Aug. 22, 1961 G. PEREZ 2,997,231

RECORD PERFORATOR

Filed Aug. 30, 1957 4 Sheets-Sheet 1

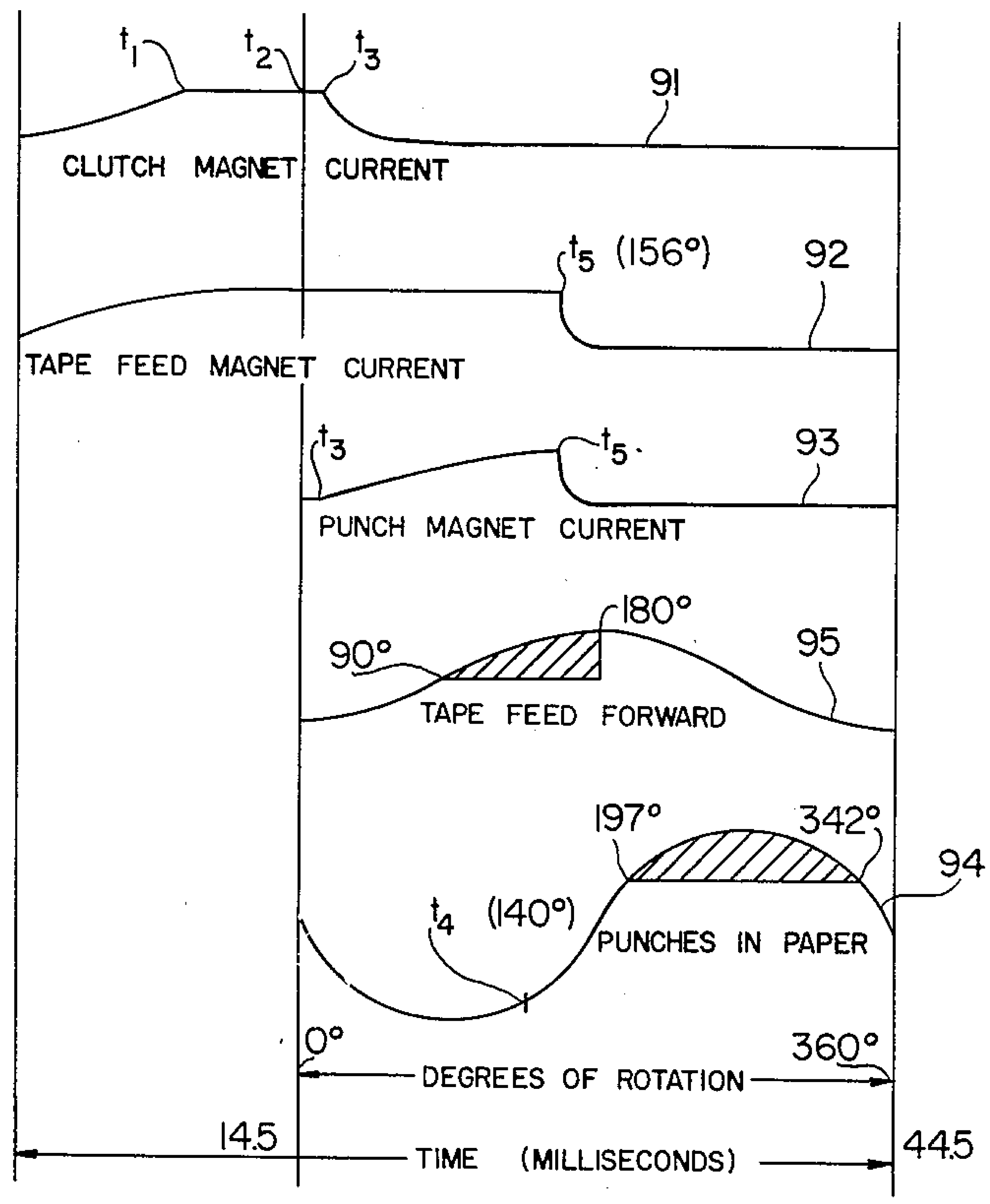

Fig. 6

