Aug. 28, 1962 W. F. BRADBURY 3,051,377

PERFORATOR

Filed July 11, 1958 4 Sheets-Sheet 1

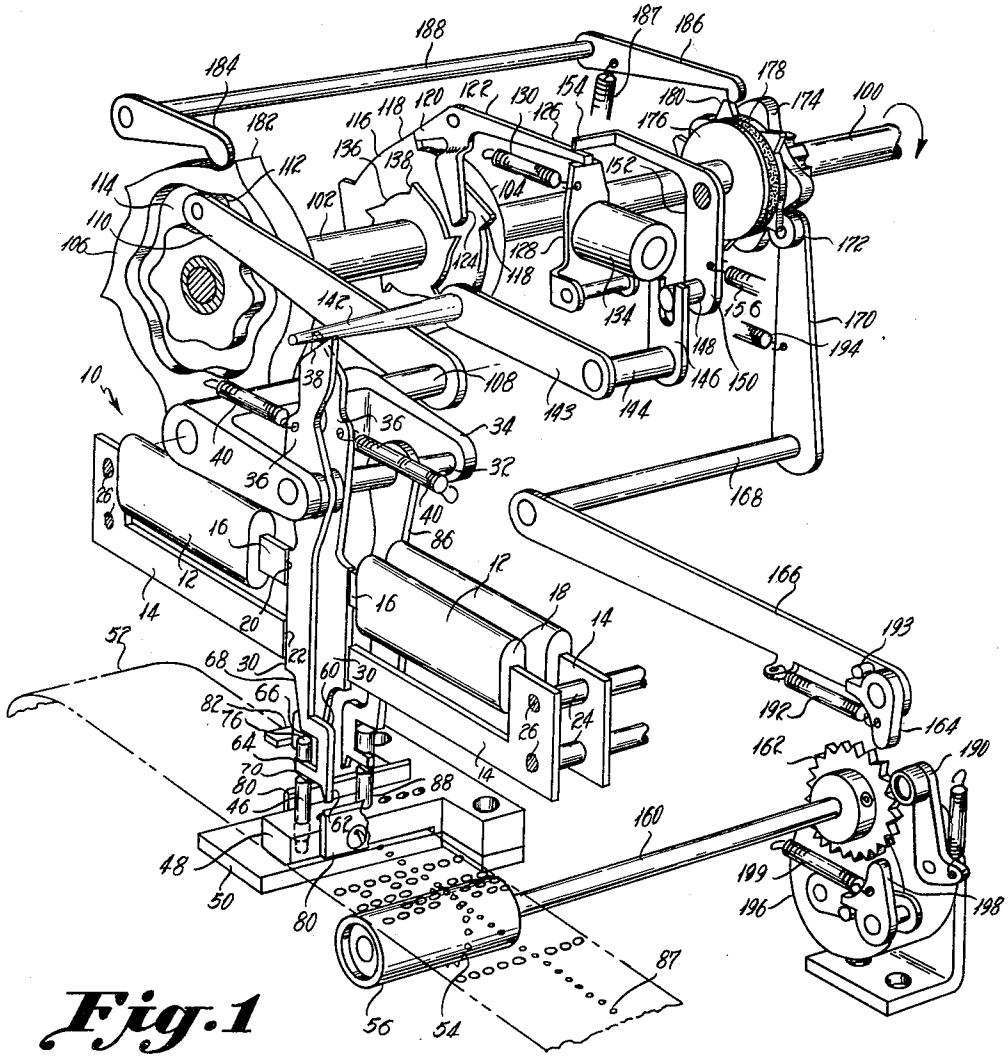


Fig. 1

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PERFORATOR

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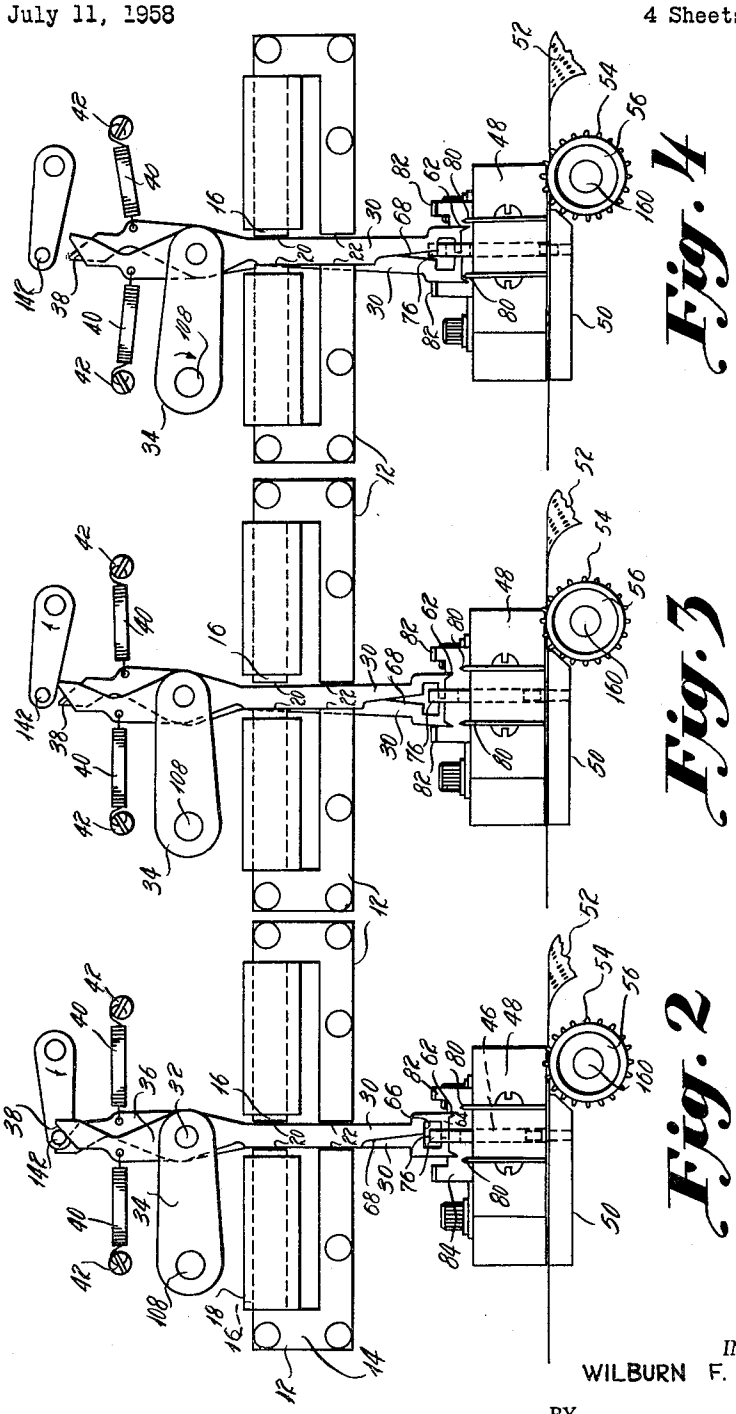


Fig. 4

Fig. 3

Fig. 2

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PERFORATOR

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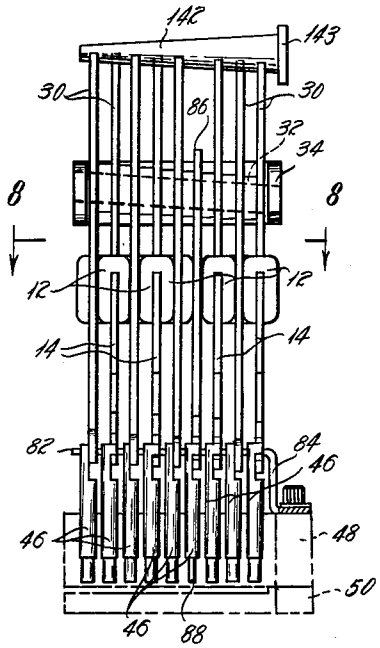


