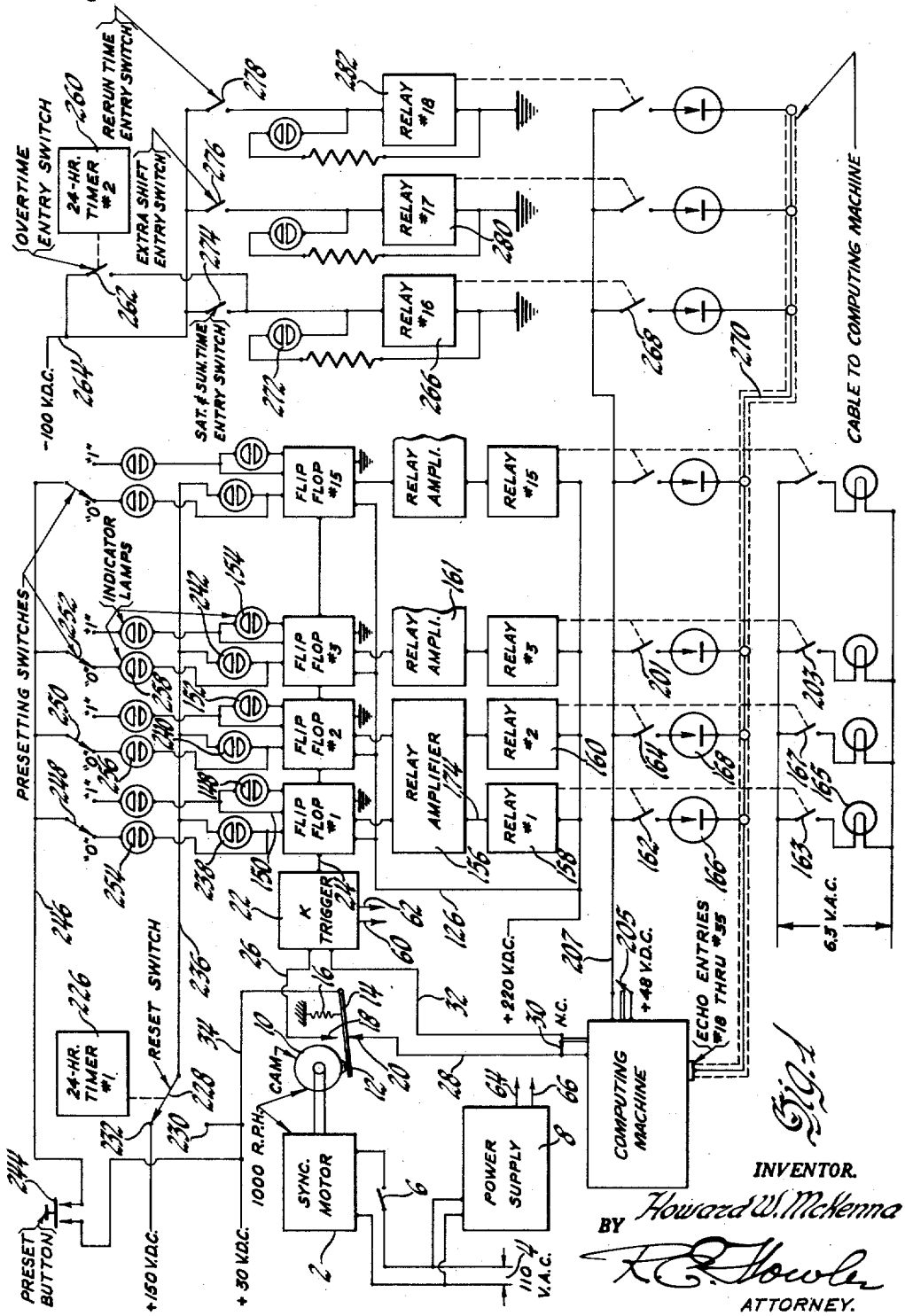
Oct. 13, 1964 H. W. McKENNA Re. 25,658

BINARY TIMER CONTROL

Original Filed Feb. 6, 1958 2 Sheets-Sheet 1



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Original Filed Feb. 6, 1958 2 Sheets-Sheet 2

