March 27, 1951 A. L. WEISBECKER 2,546,284

ELECTRICAL SWITCH

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Fig. 1.

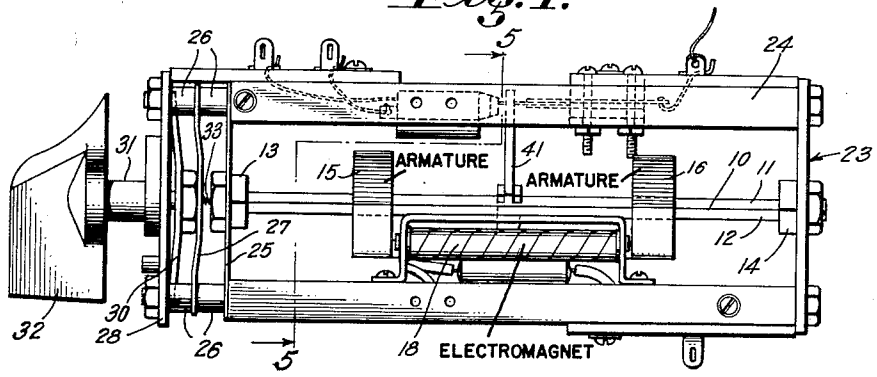


Fig. 2.

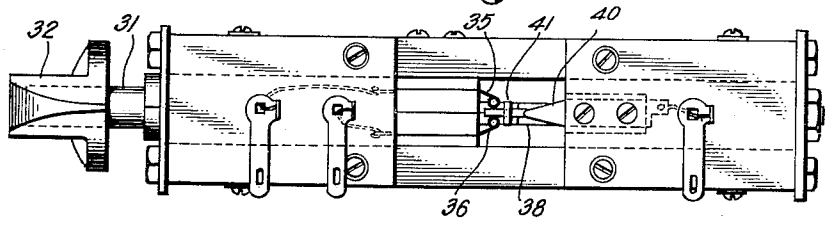
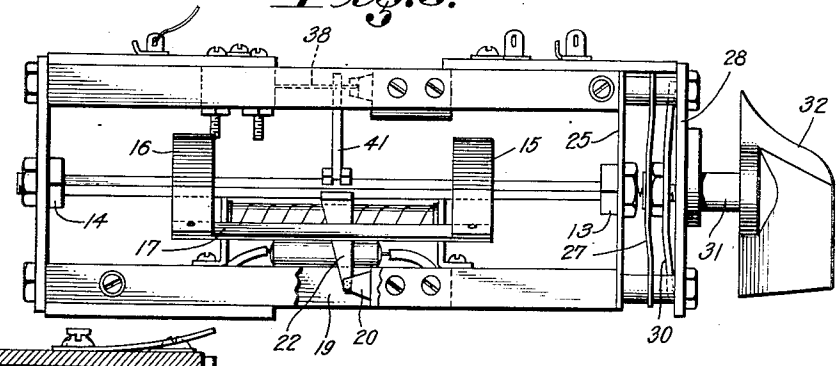


Fig. 3.



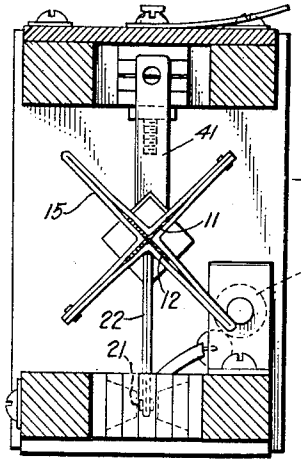


Fig. 4.

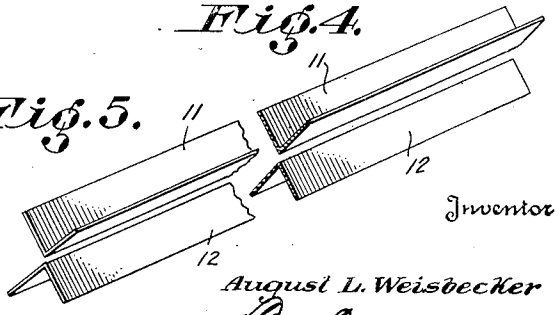


Fig. 5.

