

No. 732,279.

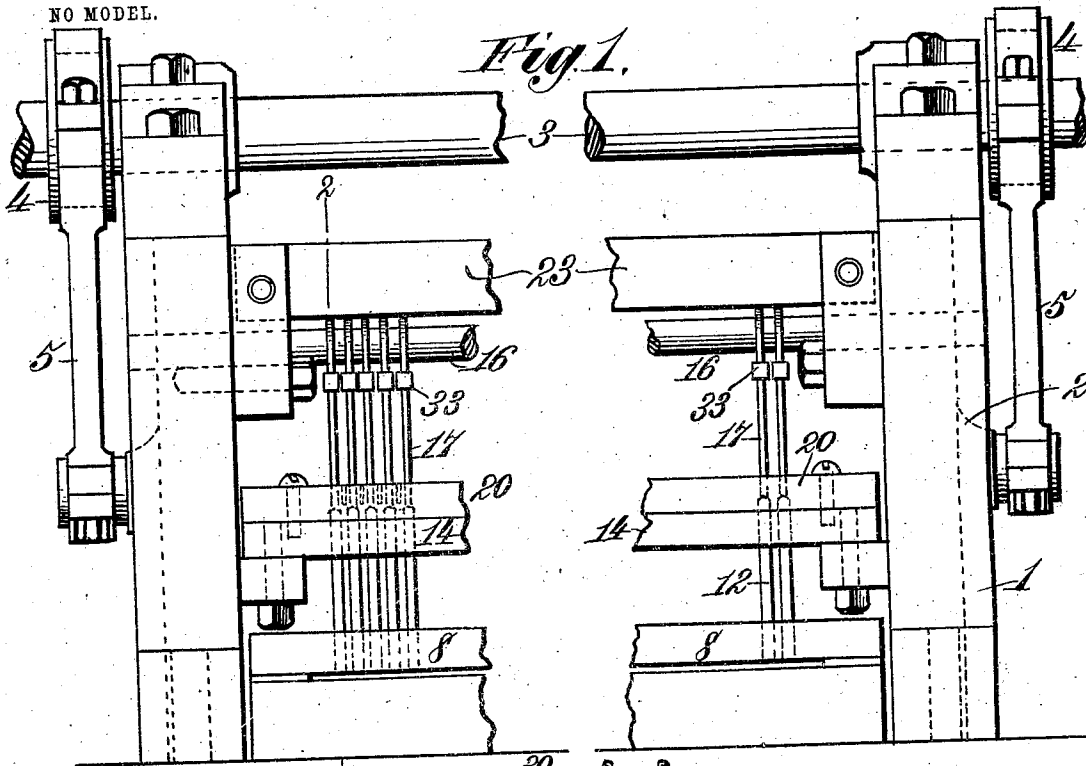
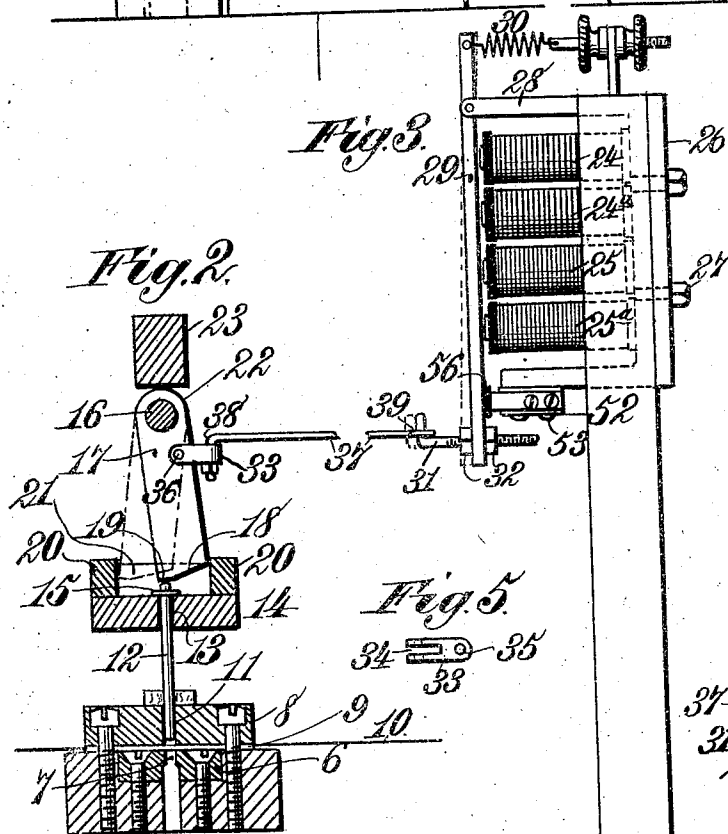
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H. L. DAVIS.

