

Aug. 24, 1954

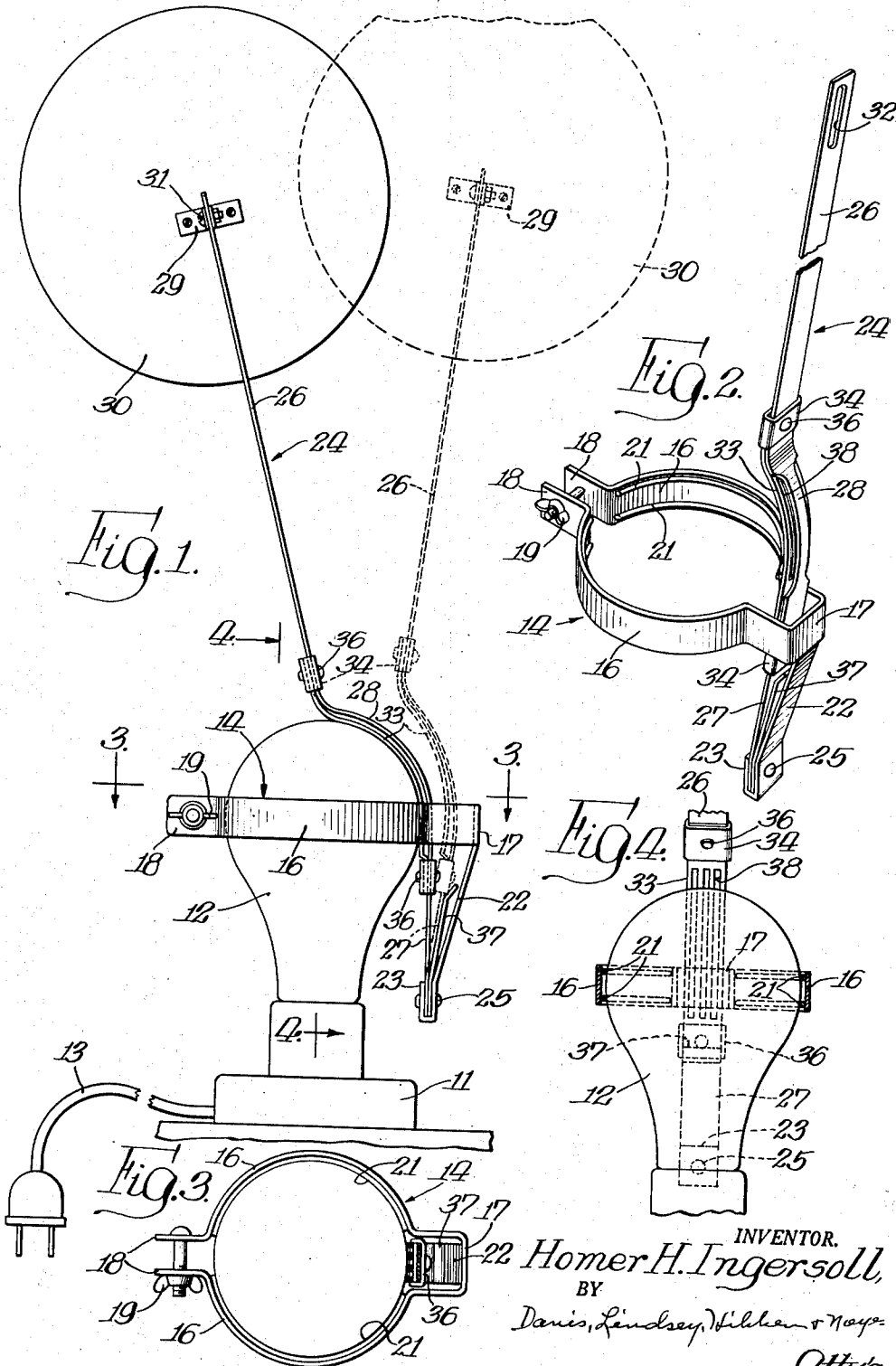
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2,687,005

