Aug. 3, 1965 B. H. SHORT ETAL 3,198,973

DISTRIBUTOR HAVING MAGNETIC PICK-UP COIL

Filed March 13, 1961 3 Sheets-Sheet 1

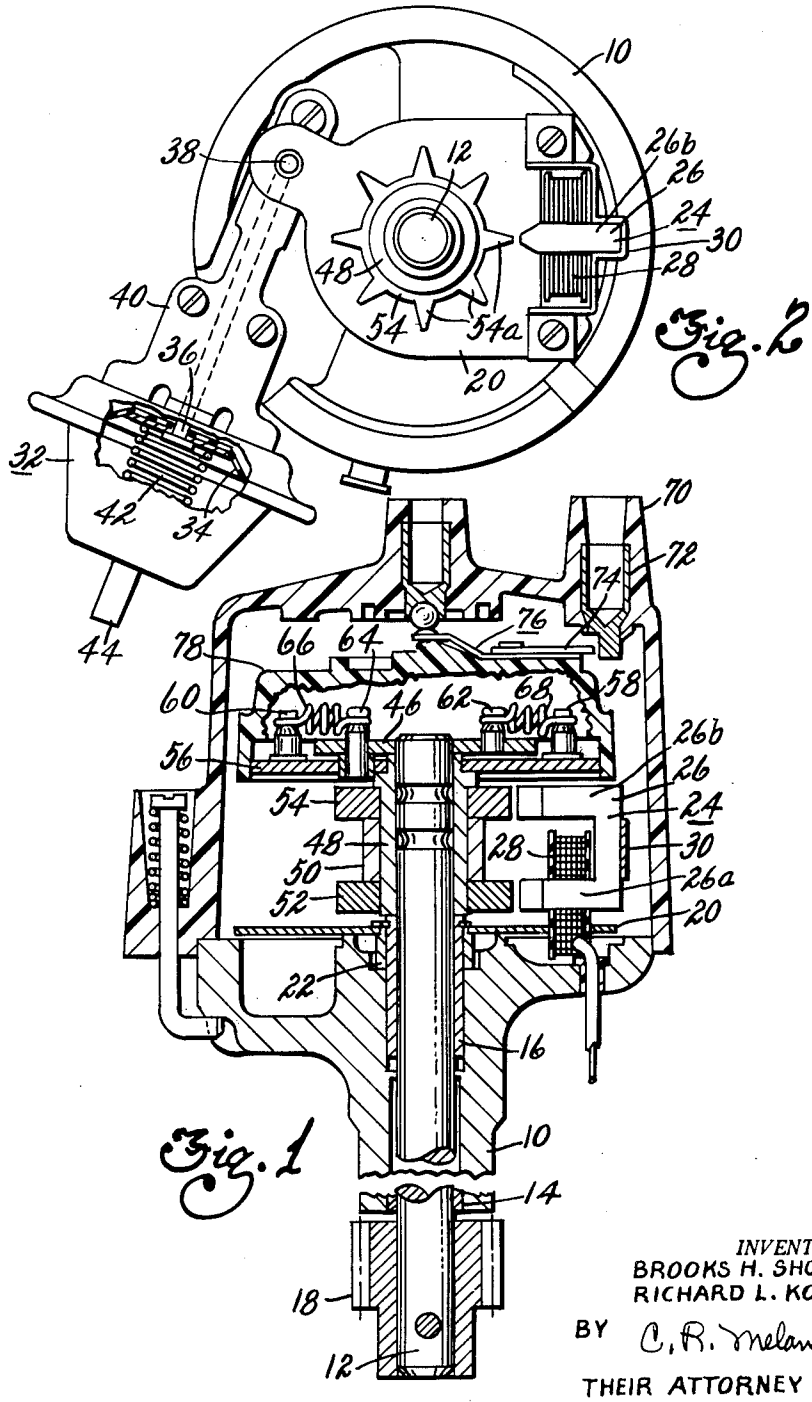


Fig. 2

Fig. 1

INVENTORS
BROOKS H. SHORT
RICHARD L. KONOPA
BY C. R. Meland
THEIR ATTORNEY

Aug. 3, 1965 B. H. SHORT ETAL 3,198,973

DISTRIBUTOR HAVING MAGNETIC PICK-UP COIL

Filed March 13, 1961 3 Sheets-Sheet 2

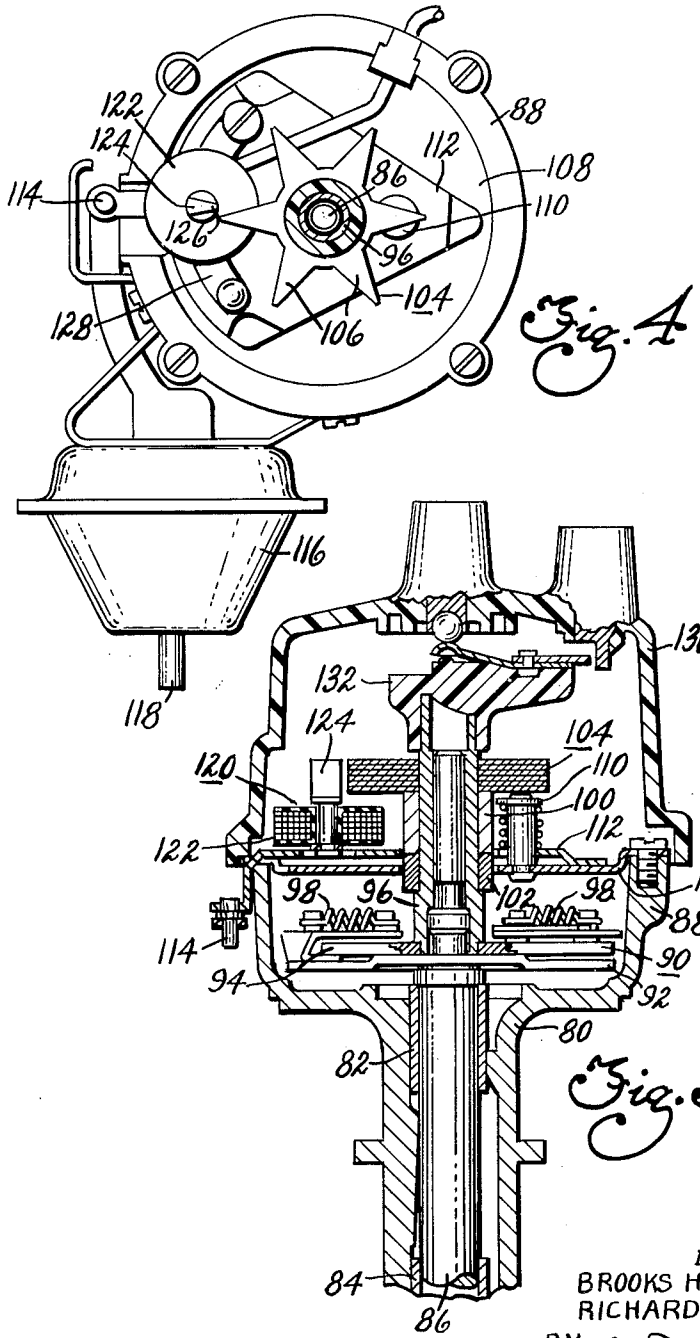


Fig. 4

Fig. 3

INVENTORS
BROOKS H. SHORT
RICHARD L. KONOPA
BY C. R. Meland
THEIR ATTORNEY

Aug. 3, 1965 B. H. SHORT ETAL 3,198,973

DISTRIBUTOR HAVING MAGNETIC PICK-UP COIL

Filed March 13, 1961 3 Sheets-Sheet 3

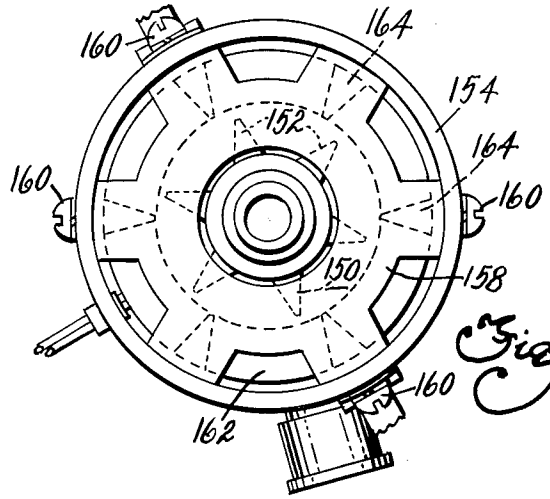


Fig. 6

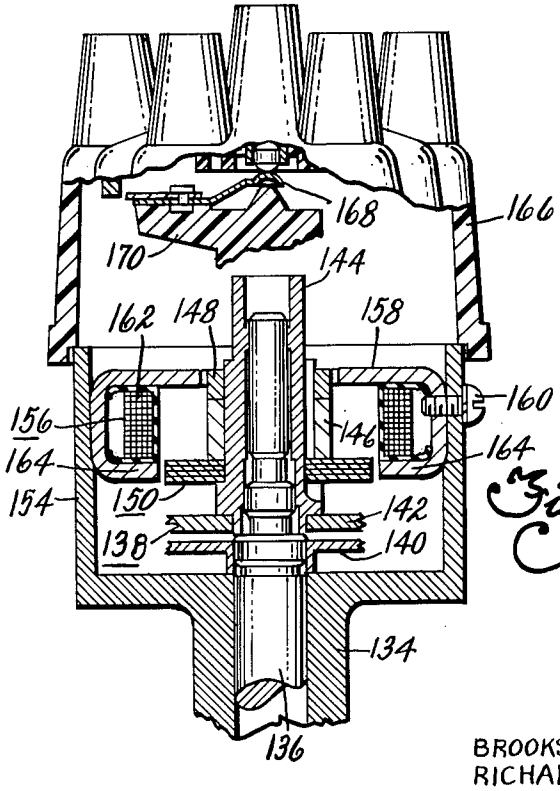


Fig. 5

INVENTORS
BROOKS H. SHORT
RICHARD L. KONOPA
BY C. R. Meland
THEIR ATTORNEY

United States Patent Office 3,198,973 Patented Aug. 3, 1965

3,198,973

DISTRIBUTOR HAVING MAGNETIC PICK-UP COIL

