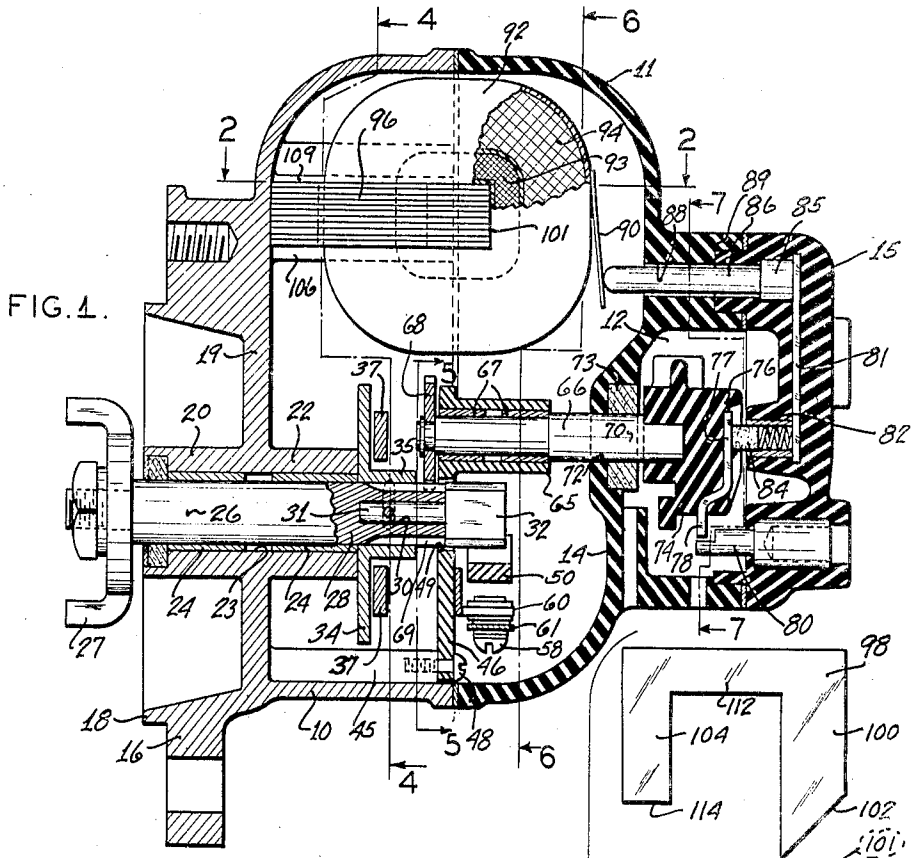
April 4, 1944. E. A. VOGEL 2,346,094

IGNITION DEVICE

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FIG. 1.



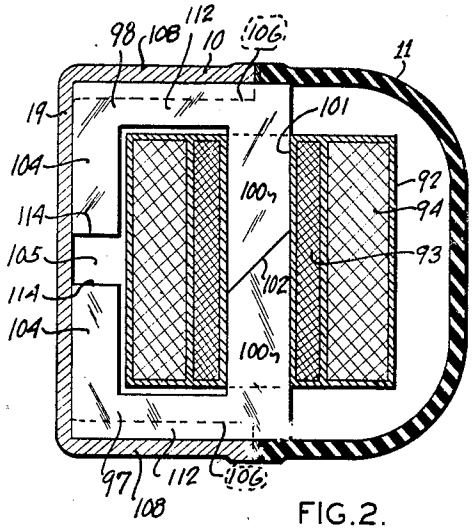
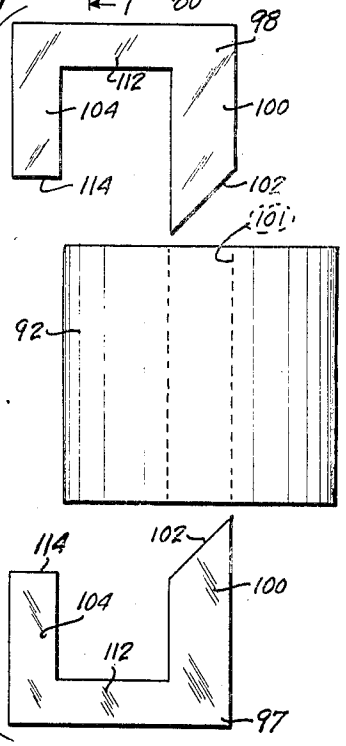


FIG. 2.

