Oct. 6, 1953 C. E. CONNOLLY 2,654,459

MACHINE FOR MARKING STATISTICAL RECORDS BY CONDUCTIVE MARKS

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FIG. 1.

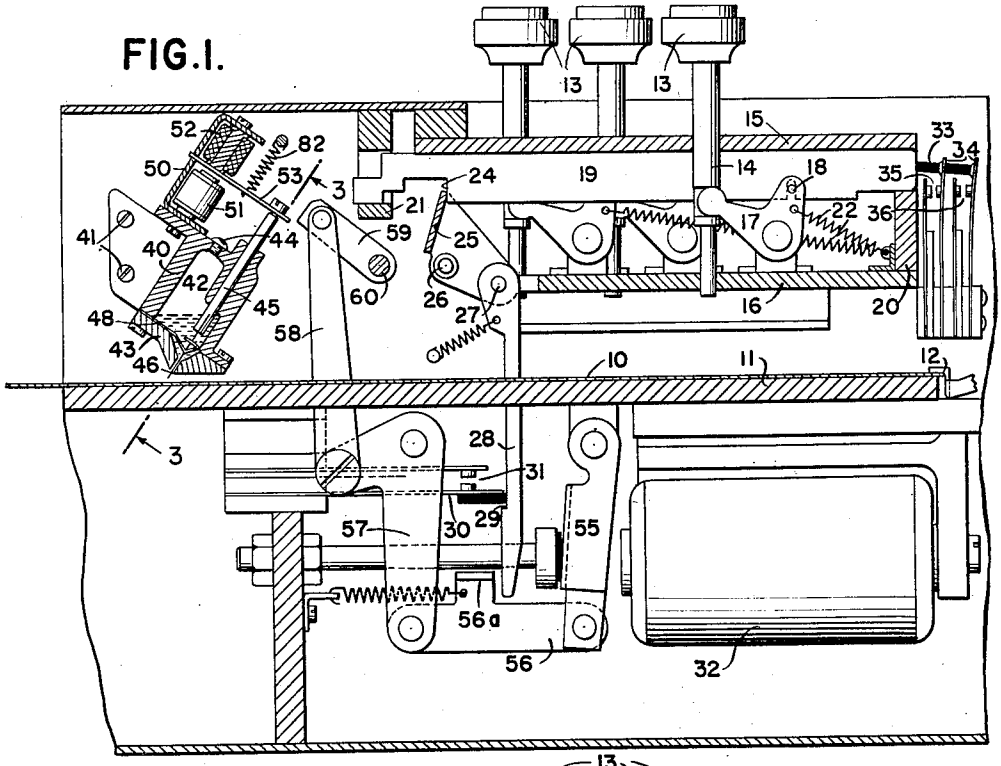
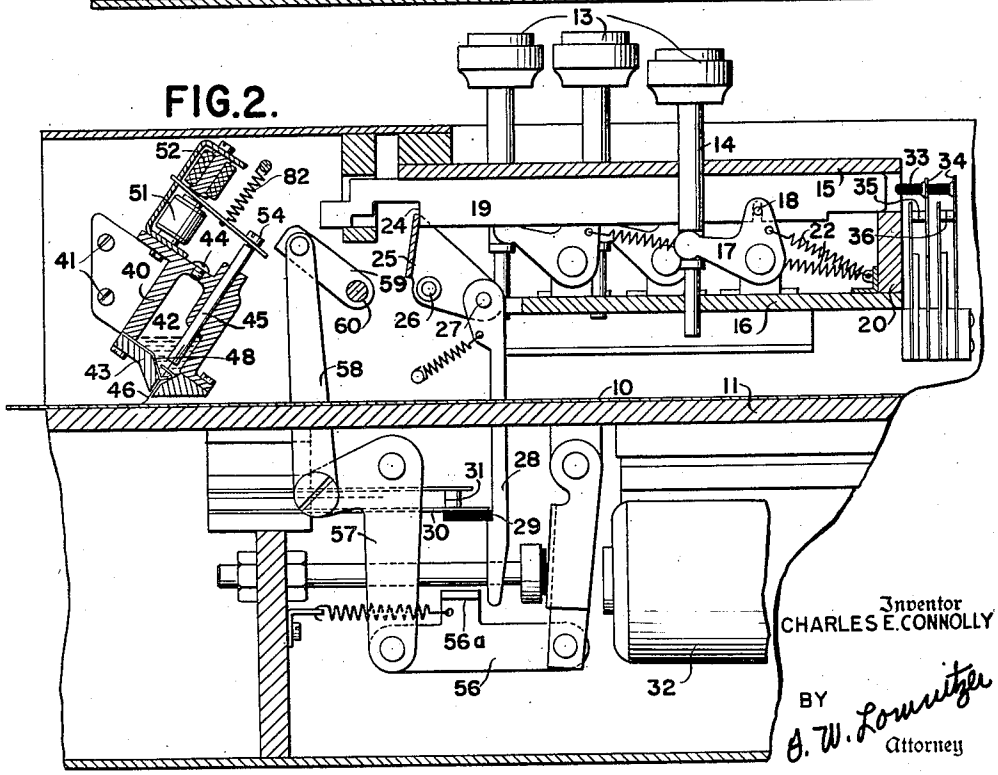



