June 19, 1956 M. SIMON ET AL 2,750,982

APPARATUS FOR ADJUSTING ELECTRICAL CONTACTS

Filed March 3, 1952 2 Sheets-Sheet 1

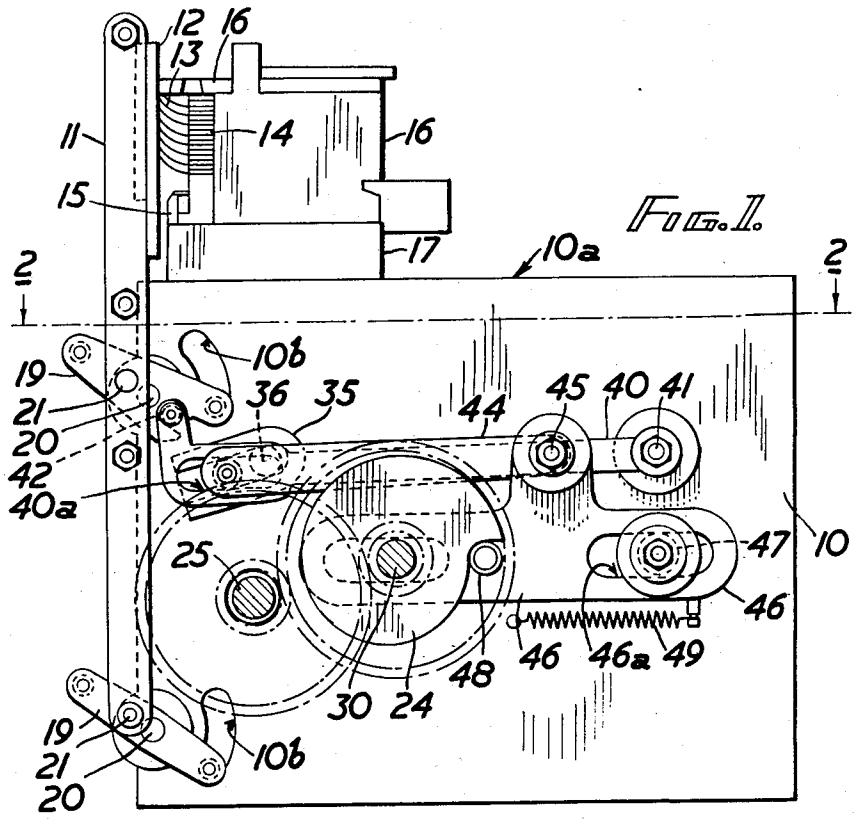

FIG. 1.

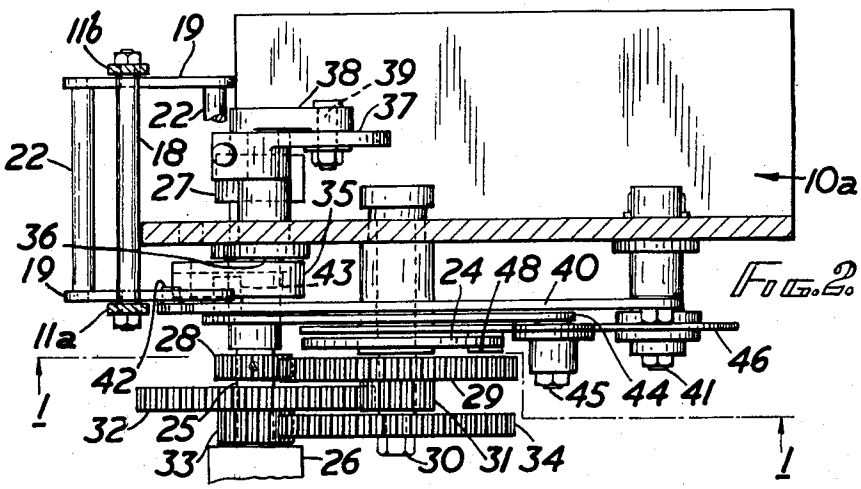

FIG. 2.