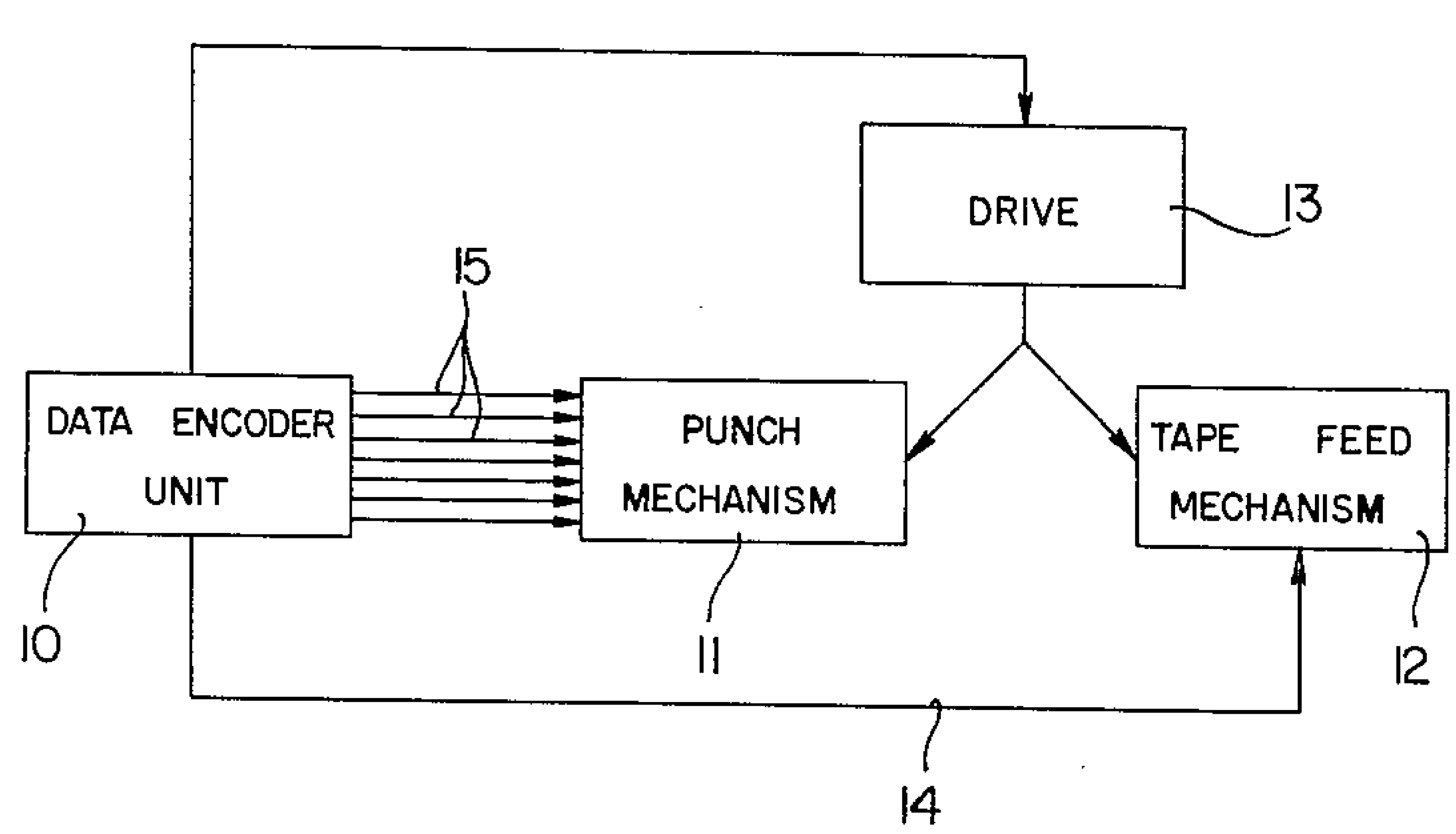

Fig. 1

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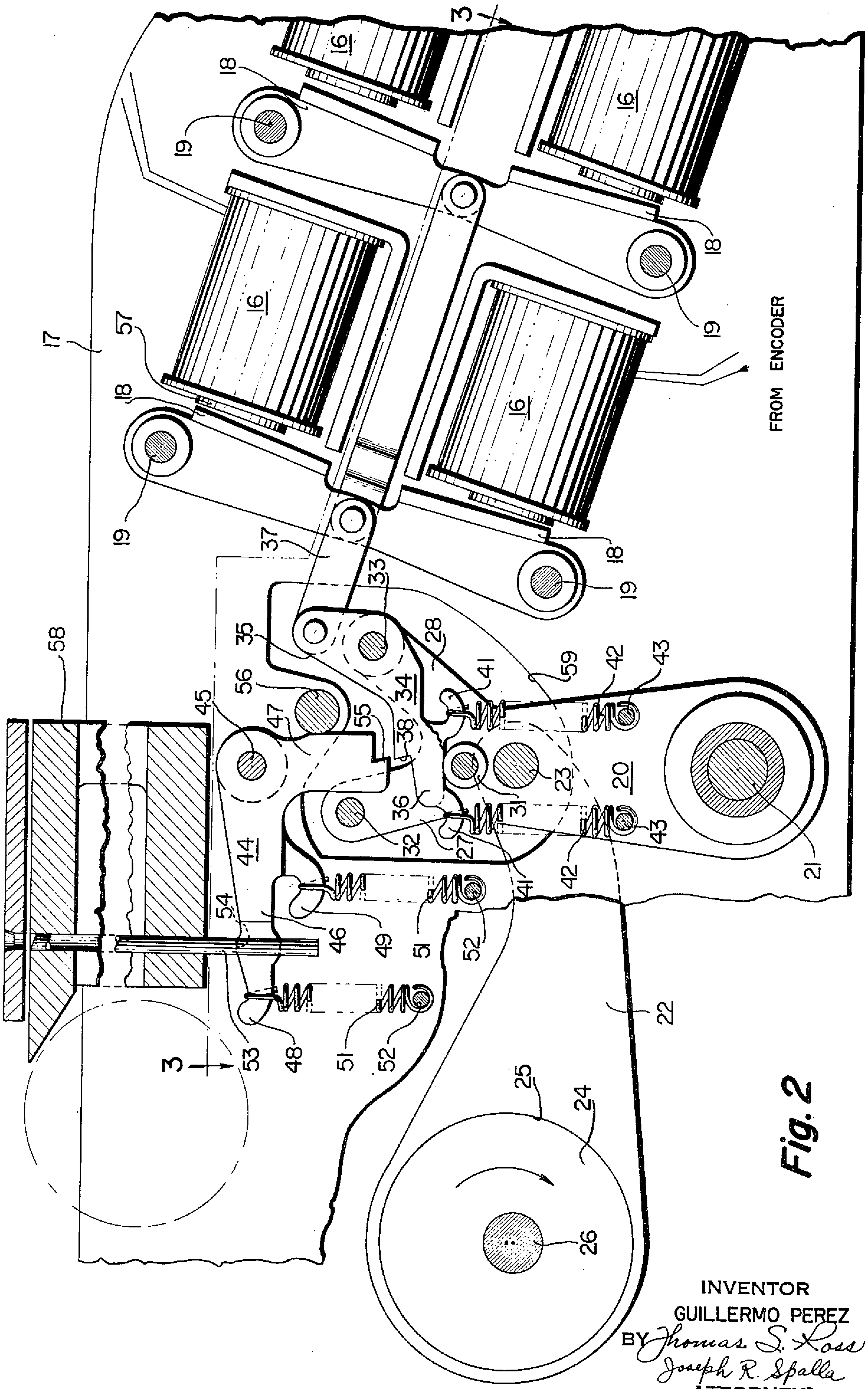

