United States Patent

Otterlei

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[54] **SLIDE SWITCH WITH IMPROVED MOVABLE CONTACT ACTUATOR RESILIENT BIASING MEANS**

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[21] Appl. No.: **103,394**

[52] **U.S. Cl.** .....**200/16 C,** 200/166 BE

[51] **Int. Cl.** **H01h 15/06**

[58] **Field of Search** ....200/16 C, 16 D, 153, 166 BE, 200/166 BF, 11 K, 11 J, 166 BH

[56] **References Cited**

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[57] **ABSTRACT**

An electrical switch including an insulative casing having fixed contacts and a plunger element movable within the casing having contacts for slideably engaging the fixed contacts so as to provide a plurality of switching positions. The plunger element has a plurality of oppositely disposed recesses in the sidewalls thereof and includes a spring-like portion positioned in each recess and molded integrally with the plunger element. Each spring-like portion has two independently acting spring elements projecting divergently outward from a back wall of the recess toward front wall portions thereof so as to outwardly bias the sliding contact positioned within each recess. An embodiment is also described in which the sliding contact is either plated or vacuum deposited onto an alternative spring configuration.

5 Claims, 8 Drawing Figures

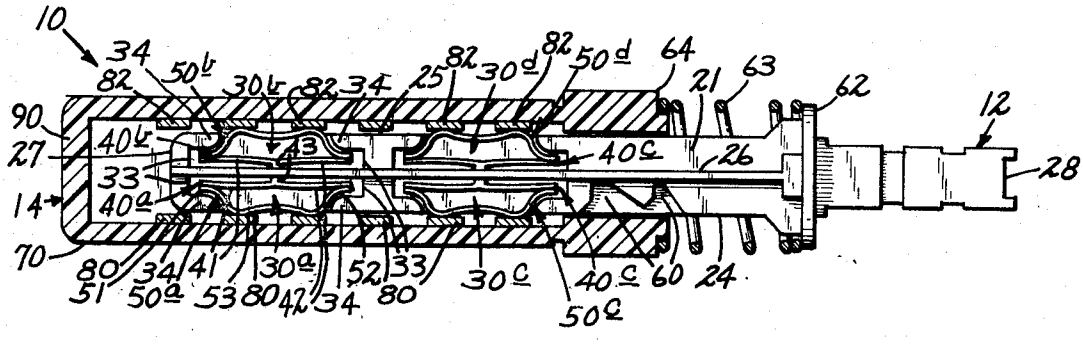


FIG. 1

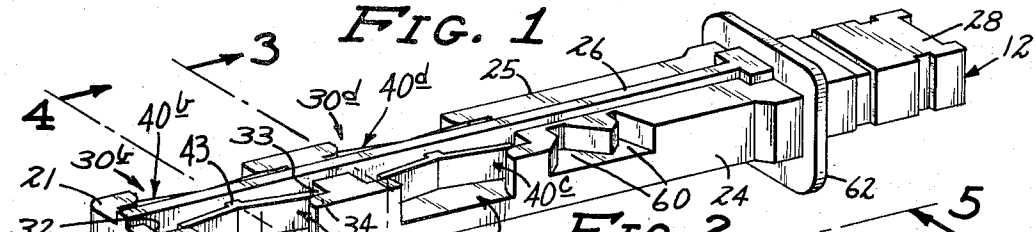


FIG. 2

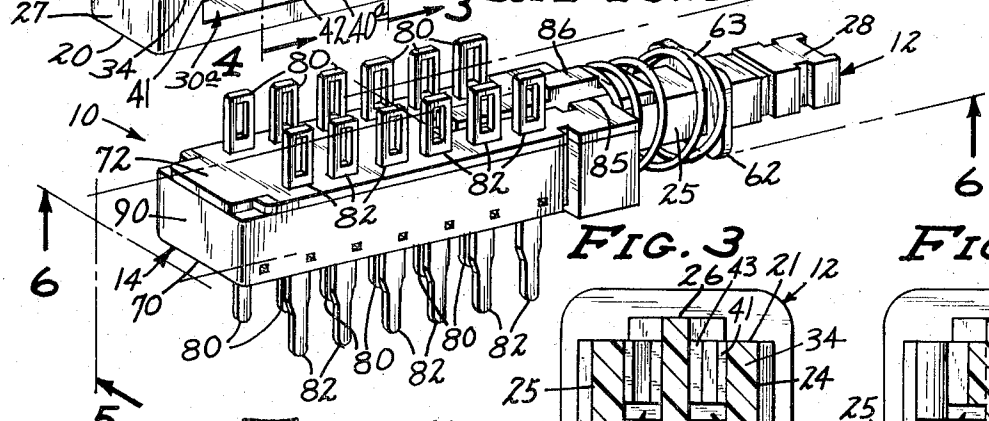


FIG. 3

FIG. 4

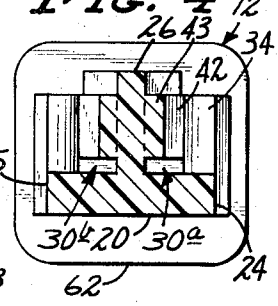


FIG. 5

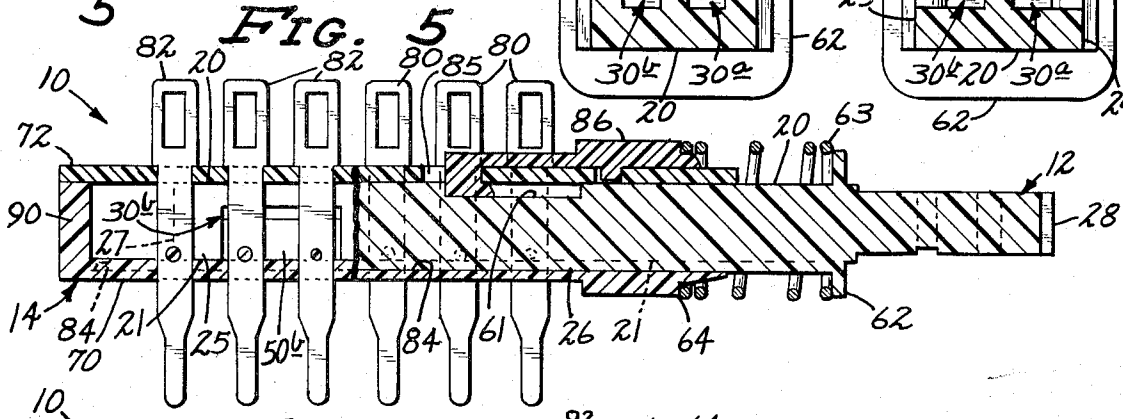


FIG. 6

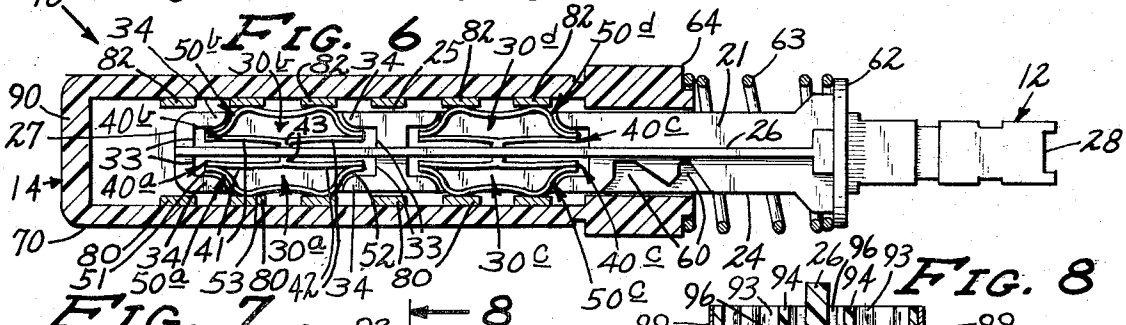


FIG. 7

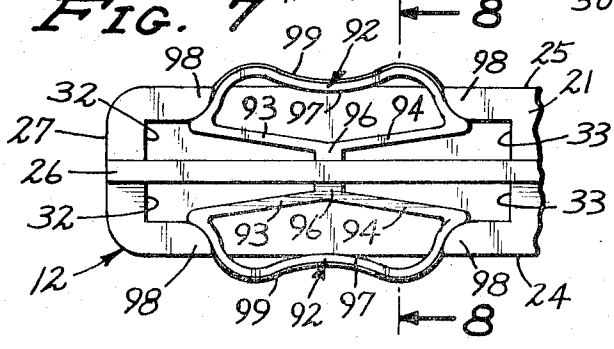
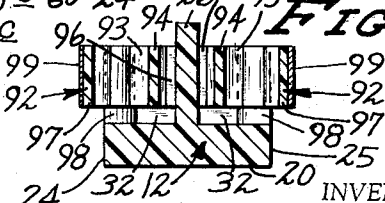


FIG. 8



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SLIDE SWITCH WITH IMPROVED MOVABLE CONTACT ACTUATOR RESILIENT BIASING MEANS

BACKGROUND OF THE INVENTION

The present invention relates to electrical switching apparatus.