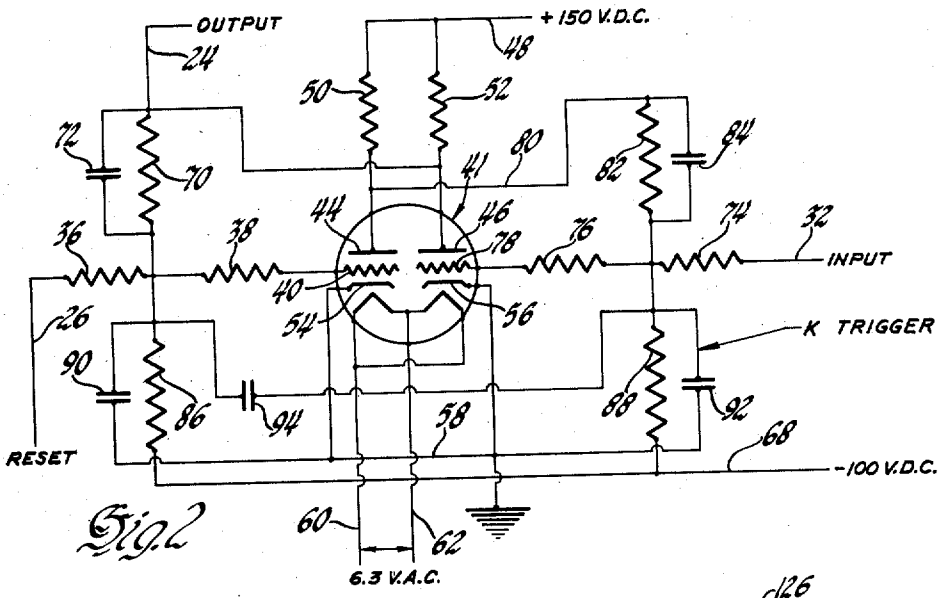


Fig. 2

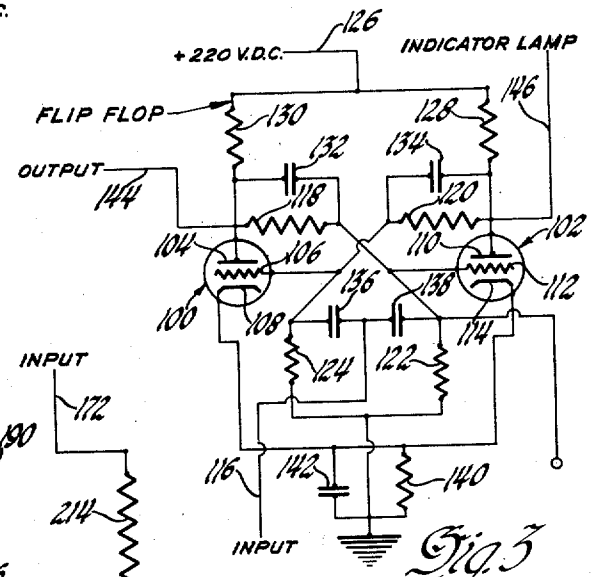


Fig. 3

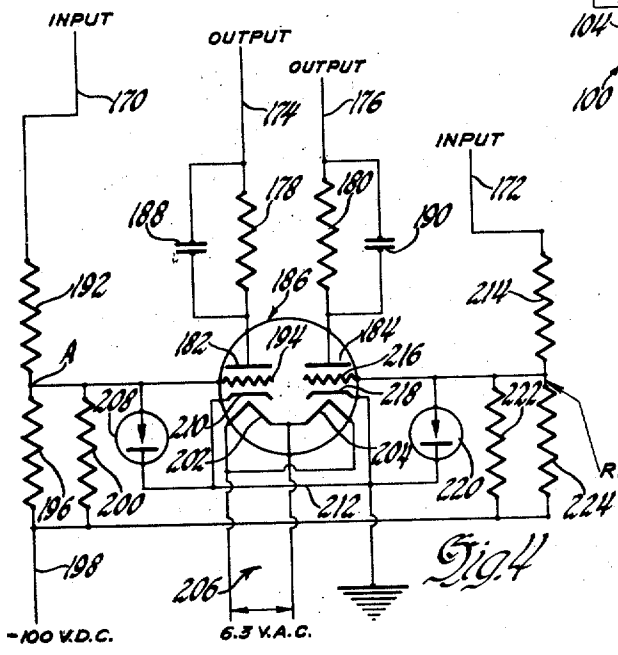


Fig. 4

RELAY AMPLIFIER

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BINARY TIMER CONTROL

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5 Claims. (Cl. 324—68)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to timing control means and more particularly to timing control means which may readily be associated with computing or data processing equipment to accurately record the time period during which the machine is in use.

Many of the current electronic calculating, computing, or data processing machines operate at such high rates of speed that ordinary hand operated methods of recording time for any one phase of operation are inadequate. Since charges for machine use are based on time of operation, determining such time accurately becomes important. It would also be advantageous to incorporate time indications directly on the output record of the machine, so that the subscriber would known exactly the basis for billing.

It is therefore an object in making this invention to provide counting means producing timed pulses that may be fed into a computing machine to indicate intervals of operation.

It is a further object in making this invention to provide an electronic counter of the binary type to produce control pulses indicative of time intervals which may be injected into a computing machine and produce a time record as part of the record produced by the machine.

It is yet a further object in making this invention to provide an electronic binary counter for connection to a computing machine for producing timed records as part of the record produced by the machine.

With the above and other objects in view which will become evident as the specification proceeds, the embodiments of this invention will be best understood by reference to the following specification and claims and the illustrations of the accompanying drawings, in which:

FIGURE 1 is a block and schematic drawing of a system embodying my invention.

FIGURE 2 is a detail circuit diagram of the K trigger portion of the system shown in FIGURE 1.

FIGURE 3 is a detail circuit diagram of one of the "flip-flop" circuits used for the binary counter, and

FIGURE 4 is a detail circuit diagram of one of the relay amplifiers.

