

Nov. 26, 1940.

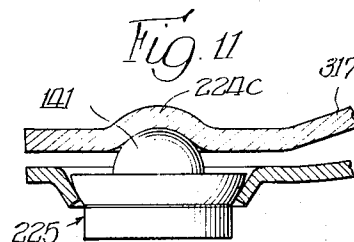
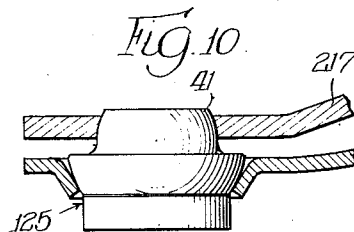
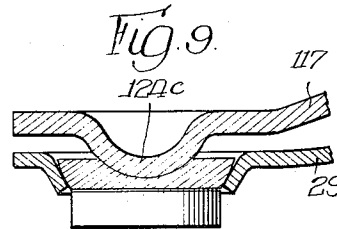
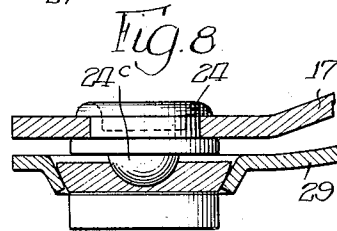
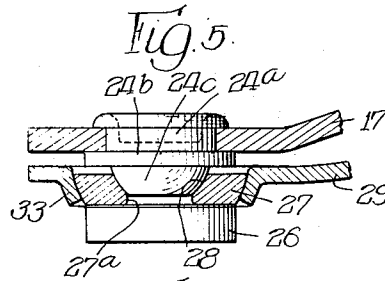
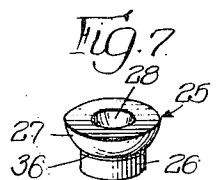
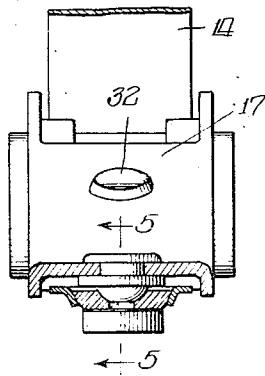
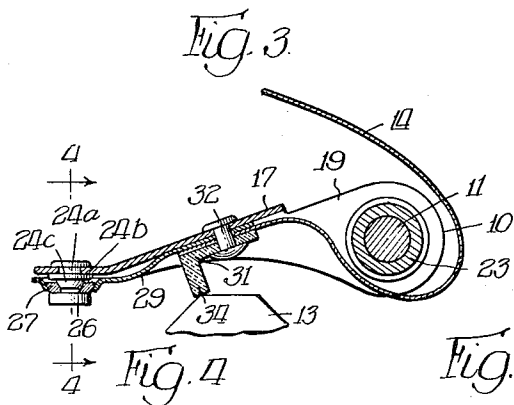
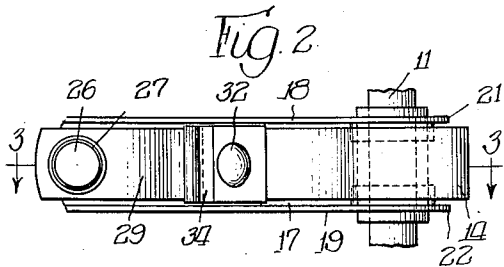
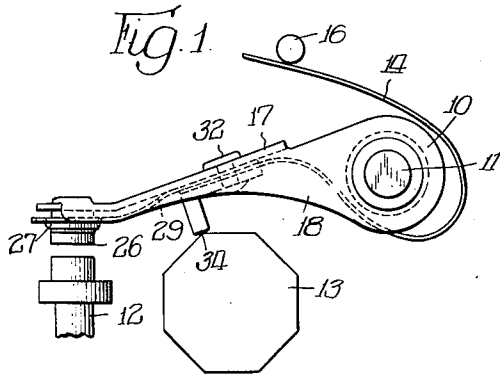
C. E. IVES

