Feb. 10, 1948. R. E. PARIS 2,435,725

CONDUCTIVE FLUID ELECTRICAL CONTACT DEVICE

Filed Oct. 9, 1943 3 Sheets-Sheet 1

FIG. 1.

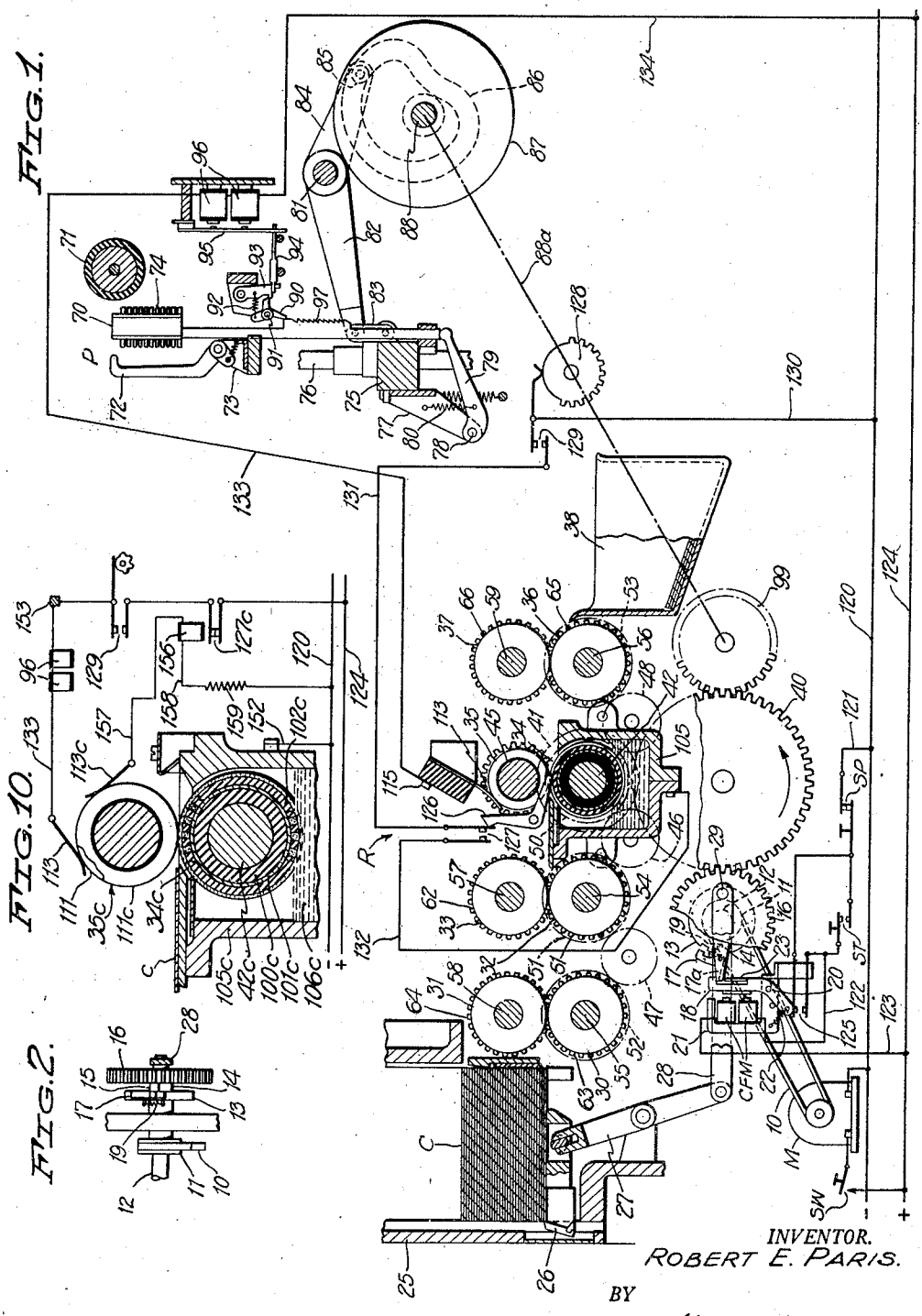


FIG. 10.

FIG. 2.

INVENTOR.
ROBERT E. PARIS.

BY

ATTORNEY.

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CONDUCTIVE FLUID ELECTRICAL CONTACT DEVICE

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FIG. 3.