FIG. 2.




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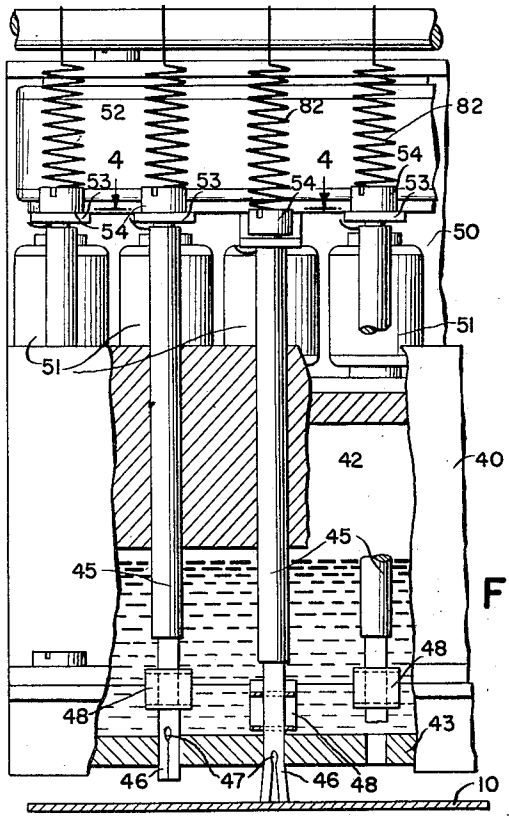



FIG.3.

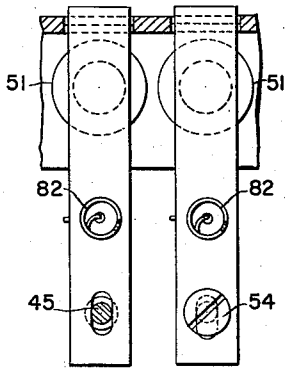



FIG.4.

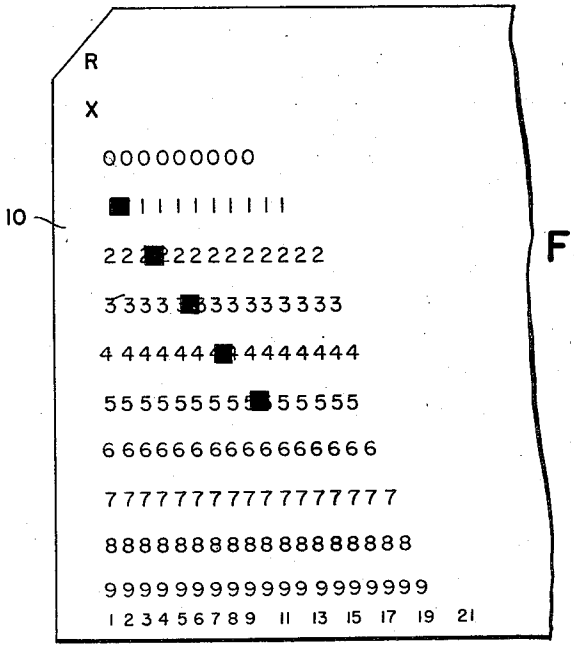



FIG.5.

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FIG.6.

