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FAULT SENSING APPARATUS

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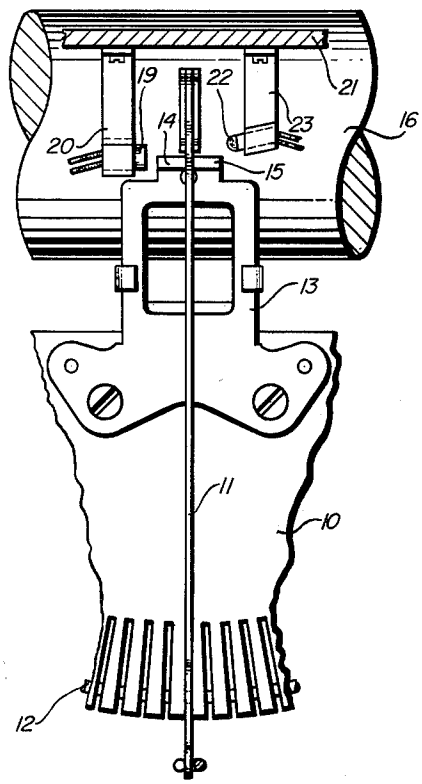

Fig_1

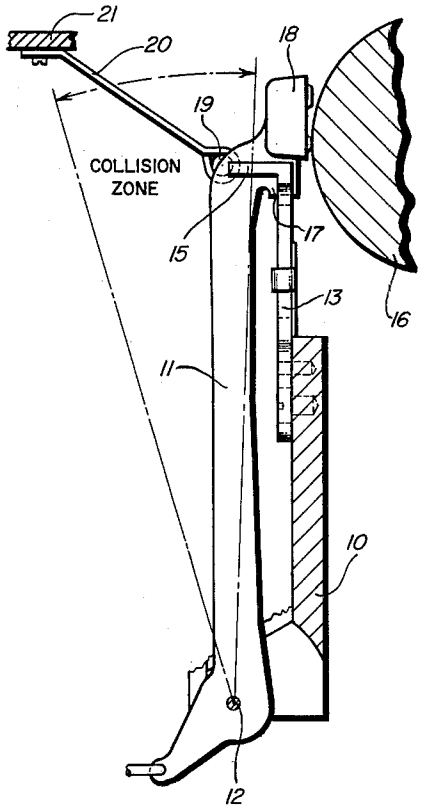

Fig_2

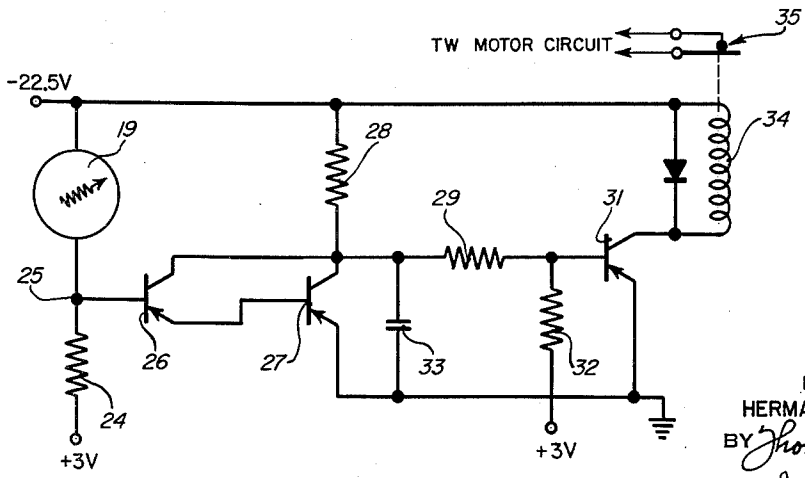

Fig_3

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FAULT SENSING APPARATUS

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This invention relates to a fault sensing apparatus employing photoelectric detectors; more particularly it relates to a fault sensing apparatus employing a photoelectric detector and associated circuitry to monitor the motions of serially power actuated mechanisms and to respond to delays in the motion of one or more of said mechanisms which persist beyond a predetermined time interval.

While the present invention finds particular application in the typewriter or business machine art it is to be understood that there are many applications involving serially power actuated mechanisms wherein it is desirable to provide monitoring apparatus which responds to delays in or stoppage of the movement of said mechanisms which persist beyond a predetermined interval to halt operation and thereby prevent machine damage.

