March 2, 1943. J. J. ROOT 2,312,980

BREAKER DEVICE FOR ELECTRICAL CIRCUITS

Filed Feb. 6, 1941 2 Sheets-Sheet 1

Fig. 1.

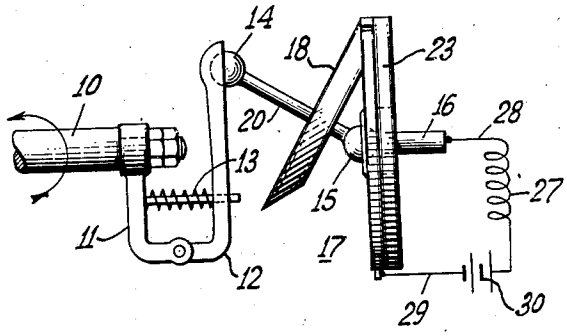


Fig. 3.

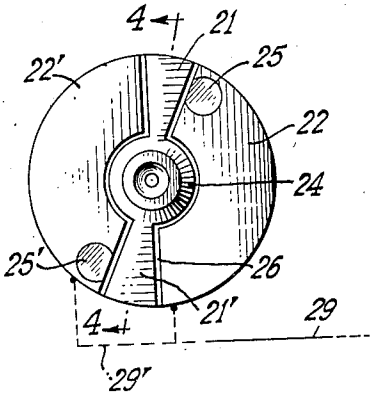


Fig. 2.

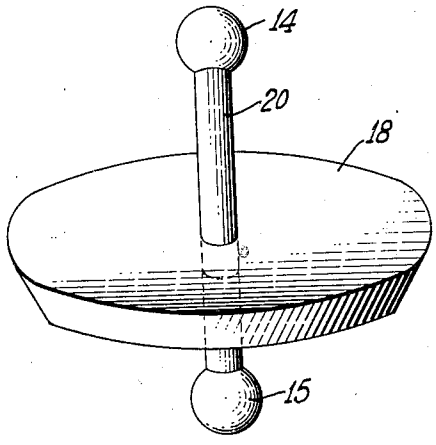
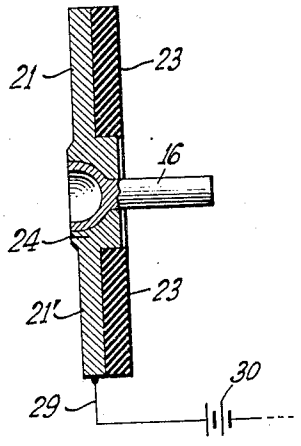


Fig. 4.



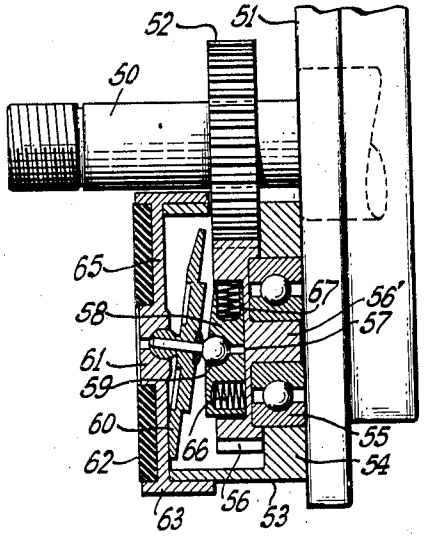
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Fig.5.



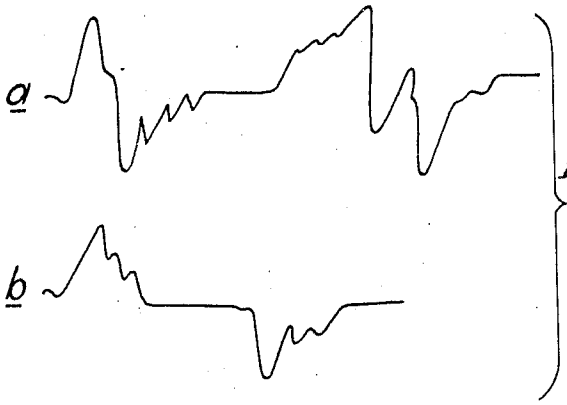


Fig. 7.

