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Hohne et al.

[11] **3,916,863**

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[54] **ELECTRICAL SIGNAL GENERATING DEVICE FOR USE IN COMBUSTION ENGINES**

[75] Inventors: **Gerd Höhne**, Ludwigsburg; **Jörg Issler**, Stuttgart; **Gerhard Söhner**, Geradstetten; **Leo Steinke**, Hegnach, all of Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart, Germany

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Oct. 21, 1972 Germany 2251834

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[51] **Int. Cl.**[2] **F22B 7/12**

[58] **Field of Search** ..... 123/148 R, 148 E, 148 AC, 123/149 R, 149 C; 310/70 R, 70 A; 200/19 S, 19 M

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Primary Examiner—Charles J. Myhre
Assistant Examiner—Paul Devinsky
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A stator and a rotor are provided, the latter being coaxial with the stator and connected with the shaft which is driven by the combustion engine. During the rotation of the rotor the same can assume at least two angular positions relative to the stator. A first group of pole pieces is provided on the rotor or stator and these are equi-angularly spaced about the same projecting on radii which extend outwardly from the axis of rotation. A second group of pole pieces are provided on the stator or rotor, spaced angularly about the same and including at least two sets each of which is composed of a second plurality of pole pieces which is identical with the first plurality. The pole pieces of the first group are all simultaneously juxtaposed with one each of the pole pieces of one of the sets when the rotor is in one of its angular positions, and they are all simultaneously juxtaposed with one each of the pole pieces of the other set when the rotor is in the other of its angular positions. The angular distance through which the rotor travels in its direction of rotation from its one to its other angular position is different from the angular distance which it travels in the same direction to return from the other to its one position.

6 Claims, 4 Drawing Figures

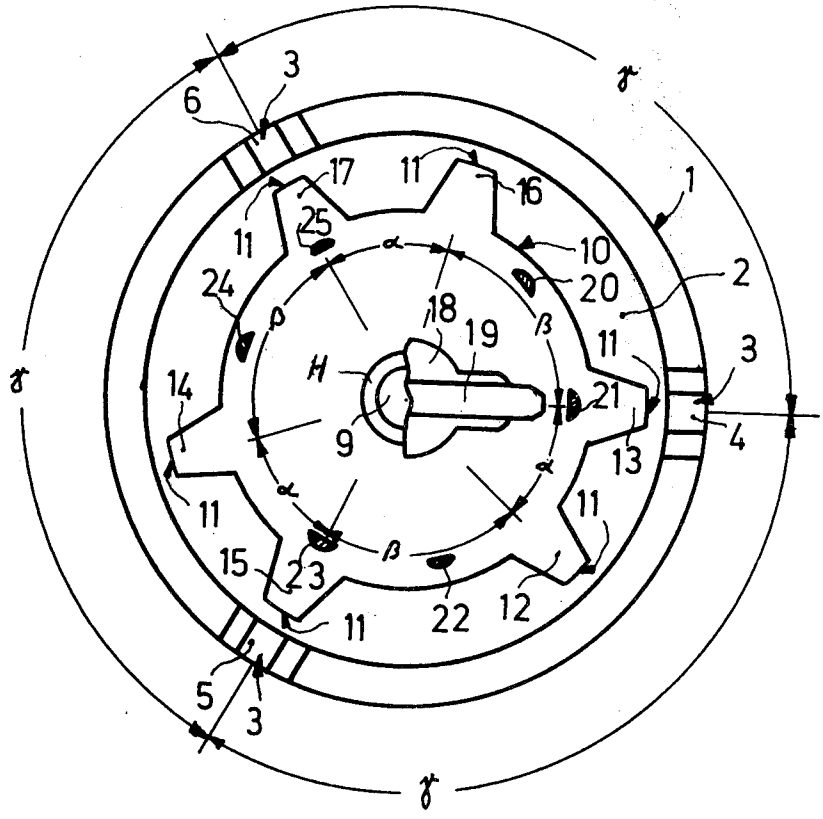
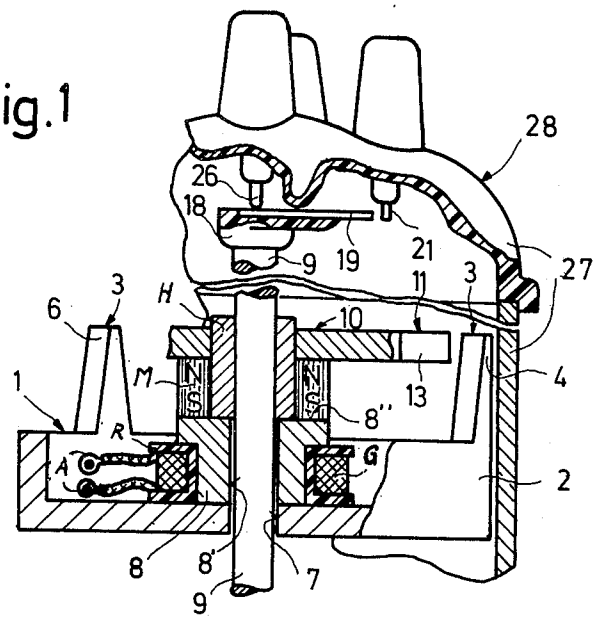