ELECTRICALLY CONTROLLED PERFORATING MACHINE.

APPLICATION FILED OCT. 14, 1901.

NO MODEL.



Witnesses.

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ELECTRICALLY-CONTROLLED PERFORATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 732,279, dated June 30, 1903.

Application filed October 14, 1901. Serial No. 78,585. (No model.)

To all whom it may concern:

Be it known that I, HERBERT L. DAVIS, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Electrically-Controlled Perforating-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to electrically-controlled perforating-machines and especially to that class of perforating-machines designed and employed for perforating music-sheets for use in connection with automatic or self-playing musical instruments, and it is in the nature of an improvement on the perforating-machines shown and described in Letters Patent No. 659,053, granted to George H. Davis on the 2d day of October, 1900, and in a pending application for patent filed by said George H. Davis on the 22d day of April, 1901, Serial No. 57,000. In said Letters Patent and application is shown and described a perforating-machine comprising a series of punches, a series of punch setting and controlling dogs, electromagnets for actuating said dogs, a circuit-selector for throwing the electromagnets into circuit at proper times, a die-block over which the sheet to be perforated is fed, and means for reciprocating the punches. In each of said machines a relatively large space intervened between the magnets and their armatures in order to cause the latter to communicate sufficient movement to the punch-setting dogs, and in order to move the armatures through such relatively large spaces a large amount of electrical energy was necessarily consumed; furthermore, the action of the magnets in said machine was objectionably slow and there was great liability of sparking where the circuits were broken at the circuit-selector and consequent danger of injuring or destroying the paper stencil.

It is the purpose of the present invention to provide in a machine of the type referred to improved dogs for setting the punches.

It is a further purpose to effect an economy in the electric current expended in actuating

the punch-setting dogs by providing improved electromagnetic actuating mechanism.

My invention also has for its object to provide certain other improvements, which will hereinafter be rendered apparent.

To these ends my invention consists in the features and in the construction, combination, and arrangement of parts hereinafter described, and particularly pointed out in the claims following the description, reference being had to the accompanying drawings, forming a part of this specification, wherein—

Figure 1 is a view in front elevation of my improved perforating-machine. Fig. 2 is a transverse sectional view taken on the line 2-2 of Fig. 1. Fig. 3 is a view in side elevation of one of the electromagnetic dog-actuating devices, and Fig. 4 is a detail bottom plan view of one of the circuit-breakers.

In carrying my invention into practice I utilize two well-known laws of mechanics—viz., first, that the power of a lever varies directly as the point at which the power is applied is located near to or remote from the fulcrum; second, that the force with which an electromagnet attracts its armature varies inversely as the square of the distance which separates the two. In the machines constructed in accordance with the patent and pending application for patent hereinbefore referred to the armatures each required a movement of substantially one-half inch in order to communicate the necessary movement to the dogs, and in order to produce such relatively large movements of the armatures a large amount of electrical energy was necessarily consumed, and the action of the magnets was, moreover, rendered objectionably slow. By utilizing the two known mechanical and electrical laws above set forth by means of the improved construction and arrangement of parts presently to be described each magnet is enabled to attract its armature and actuate the punch-setting dog connected therewith, assuming an equal amount of electrical energy is employed, approximately sixteen times faster and with eight times the amount of force or power than was possible in the machines before alluded to.

