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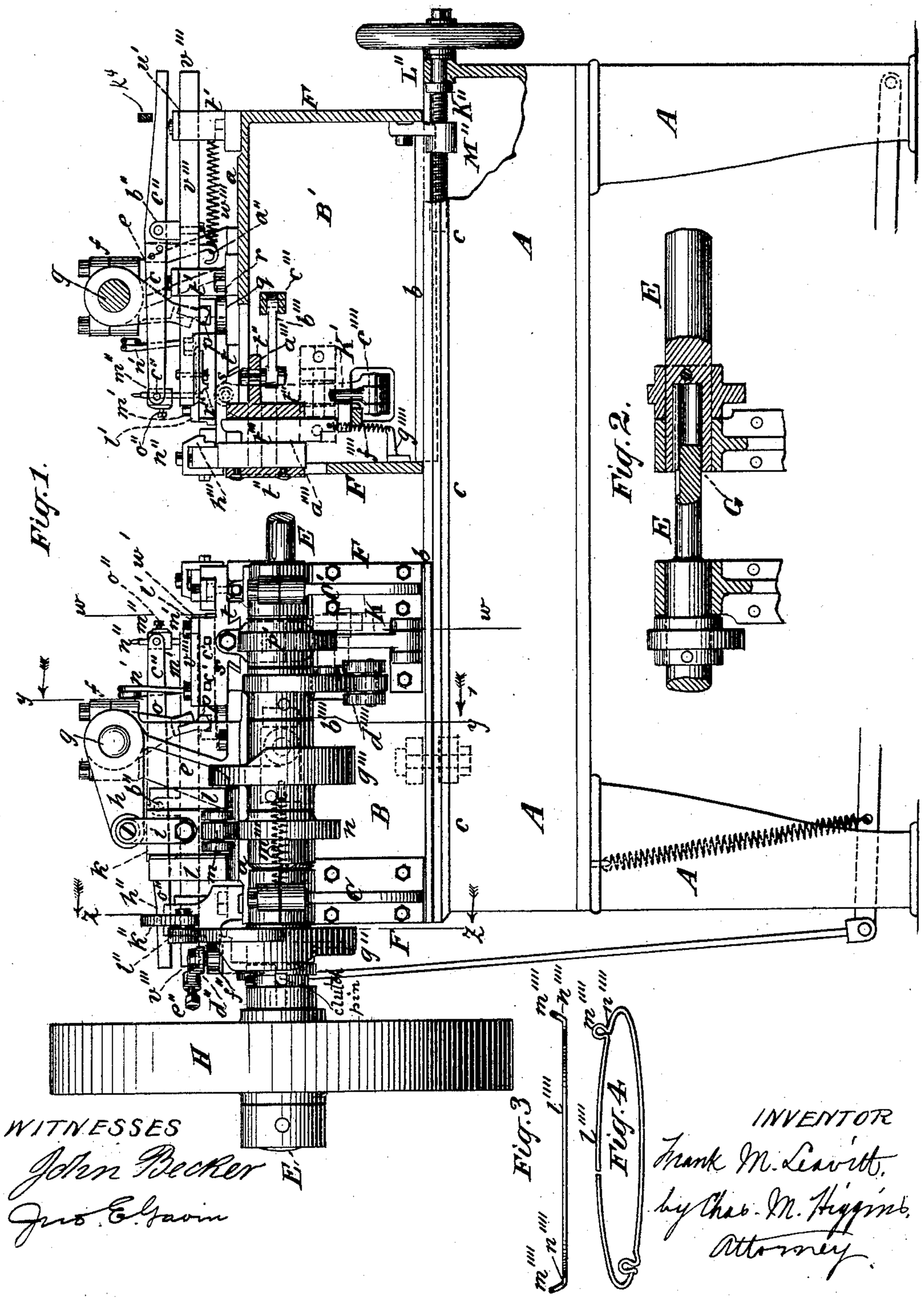
F. M. LEAVITT.

AUTOMATIC EAR BENDING MACHINE.

No. 353,261. Patented Nov. 23, 1886.



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F. M. LEAVITT.

AUTOMATIC EAR BENDING MACHINE.

No. 353,261. Patented Nov. 23, 1886.

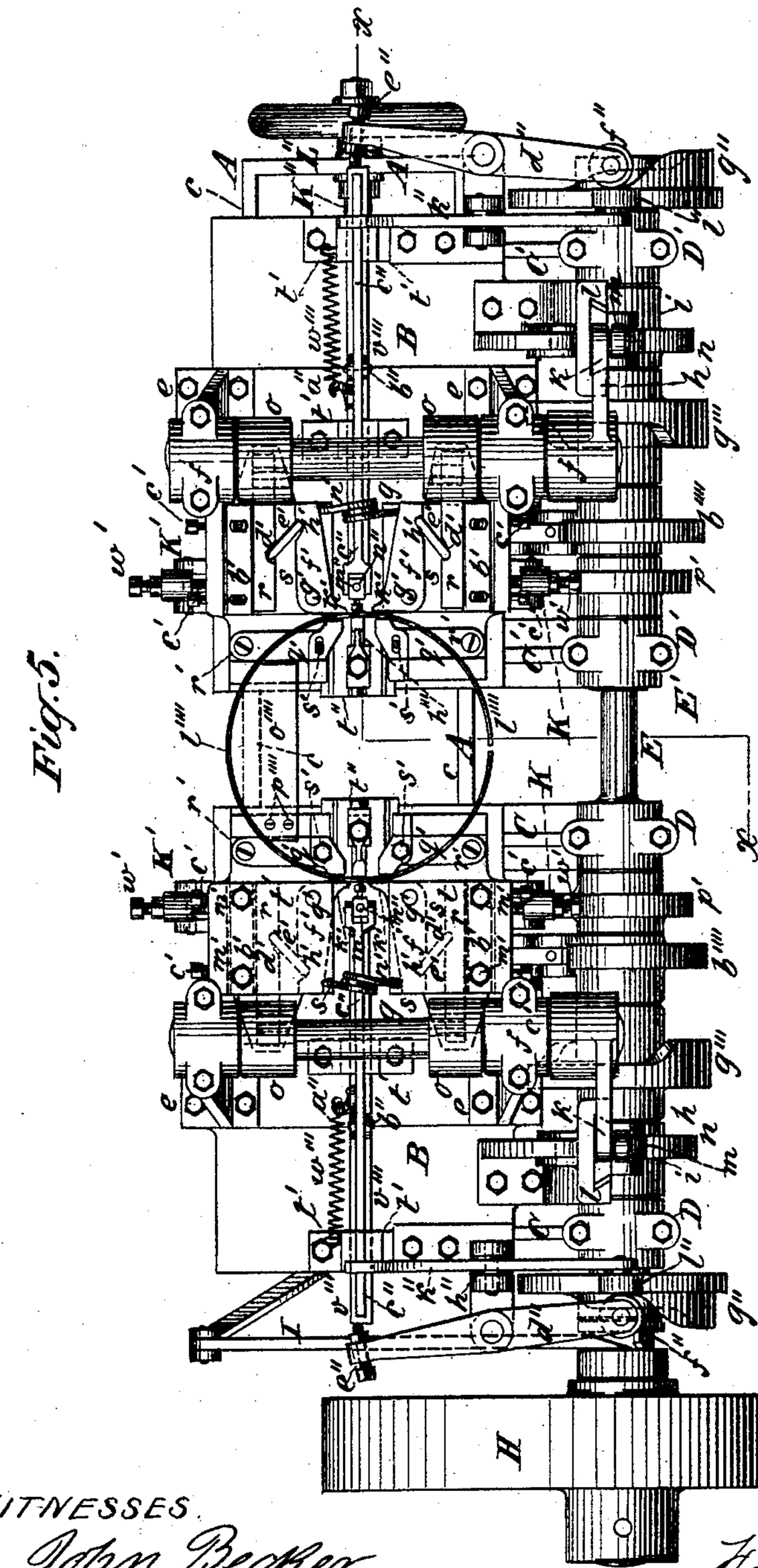

Fig. 5.

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AUTOMATIC EAR BENDING MACHINE.

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Fig. 8.