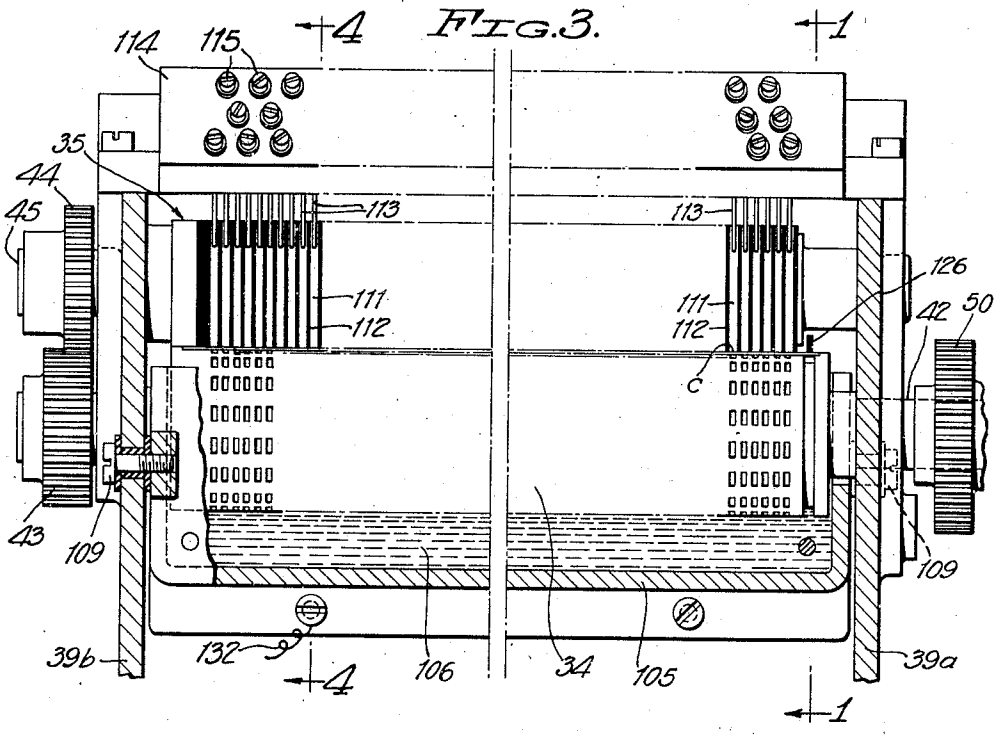


FIG. 4.

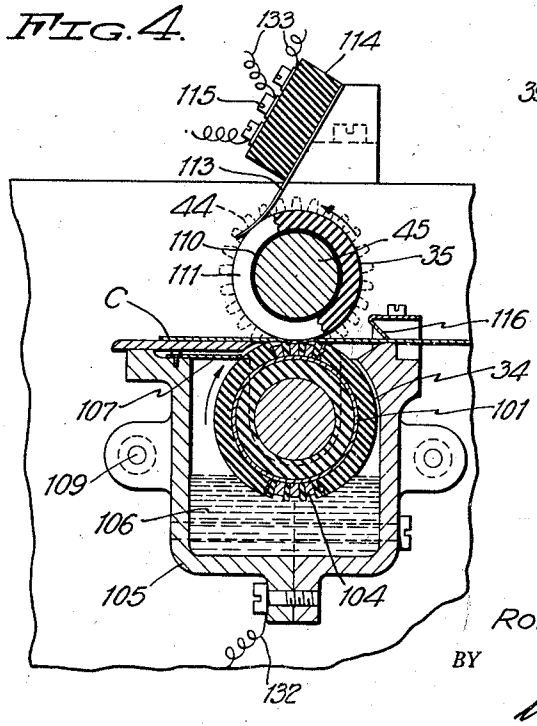


FIG. 5.

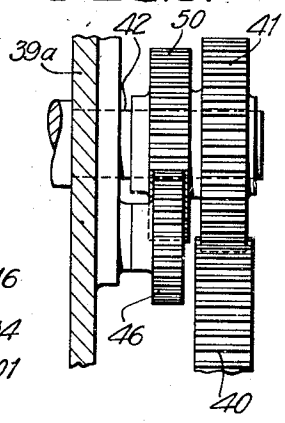
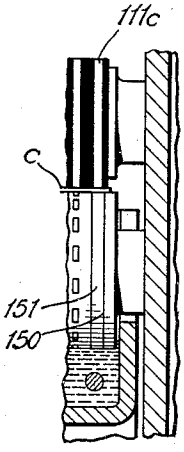


FIG. 12.



INVENTOR.
ROBERT E. PARIS.

BY

W. M. Wilson

ATTORNEY.

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FIG. 6.

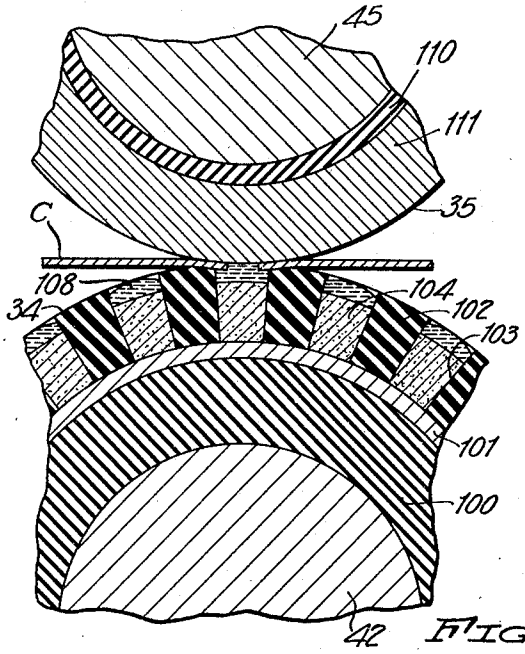


FIG. 7.

