United States Patent [19]

Streich et al.

[11] **3,792,393**

[45] **Feb. 12, 1974**

[54] **ARRANGEMENT FOR ADJUSTING THE AIR GAP IN AN ELECTROMAGNETIC SWITCHING APPARATUS**

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[22] Filed: **Dec. 13, 1972**

[21] Appl. No.: **314,563**

[30] **Foreign Application Priority Data**

Dec. 16, 1971 Germany 2162363

[52] **U.S. Cl.** **335/273,** 335/281

[51] **Int. Cl.** **H01f 7/08**

[58] **Field of Search** 335/258, 273, 281, 298

[56] **References Cited**

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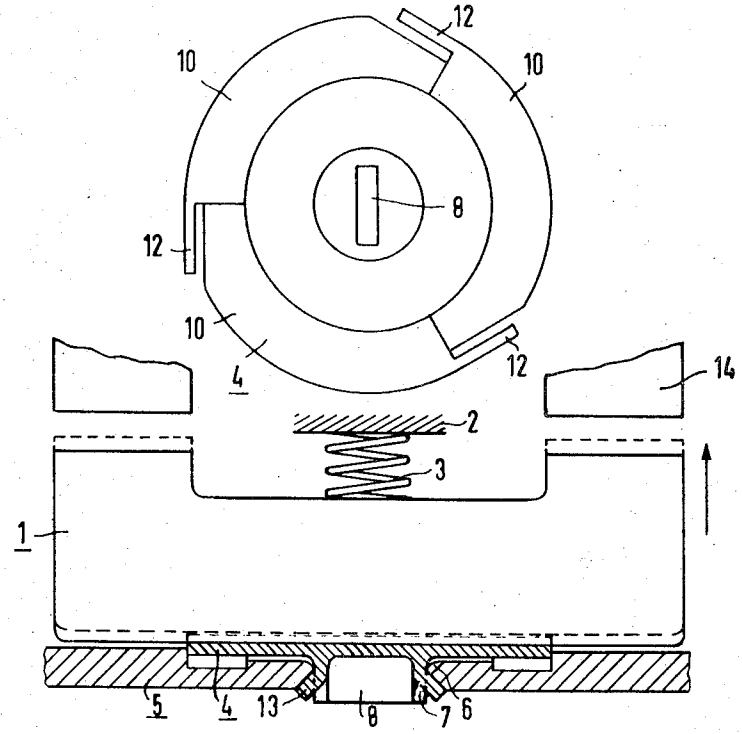
Primary Examiner—George Harris

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[57] **ABSTRACT**

In an electromagnetic switching apparatus where the non-switching magnet part is in a housing and spring loaded in the direction toward the housing, means are provided for adjusting the air gap between the switching and non-switching magnet parts when the magnet is not energized, said means comprising at least one adjusting part having wedge surfaces and adjustable in the housing, being placed between the non-switching magnet part and the housing, such that the non-switching magnetic part can be lifted from the housing by moving the adjusting part.

