June 10, 1958 A. J. FINDLAY ET AL 2,838,361

TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 1

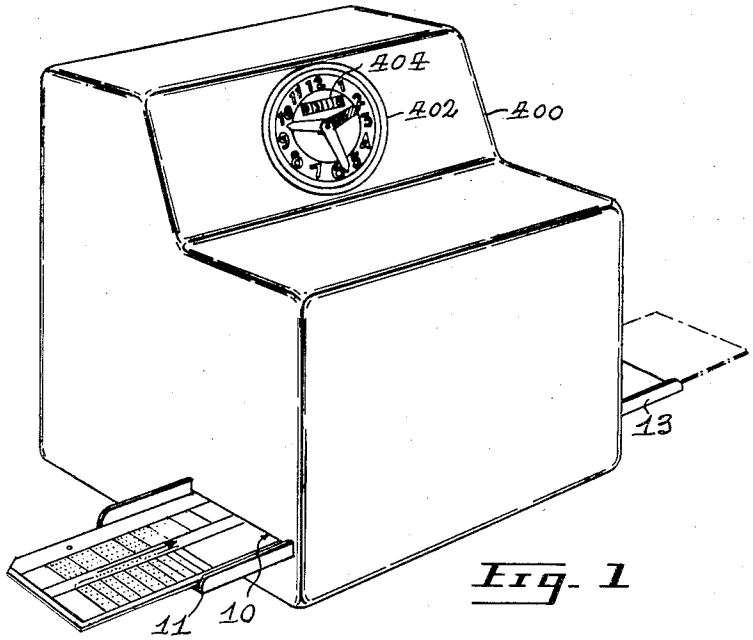


Fig. 1

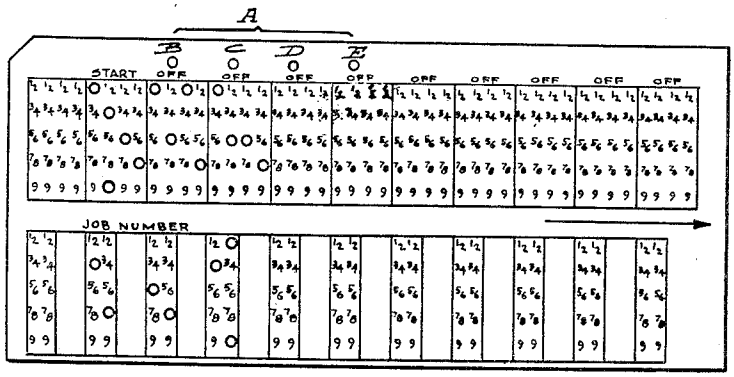


Fig. 2

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TIME RECORDING APPARATUS

Filed April 22, 1955

12 Sheets-Sheet 2

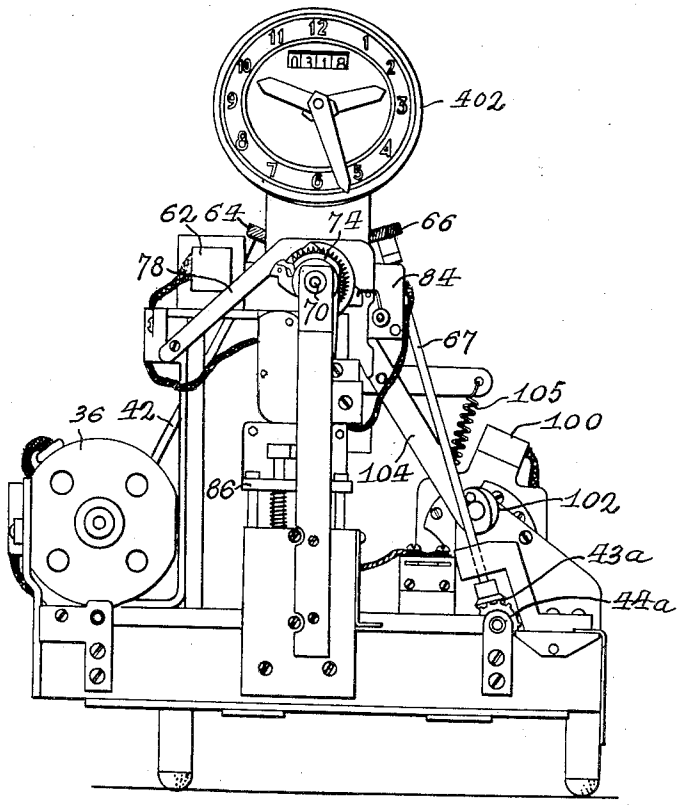


Fig. 3

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 3

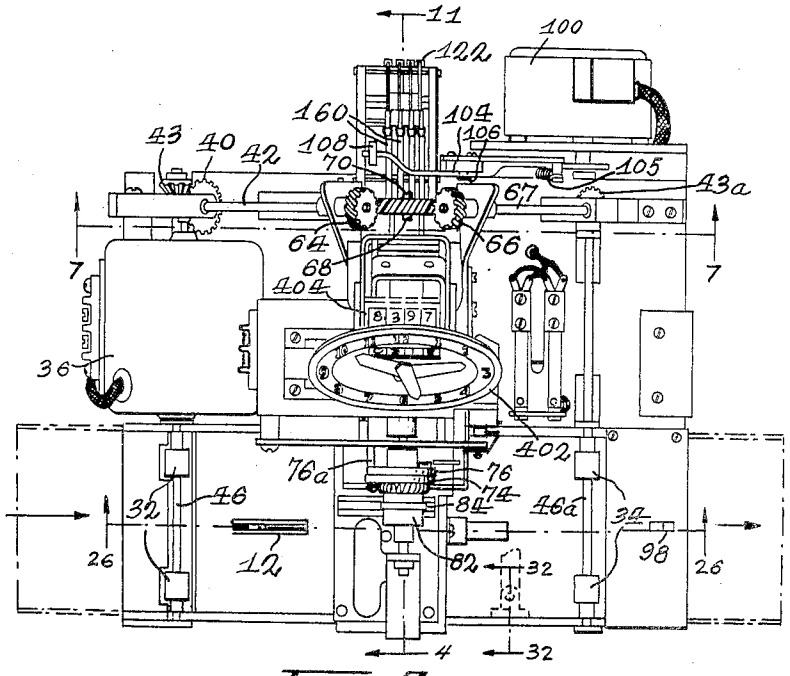


Fig. 4

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 4

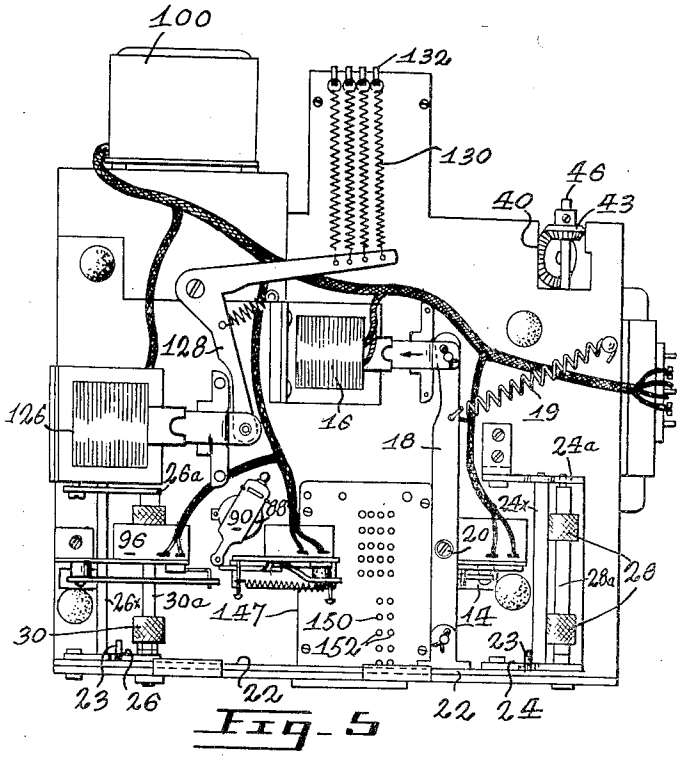


Fig. 5

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 5

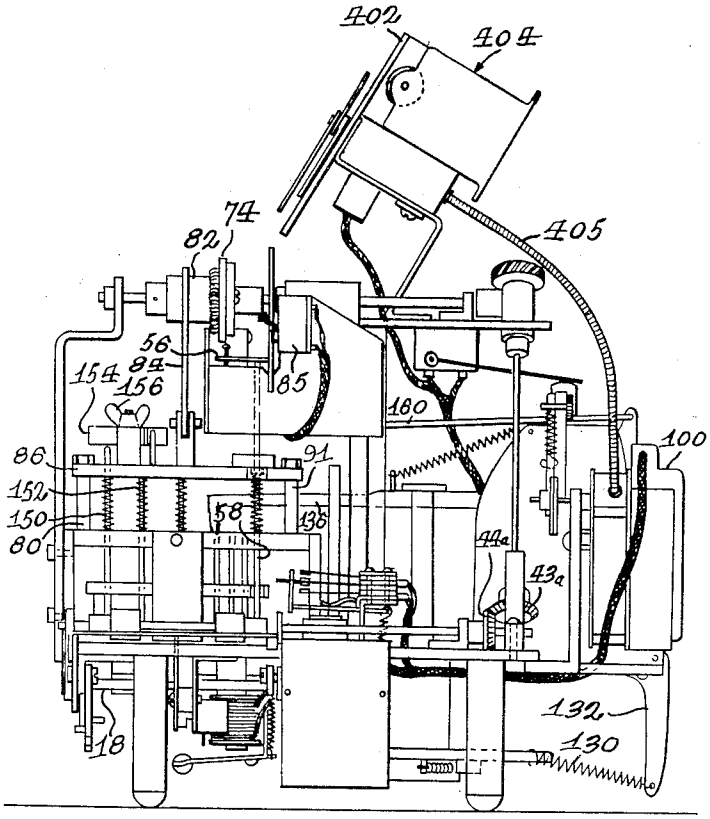


Fig-6

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TIME RECORDING APPARATUS

