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APPARATUS FOR INDICATING RELATIVE ALIGNMENT OF ENGAGEABLE CONTACTS USING A PRINTED CIRCUIT SENSOR

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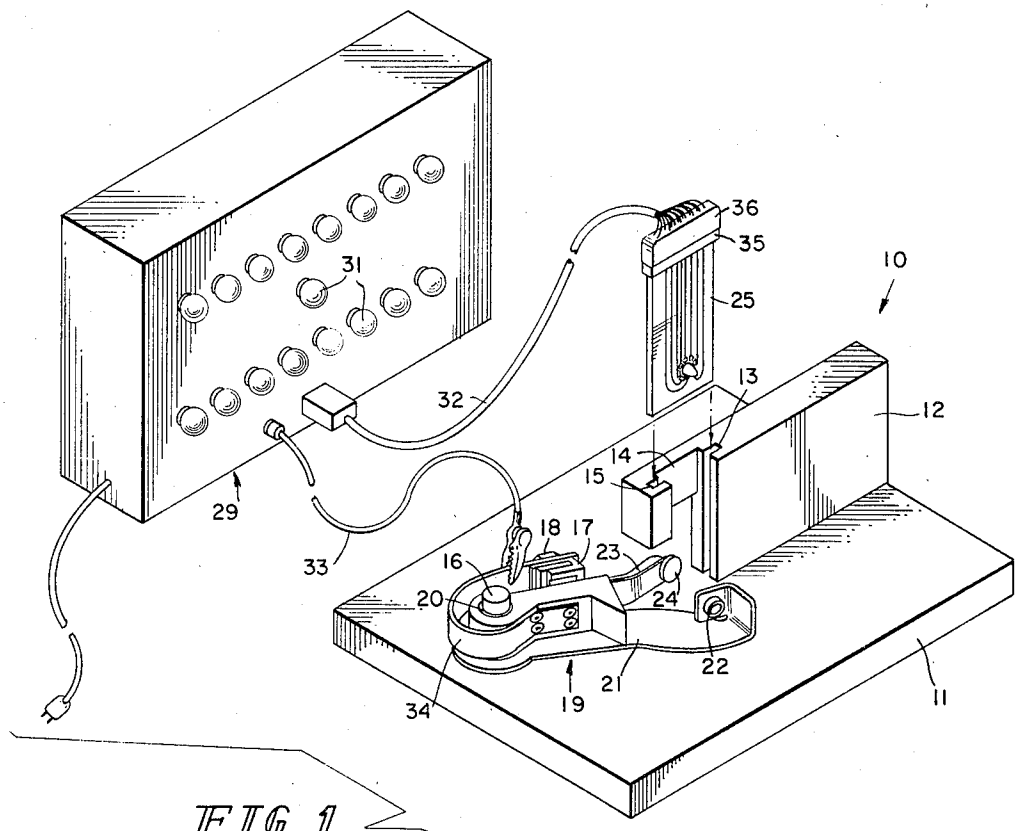


FIG. 1

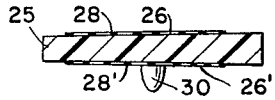


FIG. 5

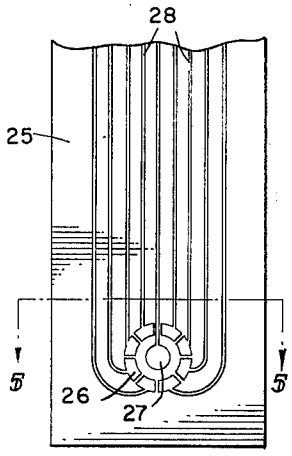


FIG. 2

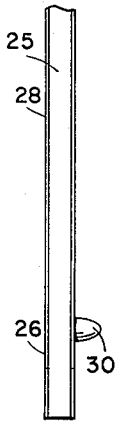


FIG. 3

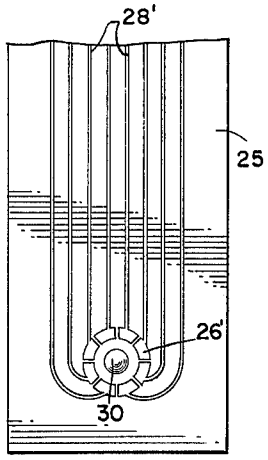


FIG. 4

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APPARATUS FOR INDICATING RELATIVE ALIGNMENT OF ENGAGEABLE CONTACTS USING A PRINTED CIRCUIT SENSOR

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U.S. Cl. 324—28 7 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for indicating the relative alignment of engageable contacts. A printed circuit board having adjacent electrically conductive areas is positioned between the contacts. The displacement of one of the contacts with respect to the other contact causes the contacts to engage with the printed circuit board and at least one of the conductive areas. Indicating means is electrically coupled between the contacts and the conductive areas of the printed circuit board for indicating at least one of the conductive areas engaging wih the contact or contacts thereby indicating the relative alignment of the contacts.