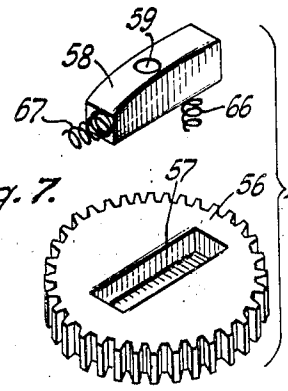
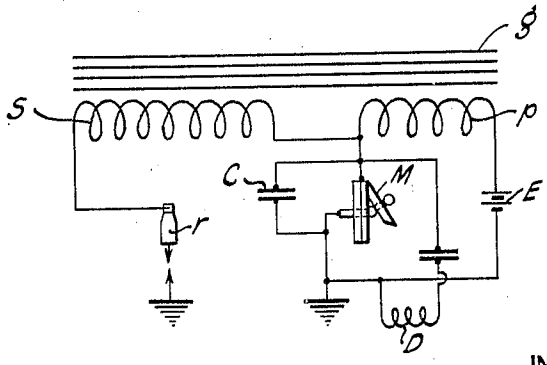


Fig.6.

Fig.8.



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BREAKER DEVICE FOR ELECTRICAL CIRCUITS

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Application February 6, 1941, Serial No. 377,634

8 Claims. (Cl. 200—23)

This invention relates to breaker devices for electrical circuits such as ignition systems of internal combustion engines, and more particularly to devices for making and breaking an electric circuit in an accurately timed manner and at a desired speed.

The invention has for its object generally an improved construction and arrangement of parts for devices of the character indicated, which is economical, long lived, and accurate, and incorporates additionally a so-called "deionizing" means.

More specifically, the invention has for its object the provision of a make-and-break device for electric machines, such as magnetos, requiring a periodic make and break in accurate timed relation, with an improved arrangement of rolling contacts by which there is achieved a precise make and quick break of the circuit, together with a relatively long life of the contacting parts without any substantial impairment of functions.

Another object is to provide a rolling contact make-and-break device in which the rolling member is so arranged that it rolls substantially continuously on a metallic surface whereby the tendency to wear unevenly is substantially eliminated.

Still another object is to provide a combination with a special electric circuit of a make-and-break device having improved rolling contacts arranged to effect the making and breaking of the electric circuit in an invariable manner.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a view, mainly in elevation, showing rolling contact elements for an electric circuit arranged in accordance with the invention;

Fig. 2 is an enlarged perspective view of one of the contact elements shown in Fig. 1;

Fig. 3 is a front elevational view of another contact element shown in Fig. 1;

Fig. 4 is a sectional view of the contact element shown in Fig. 3, taken on the line 4—4 thereof;

Fig. 5 is a view, partly in elevation and partly in section, showing a modified form of the contact device shown in Fig. 1;

Fig. 6 is a perspective view, showing details of parts of the modification shown in Fig. 5;

Fig. 7, parts *a* and *b* are explanatory diagrams; and

Fig. 8 shows diagrammatically a special electric circuit for an ignition system employing a make-and-break device, as shown in Fig. 1.

In electrical ignition systems for internal combustion engines, a device for making and breaking an electrical circuit periodically in accurately timed relation with the revolution of the engine shaft is an essential component and much time and effort has been expended in the development of devices for this purpose.

At the present time a type of device consisting of a spring biased breaker arm actuated by a cam rotating in synchronism with the engine shaft against a rubbing block secured to the breaker arm is in almost universal use, the breaker arm carrying an electrical contact disk which makes intermittent contact with a cooperating stationary contact disk.