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Fig. 6.

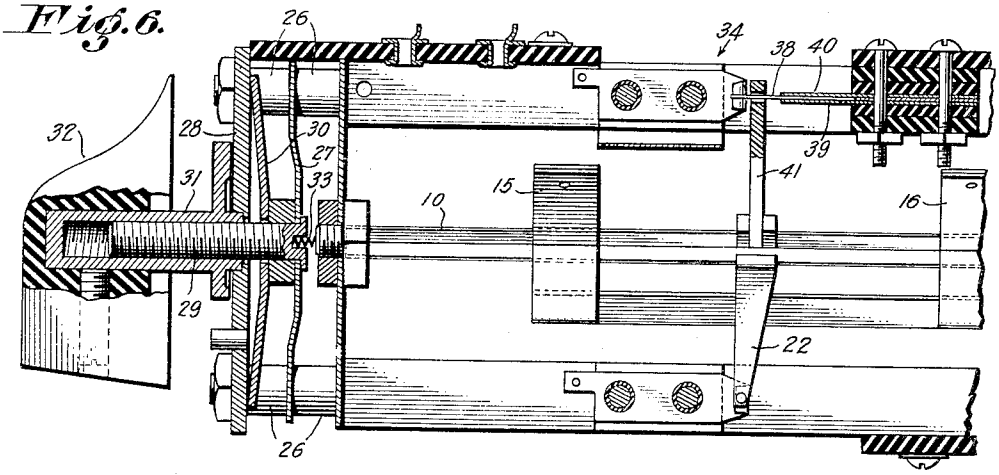
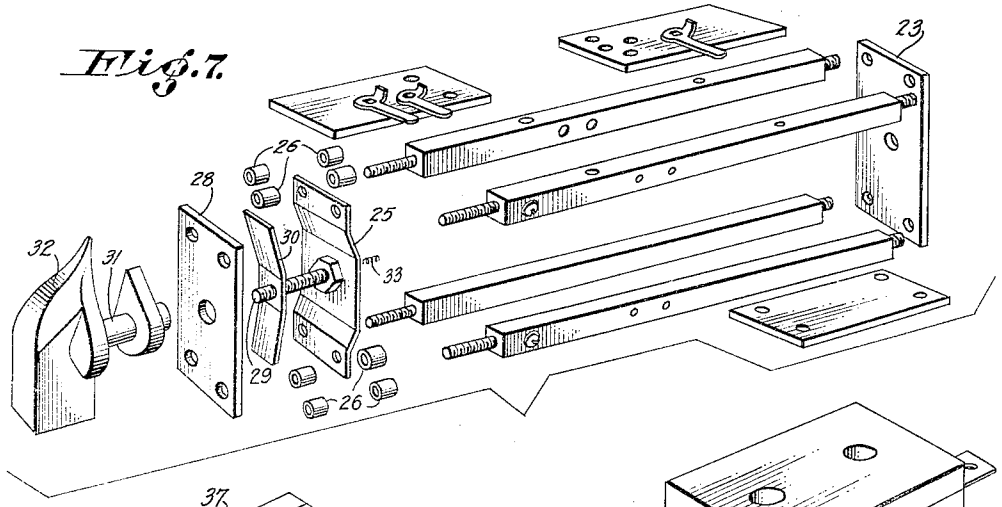


Fig. 7.



