

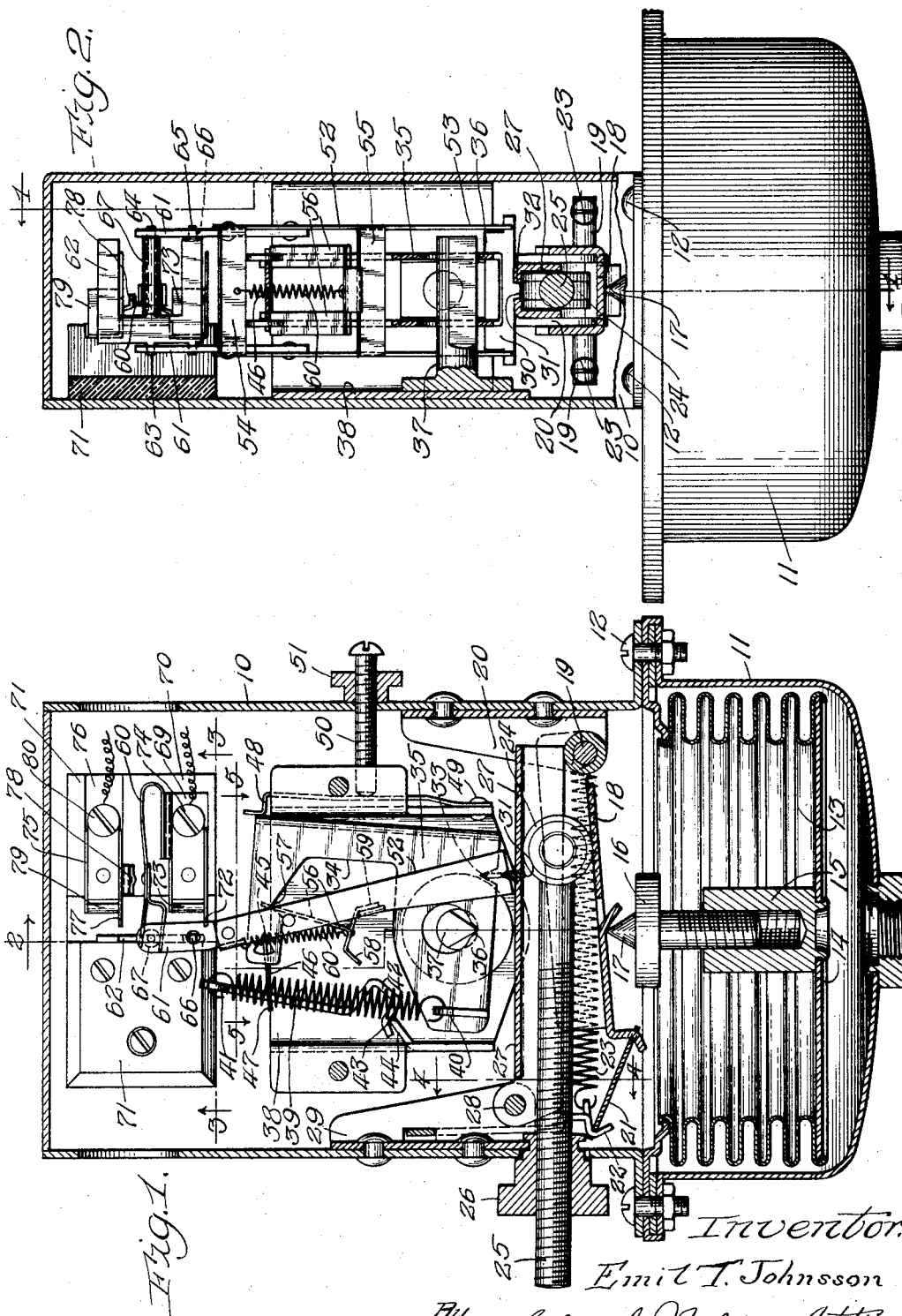
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CONTROLLING APPARATUS

