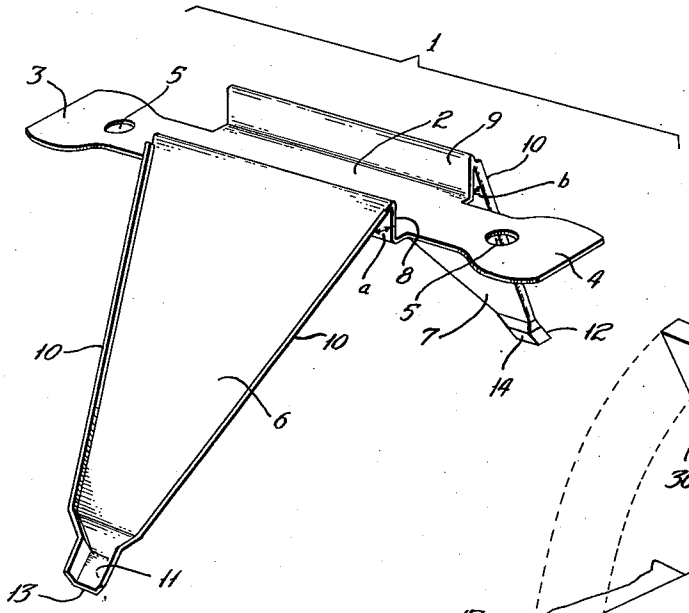
June 26, 1951 G. DEAKIN 2,557,947

AUTOMATIC BRUSH SPRING ADJUSTER

Filed Aug. 14, 1947 4 Sheets-Sheet 1

FIG. 1.



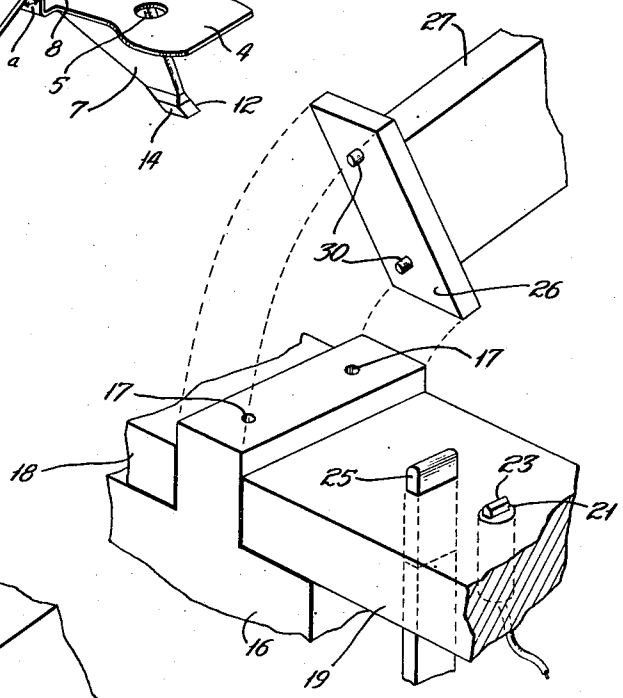
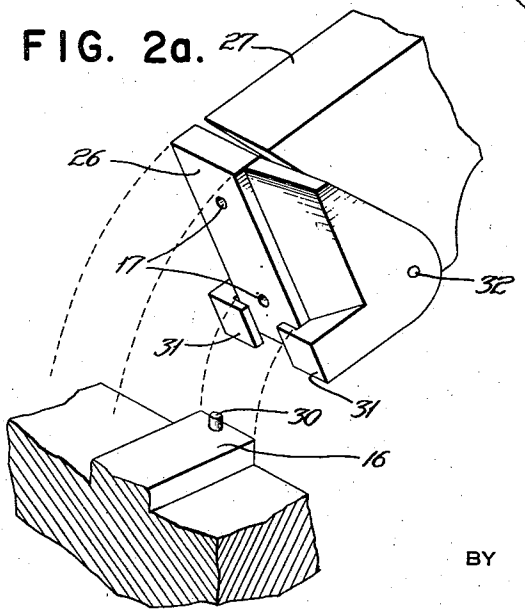


FIG. 2.

FIG. 2a.



