March 19, 1935. R. M. HOPKINS ET AL 1,995,030

INTERMITTENT CURRENT CONSTANT TAPE FEED RECORDER

Filed April 27, 1932 5 Sheets-Sheet 1

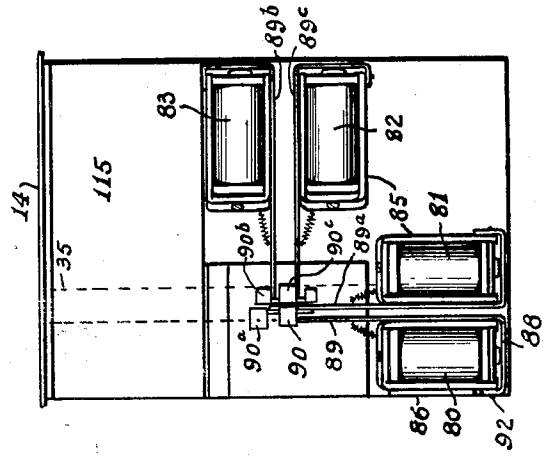


Fig. 2.

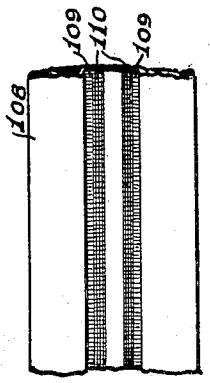


Fig. 10.

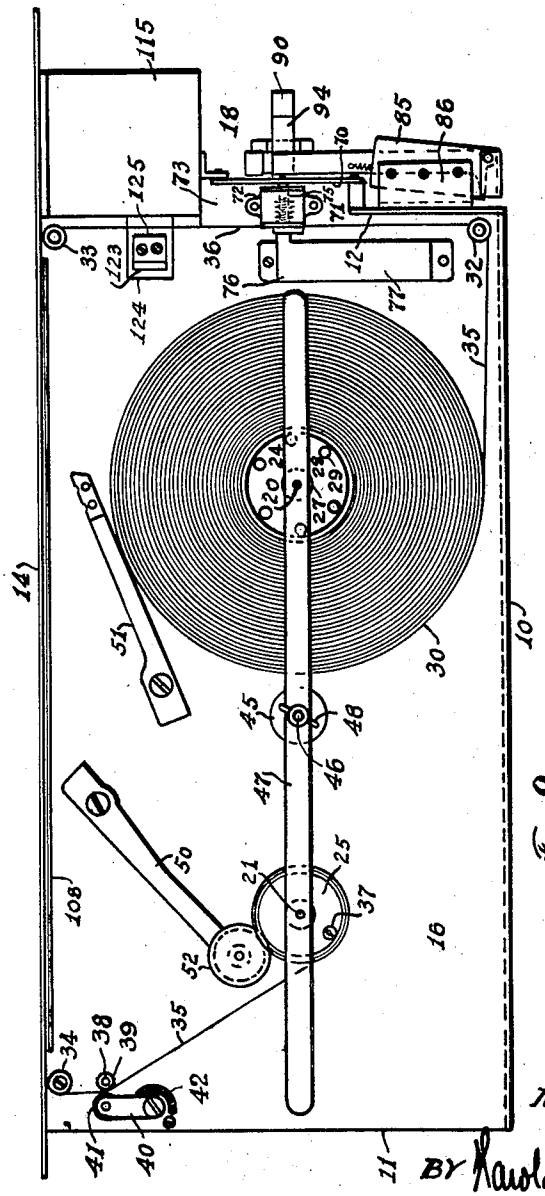


Fig. 1.

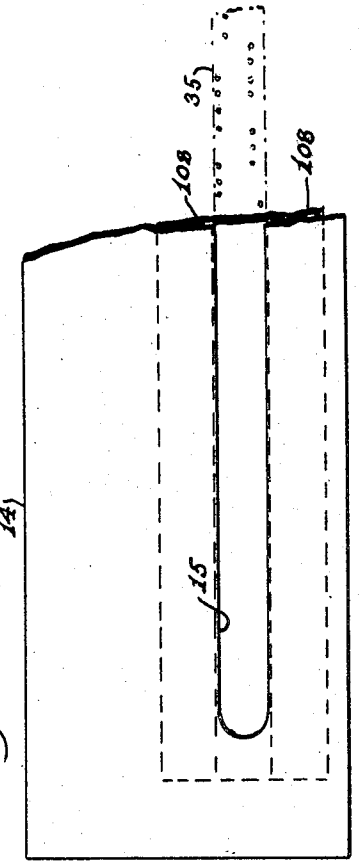


Fig. 9.

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INTERMITTENT CURRENT CONSTANT TAPE FEED RECORDER

Filed April 27, 1932 5 Sheets-Sheet 2

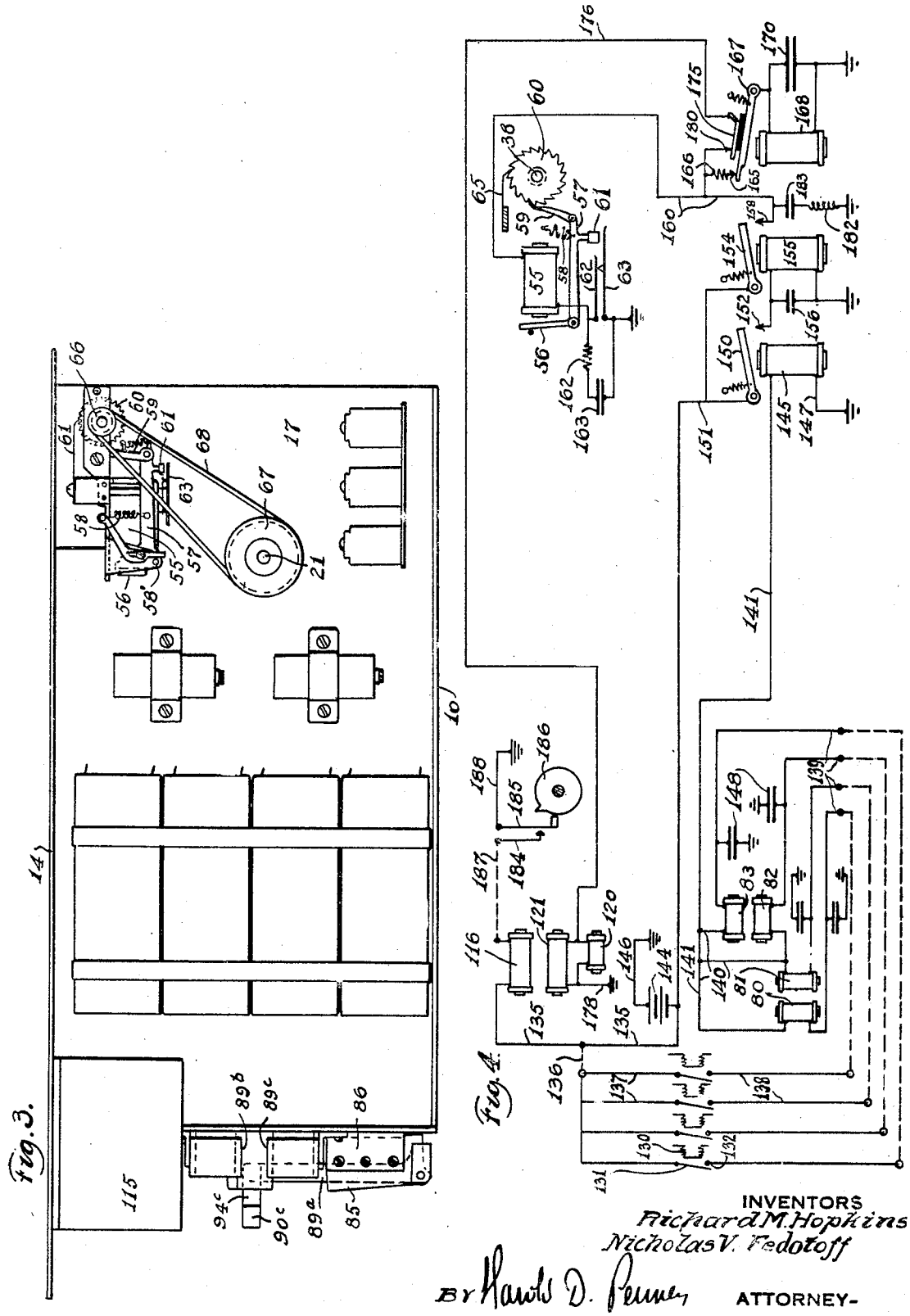


Fig. 3.

