No. 740,730. PATENTED OCT. 6, 1903.

E. ZEH.

SHEET METAL CUTTING MACHINE.

APPLICATION FILED MAY 8, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

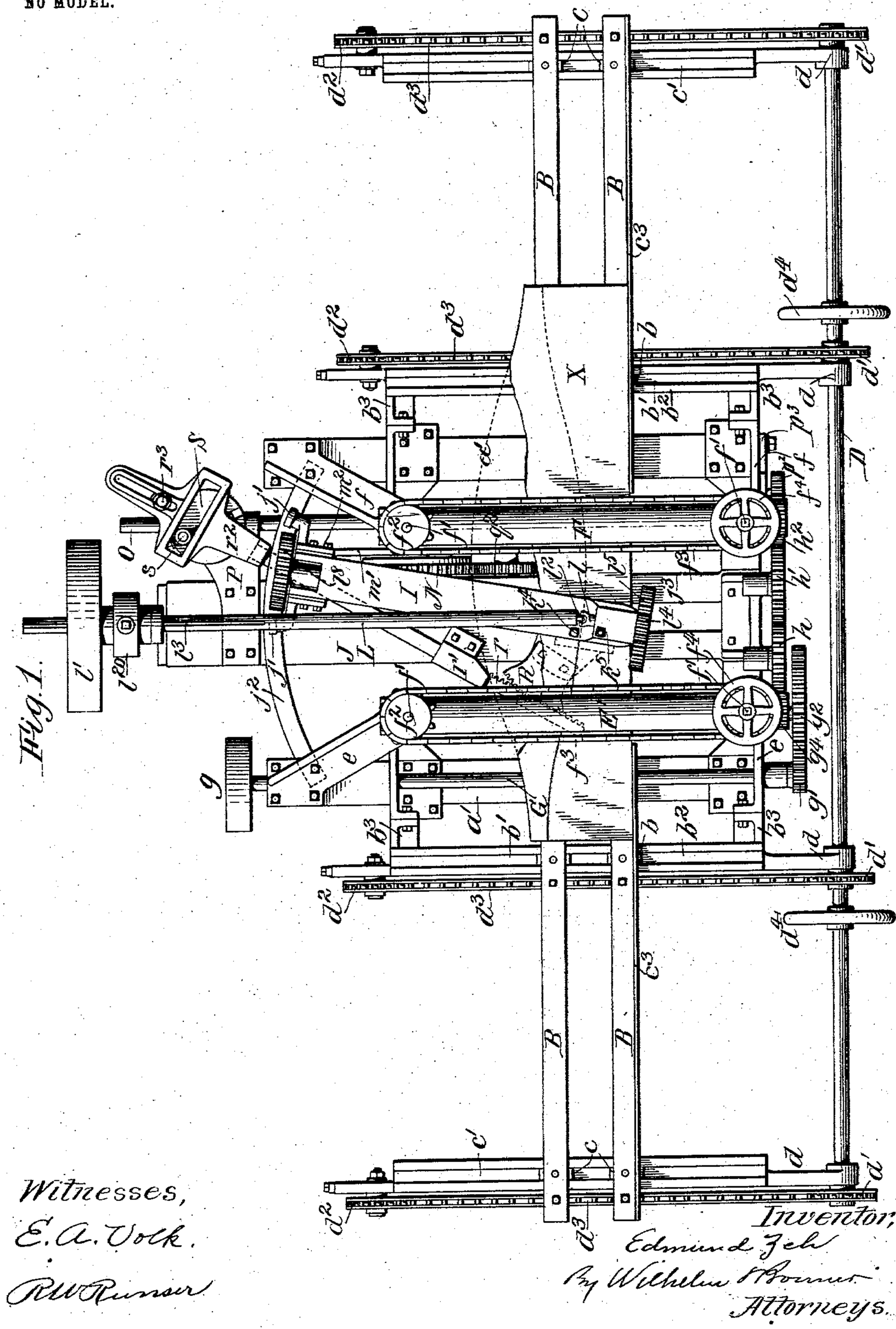

Fig. 1.