Fig. 5

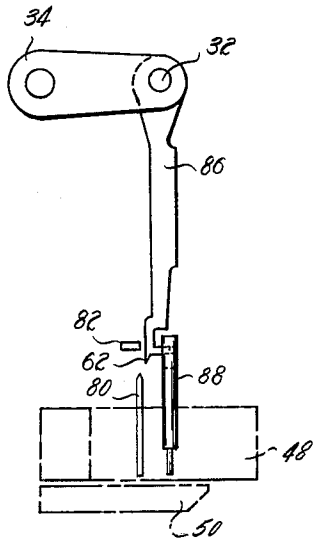


Fig. 6

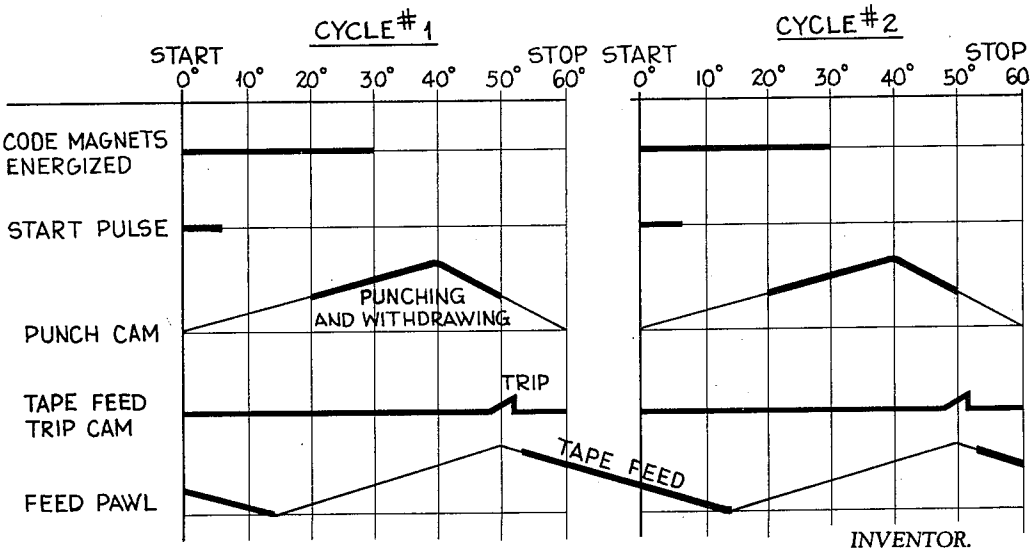


Fig. 7

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PERFORATOR

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Fig. 9

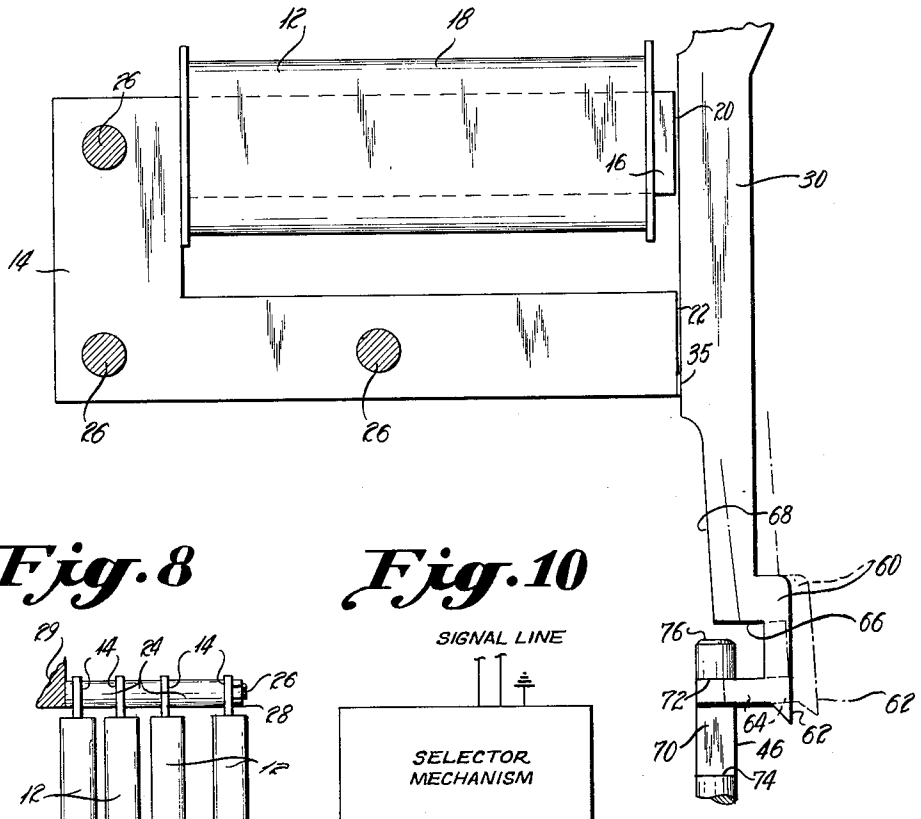


Fig. 8

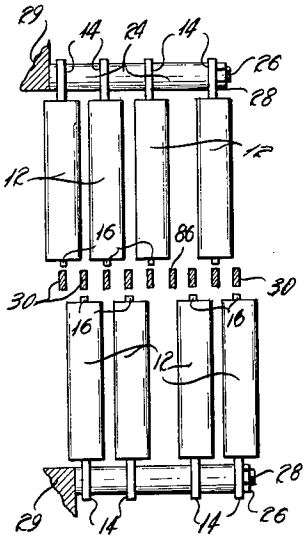


Fig. 10

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3,051,377

PERFORATOR

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Filed July 11, 1958, Ser. No. 748,019
28 Claims. (Cl. 234—115)

This invention relates to a high speed perforator adapted to punch, on tape or other media, coded data from high speed systems such as business machines, calculators, computers and telegraphic systems.

Many reperforators in use today frequently employ highly complicated cam elements and involved linkages which place mechanical limitations on operation speed and also pose difficult machining problems with consequent higher manufacturing costs. For some time, in an effort to attain much higher operating speeds, interested segments of industry have been seeking a simplified code punching mechanism which is dependable at very high speeds and is capable of being produced at reduced manufacturing costs.

The use of electro-magnets in punching mechanisms is well-known, however the combination structural and functional association of electro-magnets and punching mechanisms as they are used in this invention has not been previously known. Prior art reperforators normally use a series of punches and a punch selecting mechanism utilizing a punch operating device, interponent levers selectively interposed in some manner between the operating device and the selected punches, selecting levers for operating the interponent levers, an armature to control the positioning of selecting levers, an electro-magnet for moving the armature in accord with electric code impulses, and associated cams. Generally the code impulses received at the perforator are in sequential order within groups and require seriatim operation of a multiplicity of mechanical components. Various ingenious mechanisms have been devised to reduce the number of and extent of movement of mechanical components to result in higher speeds of operation but, even so, a practical operational speed limit exists when a series of mechanical operations is required for each punch and such mechanical operation is initiated sequentially.

In the present invention, a series of punch levers are mechanically retained, against a biasing force, in a punch actuating position at the start of reception of a code signal combination. A corresponding series of electro-magnets are arranged so each magnet utilizes an associated punch lever as its armature. Selected electro-magnets, when energized by electric impulses in a simultaneous code signal combination, magnetically retain selected associated punch levers in a punch actuating position, and non-selected electro-magnets, which are not energized due to absence of electric impulses, do not magnetically retain associated punch levers. At this point the mechanical retaining force is removed and the unselected punch levers are biased away from their punch actuating position and the selected levers are shifted to actuate punches. A lesser amount of current is needed to energize the selector magnets to hold the pre-positioned punch levers in punching position than would be required to attract and move the punch levers into punching position. The use of the armature as a punch lever is an important aid in the development of desired higher operating speeds, with simplified operating components.

Accordingly a principal object of this invention resides in the provision of a multiple punch code perforating apparatus capable of very high operating speeds.

Another object of this invention resides in the provision of a high speed punching apparatus having a plurality of selector magnets which when energized by coded signals, permit a plurality of punch levers previously cammed

to a proper punching position adjacent the pole faces of the magnets, to be magnetically retained in such position at least through the initial portion of the punching cycle.