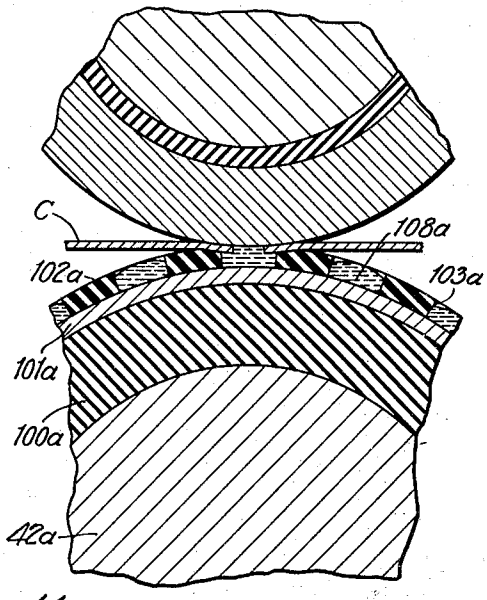


FIG. 11.

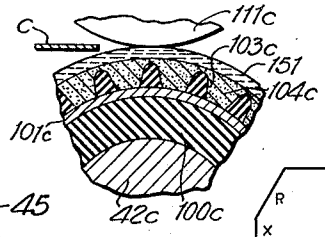


FIG. 8.

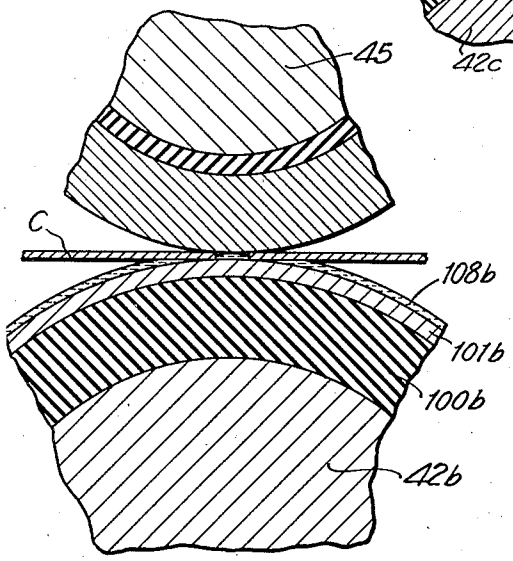
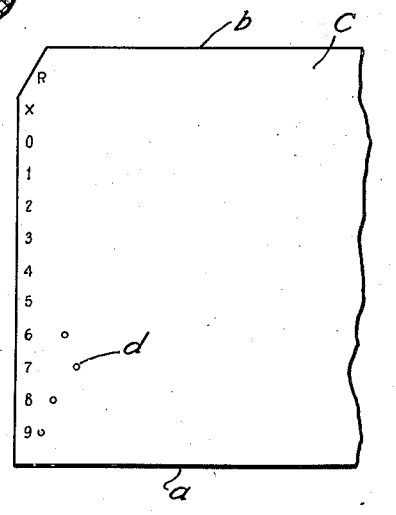


FIG. 9.



INVENTOR.
ROBERT E. PARIS.

BY

ATTORNEY.

Patented Feb. 10, 1948 2,435,725

UNITED STATES PATENT OFFICE

2,435,725

CONDUCTIVE FLUID ELECTRICAL CONTACT DEVICE

Robert E. Paris, Teaneck, N. J., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application October 9, 1943, Serial No. 505,687

8 Claims. (Cl. 235—61.11)

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This invention relates to electrical sensing devices, its principal object being to provide an efficient and reliable means for sensing sheets of insulating material, or portions thereof, in order to detect an edge of the sheet, or a perforation therein.

In accordance with the principle of the invention an electrically conductive fluid is used as the effective sensing instrumentality. The conductive fluid is positioned by suitable supporting means so as to make contact with one surface of the sheet and is complemented by a counter contact device positioned to make contact with said conductive fluid, subject to the interposition of the insulating sheet between the complementary contact areas of the counter contact and the conductive fluid.

One advantage of the use of a conductive fluid as the effective sensing instrumentality, particularly where the insulating sheet is sensed in motion, is that the fluid flows instantly, on being released by the arrival of a perforation, or edge of the sheet, at the contact area, and makes and maintains continuous contact with the counter contact, until separated by the sheet again. The fluid nature of the sensing instrumentality enables it to sense very small perforations in a moving sheet. This operation can be enhanced, in accordance with a particular feature of the invention, by maintaining the conductive fluid under a yielding hydrostatic pressure during the sensing.

Accordingly, one advantage of the invention, as applied to the reading of control records, is that it increases the speed and reliability of the sensing operation.

Another advantage is that it will read smaller perforations than those now commonly used in perforated records.

Another advantage is that it is capable of sensing extremely small perforations in moving records.