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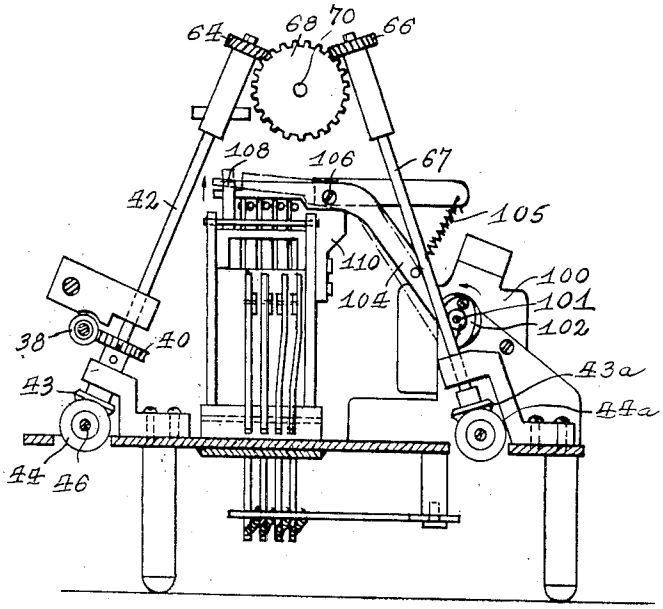


Fig. 7

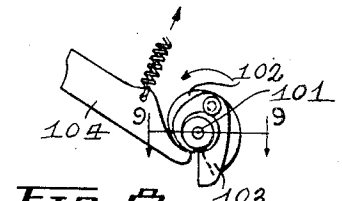


Fig. 8

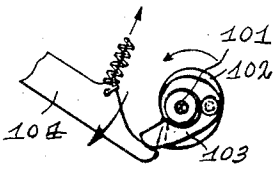


Fig. 10

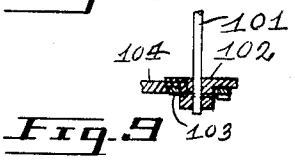


Fig. 9

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TIME RECORDING APPARATUS

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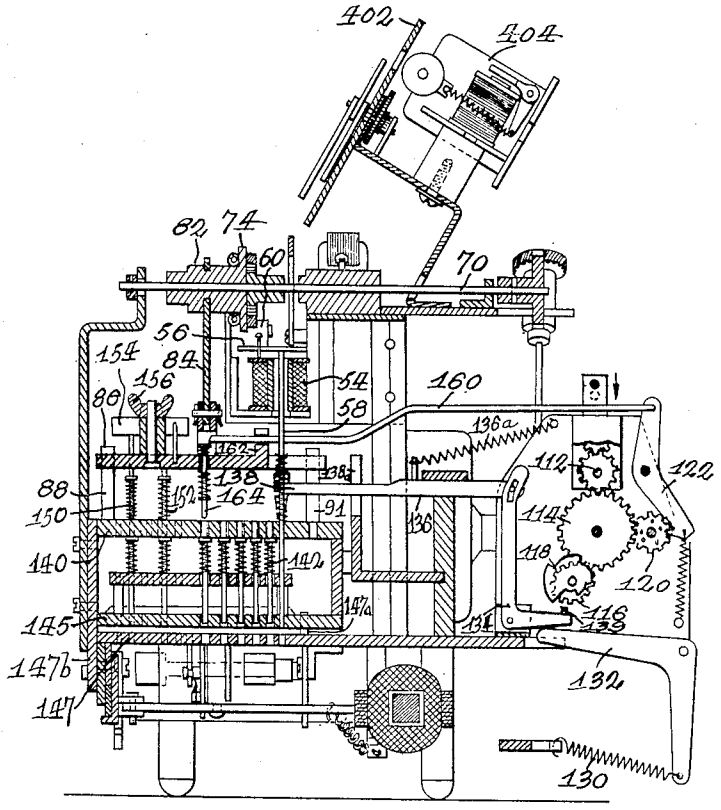


Fig. 11

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 8

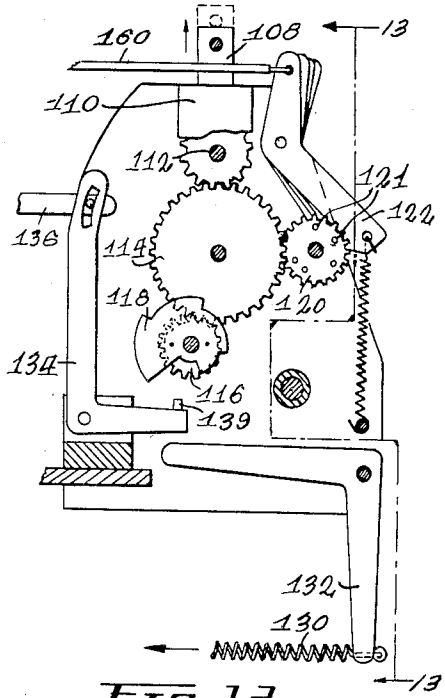


Fig. 12

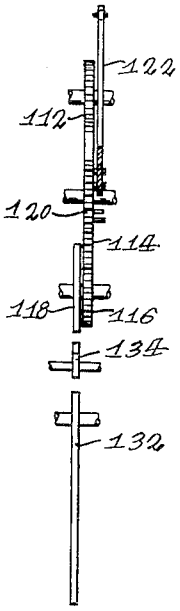


Fig. 13

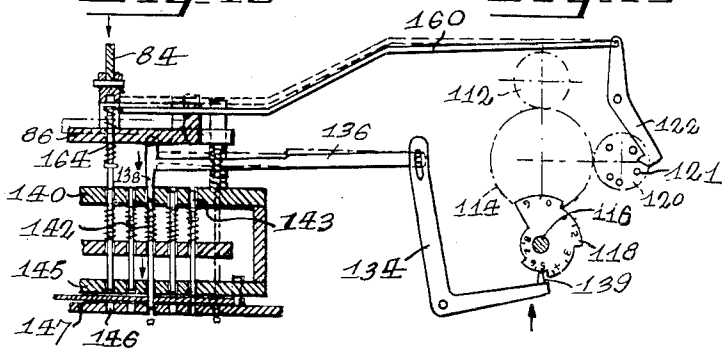


Fig. 14

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TIME RECORDING APPARATUS

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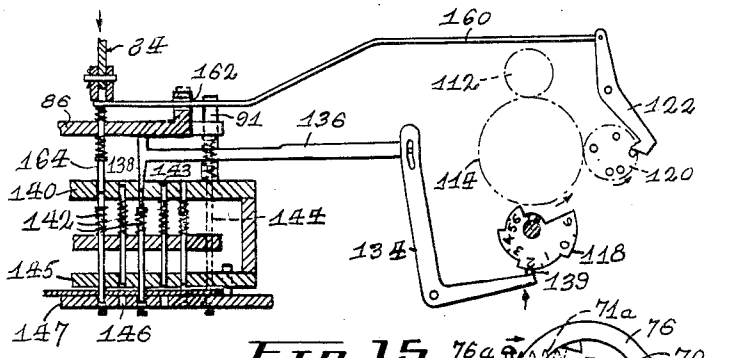