Despite the fact that breaker devices of this type have practically superseded all other types of breaker devices in the commercial art, they are nevertheless subject to certain definite drawbacks which, with the passage of time, lead to serious impairment of the performance of the internal combustion engine and require readjustment or replacement. For example, the rubbing block on the breaker arm which bears against the rotating cam is subject to wear which cannot be compensated for in any practical way; and such wear has the effect of changing the timing of the make and break with respect to the revolution of the engine shaft. Also in devices of the breaker arm type the electrical circuit is made and broken between two contact points of relatively small size, and in present-day ignition systems a spark discharge of greater or less intensity always occurs at the break of the electrical circuit. The localization of this spark on the area of the small contact point with the development of localized high temperature and the accompanying phenomena of electrical evaporation of the contact point material, results ultimately in the impairment or destruction of contact surfaces, with consequent poor performance of the engine.

According to the present invention, an interrupter device for the ignition systems of internal combustion engines is provided, which, throughout its life, will always maintain the same timing relation of the make and break with respect to

the revolution of the engine shaft as was given it on its initial installation.

Referring now to the drawings, and particularly to Figs. 1 to 4, 10 denotes a rotatable shaft having a crank arm 11 made fast to one end, and is provided with a portion 12 pivotally attached and bent back over arm 11. A spring 13 is interposed between arm 11 and portion 12 and arranged to be under compression. Spring 13 thus arranged operates to urge the free end of arm 12 away from the shaft 10 and arm 11. The free end of arm 12 is eccentric with reference to the shaft 10 and is preferably provided with a bearing portion which may be in the form of a socket-like recess adapted to serve as a supporting bearing for a ball-like end 14 of a shaft 20; the other end 15 being with advantage also ball-like. The latter end is arranged to engage with another socket-like recess or bearing member 16 that is preferably at the surface of and stationarily disposed in the center of a disk or plate-like contact member 17. The member 17 is also stationarily supported and disposed and arranged to incorporate member 16 in a manner such that the center of the member 16 is in line with the axis of shaft 10, and the surface of member 17 in a plane perpendicular to the axis.

To provide a rolling contact in accordance with the invention, a second disk-like contact member 18 is provided to cooperate with member 17 and mounted on shaft 20. Since shaft 20 has its axis at an angle to axis of shaft 10, the edge of member 18 is preferably beveled as indicated in order to provide a band-like contact area between members 17 and 18. The members 17 and 18 are made of suitable conducting materials, for example, the member 17 may be of silver, while the member 18 is of a non-arcing metal, such as tungsten, molybdenum, or a beryllium-copper alloy.

To provide suitable points where an electric circuit may be made and also broken, when the members 17 and 18 roll upon one another, the surface of one member is arranged to be interrupted during the course of the rolling contact. This is advantageously achieved by dividing the surface of member 17 into segments, a plan view of an exemplary arrangement being shown in Fig. 3. Here, a pair of relatively short segments 21 and 21' are interposed between a pair of relatively long segments 22 and 22', the whole having an insulating support 23. Segments 21 and 21' have an adjoining conducting hub portion 24 arranged to support bearing member 16. The segments 21, 21', 22 and 22' thus arranged provide a metallic surface upon which the member 18 rolls and insures substantially equal wear around the circumference thereof. The pair of segments selected for circuit making, for example, segments 22 and 22', preferably have insets, as shown at 25 and 25', disposed at the edges at which the circuit break occurs. Such insets are of a relatively refractory material, such as tungsten, whereas the remainder of the surface of the segment is of a less refractory metal, such as copper-beryllium. These insets are preferably brazed in place, while the space between the segments, such as shown at 26, is preferably unfilled with any insulating material, air therein generally providing sufficient insulation.