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Filed May 28, 1931

2 Sheets-Sheet 1



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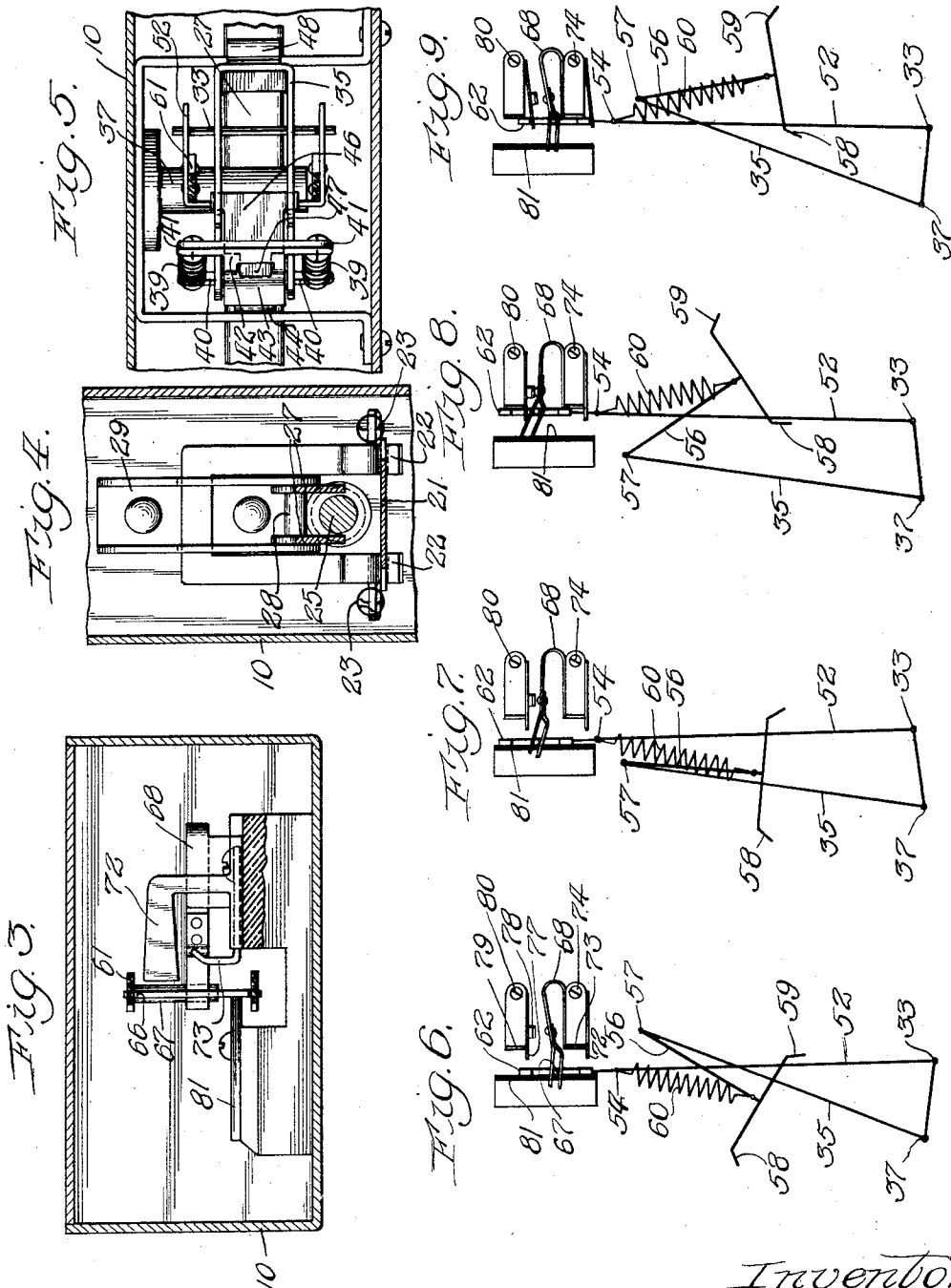
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CONTROLLING APPARATUS

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This invention relates to controlling apparatus for controlling pressure, heat, temperature, or the like, and is particularly intended for use in connection with apparatus requiring very close control and is designed to operate on a low differential of pressure or temperature. However, certain features of the invention may be adapted for general use other than for such particular purposes. Devices of this kind are adapted for use in connection with chemical processes, control of the temperature of rooms, for refrigerators or cooling apparatus and for other purposes which will be apparent from a description of the same.