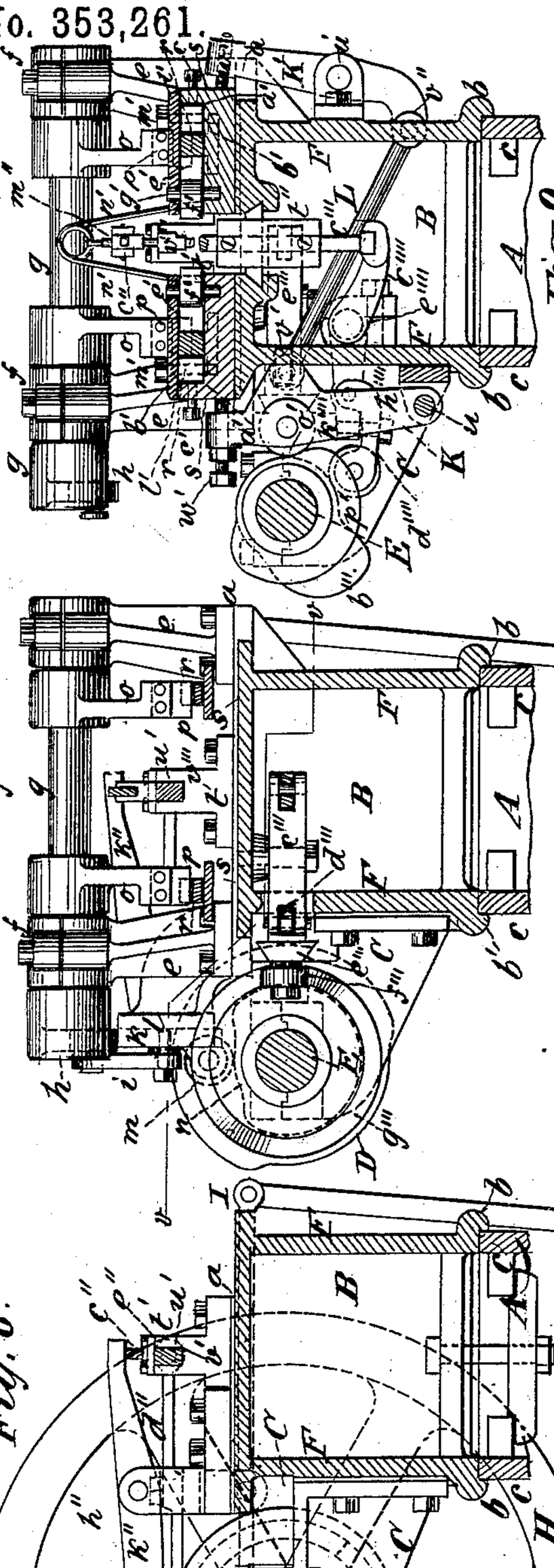

Fig. 9.

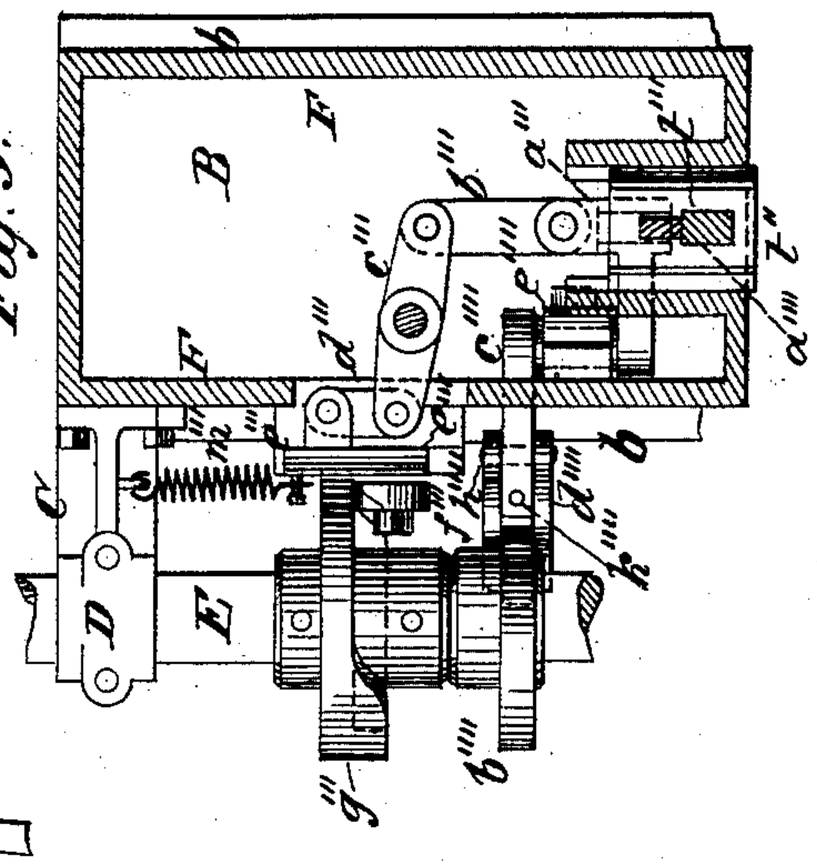

Fig. 7.

Fig. 6.

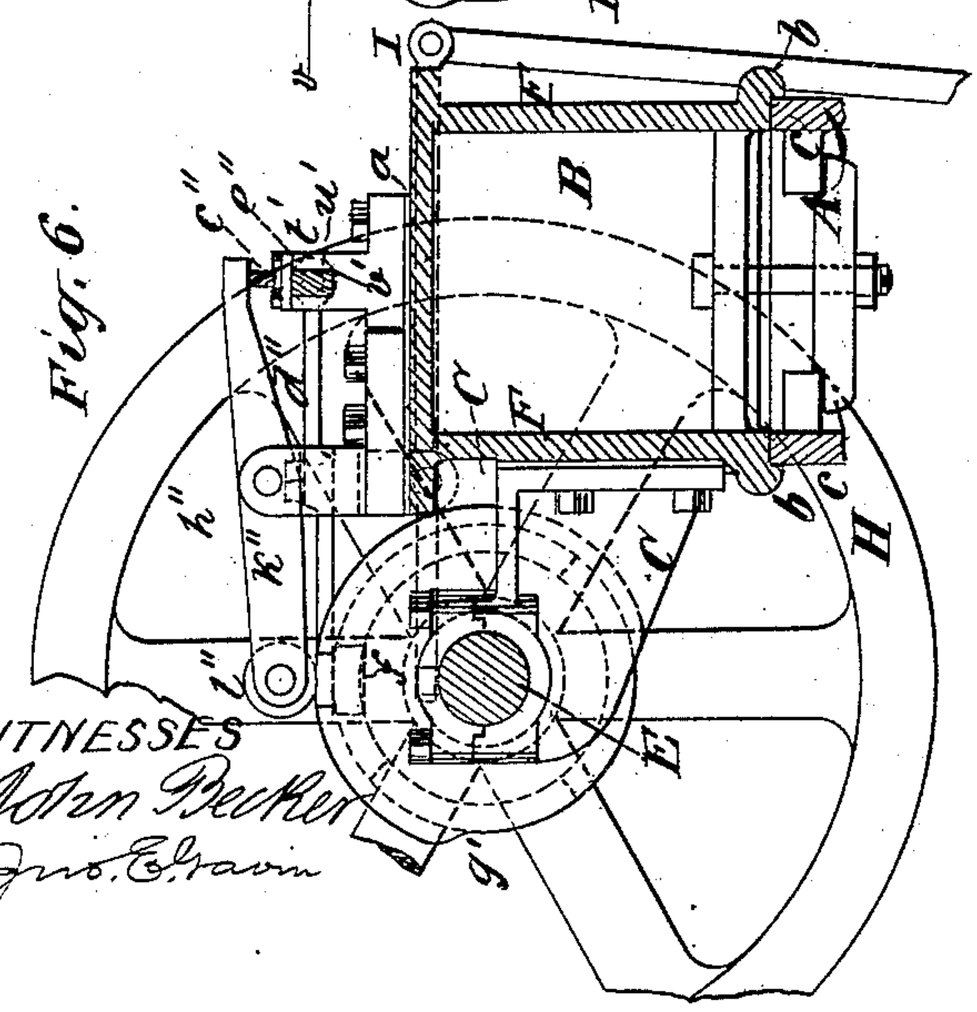

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Fig. 17.

Fig. 14.

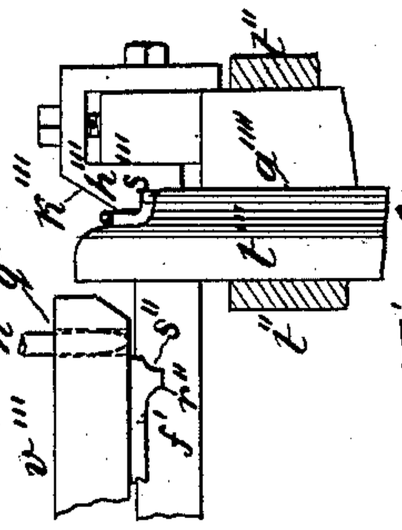


Fig. 16.

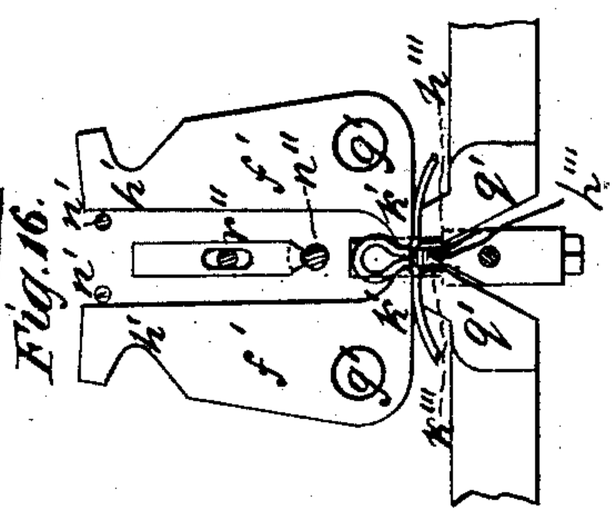


Fig. 12.