Electrical switching apparatus of the type having electrical contacts fixedly carried by an insulative casing and a selector or plunger element having contacts for slideably engaging the fixed contacts is known in the art. Further, it is well known that such switches can be readily miniaturized and that such miniaturization has given rise to extensive application thereof. For instance, switches of this type can be used as wave-change switches in portable and car radio sets, in tape recorders, in measuring, testing and other instruments, and especially in telecommunication to perform the switching of weak-current circuits of high or low frequency.

Generally, the quality of electrical switches of the above-described type is gauged by the lowness and constancy of the contact resistance. In order to obtain a constant, low value contact resistance, the tension or pressure between the fixed contacts and the sliding contacts must be well balanced and constant.

In the prior art, a balance has been sought between providing time-stable low contact resistance and an inexpensive switch which is readily manufactured and assembled. The prior art switches have not, however, satisfactorily provided a combination of these features. For instance, a coil spring has commonly been utilized to influence the sliding contact outward from the sidewall of the plunger element so as to provide engagement thereof with the fixed electrical terminals carried by the insulative casing. While providing a generally well-balanced contact pressure, insertion of this extremely small coil spring has been exceedingly difficult and, to obtain high volume production requires a large investment in automated equipment. Alternatively, the spring bias for the sliding contact has been achieved by utilizing a contact element having resilient material forming at least a portion thereof and designed so as to provide an outward bias to the contact. While such sliding contacts are inexpensive to manufacture, they generally do not have a stable, well-balanced contact pressure.

SUMMARY OF THE INVENTION

