

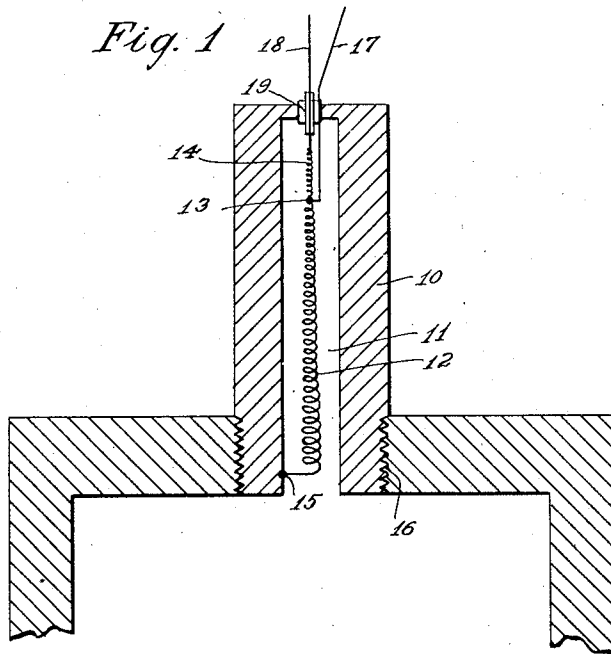
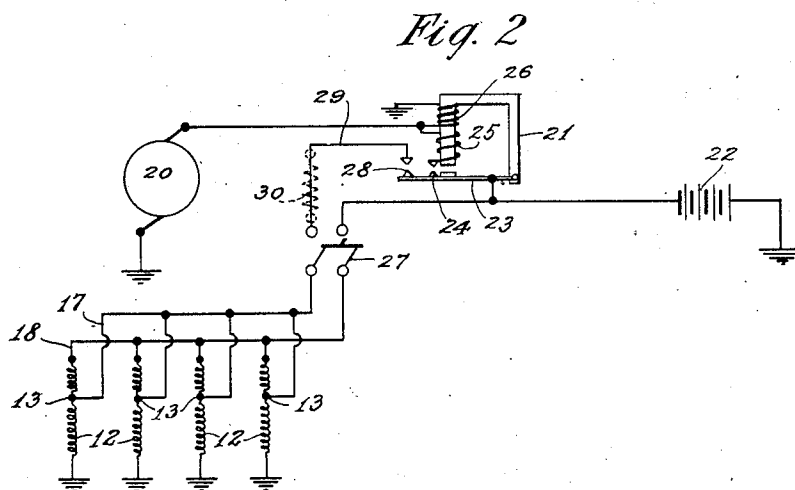
June 29, 1926.

1,590,892

J. A. HEANY

IGNITION SYSTEM

Original Filed Nov. 30, 1921 2 Sheets-Sheet 1



INVENTOR.

John A. Heany

BY

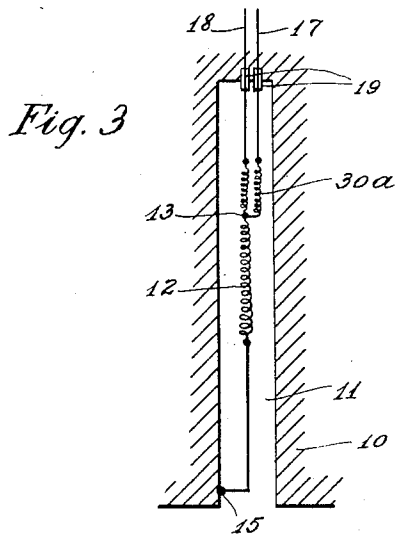
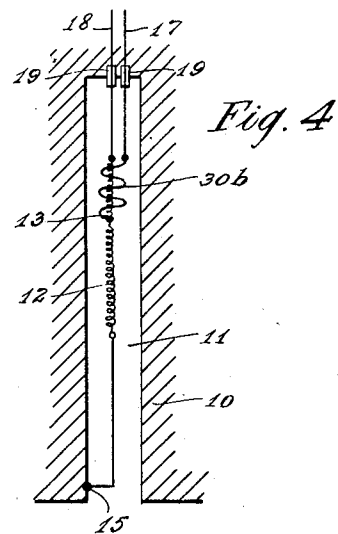
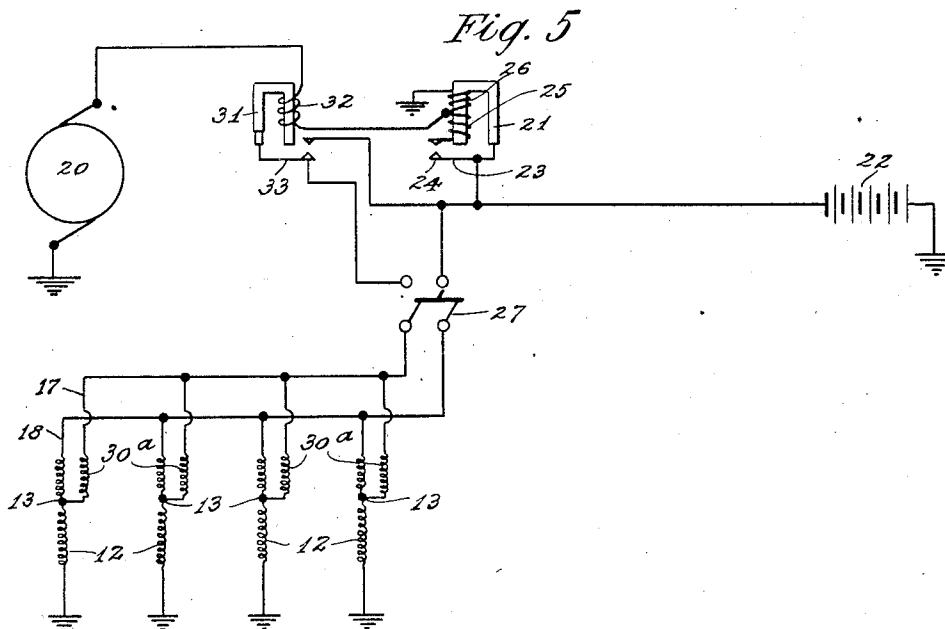
Chamberlain & Newman ATTORNEYS.