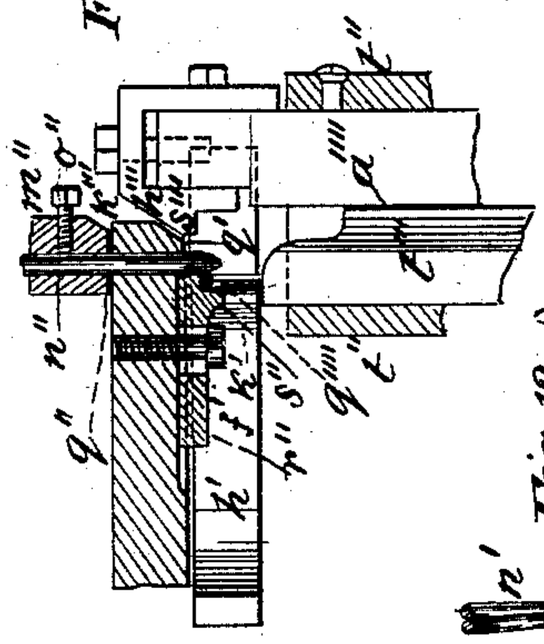


Fig. 13.

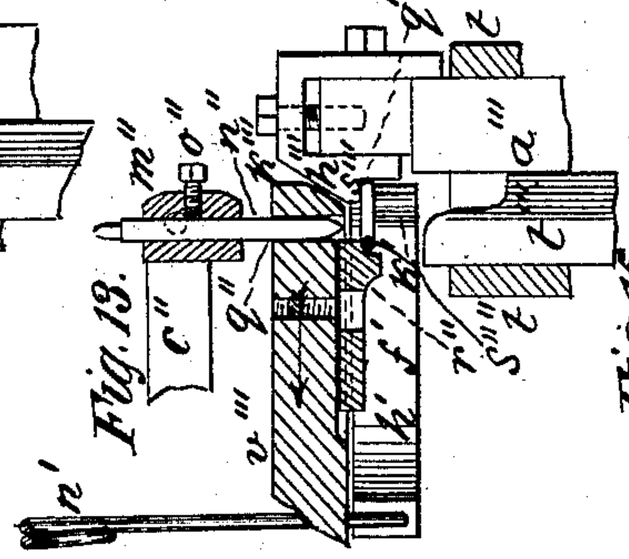


Fig. 15.

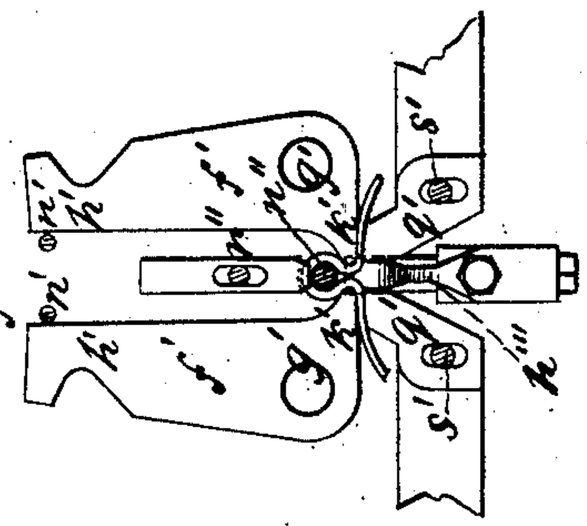


Fig. 10.

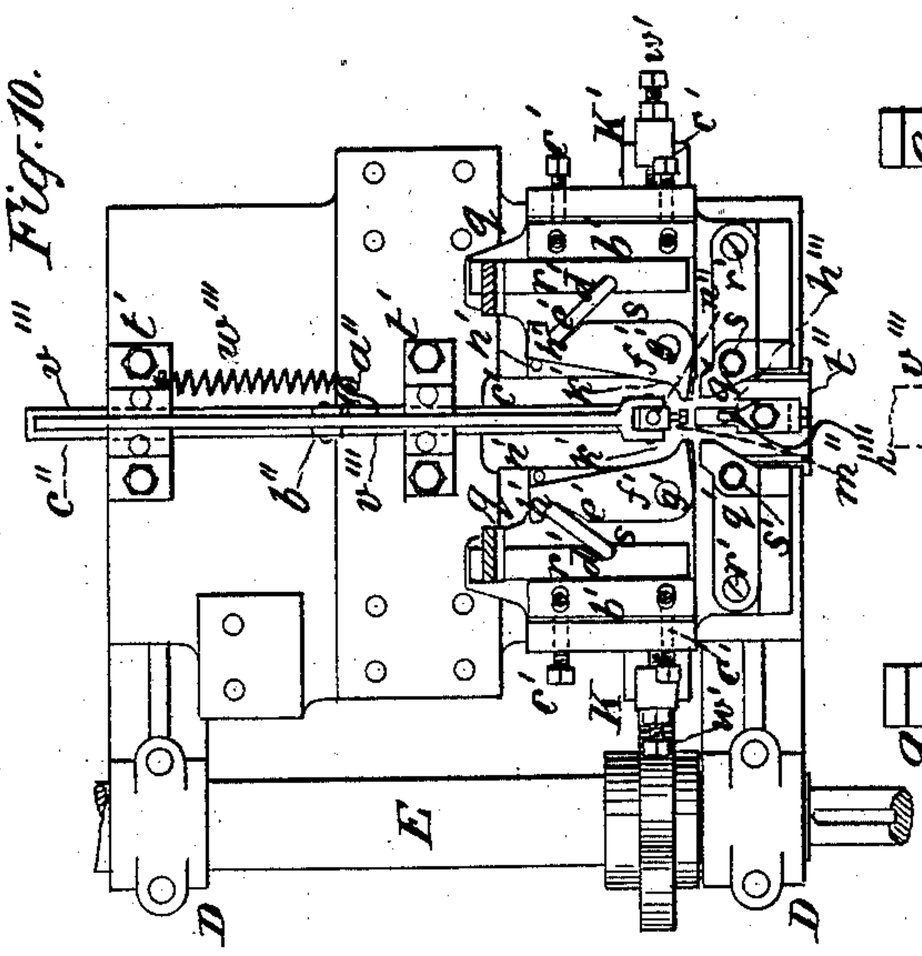
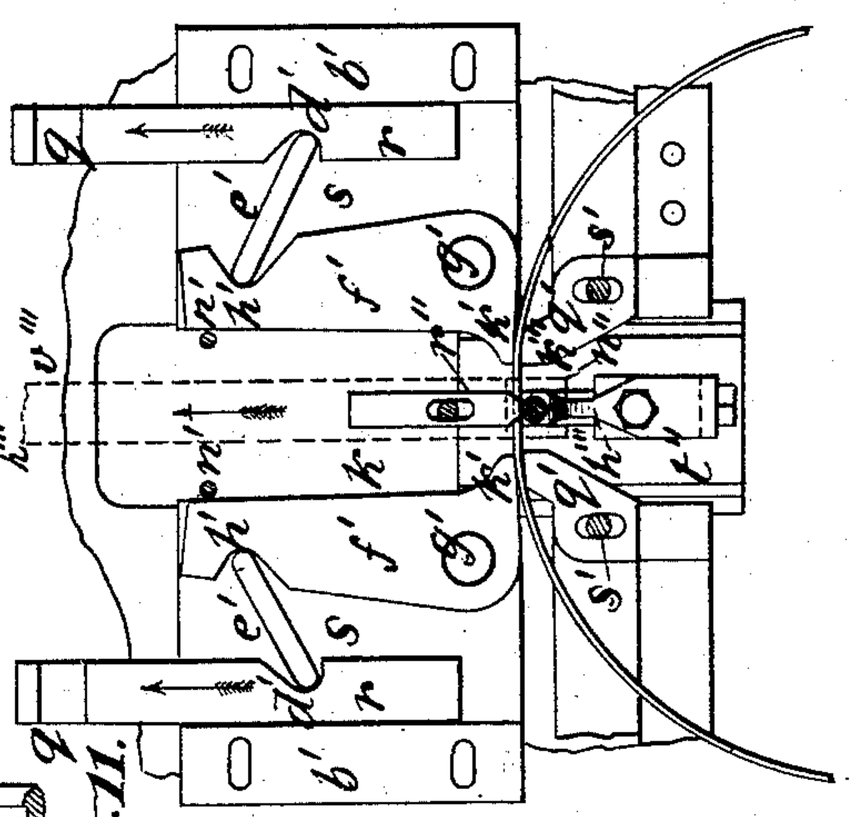


Fig. 11.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC EAR-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 353,261, dated November 23, 1886.