Fig. 4.

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INTERMITTENT CURRENT CONSTANT TAPE FEED RECORDER

Filed April 27, 1932 5 Sheets-Sheet 3

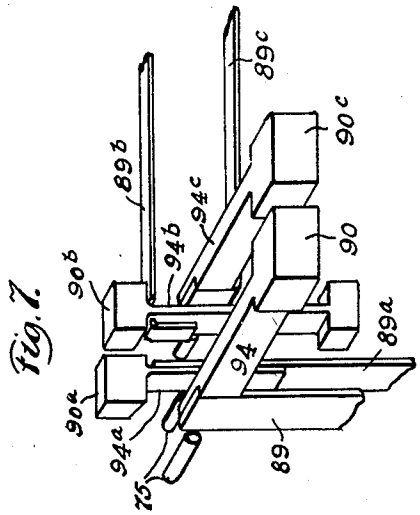


Fig. 7.

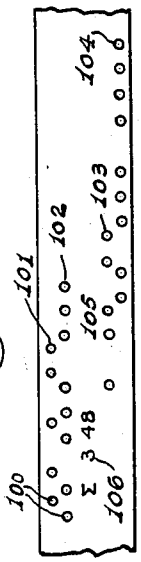


Fig. 8.

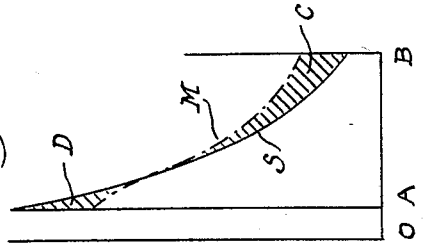


Fig. 5a

Fig. 6.

Fig. 5.

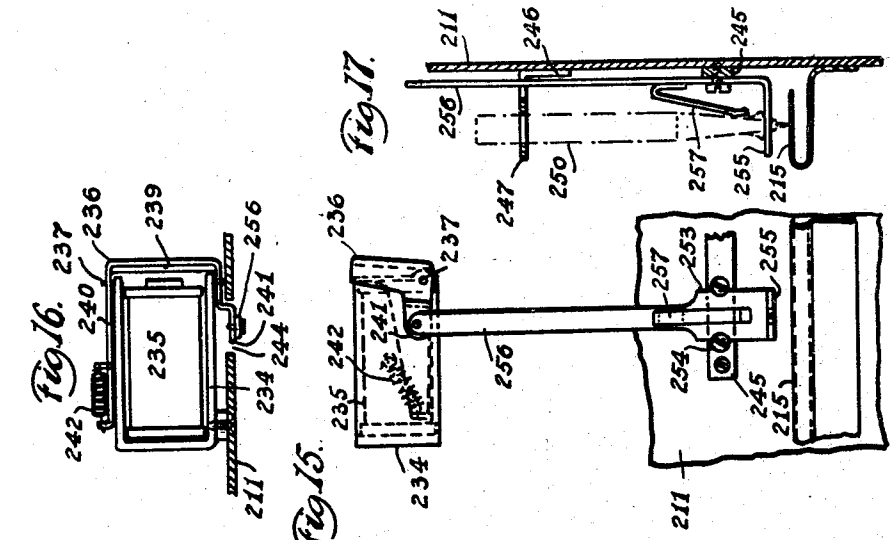
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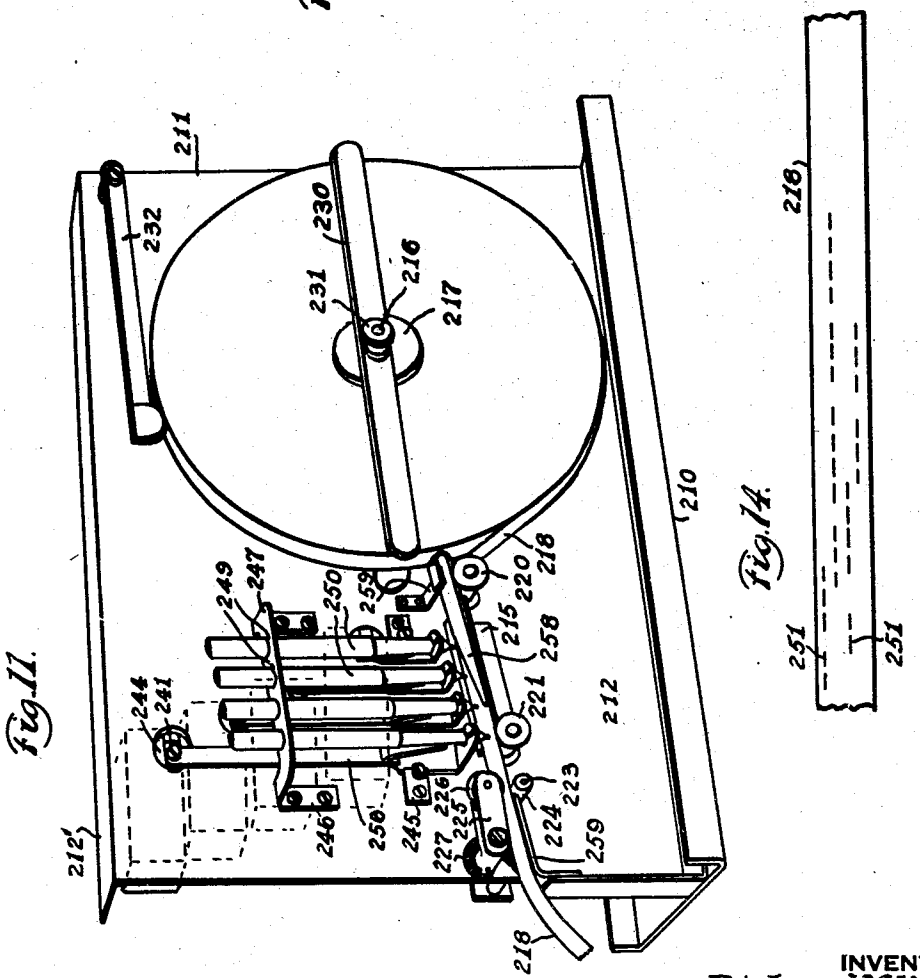
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INTERMITTENT CURRENT CONSTANT TAPE FEED RECORDER

