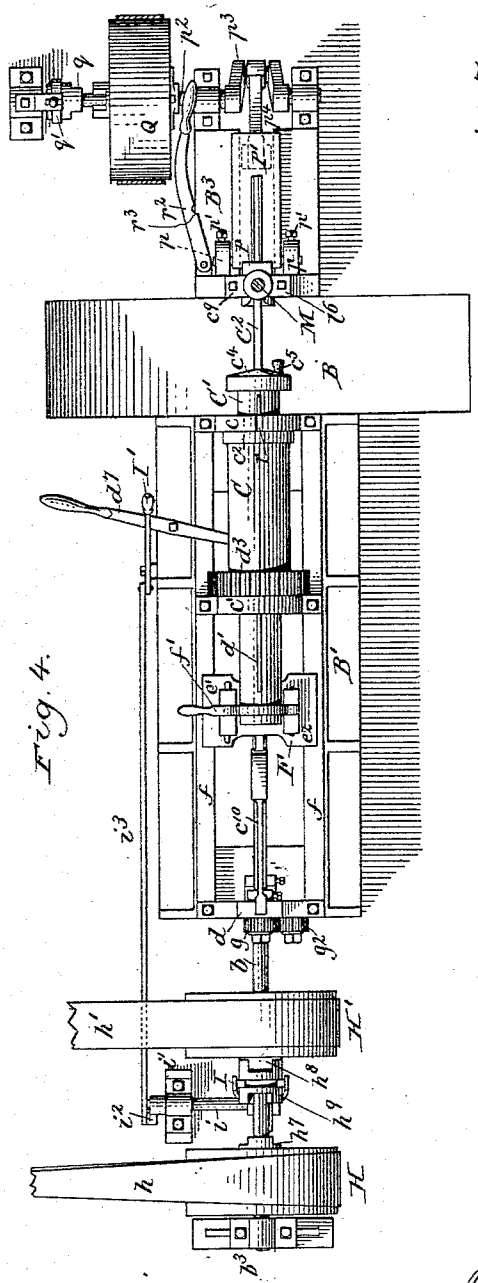


Fig. 4.

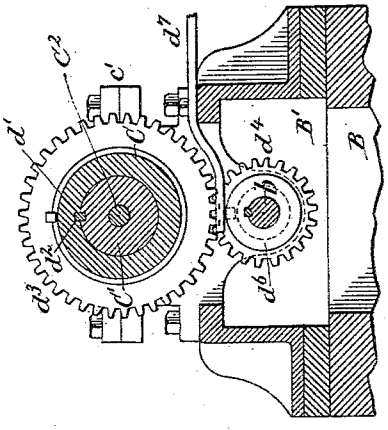


Fig. 7.

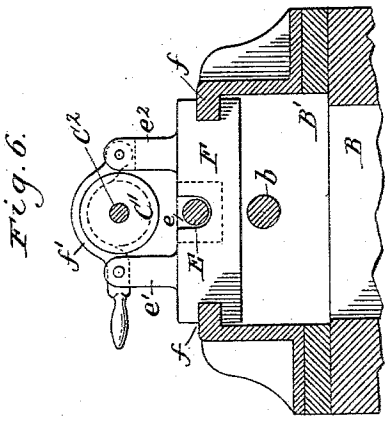


Fig. 6.

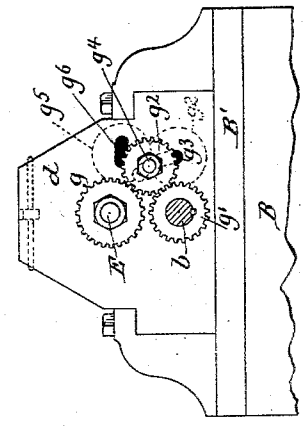


Fig. 5.

Witnesses:
Chas. J. Buckhout.
Theo. L. Popp.

James N. Rice Inventor.
By Wilhelm Bonner.
Attorneys.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 3.

