3 Sheets—Sheet 1.

W. & C. SELLERS.
Punching Machine.

No. 236,096. Patented Dec. 28, 1880.

Fig. 5.

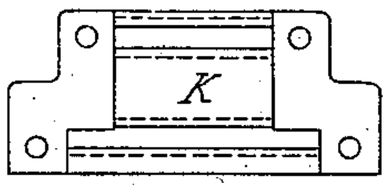


Fig. 6.

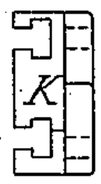


Fig. 9.

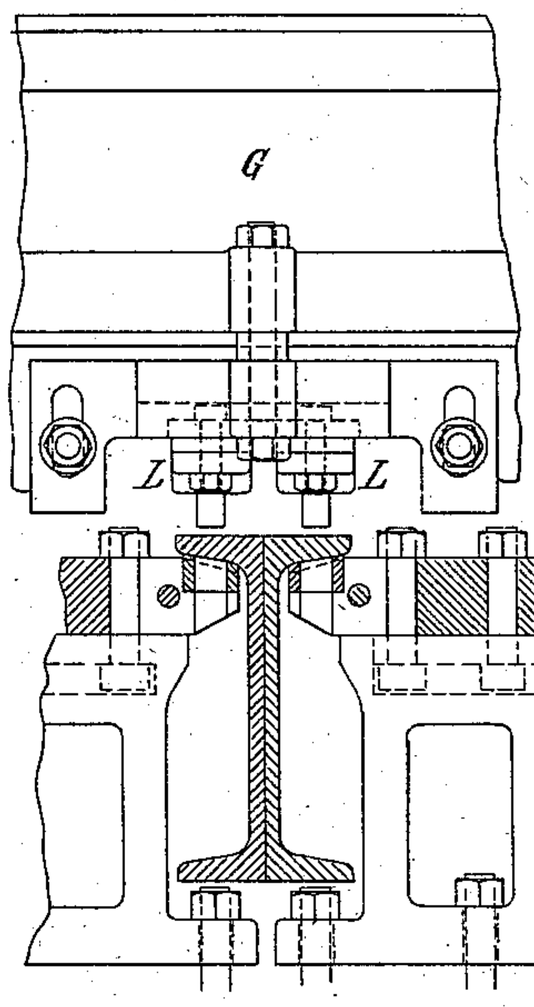


Fig. 8.

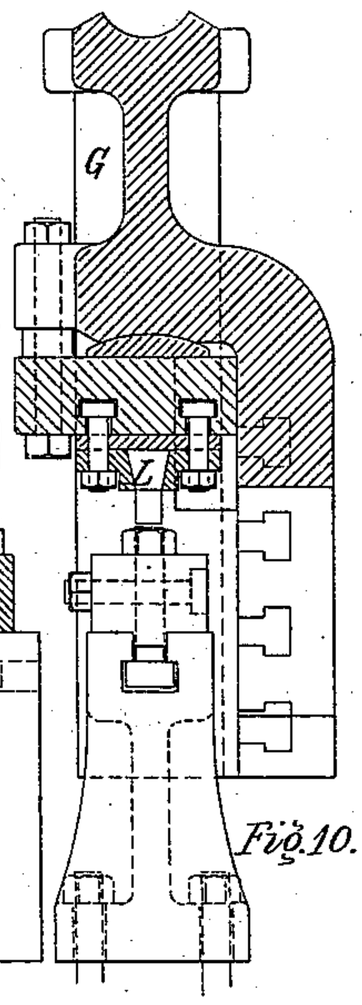


Fig. 10.

Fig. 4.

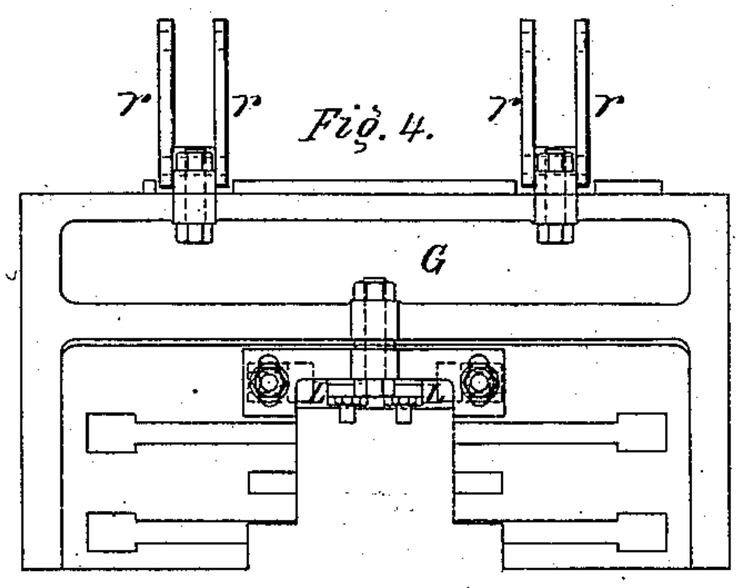


Fig. 1.