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UNITED STATES PATENT OFFICE.

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IGNITION SYSTEM.

Application filed November 30, 1921, Serial No. 518,021. Renewed September 12, 1925.

This invention relates to an ignition system for internal combustion engines of that type possessing inherently self-regulating features due to a combination of normal battery voltage, charging battery voltage, intake cooling and explosion heating, and serving on the engine as a substitute for all of the usual apparatus required in conjunction with the ordinary spark ignition system heretofore employed, as timing gears, spark coil, distributor, circuit breaker, condenser and high tension wiring.

The object of the invention is to provide an improved system of continuous circuit ignition for variable speed internal combustion engines having an added means of definitely fixing the retard and advance points in the location of the igniting temperature of the ignition element by means of one or more relays operating by fixed conditions of generator voltage as determined by the engine speed, these fixed conditions being either definite points along the elements by special construction or points additional to or modifying the inherently regulated points of ignition as obtained by a gradually increasing pitch winding of the ignition element itself.

An ignition element of a system of the present character, primarily consists of an electric conductor to be heated by low voltage direct current so constructed that its upper portion has a more concentrated heating section than its lower portion so that at low voltage only the upper portion is heated and as the voltage increases the element continues to become heated to an ignition temperature toward the lower portion. The fundamental principle of the improved system is that of employing an elongated metal member connected to be heated by an electric current passing through the member for the purpose of firing charges in engine cylinders. This member obviously becomes heated throughout its length and owing to its peculiar form is first and more intensely heated at one end than at the other, and also gradually becomes hotter throughout its length by increased voltage. The member or ignition element is preferably a relatively long strand of fine wire which is wound to form a tapered coil of gradually increasing pitch toward its lower end so that the windings are spaced farther apart at said lower end and if desired may be wound to form a

helical coil which is also more closely wound at one end than at the other, the windings gradually increasing toward the lower end, the coils being mounted free and self-supporting or being provided with suitable supports.

The improved system forming the subject-matter of this invention possesses an ignition element which, as shown, consists of a helical coil of fine wire wound on a small diameter with gradually increasing pitch toward its lower end, and which has added to its upper end an additional helical coil of the same or a smaller size wire wound on the same or a smaller diameter and constructed so that it will heat to ignition temperature with a lower current than will the main ignition element, the entire element being arranged to be connected by a manually operated switch to the battery current, and when the entire element is so connected the auxiliary portion at the top of the element is heated to igniting temperature corresponding to a retarded spark. When the engine speed increases to such an extent that the generator produced charging voltage the relay short circuits the auxiliary portion and the upper portion of the main element is heated to igniting temperature corresponding to a semi-advanced spark. At a still higher engine speed, at which the generator produces full charging voltage, the entire main element is heated to igniting temperature corresponding to a fully advanced spark.

With the above and other objects in view the invention resides and consists in the construction and novel combination and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawings, and pointed out in the appended claims, it being understood that various changes in the form, proportion, size and minor details of construction within the scope of the claims may be resorted to without departure from the spirit or sacrificing any of the advantages of the invention.