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INTERMITTENT CURRENT CONSTANT TAPE FEED RECORDER

Filed April 27, 1932 5 Sheets-Sheet 5

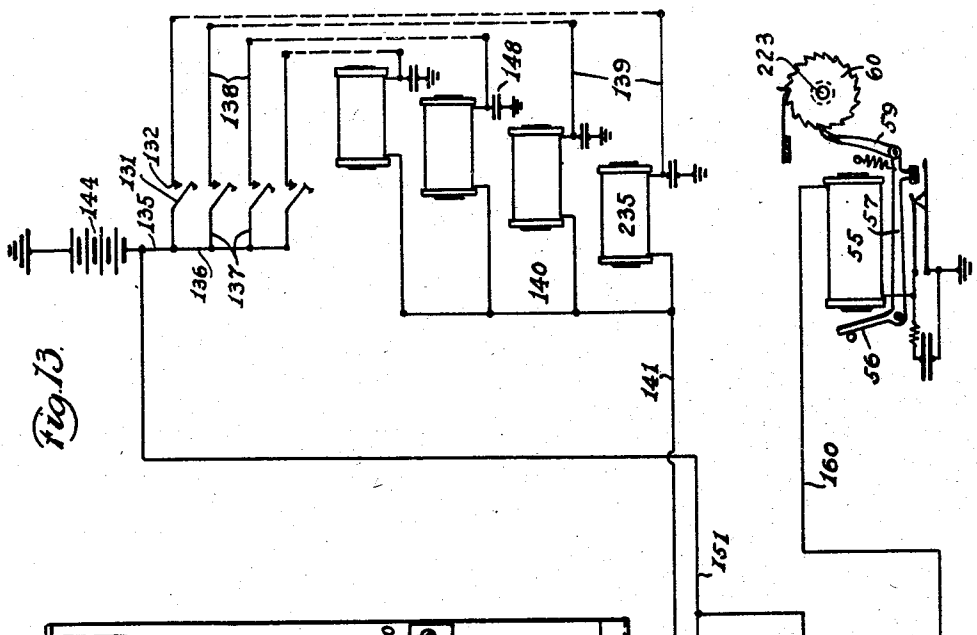


Fig. 13.

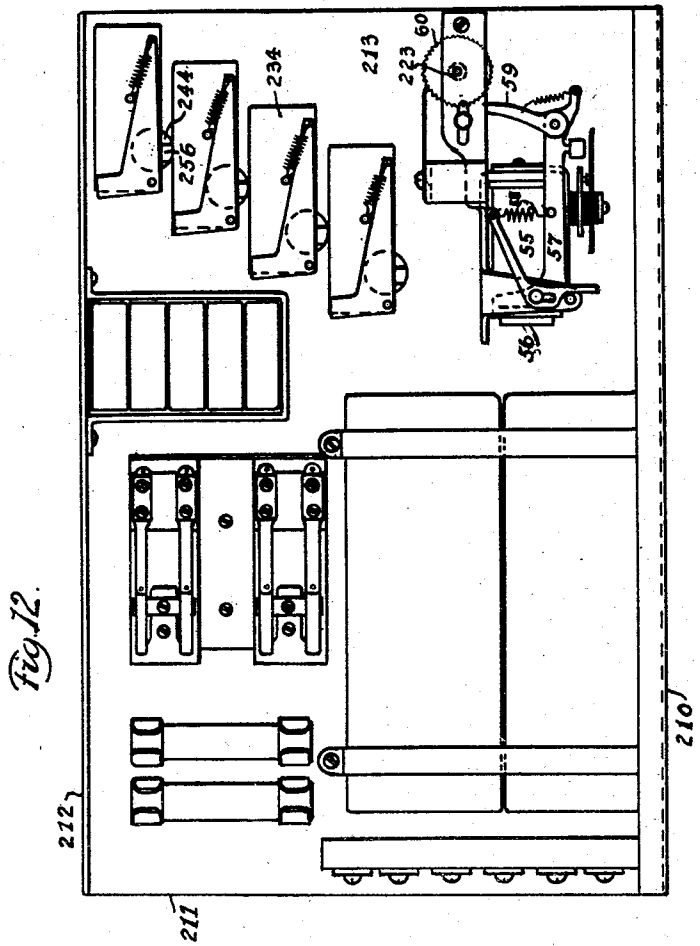


Fig. 12.

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Patented Mar. 19, 1935 1,995,030

UNITED STATES PATENT OFFICE

1,995,030

INTERMITTENT CURRENT CONSTANT TAPE FEED RECORDER

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Application April 27, 1932, Serial No. 607,770

33 Claims. (Cl. 178—42)

This invention relates to signal receiving methods and apparatus for recording intermittent code signal impulses and more particularly to means for recording such impulses in the form of dashes or dots and spaces on moving tape, though it is noted that in some of the claims the invention is not limited to impulse signals nor in some respects even to recording means.

One object of the invention is to provide an apparatus or device of this kind in which the intermittent code signal current impulses effect constant feed of the tape.

Other objects of the invention are to provide an apparatus of this kind for either perforated or inked records on the tape.

In apparatus in which the current signals, transmitted in the conductor in form of dots or dashes and spaces, are punched in the movable paper tape, it was heretofore the practice to have the first incoming signal impulse start the motor for feeding the tape and on the same initial impulse perforate the tape. It was intended that between the first and the second signal perforations, the tape should accelerate from 0 to normal speed and remain constant as long as the signal was coming in. However, it was the custom heretofore to perforate the paper on the forward stroke of the electro-magnet; and it was clearly noticed, that on account of the time necessary for this necessary acceleration, the space between the first and the second perforations was smaller than the space between the subsequent spaces.

One object of the present invention is to cure this defect. This is accomplished by perforating the tape on the back stroke of the punch operating electromagnet and thus gain enough time for the tape to accelerate to the normal speed before the first perforation occurred. In order to perforate the paper on the back stroke, the novel type of electromagnet shown herein was devised.

Another object of this invention is to provide an apparatus in which all controls of signal perforating means, the tape feed, time stamp, ink ribbon motion and other functions of the apparatus, are accomplished by electrical means instead of the usual constructions, spring clocks, and mechanical gears, clutches and timing devices.

Another object of the invention is to provide compactness in the arrangement of the perforator operating means, permitting the perforation of a plurality of signals on a single narrow tape, thereby adapting the single narrow tape and associated machinery to a large number of signal channels.

Another object of the invention is to provide a method of easily distinguishing the several closely adjacent rows of signal perforations, when reading the signals.

Another object is to provide the combination with the signal registering devices, of a well-known electrical pulsating motor, instead of a usual type of electrical motor, thus rendering unnecessary the heretofore used reduction gear system and effecting a quick acceleration of the tape.

Other objects of the invention are to improve generally the simplicity and efficiency of such methods and apparatus and to provide a device or apparatus of this kind which is economical, durable and reliable in operation, and economical to manufacture.

Still other objects of the invention will appear as the description proceeds; and while herein details of the invention are described in the specification and some of the claims, the invention is not limited to these, since many and various changes may be made without departing from the scope of the invention as claimed in the broader claims.

The inventive features for the accomplishment of these and other objects are shown herein in connection with two improved registers one of which, briefly stated, includes registers receiving signals from a plurality of code signal devices for sending intermittent current impulses. In one form of the register the impulses are recorded by the register by punching the code signals in tape fed by a motor driven feed means.

Means are provided for connecting said devices to the punch means and a slow-release timed relay, whereby the timed relay is energized during and between the signal impulses and acts to constantly connect the feed motor to a current source during the intermittent operation of said device, whereby the tape is constantly fed only during signal sending.

In the other form of the register, the impulses are recorded on the tape by a plurality of marking devices such as fountain pens or pencils.