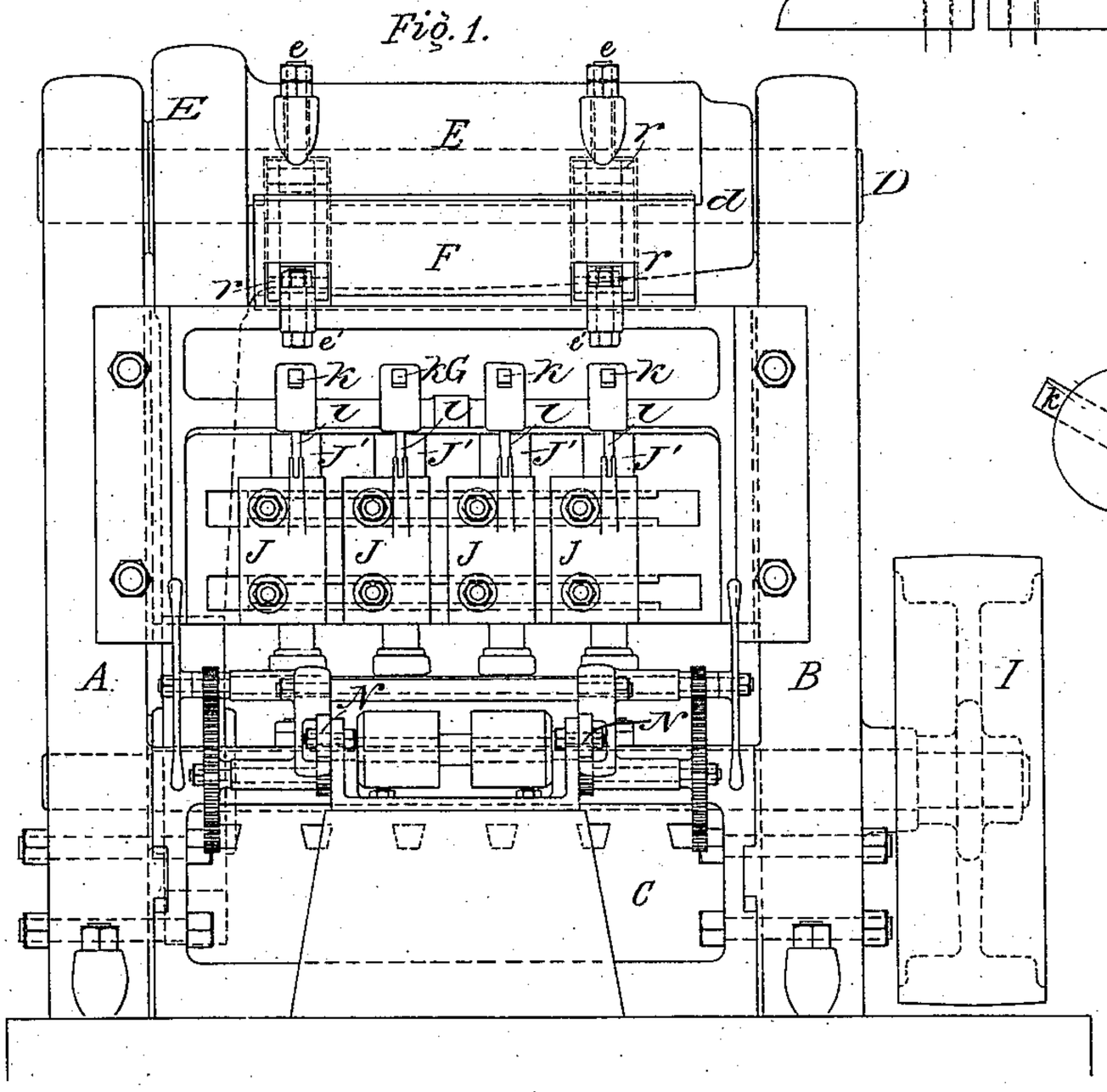
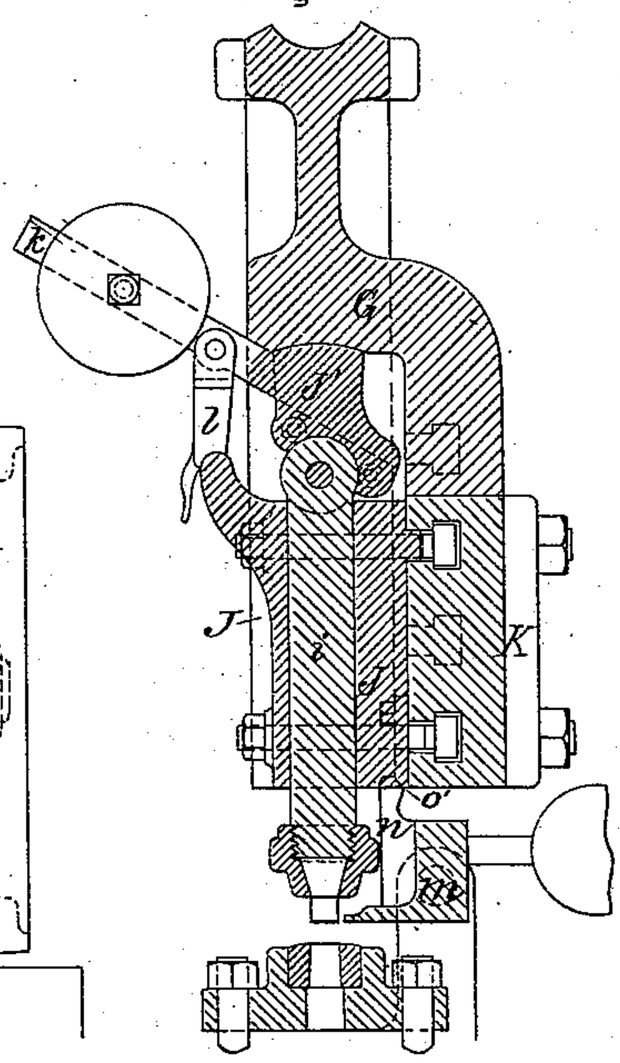


