

## Technical contribution

### A WARNING DEVICE WHICH INDICATES THE STOPPAGE OF PAPER IN AN INK-WRITING RECORDER

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In several types of neurophysiological investigation, such as in sleep research, there is a need for continuous recording of biological signals over periods of many hours. Ink-writing polygraphs are commonly used for such purposes and it is a source of great annoyance that the recorder paper sometimes stops for one reason or another during the recording. With the polygraph properly adjusted and with the paper folded into sheets but not torn, such a stoppage should be uncommon. However, when it does occur, particularly in the middle of the night, the operator may not notice it for some time and much irretrievable information may be lost.

We have overcome this problem by the use of a simple, inexpensive and, we believe, entirely new warning device which indicates to the operator that the paper has either ended or, for whatever reason, has stopped moving beneath the recorder pens.

#### Principle of operation

The principle upon which this device operates is as follows (Fig. 1). A potential difference of about 9 V DC is applied between one or more of the recorder pens and the metallic frame of the polygraph. While the pens are writing on paper which is moving at any speed greater than about 1 mm/sec the electric resistance offered to the passage of current between the pens and the underlying frame is

very high (in excess of 10 MΩ). When the paper stops moving, the degree to which the ink wets the paper increases and its electrical resistance falls markedly within about 5 sec. Similarly, if the paper is no longer present beneath the pens an electrical contact is made and the current flows between it and the polygraph frame. This current is made the base current of a single transistor circuit which provides sufficient amplification to operate a warning signal in the form of a small buzzer (Sonalert, manufactured by Mallory and Co., Tarrytown, N. Y. 10591). A current of approximately 150 μA is required to operate this buzzer. The type of NPN transistor used is unimportant provided sufficient gain is obtained.

Electrical contact is made with one or more of the recorder pens via a wire placed in the ink of the inkwell or by a fine, flexible wire

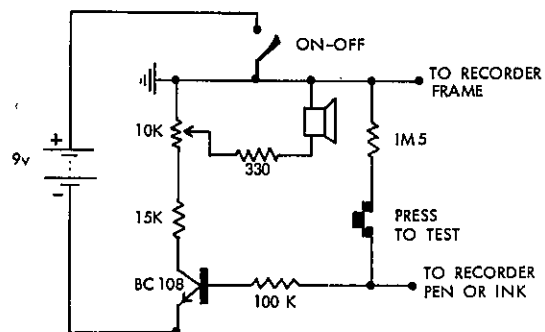


Fig. 1. Circuit diagram of the warning device.

attached directly to the pen-mounting. The former method has the advantage that the frequency response of the pen is unchanged. Because virtually no current is drawn until the alarm sounds, the 9 V dry cell lasts for many months without having to be replaced. Commercially available ink can be used without modification in the recorder.

### Discussion

This device is simple, reliable and cheap — the total cost would be a few dollars. The function of the polygraph is unimpaired by its presence and no additional force is applied to the paper which might make it more likely to tear. The device operates, without modification, over a wide range of paper speeds. It could be fitted easily to existing ink-writing polygraphs and EEG machines provided the recorder pens and their ink supplies are isolated electrically from the frame of the machine.

### Summary

A simple and inexpensive warning device is described which indicates when the paper has

stopped moving beneath the pens of an ink-writing polygraph. The device operates on the principle that the electrical resistance of the paper under the recorder pen is markedly reduced when the paper stops moving and is made wetter by the ink. A buzzer sounds within a few seconds of the paper stopping and so reduces the possibility of failing to record otherwise irretrievable information, for example during all-night recordings of the EEG in sleep research.

### Résumé

*Dispositif d'alarme pour enregistreur à plume indiquant l'arrêt du papier*

On décrit un dispositif simple et peu coûteux, qui signale que le papier a cessé de défiler sous les plumes du scripteur. Il se base sur le fait que la résistance électrique du papier sous les plumes baisse significativement lorsque celui-ci s'arrête et se trouve donc imprégné d'encre. Un signal sonore se fait entendre dans les quelques secondes après l'arrêt, réduisant ainsi le risque de manquer des enregistrements utiles, en particulier au cours d'études EEG prolongées sur le sommeil.