Referring to the drawings, the numeral 1 indicates the frame of the machine, which

may be of any construction suitable for the purpose, in which is arranged to vertically reciprocate a head 2. In the top of the frame is journaled a driving-shaft 3, which may be driven from any source of power capable of communicating a very rapid rotary movement to said shaft, and mounted on the latter are two eccentrics 4, which are connected to the head 2 by eccentric or connecting rods 5, which operate to impart to the head a slight but very rapid movement. Rigidly bolted to the bed of the frame beneath the reciprocating head is a die-plate 6, in which is formed a series of holes or perforations 7, enlarged or reamed out from their bottoms to a point near the upper face of the die-plate to permit the easy discharge of the punchings or "wads" punched from the music-sheet. A die-block 8 is rigidly bolted at each end to the bed of the machine above the die-plate, thus leaving a narrow space between the bottom of the die-block and top of the die-plate, as indicated at 9, through which the music-sheet 10 to be punched is fed by any suitable means. Formed in the die-block 8 is a series of holes or perforations 11, which accurately register with the holes or perforations in the die-plate, and arranged to reciprocate in said perforations 11 are punches 12. The upper ends of the punches loosely pass through perforations 13, formed in a bar 14, termed a "punch-plate," and are provided with heads 15, which are adapted to rest on the upper side of the punch-plate. The punch-plate is bolted to and reciprocates with the head 5. As the punches are loosely mounted in the punch-plate, it will be evident that said punches will not operate to punch the music-sheet fed between the die-block and die-plate unless some means be provided for setting the punches—that is to say, for locking the punches to the punch-plate, so as to be forced down by the latter through the music-sheet and into the perforations in the die-plate—and for this purpose dogs are provided that may be thrown into operation to lock the punches rigidly to the punch-plate.

All the parts constructed and arranged as above described are fully shown and described in the Letters Patent and pending application of George H. Davis before set forth and form no part of the present invention.

The improved dogs for locking the punches to the punch-plate and forming a part of my present invention are constructed and arranged as follows: Carried by the head 2 and arranged above the punch-plate 14 is a rod or shaft 16, on which are fulcrumed or loosely mounted the upper ends of pivoted or swinging dogs 17, each consisting of a metallic plate or bar, the lower end of which for nearly its entire width is beveled or inclined, as at 18, the lowermost edge or corner being approximately square or at a right angle to the longitudinal axis of the dog, as indicated at 19. There will of course be provided one such dog for each punch, and each dog will be suspended in vertical align-

ment with one of the punches. Strips 20 are attached to the upper opposite sides of the punch-plate, and formed in the upper side of the punch-plate are transverse grooves 21, in which the lower ends of the dogs are guided in their oscillating movements, such movements being limited in both directions by the strips or stops 20. The lower ends of the dogs are thus caused to lie in exact alignment with the upper ends of the punches. The upper ends of the dogs are formed semicircular, as at 22, the center of the circles being the axial center of the shaft 16, and said semicircular ends rest lightly in contact with the under side of a presser-bar, 23 fixed in the head 2, whereby all strain exerted in forcing down the punches is taken off the shaft 16. It will be evident that when any of the dogs occupy the position shown in dotted lines said dogs as they and the punch-plate descend will exert no pressure on the corresponding punches, and hence the latter will not punch the music-sheet; but if some of the punches be swung to the position shown in full lines then the lowermost and square end or edge 19 of such dogs will engage the upper ends of the punches and set the latter, and as the punch-plate and dogs descend the set punches will be forced down into the die-plate and will punch the paper.

I will now describe my improved electromagnetic mechanism for actuating the dogs. For each dog I provide two electromagnets, each comprising two helices, said helices being arranged one above the other, as shown in Fig. 3, and in pairs, as usual, said helices being respectively indicated by the numerals 24 24^a 25 25^a, the helices 24 and 24^a constituting one electromagnet and the helices 25 and 25^a another. The helices are fixed to an upright metallic U-shaped frame 26, which is rigidly secured to the frame of the machine by lag-bolts 27, and to the upper free end 28 of the frame 26 is pivoted the upper end of the armature 29, an adjusting-spring 30 being attached to the upper extremity of the armature and operating to normally hold the armature away from the poles of the magnets in a usual manner. Passing loosely through a suitable aperture in the lower end of the armature is the threaded end of a hook 31, which is adjustably held in place on the armature by two nuts 32, screwed over the threaded end of the hook on opposite sides of the armature. Pivottally connected to each of the dogs is a clip 33, consisting of a small bar forked at one end, as at 34, and perforated, as at 35, at the other end, said forked end straddling or embracing one edge of the dog and pivoted thereto by a pivot-pin 36. As clearly shown, the clips are pivoted to the dogs immediately below or contiguous to the fulcrums of the latter. Each of the dogs is connected to one of the armatures 29 by a link consisting of a rod 37, one end of which is bent at a right angle, as at 38, and loosely fitted in the perforation 35 of the clip on the

dog, and the other end thereof is bent to form an eye 39, which loosely engages the hook 31, fixed in the lower end of the armature. By means of the described connections between the armatures and the dogs shown it will be obvious that any movement of any one of the armatures will be communicated to its corresponding dog, and by connecting said links to the dogs at points contiguous to the fulcrums of the latter it follows that but a very slight movement of the armatures will be sufficient to completely throw the dogs into and out of operation.