In operation, members 16 and 17 are seen, when rolling, to make and break periodically an electric circuit, for example, that shown in Fig. 1, which comprises a winding 27 having one terminal connected by conductor 28 to member 16 and the other to a source of E. M. F., symbolically indicated at 30 and may be a battery or a magneto. This latter has its other terminal connected by a conductor 29 to one of the circuit making segments, such as 22, with a branch 29' connecting segment 22'. When the shaft 10 revolves, this is seen to cause the eccentric end of arm 12 to urge the end 14 of shaft 20 in a circle, and thereby causes the rolling of member 18 on the surface of member 17. This in turn causes disk 18, as it is driven with its axis following the surface of a cone, to appear to wobble and oscillate from side to side. As shaft 20 and disk 18 are in conducting relation with member 16, it is seen that the circuit is completed as long as disk 18 engages with either segment 22 or 22'. When disk 18 is rolled onto segments 21 and 21', there is no connection to the circuit, so that the circuit is broken.

By changing the relative sizes of the segments (i. e., their angular widths) and their number, substantially any desired timing of makes and breaks may be had, together with desired closed circuit periods; the arrangement shown comprising two segments 21 and 21' of approximately 68° width, and two segments 22 and 22' of approximately 112°.

A modification is shown in Fig. 5, in which the rotating part is connected through gearing to the contact making and breaking device, whereby a desired time relation to the number of revolutions of the driving member may be had.

In Fig. 5, a shaft 50 is shown journaled in and protruding from a casing 51 and has secured on it a gear 52 which entends through and runs in a slot formed in the side of cylindrical housing 53 that is shown mounted on the exterior of casing 51 and is arranged to house the contact members provided in accordance with the invention.

Housing 53 has an internal flange 54 that serves as a support for a bearing 55, which is preferably of the antifriction type and is here depicted as a ballbearing. Bearing 55 in turn supports the rotating part of the make-and-break device. Such part here comprises a gear 56 provided with a stud or shaft 56' supported in the bearing 55 and has teeth which mesh with those on gear 52.

Gear 56 is provided with a centrally disposed recess 57 (see Fig. 6) cut away rectangularly at the center and arranged to receive a socket member 58 which may be also rectangularly formed and provided with a bearing socket 59 in its upper face which is eccentric to the axis of stud 56' and serves as a bearing for one ball-like end of the shaft carrying a contact member 60, which is here the member having wobbling motion.

The other ball-like end of this shaft is mounted in a stationary bearing member 61 that is in line with the axis of stud 56' and is of conducting material and mounted in an insulating disk 62. This latter overlies and is preferably an inset in a ring member 63 and forms therewith a closure for the housing 53.

The closure for housing 53 is arranged to support the stationary contact member and is hence provided interiorly with suitable conducting segments 65 that extend in a plane across the path of the edge of the member 60. This conducting surface of one pair of segments does not extend into conducting proximity to the bearing member 61, while the other pair may do so.

In order that the rolling contact member 60 may always be under tension and pressed into good contacting engagement with the surface of segments 65, a pressure applying means is in-

corporated. Accordingly, one end of the socket member **58** is resiliently supported by means of a spring member, as shown at **66**, preferably the end carrying the socket **59**. The other end also may have a spring member **67** arranged to urge the member **58** radially. These spring members are under compression and hence urge the member **58** both upwardly and outwardly so that the edge of contact member **60** is tightly pressed into engagement with the surface of segments **65**.

In operation, it is seen that when shaft **50** revolves, it imparts motion of rotation through the meshing gears to the socket member **58** which causes the rolling of member **60** upon the surface of segments **65**. Since the surface of the latter has portions in conducting relation with the external circuit, it is seen that a desired sequence of makes and breaks is had with this form of the invention. The electric circuit is seen to be made and broken in the same manner as in the first-described form. In this form, however, the contacting surfaces are totally enclosed and are hence protected against dust and dirt and may be conveniently segregated from other devices.

