Dec. 22, 1959 C. J. BUCCINI 2,918,548

CONTROL DEVICE

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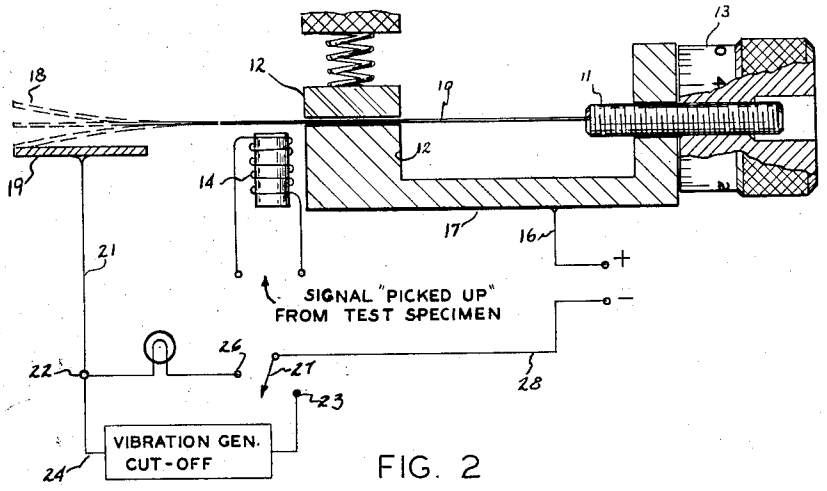


FIG. 2

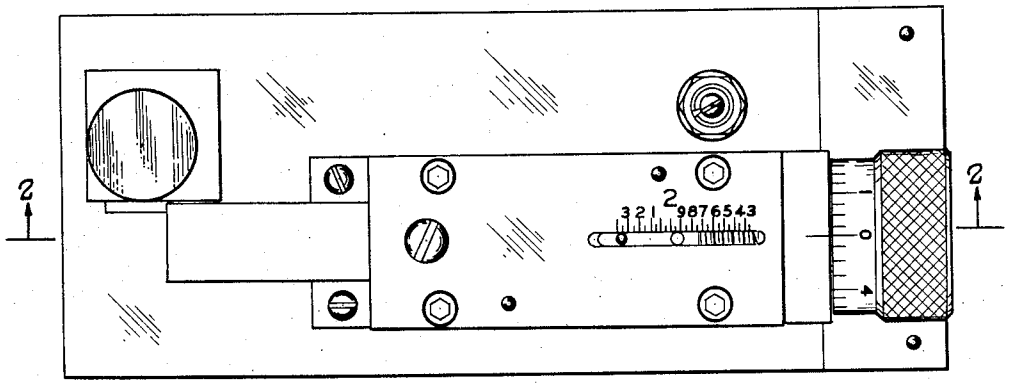


FIG. 1

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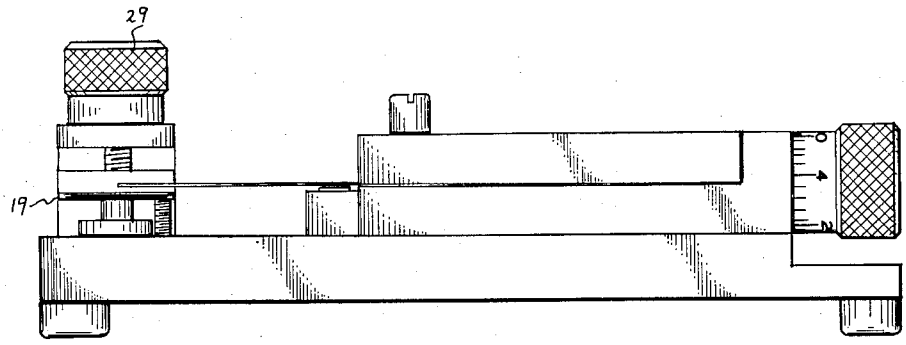


FIG. 3

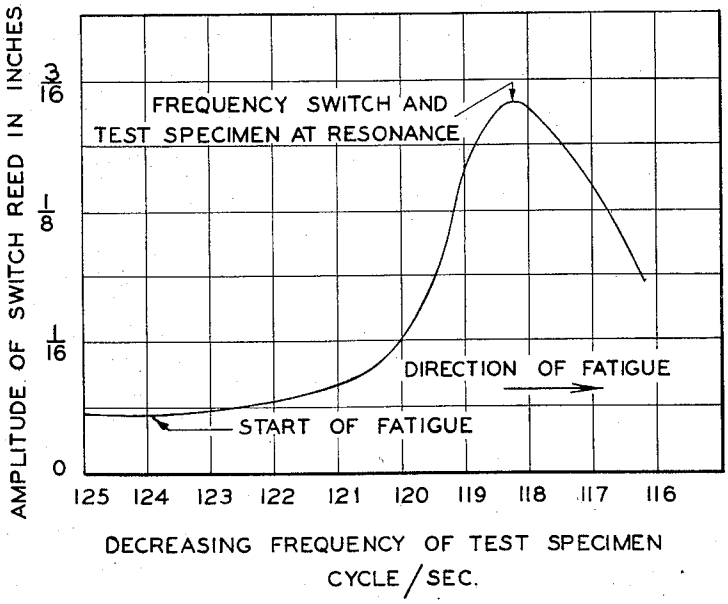


FIG. 4

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CONTROL DEVICE

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2 Claims. (Cl. 200—91)