In order to measure time periods, a unit of measure must first be determined. Conventionally our hours are broken down into minutes and seconds. However, in determining time intervals upon which charges are to be based for time of use of a machine, it may be more desirable to use as a unit, a base of 10. As an illustration only, for my system will operate on any given unit base, I have selected time intervals of $\frac{1}{1000}$ of an hour. In order to produce control pulses of this frequency, a synchronous motor **2** is directly connected to the power supply lines **4** and controlled by a manual switch **6**. A power supply unit **8** for the electronic components of the system is also connected to the main power supply lines **4**. The synchronous motor **2** is adapted in this case to rotate at 1000 r.p.h. though any other speed may be used.

The motor **2** drives a cam **10** which has a single lobe **12**. A switch armature **14** spring biased toward the cam by spring **16** has its pivotal end in engagement with the

cam surface and is moved between spaced stationary contacts **18** and **20** by said cam. Thus 1000 pulses per hour are fed to the K trigger circuit **22**.

The trigger circuit **22** is provided to produce one control pulse on line **24** for each operation of the cam switch **14–18–20**. In the present design this is a negative pulse. Thus, 1000 negative pulses are applied to line **24** each hour by this construction. FIG. 2 shows in detail the circuit of the K trigger section. Stationary contact **18** is connected to the K trigger circuit by line **26** and stationary contact **20** is connected through line **28** and normally closed interlock switch **30** with line **32** also connected to the K trigger circuit **22**. Said switch **30** is actuated by certain operations of the printer. A power supply line **34** connected to a source of **30** volt direct current power is directly connected to armature **14** and supplies that voltage to either line **26** or line **32** depending upon the position of armature **14**, to reset or trigger the circuit.

Referring now to FIG. 2, line **26** is shown connected through resistances **36** and **38** in series to the control grid **40** of the first triode section of tube **41**. Plates **44** and **46** of the tube are commonly supplied with power from line **48** which is connected to a supply of 150 volt direct current. Load resistors **50** and **52** are serially connected with plates **44** and **46** respectively. Cathodes **54** and **56** are commonly connected to line **58** which is grounded. The filaments of tube **41** are supplied with low voltage power through leads **60** and **62** which although not shown connected, extend to lines **64–66** on the power supply **8**. Line **68** is connected to a source of constant negative D.C. voltage, in this instance —100 volts from the power supply **8**. A symmetrical trigger circuit is provided. Plate **46** of the second section is directedly connected to output line **24** and through resistance **70** to a point intermediate resistances **36** and **38** and then to control grid **40**. Resistance **70** is shunted by condenser **72**. In a similar manner input line **32** is connected through series resistances **74** and **76** to grid **78** of the second triode section. Plate **44** of the first section is connected through line **80** and resistance **82** to a point intermediate resistances **74** and **76**. A condenser **84** is connected in shunt to resistance **82**. To complete the trigger network, the power line **68** is connected through resistance **86** to the common terminus of resistances **36** and **38** and also through resistance **88** to the common terminus of resistances **74** and **76**. Condenser **90** is connected from one end of resistance **86** to ground and condenser **92** from one end of resistance **88** to ground. Condenser **94** is connected between the common terminus of resistances **36** and **38** and that of resistances **74** and **76**.

As before mentioned, the function of this trigger circuit is to apply one negative pulse to output line **24** for each actuation of switch **14–18–20**. With the armature **14** riding on the low part of the cam, +30 volt D.C. is applied to line **26** to overcome the negative bias imposed by the —100 volt D.C. on line **68** and remove the bias applied to the first triode section so that conduction through this section is high and the voltage on the plate **44**, low. Since this is connected to grid **78** of the second section, the voltage thereof is low and conduction through this section is cut off and the voltage at plate **46** is relatively high. Thus a positive signal is applied to output line **24**. When the lobe **12** causes the armature to move, the 30 volt D.C. is removed from line **26** and applied to line **32**. This forces the second section to conduct and cuts off the first section. This raises the bias voltage on grid **78** of the other section and together with the application of the +30 volt D.C., causes the second section to conduct, reducing the plate voltage at **46** and applying a negative pulse to output line **24** which will be counted by the binary counter. The K trigger circuit is stable and will not revert to its initial

condition until the switch is allowed to assume its opposite position and apply 30 volts to line **26**.

The equipment so far described therefore produces a train of pulses equally spaced in time for producing timing marks on the computer record. In order to count the pulses from a certain time zero, a binary timing system is utilized. This consists of a cascaded series of trigger circuits which maintain either one of two fixed positions, which combination of positions indicates the total number of impulses received during a certain predetermined time interval. These trigger circuits are all alike and are stable multi-vibrator circuits identified as "flip-flop" No. 1, No. 2, No. 3, etc. Any number of these circuits may be utilized in cascade depending on the size of the numbers which are to be counted. The specific detail of each flip-flop circuit is illustrated in FIGURE 3 and as before indicated, each flip-flop circuit remains in its last actuated position until the next succeeding negative pulse changes the condition of conductance from one of its tubes to the other. Various types of trigger circuits may be used and it is desired to state that the current trigger or flip-flop circuit is only one type exemplary of many.