While in this specification and claims mention is made of the pens, pencils, punches and tape, it is understood that these words are used for designation and description and that for purposes of protection they are to be construed broadly enough to cover other recording means and devices, in general the terms herein are to be given for the purposes of protection broad interpretation when possible.

In the accompanying drawings showing, by way of example, two of many possible embodiments of the invention,

Figs. 1 and 2 are respectively side and end elevations showing the punching register with side walls removed;

Fig. 3 is a side elevation showing the opposite side thereof;

Fig. 4 is a diagram showing the electrical connections for the register operating means;

Figs. 5 and 6 are respectively side and end elevations showing a spring and magnet operated punch hammer;

Fig. 5*a* is a diagram showing the relation between the spring and magnet forces and air gap;

Fig. 7 is a fragmental perspective view showing the compact arrangement of the punch hammers;

Fig. 8 is a fragmental plan showing a short piece of tape with four code signals punched therein;

Fig. 9 is a fragmental plan of the register top wall showing the window therein for viewing the tape;

Fig. 10 is a fragmental plan showing a table or shelf disposed under the tape and window and having contrasting stripes registering with the perforations of the respective separate signals for distinguishing the signals from each other;

Fig. 11 is a perspective view showing one side of the pencil register, parts being removed;

Fig. 12 is a side elevation of the other side thereof;

Fig. 13 is a diagram of the electrical connections thereof;

Fig. 14 is a fragmental plan showing the tape with code signals marked thereon by the pencils;

Figs. 15 and 16 are respectively side elevation and plan of the pencil operating means and holder; and

Fig. 17 is an edge elevation of the pencil holder, the support for the tape and holder being in section.

The multiple punching register

The principal features of the punching register will first be briefly indicated, after which they will be described in detail.

A plurality of line relays 130, 131, 132 (Fig. 4) or other code-signal devices are each adapted to send intermittent code-signal impulses by way of conductors 138, to punch operating magnets 80 (Figs. 4 and 5) corresponding with said signal devices for operating hammers 90 (Figs. 2, 5, 7) for driving punches 75 for punching the code signals in tape 35 (Fig. 1) fed by tape feed means 38, 41 operated by a feed-motor 55, 57 (Fig. 3) operated as will be explained.

Conductors 138, 139, 140, 141 (Fig. 4) connect said magnets 80 in series between the respective devices 130, 131, 132 and a main relay 145, 150, 151, whereby the relay switch 150, 152 is intermittently actuated during signal sending.

A slow-release timed relay 154, 155, 158 is actuated by said main relay for constantly connecting the motor 55, 57 through conductors 151, 160 to the current source 144 during, between and after the intermittent operations of the main relay, whereby the motor operates to feed tape continuously during and a few seconds after the intermittent signal impulses.

A time clock 115, has a magnet operated means 121, 123 (Fig. 1), for stamping the time on the tape, set in operation by a slow release stamp operating relay 167, 168 controlled by the timed relay switch 154, 158 for slowly intermittently connecting the current source 144 to a stamp operating magnet 121 in the time clock 115.

Now the various features of the punching register will be described in detail.

The register housing

The various parts of the code-impulse-operated constant-tape-feed register are shown herein as mounted on sheet metal, housing parts including a frame comprising a base 10 (Fig. 1), an upright inner longitudinal main partition 11 and an end cross partition 12 mounted on the base, and a top wall 14 mounted on the partitions and having a long longitudinal window 15 (Fig. 9) therein.

Said frame is adapted to carry side and end housing-walls (not shown), the partitions cooperating therewith to form tape supply and control longitudinal compartments 16 (Fig. 1) and 17 (Fig. 3) and an end compartment 18 (Fig. 1) for receiving the various apparatus parts.

The paper feed

A rotary supply reel shaft 20 and a take-up reel shaft 21 mounted on the main partition 11 in the supply compartment carry supply and take up reels 24, 25 respectively, the supply reel 24 being nearest the end partition 12 and comprising a hub 27, a disk 28 fast thereon, and an annular series of round-ended pins 29 on which the supply roll 30 of tape may be frictionally forced, slightly deforming the round shape of the roll opening. Small guide rollers 32, 33, 34 mounted at corners of the main partition guide tape 35, 36 from the supply roll upwardly along the end wall 12, under the full length of said window 15 to the rear upper corner of the supply compartment, whence the tape is guided to the take up reel 25, as will be explained.

The take up reel comprises a cylindrical block mounted fast on the shaft 22 having a small cylindrical peripheral cut-out 37 having a slit communicating with the reel periphery, into which slit and cut out the end of the tape is threaded in order that the tape may be frictionally wound around the reel.

A motor-driven rotary feed-shaft 38 mounted in the main partition between the take-up reel and the adjacent guide roller 34 carries a knurled or toothed feed wheel 39 engaged with the tape.

A pivoted frame 40 pivotally mounted on the partition carries a pressure roller 41 held engaged with the opposite face of the tape by a spring 42 strained between said frame and a screw on the partition, for causing the pressure roller to press the tape into driving relation with the tape.

A supporting block 45 mounted on the partition 11 about midway between the reels carries a threaded projecting pin 46 carrying a retaining bar 47 perforated to receive said shafts 20, 21 and pin 46 removably held in place by a wing nut 48 on the pin holding the bar and consequently the rolls and reels in place.

Drag levers 50, 51 are pivotally mounted on the partition 11, one lever 51 frictionally engaging the feed roll, the other carrying a flanged guide roller 52 engaging the take up roll to guide the tape to the latter and to prevent the rolls from unwinding.

The paper-feed motor

The tape is fed to the punching means by a pulsating or stepping feed motor mounted on the main partition in the control chamber and

comprising a pulsating magnet 55 (Figs. 3 and 4) and a bell crank lever 56, 57 pivoted at its angle part 58' near said magnet and comprising an arm 56 forming an armature attracted by the magnet and an active arm 57 longitudinal to the magnet and lowered when the armature is attracted by the magnet.

A spring 58 raises the arm when the magnet is deenergized, thereby causing a pawl 59 on said arm to rotate a ratchet wheel 60 on the feed shaft 38 thereby to drive the feed shaft and tape a very small increment each time the magnet becomes deenergized. When the magnet is energized the insulated projection 61 opens the switch 62, 63, breaking the current through the magnet 55, causing the motor to pulsate. A detent pawl-spring 65 mounted above the motor engages the ratchet wheel to prevent retrograde rotation thereof.

Pulleys 66, 67 in the control chamber 17, carried on said feed and take-up shafts 38 and 21 respectively, carry a belt 68 yieldably connecting the pulleys to yieldably rotate the take-up reel 25 as the feed rollers feed tape thereto.

The punches

The end or cross-partition 12 is constructed with an off-set portion 70 (Figs. 1 and 2) adjacent to the up-course 36 of the tape to form an inner recess 71 receiving a punch box 72 disposed in said recess and secured to an extension 73 of the main partition 11, and carrying a horizontal row of yieldably retracted punches 75 perpendicular to, and adapted to engage, the tape and passing through said off-set wall portion 70. A die 76 mounted on the main partition backs the tape and has apertures alined with and receiving the punches, the punched out pieces of tape dropping into a magazine 77.

The back stroke magnet perforator

The magnets 80, 81, 82, 83 (Fig. 2) for driving the punches are mounted in frames 85 mounted on brackets 86 (Fig. 1) mounted on the outer face of the end partition 12. The magnet frames 85, and the magnets therein are mounted on said brackets respectively, in vertical and horizontal planes perpendicular to the partition and intersecting said offset portion 70, the magnets being axially inclined toward said portion and away from the partition 12.

