Oct. 18, 1938. J. SCHMIDINGER 2,133,309

CIRCUIT CONTROLLING MECHANISM

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Fig. 1.

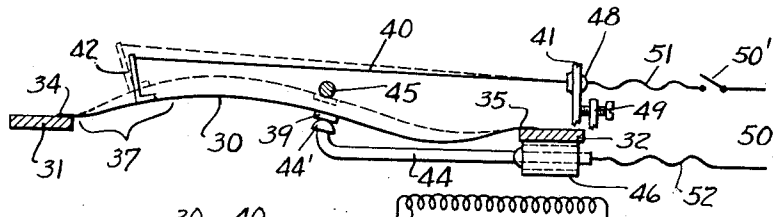


Fig. 2.

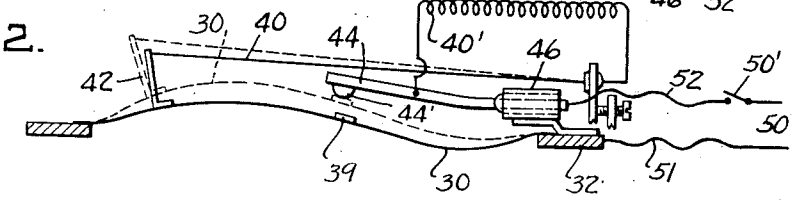


Fig. 1a.

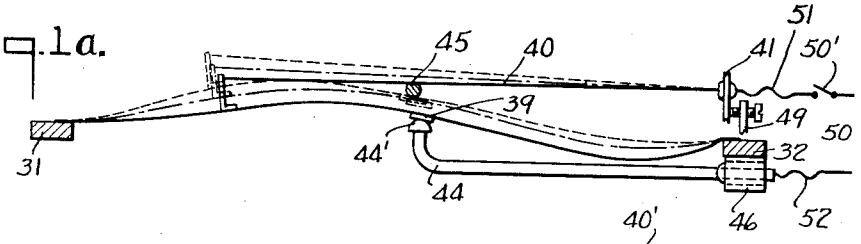


Fig. 2a.

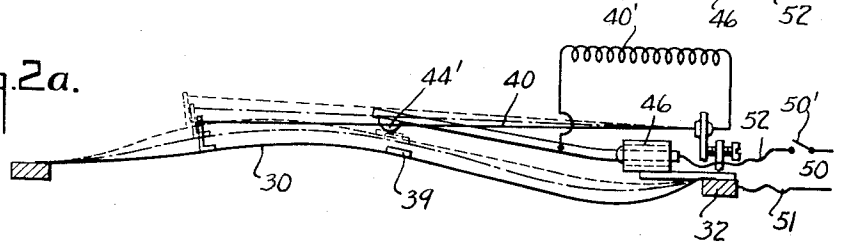


Fig. 3.

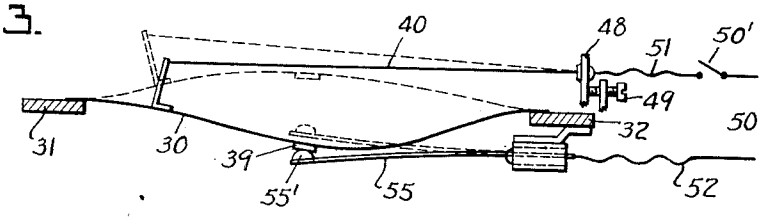
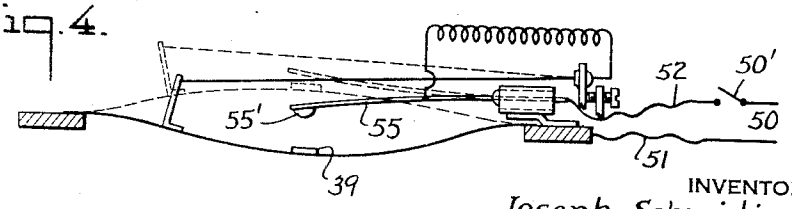


Fig. 4.



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Fig. 4a.