A further object of this invention resides in the provision of a high speed punching apparatus with a plurality of similar shaped punch levers mounted on an angular axis on a common punch arm. This angular mounting and a finger and slot lost motion link between punch levers and punches, assures that no two punches initiate actual punching at the same instant, thus requiring less power to perform a multiple code hole punching operation.

A further object in conjunction with the preceding object resides in the provision that all punches (excluding the feed punch) can be made identical, to permit ease of interchangeability and lower production and maintenance costs.

A still further object resides in the provision, in a reperforator, of pre-set combination punch lever and magnet armatures mounted for pivotable and slidable movements enabling retention of selected punch levers by selected electro-magnets and sliding punching action while being magnetically retained. In conjunction with this object, it is also an object to mechanically maintain selected levers in selected punching and/or non-punching positions after an operating cycle is initiated even in the event of electric impulse signals of short duration to the electro-magnets.

Still another object resides in the provision of simultaneously selected and operated code punch actuating levers with a punch arm actuated by a multi-lobe captive cam operated to enable a multiplicity of punching operations during one rotation of a function shaft to enable super high speed perforator operation without the need of high speed shaft bearings and associated shaft components.

A further object resides in providing a high speed coded tape punching apparatus with automatic mechanism for back-spacing the tape, adapted for operation by a key in standard keyboard transmitter operation.

These and additional objects will become more fully apparent from the following description and claims taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a fragmentary perspective of a punching mechanism in accord with the principles of this invention, illustrating only three of the exemplary eight sets of electro-magnets, punch levers and punches—the remaining sets, various bearings and fixed support structure being omitted to enable clarity of disclosure;

FIGURE 2 represents a front elevation of the punch levers, punches and closely associated members showing them in the "reset" position of a punching cycle prior to receipt of an incoming signal;

FIGURE 3 represents a front elevation of the punch levers, punches and closely associated members showing them in a position instantly after a code group signal has been received, with selected punch levers held in punching position by their respective energized electro-magnets and with non-selected punch levers, not retained because their respective selector magnets are not energized, pulled out of their "reset" punching position by biasing springs;

FIGURE 4 represents a front elevation of the punch levers, punches and closely associated members showing them in a punching position, approximately midway of a punching cycle;

FIGURE 5 represents a side elevation of punch levers, punches, and their respective selector magnets illustrating the alternate relative positioning of the magnets;

FIGURE 6 is a detail view illustrating the punch arm, the feed hole punch lever and punch;

FIGURE 7 is a timing chart showing two cycles of operation;

FIGURE 8 is a section taken on line 8—8 of FIGURE 5 and illustrate the horizontal disposition of the punch lever electro-magnets;

FIGURE 9 is an enlarged detail view showing one selector magnet and a portion of its associated punch selector lever; and

FIGURE 10 is a diagrammatic representation of the connections from a selector mechanism to a signal line and to the start and selector magnets of the reperforator.

In the exemplary mechanism herein described, there are shown eight code punch levers, eight punches, one feed punch lever and a feed punch. All of the punch levers are mounted on a single inclined axis and each code punch lever has an individual selector electro-magnet. More or less sets of punch lever, punch and associated electro-magnet can be utilized as desired.

When the selected selector magnets are energized the selected punch levers are held in a pre-set punching position by magnetic attraction of the selector magnets while the unselected punch levers are permitted to be pulled out of punching position by springs attached to the upper arms of the punch levers. Simultaneously, or an instant later, a start magnet is energized, tripping the function control mechanism and clutching a powered main shaft to a rotatable sleeve and causing such sleeve and all function components mounted on the shaft to commence rotating. One of these components is a captive cam which, through operating levers, releases a pre-set control of the punch levers, actuates the selected punches to perforate the tape, withdraws them to complete the punching cycle and resets all punching levers. Operating from the periphery of the captive cam is a follower which actuates a release linkage to trip a friction clutch mechanism on the main shaft. The friction clutch in turn, through a cam and lever arrangement, operates the tape feed mechanism. Back spacing of the tape is performed by a solenoid which is pulsed from a transmitter when corrections become necessary.

Referring now to FIGURE 1, a tape reperforator **10** is illustrated, as an exemplary embodiment of this invention, with various elements such as drive motor, fixed support structure and shaft bearings not shown.

Reperforator **10** is to be used with a plurality of electric circuits which provide paths for a simultaneous, coded electric signal combination. To this end a selector mechanism of a suitable type, shown in block diagram in FIGURE 10 can be used to receive a sequential coded signal combination, transform it to a code combination of simultaneous signals and send such simultaneous signal combinations to reperforator **10**.

The selector mechanism imparts a start impulse either simultaneously with the sending of the code impulse or after a very slight delay. Various electro-magnets **12** and **134** in the reperforator **10** are energized by the signals to initiate and control reperforator action.

Included in the reperforator structure are a plurality of punch selecting electro-magnets **12** (see FIGURE 9), each of which includes a U-shaped flat bridge **14** of magnetically conductive material. One arm **16** of bridge **14** serves as the magnet core and carries a winding coil **18** which is relatively flat in vertical cross section, FIGURE 1. Each of the flat bridges **14** is arranged in vertical disposition with both arms projected sideways and the core pole face **20** and bridge pole face **22** positioned one above the other in substantially the same vertical plane.

As illustrated in FIGURES 1, 5 and 8 the flat nature of the electro-magnet coils **18** and bridges **14** enables a group of such electro-magnets **12** to be placed in closely spaced side by side relationship with all pole faces **20** and **22** disposed in the same plane. Sleeve spacers **24** and supporting studs **26** with nuts **28**, all made of non-magnetic material secure a group (in the disclosed embodiment, four) of electro-magnets **12** in fixed side by side disposition on the frame structure **29** (FIGURE 8) of the reperforator. A second similar group (in the disclosed embodiment, four) of electro-magnets **12** is fixed to the frame structure **29** in opposed and staggered relationship to the first group, enabling eight selector electro-magnets **12** to control the operating disposition of eight parallel vertically disposed punch selecting and operation levers **30**.

Each punch lever **30** is made of flat magnetically conductive material, essentially the same thickness as that of the electro-magnet bridges **14**, and is disposed in vertical co-planar relationship immediately in front of the core and bridge pole faces **20** and **22** of an associated electro-magnet **12**. These punch levers **30** constitute the armatures of the associated selector magnets **12** and all levers **30** are pivotally supported on a common pivot pin **32** carried by a punch arm **34**. If desired, to prevent sticking of "armature" punch levers **30** to the magnet pole faces **20** and **22** and to reduce friction between the levers **30** and pole faces **20** and **22**, a thin spot **35** (FIGURE 9) or strip of low friction material, such as the high polymer plastics, can be affixed to an edge of one of the pole faces. The pivot pin **32** has a slight inclination in a vertical plane, for a purpose to be later described, and is aligned with and above the open space between the pole faces of the oppositely directed sets of alternate electro-magnets **12**. Thus the punch levers **30** depend from their pivotal mount and can be moved toward and away from the associated magnet pole faces.

All punch levers **30** are identical but alternate ones are reversed in position to correspond with alternate oppositely positioned electro-magnets **12**. Accordingly, a detail description of one punch selecting lever will suffice for this description. Each punch selecting lever **30** has an upper arm **36**, extending vertically above the pivot pin **32** and terminating in an inclined camming edge **38**. The inclination is disposed so a downwardly directed force on edge **38** will produce a camming action to pivot the lower portion of the lever **30** toward the pole faces **20** and **22** of its associated electro-magnet **12**. A coil spring **40**, anchored between the upper lever arm **36** and a fixed spring post **42**, exerts a biasing force tending to move the lever **30** away from its associated electro-magnet **12**.

Levers **30** constitute an aligned series of punch operating members disposed immediately above a series of punches **46** which are vertically, slidably carried by a punch guide **48** above a die plate **50**. A tape **52** passes between the guide **48** and die plate **50** and is stepped past the punching station by pins **54** in a tape feed roller **56** operated by mechanism to be hereinafter described.