Fig. 2

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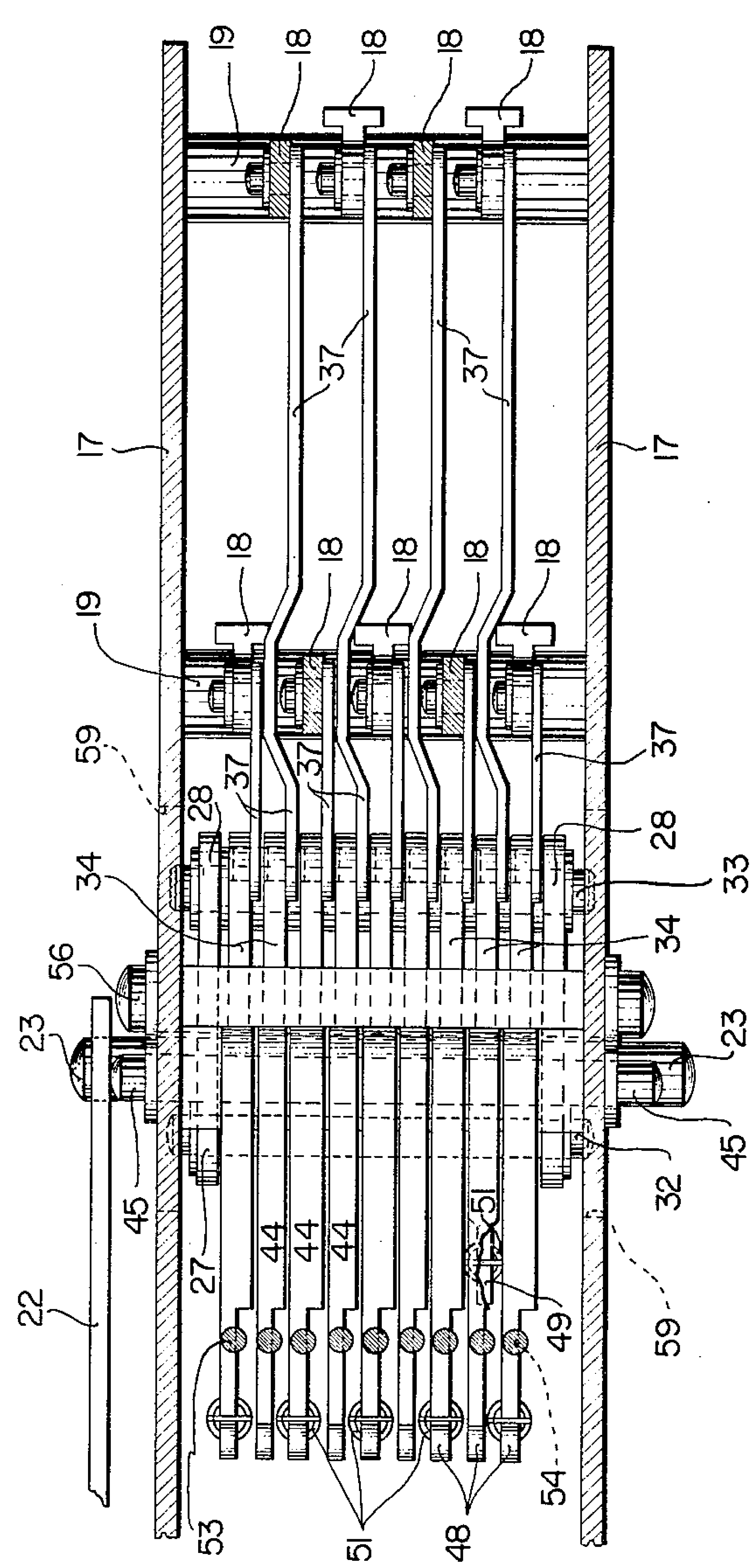