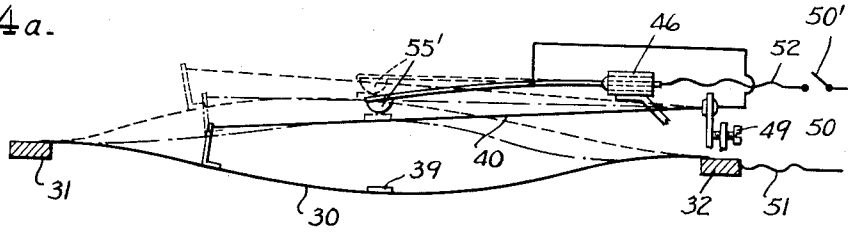


Fig. 4b.

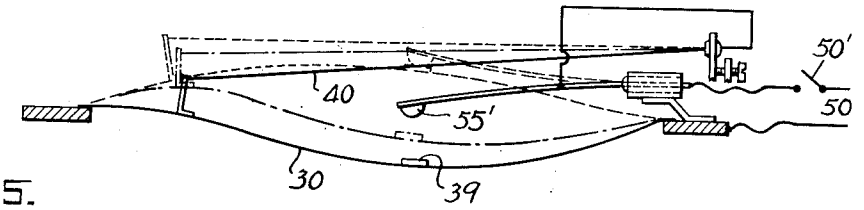


Fig. 5.

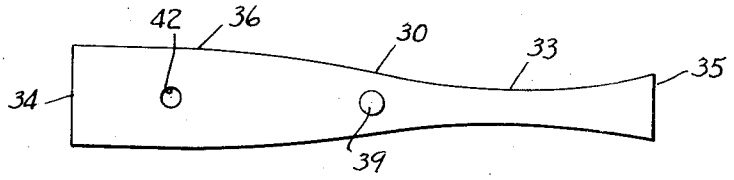


Fig. 6.

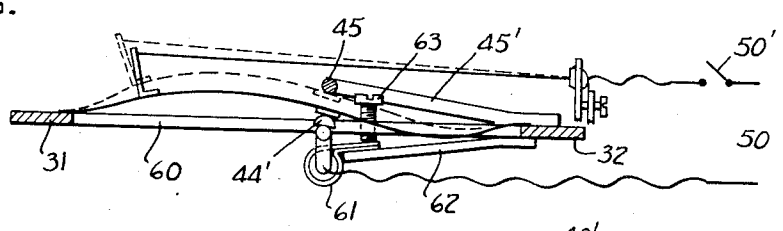
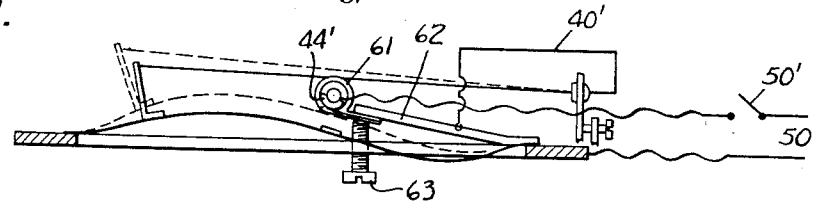


Fig. 7.



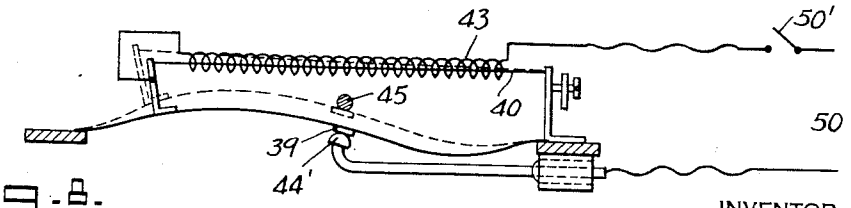


Fig. 8.

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CIRCUIT CONTROLLING MECHANISM

Joseph Schmidinger, New York, N. Y.

Application January 12, 1937, Serial No. 120,230

17 Claims. (Cl. 200—113)

This invention relates to thermo-responsive electric switch devices and particularly switch devices of the character set forth in my Patent No. 2,074,345, issued March 23, 1937.

One object of the invention is an improved switch device of the above indicated character which is characterized by its simplicity in construction, its wearing endurance in operation and the economy with which it may be manufactured in large quantities.

Further objects of the invention will hereinafter appear.