Another advantage is that it allows a greater tolerance of variations in the position of the perforations, while providing exact limits of tolerance.

Another advantage is that it produces no dust from the records, such as brush sensing mechanisms are known to produce.

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.

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In the drawings:

Fig. 1 is a partly diagrammatic vertical sectional view showing a tabulating machine embodying a sensing mechanism in accordance with the invention, the section through the sensing mechanism being on the line 1—1 of Fig. 3.

Fig. 2 is a detail side elevation of a part of the driving mechanism.

Fig. 3 is a vertical section through the sensing mechanism, parallel to the shafts of the sensing rollers.

Fig. 4 is a vertical section at right angles to Fig. 3, on the line 4—4.

Fig. 5 is a detail view of a portion of the gearing which drives the sensing rollers and the feed rollers.

Figs. 6, 7, and 8 are detail sectional views on a large scale of portions of three modifications of the sensing mechanism.

Fig. 9 is a portion of a record card.

Fig. 10 is a semi-diagrammatic vertical sectional view of a modified tabulating machine, in which the invention is applied to the function of detecting the presence of a control record at the sensing rollers, in place of the card lever used for this purpose in Fig. 1.

Fig. 11 is a detail view on an enlarged scale of portions of the sensing rollers shown in Fig. 10.

Fig. 12 is a detail view, partly in section, of the sensing rollers disclosed in Fig. 10, showing portions of the latter in side elevation.

Background structure of the illustrative embodiment

The machine partially shown in Fig. 1 is a tabulating machine designed to feed record cards in sequence through a reading mechanism R, which analyzes the cards and controls a printing mechanism P, whereby the data from the record cards is tabulated in printed form. Such a machine ordinarily includes accumulators for totalizing statistical data, but these are not shown in the drawing since the printing mechanism will sufficiently illustrate the manner in which the record reading mechanism controls another mechanism. The printing mechanism would ordinarily be positioned beside the card feeding mechanism, but has been moved to the right in Fig. 1, to make it visible in the same view.

The Driving Mechanism

The drive of the machine is taken from an electric motor M, the shaft of which is connected by a belt 10 to a pulley 11 on a shaft 12. This shaft has fixed to it a notched disk 13 and

revolubly mounted on it a unit comprising an arm 14 connected by a hub 15 (Fig. 2) to a gear 16. The arm 14 has pivoted to it a dog 17 adapted to engage the notch of the disk 13. When the machine is not feeding cards, the arm 14 is latched by a latch 18 which also engages the finger 17a of the dog 17 and retracts the dog from the notch, against the pull of a spring 19. The latch 18 is pivoted at 20 on a magnet frame 21 and normally pulled clockwise by a spring 22. A detent 23 pivoted to the latch 18 and biased by a spring (not shown) engages behind the arm 14 when the latter is stopped by the latch and locks the unit comprising the arm 14 and gear 16 in a fixed position. The latch 18 can be released from the arm 14 by a magnet CFM. When the latch 18 releases the arm 14 and finger 17a, the dog 17 drops onto the disk 13 and engages the notch thereof, setting the arm 14 and gear 16 in rotation. The rotation will continue as long as the magnet CFM remains energized.

The Card Feeding Mechanism

The card feeding mechanism is of a well known type shown in Carroll Patent 1,791,883. The cards C are stacked in a hopper 25 and fed singly from the bottom of the stack by a reciprocating picker 26 operated by a lever 27. The lever is driven by a link 28 connected to an eccentric pin 29 on gear 16. The picker feeds a card for each revolution of the gear 16. The cards, on emerging from the hopper, are engaged by a first pair of feed rollers 30 and 31, by which they are fed to a second pair of feed rollers 32 and 33. The latter feed the cards to the sensing mechanism, which comprises a lower roller 34 and an upper roller 35, the construction of which will be described in detail presently. The cards are received from the sensing rollers by a pair of feed rollers 36 and 37, which deposit them in a hopper 38. The feed rollers are journaled in frame plates 39a and 39b (Fig. 3).

The drive of the sensing rollers and of all the feed rollers is taken from the gear 16 through a large gear 40, which meshes with a gear 41 on the near end (Fig. 1) of shaft 42 of the lower sensing roller 34 (see also Fig. 5). At the opposite end of shaft 42 is fixed a gear 43 meshing with a gear 44 fixed to the shaft 45 of the upper sensing roller 35. The lower feed rollers 30, 32 and 36 are geared to the sensing roller 34 by intermediate gears 46, 47, and 48 meshing, in the manner indicated by dot and dash lines in Fig. 1, with gears 50, 51, 52, 53, which are respectively fixed to the shafts 42, 54, 55 and 56. The lower shafts 54, 55, 56 are geared to their respective upper shafts 57, 58, and 59 by pairs of gears 61, 62; 63, 64; and 65, 66. The gearing is such as to impart the same peripheral speed to all of the rollers along the card feeding path. The gears 16 and 41 have the same number of teeth, hence the roller 34 makes one revolution for each revolution of the gear 16.