Fig. 3

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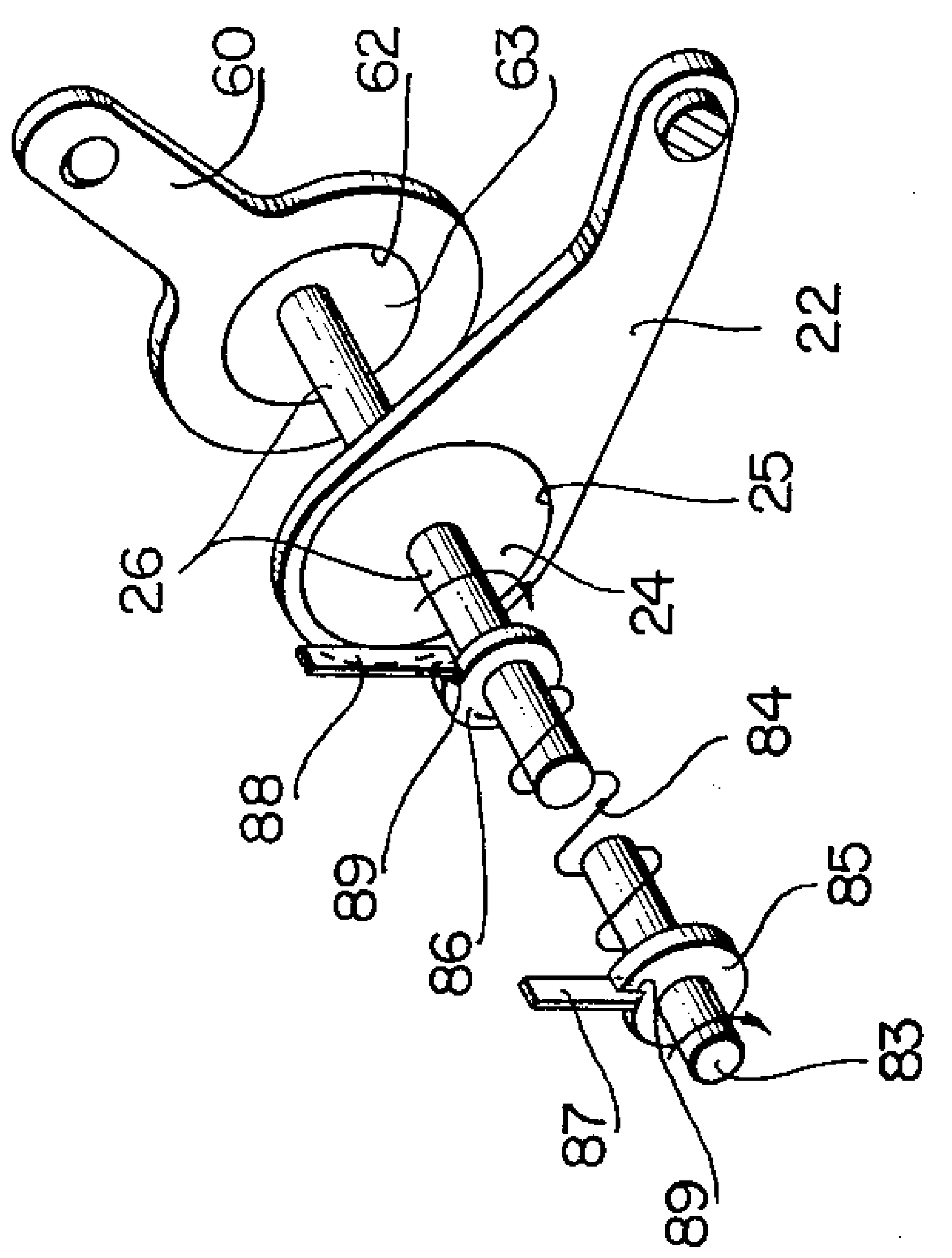

Fig. 5

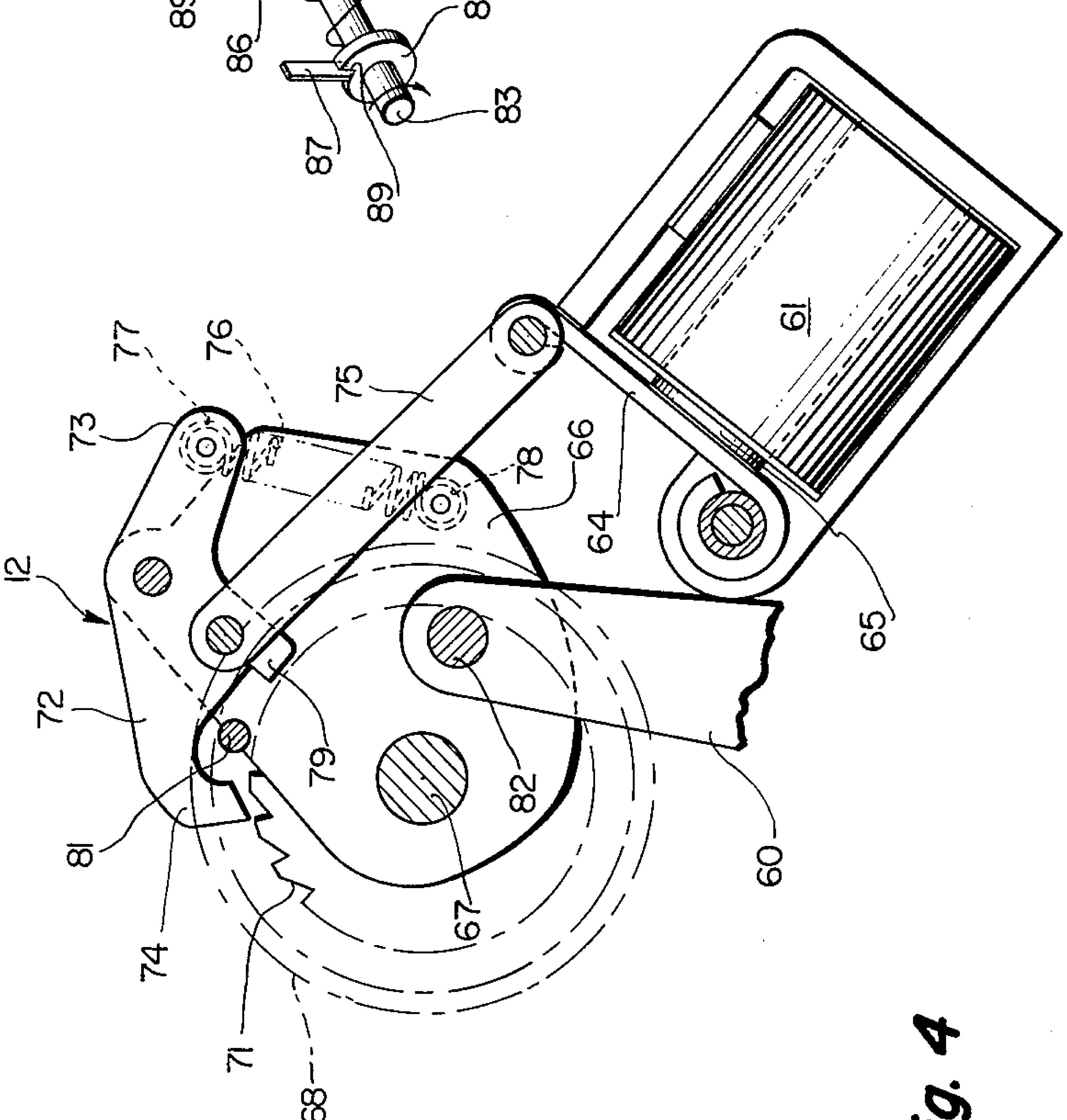

Fig. 4

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2,997,231

RECORD PERFORATOR

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5 Claims. (Cl. 234—119)