For a better understanding of the invention reference may be had to the accompanying drawings forming a part of this application wherein:

Fig. 1 is a diagrammatic side view of a device embodying one form of the invention;

Fig. 2 is a diagrammatic side view of a device embodying another form of the invention;

Figs. 1*a* and 2*a* are enlarged diagrammatic views corresponding to Figs. 1 and 2 respectively illustrating the operation thereof;

Fig. 3 is a diagrammatic side view of a device embodying another form of the invention;

Fig. 4 is a diagrammatic side view of a device embodying another form of the invention;

Figs. 4*a* and 4*b* are enlarged diagrammatic side views indicating the operation of the device of Figs. 11 and 12 from one position to the other;

Fig. 5 is a plan view of an element of the devices of Figs. 1 to 4; and

Figs. 6, 7 and 8 are diagrammatic side views of further modifications.

Referring to the drawings, I have illustrated my invention as embodying a control member **30** which is mounted and rigidly fastened at its ends to frame supports or parts **31** and **32**, the distance between the parts **31** and **32** of the frame being less than the length of the control member **30** so as to cause the same to buckle, as illustrated in the drawings. This control member **30** has a portion **33** intermediate its ends of weaker and less rigid construction than other parts of the member, and preferably, beginning at a point **36** adjacent the end **34**, the control member **30** is gradually reduced in cross section to the point **33** and then gradually increased in cross section to the end **35**. The latter facilitates the fastening of the end **35** to the frame part **32**, particularly when the control member **30** is a spring metallic strip as shown which is of substantially the same thickness but gradually reduced in width to and from the narrowed weakened part **33**.

The frame part **31** and the control member are so mounted and fastened to each other as to set up a bias in that part of the member **30** adjacent to the frame part **31** which bias tends at all times to cause the strip **30** to buckle laterally in one direction (upwardly as illustrated in the drawings). This may be effected by rigidly fastening the end **34** of the strip flat against the part **31** and then forming a permanent set in the part **37** adjacent the frame part **31**, this part **37** being set at an angle to the surface of the frame part **31** against which the end of the strip is fastened. This is the preferred way of setting up the bias but any other suitable way of accomplishing this may be employed. In the embodiment of the drawings the frame part **32** is shown disposed parallel to and in the plane of the part **31**, and the end **35** of the strip **30** is fastened flat against the frame part **32**, and the strip **30** may be fastened in any suitable manner to the frame parts **31** and **32** as by welding, riveting, etc.

A thermo-responsive means is provided for operating the strip **30** against the bias of the part **37** and in the particular embodiment shown this means includes an expansible and contractable wire **40** which is rigidly connected at one end to a frame part **41** and at its other end directly to the bias part **37** of the strip **30**. The latter fastening connection is formed by means of an element **42**, in the particular embodiment shown a pin member, which is either formed of a part of the strip **30** or is welded or otherwise rigidly fastened thereto. When the wire **40** is cold, it operates the strip **30** against the bias formed therein to cause the strip to occupy one control position of equilibrium, and when the wire **40** is heated and thereby caused to expand the bias of the strip is permitted to cause the strip **30** to buckle into another control position of equilibrium. The wire **40** may be heated directly by current passing therethrough or by radiation from an electrical heater element.

In the embodiment of Figs. 1 to 7 the wire is heated by current flowing directly therethrough, while in the embodiment of Fig. 8 the wire is heated by a heater element **43** associated with the wire **40**.

In the embodiment of Fig. 1 the two control positions of equilibrium of the strip **30** are defined by a contact arm **44** disposed on one side of the strip and a stop **45** disposed on the other side of the strip, the contact arm **44** carrying the contact **44'** being insulatedly carried from the frame by a sleeve element **46**. The stop **45** is preferably