Punch-actuating members 88, 89, 90 (Fig. 5) are pivotally mounted on said frames 85, and each comprises a U-shaped portion 88 having its yoke portion formed with or carrying an armature 91 adjacent to the outer end of the magnet and its arms pivoted as by the pin 92 to said frame 85; one arm 89 of each member being extended beyond the opposite end of the magnet and disposed vertically across the outer end of one of the respective punches 75. The pivotal axis of the pin 92 is so arranged that when the armature 91 is attracted, the arm 89 is retracted a distance from the punch in the plane of the punch.

Massive heads 90, 90*a*, 90*b*, 90*c* are secured on the ends of the arms 89, 89*a*, 89*b*, 89*c* respectively, the heads respectively compressing slender portions 95, 94*a*, 94*b*, 94*c* secured to the adjacent end of the arm, and one or more mass portions disposed a distance from the punch to avoid crowding. A tension spring 95 (Fig. 5) is secured between an eye 96 on each arm and a pin 97 on the frame, the spring being approximately parallel with the arm when the arm is not retracted from the punch, and about 45 degrees to the arm when the arm is retracted and the spring is under tension.

The special construction of the perforator magnets and hammers show many advantages.

All of the electromagnets are located radially with respect to the associated punches, as it is shown in Fig. 7. While there are only four magnets shown, the same arrangement can be used with a greater number of electromagnets.

The thin portion 94, of each hammer which delivers the blow to individual punch pins 75, are closely spaced and permit the punches to be spaced closely.

The masses 90 which furnish most of the necessary mass of hammer are placed on extensions of thin portions 94, so as not to obstruct the movement of the individual hammers.

The mass 90 is connected to the thin portion of hammer in such a manner that the center of gyration of hammer and magnet arm passes substantially through the axis of corresponding perforation punch 75.

Operation of the punches

Thus it is seen that said magnet, arm, mass and spring are so related that when the air gap is greatest, the magnetic pull on energization is much greater than the pull of the spring, the pull of the spring increasing slightly faster than the magnetic pull as the air gap decreases and exceeds the magnetic pull as the gap reaches its minimum, whereupon the increasing momentum of the head continues and increases the tension of the spring, so that after deenergization of the magnet, the recoil of the spring overcomes the momentum and drives the hammer and arm against the punch with great force relative to the amount of current used.

Fig. 5*a* indicates the relative values of spring tension and magnet pull. The distances OA and OB represent the minimum and maximum air gaps respectively, and the distances from the line OB to the curves M and S represent the magnet pull and spring tension.

During the travel C where magnet pull is greater than spring tension the resultant force will accelerate mass 90.

During the following travel D, spring tension is greater than the magnet pull and the mass 90 will decelerate until energy stored in it is zero. At this time the tension of spring 95, which in this case is considerably greater than the magnet pull, will bring mass 90 back and strike the punch 75.

For a person skilled in the art, it is possible to select the spring tension curve, and value of mass 90 and also design the magnet for any particular speed of incoming signals. This spring system is a great deal more efficient than the ones previously used.

The signal distinguishing table

Said punches 75 form rows of perforations 100 (Fig. 8) in two pairs of longitudinal paths 101, 102, 103, 104 on the tape corresponding to the respective lines or signal devices from which the signals are received, with a space 105 therebetween for printing the time data 106, as will be explained.

A table 108 (Figs. 1 and 9) secured just under said top 14, and window 15 and the top course of the tape 35 is provided with longitudinal stripes 109, 110 of two or more contrasting colors or shades adapted to show through the perforations

100, adjacent stripes contrasting, to facilitate distinguishing one signal from another.

The time clock

A time and calendar clock 115 mounted on the cross-partition above the hammers 90 (Figs. 1 and 2) is of usual construction and not shown in detail. As will be explained, it comprises a magnet 116 (Fig. 4) adapted to set the time stamps and receiving minute impulses. The clock is also provided with a ribbon feed magnet 120 and a stamp actuating magnet 122 adapted in the usual manner to actuate a platen lever 123 (Fig. 1) passing through an opening 124 in the main partition 16 and having a platen 125 on its end engaging behind the tape 35 to strike the tape against time stamps.

The electrical connections for actuating the various parts above described will now be described in detail.

The signal sending means

The signal impulses may be supplied in any suitable manner and are here shown as being received from a plurality of line relays each comprising a line magnet 130 (Fig. 4) adapted to receive code signal impulses from signal lines or loops not shown, and a switch 131, 132 intermittently closed by said magnet when intermittently energized by code signal impulses.

The signal punch actuating magnets and main relay

Conductors 135 to 141 connect said punch actuating magnets 80 and the respective signal switches 131, 132 in series between the ungrounded terminals of the current source 144 and main relay magnet 145, said main source and relay magnet having grounded terminals 146 and 147, to complete the circuit, whereby whenever one or more relays 131, 132 are actuated, respective punch magnets 80 and the main relay magnet 145 are energized. A condenser 148 is connected between a ground and each conductor 139 at a point between the actuating magnet and the relay switch 131, 132 to prevent sparking at the latter switch.

The armature 150 of the main relay is connected by a conductor 151 with the main current source 144, and is adapted to engage a switch contact 152.

The timed relay

A slow release timed relay comprises an armature 154 connected to said main source 144, and a magnet 155 having one terminal grounded and the other connected to said main relay switch contact 152 whereby whenever the main relay is operated the timed magnet 145 is energized and charges a condenser 156 interposed between the magnet terminals, which discharges on deenergization of the magnet 145, and holds the magnet 155 energized a few seconds; whereby when the main relay switch is momentarily closed by code signal impulses the timed relay magnet is energized from the contact 152 and said condenser is charged, the condenser being of a capacity large enough to hold the magnet charged several seconds after the impulse has ceased, thereby to hold the timed relay contact 158 engaged continuously during a multiple-impulse code signal and several seconds after the last impulse, thereby to furnish current to the impulse motor through a service conductor 160 connecting the timed relay switch contact 158 with one terminal of the motor magnet 55.

The switch 62, 63 is connected between the other terminal of the motor magnet and a ground and is opened by action of said member 61 when the armature is attracted, for pulsating the motor. A resistance 162 and condenser 163 are connected around said switch 62, 63 to reduce sparking at the switch. It is thus seen that said motor pulsates continuously so long as the timed switch 154, 158 is closed.

The time stamp relay

A slow action pulsating time stamp relay for energizing the time stamp magnets 120, 121 comprises a contact 165 connected through a resistance 166 to said service conductor 160, an armature 167 normally engaging said contact 165 and a magnet 168 connected between the armature 167 and a ground. A large condenser 170 is connected around the magnet 168, whereby the condenser 170 is charged and the magnet 168 is energized whenever the timed switch 154, 158 is closed, the magnet being held energized by the discharge of the condenser 170, and the armature after being attracted is slowly released and consequently slowly pulsated as long as the switch 154, 158 is closed.

A contact plate 175 mounted on said armature and insulated therefrom is connected by a conductor 176 to the time stamp magnet 121 and a ribbon feed magnet of the calendar clock 115 (Fig. 1), said magnets being connected between said contact plate and a ground 178. A contact 180 connected to said service conductor 160 and engageable by the plate 175 causes the stamp and feed magnets 121, 120 to be energized when said contact 180 is engaged and the timed relay switches 157, 158 are closed at the same time, thereby at intervals actuating the time stamp lever 123 (Fig. 1) to print the time indicia 106 (Fig. 8).

A condenser 182 and resistance 183 in series between the service conductor 160 and a ground is provided to eliminate sparking of switch contacts connected to such conductor.