Fig. 15

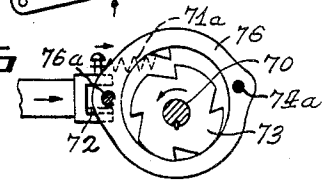


Fig. 17

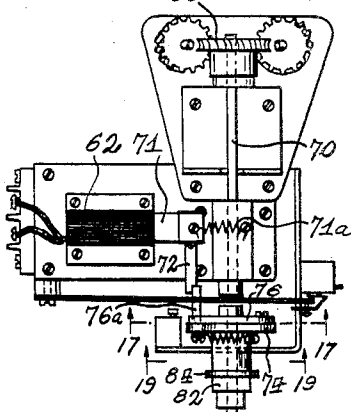


Fig. 16

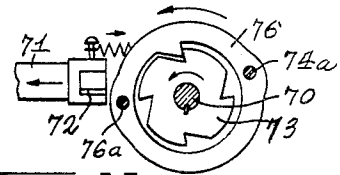


Fig. 18

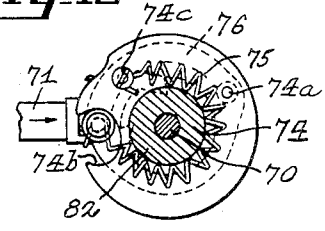


Fig. 19

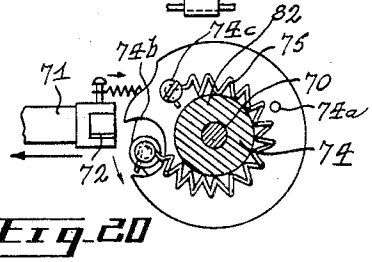


Fig. 20

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 10

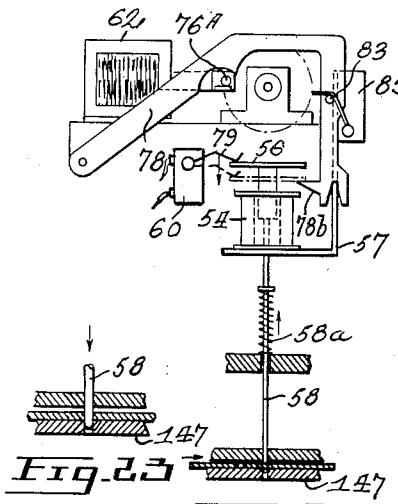


Fig. 23

Fig. 21

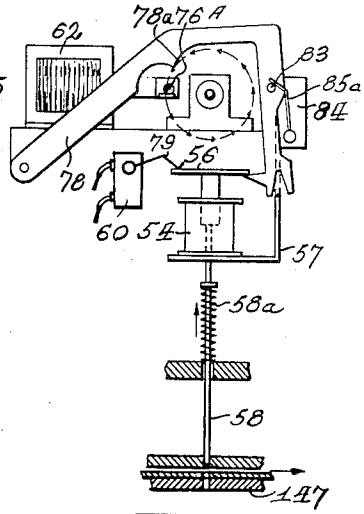


Fig. 22

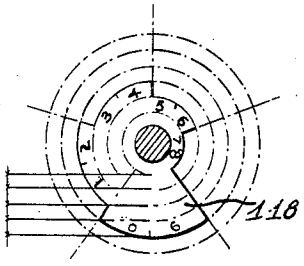


Fig. 24

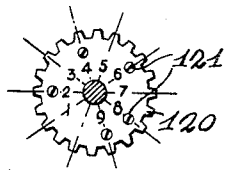


Fig. 25

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 11

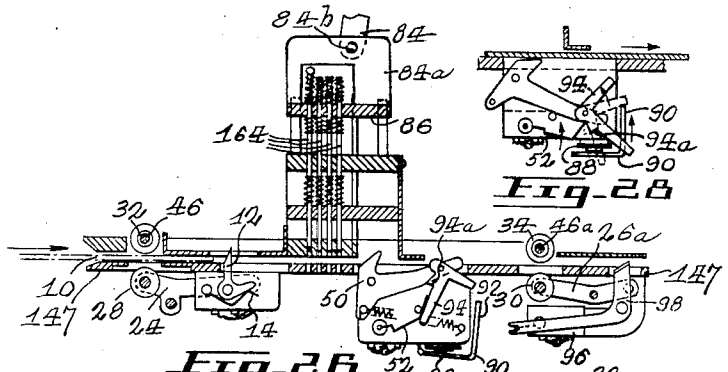


Fig-26

Fig-28

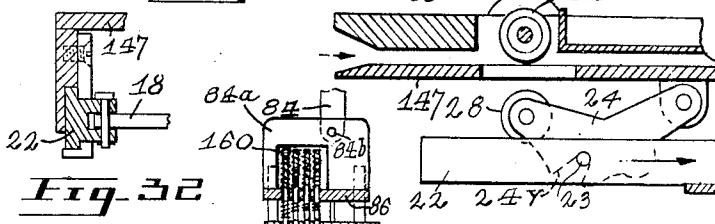


Fig-30

Fig-32

Fig-27

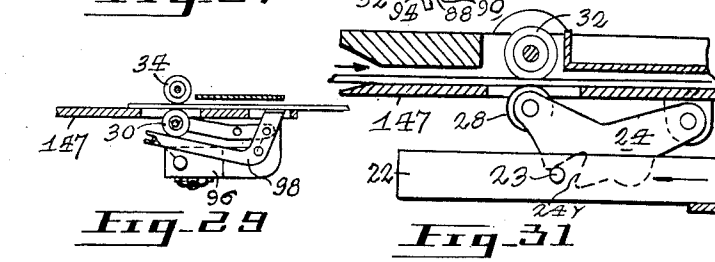


Fig-31

Fig-29

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TIME RECORDING APPARATUS

Filed April 22, 1955 12 Sheets-Sheet 12

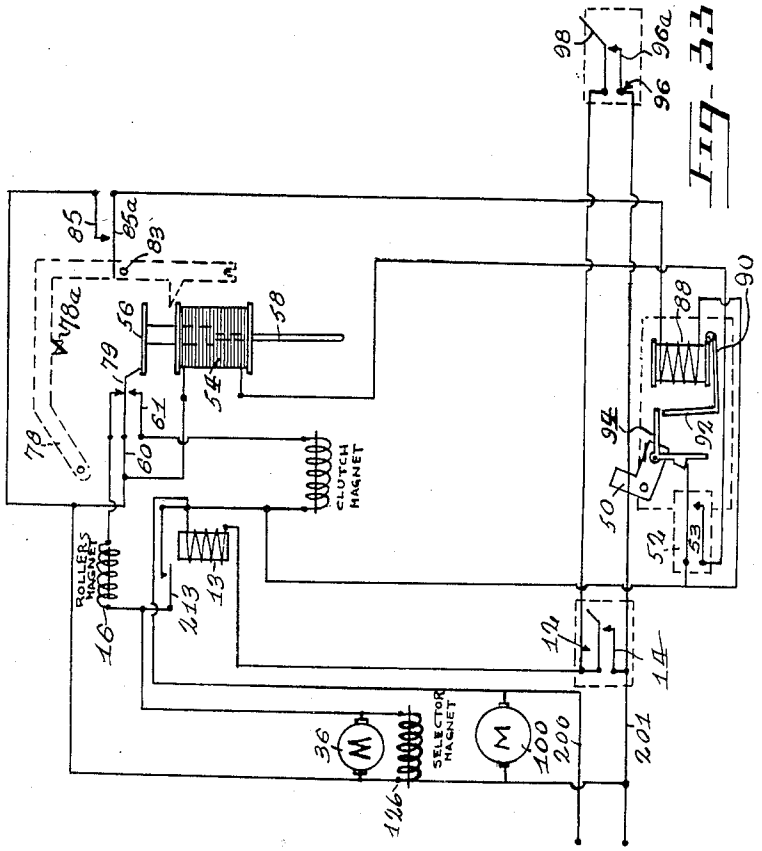


Fig. 11

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United States Patent Office 2,838,361
Patented June 10, 1958

2,838,361

TIME RECORDING APPARATUS

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Application April 22, 1955, Serial No. 503,302

8 Claims. (Cl. 346—83)

This invention relates to a method of recording time in such form that it may be read by a tabulating machine and to apparatus for so automatically recording time.

For many years there has been a demand wherever labour is employed either on a paid for time basis, or for salaried employees, for a time recorder capable of preparing a card which will enable a tabulating machine to automatically extend and compute both time elapsed and money values based on the elapsed time for both job costs and payrolls. Heretofore, it has always been necessary to obtain from the usual time recording apparatus the starting time and the finishing time, compute the elapsed time and then compute the resultant hours and minutes worked on any assignment with respect to an hourly rate to obtain the money value. Thus, for example, one machine provides for punching at the appropriate point a card printed with divisions representing hours and minutes, the result being read by a worker who must subtract the starting time from the finishing time and calculate the wages due for the elapsed time manually or by machine.

It has been proposed to eliminate the manual steps of subtracting the starting time from the finishing time by so punching a card in fractions and multiples of hours that the punched card may be read directly by the tabulating machine; but this proposal suffers from several disadvantages. Firstly, the machine must be set back to zero at the beginning of each day. Secondly, it is accurate only to tenths of hours so that only an approximation is possible in the recording of minutes. In addition it involves a complicated arrangement for selecting the proper punches to be actuated in accordance with the actual time. Finally, it involves a complicated and expensive arrangement of machinery for shifting from the punching of "in" to "out" and on to the next work period and as a result of this complicated arrangement, together with the fact that the machine lacks any means for punching a job code on the card, the machine is suitable only for recording time in and out on one job.