J. N. RICE.

SPRING BENDING MACHINE.

No. 399,160. Patented Mar. 5, 1889.

Fig. 8.

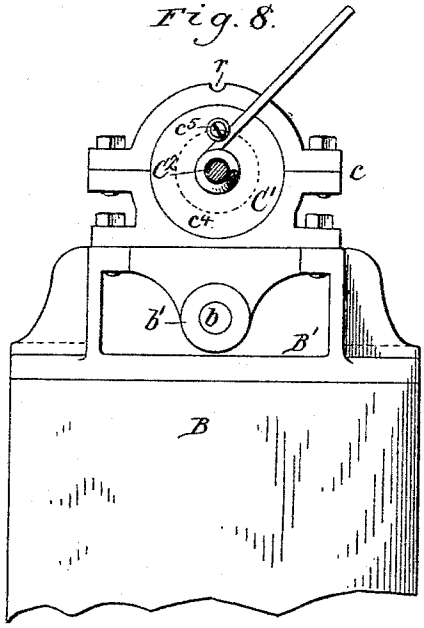


Fig. 9.

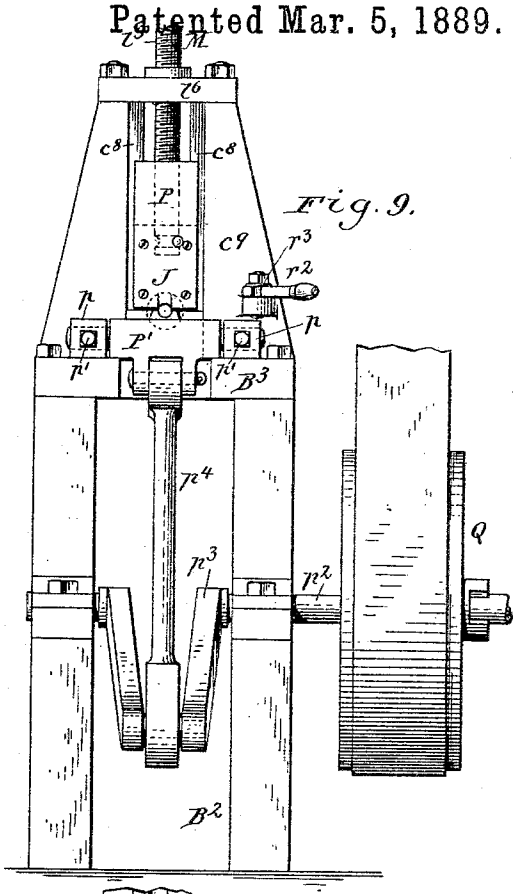


Fig. 10.

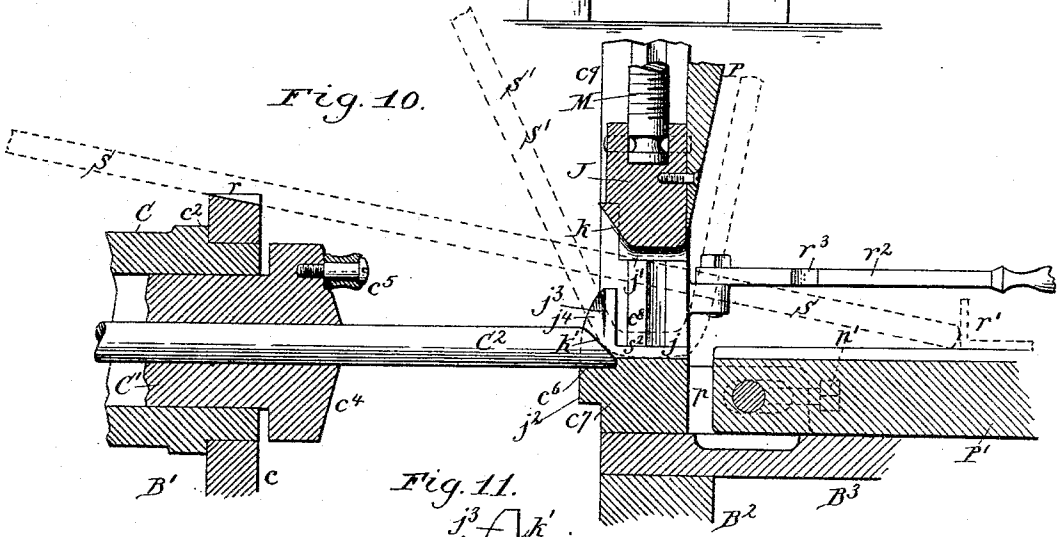
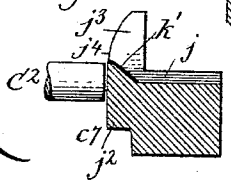