Application filed April 28, 1886. Serial No. 200,432. (No model.)

To all whom it may concern:

Be it known that I, FRANK M. LEAVITT, a citizen of the United States, residing at Brooklyn, Kings county, New York, have invented an Improvement in Automatic Ear-Bending Machines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to machines for forming the ears or bail-loops on the ear-wire, otherwise called "body-wire," of tin pails or analogous vessels made of tin, or sheet metal other than tin.

It consists in the construction, arrangement, and means for automatically operating certain gripping, forming, and bending devices harmoniously, and in a specific order of action to secure the desired forming of the ears on an ear-wire after the same has been bent into circular form, and for forming both ears of such wire simultaneously, said wire and its ears being made all in a single piece, as hereinafter described with reference to the drawings, in which—

Figure 1 is a side elevation of the machine, one head of the same being in section on the line *x x* in Fig. 5, it being premised here that the term "head" is used in a sense analogous to that of the same term as applied to the mechanism of a lathe—that is to say, an assemblage of working parts which may be together removed from or replaced upon a supporting frame or bed. Fig. 2 is a sectional detail, showing the method of connecting parts of the main driving-shaft of the machine, which shaft is in two parts, as shown in this figure. Figs. 3 and 4 are respectively a side view and a perspective view of a completely-formed ear-wire as it is made by my invention. Fig. 5 is a top view of the machine, having certain parts removed for the purpose of more clearly showing other essential working parts. Fig. 6 is a sectional view, the section being made on the line *z z* in Fig. 1. Fig. 7 is a sectional view, the section being made on the line *y y* in Fig. 1. Fig. 8 is a sectional view, the section being made on the line *w w* in Fig. 1. Fig. 9 is a sectional view, the section being made on the line *v v* in Fig. 7. Figs. 10 to 16, inclusive, are detail views showing various parts and positions of the mechanism. Fig. 17 comprises a perspective view and a sectional view of one of the ears of the ear-wire or body-wire as formed by my invention.

A, Figs. 1, 5, 6, 7, and 8, represents the supporting bed or frame of the machine, which carries all the working parts of the same. Upon the bed A are supported two detachable and adjustable heads, B B′, Figs. 1, 5, 6, 7, 8, and 9. From the rear sides of the heads B B′ project brackets C C′, having bearings D D′, for a composite rotating shaft, E E′, Figs. 1, 2, 5, 6, 7, 8, and 9. Said brackets may be cast integrally with the head-frames F, but are preferably bolted thereto, as shown in Figs. 1, 2, 6, 7, 8, and 9. The bearings D support the part E of said shaft, and the bearings D′ support the part E′ of the same, the parts E and E′ being, when in use, connected together by a feather and spline sleeve-coupling, G, as shown in Fig. 2. This construction permits the heads to be separately detached from the bed of the machine without taking the shaft E E′ out of its bearings. I call this shaft "composite," because when the parts E and E′ are connected, as described, they act together and perform the function of a single shaft, upon which are rigidly keyed a series of cams, which impart motions to other mechanisms, as hereinafter described, when motion of rotation is imparted to the shaft through the agency of a fly-wheel pulley, H, Figs. 1, 5, and 6, or its equivalent. The feather and spline sleeve-coupling G also permits the endwise adjustment of the head B and all its attachments, including the part E′ of the composite shaft E E′, toward or away from the head B in adjusting the machine for use in making various sizes of ear-wires. This adjustment of the head B′ is made by the use of a hand-wheel screw, K″, Figs. 1 and 5, which has a fixed bearing at L″ in the frame A, and runs in a nut, M″, Fig. 1, attached to the lower part of the head B′. Turning the screw to the right withdraws the head B′ from the head B, and vice versa.

The fly-wheel pulley H runs idly on the shaft E E′, except when engaged by a spring clutch-pin controlled by a lever, I, operated by a treadle, J, the lever I being pivoted to the frame A and connected by a link to said treadle;

but as the construction of this part of the machine forms no part of my present invention it is unnecessary to further describe it, except to add that this coupling is of that kind which, when the foot is removed from the treadle, automatically stops the revolution of the shaft always at the same position in its rotation, and never permits the shaft to make less than one complete revolution.

Any other kind of coupling device which will act similarly may be used without affecting the form or action of the parts essential to my invention.

The heads B and B′ are held firmly to the bed A by any of the usual methods employed to hold lathe-heads or the heads of analogous machine-tools, and I have indicated one method of effecting this object in the drawings, which may be varied without affecting in any manner the nature of my invention, and I do not therefore deem it necessary to describe in detail this part of the machine.

Both parts of the shaft E E′ have their bearings at D and D′ formed with shoulders, for receiving the end-thrust which the side action of some of the cams carried by the shaft impart to it, and as the sole function of the rotation of this shaft is to actuate sundry cams keyed to the same for actuating other parts of the mechanism yet to be described, I will hereinafter designate this shaft by the term "cam-shaft," as more convenient for purposes of description.

I come now to the more essential and characteristic features of my invention, which are comprised in the heads B and B′ and their attachments, and in the cams carried and actuated by the cam-shaft E E′.

The heads are in all their general features counterparts of each other, with the exception that the head B′ has the hand-screw device for adjusting it toward or away from the head B, as hereinbefore specified, and therefore like parts in each of the heads will be similarly lettered in the drawings for reference.

The head-frames F have the general form of rectangular boxes with open bottoms, a portion of the mechanism being arranged in the interiors of said frames and other portions on the tops of the frames. The top of each frame F is cast with a facing-strip, *a*, planed to a bearing, for the support of mechanism bolted thereto, and the bottom with shouldered flanges *b*, Figs. 1, 6, 7, 8, and 9, planed to fit and embrace the planed upper margins of the side pieces, *c*, of the frame A.

Upon the facing-strips *a* of the head-frames F are bolted brackets or supports *e*, Figs. 1, 5, 7, 8, which support boxes *f* at their upper extremities for rock-shafts *g*, which are placed with their axes in planes at right angles with the axis of the cam-shaft E, and extend across over the upper faces of the head-frames F, as shown in Figs. 5, 7, and 8. Each of the rock-shafts *g* is provided with a crank or rocker arm, *h*, Figs. 1, 5, 7, and 8, keyed to the end of said rock-shaft which is nearest to the cam-shaft in such manner that said arms extend in opposite directions, each toward the end of the machine nearest the shaft which carries it. The outer end of each rock-shaft *h* is pivoted to a short link, *i*, which in its turn is pivoted to a slide, *k*, fitted to work in a vertical guide, *l*, which is bolted to the upper surface of its supporting head-frame F. This construction and arrangement are clearly shown in Figs. 1, 5, and 7.

At the bottom of each of the slides *k* is pivoted a friction-roller, *m*, which bears upon the periphery of a cam keyed to the cam-shaft E E′, as shown in Figs. 1, 5, and 7. Similarly arranged with reference to the opposite bearing of the rock-shaft *g* is also keyed to said rock-shaft another rocker-arm, *o*. Said rocker arms *o*, Figs. 1, 5, 7, and 8, are also arranged to project downward in rectangular or nearly rectangular relation with the rocker-arms *h*, to impart motion to sliding mechanism (soon to be described) in a plane at right angles with the faces of the guides *l*.

To the lower extremity of each rocker-arm *o* is fastened, by set-screws or other suitable device, a toe, *p*, Figs. 1 and 7, preferably of steel or of case-hardened iron, which toe projects into a rectangular notch, *q′*, in a horizontal sliding plate, *r*, Figs. 1, 5, 7, 8, 10, and 11, which slides on the upper surface of a laterally-sliding carriage, yet to be described.

It will be perceived that the rocker-arms *o* impart a rectilinear component of motion to the plates *r* in a direction away from the middle and toward the end of the machine whenever the slides *k* are raised by the rotation of the cams *n* on the cam-shaft. It will also be evident that if the cams *n*, which are alike in peripheral contour, are set symmetrically in radial relation with the axis of the cam-shaft the motions of the plate *r*, derived from the cams, will be equal and simultaneous. The said cams are so set as to produce the specified equality and simultaneity of motion toward each other and toward the middle of the machine.

The notches *q* in the sliding plates *r* are cut entirely across the upper faces of said plates, and the toes *p* at the lower extremities of the rocker-arms *o* are made broader than the faces of the sliding plates *r*, which permits a lateral motion in said sliding plates without disengagement of said toes *p* from the notches *q*, which is necessary, in order that said sliding plates may receive another component of motion at right angles with the longitudinal motion imparted to them by the rocker-arms *o* first above described, this second component of motion being derived from laterally-sliding carriages *s*, Figs. 1, 5, 6, 7, 10, and 11, upon which the sliding plates *r* rest and are guided, and which I will now describe.