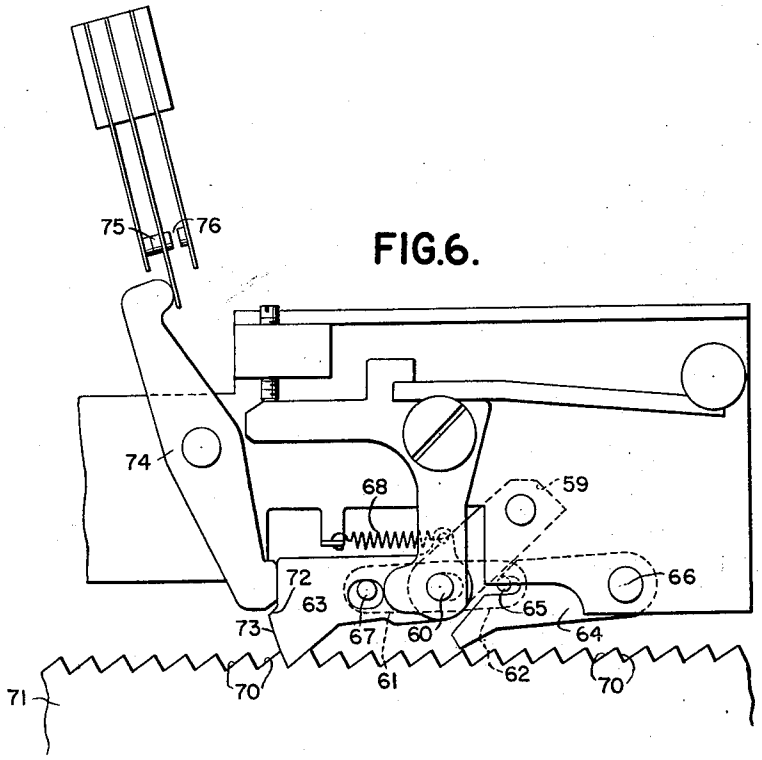
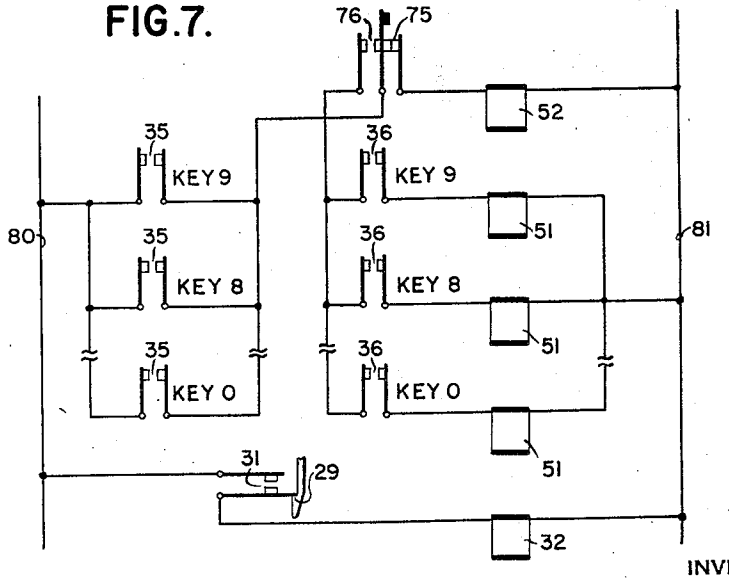



FIG.7.




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2,654,459

## MACHINE FOR MARKING STATISTICAL RECORDS BY CONDUCTIVE MARKS

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Application August 21, 1951, Serial No. 242,885

3 Claims. (Cl. 197—1)

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This invention relates to marking devices and more particularly to marking devices for applying conductive marks at differential positions on record cards or other documents for indicating statistical or like data thereon.

It is common practice at the present time to apply such conductive marks at the differentially disposed index point positions in the record columns by hand, usually by means of a pencil carrying conductive graphite through which electrical circuits may be closed. It is also proposed to electrically sense such conductive pencil marks and convert data in this form to another form comprising perforations, likewise disposed at differential index point positions in the successive columns. This is described in the patent to J. W. Bryce, No. 2,007,391, issued July 9, 1935 and No. 2,275,396, issued to Reynold B. Johnson, March 3, 1942. It is the purpose of the present invention to eliminate the time consuming manual operation for applying the pencil marks and to effect the marking under control of a keyboard, applying however, by a novel arrangement, a preferred form of conductive mark which may comprise conductive ink having a formula set forth in the patent to Samuel Brand et al., No. 2,265,419, issued December 9, 1941.