The present invention relates to a means and method of testing contacts, and more particularly to a means and method of locating the point or points on engaging face to face contacts in which a flow of current takes place.

A conventional ignition system for an internal combustion engine employs a breaker means having an actuator, generally a cam to actuate a movable arm carrying a breaker point. The movable breaker point is normally biased into contact with a fixed breaker point and is intermittently moved out of contact so as to break a cooperatively associated electrical circuit. The aforementioned make and break causes a magnetic field to collapse in the ignition coil of the cooperatively associated electrical circuit. The collapse of the magnetic field of the ignition coil produces a spark across a spark gap means such as a spark plug.

It has been found that if the surfaces of the breaker point contacts do not engage properly, there is a tendency for the points under rapid operation to char, pit and accumulate foreign matter on one or both points to the extent that the contacts are impaired. The condition generally worsens during successive operations between the contacts and correspondingly reduces the efficiency of the contacts to transfer electrical energy to the cooperatively associated spark plugs. As a result of this inefficiency, the combustion of the fuel and air mixture may be incomplete resulting in reducing the effective horsepower of an internal combustion engine. In addition, the imperfect or incomplete engagement of the breaker points results in an impaired transfer of potential from one point to another point.

Generally, manufacturers of breaker point means have utilized the vision of assembly line personnel to ascertain the point of engagement between the face-to-face surfaces of contacts of the breaker points. The observation by the assembly line personnel would of necessity be momentary since the breaker points are a mass produced item and since the observation of the engagement would be but one of the steps in the manufacture of a completed breaker point means. Such momentary observation often leads to operator fatigue with consequent inaccuracies. In many

instances defective breaker point means can be traced directly back to a fatigued observer.

Therefore, it is an object of the present invention to provide an electrical testing means for ascertaining the point of electrical engagement between engaging contact faces of a breaker point mechanism.

Another object of the present invention is to provide means and methods for testing and indicating the point of operative engagement between contacts of a breaker point mechanism.

Yet another object of the present invention is to provide an electrical testing means for testing a breaker point mechanism that is easy to fabricate and assemble.

Still another object of the present invention is to provide an electriacl testing means for testing a breaker point mechanism that is simple, efficient, and practical.

A further object of the present invention is to provide an electrical testing means for testing a breaker point mechanism that has optimum reliability characteristics afforded by a construction having a minimum number of parts.

Another object of the present invention is to provide an electrical testing means for a breaker point mechanism that can be readily fabricated and formed at low cost.

The present invention, in another of its aspects, relates to the novel features of the instrumentalities of the invention described herein for teaching the principal object of the invention and to the novel principles employed in the instrumentalities whether or not these features and principles may be used in the said object and/or in the said field.

With the aforementioned objects enumerated, other objects will be apparent to those persons possessing ordinary skill in the art. Other objects will appear in the following description, appended claims, and appended drawings. The invention resides in the novel construction, combination, arrangement, and cooperation of elements as hereinafter described and more particularly as defined in the appended claims.

The appended drawings illustrate an embodiment of the present invention constructed to function in the most advantageous modes devised for the practical application of the basic principles involved in the hereinafter described invention.

In the drawings:

FIGURE 1 is an exploded perspective view of the electrical testing means for a breaker point mechanism with the breaker point mechanism in position on the fixture of the testing means.

FIGURE 2 is a partial front view of a printed circuit board detector of the electrical testing means for a breaker point mechanism.

FIGURE 3 is a partial side view of the printed circuit board detector of the electrical testing means for a breaker point mechanism illustrating a node for locating the circuit board in a predetermined relationship with respect to said breaker point mechanism.