The present invention relates to control devices and in particular to control devices operative to sense and to respond to changes of frequency occurring in vibrating bodies.

A particular object of the present invention is the provision of an electrical switch device having elements thereof adapted to vibrate in synchronism or in sympathy with an extraneous vibrating body; slight changes in frequency of vibration which occur in the remote body are sensed by the control device and these changes are effective to actuate a switch.

An additional feature of the present invention is that it embraces a single reed whose effective length may be selectively adjusted to vibrate at a variety of frequencies natural to a particular selected reed length.

Another object of the invention is the provision of a novel method of sensing changes in frequency occurring in a remote vibrating body.

A still further object of the present invention is the provision of a novel method of controlling electrical circuits.

A control device incorporating certain features of the present invention may include a single reed adapted to be vibrated selectively at a variety of frequencies, means for adjusting the effective length of the reed, means for driving the reed at the natural frequency corresponding to a selected length of reed, and switch means cooperating with the reed and settable to operate at a predetermined reed amplitude.

It is to be understood that the principles of the present invention may be utilized to regulate a variety of different electrical devices or operations which embrace frequency sensing or control by frequency sensing; however, for purposes of illustration, the invention wil be described in connection with a conventional fatigue tester. Reference is made to a fatigue tester wherein a sample or specimen of metallic material of a predetermined configuration is vibrated by external means to the point of failure.

A more complete understanding of the invention may be obtained from the following specification and drawing, in which:

Fig. 1 is a plan view of a device embracing the principles of the present invention;

Fig. 2 is a sectional view of Fig. 1 taken along the line 2—2 thereof. Certain portions are broken away for clarity. This figure also includes a wiring diagram of a typical scheme for utilizing the present invention;

Fig. 3 is a side view of the device illustrated in Fig. 1 and;

Fig. 4 is a curve showing the variations in switch reed amplitude as compared to the change in test specimen frequency occurring during and prior to specimen failure.

Referring now to the drawings and in particular to Figs. 1, 2 and 3, there is shown a steel switch reed **10** carried by a micrometer anvil **11**. The reed is restrained by a pair of opposed pressure plates **12** and is movable to and fro (from right to left as viewed in Fig. 2) between the plates responsive to rotation of a knurled micrometer dial **13**. The dial may be graduated in any suitable fashion, for example, in thousandths of an inch to indicate the increment of distance through which the reed is advanced or withdrawn. In effect, the micrometer dial measures the effective length of the reed measured from the left face of the pressure plates to the left end of the reed. An electromagnet **14** is disposed below the reed and is utilized, in a manner which will become more apparent hereinafter, to set the reed in vibration and to drive it in synchronism with a remote vibrating body such as a test specimen vibrating in a fatigue mechanism.

Fig. 2 shows schematically the manner in which the reed **10** operates as one contact of a switch. It is noted that the positive side of a suitable source of power is connected to the micrometer frame **17** by means of the lead **16**. Current flows along the reed **10** where, depending upon the amplitude of vibration of the reed as shown in dotted line at **18**, the reed accomplishes a switching action with an adjustable contact **19**. A lead **21** connects the contact **19** with a junction **22**. The junction **22** is connected to a switch terminal **23** through a vibration generator cut off by means of the lead **24**. A second switch terminal **26** is connected to the terminal **22** through a test lamp. The circuit is then completed from a movable contact **27** to the negative side of the power source by means of the lead **28**.

It is to be noted that the movable contact **27** may be set in a position to energize the test lamp or alternatively across contact **23** to include the vibration generator cut off in circuit in a manner which will become more apparent hereinafter.

A reference to Fig. 3 reveals a knurled handle **29** operative to raise and lower the contact **19** with respect to the tip of the switch reed **10**.

The control device of the present invention is placed in operation in the following manner:

Assume that a specimen of material to be fatigue tested has been placed in a conventional vibratory tester (not shown) and is being driven at a predetermined frequency by any suitable vibration generator. The specimen in the fatigue tester is usually in the form of a metal reed and is driven by a vibration generator which in turn causes the specimen to flex vigorously at its own natural frequency.