The carriages *s* are constructed to slide laterally over the upper surfaces of the box-like head-frames F. There are two of these

carriages for each head-frame, and each is guided in its sliding motion by a dovetailed slide, *t*, Fig. 1, provided with a gib for taking up wear in the ordinary manner employed for such slides, or such slide may be guided in any other suitable manner to regulate its motion rectilinearly and laterally over the top of the frame F. The carriages *s* are made to move alternately toward and away from each other, as above specified, in the following manner.

To opposite sides of each head-frame F are pivoted at *u* and *u'* levers K and K', Figs. 1, 5, 8, and 10, in proper relation with the carriages *s* and one of the cams yet to be described, which imparts motion to said levers for moving said carriages. The pivot *u*, which is the fulcrum of the lever K, is lower than the pivot *u'*, which acts as the fulcrum of K', and the two levers K K' are connected with each other by a link, L, (shown only in Fig. 8,) pivoted at *v'* to the lever K and at *v''* to the lever K'. The link L extends laterally across the interior space of the box-like head-frame F, and obliquely upward from the pivot *v''* to the pivot *v'*, as shown clearly in Fig. 8, its ends passing into openings formed in the sides of said head-frame to connect with the levers K K'.

The pivots *v'* and *v''* have a specific position relative to each other and the pivots *u* and *u'*. The pivot *v'* is placed above the pivot or fulcrum *u*, and the pivot *v''* is placed below the pivot or fulcrum *u'*, each at such distance from its corelated fulcrum *u* or *u'*, that when said pivots *v'* and *v''* are connected by the link L (which also has a specific length between the centers of the pivots *v'* and *v''*) the chord of the arc described by the upper extremity of either of the levers K or K' shall equal the chord of the arc described by the upper extremity of the other. This insures that the lateral sliding motion toward each other of the carriages *s s*, which it is the function of the levers K K' to effect, shall be equal and simultaneous.

Through the upper extremity of each of the levers K K' is fitted a set-screw, *w'*, Figs. 1, 5, 8, and 10, which abuts against the outer face of the carriage *s*, next to it, by the adjustment of which set-screws the distance to which the carriages *s s* shall approach each other, when actuated as hereinafter described, is limited and regulated for different sizes and diameters of ear-wires. Each of the carriages *s* is formed with an L-shaped vertical cross-section, as clearly shown in Fig. 8, leaving a right angle, *a'*, Fig. 8, to which a gib, *b'*, of rectangular cross-section, is fitted, and constructed to be set up to take up wear and for purposes of adjustment, by set-screws *c'* passing horizontally through the part of said carriage which projects above the angle *a'*, these parts being shown in Figs. 1, 5, 8, 10, and 11. The outer faces of the sliding plates *r* abut and slide against the inner faces of the gibs *b'*, and also rest and slide upon the upper faces of the carriages *s s*, which lie below the angle *a'*. Each of said sliding plates has, moreover, a notch, *d'*, cut or formed in its inner face, for the reception of one end of a toggle-bar, *e'*, Figs. 5, 8, 10, and 11. The toggle-bars *e'* are rectangular in cross-section, and their under sides bear and slide upon the upper surfaces of the carriages *s s*. Both ends of each toggle bar are rounded, as shown, to enable them to work easily in the notches by which they engage the sliding plates *r* and the faces of grippers yet to be described. These grippers are shown at *f'*, Figs. 5, 8, 10, 11, and 16. Each of them is pivoted to its carriage *s* at *g'*, and has formed in its outer face a notch, *h'*, for the engagement of the inner end of one of the toggle-bars *e'*. These grippers *f'* have a lever-like action in gripping the ear-wire upon which the bail-ears are to be formed, the pivots *g'* acting as fulcrums, and the power being applied to the longer arms through the medium of the toggle bars *e'*, whenever said toggle-bars are slid by the action of the rocker-arms *o*, as hereinbefore described, in a direction toward the end and away from the middle of the machine.

On the shorter arms of the grippers are formed, facing toward each other and toward the central longitudinal axis of each head, jaws *k'*, Figs. 5, 10, 11, and 16, which act in relation with other jaws, yet to be described, to grip the ear-wire in the operation of forming bail-ears thereon.

To hold in their places the gibs *b'*, sliding plates *r*, toggle-bars *e'*, and grippers *f'*, and to guide them in their motions, plates *l'* are fastened by bolts *m'* to the carriages *s s*, said plates *l'* fitting flush upon the upper surfaces of said gibs, sliding plates, toggle-bars, and grippers, the bolts *m'* passing not only through said plates, but also through slots in the gibs *b'*, which arrangement holds the gibs in fixed longitudinal relation with said carriages, while permitting lateral adjustment, by the action of the set-screws *c'*, as shown in Figs. 1 and 5.

The longer arms of the grippers *f'* are engaged near their extremities on their inner faces by the ends of a furcated spring, *n'*, Figs. 1, 5, 8, 10, 11, 15, and 16, which works in notches, (not shown,) but which are formed in the inner margins of the plates *l'*, as a convenient method of supporting the spring in vertical relation with the plate *l'*; but this particular construction is unimportant, as many other ways of applying and holding said spring can be employed.

The function of the spring *n'* is to press the extremities of the longer arms of the grippers *f'* out toward the sliding bars or plates *r*, each of which, as hereinafter explained, derives a lateral component of motion from the lateral movement of the carriage *s*, upon which they rest, and also a longitudinal component from action of the rock-levers *o*, the movement of said carriage being effected as follows: In a recess formed in the longer arm of each lever K is pivoted a friction-roller, *o'*, Fig. 8, which

bears against the perimeter of a cam, p', Figs. 1, 5, and 8, keyed to the cam-shaft E E', and which in its rotation presses the upper extremity of said lever inward toward the head-frame F. This movement, through the agency of the link L, presses the lower end of the lever K' outward and its upper end inward toward the head-frame F, its movement being in an opposite direction to that of the upper end of the lever K, and as the set screws w' in said levers abut against the outer faces of the opposite carriages, s s, these carriages are caused to move toward each other by the rotation of the cam p'. In doing this said carriages force the sliding plates r equally and simultaneously toward each other, and through the medium of the toggle-bars e' press toward each other also the extremities of the longer arm of the grippers f', thereby also compressing the furcated spring n', which antagonizes the inward motions of the longer arms of the grippers f' with sufficient force to reverse all these motions when the proper part of the periphery of the cam p' is brought into the relation with the roller o'. (Shown in Fig. 8.) The alternate action of the cam p' and the spring n' is therefore to repeat the motions of the carriages and the coacting parts just described at each revolution of the cam-shaft E E'. The cams p' are so set and keyed to the composite cam-shaft E E' that said motions of the carriages s s at each revolution of said shaft occur simultaneously for both heads of the machine.

In its action opposed to the action of the gripper f' is rigidly but adjustably attached to each carriage a gripping-jaw, q', Figs. 5, 10, 11, 12, 14, 15, 16. Said gripper is pivoted at r' to the carriage by a screw-pin, r', Figs. 5 and 10, inserted through the outer extremity of said gripper-jaw, and near the gripping end of said jaw is a slot, through which passes a stout binding-screw bolt, s'. This arrangement permits a radial adjustment of the jaw on the screw-pin r', which is necessary to adapt the machine to use for different sizes and diameters of ear-wires.

To the upper face of each of the heads B and B' are bolted two brackets or supports, t', Figs. 1, 5, 6, 7, 8, and 10, in the upper parts of which are formed rectangular bearings for a sliding bar, v''', Figs. 1, 5, 6, 7, 8, 10, and 11. The bar v''' slides alternately toward and from the middle of the machine at specific periods relatively to the motions of other parts of the mechanism, when actuated as hereinafter described, its motion away from the middle of the machine being effected by a spring, w''', Figs. 1, 5, and 10, said spring being preferably a coiled spring attached at one end to one of the brackets or supports t', and having its other end engaged by a hook-lever, a'', projecting from the body of a lever, c'', which lever is pivoted between said hook a'' and support t' to a stud-bracket, b'', which projects upward from the body of the bar v''', from a position near the middle thereof, as shown in Figs. 1, 5, and 10. The hook-lever a'', rigidly attached to the lever c'', projects a considerable distance down from said lever to its point of attachment with the spring w'''; and said hook being rigidly attached to the lever c'', the lever c'' and hook-lever a'' may be said to form a single lever having for its fulcrum the pivot in the stud-bracket b''. The action of the spring w''' is therefore not only to draw the sliding bar v''' away from the middle of the machine, but also to press downward the extremity of the lever c'', which lies toward the middle of the machine—an important function, the application of which will be hereinafter explained.

The reverse motions of the lever c'' and the sliding carrier or bar v'''—that is to say, the simultaneous motion of the carrier or bar v''' and the lever c'' toward the middle of the machine, and the lifting of that end of the lever c'' which lies toward the middle of the machine—are effected as follows.