Operation of the punch register

As the signals come in from a signal box, one of the switches is intermittently closed, and a circuit is established from the current source 144, through conductors 136, 137, 138, the corresponding punch magnet 80, conductors 140, 141, main relay magnet, to ground 147, thus operating the corresponding punch 75. This circuit remains complete for each instant during which the switch 131, 132 is closed.

Operation of the timed relay

This closes the switch 150, 152 and connects the timed relay magnet 155 in circuit with the source 144 through conductor 151 and switch 150, 152 to ground. This energizes the magnet 155 and at the same time charges the condenser 156 and closes the switch 154, 158. Between, and a few seconds after the code signal impulses, the switches 131, 132 and 150, 152 are open; but during this time the condenser 156 is discharging through the magnet 155, thus holding the switch 154, 158 closed between and a few seconds after the signal impulses.

Operation of the pulsating motor

The delayed closure of the switch 154, 158 holds the motor magnet 55 continuously connected through conductor 160, switch 154, 158 and conductor 151 with the source 144.

This causes the motor magnet to pulsate the

armature 56 and rotate the ratchet 60 to feed the paper tape.

Operation of the time stamp relay

Closure of the switch 154, 158 also supplies current to the self energizing time stamp relay 167, 168. Action of this self-energizing time relay is also similar to that of an electric bell. Current passes from the service conductor 160 through the switch 165, 167 of this relay, charges condenser 170 (which may have a capacity of 3000 mf.) and attracts the armature 167 and opens its switch 165, 167. The magnet 168 stays energized for several seconds until condenser 170 discharges to the point of releasing the armature 167. This release closes the switch 165, 167 and the condenser charges again. This process repeats itself as long as the time delay relay 154, 155 is energized.

When the armature 167 is released of contact between the plate 175 and contact 180 supplies current through the conductor 176 to the stamp magnet 121 and ink ribbon magnet 122 and operates them periodically.

The calendar magnet 116 for time setting the time stamps is operated from the minute contacts 184, 185 closed by a cam 186 of a time clock located in central office, current being supplied from the source 144, through conductors 135, 187, 188 to a ground.

The multiple pen register

This apparatus relates to a signal recording instrument, by means of which current signals, transmitted in the conductor, in forms of dots, dashes and spaces, are recorded by a fountain pen on the movable paper tape.

The principal features of this form of the invention are briefly indicated as follows:

The code signal device 131, 132 (Fig. 13) for sending intermittent current impulses, the tape feed means 224, 226 (Fig. 11) and the motor 55, 57 (Fig. 12) therefor are similar to those shown in Figs. 1 to 10. But the recording means includes fountain pens or pencils 250 (Fig. 11) and magnet-operated means 235, 253, 255 for applying the pencil to the tape 218 for recording the code signals on the tape.

There is also a slow release timed relay 154, 155, 158 (Fig. 13) and means 141, 145, 150, 151, 152 operatively connecting said signal devices 131, 132 to said magnet operated means 235 and relay, whereby the timed relay is operated during signal sending, the timed relay serving for constantly connecting the motor 55, 57 to the current source 144 during the intermittent operation of said device, as in Figs. 1 to 10, for constantly feeding the tape during the intermittent signal impulses.

Now the various parts of this register will be described in detail.

The housing

The various parts of the multiple pen register are mounted on sheet metal housing parts or frame comprising a base 210, an upright inner longitudinal main partition 211, and a top wall 212 mounted on the partition, said frame being adapted to carry side and end housing-walls (not shown) cooperating with the partitions to form a tape supply and control apparatus compartments 212 and 213.

The paper feed

A writing table or shelf 215 (Figs. 11 and 17) and a rotary supply reel shaft 216 are mounted on the main partition 211 in the supply compartment 212, near the respective end portions of the compartment. A supply reel 217 on said shaft carries a roll of tape 218 guided by small guide rollers 220, 221 mounted on the main partition in position to guide tape from the supply roll on to the table 215, whence the tape is guided frontwardly of the housing.

A rotary feed shaft 223, mounted in the main partition between the end of the housing and the adjacent guide roller 221 at the discharge end of the table carries a knurled or toothed feed wheel 224 engaging under the tape.

A pivoted frame 225 pivotally mounted on the partition over the tape, carries a pressure roller 226 engaged with the top face of the tape under the action of a spring 227 strained between said frame and a pin on the partition, for causing the pressure roller to press the tape into driving relation with the feed wheel.

Said supply shaft 216 carries a threaded projecting pin receiving a retaining bar 230 and held in place by a nut 231 for holding the supply roll and reel in place. A drag lever 232 pivotally mounted on the partition, frictionally engages the supply roll, to exert a drag on the tape.

The feed motor

The pulsating or stepping feed-motor 55, 56, 57 mounted on the main partition 211 in the control chamber is substantially the same as in the punching register, and need not be described again.

The ratchet wheel 60 on the feed shaft 223 is engaged and rotated by the pawl 59 when raised by the spring 58 to drive the feed shaft 223 and tape 220 an increment each time the magnet becomes deenergized.

Recorder operating magnets

Magnet frames 234 (Fig. 12) and magnets 235 (Fig. 6) therein are mounted in stepped relation on the partition 211 in said control compartment 212, in horizontal planes perpendicular to the partition.

Actuating members 236 are pivotally mounted on pins 237 in said frames, each comprises a U-shaped portion having its yoke portion formed with an armature 239 adjacent to the inner end of the magnet and its arms 241, 241 extended along said frame.

One arm 240 of each member is long enough to extend to the opposite end of the magnet, the pivotal axis being so arranged that when the armature is attracted, the arm is lowered against the action of a tension spring 242 (Fig. 15) secured between the long arm and a pin on the frame, the spring being approximately parallel with the arm when not retracted and about 45 degrees thereto when the arm is retracted and the spring is under tension, whereby the arm is normally held raised by the spring.

The other arm 241 of each actuating member is short and off-set through a hole 244 in the partition into said control compartment.

The pen support

Lower and upper horizontal bars 245, 246 (Figs. 11 and 17) in the control compartment are mounted on the partition 211 above the table 215 near said short arms 241. The upper bar has an outwardly disposed horizontal shelf portion 247 provided with a series of guide openings 249 extending above the tape. The openings are progressively further from the partition 211 and

receive fountain pencils or pens 250 disposed in said openings and adapted, at times to rest their marking points on the tape to make short signal code dashes 251 thereon in parallel paths corresponding to the pens and signal sending devices.

Vertical pen supports each comprises a lower body portion 253 guided between adjacent screws 254 passing, through the lower bar 245 and held against the lower bar by the screw heads. Each body portion is formed with an outwardly disposed perforated portion 255 (Fig. 17) adapted to receive the lower end of the pen, and with an upper shank portion 256 secured to one of said short arms 241 respectively whereby the pencil support is normally held raised by the spring 242, and intermittently lowered when the magnet is energized by code signal impulses.

The arms 256 are progressively longer as they approach the adjacent end of the partition, to correspond with the stepped arrangement of the magnets 235.

A spring 257 mounted on each pen holder, presses upon the pen body and holds the pen against movement from side to side.

A flat spring 258 (Fig. 11) mounted on a bracket 259 on the partition presses the tape flat against the table; and a curved plate 259 mounted under the tape guides the tape to the discharge end of the housing, when it may be discharged through a suitable opening into a basket or elsewhere.