Referring specifically to the flip-flop circuit shown in FIGURE 3, each circuit consists of a pair of triode tubes **100** and **102** which may be either individual triode tubes or two triode sections encased in a single tube envelope. The first triode tube **100** includes a plate **104**, a control grid **106**, and a cathode **108**, and the second section in like manner includes a plate **110**, a control grid **112**, and cathode **114**. The input circuit to the flip-flop is applied to line **116** which, if it is used as flip-flop No. 1, is the same as line **24**. This applies the various time signals to the trigger stage. The plates and grids of the sections are cross-connected, since plate **104** is connected through resistance **118** to control grid **112** and plate **110** in similar balanced manner, through resistance **120** to control grid **106**. Control grid **112** is connected through biasing resistor **122** to ground and control grid **106**, through a similar biasing resistor **124** of equivalent value, is also connected to ground. Power supply to the plates of these tubes is obtained through 220 volt D.C. line **126** which is connected through load resistors **128** and **130** to plates **110** and **104** respectively. Condensers **132** and **134** are connected in shunt across resistances **118** and **120**. Input line **116** is connected through coupling condensers **136** and **138** respectively to grids **106** and **112**. The cathodes **108** and **114** are commonly connected to ground through biasing resistor **140** shunted by condenser **142**. The output of one of these trigger or flip-flop stages is obtained from a connecting line **144** and a connection also extends from plate **110** of the other half of the trigger tube through line **146** to an indicating lamp which counts and indicates the condition of the stage.

With the connections made as indicated in each trigger circuit, the application of a negative input pulse which occurs on line **24** once during each revolution of the cam will cause the conduction of the triodes to reverse. The first triode such as illustrated at **100** may be called the "0" triode and the second triode, the "1" triode. If the output is taken off the plate of the triode as indicated in FIGURE 3, there will be a negative pulse applied to each output line such as line **144** each time the trigger circuit under consideration enters the so-called "0" state, which is on every other pulse which this stage receives. Under the conditions existing when the arm **14** rides on the main cam surface, the one triode such as **102** in flip-flop No. 1 is conducting and the triode **100** or "0" triode is non-conducting. When lobe **12** forces armature **14** to assume its alternate position, a negative pulse is applied to line **24** [(line **116**)] driving grid **112** negative and cutting off the first triode **102**. The pulse simultaneously applies a negative voltage to grid **106** but since it is cut off, it does not affect this tube. However, the reduction in flow through tube **102** causes its plate voltage to raise, changing the voltage on grid **106** and letting the first tube **100** conduct. This reduces the voltage on the output line **144** to produce a negative pulse on that line. The trigger circuit remains in this condition until the next negative voltage pulse is again re-applied by the passing of the lobe when the trigger circuit again flops. Thus, at each negative pulse application, the trigger circuit changes conduction from one of the triode tubes to the other and the next application of a negative pulse reverses the action. Since each flip-flop circuit contains an output line upon which a negative pulse is developed each complete cycle, each succeeding flip-flop circuit will be reversed by the preceding one, each second pulse application to the first.

For each flip-flop stage there is provided an indicating neon light **148** which is connected to the line **146** from the plate **110** of the second triode stage. This lamp is also connected through line **150** to the 220 v. supply line **126** inside the trigger circuit, thus when tube **102** becomes non-conductive indicating lamp **148** lights to indicate the condition of this particular unit. Upon the lighting of any one of the neon counting indicators **148**, **152**, **154**, etc. of any one of the flip-flop circuits **1** through **15**, it is also desired to actuate a control relay and transmit a pulse indicating the energization of such indicating light to the computer. Therefore, the output of the flip-flop stage No. 1 is connected through an associated relay amplifier **156** which contains two sections, one amplifying the output from flip-flop stage No. 1 and the other half amplifying the output of flip-flop stage No. 2. The amplified signal passing through the relay amplifier is then applied to a control relay **158** or **160** actuating associated switches **162** or **164** to complete a circuit through series rectifiers **166** or **168** and impress suitable digitary indications on the computer or printer.