The lower end of each lever **30** is formed with an offset depending leg portion **60** terminating in a vertical wedge shaped end **62** and a lateral finger **64** projected under the main portion of the lever **30** essentially the full width of the lever. The offset of leg portion **60** provides a punch operating lateral abutment surface **66** (punch hammer) spaced above the lateral finger **64**. A recess **68** is formed in the side edge of lever **30** adjacent the abutment surface **66** and opposite the offset leg **60** whereby the lateral finger **64** extends a greater lateral distance than does the abutment surface **66**, for a purpose which will become apparent as this description proceeds.

In the side of the shank of each punch **46**, adjacent the shank end, is a flat based recess **70** which has a length substantially equal to or slightly in excess of the length of stroke of the punch **46**. Recess **70** terminates in upper and lower shoulders **72** and **74** and the lower lateral finger **64** of an associated punch lever **30** fits into the punch recess under the upper shoulder **72**. Viewing FIGURES 2 and 9, wherever a punch lever **30** is pivoted to a punch operating position, solid lines in FIGURE 9, the lever abutment surface **66** is positioned immediately above the end **76** of the shank of an associated punch **46**.

Disposed a slight distance below each group of punch levers **30** and parallel to the punches **46** are wedge edged punch lever guide blades **80** secured by suitable means such as screws to the sides of the punch guide block **48**. The pointed end **62** of the punch lever **30**, upon down-

ward movement of the lever, will pass on one or the other side of its associated guide blade **80** to retain the lever in an appropriate path during the downward stroke as will now be described.

If a lever **30** is retained by an energized magnet **12** in a punch operation position as it is shifted downward in a vertical path, the lever serves as a punch operating hammer when its abutment surface **66** engages the punch shank end **76** and forces the punch **46** through the tape into die plate **50**. When lever **30** moves downward in a punch operating position, the pointed end **62** moves inside of the guide blade **80**, as shown by the lever **30** nearest the viewer in FIGURE 4, and the lever is retained in a punch operating path for the remaining portion of the punching stroke and a similar portion of the punch withdrawing stroke. Note, that when the punch lever **30** starts its upward movement, its lower end lateral finger **64** will move into engagement with the upper shoulder **72** of the punch shank recess **70** and positively withdraw the punch **46** from die plate **50**.

If a lever **30** is not retained in a punch operating position as it is shifted downward in a vertical path (see phantom lines in FIGURE 9 and the lever farthest from the viewer in FIGURE 3) the biasing spring **40** will cause lever **30** to pivot so its lower offset leg **60** engages the edge of a guide and position limit finger **82** extending forward from a bracket **84** secured by screws to the punch guide block. When the lower end of lever **30** is in its limit position against guide finger **82** the recessed portion **68** of lever **30** is immediately above the punch shank end **76** and during a downward shifting movement of lever **30** the abutment surface **66** will pass to one side of the punch shank **76** and the punch **46** will not be operated. In the non-operating position of lever **30**, the lower end lateral finger **64** is still disposed within the shank recess **70** of its associated punch **46** however, as before described, the recess **70** is of sufficient length to permit a full cycle of punch lever shifting movement without moving the punch. Although the primary purpose of the knife edge guide **80** is to keep the selected levers in a selected position after a punch cycle has started it will also cooperate with a non-selected lever **30** as it moves downward in a non-operating position, the lower pointed end **62** then passing to the outer side of the knife edge guide **80**. Note however that the biasing spring **40** holds the lever in its non-operating position during the major portion of the operating cycle.

A feed punch lever **86** is also pivotally hung on the lever pin **32** for use in punching a feed hole **87** in the tape during each cycle of punch lever operation. Feed punch lever **86** is always disposed in a punch operating position, it has no upper arm as do levers **30**, is not spring biased in the manner of levers **30**, and always depends from the lever pin **32** with its punch abutment portion immediately above the feed punch **88**. Its lower end is shaped like and cooperates with the feed punch shank in punching and withdrawing in the same manner as described for the lower ends of levers **30**.

As was described hereinbefore, the axis of lever pin **32** is inclined essentially in the vertical plane and thus the vertical disposition of each of levers **30** and **86** is different. Because all punch levers are of similar shape and are simultaneously shifted down and up by a swinging movement of the punch arm **34** during a cycle of punching operation, only one punch will initially engage and start to perforate the tape at a given instant in the downward portion of the shift cycle, so there is sequential perforating within each code group thus placing less strain on the punch arm **34** and related mechanism and requiring less power than if all of the punches were made to perforate simultaneously. All of punches **46** can be made identical and (with the exception of feed punch **88**) are, therefore, interchangeable.

POWER COMPONENTS

Referring now to FIGURE 1, power is derived from a main shaft **100** driven by any suitable source, such as an electric motor not shown. During operation of the reperforator **10**, main shaft **100** is continuously rotating.

Journalled on the main shaft **100** is a sleeve shaft **102** which is coupled to the main shaft **100** by a positive clutch **104**. The clutch can be similar to the positive function clutch in the printer component of copending application Serial No. 547,265 filed November 16, 1955. Sleeve shaft **102** carries captive punch cam **106** (closed track cam) rigidly secured to rotate therewith. The U-shaped punch arm **34** is non-rotatably fixed on a support shaft **108** which is pivotably supported in the machine frame. One end of a punch arm operating lever **110** is fixed to support shaft **108** and the other end carries a cam follower **112** which is disposed in the captive cam track **114**. The captive cam **106** has six equal rises around the peripheral extent of track **114** so for each one sixth of a revolution of sleeve shaft **102** the punch arm cam follower will oscillate the lever **110**, support shaft **108**, punch arm **34** and punch levers **30** and **86** through an operating cycle.

Positive clutch **104** is controlled by a stop plate **116** which rotates with the sleeve shaft portion of clutch **104** and whenever the stop plate is blocked against rotation, the positive clutch mechanism is released and sleeve shaft **102** is maintained in a stationary condition. Equally spaced around the outer periphery of the clutch stop plate are six stop lugs **118** which, in rotation, can abut a stop arm **120** of a pivotally mounted start-stop lever **122**. Start-stop lever **122** is pivoted on machine frame structure and has three arms, the aforedescribed stop plate abutment arm **120**, a lever cocking arm **124** and a latching arm **126**. When lever **122** is in a "stop" position its stop arm **120** is disposed in the path of rotation of stop plate lugs **118**, one of which will abut the end of stop arm **120** and tend to force the lever **122** in a clockwise movement (FIGURE 1).

However, the lever latching arm **126** of the start-stop lever **122** extends over and rests on the edge of an armature plate **128** which prevents clockwise pivotal movement of lever **122**, and thus maintains the lever stop arm **120** in its stop plate blocking position. Armature plate **128** is biased by a spring **130** to its lever blocking position. Associated with the armature plate **128** is a "start" electro-magnet **134** which, when energized, will magnetically attract and pull the armature plate **128**, against its spring biasing force, out from under the latching arm **126** of the start-stop lever. This action releases blocking of the start-stop lever **122**, permitting it to pivot clockwise and release the clutch stop plate **116** which in turn positively clutches sleeve shaft **102** to the rotating main shaft **100**.

When the sleeve shaft **102** rotates, as before described, it will oscillate the punch levers **30** and **86** through a punching cycle. During this rotation a restoring cam **136** with six lobes **138** on its periphery, also non-rotatably fixed on the sleeve shaft, rotates with sleeve shaft **102**. Just before the punching cycle is completed, one of the restoring cam lobes **138** engages the cocking arm **124** of start-stop lever **122** and pivots the lever **122** counterclockwise to raise the lever latching arm **126** over the armature plate **128**, which under spring biasing action, moves away from the de-energized "start" magnet **134** to a latching position under the start-stop lever latching arm **126**. This latched position of start-stop lever **122** again places the lever stop arm **120** into the path of the clutch stop plate abutment lugs **118** and the next succeeding lug **118** will abut the lever stop arm **120**, disconnect the clutch **104** and terminate sleeve shaft rotation.

A punch lever reset bail **142** is operated in unison with the start-stop lever **122** to engage and position all punch levers **30** in an operative position adjacent the pole faces **20** and **22** of associated selector electro-magnets **12** during an overlap period at the end of one punching cycle and the beginning of the succeeding punching cycle.