2,222,843

CIRCUIT BREAKER

Filed Nov. 20, 1936

2 Sheets-Sheet 1



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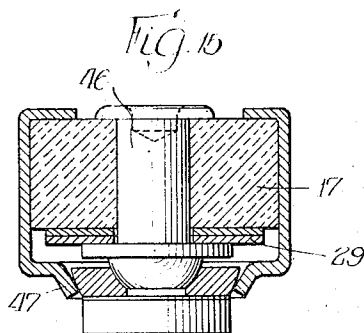
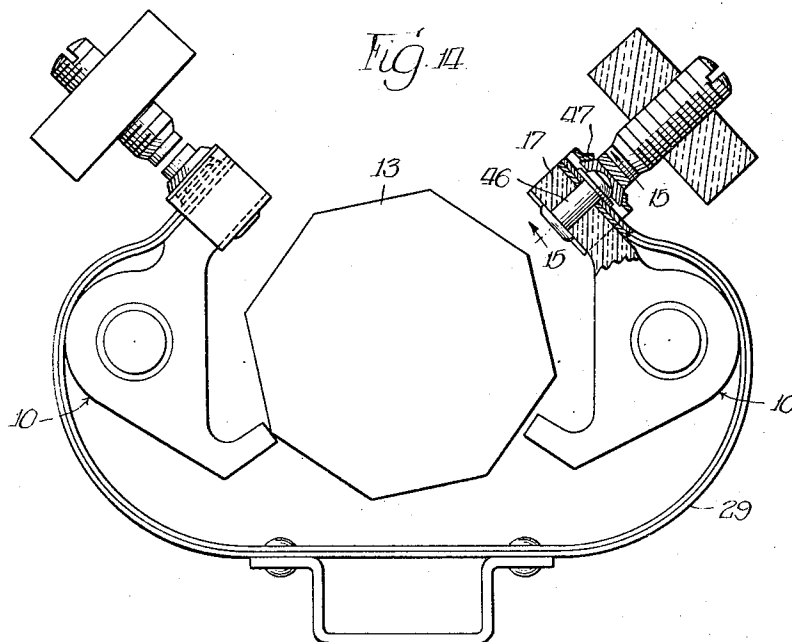
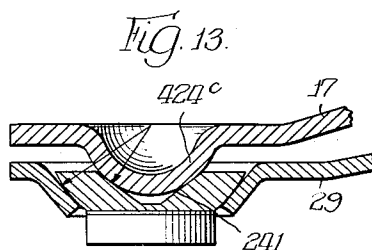
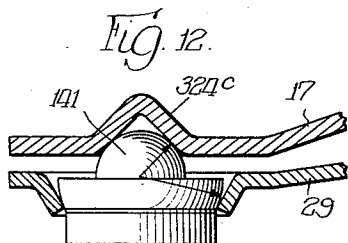
C. E. IVES

2,222,843

CIRCUIT BREAKER

Filed Nov. 20, 1936

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,222,843

CIRCUIT BREAKER

Clifford E. Ives, Chicago, Ill.

Application November 20, 1936, Serial No. 111,762

12 Claims. (Cl. 200—166)

My invention relates to circuit interrupting and closing mechanism. It relates more in particular to circuit breakers of the type employed in the ignition systems of automobiles, although not limited to such use, wherein a pair of contact points is provided, one stationary and the other adapted to be moved with respect to the stationary contact for the purpose of opening and closing a circuit.

So-called breaker points or contact points employed in automobile ignition systems, and mechanism used to control, adjust and align such points have had rather an extensive development. The mechanism now generally employed represents a great advance in design, but still there are many objectionable features and characteristics of common types of breaker points and controlling apparatus known to those skilled in the art, but which objectionable features and characteristics have not been overcome.

One of the principal disadvantages and objections to breaker points and associated apparatus now commonly employed is that true face contact between the breaker points is not obtained, contact usually occurring even in the majority of new installations at one single point, that is, only over a small portion of the total area intended for contact. This condition is aggregated by wear and adjustment of the points because of the fact that in common practice the movable point is adjusted through an arc and the fixed point is adjusted in a straight line. True parallelism, therefore, is substantially impossible after adjustments have been made, and moreover, is very seldom obtained in new installations. Attempts have been made to produce contact point supporting structures by virtue of which contact points will be self-aligning and a true surface-to-surface contact will be obtained. Such attempts, however, have not met with success and the structures suggested have not gone into general use. There are many objections to suggestions for self-aligning supports made in the past. Among the principal objections are the following: In high speed operation the contact arm must function as a unit, and the support for the movable contact point should not permit appreciable relative movement between the point and the contact arm. Structures suggested in the past have not supported the movable contact point adequately and so have permitted such extreme movement as to be objectionable, particularly at relatively high speeds. Another objection is that the structures suggested have been either impossible of production on a commercial

basis, or so expensive as to make their use substantially prohibitive, or of such a fragile nature as to result in frequent breakages. Still another objection is that supporting mechanism suggested in the past has not been capable of application to different styles of contact arms and so the use in more than one type of a system has been impossible, even assuming that other objections outlined hereinabove had been overcome.