The circuit of one relay amplifier stage such as **156** is shown in FIGURE 4 and as stated above, this amplifier serves two trigger circuits. Therefore, the output of flip-flop stage No. 1 would be connected through line **170** to one amplifier stage and control the same, whereas the output from the second flip-flop No. 2 would be connected to input line **172**. The amplifier is relatively conventional and the plates are supplied with voltage through lines **174** and **176** connected through load resistors **178** and **180** to the first and second plates **182** and **184** respectively of double triode tube **186**. A shunt capacitor **188** is connected around resistance **178** and in like manner a second capacitor **190** is connected in shunt with resistor **180**. Biasing resistor **192** is connected between the input line **170** and control grid **194** of the first section and a second resistor **196** is connected between the control grid **194** and the source of 100 v. D.C. negative voltage connected to line **198**. A resistance **200** is connected in shunt across resistance **196**. The filaments **202** and **204** of the tube are commonly supplied with 6 v. power through supply lines **206** originating with the power supply **8**. A rectifier **208** is connected between grid **194** and cathode **210** of the first section, which cathode is connected directly to ground through line **212**. The second amplifier section is a duplicate of the first and includes resistance **214** connected between input line **172** and the control grid **216** in the second section. Cathode **218** of this section is connected through a rectifier **220** to the grid **216** and two resistances **222** and **224** in parallel are connected between the grid **216** and the 110 v. source of negative D.C. voltage **198**. When the input from the odd number flip-flop such as 1, 3 or 5 is applied to line **170**, and this section conducts, the relay No. 1 is actuated to close its switch **162** and an indicating pulse is applied to the printer or computer as the instrument is being used so that a time mark appears on the record produced by the instrument and time of use can be directly read along with other intelligence on the tape. Since all of the various units are duplicates, it is not felt necessary to describe any further detail of any later sections. Neon tubes **148**, **152**, **154** are those indicating tubes appearing on the front panel of the ma-

chine and whose energization or deenergization in sequence indicate the total number of pulses counted.

To describe the counting function of the various binary circuits, as cam **10** rotates the K trigger circuit **22** shown in detail in FIGURE 2 applies a positive voltage from plate **46** to line **24** for the major portion of a cycle since the first triode section of the tube **41** conducts and the second section of this tube is non-conductive when the positive 30 volts from line **32** is applied to grid **40**. When the lobe **12** moves the armature **14** breaking contact with stationary contact **18** and making contact with stationary contact **20**, the +30 volts from line **34** is removed from grid **40** and applied to grid **78**. This raises the voltage of grid **78** of the second triode section so that that section becomes conductive to simultaneously cause the first section of the tube to become non-conductive. The voltage on plate **46** will therefore be reduced and a pulse produced in the voltage on line **24** toward the negative although the voltage always remains above zero. This negative going pulse is the one which produces the counting in the binary system. The main purpose of the K trigger circuit is to remove any difficulty arising from chattering of the switch contacts. Once armature **14** mechanically engages contact **20** and the K trigger circuit reverses conductivity of the two triode sections to produce the negative going controlled pulse in line **24**, the system will remain in this condition even though armature **14** momentarily breaks with stationary contact **20** or chatters with respect thereto. The conductivity will not revert to its original order until armature **14** engages contact **18** which positively applies the pulse +30 voltage D.C. to the control grid **40** causing the first section of the tube to become conductive. This produces a plurality of spaced negative going pulses on line **24** at the rate of 1000 per hour.

Assuming the system is set at zero indication, in this instance each zero stage in each flip-flop circuit is conducting. Referring to FIGURE 3, illustrative of each flip-flop circuit, tube **100** in this case would be conductive and tube **102** non-conductive. The negative going pulse from line **24** would be applied to input line **116**. Since this line is capacitatively coupled through condensers **136** and **138** to control grids **106** and **112**, it simultaneously drives each one of these tubes to cutoff. Since only one tube has been conducting, that is the tube affected. For the first pulse, therefore, flip-flop No. 1 receiving this negative going pulse would have applied to grid **106** a negative pulse to tend to cut off conduction through tube **100**. The voltage on its plate **104** would increase and since that is coupled directly to grid **112** in tube **102**, the conduction through that tube increases. The plate voltage at **110** therefore is reduced and since that plate is coupled also to grid **106**, tends to emphasize the negative going grid **106** assisting the cutting off of conductivity through tube **100** until tube **100** is cut off and tube **102** in full conductance depending upon the bias. This reduces the voltage on plate **110** but since the voltage at that point is connected through the indicating tube **148** to supply line **126**, there is a greater voltage difference across the lamp **148** than existed when tube **102** was non-conductive and therefore the lamp **148** glows.

At the same time the voltage on plate **104** has been increased so that the voltage on output line **144** is more and this line is directly connected to the input line **170** of the amplifier circuit shown in FIGURE 4. With normal voltage appearing on plate **104** under conditions where this tube is conductive, the voltage at the plate **104** substantially balances the —100 v. D.C. voltage applied from line **198** across the split voltage divider including resistance **192** and resistances **196** and **200** in parallel. At that time the voltage appearing at point A is relatively high negative, however, when the voltage at plate **104** is increased due to the tube **100** becoming non-conductive the balance set up in the voltage divider mentioned changes and the voltage on control grid **194** approaches zero to cause conduction through the amplifier or first triode section of the tube **186**. Conduction through this tube and through the output line **174** flows directly through relay No. 1 [(158)] and it operates to switch contacts **162** and **163**. The closure of switch **163** lights an indicating test lamp **165** on the rear of the panel. This is for checking purposes only. Closure of switch **162** *sets up* [completes] a circuit into some of the internal connections of the printing machine and sets that up for recording a counting total when desired. The reason for connecting a rectifier **166** between switch **162** and the circuits of the printer is to prevent a direct interconnection of certain circuits within the printer so that they will not be shorted. The circuits remain in the described condition with lamp **148**, and lamp **165**, illuminated and relay switch **162** closed until the advent of a second negative going pulse on line **24**.