Fig.1


28
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18
9
19
21
27
3
H
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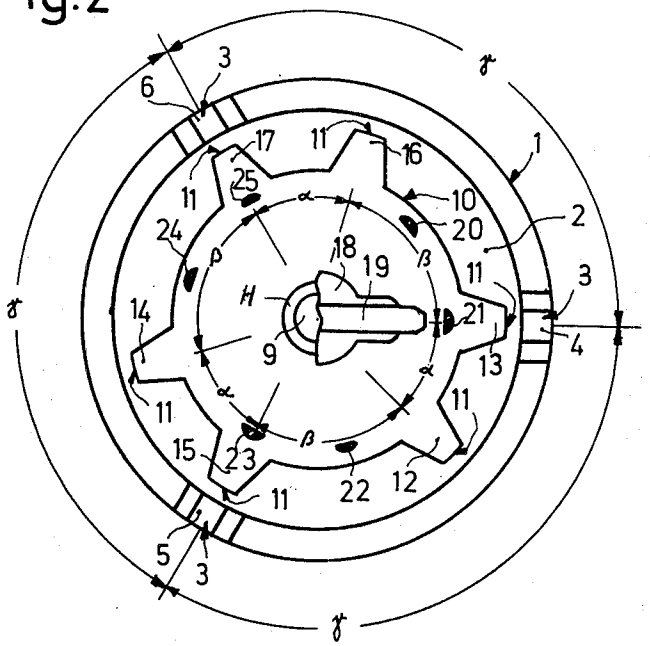
3
6
10
1
M
4
13
8''
R
G
2
A
8
8'
9
7

Fig.2


γ
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6
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16
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2
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24
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14
9
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5
3
γ

Fig. 4

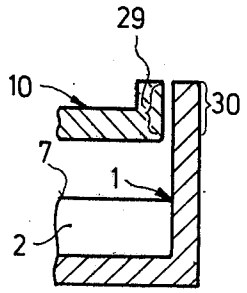
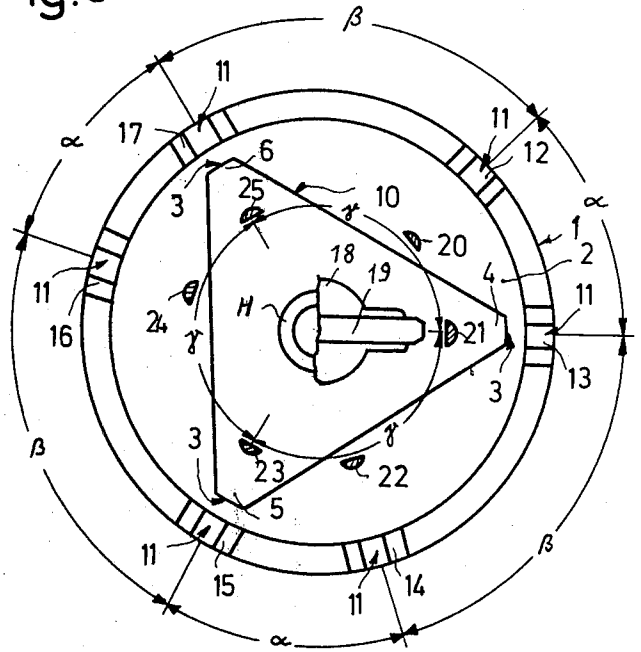

29
10
30
7
1
2

Fig. 3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ELECTRICAL SIGNAL GENERATING DEVICE FOR USE IN COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

The present invention relates generally to an electrical signal generating device for use in combustion engines, and in particular to such a device which is particularly useable for controlling operating conditions, for instance to initiate ignition signals.