Accordingly, the principal object of my present invention is the provision of an improved form of support for a movable contact member which obviates the objections outlined hereinabove.

Another object is the provision of an improved self-aligning contact point.

Still another object is the provision of means for securing a contact point to a movable contact arm whereby self-alinement may take place, but wherein during operation the point functions substantially as if fixed rigidly to the contact arm.

Other objects and features will be apparent from the following detailed description taken with the accompanying drawings wherein

Fig. 1 is an elevational view showing a stationary or fixed contact member, and a movable contact member embodying the features of my invention.

Fig. 2 is an elevational view of the contact arm looking at right angles to Fig. 1, along the line 2—2 of Fig. 1.

Fig. 3 is a longitudinal sectional view taken on the line 3—3 of Fig. 2 looking in the direction of the arrows.

Fig. 4 is an enlarged sectional view taken on the line 4—4 of Fig. 3 looking in the direction of the arrows, and showing features of construction of the movable contact point.

Fig. 5 is a still further enlarged longitudinal sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 illustrates a combination rivet and support member shown before the assembly thereof.

Fig. 7 is a contact point carrying member adapted to be seated on the member shown in Fig. 6.

Figs. 8 to 13, inclusive, are views similar to Fig. 5 but showing modifications.

Fig. 14 is a plan elevation, partly in section, showing a modified contact arm construction, and

Fig. 15 is an enlarged sectional view taken through the movable contact point and support therefor.

For convenience I have shown my invention as applied to the circuit breaker mechanism em-

played in the ignition system of an automobile, and will describe it in that connection, although obviously it may have other applications.

In Fig. 1 I illustrate generally a breaker mechanism produced in accordance with my invention as applied to the ignition system of an internal combustion engine. A movable contact arm 10 is pivoted on a vertical post 11. The movable contact arm carries a breaker point, the details of which will be described hereinafter, adapted to cooperate with a fixed point 12 (indicated without a support), a cam 13 being provided in the usual manner to make and break contact at the breaker points by oscillating the contact arm 10 about the post 11. A leaf spring 14 secured to the contact arm has a free end engaging between a pin 16 so as normally to cause the contact arm to move in a counter-clockwise direction about its pivot and maintain contact between the 20 points.

Considering now the structure of the contact arm itself, this comprises a unitary frame portion comprising a back 17 provided with flanges 18 and 19 forming a part thereof, and terminating in ears 21 and 22 which carry a sleeve 23. This sleeve engages around the post 11 and is preferably made of bronze or other bearing material so as to have a bearing action when in contact with post 11.

The outer end of the back 17 of the contact arm is apertured to receive a member 24 (Fig. 6). This member 24 comprises a rivet portion 24a, a head portion 24b and a generally semi-spherical projection 24c which forms a seat for a movable contact supporting member as will be described. This member, preferably produced from stainless steel and functioning as will be described hereinafter, is secured to the back 17 by extending the rivet portion 24a through the 40 aperture provided in the back and riveting the same into position to produce a final assembly as indicated in Figs. 3, 4 and 5.

The breaker point assembly generally indicated by the reference character 25 comprises a breaker point 26 preferably formed of tungsten or other suitable breaker point material, and a supporting member 27 to which the breaker or contact point is secured by means which will be described. The supporting member 27 is provided with a generally semi-spherical opening 28 adapted to engage over the projection 24c in the manner shown more clearly in Fig. 5. A leaf spring 29 secured to the back 17 of the contact arm by means of a rubbing block 31 fastened in position by a rivet 32 has an opening equipped with an annular flange 33 engaging against the slanting sides of the supporting member 27 so as to hold the contact point assembly 25 against the projection 24c as an adjustable seat. The rubbing block is shown in the form of an L having a cam follower 34 for engaging the cam 13, but this rubbing block may have other shapes and the cam follower may be provided in other ways. The construction shown, however, forms a firm support for the spring 29 as well as for the cam follower. It is to be noted that the rubbing block extends across the full width of the back 17 so as substantially to contact the flanges 18 and 19 of the contact arm thereby making it necessary 70 to employ only a single rivet for the purpose of securing a firm assembly.