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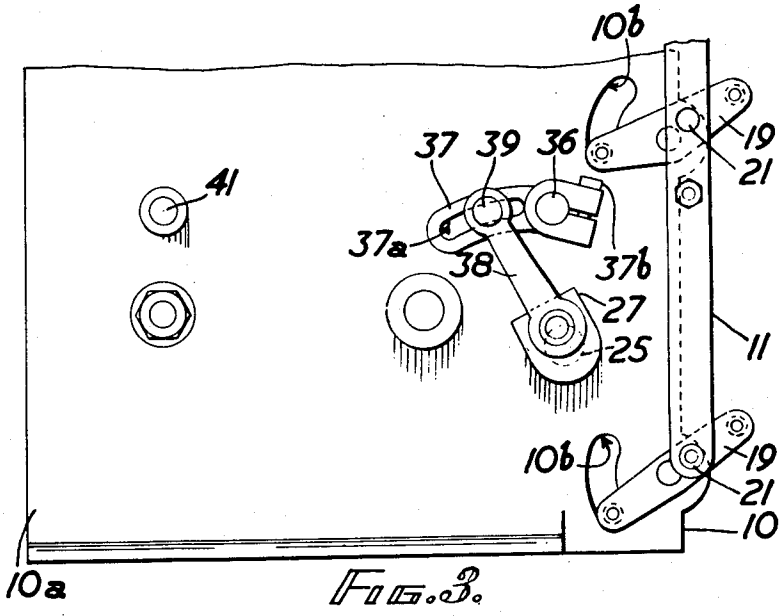

FIG. 3.

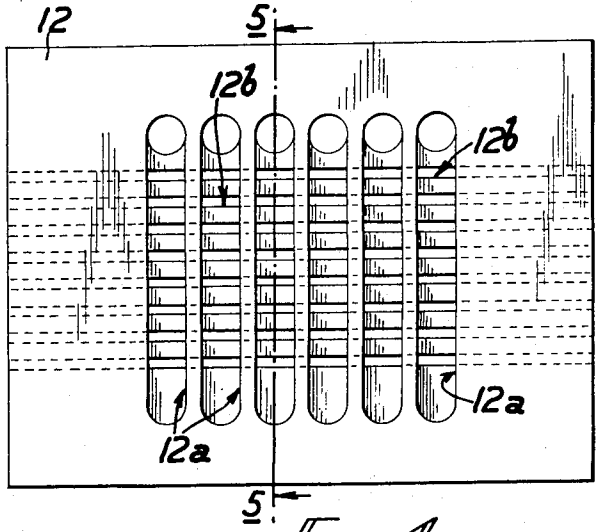

FIG. 4.

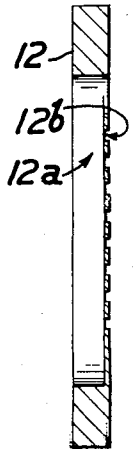

FIG. 5.

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United States Patent Office 2,750,982 Patented June 19, 1956

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APPARATUS FOR ADJUSTING ELECTRICAL CONTACTS

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Application March 3, 1952, Serial No. 274,544

Claims priority, application Great Britain March 9, 1951

13 Claims. (Cl. 153—48)

This invention relates to electrical contacts and more particularly to arrangements for adjusting multiple spring contact sets of the cantilever type.

The invention has for its object to provide an improved method of and means for adjusting electrical contact springs, and thereby the contacts carried by them and in accordance with the invention a contact spring of the cantilever type is adjusted by bending the spring past its elastic limit in one direction, then bending it past its elastic limit in the opposite direction and continuing such bending process in alternate directions with decreasing amplitude until the elastic limit is no longer exceeded.

The setting up, by manual adjustment, of multiple contact spring sets, such as those employed in electromagnetic relays for telecommunication and like services, is a lengthy, tedious and expensive procedure which contributes largely to the manufacturing cost of the relay. In an application of Frederick Emil Rommel, Ser. No. 198,061, filed November 29, 1950, now Patent No. 2,630,500, granted March 3, 1953, there is described a construction of relay in which the number of adjustments required to set up the multiple spring set employed is less than in conventional relay constructions; the construction is such that the fixed springs can be adjusted before the moving springs are inserted, the adjustment required being only that necessary to space the contacts accurately, that is, within a small working tolerance, from each other and from a datum surface.

The present invention is concerned more particularly with a method of and a machine for adjusting the fixed contacts of a relay described in that prior specification, but as will appear hereinafter a machine in accordance with the invention can be used generally where it is required to adjust a series of cantilever springs so as to space them accurately with respect to each other and, if required, to a datum surface.