The objects of the invention are to provide an improved controlling apparatus of the character indicated; to provide a controlling apparatus which will be particularly sensitive and which will be effective in providing for close control of pressure temperature or the like; to provide an improved electric switch with novel means for actuating the same; to provide an electric switch having a floating contact adapted to coact with fixed contacts; to provide a switch having a movable member having a substantially rectangular movement; to provide a switch having a movable contact coacting with fixed contacts; to provide a plurality of making and breaking points; to provide differential resistance or tension for certain operating parts; and to provide such novel features, adjustments and advantages as will appear from the following description.

In the accompanying drawings illustrating this invention;

Figure 1 is a vertical sectional view with the switch shown in open position and taken substantially on the line 1—1 of Figure 2;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a sectional view taken on the line 3—3 of Figure 1;

Figure 4 is a cross section taken on the line 4—4 of Figure 1;

Figure 5 is a cross section taken on the line 5—5 of Figure 1; and

Figures 6, 7, 8, and 9 are diagrammatic views illustrating the operation of the controller.

The operating parts are preferably mounted in a box or casing 10 which for convenience may have a vacuum or pressure chamber 11 secured directly thereto by means of bolts 12. A bellows or expansible member 13 is arranged in the pressure chamber and has a disc 14 to which is attached a threaded lug 15 which is engaged by the threaded stem on an adjustable point or thrust member 16. The point or thrust member coacts with the controlling switch but any other suitable pressure actuated means may be used for this purpose.

The point 17 of the pressure member 16 engages with a toggle arm 18 which is pivoted at 19 to a bracket 20 in the casing 10. The free end of the arm 18 coacts with a second toggle arm 21 which is pivoted to a swinging bracket or support 22. Tension springs 23 are secured to the swinging bracket or support 22 and the pivot pin 19 and tend to resist the upward movement of the toggle arms. The tension on the springs which increases as the springs are stretched, is compensated by the toggle action as the toggle members move upwardly so that a variable resistance is provided at the point 17. The bellows may be of spring type or have a spring coact therewith and the action of the toggle in connection with the springs 23 serves to compensate for the increase or decrease in tension due to the action or movement of the bellows.

A movable bearing or roller 24 rests on the upper face of the arm 18 and is pivoted to an adjusting screw 25 which extends out through the side of the box and is engaged by a nut 26 which is rotatably mounted in the

side of the box so that it cannot move longitudinally. As the nut 26 is turned, the roller or bearing 24 will move along the surface of the arm 18. This roller also engages a second
 5 arm 27 which is pivoted at 28 in brackets 29. It will be seen that as the roller 24 is moved inwardly or outwardly, the leverage is varied so that greater or less force is needed to swing the arm 27 against a relatively fixed resistance.
 10

The lever 27 is provided with a knife edge or bearing 30 which rests on the upper surface thereof and which has a tang 31 that engages with a hole 32 in the top of the lever.
 15 The knife edge engages with notches or bearings 33 in the sides of a swinging bracket or bell crank lever 34 which is substantially U-shaped in cross section. The lower arms 35 of this lever are provided with holes or bearings 36 for engaging with a knife edged fulcrum 37 which is rigidly secured to one side of a sub-frame 38 which is mounted in the box 10.
 20

Tension springs 39 are connected at one
 25 end to ears 40 on the arms 35 and at the opposite end to ears 41 on the upper end of an overthrow or toggle arm 42 which is bent at its lower end to provide a socket or bearing 43 which is pivoted on a lip or projection
 30 44 which extends inwardly from the side of the sub-frame 38. The upper arms of the lever 34 are provided with bearings 45 for receiving projections on a substantially H-shaped plate or arm 46, the opposite end of which engages with the arm 42 and is provided with a tang 47 that fits freely in a hole in said plate to hold the parts together. This overthrow or toggle arrangement is also for the purpose of providing a substantially uni-
 35 form tension or pull on the springs as the lever 34 is swung.