adjustable and the adjustment may be effected in any suitable manner, this adjustment being laterally of the strip. The wire 40 is insulatedly anchored to the element 41 of the frame in any suitable manner, but preferably by forming the element 41 with an eyelet and a recess through which the wire 40 is threaded and fusing a glass bead 43 to the wire and causing the glass bead 43 to rest firmly within the seat of the recess formed in 41. The tension of the wire 40 when cold may be adjusted by forming the element 41 of a bendable post, or the latter may be formed of a bias in a direction to increase the tension on the wire 40; and a screw adjusting means, indicated diagrammatically at 49, may be provided for overcoming the bias and lessening the tension on the wire 40. The circuit to be controlled is indicated at 50 and a switch 50' is indicated in that circuit. Upon closing the switch 50' the circuit is completed through the device as follows: wire 51, wire 40, pin 42, strip 30, contact 39 on the strip 30, contact 44', arm 44, and wire 52. The wire 40 being cold the circuit is closed at the contacts 39 and 44'. The wire 40, however, is heated by the current flowing therethrough thereby causing the same to expand and permitting the strip 30 uder its bias to be shifted to its other position of equilibrium, namely, against the stop 45. The circuit now being broken the wire 40 cools off and contracts and shifts the strip 30 to the closed position again, whereupon the wire 40 is again heated to permit the opening of the circuit.

In the embodiment of Fig. 2 the contacts 39 and 44' are disposed across the wire instead of in series with the wire, with the result that when the contacts are closed the wire cools off and when the contacts are open the current passes through the wire 40 to heat it. When the switch 50 is closed the circuit is through wire 51, frame part 32, strip 30, pin 42, wire 40, resistance wire 40', contact arm 44, outgoing wire 52.

By confining and restricting the lateral movement of the strip 30 to the comparatively short gap between the adjustable stop 45 and the contact 44', as shown in Figs. 1 and 2, certain advantages in construction and operation are obtained. It is observed that in both the opposite control positions of equilibrium the strip 30 assumes generally a buckled S form. Figs. 1*a* and 2*a*, which correspond respectively to Figs. 1 and 2, are diagrammatically drawn to a larger scale to show generally the shape of this S form in the two opposite control positions and to also show intermediate positions in dot and dash lines, these intermediate positions illustrating generally the critical position when the strip 30 is on the point of being shifted over from one position to the other control position. For example, in Fig. 1*a* the dot and dash curve corresponds to the position when the wire 40 has cooled down sufficiently to begin to buckle the strip 30 in opposition to its bias and the strip is just on the point of being shifted downwardly to bring the contact 39 into contact with the contact 44'. In Fig. 2*a* the dot and dash curve corresponds to the position when the strip 30 is on the point of being shifted abruptly from the contact 44' to the full line position. In both instances a snap action is obtained in going from either opposite control position to the other and, moreover, there is obtained at the same time a wiping action between the contacts 44' and 39 as is shown generally in Fig. 2*a*. In Fig. 2*a* during the period of contraction two distinct actions of the contacts occur. One is the shifting or rubbing action of contact 39 shown very clearly and a second action of importance is that the contact pressure is increased while the wire is moving or acting to separate the contacts. This pressure increase is progressive until the critical point is reached when the contacts snap apart, a distinct and very desirable feature of this device. This same action occurs in embodiment of Fig. 1*a* but in a lesser degree.

The number of operating cycles per minute may be changed by varying the gap between the two opposite control positions, namely, by adjusting the distance laterally of the strip between the stop 45 and the contact 44' in Fig. 1. Either the contact 44' or the stop 45 may be adjusted or both may be adjusted, as, for example, by bending their supports. In the modification of Fig. 2 no lower stop for the strip 30 is required because the tension of the wire 40 is insufficient to buckle the strip all the way through.

The number of cycles may also be varied by varying the current supplied to the wire 40 or the heating resistance 43, since an increase of current flow, other conditions being the same, would shorten the period the current is on the wire or heating coil and, conversely, a decrease of the current flow would lengthen the period the current is on.

The length of time required to shift from one control position to the other can be controlled by varying the tension of the expansible element. For example, by increasing the tension of the wire a higher temperature and consequenly a longer time is required to expand the wire sufficiently to permit the bias of the strip 30 to throw it to the opposite control position; but this higher temperature of the wire required to shift the switch results in a more rapid dissipation of the heat during the period that the heating current is off, and accordingly by increasing the tension of the wire that period is decreased. With a decrease in tension of the wire, other conditions being the same, the reverse effect is produced.

In the modification of Fig. 3 no upper stop is provided for the strip 30 and the tension of the wire 40 is adjusted with respect to the bias of the strip 30 to cause the strip to buckle all the way through against the bias. In this case the contact arm 55 carrying the contact 55' is made of substantial resiliency so as to follow, as shown in dotted lines, the strip 30 to the critical point where the latter is on the point of being abruptly shifted over to the dotted position indicated by a snap action. The circuit of Fig. 3 corresponds to the circuit of Fig. 1.