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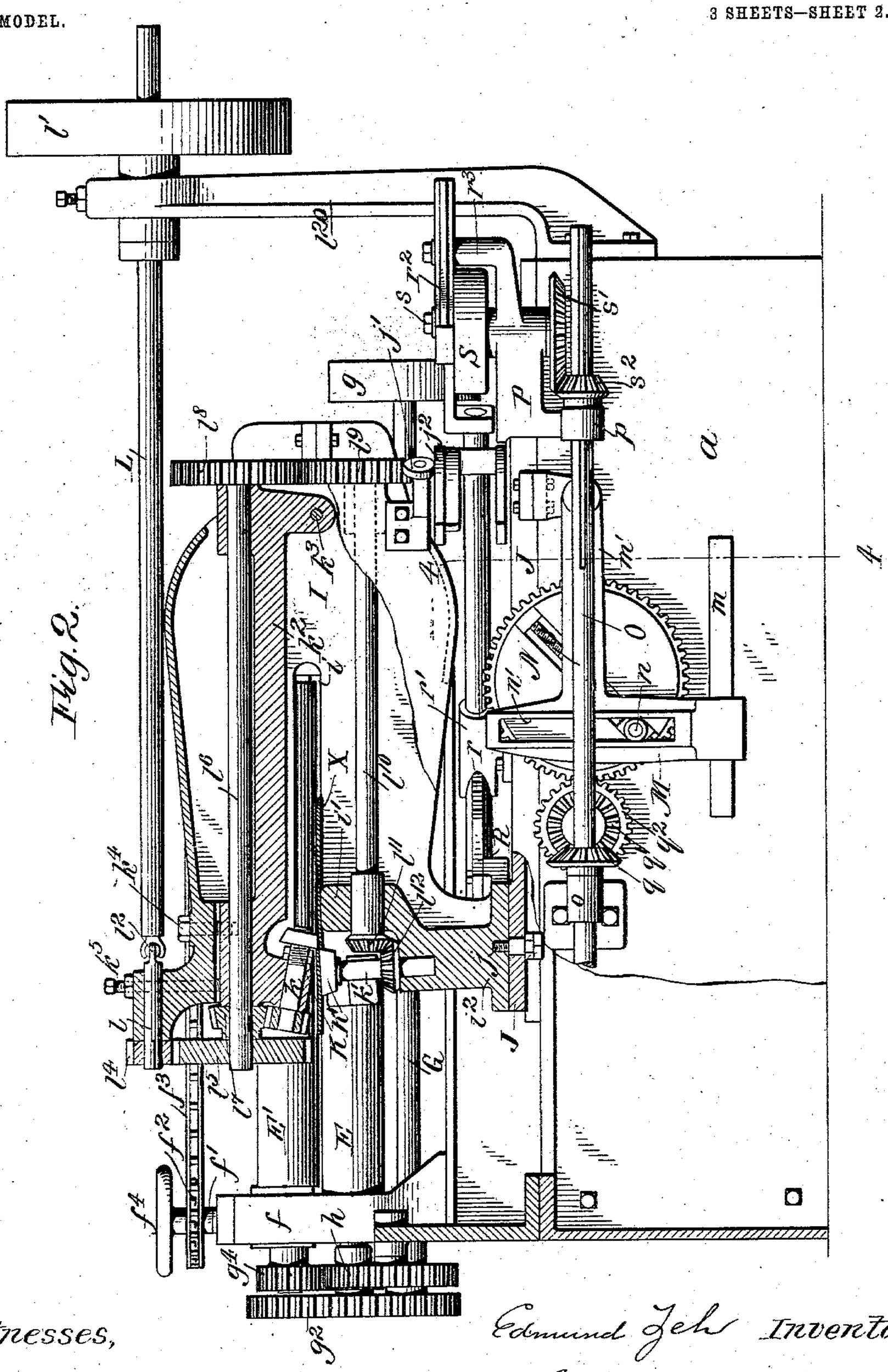
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