The main object of the present invention is to devise a marking device capable of applying on a record conductive ink marks controlled by keys or other manipulative members.

Another object of the invention is to devise an ink applying arrangement of the type wherein a plurality of ink applying devices are selectiviely positioned to make contact with the record and to have such conductive ink applying devices selected by the keyboard.

Another object of the invention is to produce an ink applying arrangement of the character described in which the card and the ink applying devices are moved relatively to each other as the keyboard is successively operated so as to present the columns of the record in successive operative relationship with respect to the ink applying devices.

A still further object of the invention, and a relatively important one, is to cause the application of the conductive mark by the positioned ink applying device to be effected by the travel of the record as it is escaped from column to column. In carrying out this object of the invention the keys cause the positioning of a selected ink applying device to contact said record prior to its movement. Thereafter, an escapement mechanism commonly controlled by the

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keyboard is operative to cause a step of movement of the card corresponding to a column whereby the conductive ink is applied by the positioned ink applying device at the index point position determined by the key.

Another object of this device is to produce a conductive ink applying device of the character described which is efficient in operation, simple in construction and inexpensive to manufacture.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a longitudinal sectional view of a well known form of key operated machine in which the present conductive ink applying card marking arrangement is preferably embodied. In this figure all parts are shown at normal.

Fig. 2 is a longitudinal sectional view similar to Fig. 1 but shows certain of the parts of the machine in an operated position effected by the depression of the right-hand key.

Fig. 3 is a transverse sectional view on an enlarged scale taken on the line 3—3 of Fig. 1 which shows in more detail the construction of the preferred form of conductive ink applying device.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary portion of a tabulating card showing how the conductive ink marking is applied to a tabulating card of a well known form by the present arrangement.

Fig. 6 is a detail view of the card carriage escapement mechanism.

Fig. 7 is a wiring diagram of the machine.

The present arrangement for applying conductive ink, or the like, to record cards for designating statistical or like data is preferably incorporated in a key operated machine of the form shown in the patent to F. L. Lee et al., No. 1,772,186, granted August 5, 1930 and the basic machine will be described in only so much detail as is necessary to understand the present arrangement.

As is well known in the basic machine referred to, the tabulating card 10 (Fig. 1) which is to be marked is carried by a card carriage 11 with its trailing edge engaged by a pivoted pusher 12 and its leading edge engaged by an abutment which is not shown. The cards to be marked may be manually placed upon the card carriage 11

or they may be fed to the left from a magazine which is at the right of the keyboard by an automatic card feeding mechanism fully shown and described in the aforementioned patent. For the purposes of the present invention the manner in which the card is placed upon the carriage is immaterial, it being understood that the card carriage is moved column-by-column to thus bring the successive vertical columns into coordination with the conductive ink applying devices as the keys are successively operated.

The keyboard may consist of ten digit representing keys 13 when the ten index point positions 0–9 inclusive are to be selectively marked but if it is desired to also mark the X and R index point positions (see Fig. 5), two additional keys X and R and associated ink applying devices may also be incorporated in the keyboard. Each key 13 has a stem 14 which is slidably mounted in guide plates 15 and 16. Swiveled to the stem 14 of each key 13 is one arm of a bell crank 17, the other arm of which has a pin and slot connection 18 to a related interposer bar 19. The series of interposer bars are suitably slidably mounted as, for example, in a slotted guide plate 20 and a slotted transverse guide bar 21. Also connected to each bell crank 17 is a spring 22 which returns the interposer bar 19 and depressed key 13 to normal positions. When key 13 is manually depressed it rocks the connected bell crank 17 against the resistance of spring 22 to shift the associated interposer bar 19 to the left. Each interposer bar 19 is notched intermediately to provide a vertical shoulder 24 engaged by a bail 25 which is common to all the interposer bars 19, said bail being pivoted upon a shaft 26. One side of bail 25 carries a pin 27 passing through a hole in the upper end of a vertical link 28. Link 28 extends downwardly and is formed with a shoulder 29 underlying a spring blade 30 which carries one of the points of normally open contacts 31.

When any interposer bar 19 is shifted to the left its shoulder 24 rocks the bail 25 to elevate link 28, the shoulder 29 of which thereupon moves blade 30 upwardly to close contacts 31, as shown in Fig. 2. The closure of contacts 31 energizes an escapement magnet 32 to effect certain operations as will be described.

