Jan. 8, 1929. 1,697,872

E. V. JOHNSON

RESILIENT MEMBER

Filed April 13, 1927

Fig. 1.

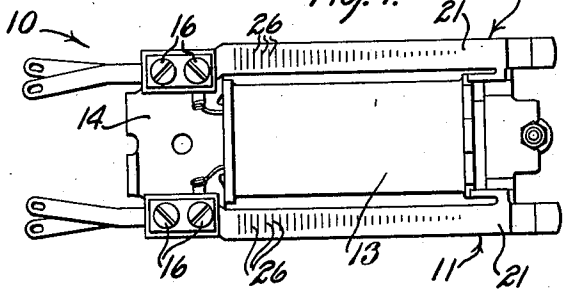



Fig. 6.

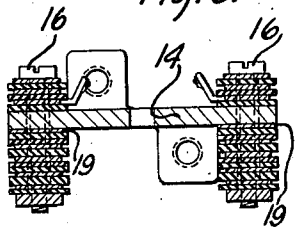



Fig. 2.

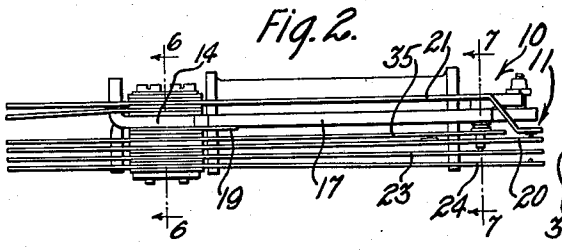



Fig. 7.

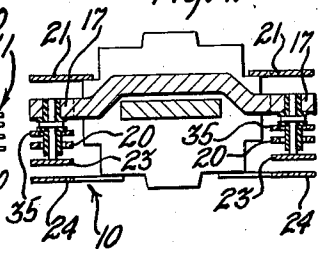



Fig. 4.

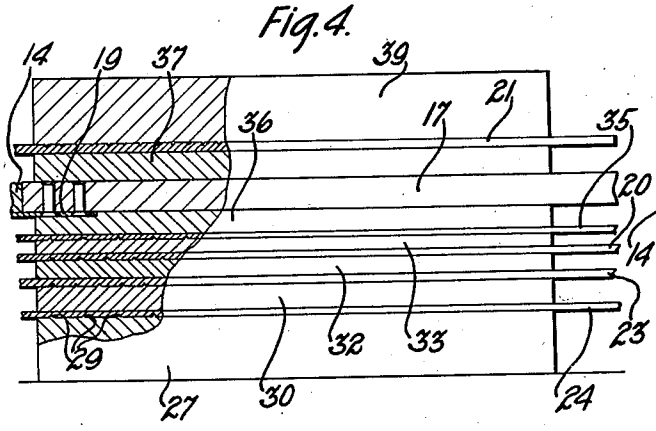



Fig. 3.

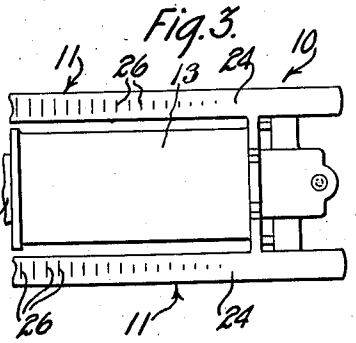
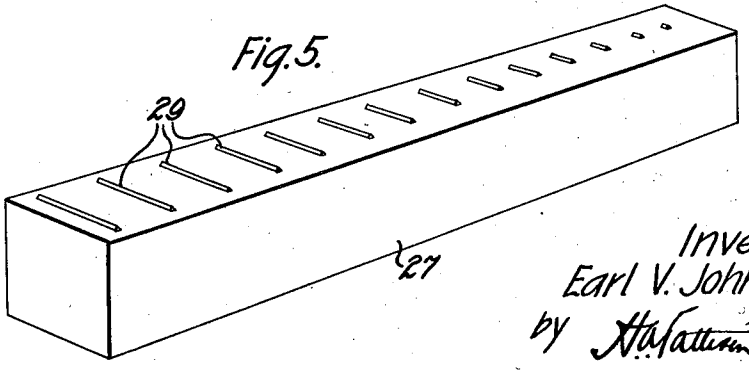



Fig. 5.




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# UNITED STATES PATENT OFFICE.

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## RESILIENT MEMBER.

Application filed April 13, 1927. Serial No. 183,440.

This invention relates to resilient members and methods of pretensioning said members, and more particularly to electrical contact elements and methods of producing a predetermined tension in such elements.

In certain types of apparatus and particularly in various classes of electrical apparatus, resilient parts, such as metallic contact springs and the like, are employed to open and close electrical circuits. Thus, for example, in telephone exchange systems, electro-magnetic devices or relays are employed which comprise a plurality of metal contact springs mounted and arranged in parallelism which are operable to control telephone circuits in response to current flow through the relay winding. The efficient functioning of these springs is dependent to a large degree upon their resilient properties and the tension of each spring should be such as to permit the yielding thereof upon the application of a predetermined force and in some instances to cause a spring to exert a definite contact pressure.

