March 25, 1969 H. BARTCH 3,434,463

TRANSISTORIZED IGNITION SYSTEM

Filed Jan. 30, 1967

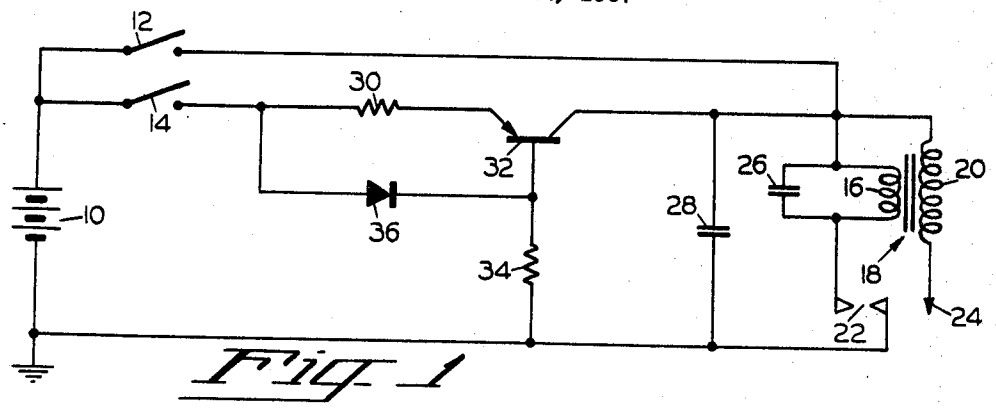

Fig 1

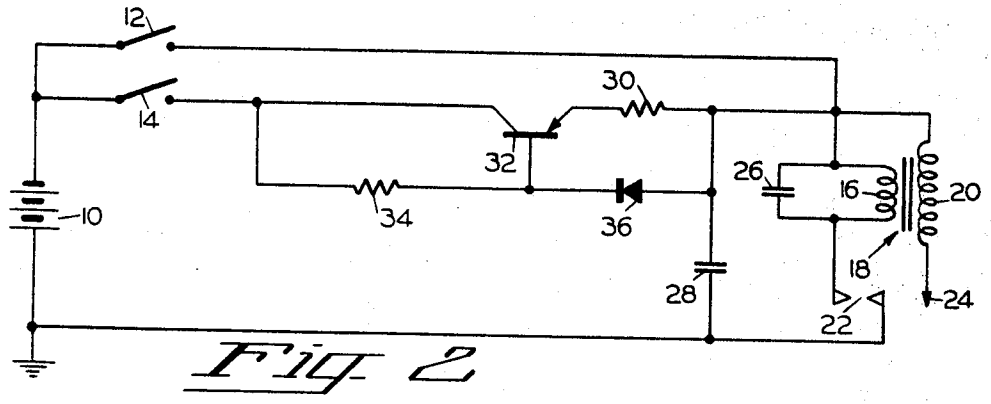

Fig 2

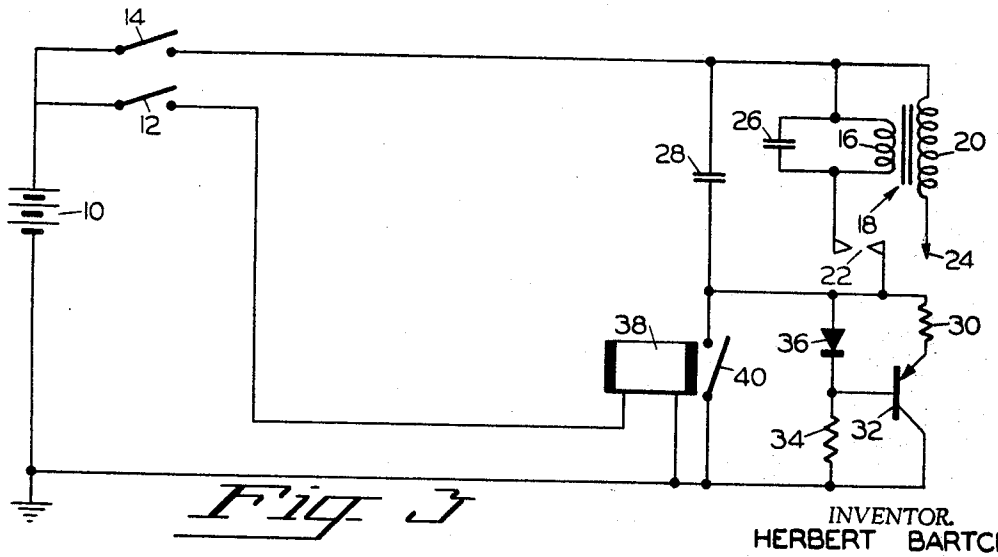

Fig 3

INVENTOR.
HERBERT BARTCH

BY Oliver D. Olson

AGENT

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TRANSISTORIZED IGNITION SYSTEM