This invention relates to a record perforator employing novel punch selecting and powering mechanisms, more particularly it relates to a record perforator having punch selecting and powering mechanisms wherein the punches are electromagnetically selected and mechanically powered; and specifically it relates to an electromechanical punch selecting and powering mechanism for a record perforator wherein electromagnets are utilized to effect the selection of punch powering means and to operatively couple said punch powering means to a drive member and to effect a coupling between tape feed means and said drive member.

Heretofore most electromechanically operated punch selector and tape feed mechanisms employed electromagnets which were designed to impart motion through armatures to set-up components having definite mass. The movement of these masses necessitated electromagnets of considerable size and power in order to overcome the initial air gap spacing between the pole pieces and armatures thereof. As an armature was drawn toward its associated pole piece and the air gap reduced, the full power of the electromagnets was unnecessary and therefore excessive, thereby constituting an inefficient use of electrical power. Further the speed of operation was limited by the pull-in time of the electromagnets.

This invention employs a novel construction which permits electromagnets of minimum size and power to be utilized thereby to provide a very rapid and efficient electromechanical selector. Efficient use of electrical power is realized by providing cyclically operable means which mechanically moves all the armatures of a bank of electromagnets, corresponding in number to the number of punches, toward and away from the pole pieces of the electromagnets. Selected ones of the electromagnets are energized in synchronism with the movement of the cyclically operable means such that when the air gaps between armatures and pole pieces are substantially closed the armatures associated with energized electromagnets are magnetically held against their pole pieces. The armatures are linked for movement with said cyclically operable means through connection with elements rotatably mounted on the latter which they are adapted to couple said cyclically operable means to punch means. The construction of the cyclically operable means, associated elements and the punch means is such that when selected armatures are held against associated energized electromagnet pole pieces, associated ones of said elements are caused to pivot about said link connection as said cyclically operable means moves away from said electromagnets. Pivoting of said elements results in the coupling of said cyclically operable means to said punching means whereby continued movement of the former drives said punching means.

Further in accordance with the invention the cyclically operable means is adapted in combination with an electromagnet to be coupled to a tape feed mechanism whereby a tape is indexed before each punching operation. As will be more clearly described infra only the holding power of the electromagnets is utilized.

An object of the invention therefore is the provision of a rapid and efficient record perforator.

Another object of the invention is to provide a record perforator of the type having punch selecting and powering mechanisms employing electromagnets wherein only the holding power of the electromagnet is utilized.

Still another object of the invention is the provision of a high speed record perforator of the type wherein the punches are positively driven into a record to be perforated.

A further object of the invention is to provide a record perforator of the type having electromechanically selected and mechanically powered punches wherein the speed of operation of the punches is limited only by the speed at which associated components can be mechanically operated.

A still further object of the invention is to provide a high speed electromechanical perforating mechanism having a construction in which electromagnets are called upon to perform only a minimum of work thereby enabling the utilization of electromagnets of minimum size and power.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a block diagram showing the organization of the record perforator.

FIG. 2 is a side view showing the construction of the punch mechanism employing novel electromechanical punch selecitng and powering means;

FIG. 3 is a sectional view taken along lines 3—3 of FIG. 2;

FIG. 4 is a side view showing a tape feed mechanism in accordance with the invention.

FIG. 5 is a diagrammatic perspective view of the record perforator drive means.

FIG. 6 is a timing diagram explanatory of the operation of the mechanism.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, and particularly to FIG. 1 which illustrates the organization of the instant record perforator there is shown an input or encoder storage unit **10** which is adapted to translate information into data processing machine language such as 5, 6, 7 or 8 channel Baudot codes in the form of electrical signals, an electromechanically operated punching mechanism **11**, an electromechanically operated tape feed mechanism **12**, and drive means **13** responsive to control signals from the input unit adapted to mechanically power the tape feed and punch mechanism. Another control signal from the encoder **10** is adapted to simultaneously energize an electromagnet in the tape feed mechanism **12** through conductor **14** and, at a later time, signals representing coded information are adapted to selectively energize electromagnets in the punching mechanism **11** through conductors **15**, whereby, as will hereinafter appear more fully, a tape is indexed and selected punches in the punch mechanism are driven through a record to be perforated.