The electromagnets are automatically thrown into and out of operation to actuate the proper dogs to in turn set the proper punches by any suitable selecting mechanism—such, for example, as follows:

The numeral 40 indicates a stencil or pattern which may conveniently consist of a thin perforated paper strip or sheet, of which the completed music-sheet formed on the machine is an exact duplicate. Said stencil or pattern sheet is fed by any suitable means over and in contact with a metallic roller 41, and arranged to bear at their ends on said roller or the stencil thereon, is a series of metallic contact-fingers 42, corresponding in number to the series of electromagnets and dogs. From each of said fingers a conductor 43 leads to a battery or generator 44, and from said battery a conductor 45 leads to each series of magnets. A conductor 46 also leads from the contact-roller 41 to each series of magnets. Each series of magnets, then, is controlled by an independent circuit in which is included the battery, the contact-roller, and one of the contact-fingers. It will be readily understood, therefore, that as the stencil or pattern sheet is fed over the contact-roller some or each of the contact-fingers will from time to time register with a perforation in the stencil and will project therethrough into contact with the roller. Whenever this occurs, the circuit will be completed through such finger and roller and will energize a corresponding series of magnets and cause the latter to actuate its dog and set a corresponding punch, thereby perforating the music-sheet at a point exactly corresponding to the perforation in the stencil through which the finger projected. The selecting mechanism described is fully shown and described in the said application and other Letters Patent of the said George H. Davis and forms no part of the present invention.

The cores 24 and 24^a of the upper magnet are wound with coarse wire 47 or wire of relatively large diameter and hence having small resistance, while the cores 25 and 25^a of the lower magnet are wound with relatively fine wire 48. The conductor 45 is connected to one of the terminals of the lower magnet, and from the other terminal thereof leads a conductor 49, while a branch conductor 50 leads from the conductor 45 to one of the terminals of the upper magnet, and from the other terminal of the latter leads a conductor 51. At-

tached to the under side of the free end 28^a of the U-shaped frame 26 is a circuit-breaker, comprising a block 52 of insulating material (see Figs. 3 and 4) fastened to the frame by screws 53. Fixed to one side or edge of said block is a fixed hook-shaped contact 54, and to the opposite side or edge of said block is fixed one end of a resilient or spring-contact 55, consisting of a flat spring bent at substantially a right angle, the free end of which normally rests against and in electrical contact with the fixed contact 54. Fixed to the lower end of the armature 29 at a point opposite the free end of the spring-contact 55 is a thin strip of insulating material 56, which when the armature is attracted by the magnets bears against said contact and forces its free end away from and out of electrical contact with the fixed contact 54. The conductor 46, leading from the contact-roller 41, is connected to the spring-contact 55 and to the conductor 49, leading from the lower magnet, and the conductor 51, leading from the upper magnet, is connected to the fixed contact 54. It will be seen, then, that when any one of the contact-fingers 42 closes the circuit through the contact-roller both the coarse and fine wound magnets will be energized, and the circuits therethrough may be traced as follows: When the circuit has been closed as set forth, it passes by wire 42 to the battery, and from the latter a portion of the current will pass by wire 45 through the finely-wound or lower magnet, and thence by wires 49 and 46 to the contact-roller. Another and by far the greater portion of the current will pass by the branch wires 50 and 51 through the coarser-wound upper magnet to the fixed contact 54 and by the closed spring-contact 55 to the wire 46 and by the latter to the contact-roller. Both magnets, then, will be initially energized and will exert their combined power, when the armature is farthest removed from the poles of the magnets, to attract the armature and thereby actuate a corresponding dog and set the proper punch. As the armature closely approaches the magnet-poles, however, when but little magnetic force need be expended—say, when the armature is within one-sixteenth of an inch of the lowermost pole—the insulating-strip 56 presses against the spring-contact 55 and forces it out of contact with the fixed contact 54, thus breaking the circuit at this point and cutting out of circuit the coarsely-wound upper magnet. The finely-wound magnet, however, remains in circuit and completes the movement of the armature and holds the latter until the circuit is broken between the contact-finger 42 and roller 41. Initially, then, when the armature is farthest removed from the poles of the magnets it is the combined strength of the magnets utilized to attract the armature and move the dog; but the moment such expenditure of electrical energy becomes unnecessary the coarsely-wound magnets are cut out of circuit and the greater portion of the current then