Brooks H. Short and Richard L. Konopa, Anderson, Ind., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed Mar. 13, 1961, Ser. No. 95,418
12 Claims. (Cl. 310—70)

This invention relates to distributors for controlling the ignition timing of internal combustion engines.

One of the objects of this invention is to provide an ignition distributor that has no breaker contacts but which is capable of delivering timed pulses of voltage that are in synchronism with operation of the engine on which the distributor is used.

Another object of this invention is to provide an ignition distributor that delivers pulses of voltage and wherein the occurrence of these pulses are timed both in accordance with the speed and load of the engine on which the distributor is used.

Still another object of this invention is to provide an ignition distributor that has a pulse voltage output and wherein the timing of these pulses is controlled by a vacuum control unit and a centrifugal advance mechanism.

A further object of this invention is to provide an ignition distributor that has a magnetic unit rotatable with the distributor shaft and a pick-up coil carried by a timing plate located adjacent the magnetic unit, the plate member being adjustable by a vacuum control unit and the magnetic unit being adjustable relative to the shaft by a centrifugal advance mechanism.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a sectional view of a distributor made in accordance with this invention.

FIGURE 2 is an end view of a part of the distributor illustrated in FIGURE 1 with the distributor cap removed.

FIGURE 3 is a sectional view of a modified distributor made in accordance with this invention.

FIGURE 4 is an end view of the distributor illustrated in FIGURE 3 with the distributor cap removed.

FIGURE 5 is a sectional view of still another modified distributor made in accordance with this invention.

FIGURE 6 is an end view of the distributor illustrated in FIGURE 5 with the distributor cap removed.