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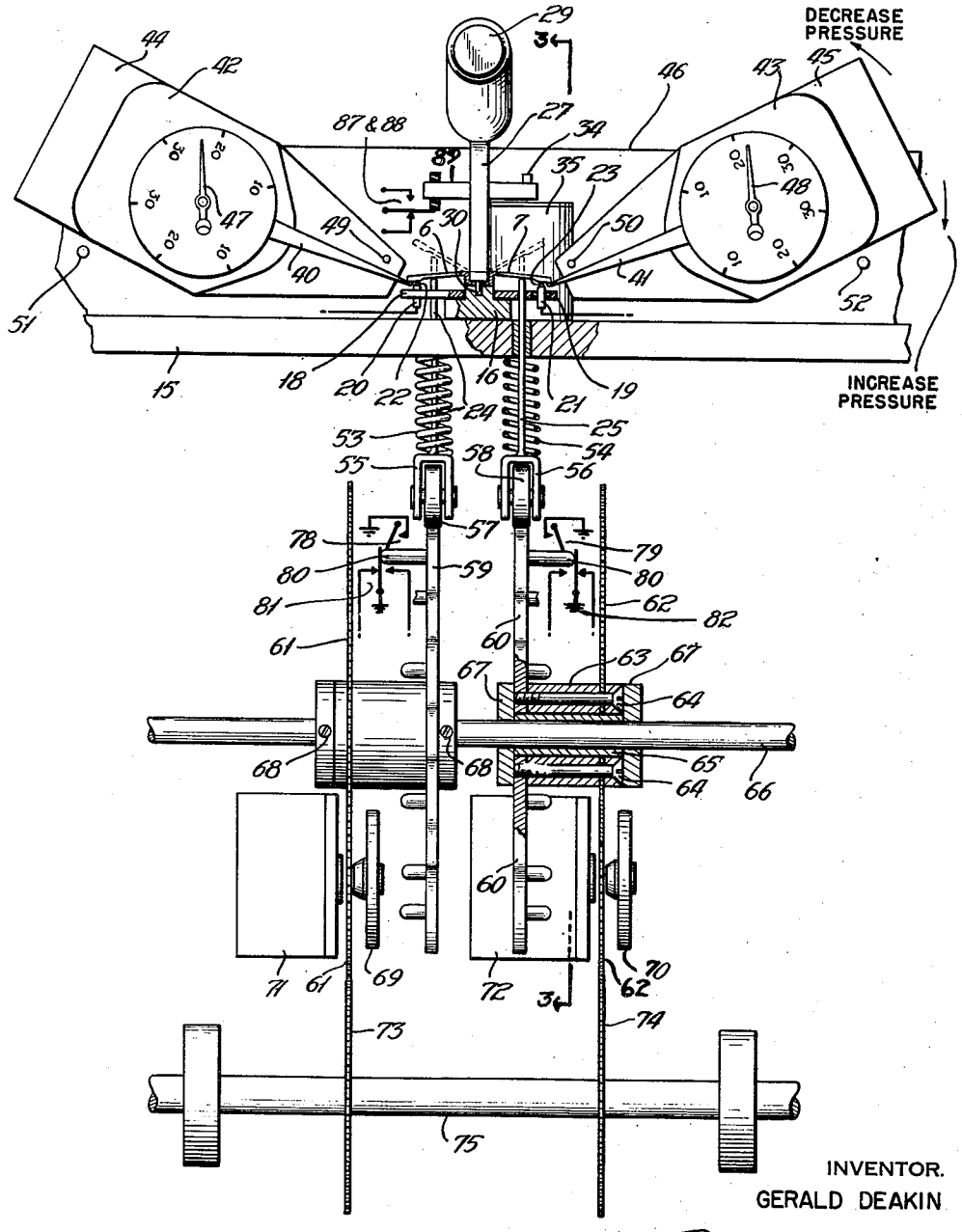
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June 26, 1951 G. DEAKIN 2,557,947

AUTOMATIC BRUSH SPRING ADJUSTER

Filed Aug. 14, 1947 4 Sheets-Sheet 2

FIG. 3.