Each interposer bar 19 when moved to the left will move its right end away from an insulating button 33 secured to the resilient blades 34 of normally open contacts 35 and 36 to allow contacts 35 and 36 to close as shown in Fig. 2 for a purpose to be more clearly understood in connection with the wiring diagram.

It is noted, as shown in Fig. 7, that a series of contacts 35 and 36 are provided and each has an associated key 13, it being observed that when a key is depressed as shown in Fig. 2, the related contacts 35 and 36 will be closed.

There is arranged, instead of punching elements which are customarily provided in the basic machine at each of the ten digit index point positions, conductive ink applying devices, each of which is selectively pressed against the card and before said card is moved to the left under control of an escapement mechanism to apply a conductive ink line on the card at an index point position corresponding to the key operated.

The ink applying mechanism is devised as a unitary structure and is located at the left end of the machine as shown in Figs. 1 and 2 as a substitute for the card punching mechanism shown in the patent to F. L. Lee et al., No. 1,772,186, so as to mark the cards. To this end a casting 40 extends transversely of the machine and is secured to the side frames of the machine by screws 41 passing through ears of the casting into said side frames, as shown in Figs. 1 and 2. The casting 40 has a pocket 42 closed at its ends and top by integral parts of the casting and at the bottom by a cover plate 43 fastened to the casting 40 to thereby provide an ink reservoir containing conductive ink which is applied to the record card. The reservoir 42 has a threaded hole by means of which the reservoir may be filled with ink when a screw 44 which closes said hole is removed. The casting 40 contains a series of holes in which fit ten plungers 45 projecting in said reservoir 42 and each of said plungers carries at its lower end an associated ink applying device which is preferably in the form of a slotted pen 46 (Fig. 3). The pens 46 pass through the cover plate 43 and over the card 10. The slot of each pen terminates at an opening 47 (see Fig. 3) into which the conductive ink from the reservoir 42 may flow and then down through the slot to the bottom of the pen. If so desired, instead of a pen a felt ink applying wick may be utilized. Fastened by the attachment of the cover plate 43 to the casting 40 is a series of leaf springs 48 preferably bent in the form shown in Figs. 1 and 2 and having two holes through which the pen 46 projects with a slight bit of friction. Normally each of the ink applying pens 46 is above the surface of the card 10 to be marked, as shown for the left-hand pen in Fig. 3, and when the selected plunger 45 is moved downwardly it will correspondingly actuate the flat spring 48 so that complete reciprocating movements of the plunger 45 will agitate the ink in the vicinity of the opening 47 of the pen 46 to be positioned, thereby maintaining conductive particles in the ink equally distributed throughout the fluid whereby each mark will be applied to the card with the same density.

Bolted to the casting 40 is a U-shaped frame plate 50 carrying ten selectively energized magnets 51 and a single pen retractor magnet 52. Disposed above the ten magnets 51 are associated armatures 53, each of which has a connection by a screw 54 to the upper end of the related plunger 45. From Fig. 4 it will be seen that the screw connection 54 which pivotally connects the end of the armature 53 to the plunger 45 is a loose slotted connection so as to enable the desired downward movement of the plunger 45 without restriction. Magnet 52 is above all of the armatures 53 and attracts any one of them upwardly. As will be described in connection with the wiring diagram, magnet 52 is first energized and this will attract an armature 53 upwardly to positively retract the last positioned ink applying pen 46 from the record if it should still be down. Thereafter, the energization of the selected magnet 51 will move associated armature 53 downwardly so as to depress plunger 45 and position the associated pen 46 to make contact with the card 10 which is thereafter moved under control of the escapement mechanism to thereby apply the conductive ink to a selected index point position of the record.

The circuits to control the energization of magnets 51 for applying ink to the index point positions and magnet 52 will later be described in connection with the circuit diagram of Fig. 7.

In the present machine, for the efficient application of such conductive ink marks, it is desirable to have the marking operation controlled

by the escapement mechanism. To this end the escapement mechanism of the basic machine is suitably modified to obtain this desirable result.