A spring 48 is secured at 49 to one side of the frame 38 and its upper end projects inwardly to engage with the back of the lever
 45 34, as shown in Figure 1. The pressure of this spring against the lever 34 may be adjusted by means of an adjusting screw 50 which engages with a threaded hole in the side of the box 10 and which is provided with
 50 a lock nut 51.

A switch actuating element or tongue 52 is also pivoted on the knife edge or bearing 30. This tongue or member has two side bars 53 with notches for engagement with the
 55 ends of the bearing 30, these bars being connected by integrally formed cross pieces 54 and 55.

A bifurcated swinging arm or tappet 56 is pivoted in notches 57 in the upper arms of the
 60 lever 34 and extends downwardly, the lower end being provided with projections 58 and 59 which are spaced apart and which take over and are adapted to engage at times with the sides of the cross piece 55. A spring
 65 60 is connected at one end with the lower end

of the swinging arm 56 and at the upper end with the cross bar 54, as shown in Figure 2.

The side bars 53 of the toggle 52 are extended upwardly by branches or projections 61 formed of insulating material. A U-
 70 shaped switch contact member 62 is pivotally mounted between these arms, being carried on central integrally formed bearing members 63 and 64 which engage with holes in the ends of the projections 61. The contact 62
 75 has a limited swinging or rocking movement being held against further rotation by tangs or projections 65 which engage with holes 66 in the arms 61, these holes being somewhat larger than the tangs to permit
 80 the necessary movement. From this description, it will be seen that the contact 62 is substantially a "floating" contact.

The pivot or pin 64 carries a sleeve 67 of insulating material which fits between two
 85 branches at the end of a spring contact or switch member 68 which is preferably formed integrally with a channel shaped plate 69 which fits in a groove 70 in a block of insulating material 71 mounted in the box 10.
 90 The plate 69 also has another integrally formed resilient switch member or contact 72 which is best seen in Figure 3. A main switch contact 73 fits in the channel 69, these parts being held together in any suitable way
 95 and being provided with a terminal or binding screw 74. Another contact plate or channel 75 is mounted in a groove 76 in the block 71 and is provided on the lower side with a yielding contact 77 which projects outwardly
 100 and is substantially of the same shape as the contact 72. The channel or terminal plate 75 also has another contact 78 which is adapted to be engaged at times by the contact 68. A main contact or switch plate 79 is secured
 105 in the channel or plate 75, these parts being provided with a terminal or binding screw 80.

The operation of the device may be best understood from Figure 1 taken in connection with Figures 6 to 9 inclusive. Figure 6
 110 illustrates the position of the parts as shown in Figure 1, at which time the switch is open and the pressure or temperature controlled element in normal or retracted position. As soon as sufficient pressure is exerted in the
 115 chamber 11 the point 17 is forced upwardly against the lever 18 and tends to swing this lever on the pivot 19 against the tension of the spring 23. As the spring is stretched, its resistance is increased but this is compensated for by the toggle arrangement of the arms 18 and 21 so that a variable resistance is provided for by this spring to compensate for the action of the bellows. The lever 18 also tends to swing the lever 27
 120 through the medium of the adjustable fulcrum or connection 24 which serves to increase or decrease the leverage or advantage of the lever 18 with respect to the lever 27.

The knife edge or bearing 30 on the lever 130

27 pushes up on the bell crank lever or swinging bracket 34 and tends to swing it on the fulcrum or pivot 37 against the tension of the springs 39. The brace or link 46 at the same time pushes the top of the arm 42 to the left thereby swinging the upper end over the pivot or dead center 44 which tends to make the tension uniform during the swinging movement of the bell crank lever 34.

As the upper arms of the bell crank lever 34 move to the left they carry the pivot 57 beyond the spring 60, as shown in Figure 7. As soon as the pivot 57 passes the dead center it pulls the lower end of the swinging arm and striking member 56 to the right as shown in Figure 7 until the projection 58 strikes the cross piece 55 on the switch actuating element or tongue 52. This movement permits the lower end of the spring to move past the tongue 52 thereby swinging the top of the tongue to the right or to the position shown in Figure 8. This gives a snap action or quick make or closure for the switch contact member 62. The striking of the projection 58 on the tongue tends to make the action more positive and to insure the proper actuation of the switch.