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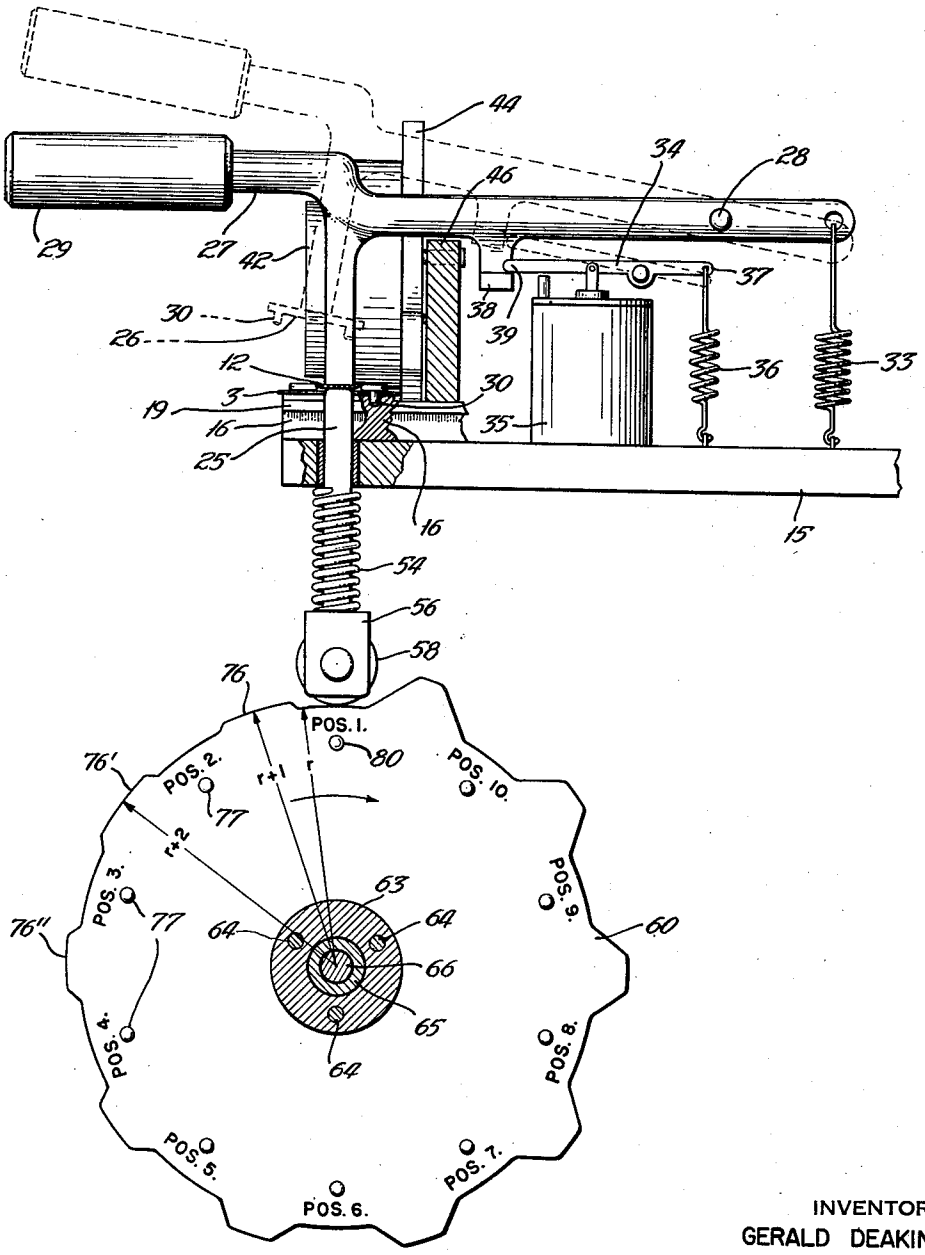
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June 26, 1951 G. DEAKIN 2,557,947

AUTOMATIC BRUSH SPRING ADJUSTER

Filed Aug. 14, 1947 4 Sheets-Sheet 3

FIG. 4.