To the armature 55 of magnet 32 there is connected a link 56 (Fig. 1) connected to a bell crank 57. Said bell crank has a link connection 58 to an arm 59 secured to the escapement rock shaft 60. The function of the rock shaft 60 is to operate the escapement mechanism shown in detail in detail in Fig. 6. As is well known, link 56 has a lug 56a which strikes link 28 to unlatch shoulder 29, and thus permit contacts 31 to open to deenergize magnet 32.

As is well known the carriage carrying the card 10 to be marked is under the influence of a suitable carriage feeding spring (not shown) of a well known construction, and the card 10 is escaped column by column under control of the escapement mechanism. To escapement shaft 60 there is secured a double arm 61, 62 (Fig. 6) having respective pin and slot connections to the escapement dogs 63 and 64. Arm 62 carries a pin 65 fitting in a larger notch in the escapement dog 64 which is pivoted on a fixed stud 66. The escapement dog 63 is loosely mounted on the rock shaft 60 which extends through an elongated slot in said dog larger than said shaft 60, and the arm 61 operating dog 63 has a pin 67 projecting in an elongated hole in said dog larger than said pin. A spring 68 interposed between a fixed part of the frame and a vertical extending tail formed in the dog 63 normally tends to draw said dog to the left but has insufficient power to do so because the carriage feeding spring is of superior tension.

When the shaft 60 is rocked counterclockwise as a result of the energization of the magnet 32 the dog 63 which is normally in engagement with a rack tooth 70 of the escapement rack 71 secured to the card carriage will be raised out of engagement with the tooth with which it cooperates. The escapement dog 64 is made slightly longer than the escapement dog used in the escapement mechanism in the machine of the aforementioned patent so that it now normally overlaps the high point of the next adjacent tooth. The slot in the arm 62 engaging the pin 65 is somewhat larger than the pin so that even though the tooth of dog 64 rests upon the high part of a tooth it will not prevent the clockwise rotation of the double arm 61, 62 to an extent to enable dog 63 to be lifted out of engagement with the tooth 70 of the escapement rack 71 by means of the pin 67 cooperating with the slotted hole in the dog 63. When said dog clears the tooth the carriage will be moved by the carriage feeding spring and the free end of the escapement dog 64 will now ride down the next tooth 70 of the escapement rack, permitting the carriage to escape to the right in Fig. 6 or left in Figs. 1 and 2 to an extent of one card column. The dog 64 will, when it has completely entered a tooth 70, bring the carriage to rest after which a counterclockwise rocking of the arms 61, 62 takes place as a result of the deenergization of the magnet 32. When the dog 63 clears the escapement rack the spring 68 moves the dog 63 to the left to a distance determined by the length of the slotted hole surrounding the pin 67, as well as the elongated slot in the dog 63 surrounding the rock shaft 60. The end of dog 63 will now be over the next tooth 70 so that when said dog is subsequently lowered it will enter the same and lock the carriage against movement as the dog 64 is moved out of engagement with the tooth 70 with which it cooperated. As it comes out of engagement the carriage feeding spring moves rack 71 slightly to the right in Fig. 6 a distance permitted by shaft 60 to allow dog 64 to now rest over the high point of a tooth, as shown in Fig. 6.

The free end of the dog 63 is provided with cam surfaces 72, 73 having a contour defining a cam surface, the effect of which is that shortly after the dog 63 is raised upwardly a double follower arm 74 will be rocked counterclockwise very quickly. The upper arm of double follower arm 74 cooperates with the center blade of contacts 75 and 76 so that when double arm 74 is rocked it will close contacts 76 and open contacts 75 and before the escapement dog 63 is moved upwardly sufficiently to release the card carriage. The construction is such that contacts 76 are maintained closed from the first instant that the escapement dog 63 is moved upwardly to almost the instant that the dog 63 is reseated in an adjacent rack tooth 70.

The operation of the machine will now be described in connection with the wiring diagram of Fig. 7. The current source is supplied by lines 80 and 81. When the operator depresses a key 13 to shift the associated interposer 19 associated contacts 35 and 36 will both be operated and closed prior to the operation of any other contacts in the wiring diagram. Hence, a circuit will be established from the line side 80, through contacts 35 pertaining to the depressed key, thence through normally closed contacts 75, through pen retractor magnet 52 to the line side 81. The purpose of initially energizing the pen retractor magnet 52 is to attract the armature 53 of the previously operated plunger 45 upwardly to insure that the pen 46 previously operated is in a normal inoperative upward position. Such operation will also cause the movement of the ink agitator spring 48 for the purpose of conditioning the ink at the outlet orifices so that said ink will not be in a semi-coagulated state upon later attempting to mark the record.