FIG. 3.



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IGNITION DEVICE

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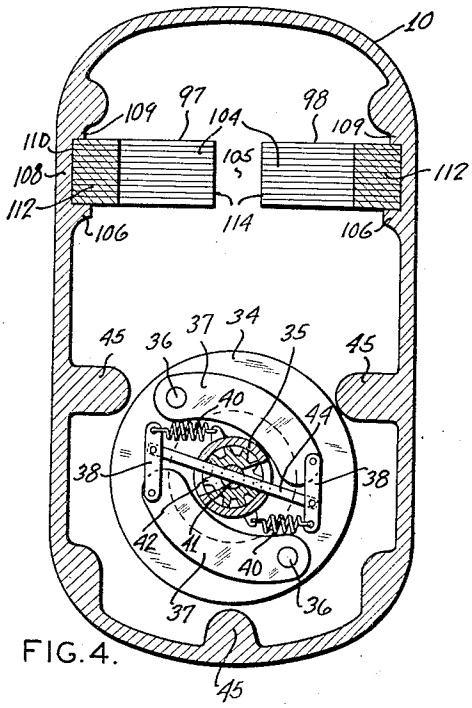


FIG. 4.

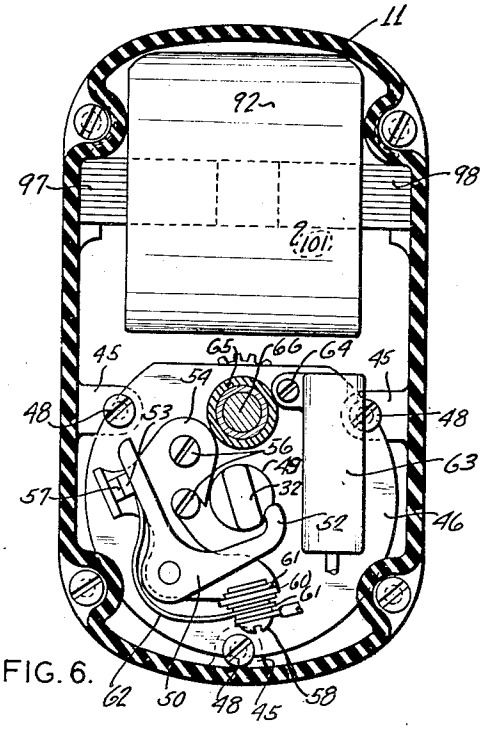


FIG. 6.

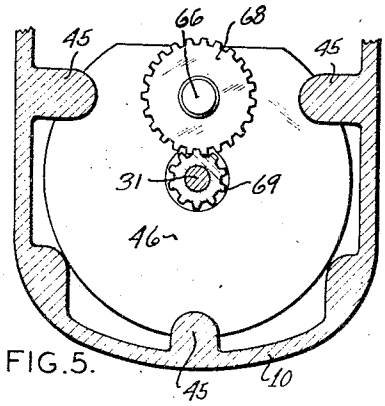


FIG. 5.

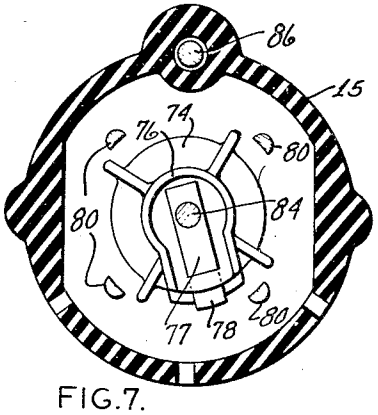


FIG. 7.

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IGNITION DEVICE

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Application May 7, 1941, Serial No. 392,312

2 Claims. (Cl. 175—361)

This invention relates to improvements in ignition devices for use in battery ignition systems for internal combustion engines, and has particular reference to an improved engine driven battery ignition device for tractor engines and the like.

While the generally prevailing practice is to equip tractor engines and the like, with magneto ignition systems usually employing a magneto unit coupled to the engine crankshaft or other rotating part of the engine, it is desirable in many instances and practically necessary in some cases, to provide such engines with battery ignition systems. For the latter purpose, it is highly important as will be readily understood, that an effective battery ignition apparatus be provided which may be readily employed on such engines without requiring any special engine design or change in engine parts.