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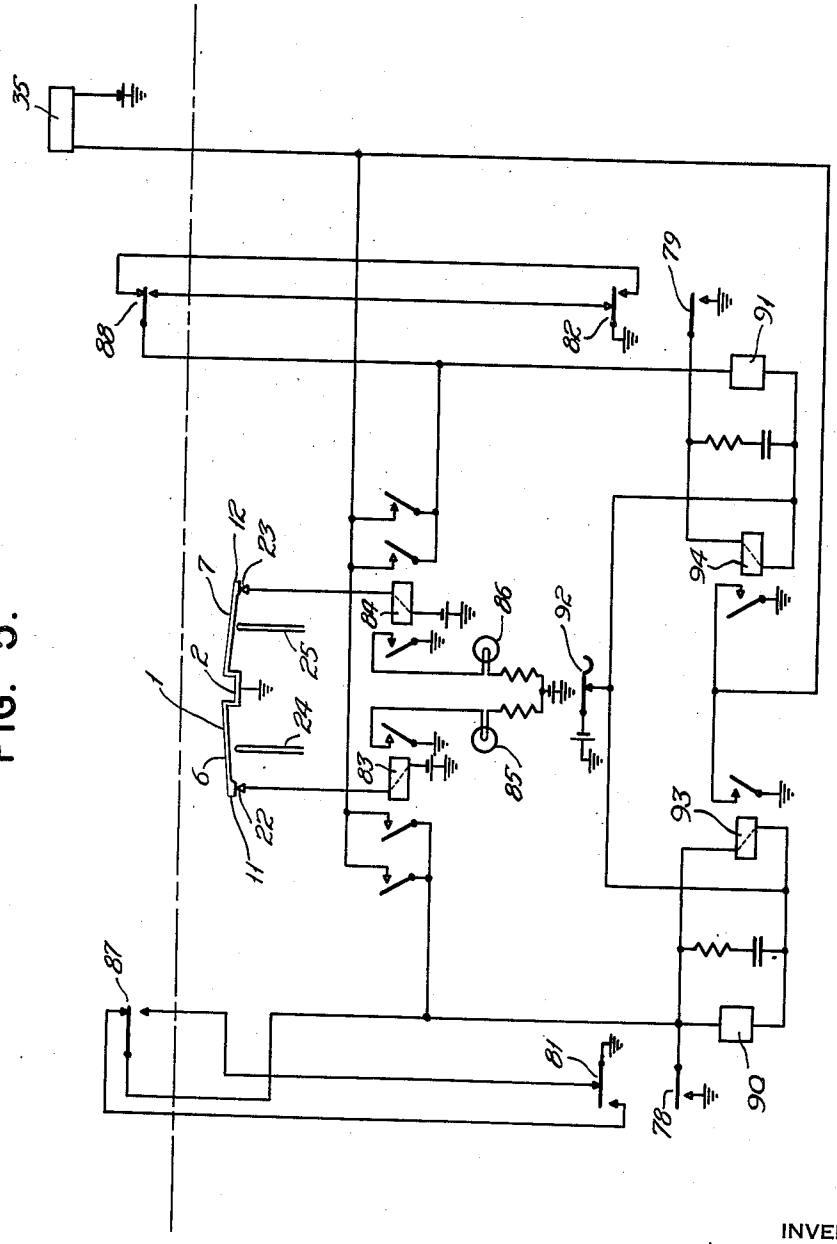
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AUTOMATIC BRUSH SPRING ADJUSTER

Filed Aug. 14, 1947 4 Sheets-Sheet 4

FIG. 5.



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AUTOMATIC BRUSH SPRING ADJUSTER

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Application August 14, 1947, Serial No. 768,677

13 Claims. (Cl. 153—21)

1

This invention relates to new and useful improvements in the tensioning of springs and more particularly of electric contact springs, such as brush and relay springs of telecommunication systems.

The object of the invention is a machine for automatically and accurately adjusting the tension of a contact spring before it is installed and thus avoid manual adjustments after installation.

Another object is a machine for registering the amount of pressure exerted by the contact surfaces of a spring.

According to the invention, an overtensioned spring is rigidly fixed in a holder and subjected to repeated blows that gradually reduce its tension to the desired amount. This amount is determined by tension measuring means, such as a pressure gauge, against which the spring bears. The gauge may either directly or indirectly control the operation of the means that delivers the detensioning blows and when the spring has the desired tension the gauge will automatically stop the detensioning operation.

These and other features of my invention will now be explained in greater detail in the following description, appended claims and drawings, in which:

Fig. 1 is a perspective view of a spring;

Fig. 2 is a perspective view of a holder for the spring;

Fig. 2*a* is a perspective view of a modification of the holder shown in Fig. 2.

Fig. 3 is a side elevation partly in section of the detensioning machine;

Fig. 4 is a section on line 3—3 of Fig. 3; and

Fig. 5 is a circuit diagram of the machine.

A flat spring such as a brush spring 1 is stamped out of a thin piece of metal, for instance, Phosphor bronze. The spring has a channelled central portion 2 provided with two ears 3 and 4 perforated at 5. Triangular arms 6 and 7 project from channel members 8 and 9 which form the side walls of the channel 2. Edges 10 of arms 6 and 7 are turned up to stiffen the arms. The ends of the arms are formed into shoes 11 and 12 having rounded sides except for short flat contact surfaces 13 and 14 on the bottoms of the shoes.