Referring now to FIG. 2 the punching mechanism **11** comprises a plurality of punch selecting electromagnets generally designated by reference numerals **16** including a feed punch electromagnet which are compactly spaced and suitably mounted on and between two horizontally spaced vertical mounting plates **17**. The array of electromagnets are all provided with armatures **18** pivotally mounted on bars **19** secured to and between the vertical mounting plates. A powering means which cooperates with the electromagnets **16** whereby punches are selected and powered comprises a pair of spaced generally Y-shaped actuator arms, generally designated by reference numeral 20 which are fulcrumed at their lower ends on a common shaft 21 secured to and between the vertical mounting plates. The actuator arms 20 are adapted to be cyclically driven between predetermined arcuate limits by a punch drive arm 22 rotatably coupled to a horizontal bar 23 secured to the actuator arms. The punch drive arm 22 is caused to oscillate laterally back and forth by a circular cam 24 mounted in a circular cutout 25 in one end of the drive arm. The cam is secured to and driven by a shaft 26 eccentrically mounted therethrough. The upper portions of the actuator arms as seen in FIG. 2 are bifurcated thereby forming angularly disposed branches 27 and 28 respectively. The actuator arms mount between them a collared pawl stop bar 31, a bell crank return bar 32 connected to and between the rearwardly disposed branches 27 of the actuator arms, and a pawl carrier bar 33 connected to and between the forwardly disposed branches 28 of the actuator arms. A plurality of pawls 34 having upper and lower arms 35 and 36 respectively are rotatably mounted on the pawl carrier bar 33. As seen in FIGS. 2 and 3 the upper arms 35 of the pawls are rotatably connected to the ends of links 37, whose other ends are rotatably connected to the free ends of the armatures 18. The upper edges of the lower arms 36 of the pawls are each provided with detents 38 and the lower edges of the lower arms 36 are each provided with an ear 41; the ears on alternate pawls as seen in FIG. 2, being laterally spaced whereby pawl return springs 42 connected between the ears 41 on the pawls and to spaced anchor rods 43 secured to and extending between the spaced actuator arms will not interfere with one another.

A plurality of bell cranks 44 are rotatably mounted on a fulcrum bar 45 extending between the two spaced mounting plates 17. The axis of the fulcrum bar 45 is vertically above and substantially coincident with the axis of the actuator arm fulcrum shaft 21 as seen in FIG. 2. Each of the bell cranks 44 has a laterally extending arm 46 and a downwardly extending arm 47. The laterally extending arms 46 of the bell cranks are each provided with an ear 48; and alternate bell cranks are provided with an additional ear 49 laterally offset from ears 48 whereby bell crank return springs 51 connected between the ears 48 and 49 and spring anchor rods 52 secured to and between the horizontally spaced vertical mounting plates 17 will not interfere with one another. Cylindrical punches 53 provided with undercut portions 54 (FIGS. 2 and 3) are mounted on each of the laterally extending arms 46 of the bell cranks, with the punches 53 vertically disposed in and guided by aligned holes in a die block 58. Included in the aligned array of punches is an index or feed punch whereby as is understood in the art a tape passing through the die block will be perforated with coded data and feed holes. The downwardly extending arms 47 of the bell cranks are each provided on their lower edges with a detent 55 complementary to the detents 38 in the pawls 34. As seen in FIG. 2 the downwardly extending arms 47 are disposed between a stop bar 56 secured between the horizontally spaced vertical mounting plates 17, and the bell crank return bar 32 secured between the branches 27 of the actuator arms. The downwardly depending arms 47 are normally biased against the stop bar 56 by the bell crank return springs 51. The pawls 34 are also biased away from the bell cranks in a counterclockwise direction by the pawl return springs 42; the pawl stop bar 31 secured to and between the spaced actuator arms serving to limit the counterclockwise movement thereof to the position shown in FIG. 2. As is apparent with the pawls 34 so biased, the armatures 18 of the electromagnets 16 are held biased away from their associated pole pieces 57 because of the links 37 connected between pawls and armatures.

As is apparent the vertical mounting plates 17 are spaced for compactness and are therefore provided with cutouts 59 whereby movement of the punch selecting and powering mechanism may move freely between the walls.

Referring now to FIG. 4 there is shown the tape feed mechanism 12 operable under the control of a tape feed drive arm 60 and a tape feed electromagnet 61. As seen in FIG. 5, the tape feed drive arm 60 has a circular cutout 62 in its lower end adapted to receive a circular cam 63 to which is eccentrically secured the shaft 26 whereby as shaft 26 rotates arm 60 is driven through an up and down motion. The electromagnet is provided with an armature 64 suitably mounted for movement toward and away from the pole piece 65 thereof. The tape feed mechanism 12 comprises an actuator 66 rotatably mounted on the axis 67 of a tape feed roll 68 which has a ratchet wheel 71 concentrically secured thereto as understood in the art. A pawl 72 mounted intermediate its tail end 73 and its ratchet engaging end 74 to the actuator is coupled to the free end of armature 64 by a link 75. A pawl biasing spring 76 is connected between a stud 77 on the tail end 73 of the pawl and a cooperating stud 78 on the actuator 66 whereby stud 77 abuts the edge of the actuator maintaining the pawl properly positioned relative to the ratchet wheel and biased against rotation relative to the actuator. The pawl 72 is also provided with a projection 79 on its lower edge which is adapted to cooperate with a fixed stop bar 81. The actuator is provided with a stud 82 whereby it is rotatably connected to the tape feed drive arm 60 which as heretofore stated is adapted to be driven through an up and down motion by the cam 63 and shaft 26 (FIG. 5). As shown in FIG. 4 the armature 64 is normally biased in zero air gap position.

Referring to FIG. 5, the shaft 26 which drives the drive arms 22 and 60 through their respective motions is adapted to be coupled to a continuously rotating drive shaft 83 by a wrap spring clutch. The wrap spring clutch well known in the art comprises a helical coupling spring 84 wrapped concentrically about the drive 83 and driven shaft 26. The ends of the spring 84 respectively are attached to a clutch control disk 85 rotatably mounted on shaft 83 and a clutch control disk 86 rotatably mounted on shaft 26. The normal diametral dimension of spring 84 is such that shafts 26 and 83 are coupled, with rotation of the shafts serving to tighten the grip of the spring. The spring is disengaged by relatively rotatably displacing the control disks 85 and 86 in a direction which will cause the diameter of the spring to expand. The spring is held in disengaged condition by a fixed and a rotatably mounted interponent 87 and 88 respectively which cooperate with steps 89 on the periphery of the disks whereby relative rotation of the disks 85 and 86 under the action of the radially expanded spring is prevented. Interponent 88 comprises the armature of a clutch electromagnet (not shown). Energization of the clutch electromagnet pulls interponent 88 out of engagement with its associated step in disk 86 whereupon the spring wraps and couples the shafts. As is understood in the art upon deenergization of the clutch electromagnet, interponent 88 will reengage the step in control disk 86 after the shaft completes a 360° revolution thereby to cause the spring to unwrap.