HEAT-ACTUATED DEVICE FOR IMPARTING OSCILLATING MOTION

Filed Dec. 13, 1950

3 Sheets-Sheet 1



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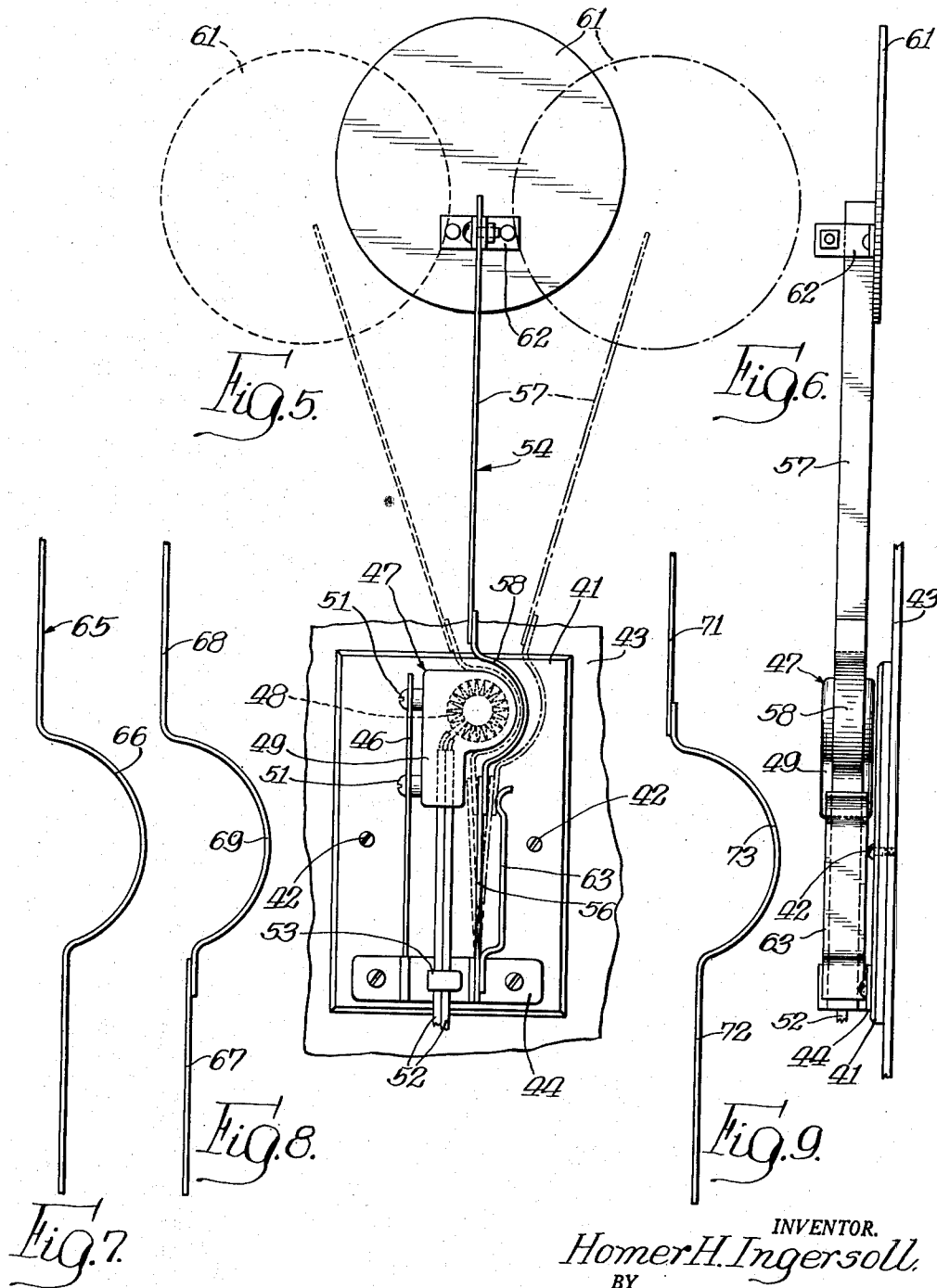
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HEAT-ACTUATED DEVICE FOR IMPARTING OSCILLATING MOTION

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3 Sheets-Sheet 2



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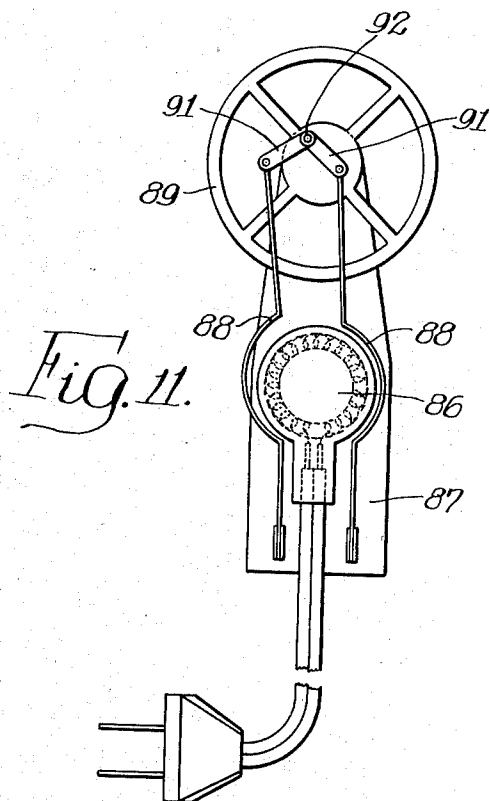
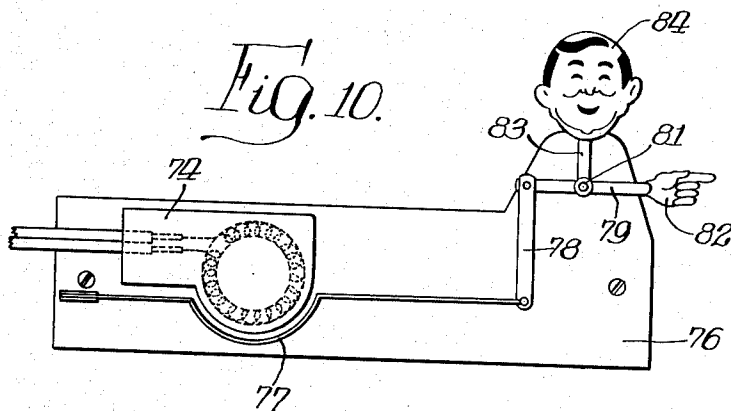
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HEAT-ACTUATED DEVICE FOR IMPARTING OSCILLATING MOTION