FIGURE 4 is a partial rear view of the printed ciruit broad detector of the electrical testing means for a breaker point mechanism.

FIGURE 5 is a cross-sectional view of the printed circuit board illustrating the transverse tapering of the board.

Generally speaking, the means and mehtods of the present invention relate to an electrical testing means for a breaker point mechanism. The breaker points are retained on a test fixture. The breaker point mechanism includes a contact coupled to a movable arm and a con-

tact coupled to a fixed arm. A tapered means including a first side having a conductive path and a plurality of conductive segments concentric with the path and a second side including a plurality of concentric conductive segments. A means is used for positioning the tapered means between the contacts such that displacement of the movable contact toward the fixed contact causes the contacts to engage with the tapered means. An indicator means is used for indicating the face to face alignment of the contacts when the contacts engage with the tapered means. The indicator means is coupled to the conductive segments and the path of the tapered means.

More particularly, the present invention relates to the means and methods for testing the face to face alignment of contacts for devices such as a breaker mechanism used in an ignition system for an internal combustion engine. A means is utilized for retaining the device having spaced apart contacts. The device generally includes a contact carried by a movable arm and a donut-shaped contact carried by a fixed arm. A traversely tapered means, such as a printed circuit board, includes a first side having a circular conductive path and a plurality of arcuate conductive segments with the circular path, and a second side including an insulative node and a pluarity of conductive segments concentric with the node. A means for positioning the tapered means between the contacts such that the node interfits with the aperture of the donut-shaped contact. Displacement of the movable contact toward the donut-shaped contact causes the contacts to engage with the tapered means. An indicator means for indicating the face to face alignment of the contacts when the contacts engage with the tapered means. The indicator means is coupled to the conductive segments and the path of the tapered means.

Referring now to FIGURE 1 of the drawings, the electrical testing means **10** for testing breaker point mechanisms of the present invention is illustrated in an exploded view. A substantially rectangular-shaped main mounting plate **11** is fabricated from any suitable durable and electrically insulative material such as plastic or the like. Fixedly coupled to the main mounting plate and at a right angle therewith is a retaining plate **12**. The retaining plate is fabricated from any suitable durable and electrically insulative material such as plastic or the like. The means coupling the retaining plate to the main mounting plate may be any suitable cement, interlocking fingers or the like.

As shown in FIGURE 1, a vertical slot **13** is cut in one extremity of the retaining plate. An L-shaped projection **14** is integral with and part of the retaining plate. The L-shaped projection includes a slot **15** that is in spaced, parallel relationship with slot **13**.

A post **16** is fixedly staked to the main mounting plate. It will be noted that the axis of the post is substantially perpendicular to the main mounting plate. A U-shaped means **17** is fixedly attached to the main mounting frame. The U-shaped means includes a bolt **18** that may be turned into a threaded aperture (not shown) so as to engage and thereafter retain matter placed between the spaced, parallel sides of the U-shaped means. An aperture **20** of the breaker mechanism **19** is loosely seated so as to surround the post **16** of the main mounting plate. A spring means **34** of the breaker mechanism has one extremity fixedly retained by the U-shaped means. The fixed contact carrying arm **21** carries thereon a donut-shaped contact **22** as illustrated in FIGURE 1. A movable contact carrying arm **23** carries a contact **24** and is pivotable about post **16**. The contact carried by the movable contact carrying arm is displaceable so as to substantially overlay the fixed donut-shaped contact.

A transversely tapered printed circuit board **25** includes on the major surface thereof a plurality of arcuate conductive segments **26** concentric about a circular conductive area **27**. FIGURE 2 shows that eight arcuate segments of equal length and equally spaced apart are utilized. However, it will be understood that the number of arcuate segments shown is for illustrative purposes only. The circular conductive area **27** and the eight arcuate conductive segments each have individual electrically conductive paths **28** that substantially extend the length of the circuit board **25**. The circuit board is fabricated from any suitable insulative material such as a partially hardened thermosetting resinous insulative material. The conductive paths may be frabricated from copper, silver, brass or the like.

As shown in FIGURE 1, the conductive paths terminate in a female connector **35** having provision for sixteen conductive path terminations. A male connector **36** is used to extend the conductive paths to an indicator means **29** that includes a plurality of means for indicating the position of the contact on the movable arm with respect to the fixed donut-shaped contact. Each conductive path is connected to a lamp means **31** through a suitable electrical coupling means **32**. The operation of means **29** will be more fully disclosed hereinlater. An insulative node **30** underlays the conductive area printed on the board and projects from the opposite side of the printed circuit board.