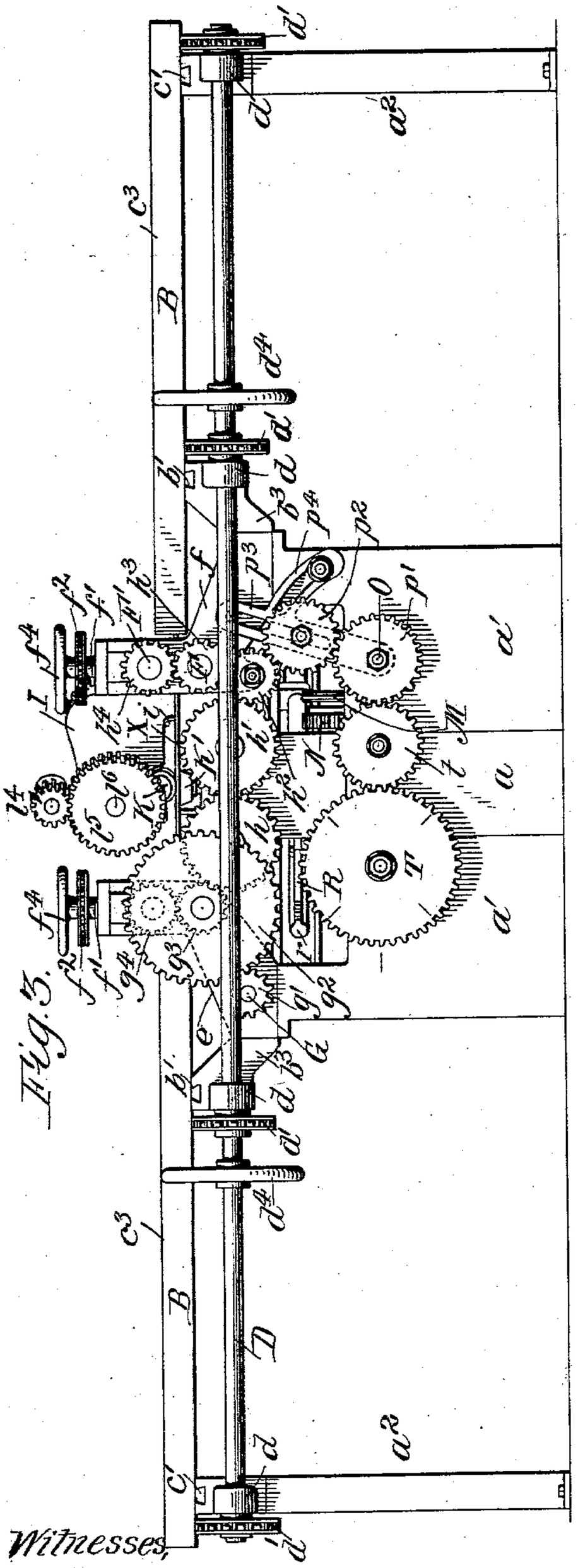
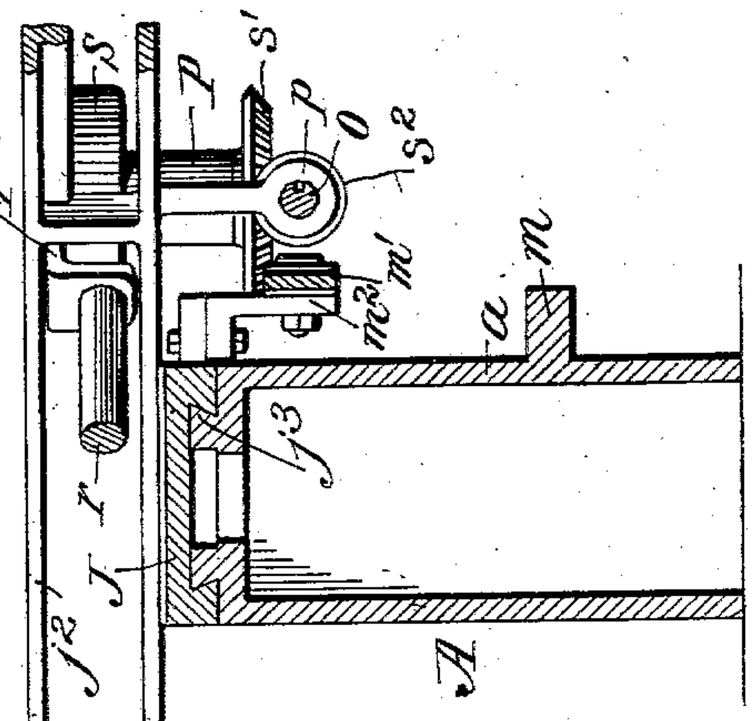


Fig. 4.



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No. 740,730. Patented October 6, 1903.

UNITED STATES PATENT OFFICE.

EDMUND ZEH, OF BUFFALO, NEW YORK, ASSIGNOR TO NIAGARA MACHINE & TOOL WORKS, OF BUFFALO, NEW YORK.

SHEET-METAL-CUTTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 740,730, dated October 6, 1903.

Application filed May 8, 1903. Serial No. 156,250. (No model.)

To all whom it may concern:

Be it known that I, EDMUND ZEH, a subject of the Emperor of Germany, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Sheet-Metal-Cutting Machines, of which the following is a specification.

This invention relates to a machine for cutting thin material, such as sheet-metal, and more particularly to a machine for cutting the blanks constituting the sections employed in making elbows for stovepipes and other tubes.

As is well known, the meeting edges of the sections of a sectional elbow for a cylindrical pipe or tube form when straightened or flattened out sinusoidal curves.

The object of the invention is to produce an efficient practical machine of simple construction for tracing or cutting geometrically true sinusoidal curves of any desired length and pitch within the limits of the machine.