Accordingly, an important object of the present invention resides in the provision of an improved engine driven battery ignition device more especially for tractor engines which are initially equipped with magneto ignition, which is adapted for direct interchange with the magneto unit and connection to the engine crankshaft without requiring any change of parts of the engine per se. The device according to the invention, therefore facilitates a ready and simply effected change-over between magneto ignition and battery ignition at any time one or the other ignition system may be desired.

A further object of the invention is to provide an efficient, compact and light-weight battery ignition device adapted for assembly disposition in the space otherwise occupied by a magneto unit, and for direct connection to the engine crankshaft substantially in the manner employed for connecting the magneto to such shaft, the device comprising essentially a two-part housing enclosing induction coil, distributor and circuit interrupter assemblies which are so compactly related and arranged therein as to facilitate the enclosure of the entire assembly in a housing of desirably reduced overall size.

Another object is to provide in an ignition device of this character, an improved induction coil assembly comprised of an induction coil and a two-part magnetic core structure therefor, the latter providing a substantially closed magnetic circuit for the coil, broken only by an air-gap suitably located in such circuit, the induction coil assembly as a unit, being removably mounted in the housing of the device, and the two parts of the magnetic structure being readily separable for removal from the coil when the unit is removed from the housing, to thereby enable replacement of a new coil for one damaged or no longer effective.

Other objects and advantages of the invention will become readily apparent from the following description of a preferred embodiment thereof, as exemplified by the accompanying drawings, in which:

Fig. 1 is a section through the improved ignition device; Fig. 2 is a sectional view thereof, as taken from the line 2—2 in Fig. 1; Fig. 3 is a plan view of the induction coil unit, showing the form of the parts comprising the magnetic core structure thereof, and these elements being shown removed from the coil; Fig. 4 is a sectional elevation vertically through the device, as viewed from line 4—4 in Fig. 1; Fig. 5 is a fragmentary vertical section through the device, as viewed from line 5—5 in Fig. 1; Fig. 6 is a vertical section as taken from line 6—6 in Fig. 1, and Fig. 7 is a section through the distributor end of the device, as taken from line 7—7 in Fig. 1.

Referring to the drawings by appropriate characters of reference, there is shown in Fig. 1 in particular, a casing 10 which is preferably an aluminum die casting, but which may be formed from any other suitable non-magnetic material. Suitably detachably secured to the casing 10 is a cover 11 preferably of molded Bakelite, the cover being formed to provide a chamber 12 exteriorly of the cover, which is separated from the interior of the cover by the cover wall portion 14. Chamber 12 is provided to accommodate the distributor mechanism presently to be described, and is closed by a removable distributor terminal cap 15 of molded Bakelite or similar material. The casing 10 is provided with a flange 16 by which it may be securely bolted to an engine frame (not shown), the flange including a circular projection or rib 18 which serves the purpose of properly locating the casing in assembly relation to the engine frame.

The casing wall 19 is provided with aligned, external and internal bosses 20 and 22 respectively, through which extends a shaft-receiving bore 23, the bore being concentric with the circular rib 18 as shown. Projecting through the bore and rotatably journalled therein by suitable sleeve bearing elements 24, is a shaft 26, the outer end of which carries a coupling device 27 for driven connection of the shaft to the engine crankshaft (not shown). It is to be noted that the bosses 20 and 22 on casing wall 19, provide the sole bearing support for the shaft 26. The inner

end portion 28 of the shaft 26 projects beyond the adjacent boss 22, and is axially recessed, as at 30, to receive and freely journal therein a spindle or stub shaft 31. The stub shaft 31 has its outer end portion enlarged and formed to provide a cam 32, of the form shown in end elevation in Fig. 6, for operating the circuit interrupter or breaker mechanism presently to be described.