Filed Dec. 13, 1950

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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HEAT-ACTUATED DEVICE FOR IMPARTING
OSCILLATING MOTIONHomer H. Ingersoll, Kalamazoo, Mich., assignor
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Application December 13, 1950, Serial No. 200,679

23 Claims. (Cl. 60-23)

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This invention relates to a novel heat-actuated device for effecting or imparting motion and more particularly to a novel bimetallic means for causing oscillatory motion.

Various devices have been utilized heretofore for effecting movement of animated advertising and display devices or the like. For example, induction motors and solenoid devices of varying types have been commonly employed for such purposes. In general, however, such devices have been relatively expensive and have often required a substantial degree of skill or experience to insure their proper installation and maintenance. Moreover, in other cases such devices have included various circuit breaking means which are subject to serious disadvantages such as excessive fire hazard, interference with radio reception, and noisy operation.

A primary object of the invention is to provide a novel heat-actuated device for effecting or imparting motion which is relatively simple in construction and inexpensive to manufacture.

A further object of the invention is to provide a novel device of the character described which is compact, easy to install and maintain, involves no fire hazard, and does not depend upon intermittent interruption of an electrical circuit.

Another object of the invention is to provide a novel heat-actuated device including a thermostatic or bimetallic means which is adapted to produce sustained oscillating motion for an indefinite period of time.

An additional object of the invention is to provide a novel heat-actuated device of the character described wherein the thermostatic effect of a bimetallic means and the momentum of a moving object cooperate to produce a smooth continuous back and forth swinging movement.

Another object of the invention is to provide a novel device of the character described which is especially adapted for use as a simple and inexpensive animating means for advertising displays and the like.

Still another object of the invention is to provide a novel heat-actuated device of the character described which is adapted for use with an ordinary electric light bulb as a source of heat.

Other objects and advantages of the invention will become apparent from the subsequent detailed description taken in connection with the accompanying drawings wherein:

Fig. 1 is an elevational view of an assembled device embodying the principles of my invention and comprising the preferred form thereof;

Fig. 2 is a perspective view of a portion of the device shown in Fig. 1;

Fig. 3 is a horizontal sectional view taken along the line 3-3 of Fig. 1;

Fig. 4 is a vertical sectional view taken along the line 4-4 of Fig. 1;

Fig. 5 is an elevational view of a different embodiment of the invention;

Fig. 6 is a side view of the device as viewed from the right-hand side of Fig. 5;

Figs. 7 to 9 are elevational views showing slightly different forms of one of the elements of my device;

Fig. 10 is an elevational view of another embodiment of the invention; and

Fig. 11 is an elevational view of still another embodiment of my invention.

Broadly speaking, the invention comprises an elongated reciprocable member having one end fixed and its opposite end free for back and forth swinging movement. A heat-responsive means, such as a bimetallic element, is associated with the member along a portion of its length for imparting swinging movement to the member. The invention also contemplates broadly the combination of such a swingable heat-actuated member with a fixed heat source for actuating the heat-responsive means whereby to impart back and forth movement to the member away from and toward the heat source. As will hereinafter appear, in the preferred form of the invention, the elongated swingable member is formed from relative flexible material and the heat-responsive means has a normally curved configuration.

Although the invention is described herein with particular reference to an animated advertising or display device, it will be understood that this is merely for the purpose of illustration and that the invention is generally applicable to a wide variety of uses such as in novelties, toys, safety or control devices, scientific instruments, and various other applications where back and forth movement is desired.

Referring first to Figs. 1 to 4, the device illustrated therein comprises a lamp socket 11 of a conventional type having an electric light bulb 12 inserted therein and provided with a connecting electric cord and attachment plug 13. As

will hereinafter appear, the electric light bulb 12 comprises a source of heat for actuating the thermo-responsive portion of the device.

Surrounding the enlarged portion of the bulb 12 is an adjustable holder, indicated generally at 14, which comprises a pair of substantially semi-circular straps or bands 16 adapted to fit circumferentially around the bulb 12 and connected together at one side of the bulb by means of an outwardly extending and integral U-shaped portion 17. The bands 16 may conveniently be formed from resilient material such as spring metal or the like, and the opposite ends thereof are provided with a pair of extensions or ears 18 adapted to be drawn together in tightened relation on the bulb 12 by means of a thumb screw 19. Secured to the inner periphery or surfaces of the straps 16 are pairs of spaced beads comprising elongated round wires 21 which are welded or otherwise fastened in spaced relation adjacent the longitudinal edges of the straps. Thus, it will be seen that the curvature of the bulb 12 engages the spaced wires 21 which provides a slight recess or socket for the curvature of the bulb to enter whereby to permit easy adjustment in the nature of a swivel action of the holder 14 relative to the bulb 12.