The breaker point assembly 25, as previously described comprises a tungsten disc or pellet 26 and the supporting member 27. This supporting 75 member 27 is preferably made of cold rolled steel

for requisite strength, and to facilitate attachment of the tungsten pellet. It is preferably first coated with a thin layer of copper or other corrosion resisting material having suitable conductive characteristics, and then assembled by utilizing a thin disk 36 of copper or other suitable metal between the tungsten pellet and its supporting member to act as a bond between the two members. The members are held under pressure and heat is applied for example by a 10 passage of an electrical current so as to fuse the copper which thus bonds the two sections together. During this bonding operation some of the copper flows through the opening 27a and also along the outside of the member 27, flow being induced by capillary action and supplemented by pressure so as further to coat the surface of the member 27 through which contact is made. 15

The rubbing block 31 or at least the extension 34 thereof is made of insulating material in accordance with the usual practice in the type of installation illustrated. The leaf spring 29 is formed of corrosion resisting material. Preferably it is coated with copper or formed of a suitable copper alloy in order to resist corrosion and also promote electrical contact. 25

In forming the member 24, as previously described, a stainless steel alloy is advisable. In the form shown in Fig. 6 before the rivet portion 24a has been distorted the part is preferably 30 made on a screw machine. During manufacture I preferably make the part 24c which is of generally semi-spherical shape, somewhat oversize. This portion is then placed in a die having exactly the proper size and shape and by striking the member 24c a sharp blow the semi-spherical portion 24c is brought to exactly the proper size, and whatever tool marks may be present on its surface are removed in the forming process. It is to be noted that the part of the portion 24c 40 in line with the axis of the rivet portion 24a is flattened so that it will remain out of contact with the inside wall of the socket 28 in which this member seats for reasons which will be explained fully hereinafter. 45

Similarly, the semi-spherical opening 28 is made slightly undersize, (the supporting member 27 is conveniently made also on an automatic screw machine) and this opening 28 is given the proper size by placing a steel ball therein and striking the steel ball a sharp blow so as to produce an opening of exactly the right size and shape wherein the inside surface is substantially free of tool marks. Although the proportions may be changed, I have found that for contact arms 50 for use in automobile ignition systems, the portion 24c may be made as part of a $\frac{1}{8}$ inch sphere, and the opening 28 is exactly the size to receive a $\frac{1}{8}$ inch sphere. 55

It will be noted that the surface of the semi-spherical member 24c and the opening 28 are so proportioned that there is substantially a wedging action so as to cause the contact point assembly to have a firm and intimate contact with the member 24 whereby to decrease to a minimum the contact resistance between these two members. The spring 29 bears firmly against the angled outer walls of the supporting member 27 so as to promote contact at this point and also hold the parts in intimate assembly. The tension of the 70 spring and the shape of the parts is so proportioned that there is a strong wedging action and swiveling of the member 25 is resisted with considerable force by the action of the spring and the intimate association of contacting surfaces; 75

but the resistance to wedging action is not sufficient to prevent the automatic alinement necessary to keep the face of the tungsten pellet 26 dead in line with the opposing face of the stationary contact 12.

The diameter of the tungsten pellet 26 is preferably about .175 of an inch. This relatively large diameter not only results in the provision of more than adequate contacting surface between the movable and stationary points, but it also serves to a considerable extent to keep the movable point in proper alinement.

It is obvious that the angle between the center line and a line running from the outside edge of the contact point and the outside edge of the opening 28 is relatively large, and obviously the wider this angle is the easier it is for the movement of the stationary contact point to correct for errors in alinement even though the spring 29 tends to hold the assembly 27 quite firmly.