The interrupter cam 32 through its stem or spindle element 31, is driven from the shaft 26 preferably by an interconnecting governor means which is operable in response to change in engine operating speed, for effecting angular shifts of the cam 32 relative to the shaft 26, and hence relative to the engine crankshaft, to thereby advance or retard the cam-operation of the interrupter in accordance with increasing or decreasing engine speed. The governor mechanism for controlling the ignition spark advance and retard, may be of any well known type, and according to the presently preferred embodiment thereof (Fig. 4), it is comprised of a plate-disc 34 having a hub 35 seating on the inner end 28 of shaft 26 and suitably secured thereto. Pivotally mounted on the disc by means of pivot pins 36, are a pair of weight elements 37 each of substantially arcuate extent. As appears in Fig. 4, the relative pivotal arrangement of the weights is such that each tends to swing in the counterclockwise direction under the influence of centrifugal force resulting upon rotation of the shaft 26. To the free end of each weight element is pivotally connected a link element 38, and to the free end of each of the latter elements is connected one end of a spring 40, the opposite ends of the springs 40 being suitably anchored to the disc hub 35, as shown. The cam spindle 31 is bored transversely therethrough as at 41, and diametrically opposed slots 42 are provided in the shaft end 28, in registry with the bore 41. Projected through the slots and bore is a rod 44 having its free ends suitably pivotally connected to the link elements 38. The resulting governor mechanism as will now appear, thus effectively provides for angular shift of the cam shaft and cam relative to shaft 26, in response to changes in engine speed, the total extent of cam shift being limited by abutment of the rod 44 with the upper and lower ends of the slots 42.

As appears in Figs. 1, 5 and 6 of the drawings, the casing 10 is provided with spaced internal bosses 45 for the support of a frame member or plate 46 formed by preference, of insulating material, the plate being removably attached to the bosses by suitable screws 48 and its location being in the lower part of the casing, in vertical disposition as shown. The plate which serves to support the interrupter mechanism, is centrally apertured, as at 49, to receive therethrough the cam 32 and end 28 of shaft 26. The interrupter or circuit breaker device operated by cam 32, may be of any well known construction, but as here shown (Fig. 6) includes a bell crank 50 having one end 52 adapted for cam-following contact with cam 32, and its opposite end supporting a contact 53. Bell crank 50 is formed of insulating material, and is pivotally mounted intermediate its ends, on an adjustably fixed plate element or bracket 54 secured to frame plate 46 by suitable screws 56. A fixed contact 57 is carried by bracket plate 54 in position for circuit make-and-break cooperation with the movable contact 53, and its circuit connection is made to ground in any suitable manner, through the metal casing 10. The bracket also supports a conductor terminal 58, through an upstanding ear 60 from which the terminal is insulated, as by insulating washers 61. A leaf spring 62 of conducting material, has one end secured to terminal 58 and its opposite end secured to the contact 53 on bell crank 50, the spring serving to load the bell crank such as to urge the bell crank end 52 toward the cam 32, to maintain cam-following engagement thereof with the cam. The leaf spring serves also, to provide the circuit connection between the movable contact 53 of the breaker assembly, and the terminal 58. As appears in Fig. 6, a condenser unit 63 is carried on the frame plate 46, being mounted thereon in any suitable manner as at 64. The condenser as will appear hereinafter, is provided for connection across the interrupter contacts 53—57 to dampen arcing upon separation of the contacts in the interrupter operation.

The frame plate 46 is formed to provide a horizontal, laterally projecting bearing member 65, arranged on the upper portion of the plate such that the axis thereof is parallel to and substantially vertically above the axis of the plate aperture 49, which aperture receives therethrough the end 28 of shaft 26 and the cam 32 (Fig. 1). A stub shaft 66 is extended through the bearing member 65 and is rotatably journalled therein by means of sleeve bearings 67. Secured to one end of the shaft 66 is a gear 68 which enmeshes a pinion 69 on the end 28 of the shaft 26, the pinion in the present example, being formed integrally with the latter shaft end, as by cutting the pinion teeth in the peripheral surface of the shaft end, as indicated in Figs. 1 and 5. Also, as appears in Fig. 5, the gear ratio between gear 68 and pinion 69 is approximately two to one, so that shaft 66 will be rotated at one-half the speed of shaft 26, the latter as before mentioned, operating at engine speed. It may be noted here as an important feature of the present arrangement, that the bearing member 65 provides substantially the sole journalling support for the shaft 66.