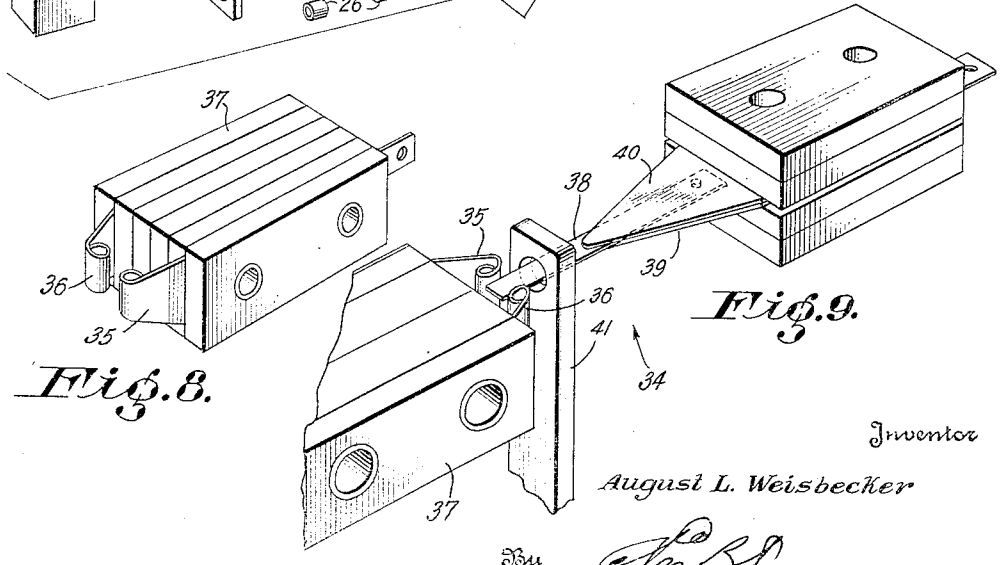


Fig. 8.

Fig. 9.

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ELECTRICAL SWITCH

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Application September 7, 1948, Serial No. 48,069

12 Claims. (Cl. 200—90)

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This invention relates to switching devices and more particularly to such a device having a high rate of switching of the order of 100 cycles per second combined with a very short switching interval of the order of a few microseconds.

So-called "electronic switches" are known, by means of which two voltages may be simultaneously viewed on a cathode-ray oscillograph. However, such apparatus is both bulky and expensive. It is also subject to the limitation that high switching rates, combined with a short switching interval cannot be maintained without considerable distortion of the applied voltages. It is accordingly an object of my invention to provide an electrically operated switch peculiarly adaptable to such usage, which will overcome these limitations. While my invention is designed primarily for use in the apparatus disclosed in my copending application Serial No. 37,880, filed July 9, 1948, it will be apparent that it is not limited to such use. In fact, it has broad application throughout the electrical industry wherein high switching rates with very short switching intervals are required. It can be used, for example, in place of vibrating reed devices now used in mobile radio power supplies.

Briefly, the apparatus of my invention comprises a torsional spring element, supported at each end, operated in oscillatory motion by suitable actuating means, and having a switch operating lever connected thereto. The switch itself, for example, may be of the knife blade type in which case the switch operating lever strikes a hammer-like blow against alternate sides of the knife blade.

The accompanying drawings show a preferred embodiment of my invention in which:

Figure 1 is a side elevation.

Figure 2 is a top view.

Figure 3 is a side elevation from the opposite side of that shown in Figure 1.

Figure 4 is a chopped exploded perspective view of the torsional element.

Figure 5 is a sectional view taken on line 5—5 of Figure 1.

Figure 6 is an enlarged view partially in section of Figure 1.

Figure 7 is an exploded perspective of the frame and stress producing elements.

Figure 8 is an enlarged perspective view of the switch contacts and mounting block.

Figure 9 is an enlarged perspective view of the switch itself.