Similar characters of reference denote like or corresponding parts throughout the several figures of the accompanying drawings forming a part of this specification, and upon which:—

Fig. 1 shows a sectional elevation of an ignition element capable of use in a system

embodying the features of the invention and mounted in a tubular casing resembling in appearance a commercial form of spark plug;

Fig. 2 shows a schematic wiring diagram with the ignition elements for four cylinders connected in the ordinary engine;

Figs. 3 and 4 show sectional elevations of modified forms of ignition elements; and

Fig. 5 shows a modified form of schematic wiring diagram.

The fundamental principle of an ignition system of the present character is that the ignition element thereof is constituted by a tapered wire of small section, preferably mounted in a tube or casing which in turn is inserted for use in a cylinder in somewhat the same manner as the ordinary spark plug, but does not produce a jump spark, it obviously operating by having different portions throughout its length heated sufficiently to fire a charge in a cylinder at different positions of the strokes of the pistons.

With an engine at rest the usual battery voltage is approximately 5.5 volts and when applied in use to my ignition element at this voltage, only a small portion near the top of the main ignition element would normally be heated to ignition temperature and an explosion would not occur until the compressed fresh charge reached almost to the top of the pocket in the tube. As the generator commences to charge, the voltage would rise to approximately 6.5 volts and the increased current due to this higher voltage would heat the main ignition element approximately at the middle. Higher engine speed would give a charging voltage of approximately 7.5 volts and at this voltage the extreme lower end would be heated to an igniting temperature. The lower end of the main igniting element is kept some distance back from the opening into the cylinder so as to insure some compression taking place before firing.

With more particular reference to Fig. 1 of the drawing, 10 represents a tubular body member having a central longitudinal pocket 11 formed therein to receive the main ignition element 12 which is of a general elongated formation and mounted centrally in the pocket, the upper end of the main ignition element 12 being attached at 13 to an auxiliary ignition element 14 and the lower end of said main ignition element being secured in any suitable manner, as at 15, with the lower portion of the tubular body 10 to pass the current through the element and body. The lower peripheral portion of the body may be threaded as at 16 to be located in the tapped hole of a cylinder in which it is to be employed. From junction 13 between the main ignition element 12 and the auxiliary ignition element 14,

terminal ends 17 and 18, respectively, are carried to the outside through insulated bushings 19.

Referring more especially to Fig. 2, wherein is shown a schematic wiring diagram with the ignition elements for four cylinders connected in the ordinary engine, 20 represents a generator, 21 the reverse current relay, 22 the storage battery, 23 the armature of the relay carrying contacts 24 for connecting the generator to the battery through the series coil 25 when the armature is closed by sufficient generator voltage passing through shunt coil 26. 27 is a manually operated switch of double pole type in which one pole connects through from the battery to terminals 18 of the tubular bodies and the other pole connects the battery to terminals 17 of the tubular bodies through auxiliary contacts 28 mounted on the armature 23 and closed when the armature 23 is in closed position. With the engine at rest, closing switch 27 causes the elements to be connected to battery current and the auxiliary portion 14 is heated to igniting temperature. After the engine is started and attains such speed that the generated voltage causes armature 23 to close, contacts 28 are closed thus short circuiting auxiliary portion 14 and causing the upper portion of the main ignition element 12 to be heated to igniting temperature. Further increase in speed and consequent charging voltage causes the main ignition element to be heated further down and further advances the time of explosion. At any time that the engine speed drops to a point where the generated voltage is below charging value, armature 23 opens and auxiliary part 14 of the element is again affected by the battery voltage only and acts similar to a retarded spark.

In the device just described, lead 29 from auxiliary contact 28 through one pole of switch 27 to terminal 17 of the elements is shown as a solid wire indicated by a full line. With this construction, when the relay operates and closes contacts 28, the auxiliary element 14 is practically short-circuited by the low resistance by-pass of lead 29 and its temperature almost immediately drops below the igniting point. At the same time it takes a short while for the increased voltage to bring the upper part of main ignition element 12 to igniting temperature. Similarly when the engine speed drops and the relay opens contacts 28, element 12 cools off and element 14 takes some time to heat up. In both cases the time lapse during the change from one section of the element to the other may be great enough to cause the engine to miss or even to stop. This condition is overcome by introducing a resistance shown dotted as at 30, and so proportioned that when the generator is

running at full charging voltage, auxiliary portion 14 of the element takes about the same current that it does when operating as retarded ignition in series with the main ignition element 12, and, therefore, it always continues at igniting temperature and fires as a retard spark until element 12 becomes heated when the engine is speeded up, and when the engine speed drops, it is ready to take up the retard ignition when the relay opens and main element 12 cools off. This insertion of resistance 30 therefore insures continuous firing during the change from one part of the element to the other and at the same time bypasses enough of the current so that auxiliary portion 14 is not destroyed by overheating due to the higher voltage.