Fig. 7.



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Wm. Sellers
Coleman Sellers

3 Sheets—Sheet 2.

W. & C. SELLERS.
Punching Machine.

No. 236,096. Patented Dec. 28, 1880.

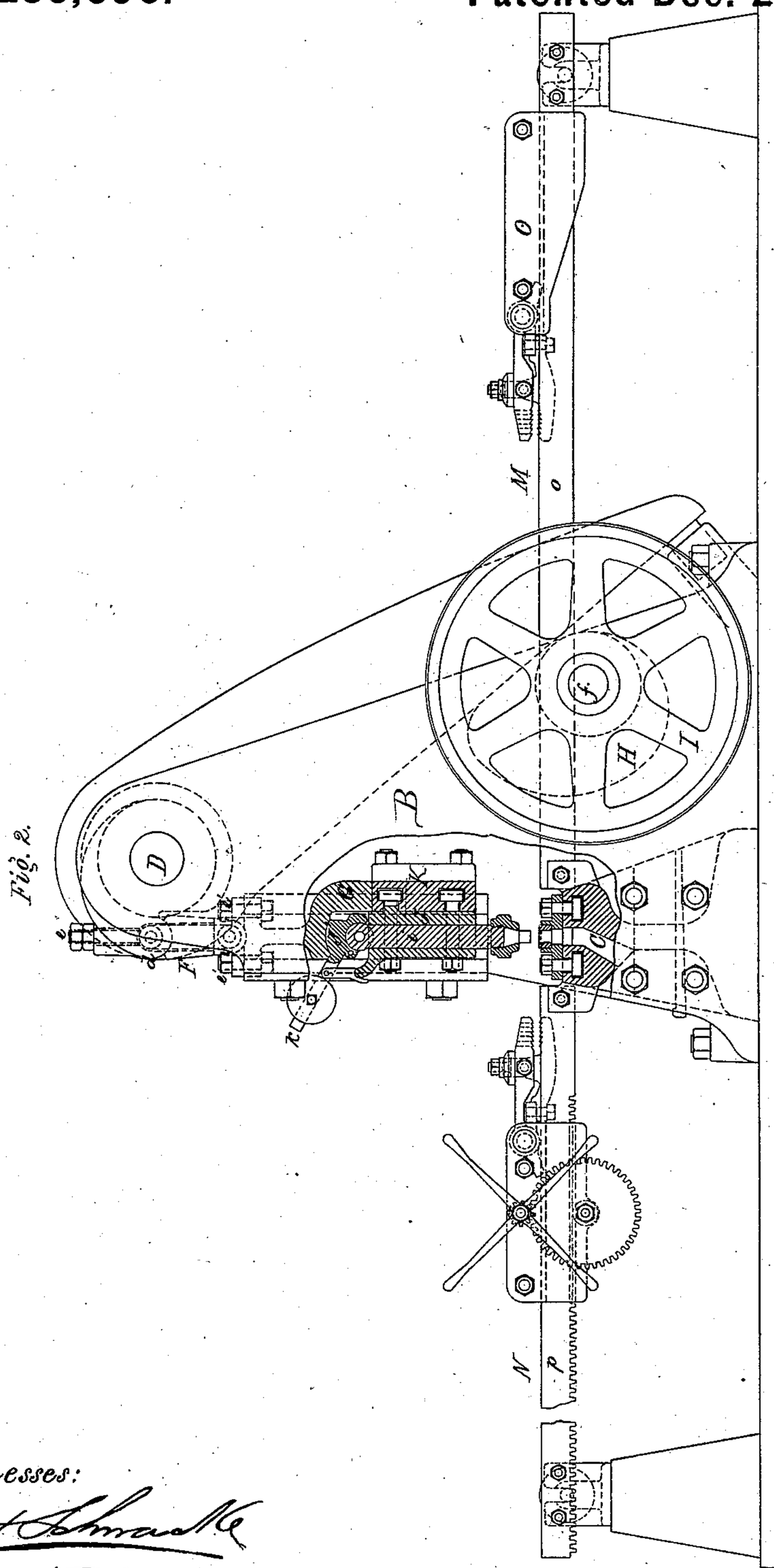

Fig. 2.