When the second negative going pulse appears it again applies a negative pulse to both grids **106** and **112** of the first flip-flop circuit, but as in the previous instance it has no effect on the tube that is already cut off, which is now tube **100**. This negative going pulse therefore drives grid **112** down and tends to reduce the conductivity in this tube which increases the voltage on plate **110** and simultaneously, in a similar manner previously described, increases the conductivity through tube **100**. As the voltage across tube **102** increases, the difference between the line voltage and the plate voltage decreases, decreasing the voltage applied to the indicating lamp **148** and it is extinguished. Simultaneously the flow of current through amplifier **210–194–182** decreases and relay No. 1 drops out. The first stage therefore reverts to its initial condition in which the indicating lamp **148** goes out at the end of two pulses.

Simultaneously with the return in conduction in the "0" tube **100**, a negative going pulse is applied to output line **144** which is connected to flip-flop No. 2. That stage is a duplicate of the flip-flop circuit shown in FIGURE 3 and the negative going pulse on the output of flip-flop No. 1 is applied to the input of flip-flop No. 2. This negative going pulse therefore changes the conductivity of the two tubes in flip-flop No. 2 to cause energization of indicating lamp **152** and relay No. 2 which closes its switches **164** and **167** to connect relay No. 2 into certain circuits in the printer. Therefore at the conclusion of two negative pulses applied to line **24**, indicating lamp **148** is out and this circuit has returned to its original condition and indicating lamp **152** is now energized and relay No. 2 also energized to close the associated switches. Each flip-flop circuit reverses its conditions of conductivity and block out each time it receives a negative going pulse.

Upon the application of the third negative going pulse to line **24** by the output of the K trigger **22**, flip-flop circuit No. 1 again reverses to energize lamp **148** and relay No. 1, but since this action does not apply a negative pulse to the output line **144**, no signal is now transmitted to flip-flop circuit No. 2 and light **152** remains energized. Therefore, for a count of three lamp **148** and lamp **152** are energized as well as relay Nos. 1 and 2. Upon the application of the fourth negative pulse to line **24** which causes a reversal in conductivity of flip-flop No. 1, this extinguishes light **148** and transmits a negative signal to flip-flop No. 2, which in turn extinguishes lamp **152** and applies a further negative signal to flip-flop No. 3 which causes lamp **154** to be illuminated. This is the only lamp illuminated on the board and indicates a total count of 4. Simultaneously of course relay amplifier **161** conducts to energize relay No. 3 which closes its switches **201** and **203**. These are the only switches closed at this time. Following the same trend, each pulse therefore causes a reversal of the flip-flop binary counters to illuminate different series of indicating lamps **148**, **152**, **154**, etc., and the energization of certain groups of lamps together with their associated relays indicates the total count from the initial point together with the closure of certain circuits into the computing machine.

The completion of the circuits into the computing machine, however, does not cause any signal or recording of the count. However, at a programmed time determined by the computing machine switch **205** is actuated. This applies a +48 v. D.C. to conductive line **207** which applies signals to the lines completed to the computing machine. The computing machine reads the information present on the lines and determines therefrom the time record. The reading, of course, is controlled by the various switches **162**, **164**, **201**, etc. that are closed.

There are a number of other neon tubes which are mounted on the back of the panel and which are used for re-set or pre-set purposes. With the number of flip-flop or trigger circuits herein provided with a 1000 r.p.h. motor, the current device is capable of counting up to 32,767. This is equivalent to 32.767 hours. Since there are twenty-four hours in a day it is best to maintain one day's count separate from another. A 24-hour timer **226** is therefore provided so that under any continued operation, the device will automatically re-set itself once every twenty-four hours if necessary. This 24-hour timer will at the end of that period close a re-set switch arm **228** from stationary contact **232** to engage contact **230** connected to a source of 30 volt D.C. through line **34**. This is a very fast acting switch arm and only closes with contact **230** momentarily. This drops the voltage on line **236** from 150 volt D.C. to 30. When the timer **226** is actuated, a gas tube such as **238**, **240** or **242** for each of the flip-flop circuits is connected to its associated flip-flop circuit and the relay is energized momentarily to set to zero. The re-set line **236** is connected to the 0 plates of all the flip-flop trigger stages through the neon tubes. When the counter is operating normally the re-set line **236** is connected to the 150 volt line as shown and the neons **238**, **240** and **242** do not have sufficient voltage thereacross to fire because the plate voltage of the triode with which each is associated, varies from 100 to 200 volts. However, when the voltage on line **236** drops to 30 volts, the voltage across each neon is then sufficient to fire them and make all the 0 or lefthand triodes conduct which automatically re-sets the count register to 0. The closure of switch arm **228** on contact **230** is only for a short period of time and it then moves back to its original contact **232** and the device may then continue to count as previously.

If it is desired to at any time pre-set the system manually, there is a pre-set switch **244** provided which connects the 30 volt D.C. line to a second pre-setting set of switches through line **246**. This line is connected through a plurality of so-called pre-setting switches **248**, **250** and **252** which can be adjusted to pre-set either the "0" or "1" stage of each trigger circuit as desired. It operates in the same manner to apply 30 volts to further discharging neons **254**, **256** or **258** operating in the same manner as previously described with relation to neons **238**, **240** and **242**.