Devices of this general type are already known and are intended to eliminate the heretofore necessary contacts in such electrical equipment of combustion engines as distributors, being intended to eliminate the provision of such contacts and thereby to avoid difficulties which come from fouling of the contacts. One such device is known from German allowed application No. 1,539,172. It utilizes a stator and a rotor, each of which is provided with an identical number of pole pieces projecting from it and being spaced at equi-angular distances about the respective stator and rotor. This device of the prior art is well suited to fulfill its intended purposes, but it can be used in conjunction with only those multi-cylinder combustion engines in which the pistons in all of the cylinders simultaneously reach one of their dead center positions, that is either the top dead center or bottom dead center position. The device cannot be used in types of combustion engines wherein the pistons in the various cylinders do not all simultaneously reach one or the other of their dead center positions.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention, to provide an improved electrical signal generating device for use in combustion engines which makes it possible to control operating conditions, particularly ignition signals, in multi-cylinder combustion engines the pistons of which do not all simultaneously reach one of their respective dead center positions.

Another object of the invention is to provide such a device which is reliable in its operation and is relatively uncomplicated in its construction.

In keeping with these objects and with others which will become apparent hereafter, one feature of the invention resides in an electrical signal generating device for use in combustion engines, which briefly stated, comprises stator means, and rotor means coaxial with the stator means and adapted for connection with the combustion engine to be rotated by the same in one direction relative to the stator means to at least two angular positions. A first group composed of a plurality of pole pieces which are equi-angularly spaced about one of the means is provided, and these pole pieces project therefrom on radii which extend outwardly from the axis of rotation of the rotor means. A second group of pole pieces is also provided, being angularly spaced about the other of the means and including at least two sets each of which is composed of a second plurality of pole pieces which is identical with the first plurality. All of the pole pieces of the first group are simultaneously juxtaposed with one each of the pole pieces of one of the sets when the rotor means is in its one angular position, and all of the pole pieces of the first group are simultaneously juxtaposed with one each of the pole pieces of the other set when the rotor means is in the other of its angular positions. Furthermore, the angular distance through which the rotor means travels in the aforementioned one direction from its one to its other angular position is different from the angular distance through which it travels to return from the other to its one position.

With this device it is possible to construct a combustion engine with which the device is to operate, exclusively from the point of view of assuring that during the operation of the combustion engine a satisfactory stressing of the crankshaft and an acceptable mass compensation can be obtained.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary vertical section illustrating one embodiment of the invention;

FIG. 2 is a diagrammatic top-plan view of the stator and rotor of the embodiment of FIG. 1;

FIG. 3 is a view similar to FIG. 2 but illustrating a further embodiment of the invention in a top-plan view of the stator and rotor thereof; and

FIG. 4 is a fragmentary sectioned detail view illustrating a detail in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring firstly to the embodiment illustrated in FIGS. 1 and 2, it will be seen that reference numeral 1 identifies a stator which is of magnetically conductive material and composed of a cupped body 2 and a group 3 of pole pieces 4, 5, 6 which project from the edge which bounds the open side of the cupped body 2. The transverse bottom wall of the body 2 is provided at its center with an opening 7, and coaxial with the same is a central bore 8' of a supporting sleeve 8 which extends into the body 2 and is also of magnetically conductive material. The end of the sleeve 8 which faces away from the opening 7 is provided with a flange 8''. A shaft 9 is turnably mounted in the opening 7 and the bore 8', and this shaft 9 is connected with the non-illustrated combustion engine, so as to be rotated in one direction as the crankshaft of the combustion engine turns over.

A rotor 10, also composed of magnetically conductive material is mounted on the shaft 9 for rotation with the same. It is of circular configuration and provided on its circumference with a group 11 of radially projecting pole pieces 12, 13, 14, 15 and 16, 17. These pole pieces, are, in the illustrated embodiment, arranged in form of two sets, one of which is composed of the pole pieces 12, 14, 16, and the other of which is composed of the pole pieces 13, 15 and 17. It will be noted that the number of pole pieces of each set is equal to the number of pole pieces on the stator 1, so that the total number of pole pieces on the rotor 10 is a whole-number multiple of the total number of pole pieces on the stator 1.