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3 Sheets—Sheet 3.

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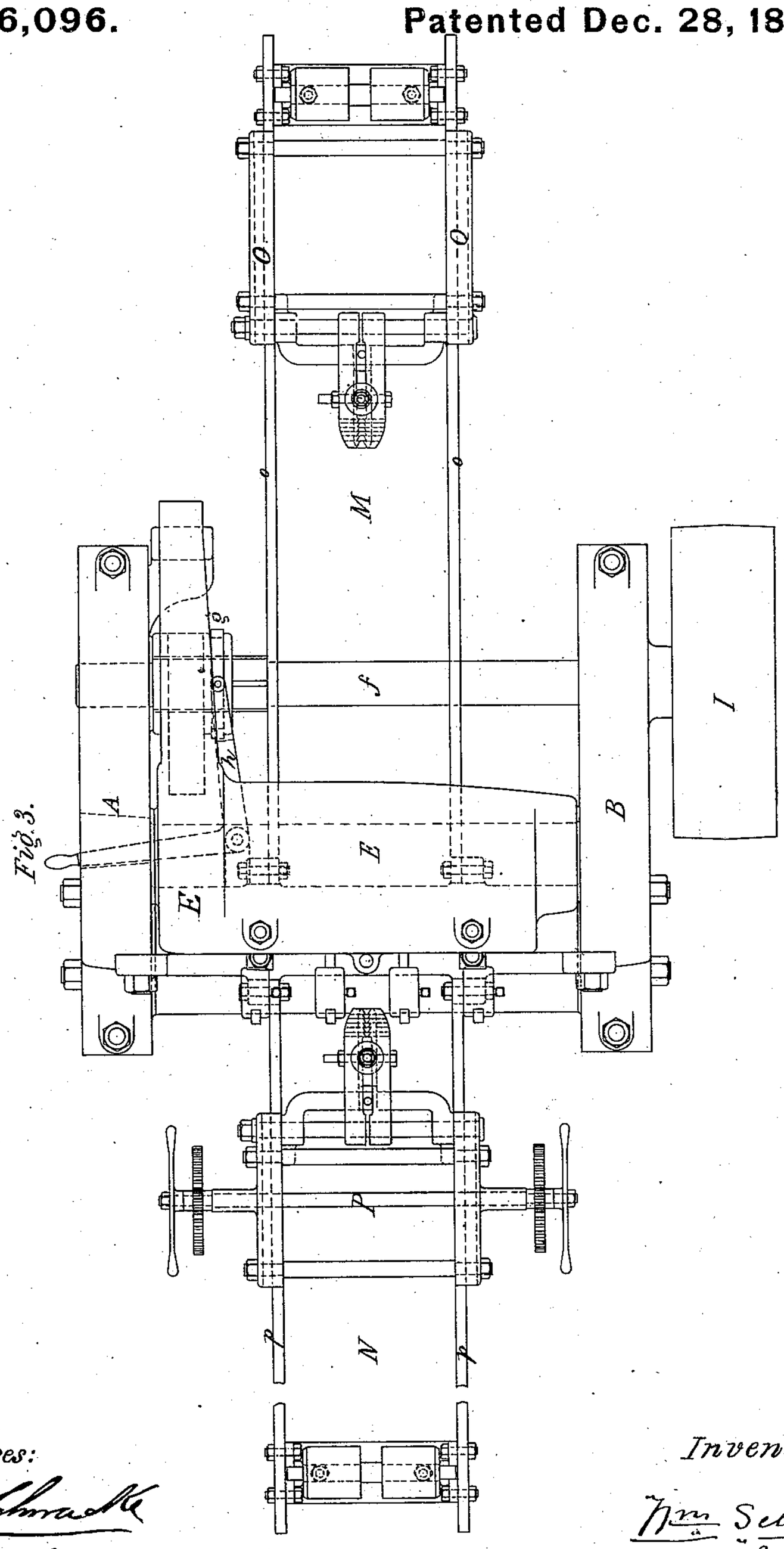

Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM SELLERS AND COLEMAN SELLERS, OF PHILADELPHIA, PA.; SAID COLEMAN SELLERS ASSIGNOR TO JOHN SELLERS, JR., OF SAME PLACE.

PUNCHING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 236,096, dated December 28, 1880.

Application filed September 24, 1877.

To all whom it may concern:

Be it known that we, WILLIAM SELLERS and COLEMAN SELLERS, of the city and county of Philadelphia, in the State of Pennsylvania, have jointly invented certain new and useful Improvements in Punching-Machines, of which improvements the following is a specification, reference being had to the accompanying drawings, forming part of this specification, in which similar letters refer to similar parts.

In punching iron for engineering structures, such as bridges, roof-trusses, and viaducts, and in various kinds of boiler and tank work, it frequently occurs that, in addition to the ordinary lines of equally-spaced holes, other holes are required outside of these lines, which heretofore it has been requisite to punch by a secondary operation, necessitating additional handling of the material.