To the outer face of each head-frame, at or near the angle of the same which lies nearest the cam-shaft, or to a bracket formed thereon or bolted to said frame, is pivoted a lever, d'', Figs. 1, 5, and 6, which works in nearly a horizontal relation with the sliding bar or carrier v'''. Through the end of the lever d'' farthest from the cam-shaft is fitted a set-screw, e'', Figs. 1 and 5, which bears against the outer end of the carrier-bar v''', and which is used to regulate and limit the distance toward the middle of the machine, as is necessary in working different sizes of ear-wires. At the other end of the lever d'' is pivoted a friction-roller, f''', which bears against the outer side face of a cam, g'', keyed to the cam-shaft, said outer face of said cam having a contour which will, at a specific period in its rotation relatively to the motions of other parts of the mechanism, force the outer end of the lever d'' in a direction away from the middle of the machine, imparting a motion in a contrary direction to the inner end of the lever, which then presses the carrier-bar v''' toward the middle of the machine. During the further rotation of the cam g'' other portions of the contour of its outer face permit the spring w''' to perform one of its functions, which is to reverse this motion, so that during a single rotation of the cam-shaft the carrier-bar v''' and its attachments are made to move together toward the middle of the machine and back again at proper periods, to act in proper order and in conjunction with other parts of the mechanism, as will be hereinafter more fully explained.

To a bracket, h'', Figs. 1, 5, and 6, attached to or formed with each head-frame, at its upper part and at or near its outer angle next the cam-shaft, is pivoted a lever, k'', the inner end of which bears upon the upper side of the lever c'', near the end of the latter which lies toward the lever d''. To the other end of the lever k'' is pivoted a friction-roller, l'', which bears upon the perimeter of the cam g''. The

contour of this perimeter is indicated in Fig. 6, and is such that, at a specific period in its rotation relatively to the motions of other parts of the mechanism, it actuates the lever k'' to press down the outer extremity of the lever c'' against the action of the spring w''', the action of the cam g'', lever k'', and spring w''' thus causing the inner end of the lever c'' to be depressed once and raised once during each rotation of the cam-shaft.

The function of the lever c'' is to bring into proper relation with the grippers and gripping-jaws f' and g' a former pin or mandrel, around which the ear-wire is bent in forming an ear thereon, as will be fully explained in the description of the operation of the machine farther on; but I will here describe the nature of this mandrel and its attachment to the lever c''. The end of the lever c'' nearest the middle of the machine, the motions of which have been described, is furcated, and between its furcations is pivoted a chuck, m'', Figs. 1, 5, 8, 10, 12, and 13, which carries the mandrel above referred to. This mandrel is shown at n'', Figs. 1, 5, 10, 11, 12, 13, 14, and 15. It passes through a hole in the chuck m'', to which it is fitted and in which it is firmly secured by a set-screw, o'', Figs. 1, 12, and 13. The general shape of the body of this mandrel is cylindrical, and it is held in the chuck m'' by the set-screw o'' in such adjustment that when the end of the lever c'' which carries the mandrel is in its highest position the lower extremity of the mandrel passes nearly through a hole, q'', Figs. 12, 13, and 14, in or near the end of the sliding bar v''', directly under said mandrel, and also in such adjustment that when the same end of the lever is depressed the mandrel is caused to move downward and project some distance below the under side of the sliding bar v''' in the position shown in Fig. 12. The mandrel n'' is tapered or shaped off into an obtuse point at the lower end, which permits a freer action in the hole q'' than it could otherwise have, and prevents its catching upon the ear-wire in its descent when the machine is in operation, as hereinafter more fully explained, and at its upper end it is provided with a similarly-shaped point, but of smaller size, so that the mandrel may be used for making two sizes of ears by turning it end for end.

Upon the under side of the sliding bar v''' is adjustably attached a detachable die, r'', having a form indicated in Figs. 1, 11, 12, 13, 14, 15, and 16. This die has a face, s'', Figs. 12, 13, and 14, which is curved vertically to measurably conform to the circumference of the cross section of the wire to be worked, and horizontally to measurably conform to the shape of the outer part of the ear to be formed on the wire. The die r'' is by means of a slot and clamping-screw, or any other suitable means, adjusted in relation with and rigidly clamped in such manner that the face s'' of said die which lies toward the mandrel is at its lower part a distance from the mandrel equal to the diameter of the wire to be worked in the machine whenever the mandrel is forced downward into the position shown in Fig. 12, and the vertical curvature of the face extends up over the wire to a distance about one-fourth the circumference of the cross-section of the wire, as shown distinctly in Figs. 12 and 13. The function of the die r'' is to prevent any bending of the ear upward during the process of its formation and to assist in perfecting the shape of the ear, as hereinafter more fully explained.

Between the bodies of the gripper-jaws q' is a sliding carriage, t'', Figs. 1, 5, 8, 9, 10, 11, 12, and 14, which has a longitudinal motion in line with the sliding bar v''', but not coincident therewith. This carriage is guided in its longitudinal motion by gibs and ways in the head-frame, after the manner of guiding similar carriages in machine-tools generally; or it may be guided in any other suitable manner. To a projection, a''', Figs. 1 and 9, on said carriage is pivoted one end of a link, b''', the other end of which is pivoted to the end of a horizontal rock-lever, c''', Figs. 1, 7, 8, and 9, which rock-lever has its other end pivoted to one end of a link, d''', the other end of which link is pivoted to an inwardly-projecting lug formed on or attached to a horizontal slide, e''', Figs. 7 and 9. To the opposite side of the slide e''' is pivoted a friction-roller, f''', which bears against the side face of a cam, g''', Figs. 1, 5, 7, and 9, said face of said cam having a contour such that when the cam is set properly on the cam-shaft the carriage is moved by the cam, through the mechanism of the lever c''' and the links connecting said lever with said carriage, at the proper period in relation to the motions of other parts of the mechanism, in a direction from the middle of the machine toward the end thereof.

To the bracket C is attached one extremity of a coiled spring, m''', Figs. 1 and 9, the other end being attached to the slide f''', the tension of said spring opposing the motion of the slide caused by the cam g''', the combined action of said cam and spring causing said slide and its connected mechanism to move reciprocally once during each rotation of the cam-shaft. The function of the carriage t'' is to bring certain dies into position for bending the ear into a proper angle with the body of the ear-wire after the ear has been formed and shaped by other parts of the mechanism, as will be hereinafter more fully described. One of the dies alluded to is shown at h''' in Figs. 1, 5, 10, 11, 12, 14, 15, and 16. It has an upper face, k''', inclined downwardly toward the end of the machine, which face is terminated below by an angular former, s''', as shown in Figs. 12, 13, and 14, the function of which is to control the angle to which the ears are bent after they are formed, as hereinafter explained. The sliding carriage t'' also carries another die, t''', Figs. 1, 8, 9, 12, 13, and 14, the function of which die is to act in relation with the die h'''

in bending the ear to the proper angle after said ear has been formed on the ear-wire by other mechanisms, the construction and motions of which have been described, and the operation of which will be hereinafter specified. The die t''' is not, like the die h''', rigidly attached to the carriage t''. On the contrary, it slides in a vertical way, a'''', Figs. 1, 9, 12, 13, and 14, formed in the body of said carriage, and has a vertical upward motion therein derived from the cam b'''' on the cam-shaft, as follows:

A composite rock-lever, c'''' d'''', Figs. 1, 8, and 9, is pivoted in a box or bearing, e'''', Figs. 8 and 9, said box or bearing being attached to the inside of the head-frame F, at or near its upper part, and near that end of said frame which faces toward the middle of the machine, said lever extending through an opening in the side of the head-frame to reach the cam b'''', by the perimeter of which it is operated in one direction, the part d'''' of said lever being provided with a friction-roller which bears on said perimeter. The composite lever c'''' d'''' does not reverse the motion of the vertically-sliding die t'''. This is done by a coiled spring, f'''', attached to the lower part of said die at one end and to a bracket, g'''', projecting from the inner side of the inner end of the head-frame F, and placed in proper relation with said spring and die, as shown in the section of the head-frame B′ in Fig. 1. The combined action of the composite rock-lever c'''' d'''' and the spring f'''' causes the die t''' to make one reciprocating movement during each rotation of the cam-shaft. The inner end of the lever c'''' d'''' is provided on its upper side with a gib, upon which the die t''' rests, and which is of dimensions to permit the sliding of the carriage which carries said die without ceasing to bear against the lower end of the die. This arrangement is shown in Fig. 8.

I have styled the rock-lever c'''' d'''' "composite," because it consists of a part, c''''. and another part, d'''', pivoted together at h'''', as shown in Figs. 8 and 9, the end of the part c'''' projecting over the part d'''', as shown, and the end of c'''', which projects over d'''', being bound to the latter by a screw-bolt, k'''', Figs. 8 and 9, which passes freely through the part d'''' and screws into the extension of c'''', which lies over d''''. By means of this screw-bolt the distance through which the composite lever c'''' d'''' will be moved by the cam b'''', and consequently the distance to which the die t''' will be moved upward from its lowest position, can be limited and regulated, which is necessary for working different sizes of wire in the machine. The die t''' may be used, not acting in conjunction with a die h''', for bending up the loops of the ears of an ear-wire; but a neater and more uniform bend is attained by the use of both dies.