In the typewriter art, particularly in applications where an electric typewriter is automatically operated, if a type bar delays too long in the type guide of the typewriter it is likely to encounter a subsequently actuated type bar causing a pileup.

In accordance with the present invention, actuated type bars, while in the type guide of a typewriter, intercept a beam of light focused on a photoelectric cell. The change in photocell current permits the accumulation of charge on a condenser which, in the event that the type bar remains in the type guide too long, will charge to an amount sufficient to effect the opening of the typewriter motor circuit thereby preventing machine damage and loss of information. In normal operation, however, where the type bar moves into and out of the type guide in a proper interval, the beam of light is not interrupted for a sufficient length of time to enable the condenser to charge to the point where it will be effective to halt operation; the restoration of the beam effecting a discharge path for the condenser to restore the circuit to normal.

An object of the invention is to provide a motion monitoring apparatus.

Another object of the invention is in the provision of monitoring apparatus responsive to overlong delays in the motion of a cyclic mechanism.

A further object of the invention is in the provision of a photoelectric motion monitoring circuit operative in response to overlong delays or stoppage in the cyclic motion of type bars.

A still further object of the invention is in the provision of a photoelectric motion monitoring circuit operative in response to delays in type bar motion which persist beyond a predetermined interval for stopping the operation of the typewriter motive source.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIGURE 1 is a fragmentary front view with parts cut away of a typewriter showing a type bar in the type guide of the typewriter and also elements in accordance with the invention;

FIGURE 2 is a viewt showing the elements of FIGURE 1 in side elevation; and

FIGURE 3 is a schematic view of the fault sensing apparatus circuitry in accordance with the invention.

Referring now to the drawings there is shown in FIGURES 1 and 2 conventional typewriter structure comprising an arcuate type bar segment **10**, adapted to be moved to upper and lower case positions by linkages (not shown). The type bar segment serves to mount a set of type bars, only one of which is shown at **11** as being pivoted at **12** on the segment **10**. The segment **10** mounts a type guide **13** which serves also to support a ribbon vibrator as is well understood in the art. The type guide has at its upper end two spaced forwardly extending tabs **14** and **15** so formed as to provide a channel which decreases in width toward the typewriter platen **16** thereby to guide the relatively wide upper and sections **17** below the type head **18** of serially power actuated type bars whereby the type faces strike the platen at the proper place.

For various mechanical reasons not pertinent to the present description, a type bar sometimes is slowed down in its approach to the platen or in receding from the platen while within the type guide as illustrated in FIGURE 2. When a typewriter is being automatically operated, actuation of the type bars occurs serially at a predetermined constant and relatively high rate. If there is any overlong hesitation of the type bar within the type guide then, and this event occurs too frequently to be tolerated in automatically operated typewriters, a collision between the receding and an approaching type bar will occur in the common path zone of all the type bars. As a consequence several bars may pile up and machine damage result.

In accordance with the present invention apparatus for detecting overlong hesitation of a type bar within the type guide is operative to halt machine operation before collision and pileup can occur. The apparatus comprises as shown in FIGURES 1 and 2 a photoelectric cell **19** supported closely adjacent the forward end of guide tab **14** by a bracket **20** secured to the typewriter cover **21**. Associated with the photoelectric cell is a light source **22** supported closely adjacent the forward end of guide tab **15** by a bracket **23** also secured to top cover **21**. The light generated by source **22** is adapted to be focused on the photosensitive area of the cell. The photoelectric cell is of the photoconductive type characterized by a low resistance when exposed to light and a high resistance when not exposed to light. Hence when a type bar is within the type guide the light directed toward the cell is intercepted thereby and the resistance of the cell increases to a high value.

Referring now to FIGURE 3 there is shown a circuit which responds to changes in photocell current and which energizes a utilization circuit in response to changes which persist beyond a predetermined interval. As shown in FIGURE 3 the photo conductive cell **19** is connected in series with a resistor **24** across supply terminals whereby the voltage at the junction **25** between cell and resistor will be negative when the resistance of the cell is low and will swing positive when the resistance of the cell increases due to the interception of the light beam by a type bar in the type guide. The signal on junction **25** is amplified by p-n-p transistors **26** and **27**. More particularly junction **25** is connected to the base electrode of transistor **26** which has its emitter and collector electrode connected respectively to the base and collector electrodes of transistor **27**. The emitter and collector electrodes of transistor **27** are connected respectively to ground and to the negative supply via resistor **28**. Transistors **26** and **27** when so connected comprise an amplifier characterized by a high input impedance, a low out-

put impedance, and by a high gain. Where the photoconductive cell 19 employed has a high signal output and a high signal to noise ratio e.g. a 2N2175 photoconductive cell made by Texas Instrument Corporation, junction 25 may be connected to the base of a single transistor amplifier having its collector and emitter electrodes connected respectively to the supply source via resistor 28 and to ground.