In punching plates it is usual to clamp them upon a table and punch one edge at a time, so that the table becomes the guide for the alignment of the holes in the plate. In some cases, where the edges of the plates are parallel and straight, these edges are passed between stationary guides fastened upon the bed of the machine, or upon the stripper, which is secured to the bed, these guides being at the proper lateral distance from the punching-die and from each other, so that the edges of the plate become the guide for the alignment of the holes; but this is only admissible in narrow plates that have been rolled in grooves; or, if wider than admissible for grooves, in what is technically known as a "four-roller mill." In other cases, where the edges of the plates are not sufficiently true, the plate has been guided through the punching-machine by guiding-carriages at each end of the plate. By far the largest proportion of wide plates are now rolled wider than required, and their edges are sheared to bring the plate to the proper width. In all such plates, and in many of the others, the edges are not sufficiently true to serve as guides for the punching, and for such the reciprocating table has been the guide heretofore generally used, though its use involves the loss of time required to move it back to the place of beginning for each row of holes in the plate, as well as loss of time in adjusting the plates thereon, and as but one side of the plate can be punched at each pass the liability of error in adjustment upon this table is very great.

It is the object of our invention to provide a means for punching irregularly-occurring holes, as well as the regular lines of holes, during a single passage of the work through the machine, so as to lessen the handling, and at the same time insure greater accuracy in the location of such holes; and it is our further object to punch all the holes that may be required between the two edges of any plate during a single passage of such plate through the machine, instead of moving the plate back and forth, or laterally, so that the spacing-machinery may be subjected to strain in one direction only, and thus insure greater accuracy in the spacing; and it is our further object to punch all the cross-lines of holes required for stiffness or for splicing the ends of plates for girder work during the one passage of the plate through the machine, and to punch the longitudinal lines of holes so as to insure that these cross-lines of holes shall be at right angles with the longitudinal lines of holes; and it is our further object, while avoiding the use of a reciprocating table, and the clamping of plates thereon, to give the plate a true direction in its passage through the machine without depending upon the edges of the plate to give this true direction; and it is our further object, in a machine adapted to the foregoing requirements, to provide a means for punching the flanges of channel-bars or the tables of beams, in addition to its capacities for the purposes before named.

To these ends our invention consists, first, in combining a rectangular beam carrying a series of punches and moving vertically in guiding-uprights with devices for maintaining the parallelism of the beam to the dies; second, in combining with the punching-beam a series of punch-holders laterally adjustable upon the side of the beam; third, in combining with the series of punch-holders a corresponding series of devices whereby any or all of the punches, each independently of the others, may be thrown into or out of action without affecting the movement of the punch-beam;

fourth, in providing each of the punches with an independent locking device, whereby the action of the punch is assured and maintained until it is again unlocked; fifth, in combining the punch-bar holders, whereby the locations of the holes across a plate are determined, with a feeding and spacing carriage, whereby the locations of the holes longitudinally in the plate are determined; sixth, in combining a series of laterally-adjustable locking punch-bars, whereby one or more of the punches may be put in action at will, with the feeding and spacing carriage, whereby the locations of the holes longitudinally in the plate are determined, so that irregularly-occurring holes may be punched both lengthwise and crosswise of the plate; seventh, in a peculiar construction of the punching-beam, whereby it may be used for punching plates or for punching channels or I-beams; and, eighth, it further consists in providing a device to hold the plate while the punches are entering, passing through, and withdrawing from it, and then leave it free for the operation of the feeding and spacing apparatus.

In the accompanying drawings, Figure 1 is a front elevation of our punching-machine with its feeding and spacing carriages and guides. Fig. 2 is a side elevation of the same, partly in section. Fig. 3 is a plan of the same. Fig. 4 is a front elevation of the reciprocating punch-beam which carries the punch-holders, showing this beam as used for punching channels or I-beams, and also showing the link-connection which sustains it. Fig. 5 is a front elevation of the central section removed from Fig. 4, and to be replaced when the beam is used for punching plates. Fig. 6 is a side elevation of Fig. 5. Fig. 7 is an enlarged side elevation of the punch-beam, shown in vertical section and through the axis of a punch-holder. Fig. 8 is an enlarged vertical section through the center of the punch-beam, showing the position of the punches and dies and the mode of attaching the punches to the beam for the purpose of punching channels. Fig. 9 is a front elevation of the same, and showing, in end section, two channels in position for punching. Fig. 10 is a side elevation of a die-holder for punching channels or beams, the front elevation of which is shown in Fig. 9.

The punching-machine is composed of two principal uprights, A and B, firmly united at their lower ends by a strong cross-girt, C, which we call the "die-beam," and upon the top of which the dies are adjusted and securely fastened, the bases of the uprights A B and cross-girt C being flanged outward to give them a broad footing or support upon a heavy foundation-stone.

The upper ends of the uprights A and B are bored out to receive the ends of the pin D, about which and between the uprights A and B the lever E vibrates. This lever has cast upon one side of it a long hub, which, with the lever, extends across the space between the uprights, and fits accurately upon the pin D. The punch-beam G is rectangular in form and slides freely between the uprights A and B, which are provided with guides so arranged as to permit only a vertical movement to the punch-beam G.