Depending from the U-shaped portion 17 of the holder 14 is an arm or bracket 22 provided with an upturned end portion 23. An elongated member or arm, indicated generally at 24 and comprising the principal operating element of the device, is disposed with its lower end seated in the upturned portion 23 of the bracket 22 and secured in fixed position therein by means of a rivet 25 or the like. The arm 24 comprises a continuous length of relatively flexible material, preferably flat spring steel in order to provide the required degree of resilience, and is formed with substantially straight upper and lower end portions 26 and 27, respectively, and an integral intermediate curved portion 28 adapted to conform generally to the curvature of the bulb 12. The curved portion 28 of the arm 24 is cut away or narrowed, as best seen in Fig. 2, in order to facilitate flexing of the arm at this point. Secured adjacent the extremity of the upper end portion 26 of the arm 24 by means of an adjustable clip or fastener 29 is an object 30 which it is desired to animate or move in an oscillating manner. For purposes of illustration, the object 30 is here shown merely as a circular disk which may comprise part of an animated advertising display, but it will be understood that any suitable figure, replica, indicator or the like may be employed. The fastener 29 includes a screw 31 which extends through a slotted portion 32 at the upper end of the arm 24 to permit longitudinal adjustment of the object 30 thereon.

Extending along the inside face of the curved portion 28 of the arm 24 is a normally curved bimetallic strip 33 which also conforms generally to the curvature of the bulb 12 and is secured to the arm 24 in slightly spaced relation from the curved portion 28 thereof by means of a pair of attaching clips 34. The clips or fasteners 34 surround the arm 24 and the opposite ends of the bimetallic strip 33 and are secured in place by means of a pair of rivets 36 or the like. The bimetallic strip 33 is of the conventional construction well known in the art, and I preferably provide the strip with a plurality of longitudinal slots 38 or other equivalent openings in order to permit more rapid heating and cooling of the bimetallic element. Also, the provision of the slots

38 weakens the strip and facilitates flexing movement thereof. A stop member or resilient retainer is provided for coaction with the arm 24 and comprises an upright length of spring material 37 fastened at its lower end by the rivet 25 between the arms 22 and 24. As will hereinafter appear, the stop 37 together with the bulb 12 constitute limiting means for movement of the arm 24.

The operation of the device is as follows: First the operating mechanism, as illustrated in Fig. 2, is positioned as desired on the bulb 12 by adjustment and tightening of the thumb screw 19 in order to fit the straps 16 of the holder 14 securely on the bulb. By adjusting the longitudinal position of the object 30 on the arm 24 and also by tilting the holding device 14 relative to the bulb 12 as required, the arm 24 is caused to assume the initial position shown in full lines in Fig. 1. It will be understood that with the arm 24 of the device in this position the center of gravity of the object 30 is disposed beyond center and to the left with the result that the curved bimetallic element 33 engages the curved surface of the bulb 12 whereby the arm 24 is retained or supported in its extreme left-hand position as seen in Fig. 1. When the attachment cord and plug 13 are connected to a source of electricity, the bulb 12 is illuminated and heat is evolved whereupon the curved bimetallic element 33 undergoes the well known thermostatic or temperature responsive action. In response to heating by the bulb 12, the bimetallic element 33 flexes outwardly, i. e. expands or uncurls, with the result that the arm 24 carrying the object 30 is displaced or swung to the right whereby the center of gravity of the object 30 is shifted beyond center and to the right so that the arm 24 occupies the extreme right-hand position indicated in broken lines in Fig. 1. In this position the bimetallic element 33 is disposed in spaced relation from the bulb 12 and is, therefore, cooled by the surrounding air. The provision of the slots 37 in the bimetallic strip 33 facilitates rapid cooling. As the bimetallic element 33 cools, contraction or reverse flexing movement of the curved strip takes place so that the element 33 resumes its initial curved position and the arm 24 carrying the object 30 is swung back to its initial position.

An important feature of my invention resides in the manner in which my device utilizes the combined effects of thermostatic movement of the element 33 and the kinetic energy or momentum of the object 30 to produce the desired back and forth oscillating movement of the arm 24. Thus, as the bimetallic element 33 is heated when the arm 24 is in its left-hand position, the thermostatic effect causes the initial movement or displacement of the arm 24 to the right. However, as the arm 24 moves to the right the momentum of the object 30 causes the arm 24 to swing to the right far beyond the point to which the flexing movement of the bimetallic strip 33 alone would have carried the arm. Similarly, upon movement of the arm 24 in the reverse direction, i. e. from right to left, the reverse flexing of the strip 33 upon cooling thereof merely initiates the swinging movement to the left and the momentum of the object 30 carries the arm 24 well beyond the position which would correspond merely to the effect of the bimetallic element 33.