Fig. 11.



Witnesses:
Chas. J. Buckheit
Theo. L. Popp.

James N. Rice Inventor.
By Wilhelm Bonner.
Attorneys.

N. PETERS. Photo-Lithographer. Washington, D. C.

(No Model.) 4 Sheets—Sheet 4.

J. N. RICE.

SPRING BENDING MACHINE.

No. 399,160. Patented Mar. 5, 1889.

Fig. 12.

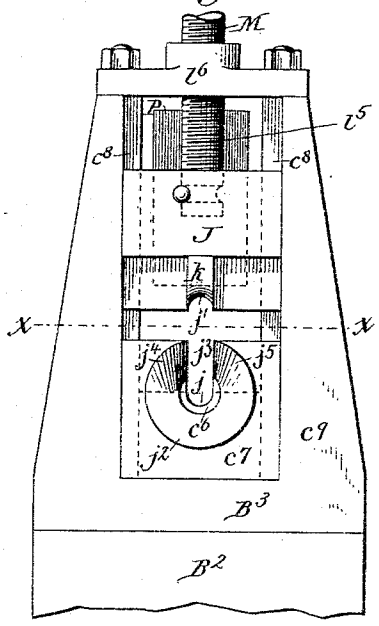


Fig. 14.

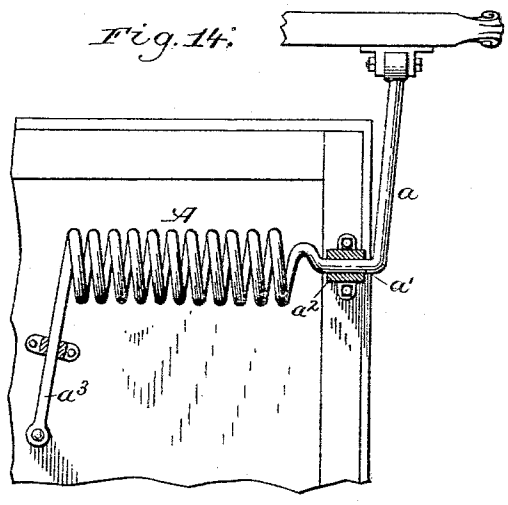
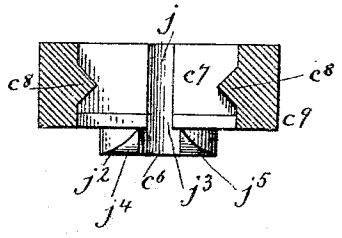


Fig. 13.



Witnesses:
Chas. J. Buckheit
Theo. L. Popp.s

James N. Rice Inventor.
By Wilhelm Bonner
Attorneys.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

JAMES N. RICE, OF PITTSTON, PENNSYLVANIA, ASSIGNOR TO WILLIAM T. HAYDOCK, OF ST. LOUIS, MISSOURI.

SPRING-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 399,160, dated March 5, 1889.

Application filed September 25, 1888. Serial No. 286,313. (No model.)

To all whom it may concern:

Be it known that I, JAMES N. RICE, of Pittston, in the county of Luzerne and State of Pennsylvania, have invented new and useful Improvements in Spring-Bending Machines, of which the following is a specification.