The invention will be better understood, and further features of the invention will appear from the following description of one embodiment of the invention, as applied to a machine for adjusting the fixed contact springs of a relay of the type described in the Rommel patent, in conjunction with the accompanying drawings in which:

Figure 1 is a side elevation, with part of the drive gears removed, of the contact setting machine;

Figure 2 is a section through the same machine taken on the line 2—2 of Figure 1; in this figure the line 1—1 shows the plane of the view on which Figure 1 is taken;

Figure 3 is a side elevation, showing the side opposite that shown in Figure 1;

Figure 4 is a front elevation, on an enlarged scale, of the setting plate, and

Figure 5 is a cross-section of the setting plate on the line 5—5 of Figure 4.

Very briefly this machine comprises a main, robust framework **10**, of roughly rectangular shape, at one end of which is a frame **11** which reciprocates in a vertical plane; this frame carries a setting plate **12** which receives the tips of the contact springs **13** of the spring set **14** of

the relay, which is located accurately on the framework. The frame is reciprocated by a mechanism which causes the amplitude of the reciprocations to be gradually and successively decreased, and the mechanism permits of adjustment of the initial, maximum amplitude, and also the mean position of the frame. The mechanism is operated from hand or power driven shafts, and the operation is automatic and cyclic, so that in one cycle of adjustment the amplitude of reciprocation is initially a maximum, then decreases slowly to zero, and returns rapidly to maximum, on continued rotation of the shaft.

Describing now the machine in more detail, the framework **10** has at its upper part an accurately machined surface **10***a* on which the relay structure can be precisely located by stops **15** and clamped by clamps **16** with the fixed contact springs in a position which is approximately over one end face of the framework. As appears from the description of this spring set in the Rommel patent, the spring set forms a separate unit, having surfaces which can be used as datum surfaces for adjustment of the springs. Accordingly, these surfaces are located with reference to the stops **15** and the datum surfaces **10***a*, either by directly engaging these surfaces or with interposed gauge blocks **17**.

At the forward end of the framework **10** is the reciprocating frame **11**. This frame consists of two vertical parallel side members **11***a* and **11***b* secured rigidly together by cross members **18**, and is carried from the framework by means of two pairs of parallel links **19** pivoted to the frame at **20** and to the side members at **21**. The links are themselves coupled together by cross members **22**; the rear of these members pass through holes **10***b* in the frame.

At its upper part the frame **11** has secured to it, preferably detachably, the setting plate **12**. This setting plate has in it a series of accurately finished openings which are intended to receive respectively the tips of the contact springs. The plate is made by milling grooves **12***a* and **12***b* at right angles in opposite faces of a rectangular steel plate, the openings being formed where the grooves intersect, so providing a pattern of rectangular openings as shown in Figure 4. The grooves **12***b* on the one face are made quite shallow, whilst the grooves **12***a* on the other face are substantially wider and deeper. This leaves ample room for movement of the spring contacts.

The mechanism for reciprocating the frame includes a main driving shaft **25** mounted horizontally in the framework and which is provided with a handle at **26**, or is adapted to be power driven. This driving shaft passes through the framework **10** and at its inner end carries a crank member **27**, and in addition the shaft is coupled to drive a rotary snail cam **24** at a substantially reduced speed, in this particular construction at a speed of one forty-third of that of the driving shaft **25**. With this object there is secured to the shaft **25** a pinion **28** which meshes with a pinion **29** on a shaft **30**, mounted in the framework **10**; pinion **29** drives pinion **31** on the same shaft **30**, and this pinion **31** in turn drives pinion **32** on shaft **25**. Pinion **32** likewise moves with a further pinion **33** on the same shaft and this pinion **33** drives the final pinion **34** on shaft **30**, and thereby to drive that shaft. The snail cam is fast on the shaft **30**, and is accordingly driven thereby.

The crank member **27** on the shaft **25** is used to cause the oscillation of a forked arm **35**, this being effected by securing the forked arm on a supporting shaft **36**, this shaft also having secured to it a drive lever **37**. A connecting link **38** is then attached at its one end to the crank member **27** and at its other to the drive lever **37**, as shown in Figure 3. The attachment of the link to the drive lever is by a pivot pin **39**, which is mounted in a slot **37***a* in the lever **37** so that its position along the slot

can be varied. As the crank rotates, the drive lever and hence the arm shaft is oscillated; the extent of the oscillation can be varied by movement of the pin in the slot; the mean position of the arm shaft can be varied by adjusting the shaft angularly with respect to the drive lever. For this purpose the drive lever is adjustably secured to the shaft, by a split clamp 37*b*.