Bail **142** is a tapered rod disposed with its axis extending horizontally above the inclined upper camming edges **38** of the punch operating levers **30**. The taper angle of the bail rod **142**, which is exaggerated in the drawings, is double the angle of inclination of the punch lever pivot pin **32**. This taper enables the bail **142**, when the punch levers **30** are raised, to be simultaneously engaged by all of the punch lever camming edges **38**. At this stage in the operating cycle bail **142** is prevented from moving upward, as will be explained, and upon being engaged by the lever camming edges **38**, all levers **30** will be forced to pivot into punch operating disposition with the armature pole face portion of each punch lever **30** positioned in close proximity to the associated selector magnet core and bridge pole faces **20** and **22**.

During the initial portion of a punch operating cycle, and before the punch levers **30** are lowered to a position where the wedge ends **62** engage the lever guides **80**, the bail **142** will be raised out of engagement with the punch levers **30** and any punch lever (excepting of course the feed hole punch lever) which is not held in punch operating position by an energized selector magnet **12** will be permitted to swing to a non-operating position under spring bias.

Bail **142** is fixed to one arm **143** of a bell-crank assembly **144**, the other arm **146** of which is forked and receives an operating pin **148** in one arm **150** of a bail reset lever **152** in a direction forcing bent end **154** into engagement with the start-stop lever arm **126**. The bias force of spring **156** also tends to urge the start-stop lever in a clockwise direction. Whenever start-stop lever **122** is in a "stop" position (as shown in FIGURE 1), reset lever **152** will be pivoted against its spring bias force to rock the bail bell crank **144** and lower the reset bail **142** against the punch levers **30**. When a code signal group is received by the perforator, as previously described, the start magnet **134** is energized after a slight delay from the energization of selected ones of the selector magnets **12**. Energization of start magnet **134** attracts its armature plate **128**, permitting the start-stop lever **122** to pivot and this also permits the bail reset lever **152** to pivot under force of its bias spring. Such movement of bail reset lever lifts the bail **142** away from engagement with punch levers **30**, this release movement being subsequent to energization of the selector magnets and essentially simultaneous with initiation of the cycle of movement of the punch levers **30**. As described the start-stop lever **122** will be reset and latched just prior to completion of a cycle of operation and this resetting operation causes the bail reset lever **152** to also be reset and latched with the bail **142** in position to be engaged by the upper ends of the punch levers **30** in position awaiting receipt of the next code signal group.

Tape Feed Mechanism.—As has been described, tape feed is accomplished by a tape feed roller **56** with pins or sprocket teeth **54** engaging feed holes **87** in tape **52**. Roller **56** is non-rotatably secured to a shaft **160** and a ratchet drive wheel **162** is secured as by a set screw on the feed shaft **160**.

Feed movement is imparted to ratchet wheel **162** by an intermittently oscillated tape feed pawl **164**, which is pivotally carried by a tape feed pawl lever **166**. Lever **166** is connected through a pivot shaft **168** to a tape feed cam follower lever **170**, the follower end **172** of which rides on a six lobe tape feed cam **174** which is rotatably carried on main drive shaft **100** and drive connected therewith through a conventional friction disc clutch **176**.

Rigidly secured, coaxially with tape feed cam **174**, is a tape feed stop plate **178** having six equally circumferentially spaced stop lugs **180** on its periphery. On the periphery of the captive punch cam **106** are six circumferentially disposed cam projections **182** over which a follower arm **184** of a tape feed cam release latch **186** rides during rotation of the captive punch cam **106** and after withdrawal of the punches **46** from the punched tape code holes. When the tape feed release follower arm **184** reaches the peak of one of the six cam projections **182** a counterclockwise motion (FIGURE 1) is imparted to tape feed release latch **186**, through shaft **188**, which moves against the bias force of a spring **187** away from a blocking position in the path of rotation of lugs **180** on the tape feed stop plate **178**. This release action permits tape feed cam **174** and stop plate **178** to rotate clockwise due to the continuous rotation of the tape feed friction clutch **176** affixed to the constantly rotating main shaft **100**. The tape feed follower lever **170** then rides to the peak of one of the lobes on the tape feed cam **174**, imparting a clockwise movement to the tape feed pawl **164** which engages a notch on the tape feed ratchet wheel **162**, indexing it clockwise one position. The ratchet wheel **162** is held in restriction by a detent **190**.

Tape feed pawl **164** which is pivoted on lever **166**, has a spring **192** and pin stop **193** limiting device that restricts its counterclockwise movement when the pawl is out of engagement with the tape feed roll ratchet wheel **162**. When the tape feed pawl **164** indexes the feed roller **56** one position, it then "follows" the circular periphery of the tape feed ratchet wheel **162** until the tape feed pawl lever **166** shifts the tape feed pawl **164** back up and out of engagement with the tape feed ratchet wheel **162**. As shown in FIGURE 7, tape feed is initiated just as the punches are withdrawn from the tape and because rotation of the tape feed cam **174** is derived from the main shaft **100** and not the sleeve shaft, tape feed can occur while the sleeve shaft **102** is stopped and thus overlaps cycle operations.

Tape feed lever **166** and follower lever **170** are biased by a spring **194** to move the feed pawl **164** away from the ratchet wheel **162** and maintain the follower lever **170** in engagement with the tape feed cam. As the follower end **172** of follower lever **170** moves into a depression between lobes of the tape feed cam **174**, the feed pawl **164** is moved away from engagement with ratchet wheel **162**. At this stage in the machine operation the captive cam **106** has rotated to a position where the follower arm **184** of the tape feed release latch **186** is between two tape feed release cam projections **182** and the release latch **186** has been positioned in the path of rotation of the stop lugs **180** on the tape feed cam stop plate **178**. The succeeding stop plate lug **180** engages the release latch **186** and rotation of the tape feed cam **174**, through its friction clutch **176**, is prevented until the next cycle of punching operation.

Indexing of the tape feed ratchet **162** imparts the same directional movement to the tape feed roller **56** to advance (or back space) the tape **52** one position consecutively by means of the small peripheral feed roller pins **54** which engage the feed holes **87** in tape **52**.

Back-spacing is enabled by providing a rotary solenoid **196** which, when energized, operates a back-space pawl **198** (directly opposed to the tape feed pawl **164**) causing it to engage a notch on the tape feed ratchet wheel **162**, automatically back-spacing the tape **52** one position. Back-spacing pawl **198** is mounted similarly to the tape feed pawl **164**, except that it is restricted in clockwise movement by a pin and spring **199**. It too "follows" the circular travel of the ratchet teeth on the periphery of the tape feed ratchet wheel **162** and is disengaged on completion of the back-spacing cycle of solenoid **196**.

OPERATION

With reference to FIGURES 1 and 10, the selector mechanism receives a sequential coded signal combination, transforms it to a code combination of simultaneous signals. The simultaneous code signal combination is sent through circuits to the group of selector electro-magnets **12** which are instantly selectively energized, in ac-

cord with the code combination, to hold selected associated punch levers **30** in their punch operating position (see FIGURE 4). As has been described, all code hole punching levers **30** are mechanically pre-set and held in punch actuating position closely adjacent or against the pole faces of associated selector magnets **12** during initial receipt of a code signal combination.

The tape perforator main shaft **100** is continually rotating while the mechanism is in operation.

After receiving the coded signal combination, which energizes selector magnets **12** in accord with the code signal, the start magnet **134** (FIGURE 1) is energized, attracting its armature plate **128**, to unblock start-stop latch lever **122** which turns clockwise and releases the stop plate **116** of the captive punch cam **106**. A slight delay in energizing the start magnet can be obtained by an electronic delay circuit or the delay in mechanically removing the reset bail from engagement with the punch levers may be sufficient since the electro-magnetic attraction of selected selector magnets **12** is essentially instantaneous with receipt of the code signal impulses. Since the bent arm **154** of lever **152**, which controls the punch lever reset bail **142**, rests on the latching arm **126** of the start-stop latch lever **122**, unblocking of the start-stop latch lever **122** also unblocks the reset bail lever **152** and permits it to turn counterclockwise under the influence of spring **156**, moving the punch lever reset bail **142** up and away from the canted edges **38** of the punch levers **30**, allowing the punch levers **30** (see FIGURE 3), which are not selected by energized selector magnets **12**, to be pulled out of punching position by their biasing springs **40**.