This invention relates to that class of bending-machines which are employed for bending rods to form spiral springs, especially such springs as are used for supporting vehicle-bodies.

The object of my invention is to construct a machine whereby springs of the desired form can be quickly bent without requiring reheating of the blanks, thereby saving considerable time and expense in the manufacture of the springs.

My invention consists to this end of the improvements which will be hereinafter more fully set forth, and pointed out in the claims.

In the accompanying drawings, consisting of four sheets, Figure 1 is a longitudinal sectional elevation of my improved bending-machine, showing the parts in the position which they occupy during the process of winding a spring. Fig. 2 is a fragmentary sectional elevation of the inner portion of the mandrel stop-bar on an enlarged scale. Fig. 3 is a cross-section of the same in line *x x*, Fig. 2. Fig. 4 is a top plan view of the machine. Figs. 5, 6, 7, and 8 are cross-sections in lines *x x*, *y y*, *w w*, and *z z*, Fig. 1, respectively. Fig. 9 is a rear elevation of the die and ram mechanism on an enlarged scale. Fig. 10 is a fragmentary sectional elevation of the winding-head, mandrel, and the die mechanism on an enlarged scale. Fig. 11 shows a modified construction of the lower stationary die. Fig. 12 is a front elevation of the dies and connecting parts. Fig. 13 is a horizontal section in line *x x*, Fig. 12. Fig. 14 is a bottom plan view of a finished spring of the class for the manufacture of which my improved bending-machine is more especially designed.

Like letters of reference refer to like parts in the several figures.

A, Fig. 14, represents the spiral or coiled body of one of the vehicle-springs for the manufacture of which my machine is more especially designed.

a is the bolster-arm of the spring; *a'*, the neck or bearing portion, which is arranged centrally opposite one end of the body portion A of the spring, and which is mounted in a bearing, a^2, secured to the body of the vehicle, and a^3 represents the supporting-arm, formed at the opposite end of the spiral body A, and which projects preferably in a direction opposite to that of the bolster-arm *a*.

B represents the bed of the machine, upon which the frame B' of the winding mechanism is supported, and B^2 the bed which supports the frame B^3 of the die and bending mechanism. The beds B and B^2 are arranged in line longitudinally and are set apart to form a space, B^4, between the adjacent ends of the same.

b represents the horizontal driving-shaft of the winding mechanism, which is arranged longitudinally in the lower portion of the frame B' and journaled in bearings *b' b²*, formed in said frame, and in a standard, b^3, arranged at the outer end of the shaft *b*.

C represents a cylindrical drum arranged longitudinally in the upper part of the frame B' and journaled in standards *c c'*, forming part of the frame B'. This drum is held against longitudinal movement by shoulders c^2 c^3.

C' represents a longitudinally-movable winding-cylinder arranged in the bore of the drum C and projecting through both ends of the latter.

c^4 represents a winding-head formed on the outer end of the winding-cylinder C' opposite the die mechanism, and which is provided with a longitudinally-projecting stud or roller, c^5. The latter engages against one side of the rod or bar to be bent and winds the inner end of the same around a longitudinally-movable mandrel, C^2. The face of the winding-cylinder head is preferably made conical to correspond with the pitch of the spiral to be formed. The stud or roller c^5 is provided with a concave face, whereby the spring-bar is prevented from becoming disengaged from the roller or stud. This mandrel is arranged in an opening or bore formed centrally in the winding-cylinder C' and projects through both ends of the latter, and is supported at its

outer end in a recess or depression, c^6, formed in the lower die, c^7, of the die mechanism. The die c^7 is held in place in upright ways c^8, which are formed in a standard, c^9, of the frame B³. The mandrel C² is held from turning and against backward longitudinal movement by a locking-arm, c^{10}, which is pivoted to the upper end of a standard, d, of the frame B′. The locking-arm c^{10} is provided at its inner end with a head having in its under side a rectangular depression or socket which engages over the flat-sided end portion, c^{11}, of the mandrel C², whereby the latter is securely locked against turning, as clearly shown in Figs. 2 and 3. This construction permits the mandrel C² to be readily moved backward and withdrawn from the finished spring, so that the latter can be removed by simply raising the locking-arm c^{10} to the position shown in dotted lines in Fig. 1.