The printing mechanism

The printing mechanism is of the kind shown in the Lake Patent 1,822,594 and comprises a set of type bars, only one of which appears in the drawing at 70. These type bars are mounted so as to be movable up and down in relation to a platen 71, on which a sheet of paper which is to receive the printed record is supported. A hammer 72 is pivotally mounted on a stationary bracket 73 so that its head is positioned in line with the printing line of the platen. There is a hammer for each type bar. The type bars can be raised to positions independently determined for each type bar, so that a selected one of the type members 74 is between the related printing hammer and the platen, at the end of the setting operation. For simplicity of illustration, the type mechanism shown has only the ten type members required for printing numerals. A cross head 75, mounted for vertical movement on two bars, one of which is shown at 76, carries a bracket 77 having a cross rod 78 on which are mounted a number of arms 79, one for each type bar 70. The arms 79 are biased upward by springs 80 to engage the bottom ends of their respective type bars. On one end of a rock shaft 81 is fixed an arm 82 carrying a link 83 pivotally connected to the adjacent end of the cross head 75. This mechanism is duplicated at the opposite end of the rock shaft 81, which shaft also has fixed to it an arm 84 carrying a roller 85 traveling in a groove 86 of a cam 87 fixedly mounted on a shaft 88. When the cam revolves, the cross head is raised and moves the type bars upward. The type bars are differentially stopped in the course of their upward movement by individual dogs 90 pivoted on a stationary rod 91, each dog being biased in a clockwise direction by a spring 92 connected to an individual pivoted latch 93. The latch is connected by link 94 to an armature 95 of an electromagnet 96. When the electromagnet is energized, the latch releases the dog 90, which engages a particular tooth of a set of teeth 97 on the type bar. The upward movement of the type bars by the cam 87 is synchronized with the feed of the cards, so that as the index point positions of the cards successively reach the sensing means, the teeth 97 of the type bars successively come into position to be stopped by the dog 90, if a perforation should be sensed in the card. For this purpose the shaft 88 (indicated by dot and dash line 88a) is provided with a driving gear 99 having the same number of teeth as the gear 16 and meshing with the gear 40.

The illustrative machine shown in the drawing is designed to handle record cards similar to the well known Hollerith statistical cards, but different from those in use at present in one important respect, namely, in the size of the hole used to represent the characters recorded. Fig. 9 shows a portion of such a modified Hollerith card. If this card be thought of as having the usual length of 3¼ inches between the two long sides *a* and *b*, then the twelve index point positions 9–1, O, X, R have the usual spacing of ¼ inch. The small, round data-representing holes *d*, on the other hand, are only .04 of an inch in diameter, as compared with the customary size of (approximately) .125 by .057 inches. A sensing mechanism constructed in accordance with my invention will reliably sense holes much smaller than .04 of an inch, with advantages apparent to those skilled in the art.

The sensing mechanism

In accordance with the invention, the usual brush sensing means is replaced by two complementary sensing members, at least one of which has on its surface an electrically conductive fluid. The preferred electrically conductive fluid is mercury, or an amalgam having some fluidity. In the constructions shown in the drawing, the lower roller carries mercury on its surface, while the

upper roller has a solid electrically conductive surface, preferably repellent to mercury.

Three illustrative constructions of the lower roller 34 are shown in Figs. 6, 7, and 8, respectively. In Fig. 6 the roller comprises a central metallic shaft 42 covered with an insulating sleeve 100, the latter being covered with a metallic sleeve 101, preferably of tin, silver, or a base metal plated with silver. Surrounding the sleeve 101 is a cylinder of rubber 102 with radial holes 103 partially filled by a metallic composition 104. The composition 104 should be one having a strong attraction for mercury, such as a silver amalgam composed of 50 parts mercury and 50 parts silver, and should make good electrical contact with the sleeve 101. The holes in the rubber cylinder have the same spacing as the index points of the record cards and the roller is driven in timed relation to the feed of the cards from the hopper 25, so that the index point positions of the cards coincide with the successive holes.

The roller 34 is partially enclosed in a trough 105 (Figs. 3 and 4) partly filled with mercury 106. As the roller turns in clockwise direction, the pockets 103 are submerged in the mercury and on emerging at the opposite side each is filled with a drop of mercury adhering to the amalgam in the pocket. A doctor blade 107 reduces the mercury in all the pockets to about the level indicated at 108. The trough 105 is secured to the frame plates 39*a* and 39*b* by screws 109, and may be electrically insulated therefrom, as indicated. A scraper 116 may be provided to return to the trough 105 any stray droplets of mercury which might adhere to the card.

The upper roller 35 preferably comprises a central metallic shaft 45, an insulating sleeve 110, a series of metal rings 111, and an interspersed series of insulating rings 112. The metal rings 111 are preferably composed of steel, which has no attraction for mercury. They are spaced by the insulating rings 112 so as to have the same spacing as the pockets 103 on the lower roller, which conforms to the column spacing of the record cards. Each metal ring 111 has bearing upon it an individual brush 113, these brushes being secured upon an insulating bar 114 by means of individual terminal connectors 115.