As the captive punch cam **106** rotates clockwise, cam follower **112** on punch arm lever **110** follows captive punch cam track **114** and imparts an oscillating motion, about the axis of support shaft **108**, to punch arm **34**. The punch levers **30** and **86** carried by the punch arm **34** and interconnected by a lost motion connection to associated punches **46** and **88** by punch lever fingers **64** extending through the milled flat recesses **70** on the sides of the punches, are moved downward, and punch lever hammer ends **66** of selected punch levers strike the punch tops **76** driving selected punches **46** down through the punch guide **48**, tape **52** and into die plate **50** to complete the punching of the coded holes. Punching is sequential because of the inclination of punch lever pin **32**. The unselected punch levers **30** are also moved down with the selected punch levers **30** and **36**, but, being non-selected, that is, with their respective selector magnets **12** non-energized, springs **40** pull them out of vertical alignment with punches **30** and punch lever hammer ends **66** pass along the side of associated punch tops **76** and thus cannot actuate the unselected associated punches.

The feed punch lever **86**, which is always in punching position, punches a hole during each cycle of operation and provides a continuous line of feed holes in the tape **52**.

All of the punch levers **30** are restricted in their lateral movement by the close proximity of the punches **46** and **88** to one another and are also prevented from swinging out of complete operational alignment by the punch lever guides **82**. (See FIGURES 3, 4, 5 and 6.) It will be noted in FIGURES 3 and 4 that punch guides **82** restrict the swinging movement of punch levers **30** when, being non-selected, they spring out of punching position. Punch guides **80** also restrict the swinging movement of the punch levers **30** but during a different part of the punching cycle. In a case where a short signal is pulsed to selector magnets **12**, and the punch levers **30** were on their downward stroke, the short signal might cause the selector magnets **12** to de-energize too soon, releasing the punch levers **30**, and the springs **40** would instantly tend to snap them out of punch operating alignment, in which case the punch lever hammer ends **66** would miss striking punch tops **76**, thus not punching the coded signal even though the punch levers **30** were selected by the incoming signal before the punching action began. To prevent such an occurrence the sharp points **62** formed on the lower ends of the punch levers **30** and **86**, during the downward thrust of the punch levers, fall inside of the punch lever guide **80** (see FIGURE 4) and selected punch levers **30** and the feed punch lever **86** are held in positive punching position regardless of the length of the signal to the selector magnets **12**.

While the aforementioned punching operation is taking place, the start-stop lever restoring cam **136** on sleeve shaft **102** is rotating clockwise and a tooth **138** on the periphery of the restoring cam **136** will strike the lower cocking arm **124** of start-stop latch lever **122**, causing the lever **122** to rotate counterclockwise to place its stop abutment arm **120** in the path of rotation of a stop lug **118** on the periphery of the main clutch stop plate **116**, causing sleeve shaft **102** and all attached components to stop rotating.

This counterclockwise rotation of the start-stop latch lever **122** moves its latching arm **126** up and unblocks the "start" magnet armature plate **128** which, under bias of spring **130**, instantly snaps away from the now de-energized "start" magnet **134**. Instantaneously with the aforementioned counterclockwise rotation of the start-stop latch lever **122**, the reset bail lever **152**, which has its bent arm **154** resting on the latching arm **126** of the start-stop latch lever **122**, pivots clockwise and moves the reset bail **142** back to the punch lever reset position. The punches **46** and **88** are withdrawn from the tape **52** by the upstroke of the punch levers **30** and **86**, and the canted ends **38** of levers **30**, upon striking the reset bail **142** will cam the punch levers **30** over against or closely approximate the pole faces **20** and **22** of their respective selector magnets **12**. Thus, with punches **46** and **88** withdrawn and the punch levers **30** repositioned, the punching mechanism is reset for the next cycle of punching operation.

As will be noted in FIGURE 1, especially in the illustrated captive punch cam **106**, the captive punch track **114** has six high and six low positions and as the captive punch cam **106** rotates it imparts an oscillating motion through cam follower **112**, punch arm lever **110** and the punch arm **34** to the punch levers **30** and **86**, thus performing six complete punching operations per one complete revolution of the main shaft **100**.

An important feature of this invention is the punch lever guide means which keeps the selected punch levers always in positive punching alignment. This guide means is particularly important in the event of a short signal to the selector magnets because, were it not for these guides, the premature de-energizing of the magnets would release the punch levers too soon and spring would pull them out of punching alignment even though still being in a selected status.

Another important feature of this invention is the provision of a multi-lobed, captive cam which in this invention has six high and six low spots on the captive track. This permits six punching operations per one 360° turn of the main shaft. An advantage in this relatively slower turning of the main shaft is longer life to the shaft and all components attached thereto, especially the tape feed friction clutch which operates more efficiently at lower speeds.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In combination in a perforating device; a group of punches; a group of selector levers of magnetic material each of which is operatively coupled with, and is adapted to operate, an associated one of said punches; at least one lever, exclusive of said group of selector levers, operatively coupled with and operable on an associated one of said punches; mechanical means to cyclically cam all said selector levers into a punching position; a series of individual electro-magnets, each of which is associated with a selector lever, for selective energization to magnetically retain, when energized, selected ones of said selector levers in punching position, and operating means connected to all said levers to cyclically operate said at least one lever and associated punch and all selected electro-magnetically retained selector levers and their associated punches through a punching cycle.

2. The combination as defined in claim 1, wherein a record medium feed means is provided to step feed a record medium past said punches during each cycle of punch operation and said one lever, exclusive of said selector levers, and its associated punch comprise means for punching a feed hole in the record medium during each cycle of punch operation.

3. The combination as defined in claim 2, wherein said operating means includes a shiftable common support member, pivot means hang all of said levers from said common support member and biasing means connect to each of said selector levers tending to urge them about their pivotal support to a non-punching position.

4. The combination as defined in claim 3, wherein the sides of the shank ends of all of said punches have a recessed flat portion; the end of each of said levers has a hammer portion disposed adjacent the end in alignment with the axis of the associated punch shank and a lateral finger disposed within the recessed flat portion of its associated punch; and pivotal movement of said selector levers to a non-punching position disposes the hammer portions of such pivotal selector levers, away from alignment with said punch axis.

5. A perforating device comprising in combination: a plurality of punches; an associated plurality of unitary punch selector and operating members; means carrying said members enabling individual movement of each member to either of two positions and a shifting movement of all members regardless of which of said two positions said members occupy; means biasing said member to one of said two positions in which said shifting movement will not result in a punching operation by associated punches; first means cyclically operative during an initial portion of a punching cycle to directly engage and positively move said members to the second of said two positions in which said members are in a punch operating disposition with associated punches; a plurality of electro-magnets equal in number to said members selectively energized responsive to electrical impulse conditions for determining and selectively retaining associated punch selector and operating members in punch operating disposition; second means, cyclically operative during a portion of a punching cycle subsequent to said initial portion of said punching cycle, connected to all said members for accomplishing said shifting movement of all said members whereby only said members retained by energized electro-magnets in punch operating position will cause associated punches to be operated through a punching cycle; and power means for operating said first means and said second means through individual cycles during a punching cycle.

6. The combination as defined in claim 5, each of said punch selector and operating members having an operative lost motion guide connection with its associated punch and a hammer portion adapted to be disposed in operating alignment with the end of a punch, with which said selector member is maintained when in punch operating position; and said second means operative subsequent to initiation of reception of a coded impulse combination and causing simultaneous shifting of all punch selector and operating members enables the hammer portions of all punch selector levers maintained in punch operating disposition by said electro-magnets to engage associated punch ends to actuate selected punches during the shifting movement.

7. The combination defined in claim 6, wherein punch dies are disposed in coplanar relationship, the means to simultaneously shift all punch selector and operating members includes an arm with a mounting pin fixed therein and pivotally carrying all of said punch selector and operating members, and said pin has its axis angled toward said punches so any selected punches will enter associated dies in sequential order.