The electrical connections

As in the punching register, the multiple pen register receives signal impulses from a plurality of line relays each comprising a switch 131, 132 (Fig. 13) adapted to give code signal impulses from signal impulses; and conductors 135 to 141 connect said pen actuating magnets 235 and the respective switches 231, 232 in series between the ungrounded terminal of the current source 144 and the main relay magnet 145, whereby whenever one or more relay 131, 132 are actuated, respective actuating magnets 235 and the main relay magnet 145 are energized, connecting the switch contact 152 through the main relay armature 150 and conductor 151 to the source 144, thereby to operate the slow release timed relay 151, 155 to connect the contact 158 through the armature 154 and conductor 151 to the main source, whereby when the main relay switch is momentarily closed by code signal impulses, the timed relay magnet is energized and the condenser 156 is charged, to hold the magnet energized between and after the impulses, thereby to hold the timed relay contact 158 engaged during a multiple-impulse code signal and connect the motor 55, 57, through the service conductor 160 to the main current source 144, said motor pulsating continuously and feeding the tape so long as the timed switch is closed.

The electrical connections of Fig. 13 are provided with condensers 148 as in Fig. 4.

All functions of this apparatus are accomplished by electrical means, i. e., using retarded time relays of special construction in place of mechanical gears, spring clocks, clutches and the like.

The use of the pulsating motor for moving of tape gives the advantage of quick acceleration, and direct paper drive without use of intermediate reduction gear.

It will be seen that the circuit is quite similar to the multiple punch register, except for the omission of the time stamp relay, which can be added optionally.

The operation of the multiple pen register

The operation of the signal sending devices 131, 132, the main relay 145, 150, the timed relay 154, 155 and the paper feed motor and means will be readily understood from the operation of the multiple punch register.

The energizing of the pen operating magnets 235 is also similar to that of the punch magnets 80; but the pens 250 are lowered and caused to record on the initial stroke of the armature 239 rather than on the back stroke.

When one or more of the switches 131, 132 are intermittently closed during signal sending, the corresponding magnet or magnets 135 are energized, thus lowering the corresponding pen or pens to the tape as the latter is fed across the table 215 and discharged from the end of the machine.

The invention claimed is as follows:

1. A method of recording intermittent impulses on tape, said method comprising employing said impulses to feed the tape; employing said impulses to store up energy; and later causing said energy to perforate the tape.

2. A method of recording intermittent impulses on tape, said method comprising employing said impulses to initiate the feeding of the tape and to continue the feeding of the tape a short time after each impulse, whereby the tape is fed during and between the impulses; simultaneously employing said impulses to store up energy; and later causing said energy to operate means to perforate the tape after the feeding has had time to accelerate from zero.

3. In combination, a plurality of code signal devices for sending intermittent current impulses; a tape feed means; a motor therefor; means including separate magnets energized by the device respectively for applying separate code signals to the tape; a relay in circuit with said magnets whereby the relay is operated each time one of said magnets is operated; and means operated by the relay for setting the motor in operation.

4. In combination, a code signal device for sending intermittent current impulses; a tape feed means; a motor therefor; punch means for punching the code signals in the tape; a slow release timed relay; means connecting said device to said punch means and the relay, whereby the timed relay is operated during and between the impulses during signal sending and a short time thereafter; and means operated by the timed relay for constantly connecting the motor to the source during the intermittent operation of said signal device.

5. In combination, a plurality of code signal devices for separately sending intermittent impulses; a tape feed means; a motor therefor; means operated by the devices respectively for applying different code signals to the tape; a timed device constructed for quick operation by the signal device and for operation a short time thereafter, whereby the timed device is operated during and betweeen the signal impulses; and means operated by the timed device for causing the motor to operate during the intermittent operation of said signal devices.

6. In combination, a plurality of code-signal devices each including an intermittently closing switch; a source of current to which the switches are connected; a tape feed means; a motor therefor; punches corresponding with said devices for punching the code signals in the tape; punch

magnets for actuating the punches respectively; a main relay; means connecting the magnets in series between the respective switches and the relay, whereby the relay switch is intermittently closed and the respective magnets are intermittently energized during signal sending; a slow release timed relay actuated by said main relay; means connecting the timed relay switch in series with the source and motor, for constantly connecting the motor to the source during and a few seconds after the intermittent operation of the main relay.

7. In combination, a tape feed means; punches transverse to the tape; magnets associated with the punches respectively; pivoted actuating members associated with said magnets respectively, each comprising an armature adjacent to the magnet and an arm across one of the respective punches, the member being so arranged that when the armature is attracted, the end of the arm is retracted from the punch; massive heads on said ends respectively; a tension spring secured to each arm to force the head to the punch when the magnet is denergized; and means for intermittently energizing the magnets.

8. In combination, a feed means adapted to feed tape; punches transverse to the tape; drive members associated with said punches respectively; an armature secured to each member; magnets adapted to attract the respective armatures to retract the members from the punches; yieldable means to draw each member to the punch when the magnet is deenergized; and means for simultaneously energizing the magnets and operating the feed means.

9. In combination, a tape feed means; punches transverse to the tape; magnets associated with the punches respectively; pivoted actuating members associated with said magnets respectively, each comprising an armature adjacent to the magnet and an arm across one of the respective punches, the member being so arranged that when the armature is attracted, the end of the arm is retracted from the punch; massive heads on said ends; a tension spring secured to each arm to force the head to the punch when the magnet is deenergized; and means for energizing the magnets; said spring being disposed approximately radial to the pivotal axis of the arm when the armature is not attracted and transverse to the radius when the armature is closed to the magnet.

10. In combination, a tape feed means; punches transverse to the tape; magnets approximately radial to the associated punches respectively; pivoted actuating members associated with said magnets respectively, each comprising an armature adjacent to the magnet and an arm across the respective punches, the member being so arranged that when the armature is attracted, the end of the arm is retracted from the punch; massive heads on said ends; a tension spring secured to each arm to force the head to the punch when the magnet is deenergized; and means for energizing the magnets; said spring being slack and approximately parallel to the arm when the magnet is energized, and approximately 40° to the arm when the magnet is energized.

11. In combination, means for feeding and guiding tape; a punch box carrying a row of yieldably retracted punches perpendicular to the tape; a die backing the tape and having apertures for the punches; magnet frames and magnets therein on said end partition in vertical and horizontal planes approximately radial to the punches; actuating members pivotally mounted on said frames respectively, each comprising an armature adjacent to the outer end of the magnet and an arm extended beyond the opposite end of the magnet, the arms being disposed vertically across the outer ends of the respective punches, the pivotal axis being so arranged that when the armature is attracted, the arm is retracted a distance from the punch in the plane of the punch; massive heads secured on said ends, each head comprising a slender portion secured near the punch and one or more mass portions remote therefrom; means for retracting the heads; and means for energizing the magnets.

12. In combination, a feed means adapted to feed tape; punches transverse to the tape; pivoted actuating members carrying massive heads associated with said punches respectively; an armature secured to each member; magnets adapted to attract the respective armatures to retract the heads from the punches; yieldable means to draw each head to the punch when the magnet is deenergized; and means for energizing the magnets.

13. In combination, a plurality of code-signal devices each adapted to send intermittent code-signal impulses; a tape feed means; a motor therefor; registers corresponding with said devices for registering the code signals in the tape; register magnets for actuating the registers; a main relay; means connecting said magnets in series between the respective devices and the relay, whereby the relay switch is intermittently actuated during signal sending; a slow release timed relay actuated by said main relay; a source of current; means controlled by the timed relay for constantly connecting the motor to the source during and after the operation of the main relay; a time stamp for stamping the time on the tape; a slow release stamp operating relay controlled by the timed relay switch and slowly intermittently connecting the source to the stamp for operating the latter.