The brushes are initially overtensioned and, as exaggerated in Fig. 1, the planes of arms 6 and 7 intersect members 8 and 9 in angles *a* and *b* that are more acute than required. When 2 is fixed, the downward slopes of the arms with respect to it determine the amount of pressure shoes 11 and

2

12 apply to a surface they contact. The function of the present machine is to detension the spring by permanently bending back arms 6 and 7, i. e. increase angles *a* and *b*, until shoes 11 and 12 exert the required pressure.

A table 15 supports an anvil-like block 16 on which spring 1 is deposited. Two cavities 17 (Fig. 2) corresponding in size and spacing to holes 5 in the spring are provided in the block. Ledges 18 and 19 project parallel to table 15 from the center portion of block 16. Contact pins 20 and 21 respectively project through ledges 18 and 19 and are insulated therefrom. Tips 22 and 23 of pins 20 and 21 may contact shoes 11 and 12 of a brush spring resting with central portion 2 on block 16. Plungers 24 and 25 also project through ledges 18 and 19 and are adapted to strike the bottom surfaces of arms 6 and 7 near shoes 11 and 12 to lift them to approximately the positions shown in dotted lines Fig. 3.

Holes 5 of the spring are aligned with cavities 17 in the block so that central portion 2 may be clamped to the block with channel members 8 and 9 resting along opposite edges of a face plate 26 of a movable lever 27 pivotally mounted at 28 (Fig. 4) to a frame resting on table 15. By means of handle 29 lever 27 may be moved up and down with respect to central portion 2 of the spring. Pins 30 having a slightly smaller diameter than holes 5 project from face plate 26 and are spaced so that when arm 27 is lowered the pins register with holes 5 and cavities 17 to secure the spring to the block. Thus the combination of face plate 26 and block 16 provides a holder which fixes spring 1 intermediate its ends.

An alternative holder for the spring (Fig. 2*a*) has hooks 31 provided on face plate 26 now secured to lever 27 by rocker pin 32. Either ear 3 or 4 is inserted between hoops 31 and face plate 26 with channel members 8 and 9 resting along opposite edges of the face plate. Holes 5 of the spring are aligned with holes 17 in the face plate and pins 30 in block 16 register with the holes. The spring is thus first attached to the face plate and then lowered into contact with the block instead of first placing the spring on the block and bringing the face plate into contact with the spring as above described.

The spring holder is held open and lever 27 is held in raised position by a spring 33 (Fig. 4), connected between the end opposite handle 29 and table 15. The holder may be closed and the lever locked in its lowered position by armature 34 of solenoid 35. Armature 34 is held in the

raised position shown in dotted lines, Fig. 4, by a spring 36 attached between end 37 of the armature and table 15. When solenoid 35 is energized over a circuit to be described below, armature 34 is pulled down against tension of spring 36 to the position shown in solid lines. A catch 38 projecting downward from lever 27 will just clear armature 34 when the armature is in raised position. However, when the solenoid is energized and lever 27 is in lowered position, armature 34 engages catch 38 and locks the lever down until the solenoid deenergizes, whereupon the lever and armature are permitted to rise. If solenoid 35 energizes while lever 27 is in the raised position, then end 39 of armature 34 blocks the downward movement of catch 38. Lever 27 must, therefore, remain in the raised position until the solenoid deenergizes. Thus armature 34 functions as a lock-out as well as a lock-in element for spring 1.

Shoes 11 and 12 of brush spring 1 besides contacting tips 22 and 23 contact the ball points of operating arms 40 and 41 of tension measuring gauges 42 and 43 mounted on plates 44 and 45 which are pivotally supported on frame 46 fastened to table 15. Pointers 47 and 48 of gauges 42 and 43 register the amount of pressure applied to arms 40 and 41. Arms 40 and 41 contact shoes 11 and 12 adjacent and outboard pins 20 and 21 and are preset to exert a given amount of pressure against the shoes by manually rotating plates 44 and 45. As shown in Fig. 3 each gauge has been rotated via its supporting plate until its arm exerts 22 grams pressure against the corresponding shoe.

The pressure to which it is desired that each shoe be detensioned is pre-set as above described on each gauge and when the shoes have been detensioned to the required pressure, arms 40 and 41 prevent them from contacting tips 22 and 23 that control the energization of the detensioning means. The pressure exerted by arms 40 and 41 is increased or decreased by rotating plates 44 and 45 in the directions indicated by the arrows in Fig. 3. Thus gauges 42 and 43 control the amount of detensioning to which a shoe will be subjected.