Referring now to the drawings and more particularly to FIGURE 1, the ignition distributor of this invention includes a base member **10** which is formed of a suitable metal material. The base member **10** has a central bore which accommodates a distributor shaft **12**. The distributor shaft is journalled in porous metal bushings **14** and **16** and the lower end of the shaft **12** is connected with a gear assembly **18** which is driven from a gear on the cam shaft of an engine on which the distributor is used. It is apparent that the shaft **12** may be driven in other ways, it only being important that the shaft be driven by the engine on which the distributor is used.

The porous metal bearing **16** which is fitted to the upper end of the base member **10** carries a timing plate **20**. This timing plate is connected with a sleeve member **22** which engages the outer surface of the porous metal bushing **16** and it thus is apparent that the timing plate **20** is rotatable with respect to the porous metal bushing **16**. The timing plate **20** carries a coil winding

assembly generally designated by reference numeral **24**. This coil winding assembly includes a generally U-shaped core member **26** which is formed of a magnetic material such as steel. One of the legs **26***a* of the U-shaped member **26** carries a coil winding **28** which produces the pulses of output voltage in a manner to be more fully described hereinafter. The coil winding assembly is secured to the timing plate **20** by a bracket **30**. The coil winding assembly **24** thus will rotate with the timing plate **20** whenever it is rotated.

The timing plate **20** is rotated by a conventional vacuum control unit designated in its entirety by reference numeral **32**. This vacuum control unit has the usual diaphragm **34** which is connected with a rod **36**. The rod **36** has an up-turned portion **38** which fits within an opening formed in the timing plate **20**. The rod is positioned under the bracket member **40** which serves to secure the vacuum control unit to the base **10**. The diaphragm **34** is urged in one direction by a spring **42** and the vacuum unit has a pipe **44** which is to be connected to the intake manifold of the internal combustion engine on which the distributor is used.

With the arrangement just described, the timing plate **20** will be rotated by the vacuum control unit **32** whenever vacuum is applied to the pipe **44**. The amount of rotation of the timing plate **20** will of course be a function of the vacuum being applied to the pipe **44** and therefore will be an indication of engine load.

The shaft **12** carries a plate member **46** which is secured to the shaft and therefore rotatable therewith. In addition, the shaft **12** carries a sleeve member **48** which is formed of a suitable non-magnetic material. This sleeve **48** is rotatable with respect to the shaft **12** and carries pole pieces **52** and **54** as well as a permanent magnet **50**. The pole pieces **52** and **54** are each formed with pole tips as is apparent from an inspection of FIGURE 2. In the embodiment illustrated, the pole piece **54** has eight pole tips **54***a* as does the pole piece **52**. These pole tips are aligned so that when a pole tip of pole piece **54** is aligned with leg **26***b*, a pole tip of pole piece **52** is aligned with leg **26***a*. The number of pole tips will of course vary with the number of cylinders the engine has and it is seen that the pole tips pass closely adjacent the ends of the leg portions **26***a* and **26***b* of the U-shaped magnetic member **26**.

The permanent magnet **50** is of any well-known type and may be of the ferrite type. It is seen that the permanent magnet **50** is press-fitted or otherwise secured to the sleeve member **48** so as to rotate therewith.

The sleeve member **48** carries and is secured to a plate member **56**. This plate member carries up-standing pins **58** and **60**. The plate member **46** likewise carries upstanding pins **62** and **64**. The pins **60** and **64** are connected by a spring **66** whereas the pins **58** and **62** are connected by a spring **68**. The pins **58** and **60** carry suitable fly weights (not illustrated) which engage the plate member **46** to cause the plate members **46** and **56** to be adjusted relative to one another in accordance with speed of rotation of the shaft **12**. The fly weights may be of the type illustrated in the Hartzell, et al. patent, 2,872,537, and it will be appreciated by those skilled in the art that the mechanism which includes the plates **46** and **56** is a conventional centrifugal advance mechanism. In the subject system, it therefore will be apparent that the sleeve member **48** will be shifted relative to the shaft **12** to a degree that is a function of shaft speed. In other words, the relative position of the pole tips of pole pieces **52** and **54** with respect to the shaft **12** will be varied in accordance with engine speed.