The actuation of the switch will presently be described but the switch remains closed as long as the pressure in the chamber 11 is sufficient to hold the lever 18 and connected parts in the operative position just described. As soon as the pressure decreases the point 17 lowers and the tendency is to return the various levers and parts to normal position. As soon as the lever 27 moves downwardly, the pivot 57 of the swinging arm 56 again moves to the right until it passes the center line of the spring 60 at which time the spring tends to pull the lower end of the arm 56 to the left or until the projection 59 strikes the swinging tongue 52 which prevents further free movement. This however, causes the lower end of the spring to pass the tongue and to pull the upper end of the tongue to the left or to initial position, as shown in Figure 6, with the contact 62 resting against a suitable stop or abutment 81 on the block 71.

While such swinging movements are taking place it will also be noted that the lowering of the pivot 33 permits a corresponding downward movement of the contact 62 before it is swung out of closed position. The effect of this is such that the contact 62 moves through a substantially rectangular path or orbit. In other words, starting from initial position it first slides up along the abutment 81, then swings to the right until it strikes the main contacts 73 and 79, then moves down across the face of these contacts and then swings back to its initial position.

When the swinging tongue 52 moves upwardly it carries the roller or insulated pin 67 up so that the forked end of the switch member 68 is carried up and the end of the

member is so shaped that when the sleeve 67 moves toward switch closing position, the contact 68 engages with the fixed contact 78 just before the contact 62 closes against the main contacts 73 and 79. The closing of this auxiliary switch tends to prevent any arcing between the main switch contacts.

When the switch is opened the arms of the contact 62 slide down over the faces of the main contacts 73 and 79 and press against the auxiliary spring contacts 72 and 77 which project for some distance beyond the main contacts. The arms of the contact 62 are thus pressed against the yielding or auxiliary contacts until after they are disengaged from the main fixed contacts and the final opening action is the slipping of the arms off from these yielding contacts so that the final break occurs between the moving contact and these yielding auxiliary contacts which prevents arcing between the main contact members. It will also be understood that the spring contact 68 is disengaged from the contact 78 before this final movement occurs. Due to the tripping action of the switch actuating mechanism, the movement of the branches of the contact 62 off from the spring contacts 72 and 77 is exceedingly rapid or instantaneous so that there is little possibility of objectionable arcing at these points when the circuit is broken. It will of course be understood that the terminals or binding posts 74 and 80 are connected in any suitable circuit which is to be controlled by the switch.

The amount of pressure required for operating the switch, or the sensitivity of the same may be regulated by the adjusting screw 50 which coacts with the spring 48 for adjusting the resistance or variation in pressure required for swinging the bell crank lever 34. The drawings show the contacts so arranged that the switch moves to "on" position on a decrease of pressure in the chamber 11, but it is obvious that the contacts may be so mounted that the switch will move to "on" position by an increase in the pressure in chamber 11.

From this description it will be apparent that my controlling device may be utilized for different purposes and it will also be noted that modifications may be made in order to adapt it for different conditions and some of the features may be utilized without incorporating the entire mechanism and therefore I do not wish to be limited to the exact structure shown and described except as specified in the following claims in which I claim.

1. In an apparatus of the character set forth, the combination of an actuating member having a bearing thereon, a bell crank lever engaging with said bearing and a fulcrum adjacent thereto, a spring tending to swing the bell crank lever around on its fulcrum, a vibrating tongue pivoted on said

bearing, a swinging lever pivoted to the bell crank lever and having spaced apart tappets adapted to engage with the vibrating tongue, a spring connecting the upper end of the vibrating tongue with the lower end of the swinging lever and means for limiting the swinging movement of the upper end of the vibrating tongue, the arrangement being such that when the bearing is raised it will swing the bell crank lever and cause the last named spring to swing the swinging lever and to cooperate therewith to swing the vibrating tongue.

2. A device as per claim 1 in which one end of the first named spring is attached to a support which moves therewith so that the rotative force against the lever will be substantially uniform as the lever is swung.