It is well known that the specimen will continue to vibrate at its natural frequency until the fatigue point is reached. Experience has shown that at this point, i.e., the beginning of fatigue failure, the nature frequency of the specimen experiences a marked change. Usually the value of the frequency falls off gradually until a complete break or separation of the test specimen occurs. Conceivably a specimen approaching failure may show an increase in the number of flexures per cycle over the natural, frequency, but in the event of an increase or a decrease in frequency, the principles of the present invention would apply.

For the sake of explanation of the embodiment of the invention disclosed herein it will be assumed that at the point of failure the frequency of the specimen decreases (Fig. 4).

Utilizing a conventional "pick-up" (not shown) such as a sound head, a signal corresponding to the frequency at which the test specimen is vibrating (its natural frequency) is impressed upon the electromagnet **14**. This signal through the electromagnet sets the switch reed **10** into vibration.

Next, an operator "searches" for the frequency of the test specimen by rotating the dial **13** clockwise and counterclockwise, thus advancing and withdrawing the reed **10** (actually changing its effective length) until the

reed **10** is vibrating in sympathy or in synchronism with the test specimen and at the natural frequency of the selected effective length. At this time, what is actually occurring is that the operator is searching for the particular effective length of the reed **10** which, under the influence of the signal impressed upon it by the electromagnet **14**, will produce maximum amplitude in the reed **10**. In this way, an effective length of switch reed is selected whose natural frequency is identical to the natural frequency of the test specimen.

After the particular length of switch reed has been selected, which produces maximum amplitude in the switch reed thus assuring sympathy or synchronism between the switch reed and the test specimen, the movable contact **27** is connected to the contact **26**. Thereafter the movable contact **19** is slowly moved upwardly until the tip of the switch reed begins to "tick" uniformly against the contact **19**. This occurrence can be observed by noting a uniform flicker in the test lamp L.

At this point, then, the switch reed is vibrating in sympathy with the test specimen and the switch reed is also developing maximum amplitude because it is vibrating at its natural frequency.

Since it is known that the natural frequency of a test specimen drops or falls off to a lower frequency just prior to the occurrence of failure, the switch reed is adjusted slightly in a direction which corresponds to a lower frequency. In actual practice, this is a matter of moving the switch reed to the right or the left several thousandths of an inch. Frequently it is desirable to calibrate the micrometer directly into frequency or at least to provide a chart or graph from which micrometer readings in thousandths may be readily converted into frequency using well known formula.

After adjustment of the switch reed, the amplitude thereof immediately decreases since the signal impressed on the electromagnet **14** remains unchanged and does not represent the natural frequency for the new adjustment length of the switch reed. Thus, the tip of the reed no longer "ticks" the movable contact **19**. At this time, the contact **27** is placed across the terminal **23** thus placing the vibration generator cut-off in circuit. In this condition, the fatigue tester may be left unattended with the assurance that the interval of failure may be readily recorded and that the generator will be shut off at failure of the specimen.

As stated before, prior to failure of the specimen, the frequency of vibration of the specimen will drop off. This means that the signal impressed upon the electromagnet will reflect this drop-off and the switch reed will begin to vibrate at the new lower frequency. By virtue of the previous adjustment of the effective length of the switch reed to a point corresponding to a selected lower value of frequency the amplitude of the switch reed will increase as the falling value of frequency begins to approach the natural frequency of the adjusted effective length of the switch reed. As soon as the test specimen and the switch reed are vibrating in sympathy or in synchronism, the switch reed will again be at maximum amplitude and the tip of the reed strikes the contact **19**, the fatigue tester is immediately cut off. Termination may also include actuation of a time device, such as a time stamp, as desired.

Obviously, one of the primary features of the control device is the versatility designed into a single switch reed. It is anticipated that other modifications and variations of the present invention may be devised without departing from the spirit and scope thereof.

What is claimed is:

1. A tuned reed relay for regulating electric circuits comprising a single reed adapted to be vibrated selectively at a variety of frequencies, electrical means independent of said electric circuits for setting said reed in vibration, means for adjusting the effective length of the reed whereby the reed may be set in vibration at the natural frequency corresponding to the particular effective length, and adjustable contact means cooperating with the settable reed effective to operate at predetermined amplitudes of reed vibration and further effective to regulate said electric circuit.

2. A tuned reed relay for regulating electric circuits comprising a single reed adapted to be vibrated selectively at a variety of frequencies, means for adjusting the effective length of the reed whereby the reed may be set in vibration at maximum amplitude for a given frequency, said reed constituting an electrical contact, electrical means for impressing a vibratory signal upon said reed, said electrical means being independent of said electric circuits and adjustable contact means cooperating with the settable reed effective to regulate said circuit whenever said vibratory signal corresponds to said given frequency.

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