ceases to be expended. In this manner a great saving in electrical energy is effected. As before described, by pivotally connecting the links in close proximity to the fulcrums of the dogs a slight movement only of the armatures is rendered necessary and an accelerated movement of the dogs is obtained. It is true that such arrangement requires greater power to move the dogs, yet this is approximately compensated for or counterbalanced four times over by the great reduction effected in the distance or space between the armatures and the poles of the magnets.

As before explained, great economy in the expenditure of electrical energy is effected by cutting out the stronger current flowing through the helices of the coarsely-wound magnet, as only a small amount of current passes through the helices of the finely-wound magnet during a greater part of the time. Moreover, whenever the circuit is broken between the contact-fingers and the contact-roller but a small amount of current is passing over the circuit and sparking is thereby reduced to a minimum, thereby avoiding danger of burning or injuring the stencil.

Having described my invention, what I claim is—

1. In an electrically-controlled perforating-machine, the combination with a series of reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a pivoted bar adapted to be swung into and out of engagement with one of the corresponding punches, a clip pivotally connected to each bar, electromagnets for controlling said dogs, means connecting the armatures of said magnets with said clips, and a circuit-selector for automatically throwing said magnets into and out of operation.

2. In an electrically-controlled perforating-machine, the combination with a series of reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, a clip pivotally connected to each dog at a point in close proximity to the fulcrum thereof, means connecting the armatures of said magnets with said clips, and a circuit-selector for automatically throwing said magnets into and out of operation.

3. In an electrically-controlled perforating-machine, the combination with a series of reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, guides for maintaining the ends of the dogs in alignment with the ends of the punches during the oscillating movement of the dogs, a U-shaped clip pivotally connected to each dog at a point in close proximity to the fulcrum thereof, means connecting the armatures of said magnets with said clips, and a circuit-selector for

automatically throwing said magnets into and out of operation.

4. In an electrically-controlled perforating-machine, the combination with a series of electrically-controlled reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, and a punch-plate in which the rear ends of the punches are loosely mounted, said plate being transversely grooved on its upper face in alignment with the punches and the free ends of the dogs arranged to oscillate and be guided in said grooves, substantially as described.

5. In an electrically-controlled perforating-machine, the combination with a series of electrically-controlled reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, and a transversely-grooved punch-plate in which the rear ends of the punches are loosely mounted, the free ends of the dogs being arranged to freely oscillate and be guided in said grooves, and projections on the opposite sides of the punch-plate for limiting the oscillating movement of the dogs, substantially as described.

6. In an electrically-controlled perforating-machine, the combination with a series of electrically-controlled reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, a series of electromagnets, each series comprising two electromagnets and an armature common to both of them, connections between the armatures and dogs, one of the magnets of each series being wound with relatively coarse wire and the other with fine wire, a series of electric circuits each including a finely-wound magnet, a circuit-selector and a generator common to all said circuits, a series of branch circuits each including one of the coarsely-wound magnets, and circuit-breakers arranged to automatically cut the coarsely-wound magnets out of circuit as the armatures approach the magnets, substantially as described.

7. In an electrically-controlled perforating-machine, the combination with a series of electrically-controlled reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, a series of electromagnets each series comprising two electromagnets and an armature common to both of them, connections between the armatures and dogs, one of the magnets of each series being wound with relatively coarse wire and the other with fine wire, a series of electric circuits each including a

finely-wound magnet, a circuit-selector and a generator common to all said circuits, a series of branch circuits each including one of the coarsely-wound magnets, and means actuated by the armatures as they approach the magnets for cutting out the coarsely-wound magnets, substantially as described.