The base member **10** carries a conventional distributor cap **70** having terminals **72** that cooperate with the

electrode 74. The electrode 74 forms a parts of a conventional rotor generally designated by reference numeral 76. This rotor includes the cup-shaped member 78 which is formed of insulating material and which carries the electrode 74. The cup-shaped member 78 is secured to the plate member 56 so that the rotor rotates with the plate member 56.

When the distributor of this invention is installed on an internal combustion engine, the shaft 12 will of course be rotated in synchronism with rotation of the cam shaft of the engine. As the shaft 12 rotates, the pole tips of pole pieces 52 and 54 rotate past the legs 26*a* and 26*b* of the U-shaped magnetic member 26. This rotation of the pole tips past the ends of the magnetic core 26 will cause pulses of voltage to be induced in the coil winding 28. The magnetic circuit for flux is from one end of permanent magnet 50, through the pole piece 54, through core 26 and then back to the magnet through pole piece 52. The pulses of voltage induced in coil winding 28 will be spaced in accordance with the spacing of the pole tips and with the distributor as described, there will be eight pulses of voltage per rotation of the distributor shaft 12. These pulses of voltage may be used to control any type of ignition system that has electronic switch means such as a transistor for controlling current flow through the primary winding of an ignition coil.

It will be appreciated that the timing of the voltage output pulses will be varied both in accordance with the vacuum being applied to the vacuum control unit 32 and the speed of the shaft 12. As the vacuum increases that is applied to the vacuum control unit 32, the timing is advanced and the same is true as engine speed increases. The distributor of FIGURE 1 thus provides a voltage pulse output that is controlled both by a vacuum advance mechanism and a centrifugal advance mechanism.

Referring now to FIGURES 3 and 4, a modified distributor made in accordance with this invention is illustrated. In FIGURE 3, the reference numeral 80 is used to designate the base of the distributor which is formed of aluminum material. The base 80 carries bearings 82 and 84 which journal the shaft 86. The shaft 86 extends upwardly into the bowl-shaped portion 88 of the distributor base and this bowl-shaped portion contains a centrifugal advance mechanism which is generally designated by reference numeral 90. This centrifugal advance mechanism includes a plate member 92 which is driven by the shaft 86 and another plate member 94 which is secured to a sleeve 96 formed of nonmagnetic material. The plates 92 and 94 are adjusted relative to one another by suitable fly weights which are pivoted to one plate and which engage the other so that their adjustment is in accordance with the speed of rotation of shaft 86. The plates are also connected by springs 98 which oppose the effect of the fly weights. These springs are connected with pins that are in turn connected respectively with plate 92 and plate 94. The centrifugal advance mechanism 90 is not shown in minute detail as it is conventional and any suitable centrifugal advance arrangement which varies the angular relationship between plates 92 and 94 will be suitable for this invention.

The sleeve member 96 which is formed of nonmagnetic material carries a ferrite, or other permanent magnet designated by reference numeral 100. This sleeve member 96 may rotate relative to the shaft 86 but the magnet 100 is press fitted thereto so that the permanent magnet 100 and the sleeve 96 rotate together. Another sleeve 102 formed of magnetic material such as steel is press-fitted on the sleeve 96 and engages the ferrite or other permanent magnet 100. The sleeve 96 also carries a toothed rotor which is designated by reference numeral 104 and which is formed of magnetic material such as steel which is preferably laminated. It can be seen from FIGURE 4 that this rotor 104 has radially extending teeth 106 and is in engagement with one end of the ferrite permanent magnet 100.

The distributor shown in FIGURES 3 and 4 is provided with means for varying the timing of voltage output pulses in accordance with operation of a vacuum control unit. To this end, a plate member 108 formed of metal material such as steel is secured to the top end of bowl portion 88. The plate member 108 carries a pivot pin 110 which is headed over as shown in FIGURE 3. This pivot pin 110 forms a pivot for the plate member 112. The plate member 112 carries a pin 114 which is operated by the vacuum control unit 116. Thus as vacuum is applied to the pipe 118 of the vacuum control unit, the plate member 112 will be rotated around the pivot 110 to vary the timing of voltage output pulses in a manner that will become more readily apparent hereinafter. It is pointed out that the pivot 110 is off-set from the axis of the shaft 86 and the plate 112 therefore rotates around a point that is not concentric with the shaft 86 nor is it concentric with the plate 108 and the base 80.