The collector of transistor 27 is connected via a resistor 29 to the base of a transistor 31 which is normally maintained at a positive potential through connection to a +3 volt source terminal via a resistor 32. The collector of transistor 27 is also coupled to ground through a condenser 33. A solenoid 34 is provided in the collector circuit of transistor 31 and is adapted when energized to open its normally closed contacts 35 which are connected in the typewriter motor supply lines thereby to stop machine operation.

Normally, with the cell 19 exposed to light source 22, transistors 26 and 27 are conducting; condenser 33 carries no charge due to the discharge path provided by conducting transistor 27, and transistor 31 is normally not conducting. When a type bar 11 intercepts the light beam and junction 25 goes positive, transistors 26 and 27 will be cut off and condenser 33 will start to charge through resistor 28. The time constant of resistor and condenser is chosen such that the condenser will not have accumulated sufficient charge to render the base of transistor 31 negative and conductive, if the type bar which interrupted the light beam gets in and out of the type guide in a proper time interval. In other words if the object or type bar moves at a rate such that the interval of light interception is less than the time constant of resistor 28 and capacitor 33, capacitor 33 cannot charge high enough to cause conduction of the transistor 31. Re-establishing the light on photocell 19 will render transistors 26 and 27 conductive once again thereby providing a low resistance discharge path for condenser 33. If the type bar hesitates in the guide overlong, condenser 33 will accumulate sufficient charge to render transistor 31 conductive thereby energizing solenoid 34; breaking the typewriter motor circuit and halting typewriter operation.

In some instances two or more type bars are simultaneously operated resulting in collision and pileup before reaching the type guide. The same circuit may be employed to detect this type of fault by positioning the cell and light source within or at the beginning of the collision zone shown in FIGURE 2.

While the light source and photocell have been described as being on opposite sides of the path of motion of a type bar, it is to be understood that the only requirement is that the type bar intercept or deflect the light directed toward the photocell. It should be understood therefore that the foregoing disclosure relates to only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of

the example of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

The invention claimed is:

1. In combination with a machine having serially power actuated cyclic mechanisms, apparatus for monitoring the time of passage through a predetermined zone in the path of motion of said mechanisms comprising a light source and a photoconductive cell positioned respectively on opposite sides of the path of motion of said mechanisms, said light source being located to direct a beam of light on the photosensitive area of said cell, circuit means responsive to changes in conductivity of said cell comprising, a condenser for accumulating energy over the interval said beam is blocked by said mechanisms, and means operative in response to a predetermined energy level stored by said condenser for preventing actuation of subsequent mechanisms.

2. In combination with a typewriter having a plurality of type bars adapted to be power driven through a printing cycle, apparatus for monitoring the time of passage through a predetermined zone in the path of motion of said type bars comprising a light source and a photoconductive cell respectively positioned on opposite sides of the path of type bar motion, said light source being located to direct light on the photosensitive area of said cell, a condenser, a discharge path for said condenser, means responsive to the blocking of said light on said cell by a type bar for interrupting said discharge path and for providing a charge path for said condenser, means operative in response to the charge on said condenser when the interval over which said light is blocked exceeds the time constant of said charge path, and means responsive to the operation of said last named means for preventing operation of subsequent type bars.

3. In combination with a machine having a plurality of cyclic mechanisms adapted to be serially power operated, apparatus for monitoring the time of passage through a predetermined zone in the path of motion of said mechanisms comprising a light source and a photocell positioned to receive light from said source, the reception of light by said photocell being blocked by said mechanisms when moving through said predetermined zone, energy storage means, means responsive to photocell output for enabling said storage means to accumulate energy over the interval of passage of a mechanism through said predetermined zone, and utilization means responsive only to the energy accumulated when the interval of passage of a mechanism through said predetermined zone exceeds a predetermined interval for preventing operation of another mechanism.

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