The operation of the mechanisms of the invention will now be explained, reference being had also to FIG. 6 which shows the times of energization and deenergization of the electromagnets related to angular degrees of rotation of shaft 26 and the tape feed and punch drive arm motion over one cycle resulting therefrom. Periodic or aperiodically applied currents for energizing the tape feed and clutch electromagnet whereby 360° shaft cycles are initiated may be derived as heretofore stated from any suitable data encoder storage unit operable under control of printing machine keys. One suitable unit is disclosed and claimed in copending application Serial Number 698,083 of Lerner et al. As disclosed in said application, depression of a printing machine key sets up a coded representation of the key depressed in binary magnetic core elements and simultaneously energizes the clutch and tape feed electromagnets. After energization of the clutch electromagnet and the beginning of a cycle, a cam mounted on shaft **26** is employed to control circuitry whereby said binary magnetic core elements are read out and the resulting output signals are employed to energize the punch electromagnets, another cam on shaft **26** is employed to simultaneously de-energize the clutch electromagnet and other cams on shaft **26** at later times in the shaft cycle to deenergize the tape feed and punch electromagnets.

Referring to FIG. 6 the current vs. time curves **91**, **92** and **93** represent the current through the clutch electromagnet, the tape feed electromagnet **61** and the punch electromagnets **16** respectively. Curve **94** represents the motion of the punch drive arm **22** corresponding to 360° angular degrees of rotation of shaft **26** and curve **95** represents the motion of the tape feed drive arm **60** corresponding to 360° rotation of shaft **26**.

As is apparent from FIG. 6 the clutch and tape feed electromagnets are simultaneously energized. At time t_1 (curve **91**) the current through the clutch electromagnet is sufficiently built up to pull its associated armature i.e. interponent **88** from engagement with the clutch control disk **86** thereby permitting the spring **84** to wrap and couple shafts **26** and **83** whereby a cycle is started at time t_2. Rotation of shaft **26** causes the tape feed drive arm **60** to go through its cyclic up and down motion (curve **95**), the punch drive arm **22** to go through its cyclic right-left motion (curve **94**) and causes means in said decoder unit responsive to a predetermined angular rotation of shaft **26** to deenergize the clutch electromagnet at time t_3 on curve **91** thereby permitting the shaft **26** to complete only one cycle. Simultaneous with the deenergization of the clutch electromagnet said means causes the punch electromagnets **16** to be energized at time t_3 by signals released from said encoder unit in response to shaft rotation. The upward movement of tape feed drive arm **60** rotates the actuator **66** counterclockwise. Since the pawl **72** rotatably mounted on the actuator **66** is linked to the armature **64**, which is restrained by the energized tape feed electromagnet **61**, it rotates relative to the actuator **66** and when the drive arm **60** reaches a position corresponding to 90° rotation of shaft **26** it engages with the ratchet. Continued rotation of shaft **26** to 180° rotates the actuator **66** further counterclockwise, causing the pawl **72** to lock with and rotate the ratchet **71** one tooth. As is apparent after the pawl **72** locks with the ratchet **71**, and while the pawl is rotating the ratchet, no further relative movement of the pawl and actutaor can occur. Thereafter the armature **64** of the tape feed electromagnet is forcibly withdrawn from the electromagnet pole piece **65** until the electromagnet is deenergized; the latter occurring when the drive arm **60** reaches a position corresponding to 156° rotation of shaft **26** at time t_5. After 180° rotation of shaft **26** the actuator **66** begins a clockwise rotation due to the downward motion of arm **60**; the pawl **72** is disengaged from the ratchet **71** and returned to normal by its biasing spring **76**. As is apparent from FIG. 4, over travel of the ratchet **71** due to its inertia is prevented by the stop bar **81** which when engaged by pawl projection **79** increases the pressure of the pawl tooth in the ratchet.

As the punch drive arm **22** goes through a motion corresponding to 90° rotation of shaft **26** it causes the actuator arms **20** to rotate clockwise. The pawls **34** rotatably mounted on the universal bar **33** carried by the actuator arms move therewith thereby causing the armatures **18** through connecting links **37** to reduce the air gaps between armatures and pole pieces. During movement of the actuator arms **20** to a position corresponding to 90° shaft rotation the current through the punch electromagnets **16** which were, as heretofore stated, selectively energized at time t_3 by signals released from the encoder through means responsive to the position of shaft **26** builds up. When the drive arm reaches a position corresponding to 90° rotation of shaft **26** or zero air gap position the current in the punch electromagnets **16** is sufficiently built up to exert proper restraining force on their associated armatures **18**. As the actuator arms move in a left hand or counterclockwise direction toward a position corresponding to 180° shaft rotation the energized electromagnets **16** restrain their respective armatures **18**. The pawls **34** connected to selectively restrained armatures through associated links **37** are caused to pivot at the point of connection to the links, and since the pawls **34** are rotatably mounted to the universal bar **33** connected across the actuator arms **20**, the left hand movement thereof causes the pawls **34** to rotate relative to the actuator arms **20** until the detents **38** thereon engage the complementary detents **55** in associated bell cranks. Further movement of the actuator arms **20** in a left hand direction to a position corresponding to 140° shaft rotation causes the pawls to lock with associated bell cranks. At this point, time t_4 (curve **94**), selected punches are coupled to the actuator arms. Further motion rotates the bell cranks **44** clockwise and causes associated punches **53** to rise and perforate a tape in their path over an interval corresponding to rotation of shaft between 197° and 342°.