A magnetically non-conductive mounting sleeve H mounts the rotor 10 with the shaft 9 for rotation with the latter, and is in turn surrounded by an axially magnetized permanent magnet M, the north pole N of which contacts the rotor 10 and the south pole S contacts the flange 8'' of the sleeve 8. The latter carries

on its outer circumference a signal generating winding G which is mounted on a support R and which supplies at its terminals A a voltage which can be used as a triggering signal (for instance for triggering an ignition incident) when the pole pieces **12, 13, 14, 15, 16, 17** of the group **11** rotate past the pole pieces **4, 5, 6** of the group **3.** It is hardly necessary to point out that the generation of such a voltage is not in itself novel.

There are circumstances (which have led to the present invention) wherein, for instance in the case of six-cylinder combustion engines, the cylinders of which are arranged in two rows which are inclined in V-shaped configuration, an advantageous stressing of the crank shaft and an acceptable mass compensation cannot be obtained unless the ignition spacing between a cylinder of the first row and a cylinder of the second row corresponds to an angle (related to the rotation of the shaft **9**) which is designated with the symbol α in FIG. **2,** amounting to 45°, and wherein the same ignition distance between a cylinder of the second row and a cylinder of the first row corresponds (again related to the rotation of the shaft **9**) to an angle β of 75°. The aforementioned prior-art devices of the type here under discussion cannot meet this requirement per se, although they could be adapted to meet it by providing quite elaborate additional equipment which collaborates with them.

The present invention overcomes this limitation of the prior art, without having to resort to elaborate auxiliary equipment in that the number of pole pieces in the group **11** is a whole number multiple of the number of pole pieces in the group **3,** as already pointed out earlier. This means that during each complete revolution of the shaft **9,** each pole piece of the group **3** is temporarily located once adjacent each pole piece of the group **11.** Moreover, the pole pieces **4, 5, 6** of the group **3** are located on imaginary radii extending outwardly from the axis of rotation of the shaft **9** the radii being so located that the pole pieces **4, 5, 6,** are equiangularly spaced. The angles at which they are spaced are identified with the symbol γ in FIG. **2.**

In order to obtain a strong change in the magnetic flux so as to produce the triggering signal at the output leads A, the arrangement of the pole pieces of the group **11** is such that each of the pole pieces **4, 5, 6** of the group **3** will be simultaneously juxtaposed in one angular position of the rotor **10** relative to the stator **1,** with a pole piece of one set of the group **11,** namely with one of the pole pieces **12, 14** and **16.** In the other angular position each of the pole pieces **4, 5, 6** will be simultaneously juxtaposed with one of the pole pieces **13, 15, 17.** It should be noted that the angle α through which the shaft **9** must turn from the position at which the pole pieces **4, 5, 6** are juxtaposed with the pole pieces **12, 14, 16,** to the position at which the pole pieces **4, 5, 6** are juxtaposed with the pole pieces **13, 15, 17** is selected to differ by the desired timing distance (45° versus 75°) from the angle β through which the shaft **9** must turn until the pole pieces **4, 5, 6** are again juxtaposed with the pole pieces **12, 14, 16.**

To assure that the ignition voltage which is produced upon initiation of the ignition due to the signal derived at the output leads A, will reach the individual spark plugs associated with the non-illustrated cylinders in the proper sequence, a distributor electrode **19** is provided which rotates with the shaft **9** and is mounted in an insulating body **18.** During each juxtaposition of the pole pieces **4, 5, 6** with the pole pieces **12, 14, 16** or of the pole pieces **4, 5, 6** with the pole pieces **13, 15, 17,** the electrode **19** is located opposite one of the fixed electrodes **20, 21, 22, 23, 24,** and **25** which are shown in FIG. **3.** The ignition voltage is then supplied via a contact electrode **26** which is constantly in contact with the distributor electrode **19,** and transferred from the latter to one of the stationary electrodes **20–25** which is associated with the respective spark plug. It is self-evident that this arrangement, which acts in the manner of a distributor, can be housed together with the novel signal generating device in a housing **27** of a conventional ignition distributor **28.**

The rotor **10** can also be operatively associated with the shaft **9,** via a non-illustrated centrifugal adjuster well known in the art, and the stator **1** can be provided with a non-illustrated vacuum adjuster also known in the art, for varying the timing of the ignition in accordance with principles known the prior art.