There are also other factors that it may be advangeous to record on the final report, such as overtime, extra shift, Saturday and Sunday work and so forth. These can be added to the record of the particular work being done. At the right of FIGURE 1 of the drawings there is shown control means for setting the apparatus to introduce these additional factors into the record. A further 24-hour timer **260** is provided which actuates switch **262**. Closure of the switch **262** applies the control voltage on line **264** to relay **266** to energize the same and close switch **268** to apply the proper indicating signal to the computing machine through echo cable **270**. The closure of this switch would indicate overtime work. Neon bulb **272** connected in parallel with the relay **266** is energized at this time to indicate that the circuit is active. The operation of the overtime switch **262** will be automatic and may be adjusted to close daily at 5 p.m. It would automatically show any further use upon this time as being overtime.

There are also provided three manually operable switches **274**, **276** and **278**, for connecting power supply line **264** to the various relays **266**, **280** or **282** respectively. Each of these switches would indicate a different factor of work. For example, the closure of switch **274** might indicate Saturday and Sunday time; the closure of switch **276**, extra shift time and the closure of switch **278**, re-run time, all of which might carry a different charge. Each of these switches would have its own indicating light to indicate that that circuit was active. Each may also be adjusted by the closure of the manual switch associated therewith to provide the proper indication on the record.

I claim:

1. In an indicating system for applying indicia to a computing machine, a source of electrical power, timed pulse generating means connected to the source of electrical power, a plurality of stable multivibrator circuits connected in cascade to the timed pulse generating means, each multivibrator having two sections that are alternately conducting, [a control relay coil] *a plurality of circuit means each having two inputs and an output the circuit means being responsive to the concurrent application of signals to said two inputs to produce a signal at said output, one input of each of the circuit means being connected* in [series] circuit with one section of *a respective* [each] multivibrator [and] *to receive a signal at said one input* [energized] when that section conducts, [and switching means actuated by each relay coil connected in] *the output of each of said circuit means being connected through a* separate *circuit* [circuits] to the computing machine, [and providing intelligence in the number of switches open and closed at any instant that the computing machine completes a phase of its operation and reads the resultant number of such switches that are closed as an indication of the conclusion of a time period] and [further] switching means connected to the [sources] *source* of electrical power and commonly to *the other input of each of said circuit means, the switching means being operatively associated with the computing machine and responsive to a command therefrom to close* [the first-named switching means actuated by the computing machine] to apply *a* signal [voltage] to the *other inputs of the plurality of circuit means thereby to produce signals at the outputs of the circuit means receiving concurrent input signals which signals are a coded representation of the number of pulses communicated to said multivibrator circuits from said pulse generating means during an elapsed time period.* [separate circuits upon the command from the computing machine for such reading.]

2. In a computing machine producing a record bearing results of computation, an automatic means for applying to said record indicia indicating the period of use of the computer comprising, a time pulse generating means for producing a series of equally spaced pulses, a plurality of flip-flop circuits connected in cascade to the output of the time pulse generating means to form a binary timing means, each flip-flop circuit controlling the next in order, each flip-flop circuit including two sections which are alternately conductive, [a relay coil] *a plurality of circuit means each having two inputs and an output, the circuits means being responsive to the concurrent application of signals to said two inputs to produce a signal at said output, one input of each of the circuit means being* connected [in series] with one section of *a respective one* [each] of the flip-flop circuits [and] *to receive a signal at said one input* [energized] by conduction of that section, [a switch actuated by each coil and connected] *means for connecting the outputs* independently to the computing machine, a source of electrical power, a main control switch connected to the source of electrical power and commonly to *the other input of* each of the [switches actuated by the relay coils] *circuit means,* said main control switch being *operatively associated with* [actuated by] the computing machine

and responsive to a command therefrom at the start and completion of a run to *close, thereby to apply signals to the other inputs of said circuit means, whereby said circuit means produce, in accordance with the number of circuit means receiving concurrent input signals, a combination of signals from said outputs* [, as a combination, apply signals to the computing machine controlled by the positions of the various switches actuated by the relay coils] which signals are representative of the extent of a time period of use.

3. In a computing machine producing a record bearing results of computation, an automatic means for applying to said record indicia indicating the period of use of the computer, comprising a time pulse generating means for producing a series of equally spaced pulses, a plurality of flip-flop circuits connected in cascade to the output of the time pulse generating means to form a binary timing means, each flip-flop circuit controlling the next in order, each flip-flop circuit including two sections which are alternately conductive, [a relay coil] *a plurality of circuit means each having two inputs and an output, the circuit means being responsive to the concurrent application of signals to said two inputs to produce a signal at said output, one input of each of the circuit means being* connected [in series] with one section of *a respective one* [each] of the flip-flop circuits [and energized] *to receive a signal at said one input* by conduction of that section, [a switch actuated by each coil and connected] *means for connecting the outputs* independently to the computing machine, a source of electrical power, a main control switch connected to the source of electrical power and commonly to *the other input of* each of the [switches actuated by the relay coils] *circuit means,* said main control switch being *operatively associated with* [actuated by] the computing machine *and responsive to a command therefrom* at the start and completion of a run to *close, thereby to apply signals to the other inputs of said circuit means, whereby said circuit means produce, in accordance with the number of circuit means receiving concurrent input signals, a combination of signals from said outputs* [, as a combination, apply signals to the computing machine controlled by the positions of the various switches actuated by the relay coils], which signals are representative of the extent of a time period of use, and a master timer connected to the source of electrical power and all of the flip-flop circuits to switch to reset the system to zero at the end of fixed time intervals regardless of other factors.