From the above it will be seen that the rolling contact members of the present invention always present newly engaging surfaces at the point of contact, since the periphery of the wobbling member has a different length from the circular band-like path on the stationary member over which it rolls. As the member rolls there is a differential in the relative linear distance traveled by the wobbling member on the stationary member which results in a slow but positive procession of the wobbling member about its axis. This causes the presentation of the new contacting surfaces referred to above. This continuous presentation of new contacting surfaces at the points of circuit making removes any previous surface which may have ions from the points of contact and otherwise might tend to prolong or intensify the spark. The spark is hence more quickly quenched than heretofore. It will also be seen that wear in no way affects the timing of the makes and breaks provided by the invention. Also the use of a member **18** of silver rolling on a member **17** of copper-beryllium, or the like, having inserts of tungsten, has the advantage that pitting is avoided at the joints between segments, since silver has a tendency to build up upon the tungsten.

Since the rate at which makes and breaks may be made to take place is a design factor in the present invention, substantially any desired rate within certain limits is readily obtained. It is seen also that the make-and-break device here provided is adapted to be used in connection with electric circuits where electric means are incorporated for increasing the frequency by reason of its speed and precision. An electric circuit of this character having a make-and-break device, as above described, is shown in Fig. 8.

In Fig. 8, a primary winding is shown at *p* which has one terminal of an associated secondary winding *s* conductively connected thereto. The other terminal of secondary *s* leads to a spark gap, for example, that of a spark plug *r* that has its other terminal grounded. A core *q* of magnetic material, such as iron, is also preferably associated with the windings.

The primary *p* has one of its terminals connected to a source of E. M. F., depicted at E, which may be a battery or magneto, the other terminal thereof being connected to a make-and-break device M having a wobbling member, there being a connection back to the other terminal of the battery that may be grounded as indicated. A condenser C is also preferably connected across the contacting members of the make-and-break device, and, in parallel with it, and in parallel with the make-and-break device, is connected an oscillating circuit D, comprising inductance and capacity, which here operates to multiply the frequency in the primary *p*.

By this arrangement, it is seen that a suitable make-and-break device is provided, which cooperates in quickly quenching the arcs tending to rise at the breaks, the counter E. M. F. in the winding which tends to hold the arc, as well as the induced E. M. F., being, of course, relatively great because of the high frequency of the current passed. The quick quenching of the arcs at the break in accordance with the invention is thus seen to preserve the high voltage of the secondary for ignition purposes while avoiding dissipating primary energy by arcing.

The operation of such means and the circuit can readily be ascertained by applying thereto an instrument, such as a cathode-ray oscillograph. In Fig. 7, part *b*, is shown a characteristic curve that may be observed on the screen of the cathode-ray tube of such oscillograph when the primary has no frequency multiplying means incorporated, while in part *a* is shown the modified wave form resulting from the incorporation of the device D. The increased frequency of breaks introduced by the device M will result in a spark of greater energy and hence greater efficiency.

It will be understood, of course, that the frequency multiplying device D is merely exemplary and many other electrical arrangements may be employed for this purpose.

From the above, it will be seen that the invention provides a device in which successive sparks will not be localized on a small contact area but will be distributed uniformly over the relatively large area of one contact member, thus minimizing localized heating and evaporation.

Also, it will be seen that the invention modifies the characteristics of electrical ignition circuits in such a way as to reduce to a minimum and practically eliminate the spark occurring at the break, while preserving the full energy of the spark occurring in the engine cylinder.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a breaker device for electrical circuits, the combination comprising, a contact member having a working surface substantially lying in a flat plane, means to support one end of a shaft substantially at the central portion of the working surface, a shaft member having one end supported by said means and its axis disposed at an oblique angle to the axis of the central portion, a cooperating contact member secured to said shaft at a point removed from the working surface and having a continuous circular contacting portion substantially coaxial with and spaced from said shaft in engagement at one point with a circular path on the working surface of length

greater than the contacting portion, and means to rotate the remote end of said shaft through a circular path for moving the point of engagement between said contact members progressively around the path on the working surface, said second contact member being rotatable on its axis to compensate for the difference in lengths of the contacting portion and the contacting path substantially to restrict the contacting to rolling engagement.