The present invention aims to provide a time evaluating method and an apparatus for carrying out the method whereby certain manual operations are eliminated. The present invention embodies the use of a time recording clock card that is perforated automatically to provide a series of holes which represent the starting and stopping times of any job assignment, in such manner that the card is adapted for subsequent direct use in conjunction with certain British and American types of tabulating machine.

One difficulty encountered in extending time records manually from the printed record of the regular time recorder is the common use of the actual time recorded in hours and fractions thereof, minutes or in decimals, e. g. 8:30–12:45, making an elapsed time of 4 hours and 15 mins., which complicates future calculations since they must be reduced to minutes for the calculation of elapsed time.

Accordingly, the present invention relates to a time

recording method and an apparatus for carrying out this method which includes means for automatically obtaining lapsed time by punching holes in a card designed for this purpose or otherwise marking a card in a manner adapted to be sensed by a particular tabulating machine. In the preferred construction of the apparatus means are provided whereby sets of punches are automatically selected as time progresses so that when the card is inserted the elapsed time is automatically recorded.

In the successful carrying out of the present method, it is essential to have extreme accuracy in locating the consecutive perforations in the card so that they will function accurately in the tabulating machines utilized for further computations stemming from the time recording. In the present apparatus, this is accomplished by the co-action of a card guiding means, and a series of selectively driven rollers which operate in conjunction with an electrical sensory operated card locating device. In general terms it may be stated that the card guiding means supports the card and maintains it in exact alignment during its passage through the punching machine, that the card locating device acts to stop the card at the exact spot which permits the punches to perforate it in the correct location, and that the rollers are adapted to exert no force upon the card at the time of the punching operation. The machine is arranged so that all these operations take place automatically and while the card is out of reach of the employee. The exact manner in which these features act to insure the required extreme accuracy of the card perforating will later be discussed in greater detail.

Apparatus

This invention simplifies the calculation of hours and minutes by a system of one minute periods, these periods starting from zero at any pre-arranged time during a calendar or fiscal year, the machine being adaptable to be re-set to zero daily at the start of the official starting time in the morning; alternatively, the clock can be arranged to run continuously from midnight on December 31 and re-set at the end of the year period. Or, again, it may operate continuously year after year without having to be re-set at all.

Another feature of the invention is to have a uniform time for recording purposes across the country neglecting the different time zones. For example, December 31 would be zero Greenwich time and all time records made on the time card would be based on Greenwich time in any part of the United States or Canada. It is contemplated that adjustable means would be provided to show local time at any zone in addition to the basic Greenwich time. The advantage of using this system is the convenience of reading or interpreting time records from any place in the country, say for example, one that was made simultaneously in New York city and another that was made in Vancouver. The time record would be identical, that is, for any particular time period. While Greenwich time is mentioned, it will be appreciated that any other time base location can be used and one of the two hour hands on the time recording clock adjusted to suit the difference in time according to the locality in which the clock is being used.

Detailed description

Having thus generally described the nature of the invention, particular reference will be made to the accompanying drawings where there is shown by way of illustration a preferred embodiment of a time recording apparatus by means of which the present time evaluating method may be carried out, and in which:

Figure 1 is a front view in perspective elevation of a preferred construction of a lapsed time recorder in accordance with the invention.

Figure 2 is a diagrammatic showing of a sample time card adapted for use in combination with the present apparatus.

Figure 3 is a front view of the apparatus shown in Figure 1 with the cover removed to show the inner construction more clearly.

Figure 4 is a top plan view of the apparatus shown in Figure 3.

Figure 5 is a bottom plan view of the construction shown in Figure 3.

Figure 6 is a side elevation of the construction shown in Figure 3.

Figure 7 is a cross sectional view of the construction shown in Figure 4 along the line 7—7.

Figure 8 is an enlarged detail view of the main actuating cam as it would appear in operative position.

Figure 9 is a sectional view of the portion of the apparatus shown in Figure 8 along the line 9—9 to show the alternative position of the two cam portions and the actuating lever.

Figure 10 is a further detailed view corresponding to Figure 8 with the cam shown in lever operating position, with the main cam portion shown in released position and the floating cam portion still holding the lever.

Figure 11 is a sectional view of Figure 4 along the line 11—11.

Figure 12 is an enlarged detail view of a typical set of punch selecting lever assemblies showing in more detail the relative position of the actuating cams and driving mechanism.

Figure 13 is a side view of the arrangement shown in Figure 12 as it would appear along the line 13—13.

Figure 14 is a diagrammatic view of a typical punch selecting lever and cam arrangement shown with a portion of the punches to illustrate the relative position when the punch selecting cam is in position to select a punch designating a five (5).

Figure 15 is a diagrammatic view corresponding to Figure 14 showing the relative positions of the punch selecting cams and associated levers when the selector cam is in position to actuate the selector levers into position where a first punch indicating a five (5) and a second supplementary punch indicating a unit (1) will be actuated, the desired punch reading being six (6).

Figure 16 is a fragmentary view in plan of the clutch controlling solenoid and clutch arrangement on the punch actuating shaft.

Figure 17 is an enlarged diagrammatic view of the clutch arrangement of the punch actuating shaft showing the inner rotating portion of the clutch in free position.

Figure 18 is a view corresponding to Figure 17 with the solenoid arm shown in activated condition releasing the clutch outer portion pawl for engagement with the rotating inner clutch section.

Figure 19 shows the entire clutch section from the exterior as it would appear in non-operative condition corresponding to Figure 17.

Figure 20 is a further diagrammatic view of the exterior of the clutch arrangement showing it in operating or punch actuating position corresponding to Figure 18.

Figure 21 is an enlarged diagrammatic view to illustrate in more detail the relative position of the sensing pin solenoid and associated switch, these elements being shown in operative position relative to a card section.

Figure 22 is a view corresponding to Figure 21 with the sensing solenoid being shown in released position causing the pin to be raised from contact with the card.

Figure 23 shows on a more enlarged scale the sensing pin as it would appear when passing through the punched hole in a card.

Figure 24 is an enlarged detail view showing a typical punch selecting cam.

Figure 25 shows in enlarged detail a typical pin gear operating from the counting mechanism in conjunction with the punch selecting cam.

Figure 26 is a diagrammatic view of a portion of the apparatus shown in Figure 4 along the line 26—26 to illustrate in more detail the relative position of the control switches contacted by the passage of the card.

Figure 27 is a view corresponding in location to Figure 26 with the card shown in position for contact with the sensing pin operating in conjunction with the punch actuating mechanism.

Figure 28 is an enlarged view of a portion of the construction shown in Figure 27 to illustrate in more detail the motion of the double-acting toggle switch controlling the initial movement of the sensing pin mechanism controlling the movement of the punch actuating mechanism.

Figure 29 is an enlarged detail view of the final switch arrangement over which the card passes as it is discharged from the machine with the switch being shown in active condition.

Figure 30 is an enlarged detail view illustrating the mechanism for raising the card-advancing rollers at the entry portion of the card receiving chute.

Figure 31 is a view corresponding in location to Figure 30 with the card-advancing rollers being shown in upper or card moving position.

Figure 32 is a sectional view of a portion of the construction shown in Figure 4 to illustrate in more detail the mounting of the lever transmitting the motion from the roller raising solenoid to the card-advancing rollers.

Figure 33 is a circuit diagram of the apparatus shown diametrically with the main elements positioned in the same relative spacing as in the actual construction.

In accordance with the present invention, a set of tabulating cards adapted for use in combination with the apparatus of the invention are pre-punched with all the classified information, such as employee's number, his occupation, his rate and the shift number and any other fixed classification that is related to either payroll or job assignments. These cards form the basis of a set of master cards.

From the master cards duplicate cards are automatically made for either daily or weekly records and in addition to the classified information that is pre-punched on the tabulating card, a locating hole is punched in the top margin of the card that will correspond to the ruling on the card where the first registration will be made. By way of an example, a typical card is shown in Figure 2.

The sample card shown in Figure 2 is ruled off to provide a plurality of spaced apart columns giving starting and stopping times whereby the employee's time record can be indicated by punched out openings as shown.

It should be explained that the punching apparatus is provided with sets of five punches each adapted to punch at one of five locations or stations in a vertical column of the card, which locations or stations may be considered as representing the five odd numbers 1, 3, 5, 7, 9. When it is desired to punch an even number, a second punch in the column is operated to indicate one unit (1) to be added to the punched odd number. For this purpose, the nine (9) punch is chosen, so that if nine is punched as well as another odd number, such as three (3), the result is four (4), but if the nine alone is punched, the result is nine (9). If no location in a vertical column is punched, zero is indicated. For further details, reference should be made to the description below headed "Punch selecting cams."