The sides of the printed circuit board slidably interfit with slots **13** and **15** of the retaining plate. The printed circuit board, when interfitting with the slots of the retaining plate, is positioned between the movable contact and the fixed contact of the breaker mechanism. The node **30** interfits with the aperture of the donut-shaped contact so as to locate the printed circuit board at a predetermined location with respect to the breaker mechanism in general and the movable contact in specific. The circular conductive area is positioned so as to be in a direct arcuate line with the movable contact if the movable contact and the donut-shaped contact would engage ideally.

Concentric with the node **30** is a plurality of arcuately spaced conductive segments **26'**. The conductive segments are connected to the female connector **35** which in turn is coupled to the indicator means through the male connector **36.**

With the hereinbefore structural disclosure in mind and by continued reference to the several figures of the drawing, the following analysis of the operation of the present invention will further serve to amplify the novelty of the present invention.

A breaker mechanism is positioned on the main mounting plate so that the movable contact arm is pivotable about the post **16**. An input means **33** of the indicating means is coupled to the spring means **34** of the breaker mechanism. The spring means is electrically coupled to the movable contact carrying arm of the breaker mechanism.

The sides of the circuit board means slidably interfit with the slots **13** and **15** and the node **30** of the printed circuit board mates with the aperture of the donut-shaped aperture carried by the fixed contact carrying arm. The movable contact carrying arm is arcuately displaced toward the printed circuit board by any suitable means such as a displaceable finger (not shown) of a cooperatively associated means (not shown). The contact of the movable contact carrying arm engages with the surface of the printed circuit board. If the movable contact would mate properly with the fixed contact, an electrical circuit is completed from the input means through the movable contact, through the circular conductive area to the appropriate lamp of the indicator means. In the indicating means shown in FIGURE 1, it is contemplated that the single lamp in the second row of lamps would illuminate indicating proper alignment of the contacts. If the movable contact is not centered with the donut-shaped contact, the movable contact will engage with one or more of the concentric arcuate conductive segments of the printed circuit board. Assuming that the movable contact is off-center down and to the left, the movable contact will engage with one of the two conductive segments in the lower left quad-

rant of the printed circuit board shown in FIGURE 2. One of the lights in the top row of lights will illuminate indicating the direction in which the movable contact is off-centered. Assuming that the movable contact is off-center up and to the right, the movable contact will engage with one of the two conductive segments in the upper right quadrant of the printed circuit board shown in FIGURE 2. One of the lights in the top row of lights will illuminate indicating the direction in which the movable arm is off-centered.

On the reverse side of the printed circuit board is an insulative node **30** that has substantially the same axis as does the conductive circular area **27**. A plurality of conductive arcuate segments **26'** are coupled to the electrical connector **32** by an individual conductive path **28'**. As disclosed hereinbefore, the node **30** interfits with the aperture of the donut-shaped contact such that if the donut-shaped contact is off-center, the donut-shaped contact will engage one of the conductive arcuate segments **26'** and cause sufficient current to flow to the appropriate lamp in the bottom row of lamps, thereby illuminating the lamp. If the donut-shaped contact is properly centered, none of the lamps will be lighted since the donut-shaped contact will not be engaged with any of the conductive areas. As disclosed hereinbefore, the node **30** is nonconductive.

Any suitable manual or mechanical means may be used to straighten the arm carrying the out of alignment contact. The alignment of the contacts is again tested to ascertain the alignment of the contacts.

Having thus described my invention, I claim:

1. An apparatus for testing the face-to-face alignment of contacts comprising: means for retaining a device having engageable contacts including a first contact carried by a movable arm and having a first contact face and a second donut-shaped contact carried by a fixed arm having a second contact face; a transversely tapered means including a first side and a second side, said first side having conductive areas generally parallel to said first and said second contact faces including a circular conductive area and a first plurality of arcuate conductive segments concentric with said circular area; said second side including an insulative node and having conductive areas generally parallel to said first and said second contact faces, and a plurality of arcuate conductive segments concentric with said insulative node; means for positioning said tapered means between said contacts such that said node interfits with the aperture of said donut-shaped contact so that displacement of said movable contact toward said donut-shaped contact causes said contacts to engage with at least one of said conductive areas of said tapered means; and an indicator means including a plurality of light emitting members for indicating the face-to-face alignment of said contacts when said contacts engage with said tapered means, said indicator means coupled to said conductive segments and said path areas of said tapered means and coupled to said contacts.