Herbert Bartch, 2311 SE. 148th Ave., Portland, Oreg. 97233

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ABSTRACT OF THE DISCLOSURE

An ignition system for internal combustion engines is disclosed wherein the conventional ballast resistor and breaker points condenser are eliminated, a capacitor is connected in parallel with the primary winding of the conventional ignition transformer to form a high frequency resonant tank circuit, and the latter is connected to a battery source of potential through the conventional ignition breaker points and a transistorized current regulator.

SUMMARY OF THE INVENTION

This invention relates to ignition systems for internal combustion engines, and more particularly to an ignition system which functions to provide optimum performance and maximum efficiency over a wide range of engine speeds.

This invention is an improvement over the system invented by William V. Guyton and myself and disclosed in U.S. Letters Patent No. 3,288,125.

Prior to the invention disclosed in the aforementioned patent, conventional ignition systems utilized a current limiting resistance, commonly called a ballast resistor, between the potential source and the primary winding of the ignition transformer. However, sufficient variations in current still are developed in such systems during engine operation as to adversely affect the performance of the latter and the service life of the system components.

Further, in such prior systems, as well as in the systems disclosed in the aforementioned patent, the use of a points condenser in parallel with the ignition breaker points allows the alternating current to circulate through the entire ignition system, thereby reducing efficiency and creating deleterious interference signals.

Still further, use of a breaker points condenser in such ignition systems requires that its reactance be matched to the entire electrical system in order to obtain the highest Q factor for maximum efficiency of operation, and this is difficult to achieve.

The present invention achieves the principal objective of overcoming the foregoing disadvantages while simultaneously eliminating from the ignition system the conventionally employed breaker points condenser and, preferably, the ballast resistor also. The ignition system of the present invention thus is of more simplified construction for more economical manufacture, and provides long and faithful service with a minimum of maintenance and repair.

The foregoing and other objectives and advantages of the present invention will appear from the following detailed description, taken in connection with the accompanying drawings of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1, 2 and 3 are schematic electrical diagrams of various forms of the ignition system embodying the features of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Conventional internal combustion engines have ignition

systems in which a source of electric potential, such as the battery **10**, is releasably connected sequentially through an ignition key start switch **12** and running switch **14** to the primary winding **16** of an ignition transformer **18**. The stepped up voltage at the secondary winding **20**, which is controlled by the cam-operated breaker points **22**, is fed through the common rotor contact **24** of the distributor (not shown) sequentially to the several spark plugs of the engine.

As explained hereinbefore, conventional ignition systems heretofore have utilized a breaker points condenser connected in parallel with the breaker points **22**. It is an important feature of the present invention that such a condenser is eliminated, together with its disadvantages enumerated hereinbefore.

In accordance with the present invention, a capacitor **26** is connected across the primary winding **16** to form with the latter an L–C tank circuit which provides a closed alternating current circulating path independent of the source **10** of electric potential.

A bypass capacitor **28** is connected across the series circuit arrangement of the points **22** and L–C tank circuit, to insure that substantially all of the alternating current voltage across the points will appear across the tank circuit.

Moreover, the high circulating current thus provided is isolated from the battery circuit by the breaker points **22** which are open during that time. Accordingly, the highest Q factor and consequently the maximum efficiency of system operation, is achieved merely by matching the reactances of the capacitor **26** and the primary winding **16**.

Means also preferably is provided in the ignition system of the present invention to achieve maximum stabilization of primary winding current.

Referring first to FIG. 1 of the drawings, wherein a negative ground ignition system is illustrated, there is interposed between the ignition key running switch **14** and the positive end of the primary winding **16** of the ignition transformer the series arrangement of the emitter current limiting resistance **30** and the emitter-collector of the transistor **32**. The base of the transistor is connected through the biasing resistance **34** to the negative side of the battery **10**, herein shown as ground.

Shunting the series arrangement of the emitter current limiting resistance **30** and the emitter-base junction of the transistor **32** is the diode rectifier **36**. This diode provides a regulated source of bias voltage at the transistor base, the magnitude of which is defined over narrow limits by the value of the biasing resistance **34**. Thus, assuming there is a substantially constant voltage in shunt with the series arrangement of resistance **30** and the emitter-base junction, any change in current through the emitter will cause a corresponding change in voltage drop across the resistance **30**. This, in turn, produces a corresponding but inverse change in available voltage across the emitter-base junction and a corresponding compensating change in current through the emitter-collector circuit, thereby maintaining said current substantially constant.