The present invention provides electrical switching apparatus in which a plunger element is moveable within an insulative electrical casing to provide a plurality of switching positions. The plunger element includes a spring-like portion formed integrally with the element and positioned in a recess formed in a sidewall of the plunger.

More particularly, a plurality of recesses in the plunger element are provided each having a spring-like portion positioned therein. The spring-like portions each extend from a back wall of the respective recess toward front wall portions thereof. In one preferred embodiment, an electrical contact is engaged adjacent its opposite ends by the spring-like portion and is urged laterally outwardly thereby so as to slideably coact with adjacent ones of the electrical contacts carried by the insulative casing. In this embodiment, each spring-like portion provides two independently acting resilient strips of a plastic material having adjacent end portions in a diverging relationship. In an alternative embodiment, each spring-like portion includes two divergent, independently acting spring elements which are integrally connected by a curved center portion onto which the sliding contact is plated or vacuum deposited.

The above-described electrical switching apparatus is inexpensive, readily manufactured, and yet highly reliable. By forming (e.g. molding) the biasing spring as an integral part of the plunger element, the total number of components is reduced and assembly of the switching apparatus is greatly simplified. The additional tooling cost to mold the biasing spring as a portion of the plunger is negligible; however, the achievement of almost fully automated assembly is commercially significant. Further, the present switching apparatus provides low electrical resistance between the switching contacts and maintains this low resistance over extended periods of operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, wherein like numerals represent like elements of the invention throughout the several FIGS:

FIG. 1 is a perspective view of an inverted plunger element in accordance with the present invention;