The primary object of this invention is to provide resilient members having a predetermined tension, when in place, and simple and effective methods of producing a predetermined tension in such resilient members.

In accordance with the general features of the invention, one embodiment thereof consists in the production of electrical contact springs provided on one surface with a series of spaced alterations or depressions of varied sizes extending transversely thereof, the depressions constituting each series being arranged in graduated order along the surface according to their respective sizes with the depression of greatest size or extent positioned nearest the fixed end of the springs. The general arrangement or distribution and the relative sizes of the depressions, which are stamped upon the surface of the springs by the use of dies, are governed by the required amount of tension necessary for the efficient functioning of the individual springs.

These and other objects will be apparent from the following detailed description taken in connection with the accompanying drawings, wherein—

Figs. 1 and 2 are elevational views of a relay of the type employed in telephone circuits which is equipped with contact springs embodying the features of the invention;

Fig. 3 is a fragmentary, elevational view of the relay disclosing the reverse side of the relay shown in Fig. 1;

Fig. 4 is an enlarged, fragmentary view partly in section of the relay contact springs and die members associated therewith;

Fig. 5 is a perspective view of the lowermost die member shown in Fig. 4;

Fig. 6 is a transverse, sectional view taken on the line 6—6 of Fig. 2, and

Fig. 7 is a transverse, sectional view taken on the line 7—7 of Fig. 2.

Referring now to the drawing wherein like numerals have been employed to designate similar parts throughout the various figures, it will be observed that for the purposes of illustrating one embodiment of the invention, an electro-magnetic device or relay 10 is shown which comprises a group of contact springs denoted generally by the numeral 11 disposed on opposite sides of a relay winding 13. One extremity of a core 14 which supports the winding 13 provides a mounting for the groups of contact springs, the springs in each group being insulated from the core as well as from each other and secured in superimposed positions by means of suitable screws 16. An armature 17 (Figs. 2 and 4) is hinged at the end adjacent the mounted portions of the spring by means of a suitable leaf spring 19, and this armature is adapted to be swung downwardly about the hinge 19 from its position shown in Fig. 2 when the relay is sufficiently energized. The downward swinging of the armature 17 causes the contact point of a spring 20 of the group 11 to become disengaged from a spring 21 and contemporaneously therewith a spring 23 is carried into engagement with a contact point carried by an adjacent spring 24. When the relay winding 13 is de-energized, the contact springs will again return to their normal positions as shown in Fig. 2.

From the foregoing it will be clear that the efficient cooperation between the various contact springs will depend largely upon the tension in each spring and the alignment of the entire group. In this connection it is to be understood that each spring should have a definite tension in order to respond to a predetermined current flow through the relay winding within the proper interval of time and in proper relation to the response of other springs. The tension in the individual springs will vary in accordance with

the requirements of the relay in which they are employed. Thus, in one relay certain of the springs may be required to release upon the passage of a predetermined current through the relay winding, while in another or the same relay certain of the springs might be required to make contact and exert a definite contact pressure when the relay is energized. Relays simulating the one disclosed in the drawing which are employed in telephone circuits are often subjected to various adjustments, some being required to operate on one current and to fail to operate on a current just slightly less, while others are adjusted to operate on a current slightly more. In other words, each spring must have a tension which meets the requirements of the particular relay for which it is employed, while the spring itself may be the same as used on other relays under different conditions.

To insure the presence of a proper predetermined tension in each of the contact springs which are preferably constructed of a non-ferrous spring-hard stock, such as nickel, silver or phosphorous bronze, a plurality or series of depressions 26 are stamped or swaged upon a surface of each of the contact springs, and these depressions may be conveniently produced by the use of a plurality of punching dies such as a die member 27 shown in Fig. 5 which is provided with a plurality of cutting edges or teeth 29. This die member 27 may be placed beneath the spring 24 and a second die member 30 may be interleaved between the springs 23 and 24. Likewise a die member 32 may be inserted between the springs 20 and 23 and a similar die member 33 inserted between the spring 20 and an adjacent spring 35. Spacers 36 and 37 are inserted on opposite sides of the armature 17 and a die member 39, simulating the die member 27, may be associated with the adjacent surface of the spring 21. Applying pressure by means of any suitable pressing device (not shown) causes the formation of depressions or indentations upon one surface of each of the contact springs and it is to be understood that the spacing between the depressions formed in each of the contact springs or the spacing between the die teeth, as well as the depth of the depressions, will be determined by the amount of tension required by each contact spring in order to insure the proper functioning thereof.

