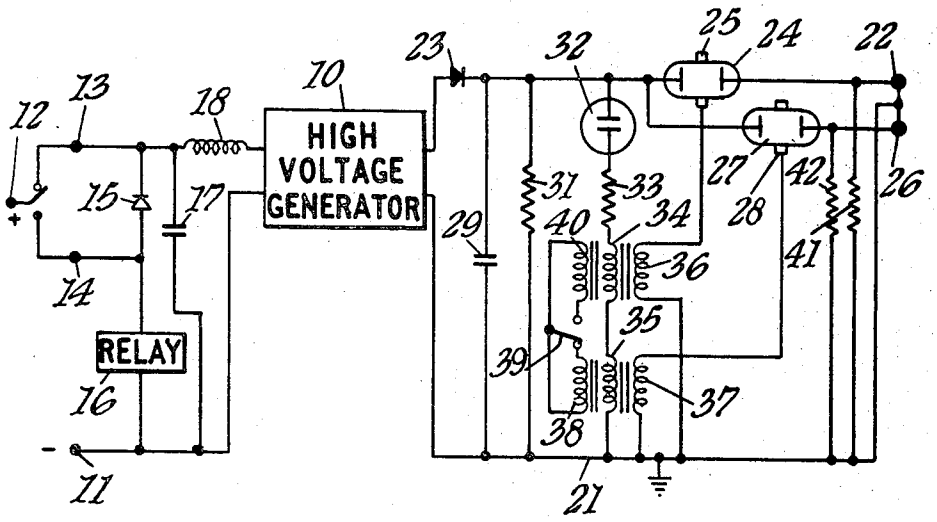
Oct. 15, 1968 N. A. PARISH 3,406,314

IGNITION SYSTEMS

Filed May 2, 1966

Fig. 1.



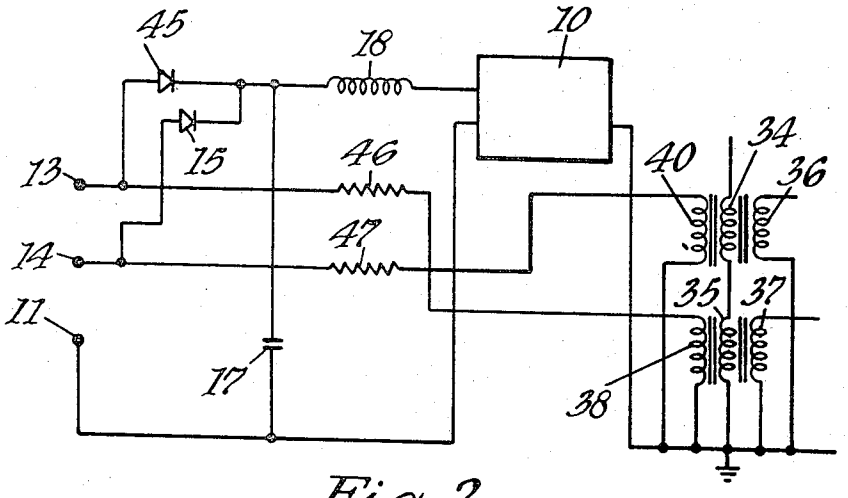


Fig. 2.

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IGNITION SYSTEMS

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ABSTRACT OF THE DISCLOSURE

In a spark ignition system, a capacitor is charged so that the voltage across it increases, and a voltage sensitive device is connected in the circuit across the capacitor so as to conduct when the voltage across the capacitor reaches a predetermined value. A transformer is provided for turning on a trigger device as soon as the capacitor starts to discharge through the voltage sensitive device, the trigger device then permitting the capacitor to discharge through a spark plug. A second transformer has its primary winding in series with the voltage sensitive device, and its secondary winding connected to another trigger device controlling another spark plug, and switch means is provided for determining which trigger device is switched to conduction when the capacitor starts to discharge through the voltage sensitive device.

This invention relates to ignition systems.

In the accompanying drawings, FIGURE 1 is a circuit diagram illustrating one example of the invention, and FIGURE 2 illustrates a modification of FIGURE 1.

Referring to FIGURE 1, there are provided terminals **11**, **12** which in use are connected to a D.C. source so as to be negative and positive respectively. The terminal **11** provides one input to a high voltage generator **10** whilst the terminal **12** is connectible alternatively to terminals **13**, **14**. The terminals **13**, **11** are interconnected through parallel circuits one of which contains a diode **15** and a relay coil **16**, and the other of which contains a capacitor **17**. Moreover, the terminal **14** is connected to a point intermediate the diode **15** and relay **16**, and the terminal **13** is connected through an indicator **18** to the other input terminal of the generator **10**.

One output terminal of the generator **10** is connected to an earthed line **21**, and the other of which is connected to an output terminal **22** through a diode **23** in series with a breakdown device **24** of the kind surrounded by a band **25**, the arrangement being such that the device **24** can be triggered by a voltage applied to the band **25**. The circuit includes a further output terminal **26** which is connected to the cathode of the diode **23** through a breakdown device **27** having a band **28**.