8. In an electrically-controlled perforating-machine, the combination with a series of electrically-controlled reciprocatory punches, of a series of reciprocating punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, a series of electromagnets each series comprising two electromagnets and an armature common to both of them, links each connected at one end to the free end of one of the armatures and at its other end to one of the dogs in close proximity to the fulcrum of the latter, one of the magnets of each series being wound with relatively coarse wire and the other with fine wire, a series of electric circuits each including a finely-wound magnet, a circuit-selector and generator common to all said circuits, a series of branch circuits each including one of the coarsely-wound magnets, and circuit-breakers actuated by the armatures as the latter approach the magnets for cutting the coarsely-wound magnets out of circuit, substantially as described.

9. In an electrically-controlled perforating-machine, the combination with a series of electrically-controlled punches, of a series of punch-setting dogs each consisting of a bar pivoted at one end and adapted to be swung at its other end into and out of engagement with a corresponding punch, a series of electromagnets each series comprising two electromagnets and an armature common to both of them, links each adjustably connected at one end to the free end of one of the armatures and at its other end to one of the dogs in close proximity to the fulcrum of the latter, the said armatures being normally disposed relatively close to the magnets, one of the magnets of each series being wound with relatively coarse wire and the other with fine wire, a series of electric circuits each including one of the finely-wound magnets, a circuit-selector and generator common to all said circuits, a series of branch circuits each including one of the coarsely-wound magnets, and circuit-breakers actuated by the armatures as the latter approach the magnets for cutting the coarsely-wound magnets out of circuit, substantially as described.

10. In an electrically-controlled perforating-machine, the combination with a series of reciprocatory punches, of a series of reciprocating punch-setting dogs each adapted to be swung into and out of engagement with a corresponding punch, a series of electromagnets each series comprising two electromagnets and an armature common to both of them, each of the armatures being connected to one of the dogs, one of the magnets of each

series being wound with relatively coarse wire and the other with fine wire, a series of electric circuits each including one of the finely-wound magnets, a circuit-selector and generator common to all said circuits, a series of branch circuits each including one of the coarsely-wound magnets, and circuit-breakers for cutting out the coarsely-wound magnets each consisting of a fixed and a spring contact normally in electric contact with each other, one of said circuit-breakers being included in each branch circuit, and means carried by the armatures for separating said contacts as the armatures approach their magnets, substantially as described.

11. In a perforating-machine, the combination with punch-setting means, of electromagnetic mechanism adapted to actuate said punch-setting means, comprising a U-shaped frame, two or more electromagnets arranged between the arms of said frame, an armature pivoted to one of said arms, a connection between said armature and the punch-setting means, and a circuit-selector for automatically throwing said magnets into and out of circuit.

12. In a perforating-machine, the combination with punch-setting means, of electromagnetic mechanism adapted to actuate said punch-setting means, comprising a U-shaped frame, two or more electromagnets carried by said frame and arranged between the arms thereof, an armature pivoted to the upper arm of the frame, a connection between the punch-setting means and the lower end of said armature, and a circuit-selector in circuit with said magnets, substantially as described.

13. In a perforating-machine, the combination with punch-setting means, of electromagnetic mechanism for actuating said punch-setting means, comprising a U-shaped frame, two or more electromagnets secured to said frame between the arms thereof, an armature pivoted to the upper arm of the frame, a connection between said armature and the punch-setting means, a circuit-breaker secured to the lower arm of the frame and adapted to be actuated by said armature, and a circuit-selector in circuit with said magnets and circuit-breaker, substantially as described.

14. In a perforating-machine, the combination with punch-setting means, of electromagnetic mechanism for actuating said punch-setting means, comprising a U-shaped frame, two or more electromagnets secured to said frame between the arms thereof, an armature pivoted to one of said arms, a connection between said armature and the punch-setting means, a circuit-breaker secured to the other arm of the frame and adapted to be actuated by the armature, and a circuit-selector in circuit with said magnets and circuit-breaker, substantially as described.

15. In a perforating-machine, the combination with punch-setting means, of electromagnetic mechanism for actuating said means, comprising a U-shaped frame, two or more

electromagnets secured to said frame between the arms thereof, an armature pivoted to one arm of the frame, a connection between said armature and the punch-setting
5 means, a block of insulating material secured to the other arm of the frame, circuit-breaking blades secured to opposite sides of said block, said blades being normally in contact and adapted to be actuated by the armature,

and a circuit-selector in circuit with the magnets and circuit-breaker, substantially as described.

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

HERBERT L. DAVIS.

Witnesses:

CLOUD LIVINGSTON,
CHAS. S. MUIR.