Accordingly, it will be seen that the oscillating back and forth movement which is characteristic of my device is the result of the combined effects

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of momentum and the thermostatic means whereby the object 30 is swung back and forth in a continuous manner. In order to facilitate a smooth non-jerky operation or swinging movement of the arm 24, I prefer that the arm be formed from a relatively resilient material such as spring steel. In this manner, the bimetallic element 33 imparts or initiates the back and forth swinging movement of the device and the flexible supporting arm 24 then amplifies or increases the extent of swinging movement to produce a pleasing mode of operation which is not usually obtained with devices operating solely on a thermostatic principle. Although the material comprising the arm 24 is preferably resilient in order to facilitate combined thermostatic and kinetic energy effects on the movement of the arm, still the arm 24 must have sufficient rigidity to hold the object 30 at the desired angles in both the extreme left-hand and right-hand positions without excessive bending.

It will be seen that as the bimetallic element 33 undergoes repeated heating, cooling, and reheating, the cycle of back and forth swinging movement of the arm 24 may be repeated indefinitely as long as the bulb 12 is lighted. It will be understood that as the arm 24 swings back and forth, the bulb 12 and the member 37 constitute retainers or stops for limiting the extent of swinging or oscillating movement. By sliding the object 30 upwardly or downwardly relative to the upper portion 26 of the arm, the elevation of the center of gravity of the object 30 may be varied whereby to control the rapidity or frequency of the back and forth movement of the arm.

In Figs. 5 and 6, I have illustrated a somewhat different embodiment of the invention wherein a special resistance heating element is employed as the source of heat rather than an ordinary electric light bulb. The device comprises a base or mounting block 41 which may be of fibre or other suitable non-conducting material. The base 41 may be secured by means of a plurality of screws 42 to a wall or other upright member such as indicated at 43. Secured adjacent the lower edge of the base 41 is a bracket 44 having an upright member 46 secured rigidly thereto and extending upwardly therefrom. The upper portion of the member 46 has attached thereto a heating element indicated generally at 47 and comprising an annular resistance coil 48 surrounded by a suitable casing 49. The casing 49 is secured to the upright member 46 by means of a pair of screws 51, and the upper portion of the casing is provided with a curved shape to conform generally to the shape of the circular or annular heating element 48. The casing 49 surrounding the heating element 48 is preferably made of a metal such as aluminum or copper which will absorb and conduct heat rapidly. A pair of wires or electrical conductors 52 are connected to the heating element 48 and extend downwardly from the bottom of the casing 49 to a conventional attachment plug (not shown). The wires 52 are retained in position adjacent the bracket 44 by means of an integral clip 53 formed on the bracket 44.

The swingable arm of the device in this form of the invention is indicated generally at 54 and comprises a lower length 56 of flexible material such as spring metal, which is rigidly secured to the bracket 44, and an upper length of spring metal 57, the strips of spring metal being welded or otherwise secured to a normally curved bimetallic strip 58. In this form of the invention,

the longitudinal slots in the curved bimetallic strip 58 have been omitted. An object 61 is adjustably secured by means of a clip or fastener 62 to the upper end of the strip 57. A resilient stop or retainer member 63 is provided at the right-hand side of the arm 54 and is rigidly secured to the bracket 44 for engagement with the lower portion of the arm.

The operation of this form of the device is generally similar to the operation of the first form of the invention. The arm 54 is shown in Fig. 5 in neutral or intermediate position in full lines and in its extreme left-hand and right-hand positions in broken lines. The curved bimetallic strip 58 fits around the curved portion of the casing 49 and is heated thereby as heat is transmitted from the heating element 48 to the casing. Upon heating, the curved bimetallic element flexes or opens up with the result that the arm 54 is swung from its left-hand to its right-hand position. In the latter position, the bimetallic element 58 cools and then retracts whereby to swing the arm 54 back to its left-hand position, this action being repeated indefinitely. During the oscillating back and forth movement of the arm 54, the casing 49 and the retainer 63 serve to limit the extent of oscillating movement. As in the first form of the invention, the momentum of the object 61 amplifies the extent of swinging movement which is initiated and sustained by the bimetallic strip 58.

Figs. 7, 8 and 9 illustrate other possible modifications of the construction of the oscillatable arm which comprises the principal operating portion of my device. In Fig. 7 the arm is illustrated at 65 as comprising a continuous length of bimetallic strip having an integral curved central portion 66. In Fig. 8 the arm is illustrated as comprising a lower strip 67 of spring metal or the like to which is secured by welding or otherwise a length of bimetallic strip 68 having a curved portion 69. In Fig. 9 the reverse situation is illustrated wherein the uppermost portion of the arm comprises a strip of spring metal 71 secured at its lower end to a length of bimetallic strip 72 having a curved portion 73. It will be understood that the oscillatable arm of my device may be formed in any one of a number of different ways, of which the drawings illustrate only a few, as long as the arm includes or has associated therewith a bimetallic portion. Certain constructions of the swingable arm will have particular advantages in some situations dependent upon the weight of the object to be oscillated, the frequency of movement desired, and various other factors. It may be pointed out that the construction of the arm 24 shown in Figs. 1-4 is particularly advantageous where a heavy object is carried on the arm because none of the load is carried by the bimetallic element.