The hub, cast upon one side of the lever E, must be of sufficient diameter and thickness to prevent the possibility of twisting under the torsional strain to which it is or may be subjected in case the punching should be required at the end of the punch-beam G farthest from the lever E, and so that this lever may be the efficient means, as it is the only one, for maintaining parallelism between the punch-beam G and the dies. This lever E, with its hub, we call the "squaring-lever," and upon one side of the hub we cast a convex semi-cylindrical projection, *d*, which must be dressed up true and with its axis parallel to and in the same plane with that of the axis of the pin D, and upon this projection the upper and concave surface of the vibrating frame F is fitted. The lower and convex surface of this frame is also semi-cylindrical and fits into a corresponding concave formed in the top of the punch-beam G. The concave and convex surfaces on the upper and lower sides, respectively, of the frame F are held in contact, but so as to be moved freely by the links *r r*, Figs. 1, 2, and 4, which vibrate about pintles held by bearing-blocks on the top of the punch-beam G, and in the axis of the concave surface in which the frame F vibrates. The other ends of these links are attached to pintles held in the axis of the convex surface *d* on the hub of the squaring-lever E by the bolts *e e*, Figs. 1 and 2. The length of the links from center to center of the pin-holes corresponds to the distance between the axis of the convex surface and that of the concave surface on the vibrating frame F. The bolts *e e* are adjustable, to determine the freedom of movement between these convex and concave surfaces.

The punch-beam G may be modified in form so as to receive a shearing-blade on its front face in place of the punch-holder, hereinafter described; and the top of the cross-girt C may likewise be modified so as to receive a corresponding blade in place of the dies before mentioned, as will be evident to every skilled mechanic, the operation of the squaring-lever being such as to maintain the blades in proper relation when cutting in any portion of their length, and the arrangement such as will permit trimming the edge of any plate, however long, and cutting any length from any plate that would pass between the lever-arm and the upright. Motion is communicated to the lever E, and through it to the punch-beam, by means of the cam H, fitted so as to slide freely upon a square portion of the shaft *f*, which, while permitting it to slide longitudinally, compels it to turn with the shaft. The drawings, Fig. 3, represents this cam in position for punching, and to stop the punching motion the cam is moved longitudinally upon the shaft, by

means of the loose collar *g* and lever *h*, a sufficient distance to carry the cam beyond the lever E, so as to permit the lever to remain at rest while the cam and its shaft are in motion, actuated from the prime mover by means of a belt upon the pulley I on the end of the shaft *f*. This system of driving through the intervention of the cam and lever has great advantages over the more direct one of the eccentric, and particularly so in a machine of this character, where the work to be moved under the punches is generally large, and the holes to be punched at each stroke are numerous.

With the cam and lever the punching motion may take place through equal spaces in equal times, and the return-stroke may be as rapid as desired, so as to permit the punches to remain at rest or to "dwell" while the work is being moved under them. It consequently requires but about half the stroke of the eccentric punch, which must make its punching and return stroke in the same time, without pause between, so that to give the requisite time for moving the work the stroke must be increased, and the number of strokes per minute and the number of holes punched correspondingly decreased.

The punch-beam G is recessed to receive the punch-bar holders, so as to bring the centers of the punches under the center of the socket on the top of the punch-beam, so as thereby to bring all the strains in the same plane, and this recess is provided with two slots to receive the bolt-heads, which attach the punch-bar holders to the punch-beam in such manner that the punch-bar holders may be secured in any position across the face of the punch-beam, and sufficient depth may be afforded for the use, as hereinafter described, of punch-bars or spindles, to which the punches may be attached, so that they can be changed, or, if broken, replaced without disturbing the adjusted positions of the holders and without removing the punch-bars.

The punch-bar holder consists of a casting, J, planed off on the back to fit upon the recessed face of the punch-beam, and having a tongue upon this side, which fits into one of the bolt-slots, which tongue determines the vertical position of the holder. This holder J is bored out parallel with the planed back and at right angles to the tongue, so as to receive the punch-bar or spindle *i*, which is fitted accurately therein, but so as to play freely in an axial direction. The top of this spindle is provided with a cylindrical head, upon which the socket-head J′ vibrates freely. The upper end of this socket-head is wider than the cylindrical end of the punch-bar spindle *i;* but for a short distance above this spindle each side of the socket-head is cut away, so that the socket is the same width as the cylindrical head of the punch-bar spindle *i*, and in the recesses formed by this cutting away on either side of the socket-head we fit plates, which are secured by countersunk screw-bolts to the socket-head, as shown by dotted lines in Fig. 7. These plates extend down so as to embrace the cylindrical head on the punch-bar spindle *i*, and their edges are dressed to exactly conform thereto, and through the center of these plates and the cylindrical heads of the punch-bar spindle *i*, a pin is passed to secure the socket-head and spindle together and permit them to play freely about the axis of the pin, as in a rule-joint. The upper end of this socket-head J′ is formed in a segment of a circle struck from the center of the pin, and fits, when in the position shown in Fig. 7, into a corresponding recess in the punch-beam.