d' represents a feather or rib arranged lengthwise in the winding-cylinder C′, and engaging in a corresponding groove, d^2, formed in the drum C, whereby the winding-cylinder is caused to rotate with the drum C.

d^3 represents a gear rim or wheel secured to the inner end of the drum C and meshing with a gear-pinion, d^4, mounted loosely on the driving-shaft b. The pinion d^4 is provided on one side with a clutch-face, d^5, with which engages a clutch disk or head, d^6. The latter is capable of movement on the shaft b toward and from the pinion d^4, and is caused to turn with the shaft b by a feather which engages in a groove in the clutch-head.

d^7 represents a laterally-projecting hand-lever pivoted to one of the side pieces of the frame B′ and engaging in an annular groove formed in the clutch-head, whereby the latter is thrown into and out of engagement with the pinion d^4.

E represents a feed-screw arranged longitudinally above the driving-shaft b and journaled at one end in a bearing formed in the standard d and at its opposite end in the standard c' of the frame B′.

The feed-screw E engages in a screw-nut, e, which is attached to a cross-head, F. The latter is guided on longitudinal ways f, formed along the upper edges of the side pieces of the frame B′, as represented in Fig. 6. The cross-head F is connected with the winding-cylinder C′ by a yoke, f', which engages in an annular groove, f^2, formed in the cylinder near its inner end, whereby the winding-cylinder is moved forwardly and backwardly. The yoke f' is attached to two standards, e' e^2, projecting upwardly from the cross-head F on opposite sides of the winding-cylinder. The feed-screw E is provided with a shoulder, f^3, and a collar, f^4, whereby the same is held against longitudinal movement.

g represents a gear-wheel secured to the outer end of the feed-screw E, and g' represents a similar wheel secured to the driving-shaft b. Motion is transmitted from the wheel g' to the wheel g by an idler, g^2, which latter is secured in a concentric slot, g^3, by an arbor, g^4, as clearly shown in Fig. 5. This arrangement of gears is employed when it is desired to make right-hand springs; but when it is desired to make left-hand springs an additional idler, g^5, (shown in dotted lines in Fig. 5,) is interposed between the wheel g and the idler g^2. When this is done, the arbor g^4 of the idler g^2 is moved downwardly in the slot g^3. The arbor of the idler g^5 is secured in a slot, g^6, formed in the standard d opposite the gear-wheel g.

H H′ represent two driving-pulleys mounted loosely on the driving-shaft b, side by side, and rotated in opposite directions by a crossed belt, h, and an open belt, h', respectively. The pulley H turns in the direction of the arrow in Fig. 1, while the pulley H′ turns in the opposite direction. The pulleys H H′ are held against longitudinal movement on the shaft b by collars h^2, which are provided with fingers h^3 and pins h^4. The latter project inwardly and engage in annular grooves formed in the hubs h^5 h^6 of the wheels H H′. The hubs h^5 h^6 are provided on their adjacent sides with clutch-faces h^7 h^8, respectively.

h^9 represents a movable clutch-head which is arranged on the shaft b between the hubs h^5 h^6, and which is adapted to engage with either of the clutch-faces h^7 h^8. The clutch-head h^9 is caused to revolve with the shaft b by a feather, which engages in a groove in the clutch-head in a well-known manner. The space between the hubs h^5 h^6 is sufficient to allow the clutch-head h^9 to free itself from both hubs when it is desired to stop the machine. The shaft b is rotated in one direction when the clutch-head h^9 is in engagement with the wheel H and in the opposite direction when in engagement with the wheel H′.