FIG. 2 is a perspective view of the assembled switching apparatus provided by the present invention including an insulative casing and the plunger element illustrated in Fig. 1 in engagement therewith;

FIG. 3 is a cross-sectional view of the plunger element along the planar section 3—3 of FIG. 1;

FIG. 4 is a cross-sectional view of the plunger element along the planar section 4—4 of FIG. 1;

FIG. 5 is a cross-sectional view of the assembled switching apparatus generally along the irregular section line 5—5 of FIG. 2;

FIG. 6 is a cross-sectional view of the assembled switching apparatus along the planar section 6—6 of Fig. 2;

FIG. 7 is a fragmented top view of a plunger element having an alternative spring biasing portion and sliding contact assembly; and

FIG. 8 is a cross-sectional view of the alternative plunger element along the planar section 8—8 of Fig. 7.

BRIEF DESCRIPTION OF THE INVENTION

In the drawings and with reference particularly to Figs. 1—6, electrical switching apparatus, generally designated 10, includes an elongated selector or plunger element 12 and an insulative housing or casing 14. Plunger element 12 has a generally rectangular axial cross-section and includes oppositely disposed top and bottom surfaces 20 and 21, respectively, and oppositely disposed first and second sidewalls 24 and 25, respectively. A center section 26 extends longitudinally from a forward end 27 toward a rearward end 28. A portion of center section 26 projects slightly vertically outward from bottom surface 21.

Plunger 12 is molded to provide a first pair of oppositely disposed openings or recesses 30a and 30b in sidewalls 24 and 25, respectively. A similar pair of recesses 30c and 30d are longitudinally spaced along

the respective sidewalls from recesses 30*a* and 30*b* . Each pair of recesses is symmetrically positioned on opposite sides of the center section 26 and each recess is defined by front, side and rear wall portions.

Since all the recesses are generally identical, only one such recess need be described in detail. To illustrate, recess 30a is defined by a longitudinally extending rear wall in the form of center section 26, laterally extending sidewalls 32 and 33, and two longitudinally extending flange portions 34 of plunger sidewall 24. Flange portions 34 define the front wall portion of the recess 30*a*. As illustrated, flange portions 34 define an opening in the sidewall so that recess 30*a* extends from center section 26 to open laterally outward at sidewall 24.

As can be seen particularly well in Figs. 1 and 6, plunger element 12 has generally similar, spring-like portions 40a-40d molded integrally therewith and extending outwardly from center section 26 toward the front wall portions of recesses 30*a*–30*d*, respectively. For purposes of convenience, only spring-like portion 30*a* is described in detail. As illustrated, spring-like portion 30*a* of plunger 12 has two independently acting resilient strips 41 and 42 having adjacent end portions integrally connected to a connector portion 43 carried by center section 26. The resilient strips 41 and 42 extend laterally outward toward flange portion 34 in a divergent relationship.

As can be seen in Fig. 6, a plurality of similar electrical contacts 50*a*–50*d* are positioned within the recesses 30*a*–30, respectively, between the respective spring-like portion 40*a*–40*d* and flange portions 34 of plunger 12. Each of the contacts (e.g. contact 50*a*) includes oppositely disposed generally planar end portion 51 and 52 and a laterally outwardly curved center portion 53 extending therebetween. End portions 51 and 52 are engaged by an outer portion of the independently acting resilient strips 41 and 42, respectively, and the resilient strips urge the respective end portions 51 and 52 laterally outward toward the flange portions 34 for engagement therewith. In this position, the curved center portion 53 of each of the sliding contacts protrudes laterally outward from the openings in the sidewall of plunger 12 defined by flange portions 34.

Although not critical to the present invention, male plunger 12 is preferably molded to provide notched sections 60 and 61 in the walls thereof. As will be subsequently described, notched sections 60 and 61 are utilized to maintain plunger 12 in a fixed switching position. A collar portion 62 of plunger 12 engages a coil spring 63 extending between collar 62 and a rearward end 64 of casing 14 so as to urge plunger 12 outwardly therefrom. Utilization of coil spring 63 allows operation of switch 10 as a momentary action switch. Normally, a knob or button (not shown) is attached to rearward end 28 of plunger 12 for aiding manual movement of the plunger within casing 14.