A modification of the relay type system with the added shunt resistance similar to resistance 30 just described is shown in Figs. 3 and 4, in which figures the shunt resistance is placed inside the tubular member as at 30^a instead of in the external circuit. This construction serves a double purpose, making the plug entirely self-contained and eliminating the cooling effect of the comparatively heavy tap wire as shown in Fig. 1 which has a tendency to conduct away sufficient heat as to make a very definite cold spot between the elements 14 and 12 and also reducing the temperature as well as the length of the heated portion of these two parts of the element. In this latter construction, the shunt resistance may be mounted as a small diameter coil 30^a placed as shown in Fig. 3, or as an open mesh coil of relatively large diameter surrounding auxiliary element 14 as in Fig. 4, or in any other suitable location. In any case, the junction between the main and auxiliary elements would be made by spot welding or by such means as to produce no appreciable cooling effect and permit a continuous heat along the element.

A modification of the relay construction already described in Fig. 2 is shown in Fig. 5. Instead of adding auxiliary contacts to the armature of the ordinary reverse current relay as shown in Fig. 2, one or more separate relays actuated by various values of the charging voltages may be used so connected to various points along the ignition element as to cause successive definite points of the element to be heated as the speed of the engine increases. In this latter case relay 21 is not provided with auxiliary contacts 28, but another relay 31 is inserted in the generator circuit to the battery and operated by a series coil 32 so that the armature 33 closes some time after the generator has been connected to the battery and at such time as the generator voltage is high enough to cause some predetermined current to flow. This construction would pre-

vent the advancing of the ignition point at too low an engine speed and could be adjusted to operate to the best advantage regardless of the normal closing time of relay 21.

A feature of the present system is that when the armature 23 is open thus connecting the entire element to the battery, the resistance is higher than that of the main element 12 by reason of the added element 14 so that ignition current taken from the battery is less than that taken at higher speeds, thus causing a lower drain on the battery at low speed running.

The ignition elements may be made in either conical or helical form with gradually increasing pitch or may be made with definite steps or different uniform pitches. They may be made as self-supporting open wire coils or they may be either internally or externally supported by some insulating means or coated with some porcelainous or other insulating composition. The particular forms of construction of the tubular bodies in which the elements are mounted does not form any material part of the invention.

This application is a continuation in part of subject matter contained in my co-pending application, S. N. 489,158, filed August 2, 1921.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections, and means for definitely controlling the heating of said sections to igniting temperature.

2. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element and means for definitely controlling the heating of the different sections of said igniting element to igniting temperature.

3. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections, and means independent of the sections for determining which section or sections shall be heated to igniting temperature.

4. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having an added section, and means for externally controlling the heating of said section to igniting temperature.

5. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections adapted to be heated and means for controlling the heating of each section to igniting temperature, said means including relays each actuated by a different definite

generator voltage dependent upon the amount of current flowing as determined by engine speed.

6. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections adapted to be heated and means for controlling the heating of each section to igniting temperature, said means actuated by different definite generator voltages dependent upon the engine speed.

7. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections adapted to be heated to igniting temperature by variable electric current and means including relays for definitely controlling the current in said ignition sections.

8. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections adapted to be heated to igniting temperature by variable electric current relays for controlling current in said sections, and means whereby the consumption of current is reduced when operating on low speed.

9. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections adapted to be successively heated to igniting temperature by application of different definite generator voltages dependent upon the engine speed, and means for insuring continuous igniting temperature in that section corresponding to slow speed ignition.

10. A continuous circuit ignition system

for variable speed internal combustion engines, including an ignition element having sections, means for successively heating said sections to igniting temperature, the igniting temperature of each section being different, and a relay controlled resistance for protecting one of said sections from overheating.

11. A continuous circuit ignition system for variable speed internal combustion engines, including an ignition element having sections adapted to be successively heated to igniting temperature by application of different definite generator voltages dependent upon the engine speed, and means for insuring proper igniting temperature in each section during changes of speed.

12. A continuous circuit ignition system for variable speed internal combustion engines, comprising an ignition element having sections as units, and means for successively heating said sections to igniting temperature as the speed of the engine is increased, said means including an external relay device.

13. A continuous circuit ignition system for variable speed internal combustion engines comprising an ignition element having sections as units; a circuit connected to the junction point of said sections; electric power supplying means for said ignition element; and means for heating said sections to igniting temperature in accordance with voltage variation.

Signed at New Haven in the county of New Haven and State of Connecticut this fifteenth day of November, A. D., 1921.

JOHN ALLEN HEANY.