Accordingly, the diode functions to provide a substantially constant voltage which, in conjunction with resistance **30** and the emitter-base junction, provides a substantially constant current through the transistor collector, breaker points **22**, ignition transformer **18** and spark plugs, regardless of changes in battery voltage, faulty regulator, or faulty transformer. Moreover, this substantially constant current is provided over the operating range of the engine, thus providing lower points current at low speeds and higher output voltage at higher speeds as compared with conventional systems. The lower points current at lower speeds effctively decreases ignition noise,

with consequent reduction in radio interference, and extends the life of the breaker points, spark plugs and all other ignition components. The higher output voltage at higher engine speeds affords efficient operation of the engine at speeds higher than those attainable with conventional ignition systems.

The use of the diode also provides automatic temperature compensation for the system. For example, as the components of the system increase in temperature the required voltage across the transistor base-emitter circuit for a given current drops, and simultaneously the voltage across the diode also drops.

The circuit illustrated in FIG. 2 as adapted for positive ground ignition systems. In this instance the breaker points **22** are connected to the common positive ground, the junction of the resistance **30** and the diode **36** is connected to the end of the primary winding **16** opposite the breaker points, and the junction of the collector and base bias resistance **34** is connected through the running switch **14** to the negative terminal of the battery **10**.

In the embodiment illustrated in FIG. 3, the transistor is interposed between the breaker points **22** and the negative ground terminal of the battery.

The embodiment of FIG. 3 also includes a relay **38** the normally open switch contact **40** of which is connected across the emitter-collector of the transistor **32**. The relay coil is connected across the battery **10** through the start switch **12** of the ignition key switch. Accordingly, for the short period of time during starting of the engine that the start switch **12** is closed, the relay switch contact **40** also closes, thus bypassing the transistor circuit to provide higher initial starting voltage, in conventional manner.

Since the high circulating current in the tank circuit is isolated from the circuit of the battery **10**, switch **14** and transistor **32**, by virtue of the open breaker points **22** which, in the present invention, are not shunted by a points condenser, the transistor does not require protection by a shunting capacitor. Such a shunting capacitor has the adverse effect of creating a low frequency current oscillation while the breaker points are closed, causing the output voltage of the transformer secondary to drop periodically to levels which may cause engine misfire at certain speeds. This occurs because the length of time the points are closed changes with engine speed, and charging current variations with respect to time show up in the secondary winding as voltage variations, since the charging rate of the coil remains constant.

In the operation of the ignition system of the present invention, the ignition key is manipulated first to close both the starting switch **12** and the running switch **14**. Closure of the starting switch by-passes the transistor circuitry, either directly in the embodiments of FIGS. 1 and 2, or through operation of the relay **38** in the embodiment of FIG. 3, to provide higher ignition starting voltage, as previously explained. Upon starting of the engine the ignition key is moved to the position at which the starting switch **12** opens and the running switch **14** remains closed. The substantially constant current provided by the transistor circuitry is maintained regardless of variations in the ignition components, battery voltage and engine speed. Thus, more uniform ignition is achieved at all speeds throughout the extended range of the engine operation, and the service life of the breaker points, spark plugs and other ignition components is substantially increased. These factors reduce materially the incidence of necessary tune-ups and component replacements and also contributes to improve economy of operation.

Moreover, the provision in the present invention of the series circuit arrangement of the resonant L–C tank circuit **16**, **26** and the breaker points **22** shunted by the bypass capacitor **28**, provides maximum efficiency of operation by the development of high circulating current which is isolated from the battery circuit. This is achieved whether the system includes the transistorized current regulator described, or a conventional ballast resistor, or no regulation at all.

Typical values of components for the circuits described hereinbefore are as follows: Resistance **30** about 0.15 ohms; resistance **34** about 80 to 150 ohms, preferably about 120 ohms; capacitor **26** about 0.18 microfarad; and capacitor **28** about 0.5 microfarad. A suitable diode is Motorola 1N4001, and a suitable transistor is Motorola 2N1544.

The ignition system of the present invention may be provided as a complete and integral system, as illustrated in the drawings, or it may be provided in kit form for modifying existing conventional systems by removing from the latter the ballast resistor and the breaker points condenser. In FIGS. 1 and 2 the kit comprises the components **26–36**, while in FIG. 3 the kit comprises the components **26–40**.