In the accompanying drawings, consisting of three sheets, Figure 1 is a plan view of a machine embodying the invention. Fig. 2 is a sectionel elevation thereof, on an enlarged scale, part of the frame being broken away and the cutter-frame being shown in vertical section. Fig. 3 is a front elevation of the machine. Fig. 4 is a longitudinal vertical section through the central portion of the main frame and associated parts in line 4 4, Fig. 2.

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

The machine hereinafter described in detail comprises, briefly stated, a work support or table for the sheet from which the blanks are cut, means for feeding the sheet longitudinally on said work-support, rotary cutters mounted in a horizontally-movable cutter-frame, and connected mechanism for simultaneously operating the sheet-feeding means and imparting a variable movement to said cutter-frame in a direction at right angles to the direction of movement of the sheet by said feeding means, whereby the cutters follow a sinusoidal curve, and means for also swinging said cutter-frame, whereby the cutters are always maintained tangential to the line of cut.

A represents the main frame or bed of the machine, which may be of any suitable form and construction and which, as shown in the drawings, consists of a central portion a and two wings a', arranged at opposite sides of and parallel with the central portion and which at their forward ends are connected to the central frame portion.

a^2 represents side-supporting standards for the laterally-projecting ends of the work-support or table. The latter is arranged above the main frame and serves as a rest for the sheet of metal or other material X from which the blanks are to be cut as it is fed horizontally to and from the cutters.

The work support or table shown consists of two pairs of horizontal separated bars or slats B, which extend longitudinally, one pair at each side of the central portion of the main frame. The bars of both pairs are provided at their inner ends with slide-blocks b, which slide forwardly and rearwardly in horizontal guideways or grooves b', formed in rails b^2, arranged parallel with and secured to the side wings of the main frame by suitable brackets or the like b^3 at the ends of the rails b^2. The bars of the work-support are provided at their outer ends with similar blocks c, working in guideways or grooves c' in horizontal rails at the tops of the two supplemental standards a^2. The front bars of the two pairs are alined and are provided with vertical flanges or lips c^3, which constitute a gage or guide for the front edge of the sheet to be cut. The work-support may be formed, supported, and guided in any other suitable manner.

The work-support is moved forwardly and rearwardly in its guides preferably by the following means: D represents a horizontal shaft, which is arranged longitudinally at the front of the machine and journaled in bearings in suitable brackets d, projecting forwardly from the guide-rails for the work-support. The shaft D is provided adjacent to each of the guide-rails with a chain-wheel d', and similar chain-wheels d^2 are journaled on stud-shafts at the rear ends of the guide-rails. Parallel endless chains d^3 run on the several pairs of chain-wheels, and the bars constituting the work-support are bolted or otherwise

secured to the upper horizontal runs of the chains. The shaft D is provided with hand-wheels d^4 or other means for rotating it to operate the chains and move the work-support forwardly or rearwardly to properly position the sheet relative to the cutters.

E E′ and F F′ represent two pairs of feed-rolls for moving the sheet from which the blanks are cut longitudinally on the work-support. The feed-rolls of each pair are journaled at their front and rear ends in boxes or bearings in standards or brackets e f, rising from the side wings of the main frame. The boxes for the upper roll of each pair are movable vertically in guides in the standards toward and from the lower roll to set the rolls to enable them to properly operate upon material of different thickness and to enable the separation of the rolls of each pair for the purpose of moving the sheet between them to the cutters at the commencement of each cut. Any usual means may be employed for raising and lowering the upper rolls. In the construction shown the boxes for each upper roll are connected to the lower ends of vertical screw-shafts f', which are provided at their upper ends with sprocket-wheels f^2, connected by chains f^3. One of the screw-shafts for each upper roll is provided with a hand-wheel or other operating means f^4 for turning the screws to raise and lower the upper rolls.

The mechanism shown in the drawings for rotating the feed-rolls to move the sheet past the cutters is constructed as follows: G represents a horizontal drive-shaft, which is arranged transversely of and journaled in bearings on one of the side wings of the main frame. The drive-shaft is provided at one end with a drive-pulley or the like, g, and at its other end with a gear-pinion g', which meshes with and drives a gear-wheel g^2, secured to the projecting front journal of the lower feed-roll E of the adjacent pair. The journals at the front ends of the rolls E E′ are provided with intermeshing gear-pinions g^3 and g^4, which cause the feed-rolls to rotate in opposite directions, so that they properly grip and feed the sheet between them. The gear-pinion g^3 of the lower roll E also meshes with and drives one of a pair of intermeshing idle gear-wheels h h', which are journaled on stud-shafts at the front end of the main frame. The idle gear-wheel h' meshes with and drives an idle pinion h^2, which in turn drives intermeshing gear-pinions h^3 h^4 on the front journals of the other pair of feed-rolls F F′. By the described gearing both pairs of feed-rolls are rotated to properly feed the sheet on the work-support in either direction, according to the direction of rotation of the drive-shaft.