Altering the surface or skin of work-hardened springs in any suitable manner such as the formation of depressions in the manner set forth, serves to cause the potential tension present within each spring to become effective. That is, the breaking or altering of the skin on one side of the spring will cause the spring to experience a bending tendency of a predetermined amount which has been found to result from the releasing of the surface or skin tension and this bending tendency is produced without subjecting the spring to a preliminary bending operation. Obviously, when the springs are closely mounted as shown in the drawings, it is difficult to bend them far enough for the purpose of imparting a predetermined tension. The fact that a spring may be produced having a predetermined tension by employing the improved method without subjection to a preliminary bending operation renders possible the effective, simultaneous pretensioning of a group of springs closely mounted in place in substantial parallelism.

It will be noted that the depressions formed by the die member 39 on the surface of the contact spring 21 are closer together than the depressions formed in the contact spring 24 by means of the die member 27. The reason for this will be clear when it is observed that the contact spring 21 is of greater thickness than the spring 24 and hence the extent of the depressions made within the spring 21 must be greater than the extent of the depressions formed within the spring 24 in order to produce a corresponding increase in tension. Thus, the increase in tension produced by the formation of depressions of a definite extent in a relatively thin spring, for example, may in some instances be as great as the increase in tension produced by the formation of depressions of much greater extent in a relatively thick spring. Each of the disclosed springs simulate cantilever beams and hence the tension of each spring will vary from the point of mounting where the greatest tension exists to the free ends thereof where the least tension exists. Thus, it will be clear that in order to produce a predetermined increase in the tension in a spring of cantilever construction, the depressions formed therein must be greater in extent at the position approximating the mounted extremity of the spring. For this reason the depressions 26 formed at the left or mounted ends of the springs are greater in extent or length and decrease in graduated order in proportion to their distance from the mounted ends thereof.

From the foregoing it will be understood that the invention contemplates the production of predetermined tensions in resilient members such as contact springs by producing alterations or depressions therein which are arranged in accordance with the tension desired and this arrangement is in turn dependent upon such factors as the relative thickness of the spring, the manner in which it is mounted, its shape and other physical characteristics. Obviously alterations or depressions of varied forms may be employed to produce the desired results and they may be produced on the spring surfaces by any suitable means. This invention enables the pretensioning of contact springs in such a manner as to make the invention particularly

adaptable for use in connection with relays of the type disclosed in the drawings wherein the contact springs are secured in place and must be maintained in substantial parallelism and in close proximity. In practice it has been found in one particular instance that in order to effect the proper functioning of the relay disclosed in the drawing, the contact springs 21 must be provided with a tension which will resist a force of approximately 35 grams and the springs 23 and 24 must resist a force of approximately 20 grams. By employing die members provided with properly arranged and spaced teeth, such as the teeth 29 of the member 27 disclosed in Fig. 5, the above mentioned required amount of tension may be simultaneously produced within specified limits in all of the springs constituting each group without impairing their parallel alignment. Obviously, the depth of the depressions made by the teeth of the die members may also be governed by the amount of compressive force to which the parts are subjected. By interleaving the contact springs with die members in the manner described, a plurality of springs may be expeditiously pretensioned as distinguished from the time, manual effort and skill required in the individual treatment of the springs in each of the groups.

Although the invention has herein been described in connection with contact springs of cantilever construction used in a particular type of relay, it will be understood that the invention is capable of other applications and is only limited by the scope of the appended claims.

What is claimed is:

1. The method of producing a predetermined tension simultaneously in a plurality of contact springs, which consists in interleaving the springs with die members, and then applying pressure to produce indentations in predetermined order on a surface of each spring.

2. The method of simultaneously producing in a plurality of spring members secured in close proximity to each other a bending tendency, predetermined in amount and location, without bending the spring members, which consists in breaking a surface of each of the springs in a predetermined pattern by simultaneously engaging the spring surfaces with forming members.

3. The method of producing a predetermined tension in a plurality of superposed spring members, which consists in interleaving the springs with die members having projections thereon, and then applying pressure to said springs and die members to cause said projections to form indentations on a surface of each spring.

4. The method of producing tension in a plurality of spring members mounted in superposed relation, which consists in interposing die members between adjacent spring members to form a pile, and then applying pressure to said pile to produce indentations upon the surfaces of said spring members.

5. The method of producing tension in a plurality of superposed spring members, each of said spring members having one of its ends fixedly mounted in a common mounting, which consists in interposing die members between adjacent spring members to form a pile, placing other die members at the top and bottom of said pile, and then applying pressure to said die members and spring members to produce indentations upon the surfaces of said spring members.

6. The method of producing predetermined amounts of tension in a plurality of superposed contact springs, each of said springs having one of its ends fixedly mounted in a common mounting, which consists in placing die members between, above and below said spring members to form a pile, and then applying a predetermined pressure to said pile to produce indentations upon the surfaces of said spring members.

In witness whereof, I hereunto subscribe my name this 28th day of March, A. D. 1927.

EARL VICTOR JOHNSON.