4. In a computing machine producing a record bearing results of computation, an automatic means for applying to said record indicia indicating the period of use of the computer comprising, a time pulse generating means for producing a series of equally spaced pulses, a plurality of flip-flop circuits connected in cascade to the output of the time pulse generating means to form a binary timing means, each flip-flop circuit controlling the next in order, each flip-flop circuit including two sections which are alternately conductive, [a relay coil] *a plurality of circuit means each having two inputs and an output, the circuit means being responsive to the concurrent application of signals to said two inputs to produce a signal at said output, one input of each of the circuit means being* connected [in series] with one section of *a respective one* [each] of the flip-flop circuits [and energized] *to receive a signal at said one input* by conduction of that section, [a switch actuated by each coil and connected] *means for connecting the outputs* independently to the computing machine, a source of electrical power, a main control switch connected to the source of electrical power and commonly to *the other input of* each of the [switches actuated by the relay coils] *circuit means,* said main control switch being *operatively associated with* [actuated by] the computing machine *and responsive to a command therefrom* at the start and completion of a run to *close, thereby to apply signals to the other inputs of said circuit means, whereby said circuit means produce, in accordance with the number of circuit means receiving concurrent input signals, a combination of signals from said outputs* [, as a combination, apply signals to the computing machine controlled by the positions of the various switches actuated by the relay coils] which signals are representative of the extent of a time period of use, a master timer connected to the source of electrical power and all of the flip-flop circuits to switch the reset system to zero at the end of fixed time intervals, a plurality of manual switching means connected to the source of electrical power, *a plurality of* additional *circuit* [relay coil] means *each having two inputs and an output and responsive to the concurrent application of signals to said inputs to produce a signal at said output, the additional circuit means each having one input* connected to *a respective one of the* [each] manual switching means [and controlled thereby and additional individual switching means actuated by the additional relay coil means and] *means for connecting the outputs of the additional circuit means to the computing machine, the other inputs of the circuit means being connected to the source through the main control switch* [connected to the computing machine and to the main control switch] to apply additional signals to the computing machine when the main switch is actuated for further indicia on the record as desired.

5. In a computing machine producing a record bearing results of computation, as automatic means for applying to said record indicia indicating the period of use of the computer comprising, a time pulse generating means for producing a series of equally spaced pulses, a plurality of flip-flop circuits connected in cascade to the output of the time pulse generating means to form a binary timing means, each flip-flop circuit controlling the next in order, each flip-flop circuit including two sections which are alternately conductive, [a relay coil] *a plurality of circuit means each having two inputs and an output, the circuit means being responsive to the concurrent application of signals to said two inputs to produce a signal at said output, one input of each of the circuit means being* connected in series with one section of [each] *a respective one* of the flip-flop circuits [and energized] *to receive a signal at said one input* by conduction of that section, [a switch actuated by each coil and connected] *means for connecting the outputs* independently to the computing machine, a source of electrical power, a main control switch connected to the source of electrical power and commonly to *the other input of* each of the [switches actuated by the relay coils] *circuit means,* said main control switch being *operatively associated with* [actuated by] the computing machine *and responsive to a command therefrom* at the start and completion of a run to *close, thereby to apply signals to the other inputs of said circuit means, whereby said circuit means produce, in accordance with the number of circuit means receiving concurrent input signals, a combination of signals from said outputs* [, as a combination, apply signals to the computing machine controlled by the positions of the various switches actuated by the relay coils] which signals are representative of the extent of a time period of use, a master timer connected to the source of electrical power and all of the flip-flop circuits to switch to reset the system to zero at the end of fixed time intervals, a plurality of manual switching means connected to the source of electrical power, *a plurality of* additional *circuit* [relay coil] means *each having two inputs and an output and responsive to concurrent application of signals to said inputs to produce a signal at said output, the additional circuit means each having one input* connected to *a respective one of the* [each] manual switching means [and controlled thereby, additional individual switching means actu-

ated by the additional relay coil means and connected] , *means for connecting the outputs of the additional circuit means* to the computing machine [and to the main control switch to] *the other inputs of the additional circuit means being connected to the source through the main control switch to* apply additional signals to the computing machine when the main control switch is actuated for further indicia on the record as desired and a second time switching means connected to at least *some* [a part] of the *plurality of* additional [relay coil] *circuit* means to energize the same at certain desired times to indicate extra time periods.

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