Sensing operation

The sensing process is illustrated in Fig. 6. The upper and lower rollers are journaled so that they just make contact when no card is between them. When a card enters the bite of the rollers, the rubber surface of the lower roller yields to admit the card. As the rollers revolve, the drops of mercury in the cups 103 are successively laid upon the index point positions of the card and, as the pressure increases near the line of centers of the rollers, if there is a perforation in the card, the mercury is extruded through the perforation into contact with the related metal ring 111 of the upper roller. During the time that the perforation is passing the line of centers of the rollers, an impulse is transmitted across the conductive path then formed between the lower roller and the ring of the upper roller, in a manner to be described presently. As the card moves past the line of centers and the pressure is relieved, the mercury withdraws from contact with the ring of the upper roller and from the perforation in the card, due to its inherent strong surface tension, and returns to its normal form, as shown at the right in Fig. 6.

The size of the hole in the card in Fig. 6 is exaggerated, for clearer visibility. In practice it can be a mere puncture, such as can be made by a needle, or by a high tension electrical spark discharge. Under the conditions existing between the rollers, with the small pool of mercury confined and subjected to pressure, the smallest perforation in the card will release a thread of mercury into contact with the upper roller.

The smallness of the perforation can be taken advantage of in either, or both, of two ways. The area of the card allotted to one index point can be reduced, thus permitting a greater amount of data to be recorded on a given card area. On the other hand, a greater tolerance can be allowed for variations in position of the perforations, caused by atmospheric influences on the cards, for example. If the center of a hole in the card is shifted a sufficient distance from the exact center of its index point position in the reading mechanism, it may cause an error by providing a conductive path in an adjacent index point position. The center of a hole of the small size contemplated herein would have to shift further from the exact center of its index point position, to make a conductive path in an adjacent index point position, than would the center of a larger hole. The embodiment shown in Fig. 6 has the additional advantage that the limits of tolerance are exactly defined by the area of the mercury pocket and are not subject to such variations as may occur where the area of contact of a flexible wire brush determines the boundaries within which an electrical impulse may be passed.

While the construction shown in Fig. 6 is preferred, other constructions will also perform the sensing function in accordance with the invention. Thus, in Fig. 7 the lower roller comprises a central metal shaft 42*a*, an insulating sleeve 100*a*, a metal sleeve 101*a*, and a relatively thin rubber cylinder 102*a* having pockets 103*a* for the drops of mercury 108*a*. In this case the amalgam plugs in the pockets are dispensed with, the mercury adhering directly to the metal cylinder 101*a* which is preferably composed of silver, or silver plated. The drops 108*a* may be composed of a mercury amalgam, which is sufficiently stiff to retain a shape imparted to it, but sufficiently fluid to penetrate a perforation in the card and make contact with the upper roller, when subjected to pressure between the rollers.

In Fig. 8 the lower roller has a continuous coating of electrically conductive fluid, preferably mercury, or amalgam. The shaft 42*b* is again covered with a cylinder of insulation 100*b*, which is enclosed in a cylinder 101*b*, the surface of which has an affinity for the electrically conductive fluid, which forms a continuous layer 106*b*. If the layer 108*b* is mercury, or an amalgam, the sleeve 101*b* may be a metal such as silver or copper, having an affinity for mercury, or may be a metal lacking affinity with mercury, plated with a metal such as silver or copper, or otherwise treated on its surface to give it an affinity for mercury, as by giving it a grained or knurled character. On the other hand, the sleeve 101*b* may be of rubber conditioned to give its surface an affinity for mercury. This can be done in various ways, such as by roughening its surface, coating it with rubber cement, or with a coating containing a powder of metal, such as silver or copper, having an affinity for mercury, or by incorporating a powder of such a metal into the

body of the rubber layer 101b. If the layer 101b is non-conductive, radially, the insulating cylinder 100b can be omitted.