I represents the cutter-frame, on which are mounted the rotary cutting wheels or disks. The cutter-frame is preferably in the form of a yoke having upper and lower forwardly-projecting arms separated by an intervening slot or opening i, through which the sheet to be cut passes. The sheet is supported between the inner ends of two sections of the work-support by the side walls of the lower arm of the cutter-frame and a horizontal shelf or part i' at the front end of said lower arm of the cutter-frame. (See Fig. 2.) The cutter-frame is provided at its lower forward portion with a base or foot i^2, which rests upon a supporting-slide or bed-plate J. The cutter-frame is swiveled or pivoted to the slide by a vertical pivot j, secured to the foot of the cutter-frame and passing through an opening in the bed-plate or in any other suitable manner. The rear end of the cutter-frame is movably supported, so that it can swing on its pivot j, by rollers or casters j', which are journaled on studs secured to the cutter-frame and travel upon a track j^2, secured to the slide and curved concentric with said pivot for the cutter-frame. The slide for the cutter-frame is movable transversely forwardly and rearwardly upon the central portion of the main frame, for which purpose the latter is provided with a dovetailed track j^3, which engages in a correspondingly-shaped groove in the under side of the slide for the cutter-frame. It will thus be seen that the cutter-frame is swiveled so as to swing horizontally on the slide, and the latter and the cutter-frame are movable horizontally forwardly and rearwardly on the main frame.

K K′ represent, respectively, upper and lower rotary cutting wheels or disks, between which the material is passed to be cut by the shearing action of the cutter-disks. The upper cutter-disk is secured to the inner end of an inclined shaft k, which is journaled in a bearing-arm k^2, arranged in the upper arm of the cutter-frame, and the lower cutter-disk is secured to a substantially vertical shaft k', journaled in a bearing at the forward end of the lower arm of the cutter-frame, the arrangement of the cutter-shafts being such as to incline the cutter disks or wheels relative to each other in such a manner as to produce the proper shearing cut. For the purpose of adjusting the upper cutter relative to the lower cutter the bearing-arm for the upper cutter is hinged at its rear end to the cutter-frame by a pin k^3, and its front end is guided vertically between the sides of the upper arm of the cutter-frame.

k^4 represents an adjusting-screw which passes loosely through a hole in the top of the cutter-frame and engages in a threaded hole in the swinging bearing-arm. By turning the screw the forward end of the bearing-arm and the upper cutter are raised or lowered.

k^5 is a stop-screw which passes through a threaded opening in the top of the cutter-frame and bears against the top of the swinging bearing-arm.

The cutters are preferably driven positively to shear the material by the following mechanism: L l represent the two sections of a jointed or flexible drive-shaft for the cutters. The rear section L of the shaft is provided

with a drive pulley or wheel l', journaled in a bearing at the upper end of a standard l^{20}, rising from the rear end of the central portion of the main frame, and is connected by a universal joint l^2 to the rear end of the front section l of the drive-shaft, which is journaled in a bearing at the front end of the upper arm of the cutter-frame. The drive pulley or wheel l' is connected to the section L of the shaft to rotate the latter by a key engaging loosely in a keyway or groove l^3 in the said shaft-section, so that the shaft is free to move longitudinally through the hub of the pulley in the forward and rearward reciprocations of the cutter-frame and its supporting-slide. The universal joint connecting the two sections of the shaft is arranged axially in line with the vertical pivot about which the cutter-frame swings on its slide, so that the front section of the shaft can swing with the cutter-frame. The front section l of the drive-shaft is provided with a gear-pinion l^4, which meshes with and drives a gear-wheel l^5, secured to the front end of a shaft l^6, journaled in the swinging bearing-arm for the upper cutter. A gear-pinion l^7, secured to the gear-wheel l^5, meshes with and drives a pinion secured to the upper cutter-shaft. The shaft l^6 is provided at its rear end with a gear-wheel l^8, which drives a gear-wheel l^9, secured to the rear end of a shaft l^{10}, journaled in the lower arm of the cutter-frame and provided at its front end with a bevel gear-pinion l^{11}, which meshes with and drives a bevel gear-pinion l^{12}, secured to the lower cutter-shaft. The cutters may be driven by any other suitable gearing.