3. In a device of the character set forth, the combination of a bell crank lever having a fulcrum at approximately the center of the lower part thereof, a bearing engaging with the lever at one side of the fulcrum and adapted to actuate the lever, a spring connected with the lever at the opposite side of the fulcrum, a swinging arm pivoted adjacent to the lever and connected at one end with the spring, a link connecting the upper end of the arm with the upper portion of the lever, a vibrating element pivoted adjacent the lower end of the bell crank lever and movable therewith, a swinging arm pivoted to the upper portion of the bell crank lever and having projections adapted to engage with opposite sides of the vibrating element when the lever is swung, a spring connecting the lower end of the swinging lever with the upper portion of the vibrating element, and means for limiting the swinging movement of the upper end of the vibrating element, the arrangement being such that when the bearing is raised the bell crank lever will be swung on its pivot and the last named spring and the swinging lever will coact to swing the vibrating element in one direction, and when the bearing is lowered, said spring and lever will swing the element in the opposite direction.

4. A device as per claim 3 having an adjustable spring mounted adjacent to the bell crank lever and tending to resist the movement of the bell crank lever in one direction.

5. The combination of a main lever, means for swinging said lever in one direction, means for swinging the lever in the opposite direction, a secondary lever pivoted to said main lever, a vibrating tongue swingingly connected with the main lever and adapted to move longitudinally when the main lever is swung, a spring connected with the secondary lever and said tongue, said levers being so arranged that a movement of the main lever will swing the pivot of the secondary lever which will be tripped by the spring, which in turn will vibrate the vibrating

tongue whereby the free end of the vibrating tongue will have a reciprocatory and vibratory movement.

6. The combination of a main lever, means for operating said lever, a secondary lever pivoted to said main lever, a vibrating tongue operatively connected with the main lever and adapted to move longitudinally when the lever is swung, a spring connected with said secondary lever and with said tongue, said levers being so arranged that a movement of the main lever will swing the pivot of the secondary lever and cause the secondary lever to be tripped by said spring and strike the vibrating tongue and also to permit the spring to swing said tongue whereby the free end of the tongue will have a compound movement.

7. In a controlling apparatus, the combination of an electric switch having a closing member adapted to move through a limited path, an actuating lever carrying said closing member, a swinging bracket, an arm pivoted to the swinging bracket and adapted to engage with the actuating lever to swing the same, a spring between the actuating lever and the swinging arm for moving the lever when the pivot thereof passes the dead center, yielding means tending to hold the bracket in normal position, a lever pivoted adjacent to the bracket, a bearing on said lever supporting the actuating lever and engaging with the bracket, a second lever pivoted adjacent to the last named lever, a roller arranged between the last named levers, a screw for adjusting said roller, a spring coacting with the last named lever, and means adapted to coact with the last named lever to actuate the same.

8. The combination of a bell crank lever member, means for actuating said member to swing it on its fulcrum, a vibrating tongue member operatively connected to said bell crank lever member and adapted to move longitudinally when the bell crank lever member is swung, a secondary lever pivotally connected to one of said first named members, and a spring having one end connected to the free end of the secondary lever, and the other end connected to the other of said first named members, said parts being arranged so that the movement of the bell crank lever member will cause the secondary lever to be swung and tripped by the spring which in turn will cause the vibrating tongue to swing.

9. The combination of a main lever, means for swinging said lever in one direction, means for swinging the lever in the opposite direction, a secondary lever pivoted to said main lever, a vibrating tongue swingingly connected with the main lever and adapted to move longitudinally when the main lever is swung, an electric contact on said tongue adapted to coact with another contact, a spring connected with the secondary lever and said tongue, said levers being so arranged

that a movement of the main lever will swing
the pivots of the secondary lever which will
be tripped by the spring, which in turn will
vibrate the vibrating tongue whereby the free
5 end of the vibrating tongue will have a re-
ciprocatory and vibrating movement, the
path of movement of the connection between
said spring and secondary lever being locat-
ed in a zone intermediate the pivotal axis of
10 said main lever and the path of movement of
the pivotal axis of said secondary lever.

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