Stops 49 and 50 on plates 44 and 45 prevent arms 40 and 41 from moving beyond the point that registers 15 grams pressure on each gauge. If the arms could move beyond this point they might not contact shoes 11 and 12 as they are clamped to block 16. Other stops 51 and 52 are provided on frame 46 to prevent injuring gauges 42 and 43 by rotating them beyond their maximum pressure points as indicated by pointers 47 and 48.

The height of contacting tips 22 and 23 with respect to block 16 is accurately adjusted to duplicate the positions of the brush shoes when in actual use.

The detensioning means consist of plungers 24 and 25, respectively, pressed by springs 53 and 54 mounted between table 15 and yokes 55 and 56, the latter being fastened to the lower ends of plungers 24 and 25. Rollers 57 and 58 are secured within yokes 55 and 56 by suitable pins. The rollers are actuated by cams 59 and 60 each coupled, respectively, to flexible gears 61 and 62 by a spacer 63 and screws 64. Each cam and flexible gear rotates in a bearing 65 supported on a shaft 66 and fixed on the shaft by collars 67 and set screws 68. Flexible gears 61 and 62 are controlled by clutches 69 and 70. When the clutch magnets are de-energized the gears are warped against clutch back stops 71 and 72 and when energized the gears under their own tension mesh with driving gears 73 and 74 mounted on drive shaft 75. Shafts 75 and 66 can serve one or more spring detensioning stations, only one of which is shown.

Each cam 59 and 60 is divided into a homing position and nine operating positions (Fig. 4) having between them progressively raised camming surfaces, 76, 76', 76'', etc. that actuate plungers 24 and 25. The radius to each succeeding raised surface is slightly greater than to the preceding one (r=radius in all positions; $r+1$ to surface 76', $r+2$ to surface 76'' etc.). The length of the strokes of plungers 24 and 25 varies directly with the height of the camming surfaces, therefore, the amount of lift to be delivered by each camming surface must be determined beforehand. The lift must be such as to impart a slight permanent deforming of arms 6 and 7 by increasing angles a and b. Turned up edges 10 of each arm give the arms overall rigidity which make them, including shoes 11 and 12, respond as a whole to each blow of plungers 24 and 25.

The number of positions into which a cam may be divided need not be ten, as shown, but may be more or less.

At the center of each position and near the periphery of each cam a stud is provided for opening and closing contacts that control the rotation of the cam. Studs 77 in positions 2—9 are all of the same length and open contacts 78 and 79 (Fig. 5) which stop the corresponding cam when rollers 57 and 58 are centered in a position. From position 1 (homing position) of each cam a stud 80 projects which is longer than studs 77 and operates contacts 81 and 82 (Fig. 5) as well as 78 and 79. Studs 80 simultaneously close upper contacts of 81 and 82 and open contacts 78 and 79. Thus home position of a cam is marked by the closing of upper 81 or 82 and opening of 78 or 79.

The electrical control of the machine will now be explained with the aid of Fig. 5. When lever 27 is moved into the operative position, ground at central portion 2 of spring 1 is connected in parallel over shoes 11 and 12, tips 22 and 23, windings of relays 83 and 84 to grounded battery. These relays energize and light lamps 85 and 86 which are conspicuously placed on frame work 46 on either side of lever 27. The movement of lever 27 from the raised to the lowered position closes lower contacts 87 and 88. Projection 89 (Fig. 3) of lever 27 controls the opening and closing of these contacts. Solenoid 35 is initially energized over front contacts of relays 83 or 84, lower contacts 87 or 88 to ground at 81 or 82, and armature 34 locks lever 27 down. Magnets 90 and 91 of clutches 69 and 70 are energized when the lower contacts of 87 and 88 are closed. Clutch magnet 91 is energized from battery at holding key 92, magnet 91 and relay 94 in parallel, lower contact 88, upper contact 82, ground. The energizing circuit for clutch magnet 90 is similar to that of magnet 91 except that it is over relay 93, lower contact 87 and upper contact 81.

In explaining what happens as a cam moves from position to position, only the right hand side of the machine will be referred to but it should be kept in mind that the left hand side operates in precisely the same way.