In assembling the breaker points of my invention, the stationary point 12 is first placed in position, and set at approximately what the installer believes to be a suitable position. The contact arm is now placed in position and with the rubbing block alined with the flat side of the cam 13 and the breaker points in contact, the contact arm is pulled back against the action of spring 14 and allowed to snap into position. One or two such actions will definitely cause the points to come into exact alinement. The internal combustion engine is then turned slightly until the high side of the cam engages the rubbing block, and the stationary point 12 is adjusted, using a suitable gauge, until the proper width gap is provided between the two breaker points. If further precaution seems advisable, the internal combustion engine can then be turned over further until the flat side of the cam is in line with the rubbing block and the contact arm can again be snapped once or twice to be sure that the points are in alinement. It may be noted that according to the design of my breaker arm, proper alinement preferably is secured in the manner described, and it is not expected that an improperly alined contact point will line itself up during operation of the engine. In general, however, even though the points are out of alinement they will usually run in but I prefer to initiate operation with the points in true alinement using the precautions in installation described hereinabove.

Looking now at the modifications shown in Figs. 8 to 11, it will be seen that the same general principles employed in the main embodiment are utilized in such modifications. Fig. 8 shows a modification wherein the member 24c is formed without the flat portion shown in the main figures. In other words, both portions of the seat are true sections of a sphere. This form is not quite so satisfactory as the form shown in the main figures, although it may be used to advantage.

In Fig. 9 the seat 124c is formed directly in the back 117 of the contact arm. The movable contact assembly 25, spring 29 and other portions of the device may in this form remain identical with the form shown in the preferred embodiment. The lower edge of the seat 124c is shown round. The lower portion of this seat, however, may be formed flat, if desired, as those skilled in the art will readily see by comparing, for example, the embodiment shown in Fig. 8 and the embodiment shown in the main figures.

In the form shown in Fig. 10, the back 217 is

formed with an annular opening through which an extension 41 on the movable contact assembly 125 extends. The curve of the engaging surface is in the form of an arc of a sphere so that swiveling or alinement at these contacting surfaces is permitted. The spring and other portions of the supporting member 125 may remain substantially the same.

In the form shown in Fig. 11, the back 317 is formed with a concave seat 224c, and a semi-spherical projection 141 is provided on the supporting member 225. In this form the other portions of the structure remain substantially unchanged. It is to be noted that the structure of Fig. 11 is substantially the reverse of the structure of Fig. 9.

In each of the embodiments a seat is provided on the breaker arm for a supporting member which carries a contact face, preferably in the form of a pellet of tungsten, a seat cooperating with the seat provided on the contact arm, and a shoulder engaged by a spring also carried by the contact arm. In each of the embodiments also the engaging portion of the seat on the contact arm and the seat on the supporting member are substantially semi-spherical, the expression semi in the term "semi-spherical" being used to indicate "a part of" rather than "half of." Throughout the specification and in the claims it is to be understood that the term "semi-spherical" is employed in this sense. In each of the embodiments also there is a very firm contact over a relatively large area of the seat so as substantially to produce a wedging action, but this wedging action is limited so as not to prevent universal swiveling of the contact supporting member within the limits of the design so as to permit automatic self-alinement of the movable contact point.

The manner in which I secure the result described in the preceding paragraph and other portions of the specification may be made clear by considering somewhat further a common principle of design employed throughout. One common feature is that a seat is provided on the contact arm, either by forming the body of the arm into a seat, or attaching a separate seat carrying member to the contact arm body. The seat cooperates with a complementary seating surface on the movable breaker point assembly. There is another point of contact, however, between the breaker point assembly and the contact arm body, namely, at the point where the spring 29 engages the annular shoulder provided on the movable breaker point assembly. All of these surfaces, four in number, are curved (except in so far as certain surfaces may be modified while still utilizing the same principle as will be explained hereinafter) and these four curved surfaces all comprise sections of spheres generated about a common center. We may consider the common center as a virtual but universal pivot around which the movable breaker point assembly can swivel. If we look at Figure 5 we will find that the member 24c has a surface which comprises part of a sphere. If now we draw two chords across these surfaces and draw perpendicular lines on each chord, these lines will intersect at the center of a sphere of which the surfaces on the member 24c comprise a part. Obviously, the inner semi-spherical surface on the member 27 has the same curve as member 24c, and this surface is also generated about the same center. Now take the outer spherical surface on the member 27; if we draw a series of lines as

we did when considering the spherical surfaces on member 24c, we find that lines perpendicular to chords intersect at the same point. The same is true of the inner surface on the flange 33 of the spring which engages the shoulder on member 27.