As is apparent after the pawls **34** lock with associated bell cranks **44** there can be no further relative movement between the actuator arms **20** and pawls **34** so that while the punches **53** are rising the armatures **18** associated with energized electromagnets **16** are forcibly drawn away from their pole pieces thereby reestablishing air gaps after which, when the punch drive arm **22** is in a position corresponding to 156° shaft rotation (time t_5) the electromagnets are deenergized by said means in said encoder unit responsive to shaft rotation.

As is apparent from FIG. 2 the counterclockwise movement of the bell cranks **44** is limited by the stop bar **56**. After a punching operation, when the pawls are disengaged as a result of the movement of the actuator arms **20** back to normal position, the bell crank return springs **51** pull the punches **53** out of the tape being perforated. The pull out is assured by the bell crank return bar **32** which, while the actuator arms are moving to normal position, engages the downwardly depending arms **47** of the bell cranks thereby forcing any bell cranks not returned by the springs to rotate counterclockwise to their normal positions.

As shown in FIG. 6 the time interval between energization of the clutch electromagnet and the beginning of a cycle is only 14.5 milliseconds and a cycle only 30 milliseconds. Inasmuch as 14 strokes a second or a stroke every 71.5 milliseconds is the maximum speed of operation of present-day typewriters it is apparent that the instant invention is capable of punching information typed at maximum speeds into data processing machine language with time to spare. If faster operation were necessary the shafts could be speeded up still further to reduce the cycle time.

Although the drive shaft has been described as being intermittently coupled to a drive shaft it is to be understood that it may be continuously driven thereby eliminating the clutch electromagnet and clutching means. In such a case signals released at a constant rate from some suitable storage unit may be delivered to the tape feed and punch electromagnets in synchronism with the motion of the continuously rotating shaft.

It should be understood therefor, that the foregoing disclosure relates to only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

The invention claimed is:

1. A record perforating mechanism comprising, means cyclically operable between predetermined limits, pawl means rotatably mounted on said cyclically operable means, means normally biasing said pawl means against rotation relative to said cyclically operable means, a plurality of electromagnets, a plurality of armatures rotatably mounted for movement into and out of engagement with the cores of said electromagnets, means coupling said pawl means and said armatures whereby said armatures are moved into engagement with said cores at one limit of motion of said cyclically operable means, said electromagnets adapted to be selectively energized at said one limit of motion in synchronism with the motion of said cyclically operable means thereby to restrain associated armatures whereby pawl means associated with magnetically restrained armatures are caused to rotate relative to said cyclically operable means as said cyclically operable means is moving toward said other limit, a plurality of punches, and means associated with each of said pawl means and punches, each of said means being responsive to its associated rotated pawl means and to the movement of cyclically operable means for moving its associated punch into a medium to be perforated.

2. In a record perforating mechanism having a plurality of punches, means for powering said punches comprising cyclically operable means, a plurality of pawls mounted on said cyclically operable means and adapted for rotation relative thereto, means normally biasing said pawls against rotation relative to said cyclically operable means, a plurality of electromagnets adapted to be selectively energized, an armature associated with each of said electromagnets, means coupling each of said armatures to an associated pawl whereby upon energization of said electromagnets said armatures are restrained and said pawls are rotated relative to said cyclically operable means, and means associated with each of said pawls and punches for driving said punches, each of said means being coupled to said cyclically operable means upon rotation of its associated pawl.

3. A record perforating mechanism comprising a plurality of punches, drive means, means for oscillating said drive means, a plurality of electromagnets adapted to be energized in synchronism with the oscillation of said drive means, a plurality of pawls rotatably mounted on said drive means, means for normally biasing said pawls against rotation relative to said drive means, means associated with each of said pawls and punches, each of said means being engageable with its associated rotated pawl and responsive to the motion of said drive means for powering the punch associated therewith, and means responsive to selectively energized electromagnets and to the motion of said drive means for rotating selected pawls.

4. A record perforating mechanism comprising drive means, means for oscillating said drive means between predetermined limits, a plurality of pawls rotatably mounted on said drive means, means normally biasing said pawls against rotation relative to said drive means, control means operative at one limit of motion of said drive means to rotate selected ones of said pawls as said drive means moves toward its other limit of motion, and punch means associated with each of said pawls, each of said punch means being engageable with its associated rotated pawl and responsive to the motion of said drive means for perforating a record.

5. An electromechanical selector and drive mechanism comprising oscillatable drive means, a plurality of pawls rotatably mounted on said drive means, means normally biasing said pawls against rotation relative to said drive means, an armature associated with each of said pawls, link members articulately connecting said pawls and armatures, an electromagnet associated with each of said armatures, means for oscillating said drive means whereby said armatures are moved toward and away from said electromagnet pole pieces as said drive member oscillates between first and second limits respectively, said electromagnets being adapted to be selectively energized when said armatures are adjacent said pole pieces, said pawls associated with magnetically restrained armatures being caused to pivot about the point of connection between said pawls and link members and to rotate relative to said drive member as it oscillates toward said second limit, a rotatably mounted bell crank associated with each of said pawls, a punch connected to each of said bell cranks adapted to perforate a record upon rotation of said bell cranks, and detents on each of said bell cranks adapted to be engaged by rotated pawls thereby coupling said drive means to said bell cranks.

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