Points intermediate the diode **23** and the devices **24**, **27** are connected to the earth line **21** through three parallel paths, the first of which contains a capacitor **29**, the second of which contains a resistor **31**, and the third of which contains in series a control gap **32**, a resistor **33**, a primary winding **34** of a first transformer, and a primary winding **35** of a second transformer. The first and second transformers having secondary windings **36**, **37**, one end of each of the windings **36**, **37** being connected to the line **21**, and the other ends of the windings **36**, **37** being connected respectively to the bands **25**, **28**. Moreover, the transformers are provided with tertiary windings **40**, **38** which have one end connected to a relay contact **39** operable by the relay **16**, the arrangement being such that when the relay **16** is not energised the contact **39** bridges the winding **38**, but when the relay **16** is energised the contact **39** bridges the winding **40**.

A point intermediate the terminals **22**, **26** is earthed, and the nature of the terminals is such that they can be

connected to spark plugs respectively so that when they are connected the spark plugs will have one side connected to the device **24** or the device **27**, and their other side earthed. Resistors **41**, **42** are provided between the terminals **22**, **26** and earth, so that in use these resistors are connected across the spark plugs to protect the discharge circuit.

In use, assume for the moment that the terminal **12** is connected to the terminal **13**, so that the relay **16** is not energised. The terminals **13**, **11** provide an input to the generator **10**, the components **17**, **18** being provided to minimise radio interference. The generator **10** may be of any convenient known form, and may for example comprise a transformer wherein current flow to the primary winding is interrupted by an interrupter, or by a circuit employing transistors. Thus, the generator produces a series of high voltage pulses which flow through the diode **23** to charge the capacitor **29**. When the charge on the capacitor **29** reaches a predetermined value, the gap **32** will break down, and the capacitor **29** will start to discharge through the gap **32**, resistor **33** and windings **34**, **35**. Because the winding **38** is short-circuited, the second transformer will not have an output pulse produced in its secondary winding **37**, but a pulse will be produced in the secondary winding **36**, which will cause the device **24** to become conductive. The capacitor discharge current is now diverted through the device **24** and the plug connected to the terminal **22** to provide the required spark.

If a spark is required at the plug connected to terminal **26**, then the terminal **12** is connected to the terminal **14**. The circuit to the generator **10** is unaltered, but the relay **16** is now energised, so that when the gap **32** breaks down, the winding **40** will be short-circuited, so that a pulse is produced in the winding **37**, which causes the device **27** to become conductive so that the main discharge path for the capacitor **29** is through the plug connected to terminal **26**.

The circuit described has a number of important advantages, Thus, in certain known circuits the voltage across a capacitor such as the capacitor **29** is sensed by a gap similar to the gap **32**, and when the gap **32** breaks down the capacitor **29** discharges through it. This means that the gap **32** must handle high energies, whereas in the current described the gap **32** only handles very small energies, and so has a long and stable life. The devices **24**, **27** do of course handle the full discharge energy, but do not have to maintain a controlled breakdown characteristic, but only to act as reliable trigger devices. The circuit design is such that the relay contacts handle only small power.

It will be apparent that a number of modifications can be made to the circuit. For example, the devices **24**, **27** can be provided with internal bands instead of external bands, or they can be other devices which can be triggered to render them conductive. A further modification is shown in FIGURE 2, in which the relay **16** and contact **39** are omitted. In this example an additional diode **45** is provided between the terminal **13** and inductor **18**, and the terminals **13**, **14** are connected through resistors **46**, **47**, to the unearthed ends of the windings **38**, **40**. In this arrangement, depending on which terminal **13**, **14** is being used, either the first transformer or the second transformer will be saturated, which of course has the same effect as short circuiting one of the windings **38**, **40**.

The invention can also be applied to circuits in which more than two plugs are to be used alternatively. This can be done for example by using one triggering device per plug with a slightly more complex relay arrangement than that shown in FIGURE 1.

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

1. A spark ignition system comprising in combination a capacitor, means for charging the capacitor to increase the voltage across the capacitor, a trigger device which when conductive permits discharge of the capacitor to produce a spark, a voltage sensitive device connected in a circuit across said capacitor so as to conduct when the voltage across the capacitor reaches a predetermined value, a transformer having its primary winding connected in series with said voltage sensitive device, and its secondary winding connected to the trigger device, said transformer being operable upon commencement of discharge of the capacitor through said voltage sensitive device to switch said trigger device to conduction, said system further including a second transformer having its primary winding connected in series with said voltage sensitive device, and its secondary winding connected to a second trigger device which when conductive permits discharge of the capacitor to produce a spark at a different

plug from that controlled by the first-mentioned trigger device, this system further including switch means operable to determine which trigger device is switched to conduction when the voltage sensitive device conducts.

2. A system as claimed in claim 1 in which said switch means acts to short-circuit a winding on one or other of the transformers.

3. A system as claimed in claim 1 in which said switch means acts to saturate one or other of the transformers.

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