2. In the apparatus of claim **1**, wherein said means positioned between said contacts is a printed circuit board and wherein said conductive areas are on opposite surfaces of said printed circuit board.

3. In the apparatus of claim **1**, wherein said contacts are contacts of an ignition breaker point mechanism.

4. An apparatus for testing the face-to-face alignment of contact comprising: means for retaining a device having engageable contacts including a first contact carried by a movable arm and having a first contact face and a second contact carried by a fixed arm having a second contact face; a tapered means including a first side and a second side, said first side having conductive areas generally parallel to said first and said second contact faces including a conductive area and a first plurality of conductive segments concentric with said area; said second side including an insulative node and having conductive areas generally parallel to said first and said second contact faces, and a plurality of arcuate conductive segments concentric with said insulative node; means for positioning said tapered means between said contacts such that said node interfits with the aperture of said second contact such that displacement of said first movable contact toward said second fixed contact causes said contacts to engage with at least one of said conductive areas of said tapered means; and an indicator means including a plurality of light emitting members for indicating the face-to-face alignment of said contacts when said contacts engage with said tapered means, said indicator means coupled to said conductive areas of said tapered means and coupled to said contacts.

5. An apparatus for testing the face-to-face alignment of contact comprising: means for retaining a device having engageable contacts including a first contact carried by a movable arm and having a first contact face, and a second contact carried by a fixed arm having a second contact face; a transversely tapered means including a first side and a second side, said first side having conductive areas generally parallel to said first and said second contact faces including a conductive area and a first plurality of conductive segments concentric with said first area; said second side including an insulative area and having conductive areas generally parallel to said first and said second contact faces, including a plurality of concentric conductive segments concentric with said insulative area; means for positioning said tapered means between said contacts such that said area interfits with the aperture of said second contact such that displacement of said first movable contact toward said second fixed contact causes said contacts to engage with at least one of said conductive areas of said tapered means; and an indicator means including a plurality of light emitting members for indicating the face to face alignment of said contacts when said contacts engage with said tapered means, said indicator means coupled to said conductive areas of said tapered means and coupled to said contacts.

6. An apparatus for testing the face-to-face alignment of contact comprising: means for retaining a device having engageable contacts including a first contact carried by a movable arm and having a first contact face and a second contact carried by a fixed arm having a second contact face; a transversely tapered means including a first side and a second side, said first side having conductive areas generally parallel to said first and said second contact faces including a circular conductive area and a first plurality of arcuate conductive segments concentric with said first circular path, said second side including an insulative node and having conductive areas generally parallel to said first and said second contact faces, and including a plurality of concentric conductive segments concentric with said insulative node; means for positioning said tapered means between said contacts such that said node interfits with the aperture of said second contact such that displacement of said first movable contact toward said second fixed contact causes said contacts to engage with at least one of said conductive areas of said tapered means; and an indicator means including a plurality of light emitting members for indicating the face-to-face alignment of said contacts when said contacts engage with said tapered means, said indicator means coupled to said conductive areas of said tapered means and coupled to said contacts.

7. An apparatus for testing the face-to-face alignment of contact comprising: means for retaining a device having engageable contacts including a first contact carried by a movable arm and having a first contact face and a second donut-shaped contact carried by a fixed arm having a second contact face; a transversely tapered means including a first side and a second side, said first side having conductive areas generally parallel to said first and said second contact faces including an insulative node and having conductive areas generally parallel to said first and said second contact faces, and a plurality

of arcuate conductive segments concentric with said node; means for positioning said tapered means between said contacts such that said node interfits with the aperture of said donut-shaped contact so that displacement of said movable contact toward said donut-shaped contact causes said contacts to engage with at least one of said conductive areas of said tapered means; and an indicator means including a plurality of light emitting members for indicating the face-to-face alignment of said contacts when said contacts engage with said tapered means, said indicator means coupled to said conductive areas of said tapered means and coupled to said contacts.

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U.S. Cl. X.R.

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