The modification of Fig. 4 is similar to Fig. 3, except that the circuit of Fig. 2 is used wherein the cooling of the wire 40 results in the opening of the circuit at contacts 39 and 55'. The contact carrying arm 55 is also here resilient in order to follow the contact 39 in its downward movement to the critical point of the strip 30.

Figs. 4*a* and 4*b* illustrate generally the operation of the strip 30 in going from one opposite control position to the other in the modification of Fig. 4. Fig. 4*a* indicates generally the operation of the strip 30 during the cooling of the wire 40, wherein the dotted position corresponds to the heated and expanded condition of the wire 30 to bring the contacts 39 and 55' together. The closing of the contacts results in short circuiting the wire 40 which then cools rapidly and contracts, and the dot-dash line indicates generally the buckle of the strip 30 at the critical point,

namely, the instant when the strip 38 is on the point of being abruptly shifted downwardly with a snap action by the contact wire 40 against the bias of the strip 38. Fig. 4b shows generally the operation of the strip 38 while the wire 40 is being heated. The full line position corresponds to the open circuit position of the contacts 39 and 55' and to the cool condition of the wire 40. Since the current now passes through the wire or since the wire is heated by the current under the control of the contacts, the wire begins to heat up and to expand and the dot and dash curve indicates generally the shape and position of the buckling strip 38 when it reaches the critical point, namely, when it is just on the point of being abruptly shifted over by a snap action by the bias of the strip to bring the contacts 39 and 55' together.

In the modification of Fig. 6 the frame parts 31 and 32 form a part of a plate or strip 60. The stop 45 is carried by a bendable arm 45' which is rigidly fastened to the plate or strip 60, and by bending the arm 45' the stop 45 may be adjusted up and down as may be desired. The lower contact 44' is insulatedly carried by a sleeve 61, which in turn is fastened to an arm 62, the latter is resilient and an adjusting screw 63 mounted in the plate 60 is provided for adjusting the arm 62 and the contact 44' against the bias of the arm 62 to any desired position. The circuit of Fig. 6 corresponds to the circuit of Fig. 1.

In the modification of Fig. 7 the upper contact 44' forms a stop and this contact is insulatedly carried by a sleeve 61 fastened to the arm 62. An adjusting screw 63 carried by the plate 60 adjusts the arm 62 against the bias thereof, the stop and contact 44' being thereby adjusted to any desired position.

The modification of Fig. 8 corresponds to that of Fig. 1 but here the wire 40 is heated not directly by current passing therethrough, but by radiation from a heater 43 associated therewith and connected in the circuit to be controlled by the contacts 44' and 39.

I claim:

1. In a device of the character described, the combination comprising a constrained member of spring material operative to different positions of equilibrium and rigidly fixed at both ends and constrained to cause it to tend to assume one of said positions, a limiting stop which the member engages when free, said constrained member having a portion intermediate its ends of weaker construction than the portion adjacent one end, the latter portion being adapted to be flexed in opposition to the inherent constraint of the member to cause the same to become disengaged from the stop and to assume a second position of equilibrium, thermo-responsive means connected with the said second named portion of the said constrained member and adapted under certain conditions to flex the same and cause it to assume the last named position of equilibrium, and means for altering the temperature of the said thermo-responsive means.

2. In a device of the character described, the combination comprising a constrained member of spring material operative to different positions of equilibrium and rigidly fixed at both ends and constrained to cause it to tend to assume one of the said positions, a limiting stop which the member engages when free, the said constrained member being a portion intermediate its ends of weaker construction than the portion adjacent one end, the latter portion being adapted to be flexed in opposition to the inherent constraint of the member to cause the same to become disengaged from the stop and to assume a second position of equilibrium, a rigid flexing element fastened to the said last named portion, thermo-responsive means connected with the said element and adapted under certain conditions to flex the constrained member and to cause it to assume the last named position of equilibrium, and means for altering the temperature of the said thermo-responsive means.