It will be apparent to those skilled in the art that various changes may be made in the number, type, value and arrangement of components described hereinbefore. For example, although the transistorized current regulator is preferred for its improved performance, a conventional ballast resistor may be employed. About 20% increase in output power over conventional systems is obtained by virtue of the association with such ballast resistor of the L–C tank circuit and bypass capacitor arrangement described hereinbefore. In this case bypass capacitor **28** is chosen to be about 2000 microfarads. These and other changes may be made without departing from the spirit of this invention and the scope of the appended claims.

Having now described my invention and the manner in which it may be used, I claim:

1. A kit for use in increasing the efficiency of an ignition system for an engine having the series circuit arrangement of an ignition transformer primary winding and breaker points normally connected across a source of electric potential, the system being characterized by the absence of an ignition condenser across said points, the kit comprising

(a) a capacitor,

(b) means for connecting the capacitor across the primary winding for forming with the latter an L–C tank circuit for providing a closed alternating current circulating path independent of the source of electric potential,

(c) bypass capacitance means, and

(d) means for connecting the bypass capacitance means in parallel with the series circuit arrangement of said L–C circuit and breaker points.

2. The kit of claim **1** including a current regulator comprising

(a) a transistor,

(b) means for connecting the collector and emitter of the transistor in series with the breaker points and primary winding,

(c) base bias voltage resistance means connected to the transistor base,

(d) means for connecting the base bias voltage resistance means to the source of electric potential,

(e) emitter current limiting resistance means connected to the transistor emitter,

(f) means for connecting the emitter current limiting resistance means to the source of electric potential, and

(g) bias voltage source means connected across the series arrangement of the emitter current limiting resistance means and the emitter-base junction of the transistor for providing substantially constant bias voltage across said series arrangement and substantially constant current through the emitter-collector circuit.

3. The kit of claim **2** wherein the collector and emitter are adapted to be connected between the primary winding and the positive terminal of the source of electric potential.

4. The kit of claim 2 wherein the collector and emitter are adapted to be connected between the primary winding and the negative terminal of the source of electric potential.

5. The kit of claim 2 wherein the collector and emittter are adapted to be connected between the breaker points and one terminal of the source of electric potential.

6. The kit of claim 5 wherein the system includes an ignition switch having a start switch and a running switch, and wherein the kit includes

(a) starter switch means connected across the transistor emitter-collector for releasably shunting the latter,

(b) electrical actuator means for the starter switch means and having an electric circuit, and

(c) means for connecting the start switch of the ignition switch in series in said actuator circuit.

7. An ignition system for an engine, comprising

(a) a source of electric potential,

(b) an ignition transformer including primary and secondary windings,

(c) breaker points connected in series with the primary winding and releasably connecting said series circuit across the source of electric potential,

(d) a capacitor connected across the primary winding and forming with the latter an L–C tank circuit for providing a closed alternating current circulating path independent of the source of electric potential, and

(e) bypass capacitance means connected in parallel with the series circuit arrangement of said L–C circuit and breaker points,

(f) the ignition system being characterized by the absence of a breaker points ignition condenser in parallel with said points.

8. The system of claim 7 including a current regulator comprising

(a) a transistor,

(b) the collector and emitter of the transistor being connected in series with the breaker points and primary winding,

(c) base bias voltage resistance means connecting the transistor base to the source of electric potential,

(d) emitter current limiting resistance means connecting the transistor emitter to the source of electric potential, and

(e) bias voltage source means connected across the series arrangement of the emitter current limiting resistance means and the emitter-base junction of the transistor for providing substantially constant bias voltage across said series arrangement and substantially constant current through the emitter-collector circuit.

9. The system of claim 8 wherein the transistor collector and emitter are connected between the primary winding and the positive terminal of the source of electric potential.

10. The system of claim 8 wherein the transistor collector and emitter are connected between the primary winding and the negative terminal of the source of electric potential.

11. The system of claim 8 wherein the transistor collector and emitter are connected between the breaker points and one terminal of the source of electric potential.

12. The system of claim 11 including

(a) starter switch means connected across the transistor emitter-collector for releasably shunting the latter,

(b) electrical actuator means for the starter switch means and having an electric circuit connected to the source of electric potential, and

(c) a start switch in the circuit of the actuator means and operable momentarily during starting of the engine to effect shunting of the transistor emitter-collector.

References Cited

UNITED STATES PATENTS

2,898,392	8/1959	Jaeschke.	
3,288,125	11/1966	Guyton et al.	
3,324,351	6/1967	Pahl	315—219

LAURENCE M. GOODRIDGE, *Primary Examiner.*

U.S. Cl. X.R.

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