8. A perforating device as defined in claim 5, further comprising: at least one punch and an associated punch operating member, said associated operating member being continually in a punch operating position relative to its associated punch; and each of said plurality of punch selector and operating members having at least a portion thereof made of magnetically conductive material and constituting the armatures of said electro-magnets.

9. A perforating device as defined in claim 5 wherein, each of said selector and operating members have at least a portion thereof made of magnetically conductive material and constituting the armatures of said electro-magnets.

10. A code operated perforating device comprising: a plurality of punches; a plurality of simultaneously cyclically shiftable, independently pivotable, selectively positionable two position punch selecting levers with at least side portions made of magnetically conductive material and each of which has a punch actuating abutment portion; one position of each lever enabling actuable engagement of said lever abutment portion with an associated punch upon a cyclic shifting to operate said associated punch; the second of said lever positions disposing said lever abutment portion away from engaging alignment with the punch during a cyclic shifting of said lever positions; means releasably holding all of said levers in said one position; means biasing all of said levers toward said second positions; a plurality of electro-magnets equal in number to said levers and each having a pole face disposed in magnetically retentive disposition to said side portions of associated levers when said levers are in said one position; and means for energizing selected ones of said electro-magnets, releasing said holding means and causing a cycle of punch selecting lever shifting movement.

11. A high speed perforating device comprising: a series of punches; a plurality of selectively energizable electro-magnets, each of which has a two position pivoted armature also mounted for shifting movement substantially parallel to the associated magnet pole face; means for shifting said armatures substantially parallel to said pole faces; releasable means for holding said armatures in one position adjacent said pole faces; resilient means biasing said armatures away from said pole faces; abutment means on each armature for engaging and operating an associated punch when the associated electro-magnet is energized and the armatures are shifted substantially parallel to the magnet pole face; and means to energize selected ones of said magnets, release said holding means and shift said armatures through one cycle substantially parallel to the magnet pole faces.

12. A high speed perforating device comprising: a punch having a shank with an anvil portion on its end; a punch lever, with at least a portion made of magnetic material, having an abutment end adapted to engage said anvil end portion; a shiftably mounted punch lever operating member pivotally mounting said punch lever; resilient means biasing said punch lever toward a position at which the path of said abutment end will miss the anvil portion upon shifting of said operating member; and releasable holding means adapted to engage and pivotally

hold said levers in a second position in which said abutment portion will engage said anvil end portion and operate said punch upon shifting of said operating member; means to release said holding means and enable shifting movement of said operating member; and an electro-magnet adapted when energized to magnetically couple with said portion made of magnetic material and maintain said selector lever in said second position during shifting movement of said operating member.

13. The perforating device as defined in claim 12, wherein each punch lever is connected to its associated punch with a lost motion connection which engages and positively retracts each actuated punch during the latter portion of shifting movement of said operating member.

14. A high speed perforating device comprising: a punch having a shank with an anvil portion on its end; a punch lever, with at least a portion made of magnetic material, having an abutment end adapted to engage said anvil end portion; a shiftably mounted punch lever operating member pivotally mounting said punch lever; resilient means biasing said punch lever toward a position at which the path of said abutment end will miss the anvil portion upon shifting of said operating member; and releasable holding means adapted to engage and pivotally hold said levers in a second position in which said abutment portion will engage said anvil end portion and operate said punch upon shifting of said operating member; means to release said holding means and enable shifting movement of said operating member; an electro-magnet adapted when energized to maintain said selector lever in said second position during shifting movement of said operating member; and fixed guide means disposed to structurally cooperate with said punch lever after initiation of shifting movement of said punch lever to maintain said punch lever in whichever of the two positions said punch lever was in when shifting movement occurs during punching operations.

15. The perforating device as defined in claim 14, wherein said guide means includes a blade member aligned with the direction of shift of, and parallel with the pivoted axis of, said punch lever; and said punch lever has a projection on its abutment end which has a path, during punch lever shifting movement, disposed closely adjacent one side of said blade member when said punch lever is in said one pivotal position and disposed closely adjacent the other side of said blade member when said punch lever is in said second pivotal position.

16. In a cyclically operable perforating device; a group of punches; associated die means for said punches; a group of punch operating levers, individually connected with associated punches, a plurality of which are selectively positionable into and out of punch operating position; each lever having portions adaptable to engage and operate an associated punch upon shifting of said levers; cyclically operable lever moving means to directly engage and positively move all selectively positionable levers to a punch operating position only during a first non-punching phase of the operating cycle of the device; selectively operable means separate from said lever moving means and operable during a phase of the operating cycle of the device which overlaps said first phase and includes the punching phase for retaining selected levers in punch operating position; means to move all non-selected levers out of their punch operating position subsequent to cyclic operation of said lever moving means; and a shiftable member directly mounting all of said punch operating levers so simultaneous shifting of all punch levers will result in punching operation of any punches associated with levers which are selectively positioned in a punch operating position.

17. In combination in a perforating device; a series of punches; means for selecting and operating said punches including an intermittently power driven cam shaft with a six lobe enclosed track cam rotatable therewith, a cam follower held captive in said enclosed track, means shifted by oscillatory movement of said cam follower each time said cam rotates one-sixth of a revolution, a plurality of unitary punch selecting and operating members, at least a portion of each member being made of magnetic material, individually pivotally mounted on said shifted means for pivotal movement between a punch selecting position and a non-punch selecting position, resilient means biasing all members toward a non-punching pivotal position, shiftable mechanical means adapted to engage and move all of said members to a punch selecting position between each cycle of shifting movement and to release all of said members upon start of a shift cycle, and selectively energizable electro-magnets associated with each of said members to retain selected members in a punch selecting position upon start of a shift cycle and just prior to release of said mechanical means; and means for starting cam shaft rotation and automatically terminating cam shaft rotation at the end of a one-sixth revolution.

18. A perforating device as defined in claim 17, wherein said electro-magnets are energized only during the initial portion of said shift cycle and guide means operatively engage all members while the selected electro-magnets are energized and positively maintain them in punch selected and non-punch selected positions during the punch actuation and retraction.

19. In combination in a code operated perforating device wherein individually positioned punch selecting levers are mounted on a common shiftable axis and serve as simultaneously shifting punch operating members for an aligned side by side series of punches; punches having shanks with recessed flats formed in the shank sides; punch selector levers at least a portion of which is made of magnetic material, of flat elongate shape pivotally mounted intermediate their ends; said elongate punch selector levers and pivotal mounts being disposed in essential alignment with the common plane through the axes of the associated punches; each of said levers having one arm with a canted end edge, and a second arm with a transverse lug slidably disposed within the recessed flat of the associated punch and an abutment adapted to be alternatively disposed immediately adjacent the end of the associated punch shank in a position essentially aligned with the punch axis and the lever pivotal mount or offset to one side of the punch axis; a plurality of electro-magnets, each electro-magnet having a thin flat bridge and core structure disposed with a pole face parallel to the shifting path of movement, and engageable by an edge of the magnetic portion of an associated punch selector lever during shifting movement of said selector lever; means adapted to engage said canted end edges of and maintain said selector levers in engagement with associated magnet armature pole faces until said magnets are energized at which time said energized magnets retain said shifting selector levers against associated pole faces.

20. A high speed, code operated perforating device comprising: a power means; a series of punches; a plurality of two position punch selector levers, each of which is operatively associated with a separate one of said punches and includes an abutment portion adjacent an end of the associated punch, and all of said levers have at least a portion made of magnetic material; means pivotally mounting said levers on a common axis; means carrying said pivotal mounting means and operable in a cycle to shift all said levers in paths toward and away from said punches; resilient means connected to bias said levers toward one of their positions in which the paths of said abutment portions will miss the ends of associated punches when said levers are cyclically shifted; a mechanism shiftable between operative and inoperative positions including a means engaging said selector levers, when said mechanism is in operative position, and maintaining said levers against the resilient bias force in the second of their positions in which the paths of said abutment portions will abut the ends of, and operate, associated said punches when said levers are cyclically shifted; latch means for

holding said mechanism in operative position; means to release said latch means; means engageable with said mechanism for resetting said mechanism in latched position; a plurality of electro-magnets one for each of said punch selector levers, disposed in the paths of pivotal movement of said levers, having pole faces adapted to be engaged by the magnetic portion of said levers when the levers are in the second of their two positions; means selectively operatively connected between said power means and said carrying means for enabling positive power operation of said carrying means through one cycle, to positively operate said resetting means at a period intermediate the beginning and end of said cycle, and to automatically terminate positive operation at the end of said cycle; start means to initiate positive operation of said selectively connected means; energization of selected said electro-magnets and operation of said start means and latch release means being responsive to code impulses of a coded impulse combination, whereby selected electro-magnets are energized and maintain associated punch selector levers in said second position, punch selector levers associated with non-energized ones of said electro-magnets are permitted to shift to said one position under spring bias, all of said punch selector levers are simultaneously cyclically operated, and the punches associated with the punch selector levers which are maintained in said second position by said energized electro-magnets are actuated through a punching cycle.