While magnet 91 and relay 94 are energized as above described, the cam moves out of position 1, 82 upper opens, 82 lower closes, ground is connected to 79 which replaces 82 as ground for

magnet 91. As roller 58 rides up one side of camming surface 76, plunger 25 pushes arm 7 and shoe 12 out of contact with tip 23, relay 84 deenergizes but solenoid 35, previously energized over front contacts 84, remains energized by finding ground over front contact of relay 94. As roller 58 starts down the other side of camming surface 76, plunger 25 is pulled down and out of engagement with arm 7 by spring 54. If shoe 12 can still make contact with point 23, relay 84 once again energizes, magnet 91 is kept energized over front contacts of relay 84 when ground is removed at contact 79 by stud 77, and the cam moves into position 2. Plunger 25 is again driven up but this time a little higher by camming surface 76' and the circuit of 84 opens again.

Assuming that arm 7 has been sufficiently detensioned by the last mentioned blow of plunger 25, shoe 12 will not contact point 23 when the plunger is withdrawn. Therefore, solenoid 35 is momentarily deenergized since neither relays 84 or 94 is energized. Armature 34 releases and lever 27 moves to the raised position and closes upper contacts 87 and 88 by projection 89. Cam 60 not being in home position is then driven through the remaining positions until home position is reached over the following circuit: ground, lower contact 82, upper contact 88, magnet 91 and relay 94 in parallel, key 92, ground. Front contact of relay 94 energizes solenoid 35 which now functions as a lock out for lever 27 as above mentioned. When cam 60 reaches home position, stud 80 opens 82 lower and closes 82 upper. The solenoid and clutch magnet deenergize and the machine is now ready for another brush spring.

Thus four parallel paths for energizing the circuits of clutch magnets 90 and 91 are provided, namely, battery, key 92, magnets 90 or 91 in parallel to relays 93 or 94, contacts 78 or 79, ground; battery, key 92, magnets 90 or 91 parallel to relays 93 or 94, lower contacts 87 or 88, upper contacts 81 or 82, ground; battery, key 92, magnets 90 or 91 parallel to relays 93 or 94, contacts 83 or 84, contacts 93 or 94, ground; battery, key 92, magnets 90 or 91 parallel to relays 93 or 94, upper 87 or 88, lower 81 or 82, ground.

There are two parallel energizing paths for the circuit of solenoid 35, namely, battery, solenoid 35, contact of relays 83 or 84, lower contacts, 87 or 88, upper contacts 81 or 82, ground; battery, solenoid 35, contacts 93 or 94 ground. According to the last mentioned path it will be seen that as long as either clutch magnet 90 or 91 is operating, as indicated by corresponding parallel relays 93 or 94 being energized, solenoid 35 will be energized and its armature performing either its lock out or lock in function.

Usually a brush will be detensioned after a cam has passed through two or three positions and the brush has been struck by the plunger two or three times. The detensioning of each shoe is independently performed, and plunger 24 may stop operating while plunger 25 continues.

The machine may be used to perform certain testing operations on springs. For instance, if an operator of a machine notices that, after a spring has been clamped in detensioning position, one or both of indicator lights 85 or 86 fails to light, she knows that the arm on the side of the machine corresponding to the light has insufficient tension. In order to check the actual tension of the spring, she throws a catch (not shown) which locks lever 27 in the lowered position independently of solenoid 35. The circuit of the clutch magnet is opened at key 92 to prevent operation of the machine when contact between shoes 11 and 12 and tips 22 and 23 is made. Gauges 42 and 43 are then rotated to decrease the pressure exerted by arms 40 and 41 until both shoes make contact with 22 and 23 as indicated by the lighting of lamps 85 and 86.

Although the invention has been described with reference to a specific embodiment thereof, it will be understood that it is not restricted thereto but is limited in scope only by the appended claims.

What is claimed is:

1. In a machine for detensioning the two ends of a flat spring, in combination, a holder having an opened and closed position to receive and fix the spring intermediate its ends, a plunger for each spring end, cam means having a home and a plurality of operating positions for actuating each plunger to deliver repeated detensioning blows to the corresponding spring end, a tension gauge for each end of the spring, mechanism actuatable by each gauge through the intermediary of the respective spring end for controlling the cam of the plunger cooperating with the corresponding spring end, a magnet for locking the holder, an armature for said magnet adapted to engage the holder while it is closed, and means controlled by said armature for preventing the holder from closing while the cams are in operating positions.