Operation of the machine

With a stack of cards in the feed hopper 25 of the machine, and with the motor M started by closure of motor switch SW, the reading of the cards is ready to begin. The start switch ST is pressed, energizing magnet CFM through a circuit running from line wire 120, wire 121, stop switch SP, start switch ST, wire 122, magnet CFM, and wire 123 to line wire 124. The latch 18 rocks back, closing contacts 125 and thereby completing a holding circuit for magnet CFM, through stop switch SP. On release of the arm 14 and finger 17a by the latch 18, the dog 17 drops upon the notched disk 13 and, on entering the notch, sets the gear 16 in rotation. The card picker is reciprocated by the lever 27 and feeds the bottom card to feed rollers 30, 31, which feed it to the second pair of feed rollers 32, 33, by which it is transmitted to the sensing rollers 34 and 35. In the course of the second cycle of the gear 16 the leading edge of the card passes under and raises a card lever 126, closing contacts 127. This occurs before the "9" index point position reaches the bite of the sensing rollers and while an emitter cam 128 is holding its contacts 129 open. The cam 128 is shown as mounted on shaft 88 (see dot and dash line 88a), so as to rotate in synchronism with the card feed. If a perforation appears in a "9" index point position (as in column "1" of the card shown in Fig. 9) the drop of mercury in the related pocket 103 will be pressed through the perforation, into contact with the opposite ring 111 of the roller 35. During the time this contact is made the first tooth of cam 128 will close the switch 129, completing the following circuit: From line wire 120, through wire 130, contacts 129, wire 131, contacts 127, wire 132, the metal trough 105, the mercury bath 106 (see Fig. 4), through the amalgam plugs 104 at the bottom of roller 34 which are submerged in the mercury bath, through the metal cylinder 101 (see Fig. 6), the top plug 104, via the drop of mercury 108 through the hole in the card, through the ring 111 and its brush 113, terminal 115, wire 133, magnet 96, pertaining to column "1," and wire 134 to line wire 124, energizing said magnet 96. The dog 90 drops in front of the first tooth 97 of the column "1" type bar, setting the "9" type member thereof in printing position. When the "8" index point row of the record card passes between the sensing rollers 34 and 35, in any column where a hole appears (as in column "2" of the card shown in Fig. 9) the mercury in the related pocket of the roller 34 will be pressed through the hole into contact with the appertaining ring 111 of the roller 35. During the period of this contact the second tooth of cam 128 will close contacts 129 and an impulse will be transmitted through a circuit similar to the one previously traced, through magnet 96 pertaining to column "2." The related dog 90 will engage the second tooth of the type bar for column "2" and the "8" type member will be set in printing position. When the last index point row of the card has passed the sensing rollers and the type bars have been set in accordance with the data on the card, the hammers 72 are actuated in the customary manner, as shown, for example, in the above mentioned Lake Patent 1,822,594, to make the printed record of the data.

When no card is between the sensing rollers contact is made between each pocket of mercury and the upper roller, but at this time the card lever contacts 127 are open, consequently the magnets 96 are not energized. During the time that the card lever contacts are closed the cam operated contacts 129 are only closed intermittently, within the portion of the machine cycle in which the twelve index point positions pass between the sensing rollers. Therefore the magnets 96 can only be energized when contact is made by the mercury through a hole in the card.

If the lower sensing roller has the structure shown in Fig. 8, the circuit from the mercury bath 106 to the upper roller 35 is through the continuous layer of mercury on the surface of the lower roller, and through the sleeve 101b, if the latter is composed of conductive material.

A further illustration of the invention appears in Figs. 10, 11 and 12, which show a record sensing mechanism similar to the one first described, but with the card lever replaced by an electrical contact comprising an electrically conductive fluid as the effective sensing instrumentality, in accordance with the principle of the invention. The lower sensing roller 34c comprises a central shaft 42c surrounded by an insulating sleeve 100c, which is covered by a cylinder 101c, of silver or other suitable electrically conductive material. A rubber sleeve 102c surrounds the cylinder 101c and is similar to the sleeve 102 in Fig. 6, except in the end zone, where the card lever 126 is located in Fig. 3. As shown in the enlarged cross section, Fig. 11, the rubber sleeve 102c has perforations 103c which are filled with a solid, or semi-solid conductive substance 104c, such as the mercury amalgam previously referred to. In this case, the amalgam is continuous from one perforation 103c to the next, to provide a continuous layer thereof in the bottom of the annular groove 150 in the sleeve 102c. This groove contains a continuous ring 151 of a fluid conductor, such as mercury, or a fluid amalgam, which is replenished from the bath 106c in the bottom of trough 105c, within which the roller revolves. The upper roller 35c has an additional ring 111c positioned for coaction with the ring of mercury 151.

As shown in Fig. 10, the circuits to the print magnets, represented by magnet 96, extend from line wire 120 through wire 152 to the trough 105c, thence through the fluid 106c and the roller 34c, as previously traced, to a disk 111 of the upper roller, brush 113, wire 133, coils of magnet 96, bus bar 153, contacts 129 and 127c to the other line wire 124. The contacts 127c are controlled by a relay magnet 156 which is in a circuit controlled by the record card C, in the manner of a card lever control. This circuit extends from the trough 105c and fluid conductor 106c, through the ring of mercury 151 to disk 111c coacting therewith, thence through a brush 113c, wire 157, the coil of relay magnet 156, and wire 158 containing a resistance 159 to line wire 124. The relay 156 is thus energized when no card is between the rollers 34c and 35c and at such times holds the contacts 127c open, disabling the print magnets 96. When the leading edge of the card C moves between the two rollers, it breaks the circuit of the relay 156, deenergizing the relay and allowing contacts 127c close. The circuits of the print magnets are

then subject only to the control of the circuit breaker contacts 129 and the perforations in the related colums of record card.

The word "fluid," as applied to the sensing conductor in this case, is to be understood as meaning having sufficient fluidity to be extruded through a perforation in an insulating sheet, under the pressure existing between the sensing rollers.