The manner in which the principle illustrated above may be modified can be shown in part by reference to modifications already described. However, by first studying the modification of Figs. 12 and 13 the principle may be made somewhat clearer. In both of these figures the seat is shown formed from the body of the movable contact arm without the imposition of a separate seat member as illustrated in the main embodiment. In each case, however, I may employ a separate seat member, and therefore no significance should be attached to the particular manner in which the seat is formed.

Referring now to Fig. 12, a portion 17 is formed into a seat 324c which is of generally conical shape. This seat is engaged by a true semi-spherical shaped body 141 on the movable breaker point assembly, which in this case has the identical shape as shown in Fig. 11. The engaging seat formed by the spring 29 in this case can be part of a cone, that is, the side walls may be straight, because the shoulder on the movable contact assembly which is engaged by the spring comprises a section of a sphere generated about the same center as the sphere comprising member 141. The two radius lines shown in this figure indicate at their point of intersection the center about which the spheres are generated.

Fig. 13 is similar to Fig. 12 in the combination of spherical and cone surfaces except that the seat 424c formed on the member 17 comprises part of a sphere, and a recess 241 formed in the movable contact assembly comprises part of a cone. The other portions of the design are the same as illustrated and described in connection with Fig. 12.

With this additional structure to consider it should be clear to those skilled in the art that while in principle the four contacting surfaces comprise parts of a sphere in each case each of the spheres being generated about a common center, certain of the surfaces may comprise sections of a cone. I have found that two of the four surfaces may comprise sections of a cone. If only two of the four surfaces comprise sections of a sphere, however, the two spherical surfaces should not be mutually engaging. The three possibilities, therefore, are for all four surfaces to be sections of a sphere generated about a common center, for three of the surfaces to be sections of a sphere as shown in Figs. 8, 9, 10, and 11, or for two of the four surfaces only to be sections of a sphere as shown in Figs. 12 and 13. Preferably also the conical surface should be generally perpendicular to a radius line drawn from the center of the sphere to the point of contact between the spherical surface and the cone surface. This is not absolutely essential but certain advantages are secured by this general relationship.

For the purpose of illustrating a still further application of my invention, I show in Fig. 14 the application of my present invention to a common type of dual system used in certain models of the Ford automobile and in a somewhat modified form also in other connections. In this arrangement there is a single cam 13 with two movable contact arms 10, one arranged to make contact while the other is breaking contact. In this design the contact arm body is usually formed

of an insulating material such as a suitably treated phenolic resin. The details of the operation and structure do not concern me in the present invention. It is sufficient to say as is common in the automobile practice that there is a stationary contact member which is adjustable to control the width of the gap.

Due to the character of the installation some modifications are required in that portion thereof which relates to my invention, and these modifications are best shown by reference to Fig. 15 in which the movable contact assembly and supporting seat are shown in an enlarged section.

The body 17 is apertured to receive a rivet 46 which carries a seat at one end thereof. The spring 29 usually provided in this particular form of installation is apertured to pass the rivet 46 and is engaged between an enlarged shoulder on the rivet and the body 17 whereby to provide the necessary electrical contact required in the system. The movable contact assembly has the same general structure as described in connection with the preferred embodiment, an inner generally spherical surface engaging the seat and an outer annular surface on an extending shoulder being engaged by a special form of spring support 47 which is formed around the main body 17. It is obvious that by this construction there is very little spring action possible in the spring member 47, only enough spring action being necessary to assure firm contact at all times between all of the engaging surfaces, and to permit the necessary take up in case of slight wear after prolonged operation. This comparatively inflexible assembly is made possible because of the relatively free sliding movement which in turn is derivable from the proper design of the mutually engaging surfaces as described more in detail hereinabove.

In each form of the device it is to be noted, that while even though I have not provided what is commonly termed "a high speed contact arm," nevertheless the contact arm of my invention is capable of operation at at least as high speeds as single piece fixed contact arms have been capable of operating in the past. Inertia of the parts does not permit unseating of the swiveling portion of the contact arm carrying the contact point, as is the case with other supposedly self-aligning contact points heretofore produced.