3. In a device of the character described, the combination comprising a member of spring material constrained between two points of support and having a part operative to different control positions of equilibrium, a limiting stop which the member engages when free, the said member having a portion adjacent to one end biased to cause the said part to tend to assume one of said positions of equilibrium but adapted to be flexed in opposition to the inherent bias thereof to cause the said part to become disengaged from the stop and to assume a second position of equilibrium, thermo-responsive means connected with said biased portion and adapted under certain conditions to flex the same and to cause the said part to assume the last named position of equilibrium, and means for altering the temperature of the said thermo-responsive means, the said member of spring material being of progressively diminishing strength from the said biased portion to the said part.

4. In a device of the character described, the combination comprising a constrained buckling member of spring material operative to different positions of equilibrium and rigidly fixed at both ends and constrained to cause it to tend to assume one of said positions, a limiting stop disposed in the path of the buckling strip and arresting the buckling movement thereof under the influence of its inherent constraint, said member assuming when resting against said stop a generally S form, said constrained member having a portion intermediate its ends of weaker construction than the portion adjacent one end, the latter portion being adapted to be flexed in opposition to the inherent constraint of the member to cause the same to become disengaged from the stop and to assume a second position of equilibrium, thermo-responsive means connected with the said second named portion of the said constrained member and adapted under certain conditions to flex the same and cause it to assume the last named position of equilibrium, and means for altering the temperature of the said thermo-responsive means.

5. In a device of the character set forth in claim 1 wherein the stop engages the constrained member at a point adjacent the weaker portion thereof.

6. In a device of the character set forth in claim 1 wherein an electrical contact is disposed on the opposite side of said member from said stop.

7. In a device of the character set forth in claim 1 wherein said stop constitutes an electrical contact.

8. In a device of the character set forth in claim 1 wherein said stop constitutes an electrical contact and the thermo-responsive means includes an expansible wire which when cold flexes the member to cause the weaker portion thereof to snap away from said contact.

9. A circuit controlling device of the character set forth comprising a frame element, an elongated spring buckling strip element having both

of its ends fastened flat against plane surfaces of said frame element, said surfaces extending generally in co-planar relation with said strip, the latter being longer than the distance between said plane fastening surfaces and adapted to be buckled laterally from one position to another, said strip having a resilient bias formed in a part adjacent one end thereof tending to cause the strip to buckle in one direction, a thermo-responsive device connected with said biased part of the strip and adapted when cold to buckle said strip in opposition to the bias thereof to shift it in the other direction and electric contacts controlled by said strip.

10. In a device of the character set forth in claim 9 wherein a stop is provided on one side to limit the buckling movement of the strip in that direction.

11. In a device of the character set forth in claim 9 wherein a stop is provided on one side to limit the buckling movement of the strip in that direction, and a contact is provided which is engaged by said strip in one position thereof.

12. In a device of the character set forth in claim 9 wherein a contact which is controlled by said strip is resiliently mounted and the strip is caused to be buckled all the way through from one extreme position to the other.

13. In a device of the character set forth in claim 9 wherein a stop is provided on one side to limit the buckling movement of the strip in that direction, said stop being adjustably mounted.

14. In a device of the character set forth in claim 9 wherein a stop is provided on one side to limit the buckling movement of the strip in that direction, and a contact is provided on the other side which limits the buckling movement in that direction, said contact and stop being relatively adjustable toward and away from each other.

15. A circuit controlling device of the character set forth, comprising a frame, an elongated spring buckling strip element having both of its ends rigidly fastened to the frame, the said strip being longer than the distance between the points of fastening and being inherently constrained to cause the same to buckle in one direction, a thermal responsive device operatively connected with said strip and adapted to buckle the same in opposition to the inherent constraint thereof to shift it in the other direction and electrical contacts controlled by said strip including a stop for arresting said strip in either of two controlled positions with the strip assuming a generally S-buckle form in both positions.

16. A device of the character set forth comprising a spring strip rigidly fastened at both ends and constrained to cause the same to buckle, with means for arresting the buckling action to cause the strip to assume a generally S buckled form, and thermo-responsive means for actuating said strip against the inherent constraint thereof.

17. A device of the character set forth comprising a spring strip rigidly fastened at both ends and constrained to cause the same to buckle, with means for arresting the buckling action to cause the strip to assume a generally S buckled form, and thermo-responsive means for actuating said strip against the inherent constraint thereof, and means for adjusting the arresting means.

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