7 Claims, 3 Drawing Figures



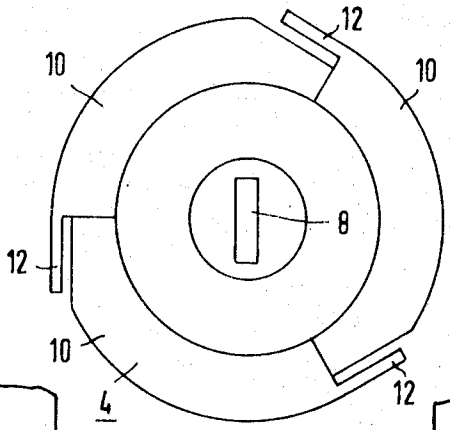


Fig. 3

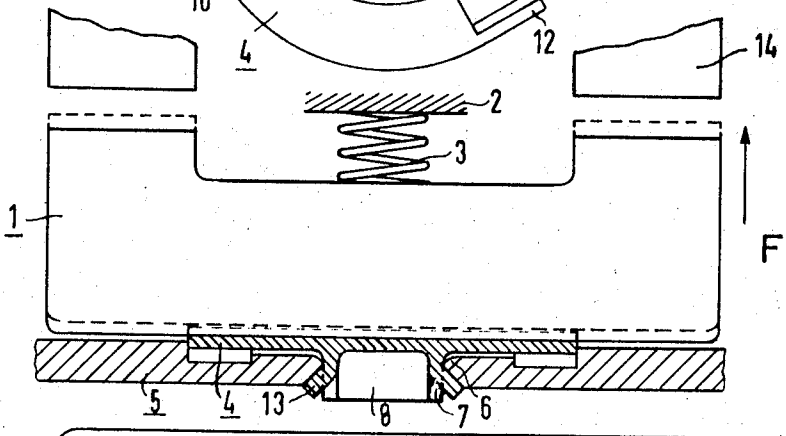


Fig. 1

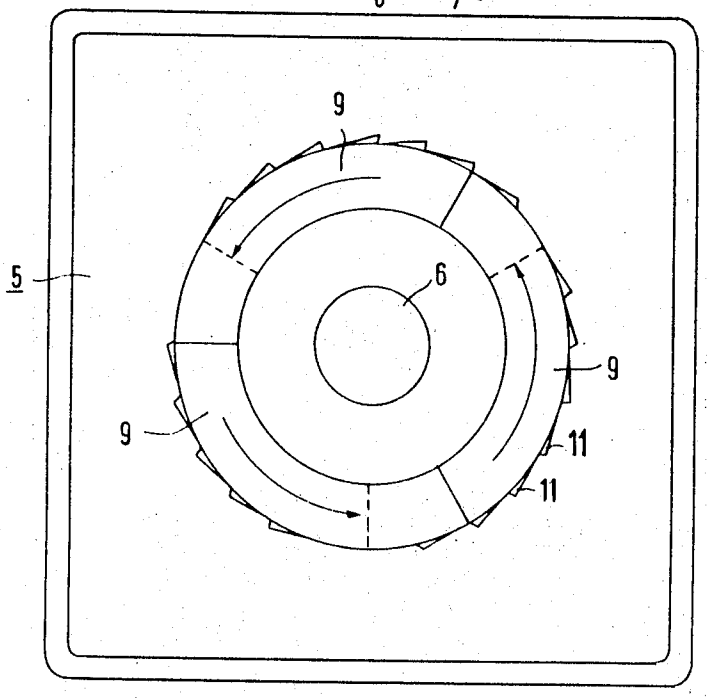


Fig. 2

ARRANGEMENT FOR ADJUSTING THE AIR GAP IN AN ELECTROMAGNETIC SWITCHING APPARATUS

BACKGROUND OF THE INVENTION

In an electromagnetic switching apparatus wherein the non-switching magnet part is pressed against the housing under tension, this invention concerns an arrangement for adjusting the air gap between its switching and non-switching magnet parts when the magnet is not energized via adjusting parts which can be operated from the outside of the housing.

One prior art method of adjusting the air gap is shown in German published U.S. Pat. application No. 1,194,955. In that device openings in the housing which holds the magnetic core are provided through which adjustment shims can be inserted from the outside between the non-switching magnet part and a stop provided at the housing after the device is completely assembled. Inserting these adjustment shims in the known arrangement is relatively difficult and expensive as prior to inserting the adjusting shims, if they are relatively thick, the magnet part must be moved in some way against its spring force so that the shim can be inserted. If, however, the shim is relatively thin, there is a danger that the shim will be bent when it is inserted between the magnet part and the housing. Moreover, the shims which are not connected with the housing, must be available as separate parts when the air gap is adjusted

DESCRIPTION OF THE INVENTION

Through the present invention an arrangement for adjusting the air gap of the kind mentioned above is provided with which it is possible to adjust the stroke of the movable magnet part by simple means from the outside, after the equipment is completely assembled. This is achieved in a simple manner by providing the adjustment parts with wedge surfaces which are adjustable with respect to the housing. One advantage of the present invention is that the residual tolerance of, say, ±0.3 mm which remains when conventional compensation shims are used, is made substantially smaller due to the gradual adjustment, and the scatter zone of the curve of the magnetic attraction is reduced. Also more economical pull-up conditions are obtained. The assembly of only one adjustment part means unilateral contact of the non-switching magnet part at the wedge. If two adjustment parts are inserted, provision is made that they are set uniformly together. In order to avoid these difficulties, it is advantageous to provide the wedge surfaces on a compensating disc which is rotatably supported in the housing. The number of the wedge surfaces can be determined according to the adjustment range, the disc diameter and the permissible angle of rotation. In order to provide a flat contact surface for the magnet part, it is advantageous to provide wedged countersurfaces matched to the compensating disc in the housing. Continuous adjustment of the air gap by means of the wedge surfaces can be achieved if the inclination of the wedge surfaces is chosen so that the adjustment parts remain in the set position due to self-locking. In order to avoid losing the adjustment in the operation of the switching device or in the event of shock, it may be advantageous if after the adjusting process, parts of the adjusting disc, which consists of

plastic, are thermally pressed together with the housing so that it is impossible for the disc to turn back. If, on the other hand, readjustment is to be possible, it may be advantageous if the adjustment parts are held in the housing by means of a detent. The detent angles can be selected dependent on the slope of the wedge surfaces, according to the requirements desired. Simple access to the compensating disc from the outside of the housing is achieved if the compensating disc is rotatably supported in a cutout of the housing via an extension which is provided with an adjustment slot. The blade of a positioning motor which, in the manner of a control, dependent on the difference between the actual width of the air gap and the normal width of the air gap, automatically causes a reducton of this difference can then be inserted into the adjustment slot.