Accordingly, in the sample card shown the starting time shown is 1457 minutes as calculated from zero. The first time out or off (third column) is shown as being 1517 minutes or 60 minutes later than the starting time. The third punching record shows the total 1557 minutes or 40 minutes later than the first off. The difference between the various columns will be, of course, the time elapsed or taken for a particular job or operation by an employee. The lower row of columns and punched records show the job number given to the operation re-

corded above which are also recorded by preset supplementary punches when the time elapsed is recorded. The job numbers shown, following the same system, is as follows:

The first job number corresponding to the starting time is 37, while the second, job number corresponding to the first "off" time is 57. As will be appreciated the "Off" punching in this case gives the starting time of the job 57 while the finishing time of the job is shown by the second "Off" punching which also gives the job number 32 of the next job and so on.

The first row of holes indicated at A are those which serve to locate the card accurately within the apparatus the first hole B being prepunched for this purpose and the holes C and D and E being punched in correct spaced apart sequence by the apparatus. The location of the first hole B is of a prime importance since it serves to initially register the card in punching position relative to the pre-printed columns ruled on the card.

As will be appreciated, the card shown is illustrative only as a sample and other cards having varying column rulings and uses can be utilized in accordance with the present invention.

In order that the operation and construction of the time recording apparatus in accordance with the invention be more clearly understood it will now be described with reference to the accompanying drawings.

With particular reference to Figure 1 of the drawings, the preferred construction shown has an overall housing **400** which is provided with a clock dial **402** showing the actual time. Within the clock dial **402** a numerical indicator **404** is provided showing the time that would be elapsed in minutes from a zero datum. The arrangement and construction of these elements will be described in more detail later.

Operation upon card insertion

The housing (Figure 1) is provided with a time card receiving slot **10** having an attached entry tray **11** and with a card exit slot and attached discharge tray **13** leading into and out of the housing respectively. The employee takes the prepared card, for example that shown in Figure 2, places it on the card entry tray **11** and inserts its end within the card receiving slot **10**.

With reference to Figure 11, the base plate **147** with the side member **147***a* together with the lower punch holding plate **145** and the side plate **147***b* define a space of definite fixed dimension which is seen in the end cross sectional elevation of Figure 11. The base plate **147** extends the full length of the machine as seen in Figure 26. The card entry tray **11** and the card receiving slot **10** (Figure 1) are so placed that entry of the card within the card receiving slot **10** places the card on top of the base plate **147** and between the side member **147***a* and the side plate **147***b* (Figure 11) which also extend the full length of the machine. The distance between the side member **147***a* and the side plate **147***b* is exactly fixed so that the card will just pass between them with no possibility of lateral play. Thus the card is provided with fixed longitudinal alignment during its entire passage through the machine on base plate **147**. This is essential to insure the accuracy of punching location required for subsequent use of the card in a tabulating machine. The co-operation of the base plate **147** with the side member **147***a* and the side plate **147***b* constitutes the card guiding means referred to above.

The rollers which drive the card through the machine will presently be described. It should be noted that the card receiving slot **10** in the housing **400** (Figure 1) is so placed that the card is beyond the reach (and hence the control) of the operator of the card i. e. the employee, by the time the first sets of rollers have driven the card forward to the position where it is punched. The card is drawn into the machine by the rollers rather than being forced in by the employee. This prevents distortion of the card. It is necessary that the card be not distorted as this would result in an improper registration during the punching operation. Since the card is entirely within the housing during the punching operation, the employee is prevented from disturbing the card during punching which would result in an improper registration.

Thus the machine possesses the distinct advantage of providing means (to be described) whereby the card, once it is inserted within the card receiving slot, is automatically advanced, stopped in proper position for punching, punched, and ejected.

Card advancing mechanism

Entry of the card within the card receiver **10** brings the leading edge of the card into engagement with a lever **12** (Figures 26 and 27) positioned in the path of the card, and pivoting of the lever by the card operates a micro switch **14**. The micro switch **14** is connected to and controls a relay coil **13** (Figure 33) connected to a solenoid **16** mounted on the under part of the apparatus—see the bottom plan view in Figure 5. The plunger of the solenoid **16** is pivotally connected to a lever **18** which is mounted to pivot about axis **20**. The other end of the lever **18** is pivotally connected to a bar **22** mounted for sliding movement along the edge of the frame of the apparatus. The movement of the bar **22** in turn acts on two pairs of roller-operating yokes **24—24***a*, **26—26***a* to raise or lower spaced apart pairs of card-engaging rollers **28**, and **30** towards or away from corresponding pairs of fixed rollers **32**, **34** mounted above the card guiding means. Referring to Figures 26 and 27 the rear yoke of each pair is seen, yoke **24***a* being to the left and yoke **26***a* to the right. Referring to Figures 30 and 31, the front yokes **24** are seen. Rollers **28** and **30** are mounted on shafts **28***a* and **30***a* journalled in yokes **24—24***a* and **26—26***a* respectively.

In the construction illustrated, the yokes **24—24***a*, **26—26***a* are disposed in spaced apart pairs adjacent the ends of the apparatus with a transverse shaft **24***x*, **26***x* extending between each pair so that movement of the front yoke **24** or **26** adjacent the sliding bar **22** is transmitted to the other yoke of the pair (**24***a* or **26***a*) between which the rollers are mounted. The front yoke of each pair has one end pivotally connected to the frame of the apparatus and each is provided with a cam slot **24***y*—**26***y* into which fits a pin **23** (Figure 30) one of which is disposed adjacent each end of the bar **22**.

Roller driving mechanism

Simultaneously with the closing of the micro-switch **14** and also through the relay coil **13**, a further circuit is completed to the electric motor **36**. A worm **38** (Figure 7) is secured to the shaft of the motor **36** and is in meshed engagement with a worm wheel **40** mounted on a shaft **42** extending obliquely upwards from the base plate of the apparatus. Also attached to the shaft **42** is a bevel gear **43** which is in meshed engagement with a bevel gear **44** mounted on the end of the shaft **46** supporting the rollers **32**. A corresponuding drive is applied to the rollers **34** through a shaft **67** and bevel gears **43***a*, **44***a*. The gear **44***a* is connected to the shaft **46***a* of the rollers **34**. The drive is transmitted from the shaft **42** to the shaft **67** by a spiral gear **64** which is in meshed engagement with a large spiral gear **68**. A further spiral **66** is mounted on the end of the shaft **67** and is in meshed engagement with the gear **68**.

Card sensing mechanism

When the pairs of card-engaging rollers **28** and **30** are raised and the pairs of rollers **32** and **34** are rotated by actuation of the switch **14**, the card is engaged by the pairs of rollers **28** and **32** and moved forward within the card guiding means described above to a point where

it contacts and depresses a toggle lever 50 pivotally mounted in the path of the advancing card, as shown best in Figures 26, 27. The depression of the lever 50 acts to close the micro-switch 52 positioned beneath the lever so as to complete an electrical circuit to a solenoid 54 mounted on an upper portion of the apparatus, see Figure 11.

An armature 56 is mounted above the solenoid 54 and a card sensing rod 58 is connected to the armature 56. When the coil 54 is energized, the armature 56 is attracted depressing the sensing rod 58 into engagement with the margin of the card. The length of the rod 58 is such that the armature 56 is prevented from operating the full stroke so that a resilient magnetic tension is maintained. As the rollers 32, 34, continue to drive the card forward the end of the sensing rod 58 locates the first of the row of holes A shown in the card sample of Figure 2. The magnetic tension applied to the rod 58 causes it to fall into the hole in the card as shown on Figure 23 allowing the armature 56 to complete the full stroke. As it does so it releases the arm 79 of the switch 60 (Figures 21, 22, 33), thereby opening the circuit to the solenoid (Figure 5) releasing its armature plunger so that the lever 18, under the influence of a coil spring 19 moves the bar 22 in the opposite direction thereby dropping the pairs of card-engaging rollers 28 and 30 to normal position so that the pairs of rollers 28 and 32 no longer act to advance the card now held against forward movement by the rod 58. The dropping of the card-engaging rollers follows instantaneously the locating of the hole by the sensing rod 58.

It has been stated that the sensing rod is maintained in a state of resilient magnetic tension during the time it is locating the first of the row of holes A shown in Figure 2. The sensing rod may be said to be resiliently biased electrically. It is in fact an electrically operated card sensing rod mounted above the path of travel of the card and adapted for resiliently biased movement toward and away from the card. The electrical biasing gives the rod its sensitive feeling action which is essential for its card sensing operation. This type of biasing is superior to ordinary spring biasing which would tend to cause the rod to deform the circumference of the hole located by the rod. Such a deformity would result in an inaccurate registration during the punching operation. The sensing rod is actually spring biased in the direction away from the card, as will be described later. This spring bias is purely for the purpose of holding the rod up against the force of gravity when the solenoid 54 is not energized. It is the electro-magnetic biasing just described which gives the rod its superior card sensing properties. Deformity of the locating hole is further prevented by the fact that the sensing rod moves in a plane substantially perpendicular to the plane of the card and by the tapered end of the rod as shown in Figures 22 and 23. The tapered end also ensures proper centering of the rod in the hole and hence proper positioning of the card for punching.