14. In combination, tape feeding means; means to guide the tape from the feeding means; means for selectively forming rows of perforations in longitudinal paths on the tape; and means adjacent to said tape and providing contrasting stripes adjacent to said paths and visible through the perforations.

15. In combination, a tape guide means; punches for forming perforations in separated paths on the tape; a time clock comprising a time stamp and a platen lever adapted to strike the tape between said paths.

16. In combination, a frame comprising a top wall having a long window therein; tape feeding means; means to guide tape from the feeding means to the space under the window; selective signal means comprising punches for forming rows of perforations in two separated pairs of longitudinal paths on the tape corresponding to the respective selective means; a table just under said window and tape and provided with stripes of contrasting colors under the perforations; a time and calendar clock comprising a time stamp and a platen lever adapted to strike the tape between said paths, a stamp actuating magnet to actuate said lever to strike the tape against time stamp; means for selectively energizing the punches; and means for energizing the time stamp magnet.

17. In combination, a frame comprising a partition; supply reel shaft and take-up reel shafts mounted on the partition; supply and take up reels on said shafts respectively; punching means; guide rollers to guide tape from the supply reel

past the punching means to take up reel; the take up reel comprising a block fast on the take-up reel shaft having a cut out having a slit communicating with the periphery of the block to receive the end of the tape; and a tape feed means engaging the tape.

18. In combination, a supply reel; a take up reel shaft carrying a take up reel; a feed shaft; a feed wheel thereon engaging the tape; recording means disposed adjacent to the tape; a feed motor comprising a motor magnet; a lever comprising an active arm and an arm carrying an armature attracted by the magnet; a spring for retracting the armature; a pawl carried by the lever; a ratchet wheel on the feed shaft rotated by said pawl when the lever is actuated by the spring; means yieldably connecting said feed and take up shafts to rotate the take-up reel; a source of current; means for operating the recording means and connecting the motor magnet to the source when the recording means is operated; and means for disconnecting said magnet when the armature is attracted for vibrating the armature.

19. In combination, a supply reel; a take up reel shaft carrying a take up reel; a feed shaft; a feed wheel thereon engaging the tape; a feed motor driving the feed shaft; punching means disposed adjacent to the tape; and yieldable means operatively connecting said shafts for simultaneously operating the take up reel and feed means.

20. In combination, devices for sending intermittent current impulses; a tape feed means; a motor therefor; recording means including pencils and magnet-operated means for applying the respective pencils to the tape; a relay; means connecting said devices to said magnet operated means and the relay, whereby the relay is operated during signal sending; and means operated by the relay for connecting the motor to the source during the operation of said devices.

21. In combination, a code signal device for sending intermittent current impulses; a tape feed means; a motor therefor; a recording means including a pencil and magnet-operated means for applying the pencil to the tape for recording the code signals on the tape; a slow release timed relay; means connecting said device to said magnet operated means and the relay, whereby the timed relay is operated during signal sending; a current source; and means operated by the timed relay for constantly connecting the motor to the source during the intermittent operation of said device.

22. In combination, a partition, a table thereon; means for guiding tape on the table; magnets adapted to be energized by code signal impulses; members attracted by the magnets and having normally raised arms; lower and upper bars mounted on the partition above the table, the upper bar being provided with guide openings over the table progressively further from the partition; fountain pencils in said openings adapted, at times to rest on the tape on the table; guide screws at said lower bar; pencil supports guided between adjacent screws and having an outwardly disposed perforated portion to receive the lower end of the pencil, and an upper shank pivoted to said arms respectively, whereby the pencil is normally held raised and lowered when the magnet is energized.

23. In combination a partition having holes therein; a table mounted on the partition; means to guide tape on the table; magnets mounted on the partition and adapted to be intermittently energized by code-signal impulses; pivotally mounted actuating members each having an armature adjacent to the magnet and a pair of arms; one arm of each member being a long arm and extending to near the opposite end of the magnet and so arranged that when the armature is attracted, the arm is lowered; a tension spring secured to each long arm whereby the arm is normally held raised; the other arm of each actuating member being short and off-set through one of the holes in the partition; and pencils operatively connected to the outer ends of the short arms and engaging the tape.

24. In combination, a frame comprising a longitudinal partition; a table and a rotary supply reel mounted on the partition; guide rollers to guide tape from the supply reel onto the table; a feed shaft mounted in the partition and carrying a feed wheel near the discharge end of the table; a pressure means to press the tape into driving relation with the feed wheel; a feed motor driven by code-signal impulses to drive the feed shaft; magnets mounted on the partition and adapted to be intermittently energized by the same code-signal impulses; and recording means actuated by the magnets for marking on the tape.

25. In combination, a longitudinal tape feed means; a record device operably engageable with the tape; and a time stamp, automatically set in operation by cessation of record device operation, for stamping the time on the tape.

26. In combination, a tape feed means; a record device operably engageable with the tape; and a slow release time stamp, automatically set in operation on cessation of record device operation, for stamping the time on the tape, said stamp being disposed near and beyond the record device in the direction of travel of the tape, whereby travel of the tape during the delay of slow release brings the record adjacent to the stamp, thereby to indicate with which record the time stamping is associated.

27. In combination, a tape feed means; a motor therefor; a record device for applying records to the tape; means, automatically set in operation on the application of said record, for starting the motor and stopping the motor when the application is finished; a time stamp near and beyond the record applying means; and delaying means set in operation by the finish of said application for operating said time stamp after the record has moved to the time stamp.

28. In combination, a longitudinal tape feed means; a plurality of record devices operatively engageable, side by side with the tape, the points of engagement being in the same straight line at a right angle to the path of travel; and a time stamp for stamping the time on the tape, said stamp being disposed near the record devices, whereby the record is adjacent to the stamping made at the same time, thereby to indicate with which record the time stamping is associated.

29. In combination, a longitudinal tape feed means; a plurality of record devices operably engageable, side by side, with the tape; and a slow release time stamp, automatically set in operation on cessation of the record device operation, for stamping the time on the tape, said stamp being disposed near and beyond the record device in the direction of travel of the tape, whereby travel of the tape during the delay of slow release brings the record adjacent to the

stamp, thereby to indicate with which record the time stamping is associated.

30. A combination, means for supplying intermittent impulses; a tape feed means automatically set in operation by said impulses to drive the tape immediately; a punch for perforating the tape, yieldable means for driving the punch; and means operated by said impulses for drawing back said yieldable means while the tape is feeding, whereby when the impulse ceases, the punch is actuated.

31. A combination, means for supplying intermittent impulses; a tape feed means automatically set in operation by said impulses to drive the tape at substantially uniform speed; a punch for perforating the tape; spring actuated means for driving the punch; means operated by said impulses for drawing back said spring actuated means to tension the spring, whereby when the impulse ceases, the punch is actuated; whereby the tape may be set in motion substantially to said uniform speed substantially as soon as the first perforation takes place, whereby the first and second perforations will be spaced normal distances apart compared with subsequent perforations.

32. In combination, a feed means adapted to feed tape; a punch transverse to the tape; a pivoted actuating member carrying a massive head associated with said punch; an armature secured to said member; a magnet adapted to attract the armature to retract the head from the punch; yieldable means to draw the head to the punch when the magnet is deenergized; and means for simultaneously energizing the magnet and operating the feed means.

33. In combination, a feed means adapted to feed tape; punches closely arranged side-by-side transverse to the tape; pivoted actuating members carrying massive heads associated with said punches respectively, one head for each punch; magnet controlled means, one for each punch, adapted to separately retract the members respectively from the punches and strike the corresponding punch; and means for energizing the magnets and operating the feed means.

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