2. The combination according to claim 1 and in which each cam has a plurality of progressively raised surfaces between successive positions, said surfaces being adapted to actuate the corresponding cam.

3. In a machine for detensioning two shoes of a brush spring, in combination, a holder for fixing the spring intermediate its shoes, a spring pressed plunger for each shoe adapted to deliver blows thereto which detension it, a cam having a home and a plurality of operating positions to move a plunger into engagement with a shoe, a drive shaft, two driving clutches for coupling the shaft to the cams, an adjustable pressure gauge for each shoe adapted to engage a shoe near its end and exert pressure thereon, a contact pin for each shoe projecting through the holder so as to make contact with the respective shoe, adjacent its point of engagement by the gauge, when the shoe by the inherent tension of the spring overcomes the pressure exerted by the gauge, an operating magnet for each clutch, a circuit for each magnet including the corresponding shoe and contact pin, a magnet having an armature for locking the spring in the holder, and a circuit for the last mentioned magnet closed while either shoe contacts its pin and either cam is out of its home position.

4. The combination according to claim 3 wherein a path of the circuit for the last mentioned magnet is jointly controlled by the first mentioned magnets.

5. In a machine for detensioning two shoes of a brush spring, in combination, a holder for fixing the spring intermediate its shoes, a lever attached to said holder for opening and closing the holder, a spring pressed plunger for each shoe adapted to deliver blows thereto for detensioning the shoe, a cam having a home and plurality of operating positions for each plunger adapted repeatedly to move the plunger into engagement with a shoe, a stud in the center of each position of each cam, a drive shaft, a driving clutch for each cam, an adjustable pressure gauge for each

shoe adapted to engage a shoe near its end and exert pressure thereon, a contact pin for each shoe projecting through the holder so as to contact the respective shoe, adjacent its point of engagement by the gauge, when the shoe by the inherent tension of the spring overcomes the pressure exerted by the gauge, an operating magnet for each clutch, a circuit for each magnet having four parallel energizing paths, the first path including a first contact controlled by the lever in the closed position of the holder and a second contact controlled by a stud in the home position of a cam, the second path including a centering contact controlled by each stud, the third path including a contact controlled by the corresponding shoe of the brush spring and a second contact controlled by a relay in parallel to the magnet, the fourth path including a first contact controlled by the lever in the open position of the holder and a second contact controlled by a stud in the operating positions of a cam, a solenoid having an armature for locking the holder opened or closed, and a circuit for the solenoid having two parallel energizing paths, the first path jointly controlled by the contacts of two relays each in parallel to a corresponding clutch magnet, the second path including a first contact controlled by a shoe and a second contact controlled by the lever, and a third contact controlled by a stud.

6. The combination according to claim 5, and in which a manually operable key is included in the circuits of the clutch magnets, and a lamp is included in the path of each shoe.

7. In a device for adjusting the tension in flat contact springs, each having a portion thereof bent in a predetermined position such as to overtension the same, a pressure gauge, a holder for engaging a spring as aforesaid and arranged so that the gauge will engage the overbent portion of the spring and tend to deflect said portion of the spring against its inherent tension, in a given direction from said predetermined position, a plunger adapted to deliver repeated blows in successive cycles to said portion in such manner as to deflect said portion in the said direction, mechanism arranged to drive said plunger through one cycle at a time, and control means responsive to said spring when engaged in said holder for initiating the operation of said mechanism through one cycle.

8. The combination according to claim 7 wherein said holder has an operative and an inoperative position, said control means being further responsive to said holder occupying said operative position.

9. The combination according to claim 7 wherein said mechanism comprises a cam adapted to impart progressively larger movements to said plunger during successive cycles.

10. The combination according to claim 9 wherein said cam has a homing position and a plurality of off-normal positions and wherein said holder has an operative and an inoperative position, further comprising electromagnetic means operable in the inoperative position of said holder and any off-normal position of said cam for advancing the same toward its home position.

11. The combination according to the claim 10 wherein said electromagnetic means is also arranged to maintain said holder in said inoperative position.

12. The combination according to claim 7, comprising a stationary support for said holder and mounting means pivotally securing said pressure gauge to said support whereby the gauge may be rotated relative to the said part, said pressure gauge comprising a member adapted upon such rotation to exert a varying pressure upon said part.

13. The combination according to claim 12, further comprising stop means for limiting the angle of rotation of said pressure gauge and, thereby, the range of pressures exertable upon said part.

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