In this way the fork on the arm is oscillated; this oscillation is communicated to one of the links 19 by which the frame is carried, thereby to oscillate the frame. This is effected by means of a pivoted coupling lever 40; this coupling lever 40 is pivoted near its one end, by a pivot pin 41 mounted in the frame 10, and at its opposite end carries a pin 42 which engages a slot in the link by which the frame is mounted. The coupling lever is slotted at 40*a* and the motion of the fork is transmitted to the coupling lever and hence to the frame by means of a stud 43 which enters the fork and also passes through the slot.

As thus far described, the fork 35 drives the stud 43, the stud drives the coupling lever 40, and the coupling lever drives the link 19 and thus the frame 11. The extent of the resultant movement of the frame depends inter alia on the distance between the centre of the shaft 36 carrying the fork 35 and the centre of the stud 43, if the stud is at the end of the fork the motion will be a maximum, and if the stud is coaxial with the shaft there will be no motion at all. The amplitude of the frame is controlled by movement of the stud in this way, the stud being secured at the end of a support rod 44 the other end of which is pivoted at 45 in a slide plate 46. The slide plate is guided for linear movement by guide slots 46*a* therein engaging guide pins 47 on the framework 10 of the machine, and carries a cam-follower roller 48 engaging the edge of the snail cam 24. The slide plate is tensioned by spring 49 to keep the follower on the cam.

This arrangement produces the effect that on rotation of the driving shaft 25 the fork 35 is oscillated as described above; at the same time the cam 24 is rotated slowly moving the slide plate 46 and with it the support rod 44 and the stud 43. The movement transmitted to the link 19 and to the frame 11 is thus slowly decreased, until the stud reaches a point on or near the axis of the shaft 36, when the frame ceases to oscillate. If the driving shaft 25 continues to rotate the cam follower falls down the steep return part of the cam 24 to bring the parts back to their initial position, as shown in Figure 1.

As a result of this motion the contact springs 13 are bent backwardly and forwardly with decreasing amplitude, and are finally accurately located with respect to each other and to a predetermined surface on the relay assembly. The backwards and forwards movement of the springs can also be used to improve somewhat the mechanical properties of the contact springs. The mechanical bending cause a work hardening of the spring, if the metal thereof has not previously been fully hardened, and there is a progressive hardening along the length of the spring with the successive bending movements. For this reason it is preferred that the metal of the springs is not fully hardened. Satisfactory results have been obtained using Phosphor bronze strip sold as "hard," and having a hardness in the range of 185 to 210 as measured by a Vickers pyramid diamond hardness test, to British standard specification No. 427.

We claim:

1. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine in spaced relation in a column and relative to a datum position, means comprising a frame with spaced slots in which the ends of said springs are individually engaged, said frame being movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member, a variable mechanical transmission means coupling said driving member to said spring engaging means to move the same in alternate directions to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

2. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine in spaced relation in a column and relative to a datum position, means comprising a frame with spaced slots in which the ends of said springs are individually engaged, said frame being movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a variable mechanical transmission means coupling said driving member to said spring engaging means to move the same in alternate directions to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

3. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine relative to a datum position, means engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a member driven from said driving member and caused to pivot about an axis, a coupling member engageable with said pivoted member at a variable distance from said axis, and cam means operated by said driving member for varying the distance of said coupling member from the axis of said pivoted member, whereby the movement of said coupling member is progressively varied, and means for moving said spring engaging means in accordance with the movement of said coupling means, thereby to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

4. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine relative to a datum position, means engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a member pivotable about an axis and driven from said driving member, a member coupling said driving means to said spring engaging means and engageable with said pivoted member, said pivoted member having guide surfaces thereon between which said coupling member is constrained to move at a variable distance from said axis, cam means operated by said driving member for decreasing the distance of said coupling member from the axis of said pivoted member whereby the range of movement of said coupling member is progressively decreased, and means for moving said spring engaging means in accordance with the movement of said coupling member, thereby to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

5. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine relative to a datum position, means engaging said springs and movable in alternate directions to bend the same through the desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a member pivotable about an axis and driven from said driving member, a member coupling said driving means to said spring engaging means and engageable with said pivoted member, said pivoted member having guide surfaces between which said coupling member is constrained to move at a variable distance from said axis, cam means operated by said driving member for decreasing the distance of said coupling member from the axis of

said pivoted member whereby the range of movement of said coupling member is progressively reduced, and means for moving said spring engaging means in accordance with the movement of said coupling means, thereby to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

6. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine relative to a datum position, means engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a member pivotable about an axis and driven from said driving member, said pivoted member having a slot therein, a member coupling said driving means to said spring engaging means, a stud carried by said coupling member and engaged in said slot of said pivoted member for constraining said coupling member to move at a variable distance from said axis, cam means operated by said driving member for decreasing the distance of said coupling member from the axis of said pivoted member whereby the range of movement of said coupling member is progressively decreased, and means for moving said engaging means in accordance with the movement of said coupling means thereby to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

7. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine relative to a datum position, means engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a slotted member pivotable about an axis and driven from said driving member, an arm carrying a stud which extends through the slot of said pivoted member, a slide plate on which said arm is pivoted, cam means operated by said driving member for moving said slide plate to decrease the distance of said stud from the axis of said pivoted member, whereby the range of movement of said stud is progressively decreased, and means coupling said stud to said spring engaging means, thereby to actuate said spring engaging means to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

8. A machine for simultaneously adjusting a plurality of electrical contact springs comprising mounting means for mounting said springs on said machine relative to a datum position, means engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, a driving member adapted to be driven at a uniform rate, a slotted member pivotable about an axis and driven from said driving member, an arm carrying a stud which extends through the slot of said pivoted member, a slide plate on which said arm is pivoted, a snail cam operated by said driving member for moving said slide plate progressively to decrease the distance of said stud from the axis of said pivoted member, whereby the range of movement of said stud is progressively decreased, and means coupling said stud to said spring engaging means, thereby to actuate said spring engaging means to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

9. A machine for simultaneously adjusting a plurality of electrical contact springs comprising a stationary framework, means for mounting said springs on said stationary framework in predetermined relation to a datum position, means engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, said spring engaging means including a plate having therein apertures to receive said springs, a driving member adapted to be driven at a uniform rate, a slotted member pivotable about an axis and driven from said driving member, an arm carrying a stud which extends through the slot of said pivoted member, a slide plate on which said arm is pivoted, a snail cam operated by said driving member for moving said slide plate progressively to decrease the distance of said stud from the axis of said pivoted member, whereby the range of movement of said stud is progressively decreased, and means coupling said stud to said spring engaging means, thereby to actuate said spring engaging means to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

10. A machine as recited in claim 9, wherein said spring engaging means comprises a frame carrying a plate apertured to receive said springs and means mounting said frame on said stationary framework for oscillation.

11. A machine as recited in claim 9. wherein said spring engaging means comprises a frame carrying a plate apertured to receive said springs, links pivoted on said stationary framework and supporting said frame for oscillation.

12. A machine as recited in claim 9, wherein said snail cam, after progressively moving said slide plate to decrease the range of movement of said stud to a minimum is reset by said driving means, in combination with spring means for returning said slide plate to space said stud at a maximum distance from the axis of said pivoted member.

13. A machine for simultaneously adjusting a plurality of electrical contact springs comprising a stationary framework, means for mounting said springs on said stationary framework in predetermined positions relative to a datum position, means for engaging said springs and movable in alternate directions to bend the same through desired set positions with reference to said datum position, said spring engaging means comprising a plate grooved at the opposite sides thereof to provide apertures to receive said springs, a driving member adapted to be driven at a uniform rate, a slotted member pivotable about an axis and driven from said driving member, an arm carrying a stud which extends through the slot of said pivoted member, a slide plate on which said arm is pivoted, a snail cam operated by said driving member for moving said slide plate progressively to decrease the distance of said stud from the axis of said pivoted member, whereby the range of movement of said stud is progressively decreased, and means coupling said stud to said spring engaging means thereby to actuate said spring engaging means to bend the springs repeatedly through their desired set positions by displacements of decreasing amplitude in the successive movements.

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