The instantaneous disengaging of the driving rollers upon completion of the sensing operation acts to prevent deformity of the locating hole which might otherwise occur if the card were urged forward against the stopping action of the sensing rod.

The micro-switch 60 is a double pole switch and when operated it simultaneously opens the circuit for the solenoid 16 and also closes a circuit to a clutch solenoid 62 (Figures 16, 21 and 22).

The clutch mechanism

During this period when the solenoid 16 is in a non-operating position the motor 36 (Figures 3 and 4) is still running and driving the shaft 42. The shaft 42, as previously explained drives the spiral gear 64 and through the gear 64 the intermediate gear 68 (Figure 7). The gear 68 is mounted on a shaft 70 which is supported for rotation between bearings mounted on the upper portion of the frame. It should be noted that the motor 36 continues to drive the shaft 70 during the entire time that a card is passing through the machine. With particular reference to Figures 16 through 20, a clutch mechanism, now to be described, is driven by the shaft 70. A ratchet 73 is secured to the shaft 70 so that it too rotates continuously while the motor 36 is in operation. The ratchet 73 is surrounded by an annular retaining pawl 76 which is pivotally mounted at 74*a* on a further clutch section 74. The clutch section 74 is integral with a bearing portion 82 mounted on the shaft 70 in such manner as to be normally stationary as the shaft 70 rotates. The clutch section 74 is formed with a notch 74*b* through which extends one end of a pin 76*a* of the pawl 76. The amount of pivotal movement of the pawl 76 (about the point 74*a*) is thus limited by the contact made between the above-mentioned end of the pin 76*a* and the sides of the notch 74*b*. To this same end of pin 76*a* is attached a coil spring 75 which extends around the bearing 82 and is fastened at 74*c*. Thus the pawl 76 is constantly urged to pivot downwardly about the point 74*a*.

The other end of pin 76*a*, however, extends to the other side of pawl 76 and is normally retained and prevented from moving downward by the arm 72 forming a lateral extension of the solenoid plunger 71 of the clutch solenoid 62. When the pin 76*a* and the pawl 76 are held in this position (Figures 17 and 19), the pawl cannot engage the ratchet 73. When the pawl 76 does pivot downwardly (Figures 18 and 20) it does engage ratchet 73 and is then rotated and causes the clutch section 74 to rotate by virtue of its attachment at 74*a* and the contact of pin 76*a* with the lower side of notch 74*b*.

When the circuit to the clutch solenoid 62 is closed by the micro-switch 60 (as described above), the solenoid plunger 71 and arm 72 are withdrawn thereby releasing pin 76*a*. Pawl 76 then pivots downwardly under the influence of coil spring 75 as already described, engages the rotating ratchet 73, and the clutch section 74 (as well as the pawl 76) make one complete revolution.

During the first half of the revolution the clutch operates the punch mechanism in the manner to be described. During the second half of the revolution the clutch performs various functions to be described, one of which is to break the circuit to the clutch solenoid 62, thus allowing the plunger 71 and arm 72 to be restored by the spring 71*a* to their original (and normal) position. Thus when the pin 76*a* has revolved to its former position it is engaged by arm 72 and held against further movement. The clutch section 74 continues its rotation until the parts are in the relative positions illustrated in Figure 19. At this point the pawl 76 is raised out of contact with ratchet 73 and the movement of pawl 76 and clutch section 74 is confined to one complete revolution.

Punch operating mechanism

With particular reference to Figures 11 and 16, a pressure arm 84 is eccentrically mounted on the bearing 82 in such manner that during the first half revolution of the clutch section 74 the pressure arm 84 descends and depresses a press plate 86 which is mounted for resiliently biased sliding movement between pairs of vertical supporting standards 89 and 91. The depression of the press plate 86 acts on the punches adapted to perforate the card as will be described in more detail later. During the second half revolution, of course, the pressure arm 84 and the press plate 86 ascend to their original position.

Second half of clutch revolution

As is shown in Figures 17 through 22, as the clutch section 74 together with the pawl 76 rotates, the end of pin 76*a* which normally engages arm 72 engages a pivotally mounted lever arm 78 at a point indicated at 78*a* (Figure 22). This contact raises the lever arm 78 so as

to bring a pin 83 into contact with an arm 85*a* of a "kick off" switch 85. The switch 85 controls a circuit to a solenoid coil 88 disposed beneath the toggle arm 50 (see Figure 27). An armature 90 mounted over the coil 88 is attracted by energization of the coil 88 raising a projecting portion 92 into contact with the upper arm of a double-armed pivotally mounted latch 94 associated with the toggle arm 50 so as to kick off the latch 94 and release the operating arm of switch 52 from the shoulder 94*a* thereby de-energizing the coil 54 (Figures 21 and 22). The de-energization of the solenoid 54 releases the armature 56 so that it may be moved upwardly to lift the sensing rod 58 clear of the card. Sensing rod 58 is biased upwardly by spring 58*a* and is positively mechanically raised by an extension 78*b* of the lever arm 78 which is adapted to engage the armature 56 as shown in Figure 22. The mechanical raising is necessary to overcome any residual magnetism in the coil of the solenoid 54. The spring 58*a* then holds the sensing rod 58 up against the force of gravity. As the armature is so raised to its top position, the double pole switch 60 is reversed by arm 79.

An extension 57 mounted beneath the solenoid coil 54 prevents the lever arm 78 from dropping too far below the armature 56. The raising of sensing rod 58 clear of the card leaves the latter free for further advancement.

Since the punching operation has now been completed, by the depression of the press plate 86, and the card is now free for further travel the above-mentioned reversal of the switch 60 closes the circuit to the solenoid 16 thereby acting to again raise the pairs of card-engaging rollers 28 and 30 into card-engaging position. The reversal of double pole switch 60 simultaneously breaks the circuit to the clutch solenoid 62 which arrests the movement of the clutch are previously described.

Card advance (second stage)

As the card is advanced by the pairs of rollers 28 and 32 it is now fed forward to a point where it is engaged by the second pairs of rollers 30 and 34 before leaving the pairs of rollers 28 and 32. Under the drive of the pairs of rollers 30 and 34 it is then driven out of the card receiving slot. The leading edge of the card after passing between the pairs of rollers 30 and 34 comes into contact with and depresses a pivotally mounted switch lever 98 which is mounted adjacent to and controls a micro-switch 96. With reference to Figure 33, the switch 96 is wired in parallel with the starting switch 14 operated by the entry of the card and is arranged so that it makes contact before the switch 14 breaks. As the card continues to advance the lever 98 is released actuating the switch 96 opening the main control circuit, thereby restoring all circuits to normal. Since either the switch 14 or 96 was maintained until the card was ejected the motor 36 remains in operation throughout.

Time recording and punch selection

The main controlling element of the present apparatus is comprised of a synchronous motor 100 (Figure 7) which operates as a timing device and has a driving shaft 101 which makes one revolution per minute. A cam 102 (Figure 7), is mounted on the shaft 101, and is in contact with the end of a lever 104 pivotally mounted as indicated at 106, so that on each revolution of the cam 102 the lever 104 raises a push pull rod 108 of a conventional counting unit 110 (see Figures 7 and 12). The lever 104 is spring biased by a coil spring 105 keeping it in contact with the cam 102.

To prevent a shock to cam 102 and shaft 101 through contact of the end of the lever 104 with the cam 102, the cam includes a pivotally mounted supplementary cam portion 103 (Figures 8 to 10) which lags slightly behind the main cam surface to prolong the contact between cam 102 and lever 104 preventing a quick slip-off as would occur with the cam surface 102.

The counting unit 110 (Figure 12) is of conventional construction and a further gear 112 is connected to each digit wheel. In the construction illustrated the counter 110 utilizes four (4) digits so that there are four gears 112 disposed in side by side relationship.

For the purpose of clarity, however, Figures 12 through 15 show one unit only, it being understood that the other units are identical.

With particular reference to Figures 12 and 13, each gear 112 is in meshed engagement with an intermediate gear 114. Each intermediate gear 114 in turn is in meshed engagement with a gear wheel 116. Mounted on a common shaft with each gear 116 is a cam 118, and the four cams control the selection of the punches actuated by depression of the press plate 86.

Punch selecting cams

Each cam 118, one of which is shown in detail in Figure 24, is for use in conjunction with a card as shown and described with respect to the sample shown in Figure 2 and controls the selection of the particular punch of the row of punches with which it is associated.