The plate 112 carries a magnetic pick-up assembly which is generally designated by reference numeral 120. This magnetic pick-up assembly includes a coil winding assembly 122 which is fitted to a pin member 124 formed of magnetic material. The lower portion of the pin member 124 is circular in cross section whereas the top end has converging side walls that merge into a tip 126 which is positioned closely adjacent the ends of rotor teeth 106 as the rotor 104 rotates. The pick-up assembly 120 is secured to the plate 112 by a metal strap member 128 formed of magnetic material and it therefore is apparent that the coil winding assembly 122 and the magnetic pin member 124 will be rotated when the plate 112 is rotated by the vacuum unit 116.

The bowl portion 88 of the distributor base carries a conventional distributor cap 130 which cooperates with the rotor 132. The rotor 132 is secured to the sleeve 96 and is therefore driven by this sleeve. As is well-known to those skilled in the art, the rotor 132 will connect the various spark plugs of the engine with an ignition coil.

In the embodiment of the invention illustrated in FIGURES 3 and 4, the rotor 104 is driven by the shaft 86. As this rotor 104 rotates, pulses of voltage will be induced in the coil winding 122 and since there are six teeth on the rotor, these will be six pulses of voltage generated for every revolution of the shaft 86. The magnetic circuit is from the ferrite magnet 100, through the rotor 104, through the pin 124, through metal strap 128, through the plate 112, and then through sleeve 102 back to the opposite side of the permanent magnet 100.

In the embodiment of the invention in FIGURES 3 and 4, the timing of the pulses of voltage will be varied both in accordance with the speed of the shaft 86 and the amount of vacuum applied to the vacuum control unit 116. It is of course appreciated that the shaft 86 is driven by the engine and that the vacuum control unit 116 is connected with the intake manifold side of the engine. The speed responsive mechanism 90 will vary the position of the rotor 104 with respect to the shaft 86 in accordance with engine speed. The vacuum control unit 116 will rotate the plate 112 to therefore shift the pin 124 with respect to the rotor 104 to also vary the timing of the voltage output pulses. In each instance the centrifugal-advance mechanism and the vacuum control until will operate to advance the timing of the voltage pulses.

Referring now to FIGURES 5 and 6, still another modified distributor that provides voltage output pulses without the use of breaker contacts is illustrated. In the embodiment of FIGURES 5 and 6, the reference numeral 134 designates the base of the distributor which journals the shaft 136. The distributor has a suitable centrifugal advance mechanism which is generally designated by reference numeral 138 and which includes the plate members 140 and 142 together with springs and fly weights not illustrated. The plate member 140 is driven by the shaft 136 whereas the plate member 142 is connected with a sleeve 144 formed of nonmagnetic material. The sleeve

144 may rotate relative to the shaft 136 and carries a ferrite, or other permanent magnet 146, a sleeve member 148 formed of magnetic material and a toothed rotor 150 which is formed of a magnetic material such as steel which is preferably laminated. The rotor 150 as is seen in FIGURE 6 has a plurality of radially extending teeth 152 there being six teeth for this particular rotor.

The upper bowl portion 154 of the base member 134 carries a magnetic pick-up assembly which is generally designated by reference numeral 156. This magnetic pick-up assembly includes a metal frame member designated by reference numeral 158 which is annular in configuration. This frame member 158 is secured directly to the bowl portion 154 of the distributor by the fasteners 160. The metal frame member 158 carries an annular coil winding 162 and is formed at its lower end with projecting teeth 164 which are positioned closely adjacent the ends of the rotor teeth 152.

The magnetic circuit for the distributor of FIGURES 5 and 6 is from one end of the ferrite or other permanent magnet 146, through the metal sleeve 148, through the top side of the metal frame part 158, thence from the projecting portions 164 of the metal frame member 158 through the teeth of the rotor 150, and then from the rotor back to an opposite side of the permanent magnet 146. It can be seen that a voltage pulse will be induced in the coil winding 162 each time that the teeth 152 are aligned with all of the projecting portions 164. It also can be seen that there will be six voltage pulses induced in the coil winding 162 for every revolution of the shaft 136.