While there have been shown and described and pointed out the fundamental novel features of the invention as exemplified in certain embodiments of the invention, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated and in their 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 device for sensing perforated records, two parallel rollers mounted close together so as to be capable of compressing records fed between them, one of said rollers having at its surface an electrically conductive liquid, the liquid and surface of the roller having a mutual affinity which causes the liquid to adhere to said surface, and the liquid being adapted to be extruded through any perforation in the record into contact with the other roller, when the portion of the record containing such perforation is compressed between said rollers, the other roller having an electrically conductive surface for engagement by said extruded liquid, and means for connecting said electrically conductive liquid and the electricaly conductive surface of said other roller to a source of electric current.

2. In a device for sensing perforated records, a pair of parallel rollers, a trough in which one of said rollers is revolubly mounted, a bath of electrically conductive liquid in said trough making contact with said latter roller, the liquid and the surface of the latter roller having a mutual affinity which causes the liquid to adhere to said surface, means to rotate said rollers, said rollers being mounted in such proximity to each other as to be capable of feeding a perforated record therebetween with pressure, whereby electrically conductive liquid picked up from said trough by the roller revolving therein will be extruded through any perforations in the record into contact with the other roller, the other roller having an electrically conductive surface for engagement by said extruded liquid, and means for connecting said electrically conductive liquid and the electrically conductive surface of said other roller to a source of electric current.

3. In a device for sensing perforated records, a pair of parallel rollers, a trough in which one of said rollers is revolubly mounted, said latter roller having on its surface an elastic layer with perforations containing solid metal plugs, means to rotate said rollers, a bath of an electrically conductive liquid in said trough, the liquid and said metal plugs having a mutual affinity which causes the liquid to adhere to said metal plugs as the roller in said trough revolves, said rollers being mounted in such proximity to each other as to be capable of feeding a perforated record therebetween with pressure, whereby electrically conductive liquid on said plugs will be extruded through any perforations in portions of the record overlying said plugs, into contact with the other roller, the other roller having an electrically conductive surface for engagement by said extruded liquid, and means for connecting said solid metal plugs and the electrically conductive surface of said other roller to a source of electric current.

4. Electrical contact means for detecting perforations in an insulating layer, comprising a solid member adapted to be positioned against one side of the insulating layer and having electrical contact means electrically connected to one terminal of a source of electricity, a second member comprising an elastic cup substantially filled with an electrically conductive liquid and provided with electricaly conductive means to lead off current from said electrically conductive liquid to the other terminal of said source of current, said second member being movable to press said cup and the electrically conductive liquid therein against the opposite side of the insulating layer from said solid member, the elastic cup being adapted to seal in the liquid so that a pressure is exerted to extrude the liquid through any perforation in the insulating layer within the area bounded by the cup into contact with the electrical contact means of said solid member.

5. In a device for sensing perforated records, two record engaging members one of which comprises elastic material, said members being mounted so as to be capable of relative movement to compress between them a perforated record to be sensed, one of said members having at its surface an electrically conductive liquid adapted to be extruded through any perforation in the record into contact with the other member, when the record material surrounding such perforation is compressed between said members, whereby the electrically conductive liquid is forcibly extruded through the perforations, said other member having an electrically conductive surface for engagement by said extruded liquid, and means for connecting said conductive liquid and the electrically conductive surface of said other member to a source of electric current.

6. In a device for sensing perforated records, two record engaging members mounted so as to be capable of relative movement to compress between them a perforated record to be sensed, one of said members having a surface of elastic material coated with an electrically conductive liquid adapted to be extruded through any perforation in the record into contact with the other member, when the record material surrounding such perforation is compressed between said members, whereby the electrically conductive liquid is forcibly extruded through the perforations, said other member having an electrically conductive surface for engagement by said extruded liquid, and means for connecting said conductive liquid and the electrically conductive surface of said other member to a source of electric current.

7. In a device for sensing perforated records, two record engaging members mounted so as to be capable of relative movement to compress between them a perforated record to be sensed, one of said members comprising elastic material with depressions containing an electrically conductive liquid adapted to be extruded through any perforation in the record opposite one of said depressions into contact with the other member, when the record material surrounding such perforation is compressed between said members, whereby the electrically conductive liquid is forcibly extruded through the perforations, said other member having an electrically conductive surface for engagement by said extruded

liquid, and means for connecting said conductive liquid and the electrically conductive surface of said other member to a source of electric current.

8. In a device for sensing perforated records, two record engaging members mounted so as to be capable of relative movement to compress between them a perforated record to be sensed, one of said members comprising elastic material with depressions containing a solid electrically conductive material and an electrically conductive liquid mutually cohesive with said solid electrically conductive material on the surface of the latter, said liquid being adapted to be extruded through any perforation in the record into contact with the other member, when the record material surrounding such perforations is compressed between said members, whereby the electrically conductive liquid is forcibly extruded through the perforations, said other member having an electrically conductive surface for engagement by said extruded liquid, and means for connecting the solid electrically conductive material in said depressions and the electrically conductive surface of said other member to a source of electric current.

ROBERT E. PARIS.

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