An example of an embodiment of the arrangement according to the invention will be described and the operation explained in further detail, with reference to the following drawings where:

FIG. **1** shows a side elevation, partly in cross section, through a non-switching magnet part pressed against the bottom of a housing, with a compensating disc placed underneath;

FIG. **2** shows the bottom of the electromagnetic switching device in a plan view; and

FIG. **3** shows a view of the compensating disc.

Similar parts are labelled with the same reference symbols in all figures.

The non-switching magnet part **1** is pushed by means of a spring **3** braced against the housing **2** against a compensating disc **4**, which itself is rotatably supported in the bottom **5** of the housing of the switching device. To this end, the bottom **5** has a cutout **6** of circular shape through which an extension **7** of the disc **4** is brought. A slot **8** in the disc **4** serves for adjusting the same. As shown in FIG. **2**, three wedge surfaces **9** are molded into the bottom **5** of the switching device, which correspond essentially to the wedge surfaces **10** in a counterrotating sense. The wedge surfaces **9** and **10** lie on a circular ring of the compensating disc **4**. Detent recesses **11** in the bottom **5** of the switching device serve as detents for resilient detent ratchets **12** which are molded on the compensating disc **4**, which consists of plastic.

For explaining the operation of the adjusting process, the non-switching magnet part is shown in FIG. **1** in a position indicated by dashed lines which shows the maximum adjustment excursion of this arrangement. Also indicated by dashed lines is the position of the compensating disc which corresponds to the greatest adjustment travel. To bring the compensating disc **4** into the position shown by the dashed lines, the compensating disc **4** is rotated clockwise by means of a tool inserted into the slot **8**, so that the wedge surfaces **10**, sliding on the wedge surfaces **9**, lift the disc **4** from the bottom **5**. As already mentioned, self-locking can be achieved by appropriate design of the inclination, so that through the force of the spring **3** it is impossible for the compensating disc to turn back by itself. In the operation of the apparatus, for instance, when the switching magnet part strikes the non-switching magnet part **1**, and through the possible lifting of the non-switching magnet part **1** from the compensating disc **4** caused thereby, it is possible for the compensating disc **4** to return. In order to prevent this, the edge of the slot **8** can be pressed against the edge of the cutout **6** by

means of a hot stamp, as may be seen from FIG. **1**, so that the tabs **13** visible in FIG. **1** result. If the tabs **13** are pushed in, the detent mechanism **11, 12** can be dispensed with. It would also be conceivable to cement the extension **7** in place in the cutout **6** after the magnet part **1** is adjusted.

Therefore, the arrangement according to the invention achieves a practically continuous adjustment of the air gap between the switching magnet part **14** and the non-switching part **1** without disassembling the apparatus and without the need for additional parts for the adjustment.

What is claimed is:

1. In an electromagnetic switching device wherein the non-switching magnet part is pressed under tension against the housing of the switching device, apparatus for adjusting the air gap between the switching and the non-switching magnet parts when the magnet is not energized, which comprises at least one adjustment part between the non-switching magnet part and the housing, said adjustment part having wedge surfaces which are adjustable with respect to the housing.

2. The apparatus of claim **1** wherein said adjustment part is a compensating disc rotatably supported in said housing.

3. The apparatus of claim **2** which further includes second wedge surfaces in said housing matched to the first wedge surfaces in said compensating disc but designed with the opposite sense.

4. The apparatus of claim **3** wherein the inclination of said first and second wedge surfaces is such that said adjustment part self-locks in its adjusted position.

5. The apparatus of claim **1** which further includes first detent means on said housing and second detent means on said adjustment part for holding said adjustment part in said housing.

6. The apparatus of claim **1** wherein parts of said adjustment part consist of plastic and said parts are thermally pressed together with said housing.

7. The apparatus of claim **2** wherein said housing further includes a cutout and said disc further includes an extension provided with an adjustment slot protruding through said cutout.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,792,393 Dated February 12, 1974

Inventor(s) Georg Streich, Johann Bauer

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Foreign Application Priority Data change the file number of the German application upon which the claim for priority is based from "2162363" to --P 21 62 363.2--

In Column 1, line 15, change "German published U.S. Pat. Application 1,194,955" to --German published Patent Application 1,194,955--

Signed and sealed this 2nd day of July 1974.

(SEAL)
Attest:

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Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

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