The slide for the cutter-frame is moved horizontally on its guide on the main frame by the following mechanism: M, Fig. 2, represents a slide-head, which is provided at its lower end with a guide groove or socket, into which extends a horizontal rib m, projecting from the side of the central portion of the main frame. The slide-head is provided with a rearwardly-projecting arm m', which is connected at its rear end to a depending bracket m^2, secured to a lateral projection on the supporting-slide for the cutter-frame. N represents a gear-wheel which is journaled on a stud-shaft at the side of the central portion of the main frame and is provided with an eccentric pin or roller n, which extends into a vertical way or slot n' in the slide-head, so that when the gear-wheel is rotated the slide-head and bed-plate are reciprocated horizontally.

The gear-wheel N is driven from the drive-gearing for the feed-rolls in the following manner: O, Fig. 2, represents a horizontal shaft, which is arranged transversely of the machine at one side of the central portion of the main frame and journaled in a bearing o on the central portion of the main frame and passes through a bearing p on a bracket P, which is secured to and projects laterally from the rear end of the supporting-slide for the cutter-frame. The shaft O is provided at its front end with a gear-wheel p', Fig. 3, which is driven from the train of gearing which drives the feed-rolls through the medium of a change-speed gear-wheel p^2. As shown, the change-speed gear p^2 is journaled on a stud or axle secured to an adjustable change-frame p^3, pivoted concentrically with the shaft O and provided with a slotted arm p^4, through which passes a securing bolt or screw secured to the main frame for holding the change-frame in adjusted position. The speed of the shaft O relative to that of the feed-rolls is dependent upon the size of the change-speed gear-wheel p^2, and the speed of said shaft can be changed as required by supplying a wheel p^2 of the proper size and properly adjusting the change-frame. The shaft O is provided with a bevel gear-wheel q, which meshes with a bevel gear-wheel q', journaled on a stud-shaft at the side of the central portion of the main frame and connected with a gear-wheel q^2, which meshes with and drives the gear-wheel N, which operates the slide for the cutter-frame. As the cutter-frame and sheet being cut move in directions at an angle to each other and the speed of the cutter-frame is variable owing to the fact that the cutter-frame is moved different distances for different portions of the revolution of its operating-wheel N, the cutters produce a curved cut, which by reason of the peculiar movement imparted to the slide-head M and cutter-frame by the wheel N is a true sinusoidal curve. As the wheel N is driven through the described gearing from the operating-gearing for the feed-rolls for the sheet being cut the said wheel N makes one complete revolution for a definite length of movement of the sheet, and as the speed of the wheel N can be changed by employing different change-speed gear-wheels p^2 it is evident that the wheel N can be caused to make a revolution and reciprocate the cutter-frame forward and backward once for any desired amount of longitudinal movement of the blank, thus adapting the machine to cut sinusoidal curves of any desired length and enabling the production of elbow-blanks for pipes and tubes of different diameters. The pin n of the wheel N is made adjustable radially of the wheel in any usual or desired manner for the purpose of changing the throw of the pin and movement of the cutter-frame to cut curves of different pitch.

The cutter-frame is automatically swung horizontally on its vertical pivot j for the purpose of maintaining the cutters always tangential to the line of cut by the following mechanism: R, Fig. 1, represents a toothed segment which is secured to the base or foot of the cutter-frame, and r a toothed rack the teeth of which engage the teeth of the segment. The toothed rack is formed on a rod which slides longitudinally in a bearing r' on the supporting-slide for the cutter-frame. The rear end of the rod is connected to or provided with a head r^2, having a longitudi-

nal guide-slot, through which projects an upright stud r^3 on the bracket P, secured to the slide. The head r^2 is provided with a transverse slot, into which projects a stud or collar *s*, secured eccentrically to a crank-disk S, which is secured to the upper end of a vertical shaft journaled in a bearing in the bracket P. The lower end of the crank-disk shaft is provided with a bevel gear-wheel s', which meshes with and is driven by a bevel gear-pinion s^2, journaled in the bearing *p* on the bracket P and provided with a key working loosely in a keyway or groove in the shaft O. The beveled pinion s^2 is driven by the shaft O, while the latter is permitted to move forwardly and rearwardly through the hub of the pinion in the reciprocations of the cutter-frame. The rotation of the crank-disk S causes the longitudinal reciprocation of the rack-bar, which as its teeth engage the teeth of the segment on the cutter-frame swings the latter on its vertical pivot. As the mechanism for swinging the cutter-frame on its pivot and reciprocating the cutter-frame are driven by the same gearing, it is only necessary to properly arrange and proportion the parts of the two mechanisms to cause the cutter-frame to swing back and forth and always maintain the edges of the cutters tangential to the line of cut.