2. In breaker devices for electrical circuits, the combination with a driving element having an axis and a driving portion adapted to rotate eccentrically about said axis, of a disk-like contact member stationarily disposed and having a bearing member in line with said axis, a shaft rotatively mounted in said bearing member at an angle to said axis and coupled to be driven by said driving member, and a second disk-like member secured to said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling engagement with said first-named contact member and arranged to interrupt an electric circuit, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

3. In breaker devices for electrical circuits, the combination with a driving element having an axis and a driving portion adapted for rotation eccentrically about said axis, of a disk-like contact member stationarily mounted and having a central bearing member in line with said axis, said disk-like contact member having a surface making a right angle with said axis and arranged to provide alternate conducting and insulating portions, a shaft having one end mounted in said bearing member and disposed at an angle to said axis and arranged to be actuated by said driving portion, and a second disk-like contact member secured to said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling contact with the working surface of said first-named contact member, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

4. In breaker devices for electrical circuits, the combination with a driving element having an axis and a portion provided with a bearing turning eccentrically about said axis, of a stationary contact member having a bearing member insulated therefrom and in line with said axis, said stationary contact member having a surface lying in a plane disposed perpendicularly to said axis, a shaft mounted at an angle to said axis and extending from said insulated bearing member to said eccentric bearing, and a cooperating contact member secured on said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling contact with said working surface and arranged to interrupt an electric circuit when connected across said stationary contact member and said insulated bearing member, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

5. In breaker devices for electrical circuits, the combination with a driving element having an axis and a portion provided with a bearing turning eccentrically about said axis, of a stationary contact member having a bearing member insulated therefrom and in line with said axis, said stationary contact member having a working surface with at least one insulated section, the whole lying in a plane disposed perpendicularly to said axis, a shaft mounted at an angle to said axis and extending from said insulated bearing member to said eccentric bearing, and a cooperating contact member secured on said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling contact with said working surface and arranged to traverse said insulated section whereby an electric circuit may be made and broken, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

6. In breaker devices for electrical circuits, the combination with a driving element having an axis and a portion provided with a bearing turning eccentrically about said axis, of a stationary contact member having a bearing member insulated therefrom and in line with said axis, said stationary contact member consisting of a suitable conducting material and having a working surface with at least one insulated section and lying in a plane disposed perpendicularly to said axis, a conducting shaft mounted at an angle to said axis and extending from said insulated bearing member to said eccentric bearing, and a cooperating contact member comprising suitable conducting material secured on said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling contact with said working surface and arranged to traverse said insulated section, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

7. In breaker devices for electrical circuits, the combination with a driving element having an axis and a portion provided with a bearing turning eccentrically about said axis, of a stationary contact member having a bearing member in line with said axis, a working surface lying in a plane substantially perpendicular to said axis, a shaft mounted at an angle to said axis and extending from said bearing member to said eccentric bearing, a cooperating contact member on said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling contact with said working surface, and means associated with said contacting member for insuring a desired pressure at the points of engagement, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

8. In breaker devices for electrical circuits, a driving element having an axis and a portion provided with a bearing turning eccentrically

about said axis, of a casing member associated with said driving element providing an interior working surface lying in a plane substantially perpendicular to said axis adapted to serve as an electrical contact and provided with a stationary bearing member, a shaft mounted at an angle to said axis and extending from said stationary bearing member to said eccentric bearing, a cooperating contact member in said casing member on said shaft at a point removed from said first contacting member and having a continuous circular portion spaced from said shaft in rolling contact with said working surface, and spring means associated with said cooperating contact member for applying pressure at the points of its engagement with said working surface, the resulting circular contacting paths of said two contact members thereby being of different lengths progressively to present to any one point on the path of said stationary member a successively different contacting portion of said second member.

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