The elongated insulative housing or casing 14 is preferably formed by a channel-like lower portion 70 and a top surface or cover 72 secured to channel-like portion 70 so as to form a unitary casing. A plurality of spaced electrical contacts or terminals 80 and 82 are carried by casing 14. The terminals extend vertically through casing 14 along the inner vertical walls defining channel-like portion 70. As illustrated, the electrical termainsl 80 and 82 are provided with an upper end suitable for use as a solder lug and a lower spiked end suitable for mounting the switching apparatus onto a printed circuit board. Other terminal designs can, however, be utilized. A longitudinally extending groove 84 in channel-like portion 70 receives the portion of plunger center section 26 extending beyond bottom surface 21 and provides means for guiding plunger 12 therein. Casing 14 includes a slot 85 in cover portion 72 for receiving a hook-like portion of a latch or stop member 86 which extends downward therethrough for engaging recessed section 61 of plunger 12. It should be understood that numerous modifications can be made to the insulative casing 14 and various alternative casings presently available can be utilized so long as the fixed electrical contacts carried thereby are positioned so as to slidingly coact with the contacts carried by the plunger element 12.

Plunger 12 is molded from a material which provides resiliency to the spring-like portions integrally molded therewith. However, since the spring-like portions are displaced only relatively short distances and are preferably molded in the form of thin strips, numerous materials will provide the desired resiliency. For example, an acetal resin("Delrin", a product of E. I. Dupont de Nemours & Co.) can be utilized. The channel-like portion 70 of insulative casing 14 is preferably formed from a thermoplastic carbonate-linked polymer (e.g.'-'Lexan 500", a product of General Electric Co.). Numerous other material can, of course, be utilized. Cover portion 72 is preferably formed from heat resistant material so as to protect the resilient material from damage during the soldering of electrical leads to the terminals 80 and 82 affixed to casing 14. Numerous sufficiently heat resistant materials are commercially available.

In its assembled position, plunger 12, including the electrical contacts 50*a*–50*d*, is inserted into the casing 14. The movement of plunger 12 within casing 14 is guided by the engagement of plunger center ridge 26 and longitudinal groove 84 of casing 14. Under the influence of the spring-like portions 40a-40d, the curved center portion of each sliding contact 50*a*–50*d* is biased laterally outward from the respective plunger sidewall. As illustrated, each center portion (e.g. center portion 53 of contact 50*a*) has a longitudinal length sufficient to extend between any two adjacent terminals 80 or 82 carried by casing 14. Thus, by moving plunger 12 longitudinally toward a forward end 90 of casing 14, the contacts 50*a*–50*d* slidingly engage or coact with adjacent ones of the respective electrical terminals 80 and 82 providing an electric circuit therebetween.

In FIG. 6, a first switching position of plunger 12 is shown. In this position, the latch member 86 is inserted into longitudinal slot 85 and prevents plunger 12 from moving longitudinally outward from rearward end 64 under the bias of spring 63. To break the electrical circuit provided by plunger 12 in its first or rearward position, the plunger is pushed against the bias of return spring 63 toward forward end 90 by applying pressure to rearward end 28 of the plunger. As plunger 12 slides longitudinally within casing 14, the spring-like portions 40*a*–40 allow laterally inward movement of the respective contacts 50*a*–50*d* to prevent damage thereto and to facilitate easier movement of the plunger. In its

second or forward position plunger **12** is maintained in such position by a conventional latch mechanism, not shown. This latch mechanism is engagable in notch **60**, so that the contacts **50***a*–**50***d* provide an electrical path between other adjacent terminal pairs **80** along one wall of casing **14** and between similarly positioned other terminal pairs **82** on the opposite wall. Pressure applied to rearward end **28**, of plunger **12** operates the latch mechanism in notch **60** and return spring **63** returns plunger **12** to its first or rearward position.