T represents an index-wheel which is journaled on a stud-shaft at the front of the machine and is provided with gear-teeth, with which mesh the teeth of a gear-wheel *t*, driven from the shaft O by the gear-wheel p', at the front end thereof, or by other suitable gearing. The wheel T makes one revolution for each revolution of the wheel N, which operates the slide for the cutter-frame, and its face is provided with marks and characters which indicate the position of the cutters at any part of their operation. This wheel indicates to the operator when the cutters are in the proper position to commence cutting a blank.

The operation of the machine is as follows: Assuming the machine to be at rest with the cutters in position to commence the cut, the upper roll F′ of the pair of feed-rolls F F′ is raised sufficiently to permit the sheet from which the blanks are to be cut to be placed on the work-support at one side of the machine and the inner end of the sheet to be passed between the feed-rolls into engagement with the cutter disks or wheels K K′. The feed-roll F is then lowered into contact with the sheet and the machine set in operation. Through the described drive-gearing the feed-rolls are rotated to feed the sheet longitudinally on the work-support and the rotating cutter disks or wheels cut the sheet. As the sheet moves on the work-support the slide J for the cutter-frame I and the latter are reciprocated by the wheel F and slide-head M transversely of the direction of movement of the sheet with such speed relative to the speed of movement of the sheet on the support as to cause the cutter-disks to produce a sinusoidal cut, as indicated by the drawings. The cutter-frame is also swung on its vertical pivot J by the described mechanism, so that the cutter-disks are always maintained tangential to the curve of the cut. When it is desired to cut a curve of different pitch or of different length, it is only necessary to provide a change-gear wheel p^2 of the proper size and adjust the wrist-pin of the wheel N. The sheet can be introduced into the machine from either side, thus enabling the sheet to be run through in one direction to make one cut and then returned in the opposite direction for the next cut, it only being necessary to reverse the direction of rotation of the driving-shafts.

While a sheet-metal-shearing machine having positively-driven rotary cutters has been described, it is manifest that for some materials a fixed or non-rotary knife could be employed on the cutter-frame in place of the rotary cutters, or it might be desirable to use the machine simply for tracing or marking the curves on the material, in which case a marking device would be substituted for the cutters.

I claim as my invention—

1. The combination of a cutting device which is movably mounted, feeding means for imparting a rectilinear motion to the work to be cut, gearing for operating said feeding means, and gearing operated by said first gearing for imparting a rectilinear motion to said cutting device in a direction at an angle to the direction of movement of the work, substantially as set forth.

2. The combination of feeding means for the work, a cutting device which is movably mounted, and gearing for operating said feeding means and cutting device to impart a rectilinear movement to the work and a simultaneous rectilinear movement to said cutting device in a direction at an angle to the direction of movement of the work whereby the cutting device produces a curved cut, substantially as set forth.

3. The combination of feeding means for the work, a cutting device which is movably mounted, and gearing for operating said feeding means and cutting device to impart a rectilinear movement to said work and a simultaneous rectilinear movement to said cutting device in a direction at an angle to the direction of movement of the work, said cutting device having a variable rectilinear movement whereby the cutting device produces a curved cut, substantially as set forth.

4. The combination of feeding means for the work, a cutting device which is movably mounted, and gearing for operating said feeding means and cutting device to impart a rectilinear movement to the work and a simultaneous rectilinear movement to the cutting device in a direction at an angle to the direction of movement of the work, whereby the cutting device produces a curved cut, and

means for shifting said cutting device whereby the same is maintained tangential to the line of cut, substantially as set forth.

5. The combination of feeding means for the work, rotary cutters, operating means for said cutters, and gearing for operating said feeding means to impart a rectilinear movement to the work and a simultaneous rectilinear movement to said cutters in a direction at an angle to the direction of movement of the work, said cutters having a variable rectilinear movement, substantially as set forth.

6. The combination of feeding means for the work, rotary cutters, operating means for said cutters, gearing for operating said feeding means to impart a rectilinear movement to the work and a simultaneous variable rectilinear movement to said cutters in a direction at an angle to the direction of movement of the work, and means for shifting the cutters to maintain the same tangential to the line of cut, substantially as set forth.

7. The combination of feeding means for the work, a cutting device which is movably mounted, gearing for operating said feeding means to impart a rectilinear movement to the work, a wheel operated by said gearing, a device connected to said cutting device and having a movable eccentric connection with said wheel whereby the rotary motion of said wheel imparts a variable rectilinear motion to said cutting device simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, substantially as set forth.