The punch-bar holder J is cut out at the top to fit the plates which connect the cylindrical head of the spindle *i* to the socket-head, so that when the socket-head is in the position shown in Fig. 7—that is, for punching—the plates fitting over the top of the punch-bar holder will withdraw the punch from the work as the punch-beam rises.

A weighted lever, *k*, is attached securely to the socket-head J′, and is provided with a latch, *l*, which, when the lever is raised, will fall and catch upon a projection provided for that purpose upon the punch-bar holder J, and in this position the socket-head and punch-bar will be securely locked, so as to transfer the motion and pressure from the punch-beam G, through the punch-bar *i*, to the punch. The length of the socket-head J′ must be such that when the latch *l* is released the weighted lever, falling upon the projection from the punch-bar holder J, can raise the punch-bar *i* a distance about equal to the stroke of the punch-beam G.

In place of the weighted lever and latch a crank-shaft attached to the punch-bar holder, with a connecting-rod to the socket-head, may be used, so that when the socket-head is in position for work the crank will have passed a line drawn from the point of connection with the socket-head to the center of the crank-shaft, in which position no pressure upon the socket-head can force it outward, and it will thus be securely locked in proper condition for working the punch.

The punch may be secured to the punch-spindle by any of the well-known devices for this purpose, and the spindle itself may be rectangular or round, as may be found most convenient. When round we prefer to form an enlarged conical end upon the punch, and hold this end against the punch-spindle by means of a socket-nut, as shown in Fig. 7.

The dies are secured in any position transversely upon the die-beam C by bolts fitting into slots provided for this purpose on the top of this beam, as shown in Fig. 2.

The punchings fall first into pockets in the die-beam, having inclined sides which direct them to the openings at the bottom and in front of this beam, as shown in Fig. 1.

To strip the plates off the punches and to allow as much height between the stripper and the dies as is possible, we provide a vi-

brating stripper-bar, *m*, which is supported at each end in journals bolted upon the die-beam C, and is counterweighted, so as to raise the edge of the bar next the punches. Upon one end of the bar *m* an arm, *n*, is provided, which is operated by a short inclined plane, *o'*, upon the recessed face of the punching-beam G. The top of this inclined plane is extended parallel to the face of the punch-beam, so that the descent of this beam will force the arm *n* away from the beam and depress the stripper-bar until the end of the arm *n* has passed the top of the inclined plane, when the parallel extension of this plane will hold the arm *n* in this position until the ascent of the punch-beam carries the inclined plane above the end of the arm *n*, when the counter-weight will raise the stripper-bar, and the whole is adjusted so that the depression of the stripper-bar will take place just before the punches strike the work, and its release and elevation will take place just after the punches are drawn out of the plate.

The arrangement thus far described is adapted to punching plates or material of low vertical section only; but to adapt the machine for punching the flanges of channels or the tables of **I**-beams, as well as for plates, we provide an opening in the recessed portion of the punch-beam G, of sufficient height to permit the passage of the largest piece which it is intended to operate upon, as shown in Fig. 4, and in this opening is fitted the removable piece K, Fig. 5. This piece is securely bolted in position, as shown in Fig. 7, and is so constructed that when in position the recessed portion of the punch-beam G will present the same appearance as first described, and will be capable of receiving and securing the punch-holders in any position, transversely, as before. To punch channel or **I** beams this removable piece K is taken out and a punch-holder, L, is bolted in the top of the opening, as shown by Figs. 4, 8, and 9, and to raise the dies to the proper height we provide die-holders, as shown in Fig. 10, which can be securely bolted to the die-beam C in the proper transverse position.

It will be seen that by having the middle section of the punch-beam removable we obviate the necessity of removing the beam itself and substituting another with every change from plates to channels, or vice versa.

To guide and space the work as it passes through the machine we provide the guiding-rack M, secured to the back of the die-beam C, from which side the material to be punched enters, and the spacing-rack N, secured to the front side of this beam. These racks are each composed of two wrought-iron bars, *o o* the guiding and *p p* the spacing rack, planed up true and supported in castings which maintain them at the proper distance apart, which castings also carry rollers to maintain the plate at the proper height and facilitate its movement. These castings are bolted upon substantial foundations, and between them we provide thimbles extending from one bar to the other, at intervals, to more effectually maintain the parallelism of the bars.

The guiding-rack may be constructed of cast-iron, if desired, but the spacing-rack must be composed of the same material as that which the machine is intended to punch, in order to compensate for variations caused by the variations in the temperature of the atmosphere.

Upon the guiding-rack a suitable carriage, O, is mounted so as to slide freely thereon without lateral play, and the front of this carriage is provided with one or more gripers, by means of which the plates to be passed through the machine can be securely attached to this carriage.