In Fig. 10 I have shown a modification of my invention wherein the reciprocable elongated member is utilized to actuate another movable mechanism such as an advertising display device. Thus, a heating device 74, which is substantially the same as the heating means 47 illustrated in Fig. 5, is shown mounted on a base or frame 76 in cooperating relation adjacent an elongated reciprocable member 77 of the type hereinbefore described. In this instance the elongated reciprocable arm is illustrated as being formed from a single length of bimetallic material such as shown in Fig. 7. The outer or free end of the arm 77 is pivotally connected to the lower end of a link 78 which is in turn pivotally connected to one end of a rockable lever 79. The

lever 79 is mounted for pivotal or rockable movement about a central pin 81 extending into the base 76. The opposite end of the lever 79 is shown, by way of illustration, as being provided with a simulated human hand 82. Extending upwardly and rigidly from the center portion of the lever 79 is an arm 83 carrying a simulated man's head. It will be readily understood that as the bimetallic arm 77 undergoes reciprocating back and forth movement away from and toward the heater 74, a rocking movement will thereby be imparted to the lever 79 as a result of the connecting link 78. The hand 82 will thus undergo back and forth movement in a vertical plane while the head 84 undergoes simultaneous back and forth movement in a horizontal plane.

In Fig. 11 there is illustrated still another application of the basic principle of my invention wherein the combination of a fixed heat source and a reciprocable bimetallic means is utilized to impart rotary motion to a wheel or the like. A resistance-type heating element 86 having a substantially circular outer contour is mounted on a base 87. A pair of elongated bimetallic arms 88 are secured at their lower ends to the base 87 on opposite sides of the heater 86, each of the arms 88 being provided with a curved central portion conforming to the shape of the heater 86. A wheel 89 is mounted for rotating movement at the upper end of the base 87 and is provided with eccentric operating connections comprising a pair of pivotal links 91. The links 91 are pivotally attached at their outer ends to the upper ends of the arms 88 and are pivotally connected at their inner ends to a pin 92 which is rigidly carried on the wheel 89 in eccentric or spaced relation from the axis of the rotation of the wheel. The operation of the device will be immediately apparent, it being understood that the arms 88 cooperate to impart back and forth movement to the links 91 which in turn coact with the pin 92 in the general manner of a crank to effect rotation of the wheel 89. It will be further understood that once the wheel 89 is in motion, the momentum thereof will serve to carry the wheel past the dead center positions of the links 91.

It will be seen that the heat-actuated device of my invention is extremely simple in construction and operation and requires only a minimum amount of skill to assemble and maintain the device in operating condition. In addition, the device has the decided advantage that it operates at relatively low temperatures of the order of 250-300° F. and does not involve making and breaking of electrical contacts. Consequently, no fire hazard is involved and also there is no interference with radio reception in the vicinity. Furthermore, the device is self-starting and will run indefinitely as long as the heating source is in operation. The form of the invention illustrated in Figs. 1 to 4 is particularly advantageous in that no special heating element is required and the device may be fitted in almost any position on a standard electric light bulb. Additional advantages of my device reside in the fact that it is adapted to be constructed in a variety of sizes and can be utilized in a number of ways either to impart motion to an object which it is desired to move in an oscillating manner or to actuate other devices in an intermittent fashion. The device is also relatively quiet in operation with the result that it makes an ideal low-priced and reliable means of animating advertising displays or the like.

Although the invention has been described in

connection with certain specific structural embodiments thereof, it will be understood that various modifications and equivalent structures may be employed without departing from the scope of the invention as defined in the appended claims.

I claim:

1. A heat-actuated device comprising an elongated flexible resilient arm, supporting means for holding said arm in a generally upright position with the lower end thereof fixed and the upper end free for swinging movement, a relatively weighted object to be reciprocated supported adjacent the free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper free end of said arm, and heat-responsive means associated with said arm along a portion thereof, said heat-responsive means being adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart back and forth movement to said arm and the object carried thereon, and the weight of said object in cooperation with the flexible resilient nature of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through said fixed end of said arm whereby to impart to said arm and said object smooth back and forth swinging movement of greater extent than the movement induced by said heat-responsive means alone.

2. A heat-actuated device comprising an elongated resilient flexible spring arm, supporting means for holding said arm in generally upright position with the lower end thereof fixed and the upper end free for back and forth swinging movement, a relatively weighted object to be oscillated carried adjacent the upper end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper free end of said arm, and a normally curved bimetallic element at an intermediate portion of said arm and adapted to undergo flexing movement in alternate directions upon heating and cooling thereof, said flexing movement of the curved bimetallic element in cooperation with the resilient flexibility of said spring arm causing said center of gravity to be shifted in an alternating manner at opposite sides of a vertical plane passing through said fixed end of said arm whereby to impart smooth back and forth swinging movement to said arm and the object carried thereon which is of greater extent than the movement induced by said bimetallic element alone.

3. The device of claim 2 further characterized in that the position of said object is adjustable longitudinally of said arm whereby to regulate the frequency of said back and forth swinging movement.