The distributor shown in FIGURES 5 and 6 has no vacuum control unit but has the centrifugal advance mechanism 138 which varies the angular relationship of the rotor 150 with respect to the magnetic assembly 156 in accordance with the speed of rotation of the shaft 136. This centrifugal advance mechanism 138 will therefore vary the timing of the voltage output pulses that are generated in the coil winding 162 in accordance with engine speed when the engine is connected with the shaft 136.

The distributor shown in FIGURES 5 and 6 has a conventional distributor cap 166 having electrodes which cooperate with the contact or terminal 168 carried by the rotor 170. The rotor 170 is driven by the sleeve 144.

While the embodiments of the present invention as herein disclosed, constitute a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A distributor comprising, a support member, a shaft rotatably suported by said support member, a timing plate, a coil winding assembly carried by said timing plate including a substantially U-shaped core and a coil winding, a sleeve member carried by said shaft, a permanent magnet carried by said sleeve member, first and second pole pieces carried by said sleeve member and positioned at opposite ends of said permanent magnet, said pole pieces each having circumferentially spaced pole tips located in alignment with a respective leg of said U-shaped core member, vacuum control means for shifting said timing plate, and centrifugal advance mechanism for rotating said permanent magnet and pole pieces relative to said shaft in response to changes in shaft speed.

2. A distributor comprising, a support member, a shaft rotatably journalled in said support member, a coil winding assembly including a substantially U-shaped core member and a coil winding, a permanent magnet rotatably driven by said shaft, and pole pieces rotatably driven by said shaft, and located adjacent opposite ends of said permanent magnet, said pole pieces having aligned circumferentially spaced pole tips that swing in close proximity to the ends of the legs of said U-shaped core member when said shaft rotates.

3. A distributor comprising, a base member, a shaft journalled for rotation in said base member, a timing plate, means pivotally mounting said timing plate on an axis that is off-set from the axis of said shaft, a coil winding assembly carried by said timing plate, and a rotor formed of magnetic material driven by said shaft forming a part of a magnetic circuit for causing a voltage to be induced in the coil winding of said coil winding assembly as said shaft rotates.

4. An ignition timing control unit comprising, a rotatable shaft, a timing plate adjustable relative to said shaft, a coil winding assembly including a coil winding carried by said timing plate, a rotor member formed of magnetic material driven by said shaft, a permanent magnet located in a magnetic circuit with said coil winding, said rotor member being so-constructed as to cause pulses of voltage to be induced in said coil winding when said shaft is rotated, and means for adjusting said rotor member relative to said shaft in accordance with shaft speed.

5. An ignition timing control unit comprising, a base member adapted to be fixed to an engine, a rotatable shaft supported by said base member, a timing plate adjustable relative to said shaft and relative to said base member, a coil winding assembly including a coil winding supported by said timing plate and shiftable therewith, a rotor member formed of magnetic material rotatable with said shaft and located in a magnetic circuit with said coil winding, said timing plate forming a part of said magnetic circuit, flux generating means for causing a flow of flux through said magnetic circuit, and vacuum control means supported by said base member for shifting said timing plate, said rotor member being so-constructed and arranged that pulses of voltage are induced in said coil winding when said rotor is rotating.

6. An ignition timing control unit comprising, a support member, a bearing member supported by said support member, a shaft journalled for rotation in said bearing member, a timing plate journalled for rotation on a portion of said bearing member, a coil winding assembly supported by said timing plate including a coil winding, a rotor member formed of magnetic material driven by said shaft, a magnetic circuit coupling said rotor member and said coil winding including an air gap, said magnetic circuit, said rotor member being so-constructed and arranged that said air gap is varied as said rotor member rotates including a flux generating means for causing a flow of flux through said magnetic circuit.