In an alternative spring biasing construction illustrated in FIGS. **7** and **8**, parts identical to parts illustrated in FIGS. **1–6** are identified by identical numerals. In this alternative embodiment, a pair of spring-like portions **92** are molded so as to each include two independently acting spring elements **93** and **94** having adjacent end portions and extending laterally outward from connector portion **96** in a diverging relationship. A curved center portion **97** extends integrally between the outer portions of spring elements **93** and **94**. Under the influence of the spring elements **93** and **94**, the center portion **97** projects outward from openings in the sidewall of plunger **12** defined by the front wall portion **98** of each recess. The outer surface of center portion **97** is coated with a conductive material **99** (e.g. silver) so as to provide a conductive path between adjacent terminals in the same manner as described previously. The conductive material **99** can be either plated or vacuum deposited onto the center portion. As in the embodiment illustrated in FIGS. **1–6**, the alternative embodiment provides a well-balanced contact pressure which remains substantially constant over extended period of operation. As will be readily appreciated, this alternative embodiment further facilitates assembly of the switching apparatus.

It is preferable that the spring tension applied to the sliding contacts is applied at the opposite ends thereof and that the spring tension applied to each end is independently acting. The spring portions of plunger **12** shown in FIGS. **1–8** provide these features. Further, lateral movement of the sliding contacts within the respective recesses is readily permitted by the biasing spring portions thereby allowing the plunger element to be readily moved between different switching positions. However, it will be apparent to those of ordinary skill in the art that the spring-like portion of plunger **12** can take numerous alternative shapes so long as it is formed as an integral portion of the plunger and urges the sliding contact associated therewith outwardly towards the fixed contacts carried by casing **14** so as to coact therewith. Since numerous modifications in the described embodiments will be apparent to those skilled in the art, it is my intent to be limited only by the spirit and the scope of the appended claims.

What is claimed is:

1. Electrical switching apparatus, comprising:

a. an insulative casing;

b. a plurality of electrical contacts fixedly carried by said casing;

c. a plunger element longitudinally moveable within said casing, said element having a recess in at least one sidewall thereof and a spring-like portion positioned within said recess and molded integrally with said element; and

d. electrical contact means in engagement with said spring-like portion of said plunger and urged laterally outward thereby for slidingly coacting with said fixed electrical contacts carried by said insulative casing.

2. The electrical switching apparatus of claim **1** wherein:

a. said recess is defined by front, rear and sidewall portions, said front wall portion having an opening therein defined by a flange portion formed integrally with the plunger element sidewall; and

b. said spring-like portion extends outwardly from the rear wall of said recess toward the front wall portion thereof.

3. Electrical switching apparatus, comprising:

a. an insulative casing;

b. a plurality of electrical contacts fixedly carried by said casing;

c. a plunger element longitudinally moveable within said casing having a recess in at least one sidewall thereof defined by front, rear and sidewall portions in which said front wall portion includes an opening therein defined by a flange portion formed integrally with the plunger sidewall and further having a spring-like portion positioned within said recess and formed integrally with said element so as to extend outwardly from the rear wall of said recess toward the front portion thereof; and

d. sliding electrical contact means having oppositely disposed planar end portions and an outwardly projecting curved center portion, said spring-like portion urging said planar end portion toward said front wall portion and said curved center portion toward said opening.

4. The electrical switching apparatus of claim **3** wherein said spring-like portion includes a pair of independently acting resilient strips having inner end portions connected to one another by a connector portion carried by said rear wall, each of said resilient strips extending divergently outward from said connector portion toward a different one of said planar end portions of said contact means.

5. The electrical switching apparatus of claim **2** wherein:

a. said spring-like portion includes a pair of independently acting spring elements extending divergently outward from said rear wall of said recess toward said front wall and an outwardly curved portion extending between the outer portions of said spring elements and integrally connected thereto; and

b. said sliding electrical contact is carried by said outwardly curved portion.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,694,590 Dated September 26, 1972

Inventor(s) Jon L. Otterlei

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

Column 2, line 2, after "portions" insert --and extending toward the front wall portions--;

Column 3, line 32, "30" should be --30d--;

Column 3, line 35, "portion" should be --portions--;

Column 4, line 53, "and" should be --or--; and

Column 4, line 65, "40" should be --40d--.

Signed and sealed this 10th day of April 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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

UNITED STATES PATENT OFFICE
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