The torsional spring element 10, as shown, is made up of a pair of members 11 and 12 substantially V-shaped in cross section and supported in back to back relationship. This is best shown in Figure 4. These members are preferably made of the alloy known commerically as Nichrome V, but it is to be understood that other alloys having adequate fatigue loading resistance could also be used. The members 11 and 12 are held in back to back relationship by having their ends secured in the two end blocks 13 and 14. It will be apparent that there are other possible mechanical equivalents of this construction. The members 15 and 16 (best shown in Figure 5) secured to the element 10 are made of magnetic material, and serve a double purpose. First they add mass to the oscillating system, and by reason of the tie member 17 and the rigid supports at each end of the spring, the entire system tends to have but one natural mode of oscillation. Second, they provide a magnetic portion for the system so that it may be driven electromagnetically as the armature of a motor. The symmetrical arrangement of the radially extending arms of members 15 and 16 is more important than the number of arms. The electromagnet 18 is centrally mounted between corresponding arms of magnetic members 15 and 16, as shown, so that when energized, a substantially equal force will be exerted on 15 and 16, and the torsional spring element will be deflected accordingly. The force exerted on the radially extending arm of members 15 and 16 is due to the fact that a magnetic material will always tend to move toward the region of maximum flux density of the magnetic field to which it is subjected. As best shown in Figure 5, the arms of members 15 and 16, when in their normal or rest position, lie outside the field of maximum flux produced when electromagnet 18 is energized. The circuit of electromagnet 18 includes a normally closed circuit breaker 19 comprising a fixed contact 20 and movable contact 21, the latter being mounted on arm 22. The arm 22 is rigidly secured to the torsional spring element 10. When electromagnet 18 is energized, the magnetic force exerted on members 15 and 16 twists the torsional spring element and contact is then broken between 20 and 21. The torsional element 10 then returns toward its position of rest and contact is again made at 20 and 21 so that the cycle is continuous, once started. It should be apparent, however, that means other than the electromagnetic means shown here could be used to apply a regularly recurrent force to the torsional spring element 10 to cause it to oscillate about its longitudinal axis. An

electric motor, for example, with a cam on its shaft could be arranged to accomplish the same result.

In order to vary the frequency of oscillation of the torsional spring element 10, it is convenient to employ means to set up a longitudinal stress in this element. In the drawings, therefore, I show a preferred means for accomplishing this. As shown in Figures 1, 3, and 6, one end of the spring element 10 is rigidly connected to a rigid end plate 23 of the frame 24. At the opposite end, a resilient end plate member 25 supports the spring element. Spacer members 26 separate, in fixed relation, a second resilient plate 27 from plate 25 and a rigid end plate 28. Rigidly secured to plate 27 is a threaded member, e. g. machine screw 29, which protrudes through the rigid end plate 28. A leaf spring 30 serves to bias screw 29 against the end of torsional spring element 10 through helical spring 33. A hollow shaft 31 is threaded to mate with screw 29. A handle 32 secured to shaft 31 provides means for varying the longitudinal stress on the torsional spring 10. The small helical spring 33 serves to act as a cushion and to force transmitting element between the end of torsional spring 10 and machine screw 29.

The apparatus thus far described is for the purpose of operating the switch 34 in a manner characterized by high switching rates of the order of 100 cycles per second and short switching intervals of the order of a few microseconds. A preferred construction of the switch 34 is shown in Figure 9, and consists first of a pair of fixed leaf spring contact members 35 and 36. These are mounted in a laminated insulating block 37. The arm 38 of the switch is frictionally held and pivotally mounted between two other leaf spring members 39 and 40. A switch operating lever 41 is rigidly connected to the torsional spring element 10, at about its mid point. At the outer extremity of lever 41, there is an opening which surrounds the outer end of the switch arm 38. Some clearance is desired between these two members so that arm 38 when struck by the lever 41 will remain in contact with either 35 or 36 until struck in the opposite direction. Contacts 35 and 36 are similar in all respects and are made of leaf spring material. As shown in Figure 8, their ends are bent to form tubular portions thereon. These are so designed that the point at which arm 38 strikes them is a node point for their natural mechanical vibrations. This feature minimizes "contact chatter" when the switch is in operation.

From the foregoing, the operation of my device will be clear. The oscillatory motion of the torsional spring element 10, causes the lever 41 to strike repeated hammer-like blows against alternate sides of the switch arm 38. Because of the clearance or lost motion connection between these two members, and the frictional loading on arm 38, the latter will strike and remain in contact with either 35 or 36 until struck from the opposite side. This results in a substantially equal duration of contact of arm 38 alternately with the switch contacts 35 and 36 throughout the cycle of operation. It also results in an extremely short switching interval between contact points. Thus if a source of voltage is connected to 35 and another to 36, these voltages may be connected alternately to other circuits such, for example, indicating circuits or measuring instruments which are connected to the switch arm 38.