The bars composing the spacing-rack N are provided with teeth upon their lower edges, which should be accurately cut, as upon their degree of accuracy may depend the accuracy of the spacing in the finished work. Upon this rack a feeding and spacing carriage is mounted, which has upon each side a short shaft, carrying upon the inner end a pinion, gearing into the teeth on the under side of each bar which composes the spacing-rack, and upon its outer end a wheel which gears into a pinion near each end of the cross-shaft, P, and on the ends of this shaft crank-handles are placed for moving the spacing-carriage. This cross-shaft thus becomes a squaring-shaft, to advance the carriage upon the spacing-rack without vibrating it thereon. The required movement of this carriage may be determined by ratchets secured upon the racks as in the ordinary spacing-table; or, its movement may be determined by revolutions and parts of a revolution imparted to the crank-handle, as in the dividing machinery for gear-cutting machines.

The plate being secured to the guiding-carriage at one end and to the spacing-carriage at the other, and resting upon the rollers in the guiding and spacing racks, as well as upon the dies, cannot move transversely in any part of its length without buckling the plate; and as it is drawn forward by the feeding and spacing carriage in a straight line, there can be no disturbing force exerted upon it sufficient to cause buckling. The punching can therefore be executed with certainty in the line of motion of the two carriages.

In punching long plates or bars, such as are required in bridge-work, in which great variations in spacing often occur in the same plate or bar, (and a series of such plates or bars is common,) it is convenient for the workman with the first of the series to mark with chalk (upon a board placed between the spacing-racks for this purpose) the commencement of any change in the spacing, so that thereafter, without consulting his drawing, he may adjust his spacing apparatus to the new spacing when his spacing-carriage reaches the proper point for such change. With a stationary spacing apparatus moving any guiding-carriage, this

would be practically impossible, and this consideration alone is of sufficient importance to determine the necessity for a traversing spacing-carriage.

To operate the machine, a sufficient number of punch-bar holders, with punches to punch all the holes which may be required in the plate transversely, are bolted upon the recessed face of the punch-beam, and these are spaced transversely to suit the position of the holes in that direction, and a similar number of die-holders with dies are bolted in corresponding positions on the top of the die-beam. The plate to be operated upon is then secured to the feeding and spacing carriage at one end and to the guiding-carriage at the other, the spacing-carriage being so arranged that all the longitudinal divisions may be obtained in operating it. When all the weighted levers *k* are raised and latched in position all the punches will operate with every stroke of the punch-beam; but whenever it is desired to stop the operation of any punch the corresponding latch must be released, when the weighted lever will fall and raise the punch, so that it will not then reach the plate when the punch is down. The operator can thus punch any number of holes transversely within the capacity of the machine at each stroke of the punch-beam; or, if he should deem the number required would produce too great a strain upon the machine, he can punch any proportion of the whole at one stroke, and, without moving the spacing-carriage, the remaining ones can be punched at a subsequent stroke or strokes.

In this machine we embody a mode of operation new in the following respects: The workman operating the adjusted spacing-carriage feeds the plate according to the spaces between the holes to be punched, while the workman operating the punching-machine punches the plate with any or all the punches in whatever transverse or longitudinal plan is required, varying the number of punches in action at the same time, or alternating the action of the punches severally by simply releasing or engaging the latches during the dwell at the top of the stroke which the cam-motion affords. Placing the two channel-bars back to back, as shown in Fig. 9, forms no part of the invention herein claimed.

We are aware that a punching-machine has been described with a punching-beam on which the punch-holders are adjustable laterally; but in that case the punch-holder is placed and adjusted upon the under side of the beam, and the punch projects from this holder necessarily to a greater distance below the beam than in our machine. In that construction a punch bar or spindle to which the punches could be attached, as in our machine, is not contemplated, and whenever a punch is to be changed or replaced it can only be done by detaching the punch-holder from the beam. The complicated attachment in that case occasioned loss of time in making this change, and in addition to removing and replacing the punch-holder it is necessary to readjust it to its position, all of which is avoided by our improved construction, in which the recessed side of the punch-beam admits of the use of an adjustable punch-bar holder, as already described, and still brings the punches in the line of strains.

Having thus described the object and nature of our improvements in punching and shearing machines, what we claim as new, and desire to secure by Letters Patent, is—

1. The combination of guiding-uprights, a punching or shearing beam, a fixed shaft, a vibrating frame, and a squaring-lever vibrating about the fixed shaft, substantially as described.

2. The combination of the punching-beam, recessed upon one side, and the punch-bar holder, laterally adjustable upon this recessed side, substantially as and for the purposes set forth.

3. The combination of a punch-beam, a punch-bar holder laterally adjustable upon the side of the beam, a punch-bar, and a vibrating socket-head, substantially as and for the purposes set forth.

4. The combination of a punching-beam, a punch-bar, a vibrating socket-head, and a locking device, the combination being and operating substantially as described.

5. The combination, with a punching-machine and a spacing-rack, of a feeding and spacing apparatus which traverses the spacing-rack, substantially as and for the purposes set forth.

6. The punching-beam having a removable central section, substantially as and for the purposes set forth.

7. The combination of the punching-beam, the inclined plane *o'*, and the vibrating stripper-bar, substantially as and for the purposes set forth.

WM. SELLERS.
COLEMAN SELLERS.

Attest:
JNO. H. SCHWACK,
H. A. FULTON.