I represents an upwardly-projecting shifting-arm secured to one end of a transverse rock-shaft, i, journaled in standards i', and which engages with its upper bifurcated end with the clutch h^9.

i^2 represents a downwardly-projecting arm secured to the opposite end of the rock-shaft i, and connected by a horizontal rod, i^3, with the lower end of a hand-lever, I′, which latter is pivoted to one side of the bed B of the winding mechanism.

J represents a vertically-movable die arranged above the stationary die c^7, and which is guided in its vertical movements in the ways c^8 of the standard c^9. The dies c^7 and J are provided on their opposing faces with horizontal semicircular depressions j j', respectively, between which the rod to be bent is securely held against lateral movement when the upper die is forced upon the rod placed in the lower stationary die, and whereby the neck portion of the spring is formed.

j^2 represents a projecting flange formed on the front or inner side of the stationary die c^7. This flange is provided in its upper portion with a vertical opening or slot, j^3, which extends down into the depression of the die.

The flange is provided on both sides of said opening with inclined deflecting-faces j^4 j^5, which cause the bar which is being bent to be deflected outwardly over one of these inclined faces, according to the direction in which the winding-cylinder is turned, when the roller c^5 of the winding-cylinder C′ engages against either one side or the other of the bar.

k represents an inclined nose formed centrally on the upper die, J, and which engages in the slot j^3 of the lower die, c^7, and confines the neck portion a' of the bar in the slot j^3 between itself and an inclined face, k', formed on the end of the mandrel C^2.

If desired, the inclined face k', instead of being formed on the mandrel C^2, may be formed on the lower die, as shown in Fig. 11; but I prefer to form the incline on the mandrel and support the latter on the lower die, as shown in Fig. 10, in order to support the end of the mandrel and prevent the same from being bent or twisted.

The upper vertically-movable die, J, is actuated by the following mechanism:

L L′ represent two horizontal driving-pulleys arranged one above the other, and having their hubs l l' journaled in bearings l^2 l^3, secured to an overhead hanger or frame, l^4. These hubs are provided with shoulders, which prevent vertical movement of the pulleys.

M represents a vertically-movable actuating-shaft, which is journaled loosely with its upper portion in the bores of the pulleys L L′, and which engages with its lower screw-threaded portion, l^5, in a threaded opening formed in a cross-piece, l^6, of the standard c^9. The lower end of the shaft M is connected to the upper die, J, by a pin, which engages in an annular groove formed in the feed-shaft, or other suitable means.

n n' represent clutch-faces formed on the adjacent sides of the hubs l l' of the pulleys L L′, respectively, and n^2 represents a clutch-head, which is mounted on the shaft M between the hubs l l', and which is adapted to engage with either of the clutch-faces n n'. The clutch-head n^2 is provided with a feather, which engages in a longitudinal slot, n^3, formed in the shaft M. The shaft M is caused to rotate in a direction so as to move the die J downwardly when the clutch-head n^2 is engaged with the hub of the upper pulley, L, and to rotate in the opposite direction, so as to raise the die J, when the clutch-head n^2 is in engagement with the lower pulley, L′. The space between the adjacent faces of the hubs l l' is sufficient to allow the clutch-head n^2 to stand between the clutch-faces n n' when it is desired to stop the rotation of the shaft M.

o represents a clutch-lever pivoted to the hanger l^4, and whereby the clutch-head is moved in either direction. The clutch-head n^2 is held in a normal position between the hubs l l' by a spring, o', or by any other suitable means.

P represents an upwardly-projecting inclined former-plate secured to the rear side of the upper die, J, and against which the bolster-arms a of the spring are bent by an oscillatory ram, P′. The latter is arranged in rear of the lower die, c^7, and is pivoted in elongated openings in lugs p, formed on the die-frame B^3. The pivots of the ram P′ can be adjusted to rods of different thicknesses by adjusting-screws p', as shown in Figs. 9 and 10.

p^2 represents a transverse crank-shaft arranged below the ram P′, and p^3 represents the crank of this shaft, which is connected by a rod, p^4, with the outer free end of the ram, and whereby the latter is swung upwardly, so as to bend the bolster-arm portion of the rod resting on the ram upwardly against the former-plate P.