The following claims set forth with particularity the novelty of my invention. What I claim is:

1. A switching device for operation at switching rates of the order of 100 cycles per second and switching intervals of a few microseconds comprising: an elongated torsional spring element; means for rigidly supporting said element at its opposite ends to allow torsional deflection of the intermediate portion thereof; means to apply a recurrent torsional stress to said element to produce oscillatory motion about its longitudinal axis; an electric switch including a movable switch arm mounted adjacent said element; and lever means, one end of which is attached to said spring element and the other end of which is operatively connected by means of a lost motion connection to said switch arm, whereby said switch is operated by said lever means striking hammer blows on alternate sides of said switch arm as said spring element is oscillated.

2. A switching device, for operation at switching rates of the order of 100 cycles per second and switching intervals of the order of a few microseconds, comprising: a torsionally-resilient transversely stiff elongated spring element; means for rigidly supporting said element at its opposite ends to allow torsional deflection of the intermediate portion thereof; means to apply a recurrent torsional stress to said element to produce oscillatory motion about its longitudinal axis; an electric switch including a movable switch arm mounted adjacent said elongated element; a switch operating lever rigidly connected to and extending radially from said elongated element; and means at the outer end of said lever forming an operative, lost motion connection with said switch arm, whereby said switch is operated by said lever means striking hammer blows on alternate sides of said switch arm as said spring element is oscillated.

3. A switching device, for operation at switching rates of the order of 100 cycles per second and switching intervals of the order of a few microseconds, comprising: a torsionally-resilient transversely stiff elongated spring element; means for rigidly supporting said element at its opposite ends to allow torsional deflection of the intermediate portion thereof; electromagnetic actuating means to apply a recurrent torsional stress to said element to produce oscillatory motion of said element about its longitudinal axis; an electric switch mounted adjacent said element and having at least one fixed contact and a switch arm movable into and out of engagement therewith; a switch operating lever rigidly connected to and extending radially from the midsection of said element; and means at the outer end of said lever forming an operative lost motion connection with said switch arm, whereby said switch is operated by said lever means striking hammer blows on alternate sides of said switch arm as said spring element is oscillated.

4. A switching device, for operation at switching rates of the order of 100 cycles per second and switching intervals of the order of a few microseconds, comprising: a torsionally-resilient transversely stiff elongated spring element; means for rigidly supporting said element at its opposite ends to allow torsional deflection of the intermediate portion thereof; means to apply a recurrent torsional stress to said element to cause oscillatory motion about the longitudinal axis thereof, said means including an electromagnet and a circuit breaker therefor carried by said

elongated member; an electric switch having at least two relatively fixed contacts and a switch arm movable therebetween, mounted adjacent said element; a switch operating lever rigidly connected to and extending radially from the midsection of said member; and means at the outer end of said lever forming an operative lost motion connection with said switch arm to provide a lost motion connection between said lever and said arm whereby said switch is operated by said lever means striking hammer blows on alternate sides of said switch arm as said spring element is oscillated.

5. In a device as defined by claim 2, in which the elongated member comprises: a pair of members substantially V-shaped in cross section; a pair of end blocks; said members being connected at each end thereof to said end blocks to provide an elongated member substantially X-shaped in cross section and having a high degree of transverse rigidity combined with a high degree of torsional resilience.

6. A switching device, for operation at switching rates of the order of 100 cycles per second comprising: a torsionally-resilient transversely-stiff torsional spring element; means providing a support and preventing rotative movement of said element at each end thereof; an electric switch including a movable switch arm mounted adjacent said element; a switch operating lever rigidly connected to and extending radially from the approximate center of said element; means providing a lost motion connection between said lever and said switch arm; a pair of weights rigidly connected to the torsional element at points substantially equidistant from the ends and center thereof, said weights comprising a plurality of symmetrical radially extending arms of magnetic material; a longitudinally extending bar member joining corresponding arms of said weights; an electromagnet mounted adjacent said spring and having its pole faces disposed in close proximity to corresponding arms of said magnetic members; a normally closed electric circuit breaker in series with said electromagnet; a circuit breaker arm rigidly connected to and extending radially from said element; and means for energizing said magnet to cause said weights to move in a circular path toward the center of the pole faces of said electromagnet and against the resistance to torsional movement of said element, whereby the said circuit breaker is rendered operative and the cycle repeated to produce oscillatory motion of said element that is effective to operate the said switch at a rate corresponding to the oscillation frequency of the said element.