I have described my invention in considerable detail in order that those skilled in the art may understand and know how to practice the same. I do not limit myself, however, to the specific form or forms of the invention shown and the invention is limited only by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. In a circuit breaker, a contact arm having a seat, a movable breaker point assembly including a seat portion, a contact portion and an arcuate annular shoulder portion, the seats on the contact arm and breaker point assembly engaging each other, one being convex and generally semi-spherical and the other concave and generally semi-spherical, and a spring carried by the contact arm and engaging said arcuate annular shoulder generally tangentially thereof with sufficient force to cause relatively great contact pressure, whereby to decrease electrical contact resistance, but not sufficient pressure to prevent swiveling of the movable breaker point assembly on said seat whereby to permit alignment of the contact portion with respect to a

stationary contact member cooperating therewith.

2. A circuit breaker as defined in claim 1 wherein the seat on the contact arm is semi-spherical and convex and comprises part of a member which includes a rivet portion extending through an aperture in a frame portion of the contact arm.

3. A circuit breaker as defined in claim 1, wherein said movable breaker point assembly comprises a section of ferrous metal carrying said seat, an annular shoulder, and a tungsten pellet bonded to said ferrous portion.

4. A circuit breaker as defined in claim 1, wherein said movable breaker point assembly comprises a section of ferrous metal carrying said seat, an annular shoulder, and a tungsten pellet bonded to said ferrous portion, said ferrous portion having a thin coating of a non-ferrous metal with high electrical conductivity, a layer of a bonding metal being provided between the ferrous portion and said tungsten pellet.

5. A contact arm as defined in claim 1 wherein said spring is in the form of a leaf spring having one end secured to the contact arm and the opposite end provided with an opening with an annular flange therearound, said flange engaging the said annular shoulder on the movable breaker point assembly.

6. A contact arm as defined in claim 1 wherein said spring is in the form of a leaf spring having one end secured to the contact arm and the opposite end provided with an opening with an annular flange therearound, said flange engaging the said annular shoulder on the movable breaker point assembly, at least one engaging surface on said annular shoulder and said flange comprising a section of a sphere.

7. In a circuit breaker, a swiveled contact member having a contacting surface on one side thereof, a convex spherical surface surrounding said contacting surface and facing in the same direction as said contacting surface but spaced therefrom, and a concave spherical surface on the opposite side thereof substantially concentric with and having a smaller radius than said convex spherical surface.

8. In a circuit breaker, a swiveled contact member having a contacting surface on one side thereof, a convex spherical surface surrounding said contacting surface and facing in the same direction as said contacting surface but spaced therefrom, and a convex spherical surface on the opposite side thereof substantially concentric with said first convex spherical surface.

9. In a circuit breaker, a swiveled contact member having a contacting surface on one side

thereof, a convex spherical surface surrounding said contacting surface and facing in the same direction as said contacting surface but spaced therefrom, and a concave conical surface on the opposite side thereof, the axis of which substantially coincides with the center of said spherical surface.

10. In a circuit breaker, a swiveled contact member consisting of a solid generated by revolving a plane about one side as an axis, said plane being described, in addition to said side, by two unlike concentric arcs joined by a line, another line substantially perpendicular to said axis, a third line joining said perpendicular line and the greater of the arcs, and a fourth line joining said side and the lesser of said arcs, the common center of said concentric arcs lying on said axis.

11. In a circuit breaker, a swiveled contact member consisting of a solid generated by revolving a plane about one side as an axis, said plane being described, in addition to said side, by five lines and an arc, one of which lines intersects and is substantially perpendicular to said axis, a second line intersecting said axis and substantially perpendicular thereto in spaced relation to said first line, a third line intersecting said first line at a point apart from the intersection thereof and said axis and divergent therewith, a fourth line substantially perpendicular to said axis intersecting said third line but not said axis, and a fifth line intersecting said second line, substantially parallel with said axis and extending in a direction to intersect said third line if extended, said arc joining said fourth and fifth lines, said arc having a center lying on said axis at a point beyond the intersection thereof with said second and first lines.

12. In a circuit breaker, a swiveled contact member having a contacting surface on one side thereof, a convex annular spherical surface surrounding said contact member and facing in the same general direction as said contacting surface, a spherical surface on the opposite side of said contact member forming a seat, said last mentioned spherical surface substantially concentric with said annular spherical surface and having a smaller radius, a support having a seat and means including a spring carried by said support for causing firm mutual engagement between said contacting member and said support, whereby said contacting member is held against the support to produce good electrical contact but may swivel on its seat sufficiently to align said contacting surface with another contacting surface with which it is adapted to cooperate.

CLIFFORD E. IVES.