As the depressed key nears the end of its downward travel contacts 31 are closed by the link 28 in a manner previously described. Closure of such contacts 31 closes an obvious circuit to the escapement control magnet 32 which, in turn, produces the rocking of the rock shaft 60 to raise escapement dog 63 which effects the operation of the follower arm 74 to open contacts 75 and close contacts 76. It is presumed that at this time the operator is still keeping the key depressed so that interposer contacts 35 and 36 are maintained closed. Therefore, at the initial rise of the escapement dog 63 a circuit is completed from line side 80, through contacts 35 of the depressed key, through contacts 76 now closed, thence through the contacts 36 of the same depressed key, associated pen selector magnet 51 to the line side 81. This will cause movement of the related plunger 45 and pen 46 so that the pen contacts the card before the card carriage moves. As soon as dog 63 clears the rack tooth the card carriage will move a distance of one card column and with the depressed pen 46 in physical contact with the moving card a line will be produced at the index point position corresponding to the depressed key.

When contacts 76 open by virtue of dog 63 reseating in the adjacent rack tooth, or contacts 35 or 36 are opened because the operator has released the key, the pen selector magnet 51 will

be deenergized. Should the dog 63 reseat before the key is released contacts 76 will open and contacts 75 will close to cause an energization of the pen retractor magnet 52 to effect the positive restoration of the pen. Should the opening of contacts 35 and 36 precede the reseating of escapement dog 63 then the pen will be restored to its inoperative position by means of a spring 82 attached between a stationary stud on the frame and the pen operating armature 53.

While there have been shown and described and pointed out the fundamental novel features of the invention, it will be undertsood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a recording machine of the class described, manually operated keys, a card carriage for carrying a card adapted to be marked with ink conductive lines capable of being sensed, a reservoir carrying a supply of conductive ink, a plurality of ink conducting pens within said reservoir and adapted to be selectively projected from said reservoir to make contact with said card prior to its escapement, a plurality of operating means for positioning said pens, means controlled by said keys for effecting the operation of the associated operating means to position the related ink conducting pen, an escapement mechanism for said carriage for enabling the escapement of the card while the selected pen is in contact with the card to make an ink line thereon at a place determined by the associated key, an operating means commonly controlled by said keys, and means controlled by the last named means for effecting the operation of the escapement mechanism after the selected pen has been positioned to contact the card.

2. In a recording machine of the class described, manually operated keys, a card carriage for carrying an adapted card to be marked with ink conductive lines capable of being sensed, a reservoir carrying a supply of conductive ink, a plurality of ink conducting pens within said reservoir and adapted to be selectively projected out of said reservoir to make contact with said card prior to its escapement, a plurality of operating means for positioning said pens, means for retracting the previously positioned pen, ink agitating means within said reservoir and operated by said pen retracting means in one direction and by the operated operating means in the other direction, means controlled by said keys for effecting operation of the pen retracting means and thereby operating the ink agitating means in one direction and then effecting operation of the associated operating means to position the related ink conducting pen and operate said ink agitating means in said other direction, an escapement mechanism for said carriage for enabling the escapement of the card while the selected pen is in contact with the card, an operating means commonly controlled by said keys, and means controlled by the last named means for effecting the operation of the escapement mechanism after the selected pen has been positioned in contact with the card.

3. In a recording machine of the class described, a plurality of keys, a reservoir having a supply of conductive ink, a plurality of ink conducting pens disposed in said reservoir and adapted to be projected therefrom to contact a card to be recorded, a card carriage for carrying said card, a plurality of magnets each adapted to position the related pen, electrical circuits controlled by said keys for selectively energizing the related magnets, an escapement mechanism for releasing said card carriage, a magnet for operating said escapement mechanism, circuit closing means controlled by said keys for energizing said magnet to operate said escapement mechanism, a pen retracting magnet adapted to retract a previously positioned pen, and circuit transfer means controlled by said escapement mechanism for causing first before the operation of the escapement mechanism the energization of said pen retracting magnet, and thereafter by the operation of escapement mechanism but before said escapement mechanism releases the carriage the energization of the selected pen positioning magnet to thereby enable the related pen to be positioned and in contact with the card before said escapement mechanism releases the card carriage.

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