Before proceeding to describe the operation of the machine and the various sets of mechanism which it comprises, the general construction of which I have sufficiently set forth, excepting only a few minor details, which will be better described in connection with their special functions, I wish to state, broadly, that while I have herein described as the general mechanism for actuating the sliding carriages, grippers, and dies used to form the ears of an ear-wire, various combinations of cams, levers, springs, and cognate devices, I do not limit myself to these precise mechanisms for effecting the successive and harmonious movements of the grippers, dies, carriages, mandrel, &c., as these combinations could be indefinitely varied to effect the movements of the essential parts of the machine.

The nature of the work which the machine performs will be understood by reference to Figs. 3, 4, and 17, in which l'''' represents the body of the ear-wire, (otherwise called body-wire,) upon which the ears m'''' are to be formed, and after their formation bent upward into an angle with the body of the ear-wire, as shown at n'' in Fig. 17. The wire is first cut into proper lengths and bent into hoops, as shown at l'''' in Fig. 5, of such diameter that when the ears are formed and finished thereon the finished ear-wire will thereafter assume the proper diameter and circumference to fit the upper margin of the pail or vessel for which it is designed. To the margin of that one of the carriages s which pertains to the head B which lies farthest from the cam-shaft is attached by screws p a guide-plate, o'''', which extends entirely across the space between the heads B and B′ to a short distance over the margin of the opposite carriage, s, which is carried by the head B′. The edge of this guide-plate, which faces away from the middle of the machine, is made of circular contour to fit the body of the ear-wire l'''', so that when the said ear-wire is laid on the machine, as hereinafter described, its inside will abut against the curved side of the guide-plate o'''', at which time the wire hoop is in proper position to be acted upon by other parts of the machine.

As a further guide for putting the wire hoop or body of the ear-wire into proper relation with the grippers and dies which are to act upon it, the grippers f' have formed on the outer and upper angles of their jaws a small groove or recess, q'''', Figs. 12 and 13, in which the wire, when brought flush up against the outside of the guide-plate o'''', will fall by its own gravity when the parts of the machine are in the position shown in Fig. 5. It will be seen that in this position the wire lies between the grippers f' and the gripping-jaws q'. The foot being now placed upon the treadle J, the fly-wheel pulley H is thereby coupled to the cam-shaft upon which it was before idly running. The cam-shaft then begins to revolve, and through the action of the cams n, which first begin to act, and the intervening mechanism between said cams and the sliding bars r, cause these slides to move in a direction from

the middle of the machine toward the ends thereof. This causes the toggles e' to press the ends of the longer arms of the grippers f' toward the central axis of the machine, thereby gripping the wire between their jaws k', and the gripping-jaws q' also compressing the spring n'. The cams g'' next come into action to thrust toward the middle of the machine the sliding bars v''' and the levers c'', attached to said sliding bars, until the mandrels n'', carried in the ends of the levers c'', are brought into relation with the wire. (Shown in Fig. 13.) The action of the springs w''' upon the levers c'' during the advance of the sliding bars v''' toward the middle of the machine depresses the inner ends of the levers c'' and forces down the mandrel n'' into the position shown in Fig. 12, the wire being then held in the groove q'''' at the upper and inner angle of the jaws k' of the grippers f' by the mandrel n'' on the inside and the jaws s'' of the die r'' on the outside. The continued rotation of the cam-shaft brings cams p' into action, which, through the medium of the levers K and K', connected by the link L, cause the carriages s on each head to move toward each other and toward the central axis of the machine. When this movement is effected, the grippers f' and gripping-jaws q' take the position shown in Figs. 15 and 16, carrying with them the wire, which is firmly gripped between them, as in a vise, and looping it around the mandrel n'', as shown in the figures referred to, thus forming the eyes. The still further continued rotation of the cam-shaft brings the cams g'' into action, and through the medium of the slides e''' and their connecting links causes the carriage t'' to move in a direction from the middle of the machine toward the ends thereof, bringing the dies h''', which up to this period have occupied the position shown in Fig. 15, into the position shown in Fig. 16, so that their angular forming parts s''', hereinbefore described, are brought up to and over the inner part of the eye at what may be called its "neck" or junction with the body of the wire. This position is also shown in Figs. 13 and 14. The cams g'', which up to this time have only actuated the slide-bar v''' to bring the mandrels n'' into position to engage the wire for forming the eye, now act with their perimeters upon the levers k'', to depress the outer ends of the levers c'' and lift the mandrel upward again into the position shown in Figs. 13 and 14. When this is done, that part of the cams g'' which hitherto pressed the slide-bars v''' and their connected levers c'' toward the middle of the machine cease to act, and the springs w''', assuming control of the slide-bars v''', pull them outward toward the extremities of the machine, thus giving opportunity for the action of the vertically-sliding dies t'''. The position of the sliding bar v''' at this moment is shown in Fig. 14. The cams b'''' now come into play, and through the medium of the composite lever c'''' d'''' thrust up the die t''' into the position shown in Fig. 14. The die t''', as well shown in Figs. 12, 13, and 14, has a contour which gives, in connection with the annular forming part s''' of the die h''', the required bending to form the angle n'''' of the eye m'''', as shown in Fig. 17 and in Figs. 3 and 4. The action of the parts is now reversed in a reverse order to that in which they began to act until all the parts have resumed their original positions and the cam-shaft has made one complete revolution. By this action the ear-wire is released from its engagement with all of the gripping and forming devices, and may be lifted off by the operator and replaced by another wire to be similarly operated upon, and so on continuously, the ears being formed upon a single ear-wire at each revolution of the cam-shaft, the action of the parts being such that the form of the ears and the angle to which they are bent relatively to the body of the wire are uniform and perfect, this perfection and uniformity being of very great advantage in the subsequent operations of inserting the wire into the body of the pail or vessel for which it is designed. The work is accurately done with great rapidity, and results in a large economy over that attained by the methods hitherto used.

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

1. The combination of the heads B and B' and the bed A of an automatic machine for forming ears upon ear-wires, said heads each comprising specific mechanism for forming one of the ears of such ear-wire, substantially as herein described, and the composite shaft composed of the parts E and E', connected together by sleeve, spline, and feather coupling G in such manner that the sections of said shaft E and E', respectively, act when coupled as one shaft and permit the removal of either of said heads without disturbing the other head or changing the relation and arrangement of the working parts in either head, substantially as and for the purpose herein specified.

2. The combination of the heads B and B' and the bed A of an automatic machine for forming ears upon ear-wires, said heads each comprising specific mechanism for forming one of the ears of such ear-wire, substantially as herein described, the composite shaft composed of the parts E and E', connected together by sleeve, spline, and feather coupling G in such manner that the sections of said shaft E and E', respectively, act when coupled as one shaft and permit the removal of either of said heads without disturbing the other head or changing the relation and arrangement of the working parts in either head, and the adjusting-screw K, arranged in relation with said bed and the head B', whereby the head B' can be adjusted toward or away from the head B, substantially as and for the purpose herein described.

3. In a head of an automatic ear-bending machine, the combination of the carriages *s*, arranged to slide laterally upon the head-frame toward and away from the central longitudinal axis of the machine, grippers *f'*, pivoted to said carriages, sliding bars *r*, arranged to slide longitudinally on said carriages, toggle-bars *e'*, connecting the sliding bars *r* and grippers *f'*, gripper-jaws *q'*, antagonizing the grippers *f'*, for clamping the ear-wire, and mechanism for actuating said carriages, sliding bars, toggle-bars, and grippers in proper relation with each other and at the proper periods for clamping said ear-wire and pressing the clamped parts toward each other to form the loop of the ear, substantially as and for the purposes herein set forth.

4. In a head of an automatic ear-bending machine, the combination of the carriages *s*, arranged to slide laterally upon the head-frame toward and away from the central longitudinal axis of the machine, grippers *f'*, pivoted to said carriages, sliding-bars *r*, arranged to slide longitudinally on said carriages, toggle-bars *e'*, connecting the sliding bars *r* and grippers *f'*, gripper-jaws *q'*, antagonizing the grippers *f'*, for clamping the ear-wire, and the specific mechanism herein described for actuating said carriages, sliding bars, toggle-bars, and grippers in proper relation with each other at the proper periods for clamping said ear-wire and pressing the clamped parts toward each other to form the loop of the ear, said mechanism consisting of a cam, *p'*, levers K K', respectively bearing against the outer margins of the carriages *s*, link L, connecting said levers K K' in such manner that their motions are in opposite directions, the cam *m*, rock-shaft and rock-levers *g h o*, for actuating the sliding bars *r*, toggles *e'*, and grippers *f'*, and the furcated spring *n'*, engaging the inner faces of the longer arms of the grippers *f'* and antagonizing the action of the levers K K', and rock-levers *o*, for reversing the motion of this entire system of mechanism, substantially as and for the purposes herein specified.