In addition to showing the arrangement of the stationary electrodes **20–25,** FIG. **3** further shows that it is possible to arrange the group **3** of pole pieces **4, 5, 6** that is the group having the smaller total number of pole pieces, on the rotor **10,** instead of on the stator **1,** and conversely to arrange the group **11** of pole pieces **12–17** on the stator **1** instead of the rotor **10.** In this case, it is particularly advantageous that the rotor **10** can be produced in a very simple manner by being made of plate-shaped form, for instance in form of a polygon, in FIG. **3** illustrated as a triangle as clearly shown.

To prevent tumbling of the rotor **10** during its rotation, it is advantageous and advisable to construct the rotor **10** in such a manner that with respect to the stator **1,** a rotationally symmetrical unit is obtained.

FIG. **4** finally, shows that the free end portion **29** of the pole pieces provided on the rotor **10** can be bent over in the illustrated manner, so as to extend in direction parallel or substantially parallel to the axis of rotation of the shaft **9,** and to be located on a projection of the respective free end **30** of the pole pieces on the stator **1.** This affords a still stronger variation of the magnetic flux and assures a most satisfactory value of the triggering signal which is derived at the output leads A.

It goes without saying that although in the two illustrated embodiments, the device according to the present invention has been shown as used for triggering ignition signals, it is equally well possible to use it for other purposes, for instance to control the injection of fuel into the cylinders of the combustion engine.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an electrical signal generating device for use in combustion engines, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and therefore, such adaptations should and are intended to be comprehended within the meaning

and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an electrical signal generating device for use in combustion engines having a crankshaft rotated by a plurality of pistons, a combination comprising stator means; rotor means coaxial with said stator means and adapted for connection with said crankshaft of said combustion engine to be rotated by the same in one direction relative to said stator means to at least two angular positions; a first group composed of a first plurality of pole pieces which are equi-angularly spaced about one of said means and project therefrom on radii which extend outwardly from the axis of rotation of said rotor means; and a second group of pole pieces angularly spaced about the other of said means and including at least two sets each composed of a second plurality of pole pieces which is identical with said first plurality so that the total number of said pole pieces of said second group is a whole-number multiple of the total number of said pole pieces of said first group, each of the pole pieces of one of said sets being simultaneously juxtaposed with one each of the pole pieces of said first group and all of the pole pieces of the other of said sets being simultaneously respectively located intermediate successive pole pieces of said first group when said rotor means is in said one angular position, and each of the pole pieces of said other set being simultaneously juxtaposed with one each of the pole pieces of said first group and all of the pole pieces of said one set being simultaneously respectively located intermediate successive pole pieces of said first group when said rotor means is in said other angular position so as to generate a large magnitude electrical signal, the angular distance through which said rotor means travels in said one direction from said one to said other angular position being different from the angular distance through which said rotor means travels in said one direction from said other to said one position, so that said differing angular distances provide for operation of said pistons in a consecutively time sequential manner so as to substantially reduce the stress on said rotating crankshaft.

2. A combination as defined in claim 1, wherein said first group is provided on said stator means and said second group is provided on said rotor means.

3. A combination as defined in claim 1, wherein said first group is provided on said rotor means and said second group is provided on said stator means.

4. A combination as defined in claim 1, wherein said rotor means and said stator means form a rotationally symmetrical unit.

5. A combination as defined in claim 1, wherein the pole which are provided on said rotor means have radially outwardly extending main portions and free end portions which extend in at least substantial parallelism with said axis of rotation.

6. A combination as defined in claim 1; further comprising a plurality of stationary electrodes corresponding to said first plurality and each located adjacent one of the positions with which the pole pieces of said first plurality become juxtaposed with pole pieces of said second plurality when said rotor means is in said one and said other angular positions thereof; and a distributor electrode mounted for rotation with said rotor means and arranged to move to locations adjacent to the respective positions during such rotation and as the pole pieces become juxtaposed at the respective positions.

* * * * *