8. The combination of feeding means for the work, gearing for operating said feeding means to impart a rectilinear movement to the work, a cutting device, a slide carrying said cutting device and movable in a direction at an angle to the direction of movement of the work, a wheel operated by said gearing and having an eccentric-pin, a slide-head connected to said slide and having a slot in which said eccentric-pin works, whereby the rotary motion of said wheel imparts a variable rectilinear motion to said slide simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, substantially as set forth.

9. The combination of feeding means for the work, gearing for operating said feeding means to impart a rectilinear movement to the work, a cutting device, a cutter-frame in which said cutting device is mounted, a slide on which said cutter-frame is pivoted and which is movable in a direction at an angle to the direction of movement of the work, a wheel operated by said gearing and having an eccentric-pin, a slide-head connected to said slide and having a slot in which said eccentric-pin works whereby the rotary motion of said wheel imparts a rectilinear movement to said slide simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, and means for swinging said cutter-frame on said slide to maintain the cutting device tangential to the line of cut, substantially as set forth.

10. The combination of feeding means for the work, gearing for operating said feeding means to impart a rectilinear movement to the work, a cutting device, a cutter-frame on which said cutting device is mounted, a slide on which said cutter-frame is pivoted and which is movable in a direction at an angle to the direction of movement of the work, a wheel operated by said gearing and having an eccentric-pin, a slide-head connected to said slide and having a slot in which said eccentric-pin works whereby the rotary motion of said wheel imparts a rectilinear movement to said slide simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, a crank-wheel operated by said gearing and having an eccentric-pin, a slide-rack bar having a slot in which said pin works and a toothed segment secured to said cutter-frame and operated by said rack-bar to swing said cutter-frame on said slide, substantially as set forth.

11. The combination of feeding means for the work, gearing for operating said feeding means to impart a rectilinear movement to the work, a slide movable in a direction at an angle to the direction of movement of the work, a wheel operated by said gearing and provided with an eccentric-pin, a slide-head connected to said slide and having a slot in which said eccentric-pin works whereby a variable rectilinear movement is imparted to said slide simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, and a device carried by said slide and which traces a curved path on the work, substantially as set forth.

12. The combination of a work-support, feed-rolls, gearing for operating said feed-rolls to impart a rectilinear movement to the work, a cutting device which is movably mounted, a wheel operated by said gearing, a device connected to said cutting device and having a movable eccentric connection with said wheel whereby the rotary motion of said wheel imparts a variable rectilinear motion to said cutting device simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, substantially as set forth.

13. The combination of feeding-rolls for the work, gearing for operating said feeding-rolls to impart a rectilinear movement to the work, a cutting device, a cutter-frame on which said cutting device is mounted, a reciprocating slide on which said cutter-frame is pivoted, a wheel operated by said gearing, a device connected to said slide and having a movable eccentric connection with said wheel whereby the rotary motion of said wheel imparts a rectilinear motion to said slide simultaneously with the movement of the work and in a di-

rection at an angle to the direction of movement of the work, and means for swinging said cutter-frame on said slide, substantially as set forth.

14. The combination of a work-support, means for adjusting the same horizontally, feeding-rolls for the work, gearing for operating said feeding-rolls to impart a rectilinear movement to the work, a cutting device which is movably mounted, a wheel operated by said gearing, a device connected to said cutting device and having a movable eccentric connection with said wheel whereby the rotary motion of said wheel imparts a variable rectilinear motion to said cutting device simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, substantially as set forth.

15. The combination of feeding means for the work, gearing for operating said feeding means to impart a rectilinear movement to the work, a cutting device which is movably mounted, a wheel operated by said gearing, a device connected to said cutting device and having a movable eccentric connection with said wheel whereby the rotary motion of said wheel imparts a variable rectilinear motion to said cutting device simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, and an index-wheel driven by said gearing and provided with means to indicate the position of said cutting device, substantially as set forth.

16. The combination of feeding means for the work, gearing for operating said feeding means to impart a rectilinear motion to the work, a cutting device which is movably mounted, a wheel, gearing including a change-speed gear between said first-mentioned gearing and said wheel, a device connected to said cutting device and having a movable eccentric connection with said wheel whereby the rotary motion of said wheel imparts a variable rectilinear motion to said cutting device simultaneously with the movement of the work and in a direction at an angle to the direction of movement of the work, substantially as set forth.

Witness my hand this 30th day of April, 1903.

EDMUND ZEH.

Witnesses:
JNO. J. BONNER,
C. M. BENTLEY.