7. A device as defined by claim 6 in which means are provided to place said spring element under a variable longitudinal stress to vary the period of oscillation of said spring element.

8. A device as defined by claim 1 in which the said torsional element is mounted in a frame; means for rigidly connecting one end of said element to one end of said frame; a resilient plate member connected to the other end of said frame; means for supporting the other end of said element in said resilient plate member; threaded adjustment means mounted on said frame; means providing a connection between said adjustment means and said element whereby the longitudinal stress in said element may be varied in order to change the natural frequency of oscillation of said element.

9. In a device as defined by claim 6 in which

the said electric switch, comprises: a pair of fixed leaf spring contacts mounted adjacent each other in an insulating block, said contacts having their free ends bent to form tubular contact portions thereon; a knife blade switching arm, pivotally mounted, and extending between said contacts; means for frictionally loading said switch arm; the tubular portions of said contacts being so located with respect to said switch arm that contact therebetween occurs at a point which is a node for the natural mechanical resonance vibration of said contacts.

10. A switching device, characterized by operation at switching rates of the order of 100 cycles per second and switching intervals of the order of a few micro-seconds, comprising: a torsionally-resilient transversely-stiff elongated torsional spring element; means providing a support and preventing rotative movement of said element at each end thereof; a pair of magnetic members rigidly connected to said spring element at points substantially equidistant from the ends and center thereof, said members having a plurality of symmetrical radially extending arms; a longitudinally extending strip connecting corresponding arms of said members at the outer extremities thereof; an electromagnet mounted adjacent said element and centrally disposed between said magnetic members, the pole ends of said electromagnet being supported in close proximity to a corresponding pair of said arms; a normally closed circuit breaker in series with said electromagnet; a circuit breaker arm rigidly connected to and extending radially from said element; an electric switch including a movable switch arm mounted adjacent said element; a switch operating lever also rigidly connected to and extending radially from the mid-section of said element and having an opening in the outer end thereof surrounding said switching arm, whereby a lost motion connection is provided between said lever and said switching arm; a source of electrical energy for said electromagnet; and a threaded type loading means for varying the longitudinal stress in said torsional element to change the natural period of oscillation thereof, thereby changing the switching rate.

11. A switching device for operation at switching rates of the order of 100 cycles per second and switching intervals of a few micro-seconds comprising: a pair of elongated members substantially V-shaped in cross-section, connected at their ends in back-to-back relationship to form a spring member substantially X-shaped in connection; means for supporting said spring member at its opposite ends to permit torsional deflection of the intermediate portion about the longitudinal axis thereof, at least one support being rigid; means to apply a recurrent torsional stress to said spring member to produce oscillatory motion about its longitudinal axis; an electric switch including a movable switch arm mounted adjacent said spring member; and lever means one end of which is attached to said spring member and the other end of which is operatively connected by means of a lost motion connection to said switch arm, whereby said switch is operated by said lever means striking hammer blows on alternate sides of said switch arm as said spring member is oscillated.

12. In a device as defined by claim 11, a resilient support for one end of said spring member; and threaded adjustment means connected to the resiliently supported end of said spring member to set up and vary the longitudinal stress

therein to change the natural period of oscillation of said element.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
802,480	Seeley	Oct. 24, 1905
1,639,178	Guillet	Aug. 16, 1927
1,750,275	Legg	Mar. 11, 1930
1,920,135	Allen	July 25, 1933
1,932,164	Petit	Oct. 24, 1933
2,043,152	Cook	June 26, 1936
2,183,934	Heiland	Dec. 19, 1939
2,313,919	Burt	Mar. 16, 1943
2,349,929	Atkins	May 30, 1944
2,445,401	Langer	July 20, 1948
2,499,632	Coake	Mar. 7, 1950