

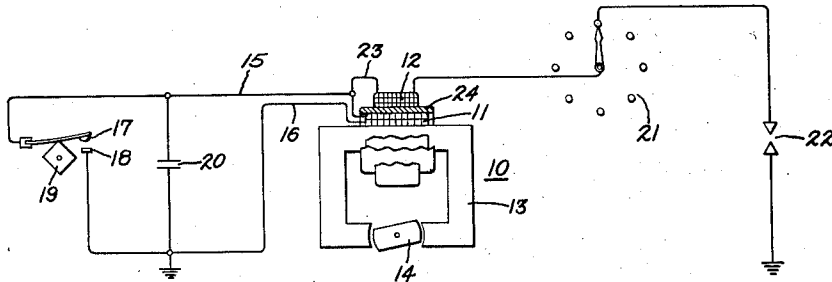
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INDUCTION APPARATUS

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INDUCTION APPARATUS

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4 Claims. (Cl. 123-148)

My invention relates to induction apparatus having particular application to electric ignition systems for internal combustion engines.

An object of my invention is to provide induction apparatus such that a maximum voltage will appear across the terminals of the secondary winding for a minimum current flowing through the primary winding.

Another object of my invention provides a magneto of such structure that the largest voltage will appear across the secondary winding terminals for a given interrupted primary current.

A further object of my invention is to provide an ignition system which will reduce the duration of the secondary current subsequent to the breakdown of the spark plug gap.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out in the claims annexed to and forming a part of this specification.

In the drawing the single figure diagrammatically illustrates a magneto for electric ignition systems which is provided with an embodiment of my invention.

In the application of induction apparatus, such as magnetos or induction coils, to electric ignition apparatus for internal combustion engines, it is desirable to obtain the largest voltage across the high voltage terminals for a minimum current which is interrupted by the breaker in the primary winding circuit. I have found that this result will obtain when the coupling coefficient between the primary and secondary windings is of a value of substantially 0.8, or more particularly between 0.75 and 0.85. With a coupling coefficient having such a value, the peak of the resultant secondary voltage wave occurs somewhat earlier than the peak of the low frequency component.

The coupling coefficient is given by the expression

$$\frac{M}{\sqrt{L_1 \times L_2}}$$

where M is the mutual inductance and L_1 and L_2 inductances of the primary and secondary windings respectively.

Referring to the drawing, I have illustrated a conventional circuit having a magneto which is provided to obtain electric ignition for an internal combustion engine. This ignition apparatus includes a magneto indicated generally by the

numeral 10 having a primary winding 11 and a secondary winding 12. In order to alternate the flux linking the coils a core 13 is provided with an inductor 14 which rotates in synchronism with the rotation of the crank shaft or cam shaft of the internal combustion engine. In order to periodically short-circuit the primary winding, it is connected through the cables 15 and 16 across a breaker having contacts 17 and 18 and an actuating arrangement for the movable contact arm 17 such as a cam 19 which is also operated in synchronism with the movement of the crank shaft or the cam shaft of the internal combustion engine. The breaker is also shunted with the conventional condenser 20 and one side of the breaker is grounded. One side of the secondary winding 12 is connected to a distributor 21 which will in turn distribute the electric ignition impulse to the spark plugs in the cylinders of the internal combustion engine in proper timed relation. One spark plug is indicated by the numeral 22. One terminal of the spark plug is of course grounded and the secondary winding 12 is connected to one side of the primary winding 11 through the cable 23 so as to form a complete circuit.

If all the flux produced by the primary winding were to link the secondary winding, the coupling coefficient is equal to one. However, since all the flux of the primary winding does not link the secondary winding the coupling coefficient is of a value less than one. I have found that substantially the largest voltage will appear across the secondary terminals for a given or predetermined interrupted primary current when the coupling coefficient between the primary and secondary windings is in the neighborhood of .80, or between .75 and .85. The coupling coefficient can be so made, in any desired manner, such as by placing between the primary winding 11 and the secondary winding 12 a magnetic shunt 24. This magnetic shunt comprises a sheet of magnetic material, such as iron, which is between the primary and secondary windings and concentric therewith. This shunt may take the form of a part turn, a whole turn or even several insulated turns of a strip of magnetic material of suitable thickness. This thickness together with the width of the shunt determines the extent to which the coupling coefficient is affected. It is, therefore, possible for the width of the shunt to be equal to, greater than, or less than the length of the coil former, depending upon the thickness and the number of turns of the material used. It is also possible for the

shunt to take the form of one or more layers or part layers, wound with wire having magnetic properties. The shunt could then, if desired, form a portion of one of the windings. The reduction of the coupling coefficient may also be effected by including a suitable inductance in series with the primary or secondary windings, or both. The transformer may also be an auto transformer.

In view of the foregoing it will be seen that I have provided an arrangement for obtaining the largest voltage across the secondary terminals of an induction apparatus for a given primary current. My invention, although not limited thereto, is particularly suitable for an electric ignition apparatus such as a magneto or an induction coil. Thus I provide that the coupling coefficient between the windings is less than one, or in the neighborhood of 0.80. This desired coupling coefficient may be obtained in any suitable manner and in addition to obtaining the desired secondary voltage wave form, this particular coupling coefficient also reduces the duration of the secondary current between the desired sparks.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States:

1. An ignition circuit for producing ignition for an internal combustion engine having an induction apparatus including primary and secondary windings, a breaker connected with said primary winding, and means for providing a coupling co-

efficient between said primary and said secondary windings having a value between .75 and .85 so that a substantially maximum voltage is obtained across said secondary winding for a predetermined current interruption by said primary winding breaker.

2. An ignition circuit for producing ignition for an internal combustion engine having an induction apparatus including primary and secondary windings, a breaker connected with said primary winding, and means for providing a coupling coefficient between said primary and second windings having a value in the neighborhood of .80 so that a substantially maximum voltage is obtained across said secondary winding for a predetermined current interruption by said primary winding breaker.

3. An ignition circuit for producing ignition for an internal combustion engine having an induction apparatus including primary and secondary windings, a breaker connected with said primary winding, and a magnetizable material between said windings and of such dimension in comparison with said windings that the coupling coefficient therebetween will have a value of in the neighborhood of .80 so that a substantially maximum voltage is obtained across said secondary winding for a predetermined current interruption by said primary winding breaker.

4. A magneto including primary and secondary windings, means for interrupting said primary winding circuit, and means including a magnetizable material between said primary and secondary windings for providing a coupling coefficient of said primary and secondary windings of substantially .8.

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