The opposite or free end portion 70 of the stub shaft 66, is projected through an aperture 72 in the wall 14 of the cover 11 and through a sealing ring 73 of suitable material, carried by the wall 14. The shaft end terminates in the distributor chamber 12, heretofore noted, and operatively supports therein a distributor member or disc 74 of insulating material. Embedded in the forward portion 76 of the disc is a metal strip 77 extending radially from the disc axis and terminating in a free end 78 outwardly of the disc periphery (Figs. 1 and 7). The strip 77 constitutes the rotating distributor contact arm, and arranged for successive cooperation therewith, are a plurality of fixed terminals 80 carried by the removable terminal cap 15, the latter being formed of insulating material. Embedded in the cap 15 is a conductor 81 having one end exposed for engagement by a cylindrical metal insert 82 carried axially of the cap. Suitably retained in the metal insert is a spring-loaded contact plunger element 84 which serves, in the assembly of the cap to the cover 11, to connect the conductor 81 to the distributor arm 77 at the inner end of the latter (Fig. 1). The conductor 81 at its opposite end, is connected to one end portion 85 of a metal rod 86, the rod portion 85 being embedded in the cap 15 and the rod

extending forwardly of the cap a substantial distance. In assembly of the cap 15 to the cover 11, the rod 86 is projected through a suitable aperture 88 in a thickened section 89 of the cover wall 14, and is exposed interiorly of the cover for contact with a spring terminal 90 carried by the induction coil unit presently to be described, which terminal is connected to the secondary or high tension winding thereof.

Referring to Figs. 1 to 4, the induction coil unit is comprised of a coil 92 including primary winding 93 and secondary winding 94, and a magnetic core structure 96 therefor. According to the present invention, the core 96 is formed by complementary core elements 97 and 98, each of a generally U-shape and of a laminated construction. The corresponding legs 100 of the elements provide the core proper for the coil 92, being adapted for insertion in the central aperture or bore 101 of the coil, into magnetic abutment therein, as appears in Fig. 2. The mating ends of the core legs 100 are by preference, oppositely bevelled, to present diagonal or oblique, planar surfaces or faces 102 which in the core assembly, engage as shown in Fig. 2, interiorly of the coil bore 101. These oblique faces provide for positive magnetic engagement of the core legs, since by pressing the core elements together, the legs tend to become wedged in the coil bore through the relative camming action of the oblique mating surfaces, as will be appreciated.

The remaining corresponding legs 104 of the core elements 97 and 98, extend substantially parallel to the legs 100 and exteriorly of the coil 92, and terminate short of each other to a predetermined extent, to thereby provide an air gap indicated at 105. The coil 92 and core 96 assembled as a unit, is mounted in the upper portion of the casing 10. For this purpose, the casing 10 is formed with interior, horizontal ledges 106 on the opposite casing side walls 108 (Figs. 2 and 4), and overhanging shoulders 109 suitably spaced above the ledges, the ledges and shoulders cooperating with the casing side walls to form channels 110 for receiving the opposite marginal portions 112 of the core 96. In assembly position, the core margins 112 rest on the ledges 106, with the side faces 113 of the core legs 104 in abutment with the casing wall 19, and the core closely confined against upward displacement by the shoulders 109. Displacement of the induction coil unit longitudinally of the casing channels 110, away from the casing wall 19, is prevented during normal operation of the assembled ignition device, by the pressure engagement of the conductor rod 86 with the coil terminal 90 (Fig. 1). Thus it will now appear that the induction coil assembly may be readily inserted or removed as a unit, relative to the casing channels 110 and supporting ledges 106, which facilitates its initial manufacturing assembly and later replacement as conditions demand. Moreover, it is to be noted that upon removing the induction coil unit from the casing, the core elements 97 and 98 may be then readily separated and removed from the coil 92, as indicated in Fig. 3. This latter feature enables quick replacement of a damaged coil, and assembly of the new coil to the core elements. By this arrangement, the entire unit does not have to be discarded in the event of damage to the coil, as would be the case were the core structure and coil assembled such as to be incapable of ready separation.

As a further feature of the induction coil unit, it is noted that in mounting the unit in the casing, the casing side walls 108 in the zone of the channels 110 prevent separation of the core elements 97 and 98 by relatively closely confining the core between these side walls, such that the core legs 100 are firmly engaged in magnetic contact along the oblique mating faces 102. Also, it is to be noted that by mounting the coil unit in casing 10 such that the core 96 thereof is disposed horizontally therein (Fig. 1), rather than in a vertical position, the vertical extent of the casing may be thereby reduced, through arrangement of the unit closely above the shaft bearing structure 64.