7. An ignition timing control unit comprising, a base member, a bearing member carried by one end of said base member, a shaft journalled for rotation in said bearing member, a timing plate journalled for rotation on an outer portion of said bearing member, a coil winding supported by said timing plate and shiftable therewith, a rotor member driven by said shaft formed of magnetic material and located in a magnetic circuit with said coil winding through an air gap, and a permanent magnet for causing a flow of flux through said magnetic circuit, said rotor member being so-constructed and arranged that said air gap is varied as said rotor member rotates.

8. An ignition timing control unit comprising, a rotatable shaft, a timing plate adjustable relative to said shaft, a rotor member formed of magnetic material driven by said shaft, a coil winding carried by said timing plate and adjustable with said timing plate relative to said shaft, a magnetic circuit coupling said rotor member and said coil winding including a permanent magnet, said rotor member being so constructed and arranged as to vary the air gap between it and a part of the magnetic circuit as it rotates, a vacuum control unit for adjusting said timing plate, and means responsive to the speed of rotation of said shaft for adjusting said rotor member relative to said shaft.

9. An ignition timing control unit comprising, a base member, a timing plate shiftable relative to said base member, a shaft journalled for rotation with respect to said base member, a rotor member formed of magnetic material driven by said shaft, a pick-up coil fixed to said timing plate, and a magnetic circuit coupling said rotor member and said pick-up coil, said magnetic circuit including a

first air gap which has a varying length at a given point when said rotor is rotating, said magnetic circuit including a second annular air gap located between said timing plate and said rotor, and a permanent magnet for providing a flow of flux through said magnetic circuit whereby pulses of voltage are induced in said pick-up coil as said rotor rotates.

10. An ignition control unit comprising, a base member adapted to be fixed in place, a shaft journalled for rotation with respect to said base member, a timing plate adjustable relative to said base member and shaft, a pick-up coil assembly fixed to said timing plate and movable therewith, said pick-up coil assembly including a magnetic part and a coil winding, a rotor member driven by said shaft formed of magnetic material, and a magnectic circuit coupling said rotor member and said magnetic part and including a permanent magnet, said magnetic circuit including a first air gap defined by said magnetic part and said rotor, said rotor being so constructed that the length of said first air gap at a given point varies as said rotor rotates, said magnetic circuit including a second air gap located between said timing plate and said rotor.

11. An ignition control unit comprising, a base member adapted to be fixed to an engine, a shaft journalled for rotation with respect to said base member, a timing plate adjustable relative to said shaft, a vacuum unit for adjusting said timing plate, a pick-up coil assembly secured to said timing plate and movable therewith, said pick-up coil assembly including a coil winding and a part formed of magnetic material, a rotor member located in a magnetic circuit with said part of said pick-up coil assembly which is formed of magnetic material, a permanent magnet located in a magnetic circuit with said pick-up coil and with said rotor member, and a centrifugal advance mechanism for adjusting said rotor

member relative to said shaft in response to said shaft speed, the outer surface of said rotor being of such a configuration that pulses of voltage are induced in said coil winding as said rotor rotates.

12. An ignition control unit comprising, a base member, a shaft rotatable with respect to said base member, a timing plate adjustable relative to said base member and to said shaft, a vacuum unit for adjusting said timing plate, a voltage pulse generating means including a pick-up coil supported by said timing plate and a rotor driven by said shaft, a centrifugal advance mechanism for adjusting said rotor relative to said shaft in accordance with shaft speed, an insulator member enclosing a part of said centrifugal advance mechanism and carrying contact means, a distributor cap formed of insulating material supported by said base member and enclosing said pulse generating means and said centrifugal advance mechanism, said distributor cap having a center electrode and a plurality of outer circumferentially spaced electrodes, said contact means carried by said insulator member being operable to sequentially connect said center electrode and said outer circumferentially spaced electrodes of said distributor cap.

References Cited by the Examiner

UNITED STATES PATENTS

2,071,573	2/37	Randolph et al.	310—68.4
2,824,245	2/58	Trevitt	310—168
2,872,537	2/59	Hartzell et al.	200—31
2,922,903	1/60	Knudson	310—156
2,953,719	9/60	Guiot.	
2,991,338	7/61	Mason	200—31

MILTON O. HIRSHFIELD, *Primary Examiner.*

ORIS L. RADER, *Examiner.*