Q represents a driving-pulley mounted loosely on the crank-shaft p^2, and having its hub provided with a clutch-face, with which engages a transversely-movable clutch-head, q. The latter is thrown into and out of engagement with the clutch-face of the wheel Q by a hand-lever, q'.

r represents a concave recess or depression formed centrally in the upper portion of the standard c, and in which the inner end of the rod to be bent is supported and centered in the machine.

r' represents a hand-gage, which is placed against the outer end of the ram P′, and against which the end of the bar to be bent is gaged, as shown in dotted lines in Figs. 1 and 10.

r^2 represents a hand locking-lever, which is pivoted to one side of the rear portion of the die-standard c^9, and which is provided in one side with a notch or recess, r^3. The latter engages over the lower portion of the bolster-arm a of the bar after the latter has been bent upwardly to the position shown in Fig. 1, whereby the rod is held from turning in the dies while the inner portion is being wound around the mandrel C^2.

The operation of my improved bending-machine is as follows: The winding-cylinder C′ is first moved backwardly in the drum C in order to allow the spring-bar to be inserted. For this purpose the clutch d^5 is disengaged from the pinion d^4 and the clutch h^9 thrown into engagement with the clutch-face of the driving-pulley H′, whereby the winding-cylinder is moved backwardly by the feed-screw E without being rotated, care being taken when the winding-cylinder is moved backwardly that the winding-roller c^5 is located on one side of the longitudinal center line, as shown in Fig. 4. The upper die, J, is next raised by engaging the clutch n^2 with the driving-pulley L′, so as to leave sufficient space to introduce the heated spring-bar in an inclined position between the dies J and c^7, as shown in dotted lines at S in Fig. 10. The clutch n^2 is then thrown into engagement with the upper pulley, L, so as to cause the shaft M to rotate in the proper direction to

move the die J downwardly. At the same time the clutch h^9 is thrown into engagement with the pulley H, so as to cause the feed-screw E to move the winding-cylinder toward the dies. This movement of the winding-cylinder causes its head c^4 to engage against the lower side of the bar and bend the same upwardly, as shown at S′ in dotted lines in Fig. 10, while the downward movement of the upper die, J, bends the bar beneath the same, so as to form the bearing portion a' of the spring, as shown in dotted lines at s^3 in Fig. 10. After the winding-cylinder has been moved sufficiently close to the dies to cause the roller c^5 of the winding-head to engage against the bar when the winding-cylinder is rotated and the upper die has tightly clamped the bar, the clutch n^2 is disengaged from the pulley L, so as to arrest the movement of the screw-shaft M. The clutch h^9 is now again thrown into engagement with the pulley H′, so as to cause the feed-screw E to draw the winding-cylinder away from the dies J c^7. At the same time that the clutch h^9 is engaged the clutch d^6 is also thrown into engagement with the pinion d^4, so as to cause the winding-cylinder to rotate and wind the bar around the mandrel C^2 while it is receding from the dies J c^7. Before the operation of winding begins the end of the bar forming the bolster-arm is bent in the following manner: The clutch q of the crank-shaft p^3 is thrown into engagement with the pulley Q, whereby the ram P′ is oscillated on its pivots by the crank p^5 and connecting-rod p^4. The upward movement of the ram bends that portion of the bar which rests on the ram upwardly against the former-plate P, and thereby forms the bolster-arm a of the spring. The ram P′ is allowed to deliver several blows against the spring-bar to insure perfect work before the clutch q is disengaged from the pulley Q. When the bolster-arm a has been formed, the clutch q is disengaged and the ram P′ is returned to its normal horizontal position by the weight of the ram P′, connecting-rod p^4, and crank p^3. The spring-bar is now locked in position by the lever r^3, the notch of which engages over the upturned bolster-arm of the spring-bar and prevents the latter from changing its position during the operation of winding. The operation of winding the spring is now begun, and is continued until the required length of spring has been wound and the body-supporting arm a^3 has been formed by allowing the unwound portion of the rod to stand in a direction opposite to that of the bolster-arm a. When this has been accomplished, the movements of the winding-cylinder are arrested by moving the clutch h^9 out of engagement with the wheel H′. The length of the spring and the proper time to stop the movement of the winding-cylinder are determined by a suitable gage or mark on the guides of the frame B′. The finished spring is then removed by raising the locking-arm c^{10}, withdrawing the mandrel C^2 from the spring, and raising the upper die, J. After the spring has been removed, the mandrel C^2 is again moved forwardly and locked in place at one end in the lower die, c^7, and at the other end by the locking-arm c^{10}.