It should be explained that when the switch 14 is closed by the insertion of a card it also closes a circuit controlling a solenoid 126 positioned beneath the apparatus, see Figure 5. When the solenoid 126 is operated a pivotally mounted lever arm 128 is pivoted by the plunger of the solenoid so as to apply tension to spaced apart coil spring 130. Each of the coil springs 130 is connected to one of the pivotally mounted levers 132 disposed beneath the cams 118 in the punch selecting arrangement, see Figures 12 through 15. The thus tensioned levers 132 move into contact with the lever arms 134 which are pivotally mounted in alignment with the cams 118. A punch selecting arm 136 is pivotally connected at one end to each of said lever arms 134 with the other end 138 being shaped for engagement in any seletced one of the punch guiding openings 143 of the upper punch holding plate 140, in the particular row of such punch openings associated with that particular arm 134 and end 138. The punch selecting arms 136 are guided and maintained in accurate alignment during their forward and backward movement by the slotted gate 138*a* (Figure 11). The gate is formed with four slots, one slot to accommodate each arm 136. Arms 134 and 136 are biased by springs 136*a* so that the ends 138 are normally retracted as shown in Figure 11 and the pins 139 are held out of engagement with any of the surfaces of cams 118.

The punches 142 are resiliently supported between the upper and lower punch holding plates 140 and 145 in alignment with corresponding die openings 146 provided in a base plate 147 so that their upper ends normally extend within the openings 143.

The distance the punch selecting arms 136 will travel, and the position of the openings 143 selected will depend on the relative position of the respective cams 118 contacted by pins 139 provided on the arms 134.

Each cam 118 has five cam surfaces (Figure 24) which determine the position of its punch selecting arm 136 (Figure 14). The highest cam surface provides for the digits nine (9) and zero (0), and when in contact with the pin 139 of its cooperating arm 134 holds the punch selecting arm 136 in the retracted position to which it is biased by spring 136*a* between the guide plate 162 and the supporting standard 91 (see Figure 11). In this position the end 138 of the punch selecting arm 136 is out of alignment with any of the punches 142 and will be untouched by the descent of the press plate 86 whose central portion is cut away at this position. Thus the highest surface of a cam 118 permits no operation of the punches 142 associated with that cam. The other four cam surfaces control the selection of punches 142 as already described.

In meshed engagement with and also driven by each

gear **114** is a further selection gear **120** (Figures 12 and 25) each of which is adapted to act on a lever **122** by the contact of spaced apart pins **121** extending from the surface of the gear. In the construction shown in detail in Figure 25 there are five (5) such pins located on the gear **120** so that they will engage the lever arm **122** (see Figure 14) when the cam **118** is in the position corresponding to 2, 4, 6, 8, and 9. There are no pins for zero, 1, 3, 5 or 7. When an of these pins is engaged with its cooperating lever arm **122**, the latter pivots and advances a rod **160** which is supported in a guide plate **162** fastened rigidly to the press plate **86** (see Figures 14, 15). When a cam **118** is in the postion of an odd number except 9 the pins in the gear **120** will not be in a position to contact the lever arm **122** (Figure 14) and therefore the rod **160** will not be advanced to cause the punch **164** to operate.

When advanced by the contact of any of the pins **121** of the gear **120** the end of a rod **160** causes a punch **164** to be depressed when the press plate **86** descends. With reference to Figures 26 and 27, the end of the pressure arm **84** is pivotally connected at **84***b* to a U-shaped foot **84***a* which is secured to press plate **86**. The upper ends of punches **164** extend into the recess within the U-shaped foot **84***a* (Figure 26), with sufficient clearance so that when pressure arm **84**, foot **84***a*, and press plate **86** descend, none of punches **164** is depressed. When retracted, the ends of the rods **160** lie within the recess in foot **84***a* but are not extended far enough to assume a position over the punches **164**. If, however, any of the rods **160** is advanced as described above, its end assumes a position over the top of its corresponding punch **164**. When foot **84***a* descends and depresses press plate **86**, the downward movement of the press plate is imparted to all the rods **160** but only those whose ends have been advanced over their corresponding punch **164** will cause that punch to be depressed. Figure 27 shows one of the punches **164** depressed in this manner.

Although not shown in Figures 26 or 27, it is desirable to have the side of the recess in foot **84***a* adjacent to guide plate **162** in the form of four vertical slots each placed in alignment with one of the punches **164** and the corresponding rod **160**, the height of each slot being such that all of rods **160** are depressed each time the foot **84***a* and plate **86** are depressed. Each slot should preferably be of just sufficient width to accommodate its corresponding rod, thus ensuring the proper alignment of each rod with respect to its corresponding punch.

Any of the punches **164** is adapted to punch a nine (9) and when depressed will perforate the card. This action takes place simultaneously with the depression of punches **142**.

The selection of punches **142** through the cams **118** takes place only when actuation of solenoid **126** places tension on springs **130**, whereas selection of punches **164** takes place continuously. When solenoid **126** is not actuated, springs **136***a* hold pins **139** out of engagement with cams **118**, and hold ends **138** in the position shown in Figure 11.

The selection of odd and even numbers will now be described with reference to Figures 14 and 15. Referring to Figure 14, the arm **134** has been pivoted by the arm **132** so that the pin **139** is in contact with the cam **118**. The cam **118**, as rotated by the time recording mechanism, is in position corresponding to an odd number, in this case a five (5). Accordingly, the punch selecting arm **136** through the movement of the lever **134** has proceeded to a point where the end **138** is in alignment with the punch opening **143** corresponding to a number five (5) punch. Since the cam **118** is in position for an odd number (5) the pins of the gear **120** are not in position to contact the lever **122** and therefore the rod **160** is not advanced. Upon depression of the press plate **86**, the (5) punch only will be actuated since the rod **160** is clear of the nine (9) punch **164**.

In the illustration of Figure 15, the cam **118** is in a position indicating an even number, in this case a (6) so that while the punch selecting arm **136** is extended to the same position as shown in Figure 14, the gear **120** has moved to a position where a pin has engaged the lever **122** so that the rod **160** is in position to cause the punching of a nine (9). Therefore, in the card, with reference to Figure 2, a (5) is punched and also a (9) is punched. In this case, as previously explained, the 9 serves as a unit (1) so that 5 and 1 are punched giving the correct reading of (6).

It will be evident from the foregoing that when any of the cams **118** is in the position of zero (0) no punch will be activated, and the particular column (Figure 2) in question will record a zero (0) by virtue of its not being punched.

Supplementary punching arrangement

In order to ensure the proper alignment and proper spacing between each punching of the card it is necessary, as previously explained, to punch an additional hole along the margin of the card in advance of the prepunched master hole for consecutive registrations. This is accomplished by a separate punch **144** mounted between the upper and lower punch holding plates **140**, **145** with the upper end protruding in a position for contact with the press plate **86** (see Figure 15). This hole punched in the margin of the card by punch **144** will be the hole sensed by the sensing rod **58** upon the next subsequent insertion of the card into the machine.

The distance between the centre of the hole in the base plate **147** into which the sensing rod **58** passes upon locating and passing through a locating hole in the card and the centre of the hole in the base plate **147** into which punch **144** passes upon punching a subsequent locating hole is therefore a critical distance. There must also be a close tolerance between the sensing rod and its base plate hole and the punch **144** and its base plate hole to prevent any movement of either the rod or the punch which would cause a variation in the critical distance between the holes. Only by accurately maintaining this distance can the accurate registration of subsequent punchings be maintained. Any error in this respect would tend to accumulate as the punching operations were repeated, and would render the card inoperable in the tabulating machine.

Any locating perforation must of course be prepunched in line with the sensing rod intended to sense it on the next insertion of the card into the machine. However, the invention contemplates more than one row of co-operating sensing rods and punches **144**, and the selective actuation of the sensing rod or the punch **144** of any row as required.

For the purpose of punching job numbers, as is shown in the sample card of Figure 2, removable punches **150**, **152** (Figures 6 and 11) are placed in the desired sequence between the press plate **86** and the top punch holding plate **140**. The upper ends of the punches **150**, **152** extend above the press plate **86** where they are retained by a plate **154** held in position relative to the press plate **86** by a thumb screw **156** (Figure 6). By loosening the thumb screw **156** the plate **154** can be revolved and the punches **150**, **152** placed in any desired location (see Figure 5) to locate a particular job or situation. It is also contemplated that the selection of these job indicating punches could be effected automatically for example by suitable push button or telephone type dial control in combination with punch selecting elements similar to that described in the present apparatus.

General arrangement

The clock showing behind the clock dial **402** (Figures 1 and 6) is of the conventional synchronous type which is connected to the main timing motor **100**. The recorder **404** shows the recorded digits of the digit wheels of the

counting unit 110 which is connected thereto by suitable gearing and a flexible shaft 405 (see Figure 6) so that the reading in the recorder 404 will be in direct relation to the position of the cams 118. Alternatively, the recorder can be arranged as an electrical counter associated with the impulse lever arm 104 (see Figure 7).

Electrical circuit

In order that the overall electrical circuit by means of which the various elements are controlled may be more clearly understood, particular reference will be made to the diagrammatic illustration in Figure 33 of the drawings.