5. In a head of an automatic ear-bending machine, the combination of the carriages *s*, arranged to slide laterally upon the head-frame toward and away from the central longitudinal axis of the machine, grippers *f'*, pivoted to said carriages, sliding bars *r*, arranged to slide longitudinally on said carriages, toggle-bars *e'*, connecting the sliding bars *r*, and grippers *f'*, gripper-jaws *q'*, antagonizing the grippers *f'*, for clamping the ear-wire, mechanism for actuating said carriages, sliding bars, toggle-bars, and grippers in proper relation with each other at the proper periods for clamping said ear-wire and pressing the clamped parts toward each other to form the loop of the ear, and the mandrel *n''* for shaping the loop of the ear, in combination with mechanism, substantially as herein described, for carrying said mandrel to a point between the jaws of said grippers and depressing it down into the interior of the wire hoop in such manner that when the grippers are pressed toward the central longitudinal axis of the machine the loop is formed around said mandrel, and that when said loop is formed said mandrel is raised out of such loop and drawn toward the end of the machine to make room for the action of the dies, which subsequently bend the ear to an angle with the body of the ear-wire, substantially as herein described, and for the purposes specified.

6. In a head of an automatic ear-bending machine, the combination of the mandrel *n''*, the longitudinal sliding bar *v'''*, through the inner end of which said mandrel passes, the lever *c''*, carrying at its inner end the mandrel *n''* and pivoted to the upper side of the bar *v'''*, or to a bracket thereon, the hook-lever *a''*, attached to the lever *c''*, between its pivoted bearing and said mandrel, the spring *w'''*, attached to the hook-lever *a''* for depressing the mandrel and causing it to project below the lower face of the sliding bar *v'''*, the lever *k''*, the inner extremity of which presses upon the upper face of the lever *c''* to antagonize the action of the spring *w'''*, the lever *d''*, the inner end of which presses against the end of the sliding bar *v'''*, also antagonizing the action of the spring *w'''*, and the cam *g''*, having one of its side faces formed to actuate the lever *d''* at the proper period for pressing the sliding bar *v'''* toward the center of the machine, and having its perimeter formed to actuate the lever *k''* at the proper period for depressing the outer end of the lever *c''* and raising the mandrel *n''* out of the loop of the ear-wire, substantially as herein described, and for the purposes set forth.

7. In the head of an automatic ear-bending machine, the combination, with the mandrel *n''* and mechanism for actuating the same, substantially as herein described, of the die *r''*, adjustably attached to the under face of the inner end of the sliding bar *v'''*, and having at its end lying next said mandrel a concave circular contour for shaping the outer extremity of the loop of the ear-wire simultaneously with the shaping of the inside of said loop by said mandrel, substantially as herein described, and for the purposes set forth.

8. In the head of an automatic ear-bending machine, the combination of carriages *s*, grippers *f'*, gripping-jaws *q'*, antagonizing the jaws of the grippers *f'*, longitudinally-sliding bars *r*, toggle-bars *e'*, connecting the sliding bars *r* with the longer arms of the grippers *f'*, for actuating the jaws of the same toward the gripping-jaws *q'*, the mandrel *n''*, for regulating the shape of the inside of the loop of the ear, the die *r''*, for regulating and forming the outside of the outer extremity of said ear, a system of mechanism for actuating said carriages toward the central longitudinal axis of the machine for forming said loop and reversing said motion, a system of mechanism for actuating the slide-bars *r* toward the end of the machine and

reversing said motion, a system of mechanism for actuating the sliding bar v''' and its attached parts toward the center of the machine and reversing such motion, and a system of mechanism for actuating the mandrel in such manner that it projects below the face of the inner end of the sliding bar v''' into the interior of the wire hoop while the loop of the ear is being formed, and is withdrawn from said loop after its formation, substantially as herein described, and for the purposes set forth.

9. The combination, with the grippers f' and gripping-jaws q', for gripping the body of the wire and pressing the gripped parts of the same toward each other for forming a loop on said wire, of the vertically-sliding die t''', for bending said loop after it is formed to an angle with the body while the shank or neck of the said loop is still engaged with said grippers, substantially as herein described, and for the purpose set forth.

10. The combination, with the grippers f' and gripping-jaws q', mandrel n'', and die r'', all constructed and operated substantially as herein described, of the vertically-sliding die t''', for bending the ear to an angle with the body of the wire after the loop of the ear has been formed and while the wire is still gripped by the grippers f' and q', substantially as and for the purposes specified.

11. In the head of an automatic ear-bending machine, the combination of the carriage t'', sliding longitudinally on said head, the vertically-acting die t''', sliding in said carriage, and the die h''', rigidly but adjustably attached to the upper part of said carriage in relation with the die t''', having thereon the shaper s''', mechanism for actuating said carriage to bring the shaper s''' of the die h''' over the neck or shank of the ear at the proper period to antagonize the upward pressure of the die t''' when the same rises to bend the ear, whereby a regular and uniform angle of bending said neck or shank is secured, and mechanism for reversing the motion of said carriage, substantially as herein described, and for the purposes set forth.

12. In the head of an automatic ear-bending machine, the combination of the carriage t'', sliding longitudinally on said head, the vertically-acting die t''', sliding in said carriage, and the die h''', rigidly but adjustably attached to the upper part of said carriage in relation with the die t''', having thereon the shaper s''', and the specific mechanism for actuating the same toward the end of the machine, and the reverse for bringing said carriage and its working parts in proper relation with the ear-wire at the proper period for bending the ear into an angle with the body of the wire, said mechanism consisting of a cam, g''', slide e''', spring m''', antagonizing the action of the cam, horizontal rock-lever c''', and links d''' and b''', connecting said lever c''' with said slide e''' and carriage t'', substantially as herein described, and for the purposes set forth.

13. The combination, with the carriage t'', the vertically-acting die t''', and the die h''', of the cam b'''', a rock-lever pivoted to the head-frame, its outer end bearing against the perimeter of the cam b'''', and its inner end bearing against the lower end of the die t''', and the spring f'''', connected with the head-frame and the lower end of the die t''', which antagonizes the upward motion of said die and the movement of the rock-lever derived from the cam b'''', substantially as and for the purposes set forth.

14. The combination, with the die t''', the spring which antagonizes its upward motion, and the die h''', of the composite lever c'''' d'''', the part d'''' of which is pivoted to the part c'''' and bound thereto by the adjusting screw-bolt k'''', for regulating and limiting the upward motion of the die t'''', substantially as and for the purposes herein set forth.

15. The combination, with the cam p', levers K K', link L, and carriages s, of set-screws w', inserted in the upper extremities of the levers K K', for regulating and limiting the motion of said carriages toward the central longitudinal axis of the machine, substantially as and for the purposes herein specified.

16. In the head of an automatic ear-bending machine, the combination, with the lateral sliding carriages s, the longitudinal sliding bars r, the grippers f', pivoted to said carriage, the toggle-bars e', connecting the sliding bars r with the longer arms of the grippers f', and the gripping-jaws q', for antagonizing the gripping action of the grippers f', of the gibs b and set-screws c', for regulating and limiting the gripping action of the grippers f' against the gripping-jaws q' in working different sizes of wire, as and for the purpose herein set forth.

17. In the head of an automatic ear-bending machine, the combination, with the lateral sliding carriages s, the sliding bars r, grippers f', and toggle-bars e', of the radially-adjustable gripping-jaws q', attached to said carriage by pivots r, and having set-screws s' passing through slides in the same into the carriages s, for holding said jaws in radial adjustment relatively to the centers of the pivots r' in working different sizes of wire, substantially as and for the purpose herein set forth.

18. The combination, with the heads B and B' of an automatic ear-bending machine, said heads being constructed and operated substantially as herein described, the head B being adjustable toward or away from the head B', of the guide-plate o'''', attached to the fixed head B, but placed in relation with the adjustable head B', whereby a certain adjustment of the head B' toward or away from the head B is permitted without removal of such guide-plate, substantially as and for the purpose set forth.

19. In the head of an automatic ear-bending machine constructed substantially as herein described, the combination, with the carriages s, grippers f', sliding bars r, and toggle-bars e',

all constructed and operating as described, of the plate l', bolted to the carriages s in such manner as to come down flush on the upper surfaces of the gibs d', sliding bars r', grippers f, and toggle-bars e', for holding the same in relation with said carriages, substantially as and for the purposes set forth.

20. In the head of an automatic ear-bending machine, the combination of the sliding bar v''', the lever c'', pivoted to the lever v''', and having the chuck m'' attached to its inner end, the reversible mandrel n'', having its middle part adapted to fit the chuck m'', and having its extremities made of different size to adapt it to different sizes of ears, and mechanism for actuating said sliding bar, lever, and mandrel in such manner as to bring the lower extremity of the mandrel into the interior of the loop of the ear while the same is being formed, substantially as and for the purpose set forth.

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