I claim as my invention—

1. The combination, with the clamping-dies, whereby one end of the spring-bar is held, of a winding-cylinder, a removable mandrel arranged within the winding-cylinder, a rotating drum surrounding the winding-cylinder and connected therewith by a groove and feather to rotate the same, and feed mechanism whereby the winding-cylinder is moved longitudinally in the drum, substantially as set forth.

2. The combination, with the clamping-dies, whereby a portion of the spring-bar is held, of the winding mechanism whereby the spring-bar is coiled, and a ram whereby the end of the spring-bar is bent, substantially as set forth.

3. The combination, with the clamping-dies, of the winding-cylinder, a mandrel arranged in the bore of the winding-cylinder, and a locking-arm whereby the mandrel is held against longitudinal movement, substantially as set forth.

4. The combination, with the clamping-dies, the winding-cylinder, and the mandrel provided with a flat-sided end, of a locking-lever provided with a flat-sided recess engaging with the flat-sided end of the mandrel, whereby the mandrel is held against rotary movement, substantially as set forth.

5. The combination, with the hollow drum provided with driving-gear whereby it is rotated, of a winding-cylinder arranged in said drum and connected therewith by a groove and feather, a cross-head provided with a screw-nut and connected with said winding-cylinder, and a feed-screw engaging with said screw-nut, substantially as set forth.

6. The combination, with the hollow drum provided with a gear-rim, of a winding-cylinder arranged in said drum and connected therewith by a groove and feather, a feed-screw connecting said winding-cylinder, a driving-shaft provided with mechanism whereby it can be rotated in either direction, gears connecting said driving-shaft with the feed-screw, and a gear-pinion and clutch whereby the drum can be rotated from said driving-shaft, substantially as set forth.

7. The combination, with the lower die provided in its face with a recess, of a mandrel having an inclined end seated in said recess and a winding-cylinder surrounding said mandrel, substantially as set forth.

8. The combination, with the clamping-dies, of a winding-cylinder and a feed-screw whereby the cylinder is moved toward the clamping-dies, thereby bending the body of the bar preparatory to winding the same, substantially as set forth.

9. The combination, with the winding mechanism, of an upper movable die and a lower stationary die provided in its upper face with a

depression, and having on its front side a slotted flange opening upwardly and projecting upwardly beyond the face of the die, and having inclined deflecting-faces to form in connection with the winding mechanism the initial bend of the spiral, substantially as set forth.

10. The combination, with the winding mechanism, of a lower stationary die, an upper movable die provided on its rear side with a former-plate, a pivoted ram, and mechanism whereby an oscillating motion is imparted to the ram, substantially as set forth.

11. The combination, with the winding mechanism, the clamping-dies, and the ram whereby the end of the spring-bar is bent, of a locking-lever which is engaged with the spring-bar and whereby the latter is held in position during the operation of winding, substantially as set forth.

Witness my hand this 15th day of September, 1888.

JAMES N. RICE.

Witnesses:
S. P. FENN,
H. C. DEWEY.