4. A heat-actuated device comprising in combination stationary heating means having a curved external shape, an elongated flexible resilient arm supported in a generally upright position adjacent said heating means with the lower end of said arm fixed and the upper end free for back and forth swinging movement, a relatively weighted object mounted adjacent the upper free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper free end of said arm, a normally curved bimetallic element at an intermediate portion of said arm adapted to conform generally to the curvature of said heating means and adapted to undergo flexing movement in alternate directions upon heating and cooling

thereof, said flexing movement of said bimetallic element in cooperation with the resilient flexibility of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through said fixed end of said arm whereby to cause said arm to move away from and toward said heating means in an oscillating manner to a greater extent than the movement induced by said bimetallic element alone, said curved bimetallic element being engageable with the curved exterior of said heating means for limiting the extent of movement of said arm in one direction, and stop means for limiting the extent of movement of said arm in the opposite direction away from said heating means.

5. A heat-actuated device comprising an elongated flexible resilient arm having a bimetallic strip at an intermediate portion thereof adapted to undergo flexing movement in alternate directions upon heating and cooling thereof, a support for holding said arm in generally upright position with the lower end thereof fixed to permit back and forth swinging movement of the upper end thereof, a relatively weighted object supported adjacent the upper free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper end of the arm, and attaching means for detachably and adjustably mounting the device on the curved surface of an electric light bulb, said support being carried by said attaching means and being arranged to position said bimetallic strip adjacent the curved outer surface of the bulb for movement away from and toward the latter, and the weight of said object in cooperation with the flexible resilient nature of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through said fixed end of said arm whereby to impart to said arm and said object smooth back and forth swinging movement of greater extent than the movement induced by said bimetallic strip alone.

6. A heat-actuated device comprising in combination an electric light bulb, an elongated flexible resilient arm adjacent said bulb and having a curved bimetallic element at an intermediate portion thereof, said curved bimetallic element fitting around the curvature of said bulb and being adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart back and forth swinging movement to the arm, means coacting with the curved surface of said bulb for supporting said arm in generally upright position adjacent said bulb and with the lower end of the arm fixed to permit said swinging movement, and a relatively weighted object supported adjacent the upper free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper end of said arm, the weight of said object in cooperation with the flexible resilient nature of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through the fixed lower end of said arm whereby to impart to said arm and said object smooth back and forth swinging movement of greater extent than the movement induced by said bimetallic element alone.

7. A heat-actuated device comprising circumferential band means adapted to be detachably secured around the curved exterior surface of an electric light bulb, a pair of spaced circumferentially extending beads at the inner face of

said band means and adapted to engage the curved surface of the bulb for facilitating adjustment of the position of the device on the bulb, and an elongated flexible arm supported at one end from said band means for back and forth swinging movement away from and toward the bulb, said arm having a bimetallic element at an intermediate portion thereof adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart said swinging movement to said arm.

8. A heat-actuated device comprising in combination an electric light bulb, an elongated flexible arm adjacent said bulb and having a curved bimetallic element at an intermediate portion thereof, said curved bimetallic element fitting around the curvature of said bulb and being adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart back and forth swinging movement to the arm, and means for supporting said arm in operating position adjacent said bulb, said means comprising circumferential band means adapted to be detachably and adjustably fitted around the curved surface of the bulb, means for tightening said band means in place on the bulb, and a pair of spaced circumferentially extending beads at the inner face of said band means and adapted to engage said bulb for facilitating adjustment of the position of the device on said bulb.

9. A heat-actuated device comprising an elongated flexible resilient arm, supporting means for holding said arm in a generally upright position with the lower end thereof fixed and the upper end free for swinging movement, a relatively weighted object supported adjacent the free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper free end of said arm, heat-responsive means associated with said arm along a portion thereof, said heat-responsive means being adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart back and forth movement to said arm and the object carried thereon, and the weight of said object in cooperation with the resilient flexible nature of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through said fixed end of said arm whereby to impart to said arm and said object smooth back and forth swinging movement of greater extent than the movement induced by said heat-responsive means alone, and stop means at the opposite sides of said arm for limiting the extent of said swinging movement.

10. The device of claim 2 further characterized in that said bimetallic element comprises a bimetallic strip provided with a plurality of openings to permit more rapid heating and cooling thereof.

11. The device of claim 2 further characterized in that said arm has an integral curved intermediate portion and said bimetallic element comprises a separate curved bimetallic strip secured at its end to said arm and extending along said curved intermediate portion of the arm in slightly spaced relation therefrom.

12. The device of claim 2 further characterized in that said arm comprises a pair of substantially straight upper and lower end portions with a separate normally curved bimetallic strip secured therebetween as the intermediate portion of said arm.

13. The device of claim 2 further characterized in that said arm comprises a substantially straight spring portion at one end thereof and a bimetallic member having an integral curved portion which is secured to said spring portion and a substantially straight portion at the opposite end of said arm.

14. The device of claim 2 further characterized in that said arm comprises a continuous one-piece strip of bimetallic material having substantially straight end portions and a normally curved intermediate portion.