It is important to the efficiency and effectiveness of a battery ignition device of the character herein disclosed, that the value of inductance of the induction coil unit be maintained without appreciable variance, as predetermined for given conditions of operation to which the ignition device is to be subjected. This factor cannot be controlled to any desirable degree, where a straight or open core is employed for the induction coil, because of the indefinite reluctance of the relatively long air path for the magnetic flux lines extending between the core ends. Accordingly, the core structure of the present invention provides a substantially closed magnetic circuit of low reluctance, about the coil, wherein the reluctance thereof is definitely controlled by a predetermined, fixed air gap, such as the gap 105, and by the predetermined area of the core faces or poles at the air gap. The inductance of the unit may be thereby determined, according to the number of turns in the primary winding of the coil, and effectively maintained at the desired value. Moreover, by reason of the presently improved core construction and the manner of its support in the casing 10, the inductance value of the unit may be readily changed, as operating conditions may warrant, through altering the reluctance of the core assembly, as by increasing or decreasing the extent of the core air gap 105. This may be done in the instance of increasing the air gap, by removing or grinding off the gap face 114 of one or both core legs 104, to provide the desired air gap dimension. Where it is desired to decrease the air gap, one or both of the oblique faces 102 of core legs 100 may be ground off, so that in the assembly of the core elements 97 and 98, a smaller gap will result. In this latter instance, since the core elements are thereby brought closer together in the engagement of the oblique faces 102, suitable shim elements may be employed in the assembly of the coil and core unit in the casing. Such shims may be inserted between one or both of the core margins 112 and the adjacent casing side walls 108, in the zone of the channels 110, to thereby closely confine the core between the casing side walls.

The improved ignition device of the present invention is especially suitable for use with tractor engines and the like, which in normal tractor use, are operated over a wide speed range, as for example, between idling at approximately 200 R. P. M. and maximum speeds of the order of 2000 R. P. M. Through control of the inductance value of the induction coil unit, as readily obtainable by the presently improved core construction, the ignition device may be readily adapted for efficient operation to produce ignition current fully effective for positive ignition of the fuel charge throughout engine operation over the in-

dicated speed range. Moreover, by judicious correlation of the inductance value of the induction coil unit, the capacitance value of the condenser 63 employed across the interrupter contacts, and the resistance value of the ignition primary circuit, inordinate heating of the ignition device may be thereby reduced to a minimum, and pitting of or metal transfer between the breaker contacts, practically eliminated.

While the invention has been described in connection with a preferred embodiment thereof, it is to be understood that various modifications may be made in the construction and assembly relation of parts, without departing from the spirit of the invention as defined by the appended claims.

I claim:

1. In a device of the character described, a casing formed of non-magnetic material and providing an end wall and parallel side walls, means forming a channel in each side wall extending toward the end wall, an induction coil unit including an induction coil having a central longitudinal bore therethrough, a pair of U-shaped magnetic core elements for said coil, one leg of one element and the corresponding leg of the other element being adapted for readily removable insertion in said coil bore into close abutment therein, and the opposite corresponding legs of the elements in the assembly of the elements to the coil, having their ends in spaced, opposed relation to form an air gap, said coil and core assembly being insertable as a unit in said casing with the bridge portions of said U-shaped core elements seating in said casing channels, said channels serving to maintain said core elements in assembly with said coil.

2. In a device of the character described, a casing formed of non-magnetic material and providing an end wall and parallel side walls, means forming parallel channels in said side walls extending toward the casing end wall, an induction coil assembly including an induction coil having a central longitudinal bore therethrough, a pair of U-shaped magnetic core elements for said coil, one leg of one element and the corresponding leg of the other element being adapted for removable insertion in said coil bore and the ends of said legs being oppositely bevelled for wedging abutment within the coil bore, the opposite corresponding legs of the core elements in the assembly of the elements to the coil, having their ends in spaced, opposed relation to form an air gap, said coil and core assembly being insertable as a unit in said casing with the bridge portions of the U-shaped core elements seating in said casing wall channels, said channels serving to support the unit and to maintain said core elements in assembly with the coil.

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