21. A tape perforating device comprising: a punching station through which the tape passes; a tape feed means; a series of punches at said punching station; a group of pivotally mounted punch selector and actuating levers adapted to be operatively disposed in one position for actuating associated punches; resilient means normally biasing said levers away from actuating position; a plurality of electro-magnets, one for each of said selector levers and adapted when energized to retain said associated levers in punch actuating position; power means including a rotating shaft; a cam shaft; a positive clutch for engaging said rotating shaft and said cam shaft; a closed track multiple lobe cam fixed to rotate with said cam shaft; a first cam follower held captive in said closed track cam; shiftable means connected to said first cam follower and carrying all of said punch selector levers, shiftable through an oscillation cycle each time the enclosed track cam rotates one of its lobes past the cam follower; said positive clutch means having a disengaging member including a plurality of angularly disposed stop lugs equal in number and correlated to the cam lobes; a pivoted stop member having at least three arms, one of which is adapted to be disposed in the path of said stop lugs to operate said clutch disengaging member; a latch member adapted to releasably engage a second of said stop lever arms and maintain said stop lever in clutch disengaging position; means to release said latch member; a rotatable reset member, fixed on said cam shaft, having a plurality of camming portions equal in number and correlated to said enclosed track cam lobes, adapted to engage the third stop lever arm upon rotation of said cam shaft, whenever said latch member releases said second arm, to shift the stop lever back to a latch position; a tape feed cam member having a plurality of cam projections and associated stop projections equal in number to said enclosed track cam lobes; a friction clutch connecting said tape feed cam member to said rotating shaft; a further series of cam lobes on said cam shaft equal in number and correlated to said enclosed track cam; stop means resiliently biased into the path of said feed cam stop projections and adapted to be engaged by one of said further series of cam lobes during rotation of said cam shaft to be momentarily shifted against the resilient bias force out of the path of said stop projections each time said first cam follower oscillates through one cycle; and means including a second cam follower engaging the cam projection portion of said tape feed cam member and a member connected with said second cam follower adapted to shift into engagement with and move said tape feed means to advance the tape one step through said punching station each time a cam projection shifts said second cam follower.

22. A tape perforating device as defined in claim 21, wherein tape back space means are included comprising: a solenoid operated back space member having a device adapted to be shifted into engagement with and move said tape feed means to back space the tape one step through said punching station each time said solenoid is energized.

23. In a code operated perforating device; a plurality of punches; an associated plurality of punch selectors; means resiliently biasing said punch selectors toward a non-punch selecting position; means in control relationship with said punch selectors for maintaining said punch selectors in punch selecting position until receipt of a coded impulse combination and responsive to receipt of a coded impulse combination to release control of said punch selectors; and means comprising a plurality of electro-magnets, one for each punch selector, responsive to electrical impulse conditions of a coded impulse combination for maintaining the punch selecting position of selected punch selectors during receipt of a coded impulse combination and punching operation.

24. A perforating device as defined in claim 23, wherein each of said punches has a recessed flat in the side of its shank end; each of said punch selectors is an elongate flat member essentially aligned with an associated punch, each punch selector also has a hook end engaged in said recessed flat of its associated punch regardless of its position, and a hammer portion adapted to be disposed adjacent the shank end of, and aligned with, an associated punch only when the punch selector is in a punch selecting position, and each punch selector constitutes an armature means for its associated electro-magnet; all punch selectors are pivotally mounted on a common pivot shaft; and shiftable means carries said common pivot shaft and selector levers for simultaneously shifting said shaft and selector levers in a direction essentially parallel with the axes of associated punches in both a punch selecting position and non-punch selecting position of said selector levers.

25. In combination in a perforating device; a group of punches; a group of selector levers of magnetic material, each of which is operatively coupled with and is adapted to operate, an associated punch; first mechanical means to cam said selector levers into a punching position; a series of individual electro-magnets, each of which is associated with a selector lever, for selective energization to magnetically couple with and retain selected ones of said selector levers in punching position; and second mechanical means to operate said selector levers so each lever retained by an energized electro-magnet will operate an associated punch.

26. In combination in a code operated perforating device wherein individually positioned punch operating levers are mounted on a common shiftable axis and serve as simultaneously shifting punch operating members for an aligned side by side series of punches: punches having shanks with recessed flats formed in the shank sides; a plurality of said punch operating levers, at least one less in number than said punch operating levers, being punch selector levers, with at least a portion of each being made of magnetic material; all of said levers being of flat elongate shape and pivotally mounted intermediate their ends; said elongate punch operating levers and pivotal mounts being disposed in essential alignment with a common plane through the axes of the associated punches; all of said punch operating levers having one arm with a transverse lug slidably disposed within the recessed flat of the associated punch and an abutment for engaging the end of an associated punch shank; each of said punch selecting levers having a second arm with a canted end edge adapted to be alternatively disposed so the abutment of its said one arm is immediately adjacent the end of the associated punch shank

in a position essentially aligned with the punch axis and the lever pivotal mount or offset to one side of the punch axis; a plurality of electro-magnets, each electro-magnet having a thin flat bridge and core structure disposed with a pole face parallel to the shifting path of movement, and engageable by an edge of the magnetic portion of an associated punch selector lever during shifting movement of said selector lever; means adapted to engage said canted end edges of and maintain said selector levers in engagement with associated magnet armature pole faces until selected ones of said magnets are energized at which time said energized magnets retain associated ones of said shifting selector levers against associated pole faces.

27. In combination in a perforating device; a series of punches; means for selecting and operating said punches including an intermittently power driven cam shaft with a six lobe enclosed track cam rotatable therewith, a cam follower held captive in said enclosed track, means shifted by oscillatory movement of said cam follower each time said cam rotates one-sixth of a revolution, a plurality of unitary punch operating members individually pivotally mounted on said shifted means, a group of said operating members, at least one less than said plurality of members, being punch selector members mounted on said shifted means for movement between a punch selecting position and a non-punch selecting position, resilient means biasing all selector members toward a non-punching position, shiftable mechanical means adapted to engage and move all of said selector members to a punch selecting position between each cycle of shifting movement and to release all of said selector members upon start of a shift cycle, and selectively energizable electro-magnets associated with each of said selector members to retain selected selector members corresponding to energized electro-magnets in a punch selecting position upon start of a shift cycle and just prior to release of said mechanical means; and means for starting cam shaft rotation and automatically terminating cam shaft rotation at the end of a one-sixth revolution.

28. In a perforating device: a group of punches; associated die means for said punches comprising a die for each of said punches with the punch entrances of all of said die means being coplanar; a group of punch operating levers, individually directly connected to associated punches, a plurality of which are selectively individually positionable into and out of punch operating position; each lever having portions which, when selected levers are in punch operating position, are adapted to engage and operate an associated punch upon shifting of said levers; shiftable means pivotally mounting all of said punch operating levers on a common pivot axis inclined toward said coplanar die means to dispose said levers at different spaced positions away from said coplanar die means; means to simultaneously shift said shiftable means and all punch levers while retaining said common pivot axis in said inclined relationship to result in punching operation of any punches associated with levers which are selectively positioned in a punch operating position and so that any selected ones of said punches will enter associated dies in sequential order; and means for selectively positioning desired ones of said levers in punch operating position during a punching operation.

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