15. The device of claim 4 further characterized in that said heating means comprises an electrical resistance heating element, a casing surrounding said element and having a curved external shape, said casing being adapted to be heated by said heating element, and said normally curved bimetallic element is adapted to fit around the curved casing.

16. The device of claim 1 further characterized in that said heat responsive means comprises a separate bimetallic strip secured at its ends to said arm at an intermediate portion of the latter.

17. The device of claim 1 further characterized in that said arm comprises a pair of upper and lower end portions and said heat responsive means comprises a separate bimetallic strip secured in end-to-end relation between said end portions.

18. The device of claim 1 further characterized in that said arm comprises a spring portion and a bimetallic strip joined in end-to-end relation.

19. The device of claim 1 further characterized in that the position of said object is adjustable longitudinally of said arm whereby to regulate the frequency of said back and forth swinging movement.

20. A heat-actuated device comprising elongated flexible resilient arm structure having a lower end portion, an upper end portion, and an intermediate portion, supporting means connected to said lower end portion for holding the arm structure in a generally upright position with the lower end thereof fixed and the remainder of the arm structure free for swinging movement, and a relatively weighted object to be reciprocated supported on said upper end portion whereby the center of gravity of the swingable portion of the arm structure is located adjacent said upper end portion, said intermediate portion of said arm structure including a heat-responsive element connected to said upper and lower end portions and adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart back and forth movement to said arm structure and the object carried thereon, and the weight of said object in cooperation with the resilient flexible nature of said arm structure causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through the fixed end of said arm structure whereby to impart to said arm structure and said object smooth back and forth swinging movement of greater extent than the movement induced by said heat-responsive element alone.

21. A heat-actuated device comprising in combination an electric light bulb, an elongated flexible resilient arm having a bimetallic element at an intermediate portion thereof adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby

to impart back and forth swinging movement to the arm, support means for retaining said arm in generally upright position with said bulb at one side of the arm and with the lower end of the arm fixed whereby to permit said swinging movement away from and toward said bulb, a relatively weighted object mounted adjacent the upper free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper end of the arm, said flexing movement of said bimetallic element in cooperation with the resilient flexibility of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through the fixed end of the arm to a greater extent than the swinging movement induced by said bimetallic element alone, said arm being operatively engageable with the exterior of said bulb for limiting the extent of movement of said arm in one direction, and a stop carried by said support means at the opposite side of said arm for limiting the extent of said swinging movement in the opposite direction.

22. A heat-actuated device comprising in combination stationary heating means, an elongated flexible resilient arm supported in a generally upright position adjacent said heating means with the lower end of said arm fixed and the upper end free for back and forth swinging movement, a relatively weighted object mounted adjacent the upper free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper free end of said arm, heat-responsive means associated with said arm along at least a portion thereof and adapted to undergo flexing movement in alternate directions upon heating and cooling thereof, said flexing movement of said heat-responsive means in cooperation with the resilient flexibility of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through said fixed end of said arm whereby to cause said arm to move away from and toward said heating means in an oscillating manner to a greater extent than the movement induced by said heat-responsive means alone, said arm being operatively engageable with said heating means for limiting the extent of movement of said arm in one direction, and stop means for limiting the extent of movement of said arm in the opposite direction away from said heating means.

23. A heat-actuated device comprising in combination stationary heating means, an elongated flexible resilient arm, supporting means for holding said arm in a generally upright position adjacent said heating means with the lower end of the arm fixed and the upper end free for swinging movement, a relatively weighted object supported adjacent the free end of said arm whereby the center of gravity of the swingable portion of the device is located adjacent the upper free end of said arm, and heat-responsive means associated with said arm along at least a portion thereof, said heat-responsive means being adapted to undergo flexing movement in alternate directions upon heating and cooling thereof whereby to impart back and forth movement to said arm and the object carried thereon away from and toward said heating means, and the weight of said object in cooperation with the resilient flexible nature of said arm causing said center of gravity to be shifted alternately on opposite sides of a vertical plane passing through

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said fixed end of said arm whereby to impart to said arm and said object smooth back and forth swinging movement of greater extent than the movement induced by said heat-responsive means alone.

References Cited in the file of this patent**UNITED STATES PATENTS**

Number	Name	Date
615,669	Beers -----	Dec. 13, 1898
739,967	Wohl et al. -----	Sept. 29, 1903
857,452	Farmer -----	June 18, 1907
912,815	Cook -----	Feb. 16, 1909

Number
1,055,439
1,212,260
1,292,105
5 1,366,286
1,804,709
2,185,436
2,382,928
2,385,155
10 2,420,078
2,427,615
2,561,217

14

Name	Date
Anderson -----	Mar. 11, 1913
Reeve -----	Jan. 16, 1917
Shoenberg -----	Jan. 21, 1919
Sahlin -----	Jan. 18, 1921
Shoenberg -----	May 12, 1931
Gordon -----	Jan. 2, 1940
Whitney et al. -----	Aug. 14, 1945
Newell -----	Sept. 18, 1945
Higley -----	May 6, 1947
Miller -----	Sept. 16, 1947
Muir -----	July 17, 1951