A line 200 and a line 201 lead from a suitable power source. The line 201 leads to the initial micro switch 14, under the control of the lever 12 in the path of the inserted card, so that closing of the switch 14 makes contact with the relay coil 13. The circuit is then completed back to the line 200. The actuation of the relay coil 13 closes the contacts 213 and completes a circuit, via line 201 to the driving motor 36, and from the contact 213 to line 200. The relay contact 213 also completes a circuit to the punch selector solenoid 126, via line 201 to contact 213, to line 200.

Further, closing of the contact 213 also closes a circuit operating the roller raising solenoid 16, via line 201 to the switch 60 controlled by the contact spring 79, through the switch 60, through the coil of the solenoid 16, and from the solenoid 16 through the relay contact 213 to line 200.

As the driving motor 36 is now actuated and through the card advancing rollers the card is now being driven forward so as to contact the lever arm 50 closing the trigger switch 52 so as to complete the circuit to the sensing solenoid 54, via line 201 to the coil of the solenoid 54, and from the coil 54 to the switch contacts 53. As previously described, partial actuation of the solenoid 54 causes the sensing rod 58 to descend and apply light pressure to the margin of the card. As the card is driven forward the sensing rod 58 will come into alignment with, and pass through the first perforation in line along the margin of the card. When this occurs, the sensing rod descends to its full extent through the action of the solenoid 54 so as to release the spring 79 breaking the contact of the switch 60 releasing the circuit controlling the roller solenoid 16. The rollers are thus released preventing further movement of the card. Upon full travel of the rod 58 and the associated armature 56 through the solenoid 54, the spring 79 is caused through the lower contact 61 of the switch 60 to close the circuit to the clutch solenoid 62, via the line 201 through the contact 61 of the switch 60, through the coil of the solenoid 62, to line 200.

As previously described, upon operation of the clutch solenoid 62, the clutch makes one complete revolution depressing the punch pressure plate for ½ of the revolution due to the eccentric mounting of the pressure arm 34. During the last ½ of the clutch revolution the pin 75*a* of the clutch engages the lever arm 78 at the point 78*a* bringing the pin 83 into contact with the contact 85*a* of the "kick off" switch 85 closing the contact momentarily. This causes the "kick off" solenoid coil 88 to operate bringing the armature projection 92 into contact with the latch 94 releasing the switch contact 53 thereby deactivating the sensing solenoid 54. As previously described, the armature 56 of the sensing solenoid 54 is at this moment mechanically raised by the lever arm 78 to its former position which reverses the switch 60, breaking the circuit to the clutch solenoid 62 and again closing the circuit to the roller solenoid 16, via line 201 through the arm 79 of the switch 60, through the coil of the solenoid 16, through the relay contact 213 and back to line 200.

When the rollers, under the influence of the solenoid 16, again urge the card forward, the leading edge of the card contacts the lever 98 controlling the switch 96 closing the contact 96*a*. Since the switch 96 is wired in parallel with the switch 14 and as it is closed before the switch 14 opens, the circuit to the motor 36 is maintained until the card is ejected by the rollers and releases the switch lever 98. Once the switch 96 is released the circuit to the relay coil 13 is opened thereby restoring all circuits to normal.

What we claim as our invention is:

1. In an electrically operated card punching time recorder of the card actuated type having means for progressively selecting a series of time indicating punches in time related sequence and means to actuate said punches including a control relay and a circuit connecting said relay to a driving motor; a card advancing means comprising in combination, a card receiver having an entry end and a discharge end, a control switch having a lever arm disposed in the path of a card passing into the entry end of said card receiver, a relay coil connected to said switch and controlling a first solenoid disposed beneath said card receiver, spaced apart opposed pairs of fixed and movable card engaging rollers mounted above and below said card receiver respectively, linkage means between said first solenoid and said movable card engaging rollers adapted to move said rollers towards and away from said fixed rollers, roller driving means connected to said fixed rollers, a driving motor connected to said roller driving means and to said relay coil, whereby entry of a card into said card receiver is adapted through said switch to actuate said driving motor and first solenoid to move said card towards said discharge end.

2. In an electrically operated card punching time recorder as claimed in claim 1, a perforated card locating mechanism comprising, a lever disposed in the path of said card passing along said receiver, a control switch connected to said lever and a second solenoid disposed above said card receiver, an armature connected to said second solenoid, a resiliently biased card sensing rod connected to said armature, a switch including a switch arm in the path of said armature and being connected to said second solenoid, whereby actuation of said lever by movement of said card causes said sensing rod to move into contact with said card and on said sensing rod passing through said card perforation said armature contacts said switch arm to operate said first solenoid moving said movable rollers away from said card.

3. An electrically operated card punching time recorder as claimed in claim 2 wherein said punch actuating means includes a rotary clutch driven by said driving motor, a lever arm disposed adjacent to and contacted by said rotary clutch, a switch disposed in the path of said lever arm and connected to a third solenoid, an armature having a projecting arm pivotally mounted on said third solenoid, a double armed latch connected to the lever mounted in the path of said armature arm whereby closing of the switch deactivates the second solenoid releasing the sensing rod and allowing the armature to be raised into contact with the said switch arm to operate the first solenoid raising the movable rollers towards said card.

4. In an electrically operated card punching time recorder of the card actuated type having means for progressively selecting a series of time indicating punches in time related sequence, a punch operating mechanism, comprising in combination, a control means embodying a sensing rod mounted for movement towards and away from a card entering said recorder and means to actuate said rod; a shaft mounted for rotation above said time indicating punches, shaft driving means between said shaft and a driving motor adapted to continuously rotate said shaft during actuation of said motor, a clutch having a first portion fixed to said shaft for rotation therewith and a second portion freely mounted on said shaft and a resiliently biased pawl between said first and

second clutch portions, a press plate mounted for resiliently biased sliding movement above said punches, a connecting arm connected to said press plate and eccentrically connected to said second clutch portion, a solenoid including a plunger adapted normally to engage said resiliently biased pawl and adapted to release said pawl on activation of said solenoid, a switch connected to said solenoid and adapted to be actuated on movement of said sensing rod to activate said solenoid for withdrawal of said plunger to release said clutch pawl and permit rotation of said second clutch portion and depress said press plate into punching operation.

5. In an electrically operated time recorder as claimed in claim 4, a further plurality of punches mounted in the path of said punch plate for interchangeable selection, and means adapted on depression of said press plate to also depress said additional punches into punching operation.

6. An electrically operated card punching time recorder adapted for use with a time card having a least one pre-punched locating perforation, comprising in combination, a card receiver, card advancing means including spaced apart card engaging rollers mounted above and below said card receiver, a driving motor connected to said card engaging rollers and to a control relay, a first switch means disposed in the path of said card receiver and connected to said control relay, a first plurality of punches mounted above said card receiver and at least one additional punch mounted above said card receiver in spaced apart relationship from said first punches, punch actuating means connected to said control relay and adapted to simultaneously act on said first and second punches, card locating means including a reciprocating electrically operated armature and sensing rod adapted to engage with a card passing through said card receiver and locate said card relative to said punches by said perforation, a second switch means connected to said control relay and disposed in the path of said armature, said second switch means adapted on engagement by said sensing rod to release said punching means whereby said card is moved into said time recorder, located and punched to provide a plurality of perforations indicating a code time record and a subsequent card locating position.

7. In an electrically operated card punching time recorder of the card actuated type having means for progressively selecting a series of time indicating punches in time related sequence and means to actuate said punches including a control relay and a circuit connecting said relay to a driving motor; a card advancing means comprising in combination, a card receiver having an entry end and a discharge end, a control switch having a lever arm disposed in the path of a card passing into the entry end of said card receiver, spaced apart opposed sets of fixed and movable card engaging rollers mounted above and below said card receiver with one of said sets of rollers mounted for movement towards and away from the other set, electrically controlled means for moving said one set of rollers, circuit means connected to said switch and controlling said roller moving means, roller driving means connected to one set of said opposed rollers, a driving motor connected to said roller driving means and to said switch controlled roller moving means, a further lever disposed in the path of said card passing along said receiver, a control switch connected to said lever and a solenoid disposed above said card receiver, an armature connected to said solenoid, a resiliently biased card sensing rod connected to said armature, a switch including a switch arm in the path of said armature and being connected to said solenoid, whereby entry of a card into said card receiver is adapted through said first switch to actuate said driving motor and roller moving means to cause said rollers to engage and move said card towards said card receiver discharge end, and actuation of said further lever by said card causes said sensing rod to move into contact with said card and on said sensing rod passing through said card perforation said armature contacts said switch arm to operate said roller moving means moving said movable rollers away from said card.

8. An electrically operated card punching time recorder as claimed in claim 7, wherein said punch actuating means includes a rotary clutch driven by said driving motor, a lever arm disposed adjacent to and contacted by said rotary clutch, a switch disposed in the path of said lever arm and connected to a further solenoid, an armature having a projecting arm pivotally mounted on said solenoid, a double armed latch connected to the lever mounted in the path of said armature arm whereby closing of the switch deactivate the first named solenoid releasing the sensing rod and allowing the armature to be raised into contact with the said switch arm to operate the roller moving means raising the movable rollers towards said card.

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