July 4, 1939. D. C. McRAE ET AL 2,164,588

INDICATING APPARATUS

Filed March 16, 1936

Fig. 1

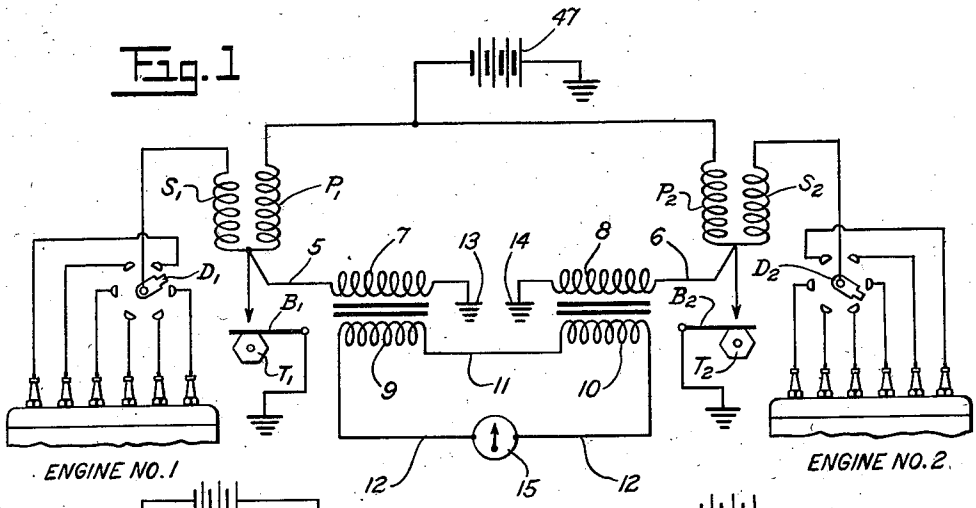


Fig. 2

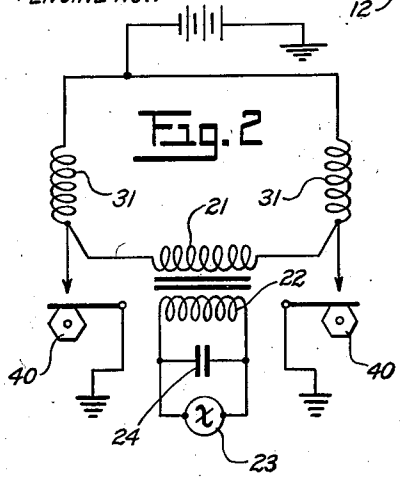


Fig. 3

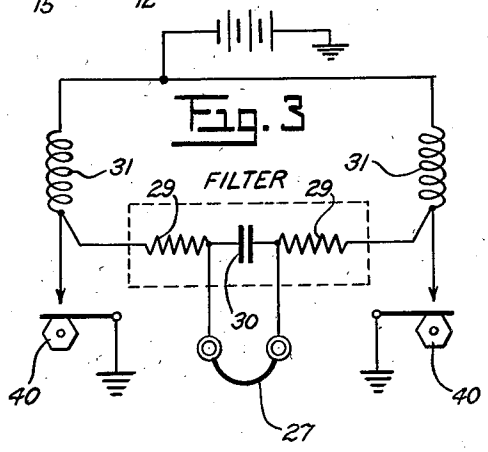
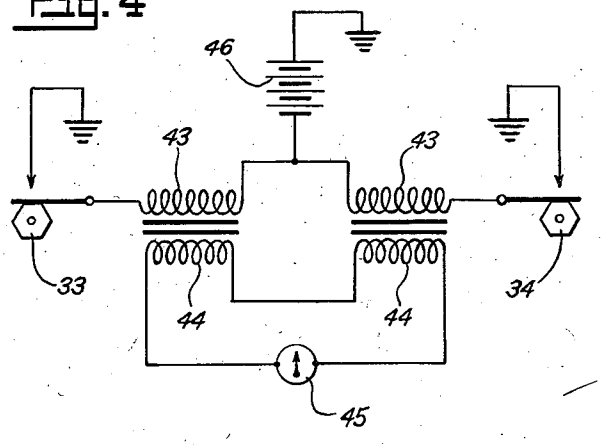


Fig. 4



INVENTORS.

Don C. McRae

John C. Franklin

BY Mark J. Finnegan

ATTORNEY.

Patented July 4, 1939 2,164,588

UNITED STATES PATENT OFFICE

2,164,588

INDICATING APPARATUS

Don C. McRae, Miami, Fla., and John C. Franklin, Kansas City, Mo., assignors to Eclipse Aviation Corporation, East Orange, N. J., a corporation of New Jersey

Application March 16, 1936, Serial No. 69,232

4 Claims. (Cl. 177—311)

This invention relates to indicating apparatus and particularly to indicating the relationship between the rates of rotation of any two or more continuously rotating mechanisms such as internal combustion engines installed on an airplane or other craft and subject to variations in speed.

An object of the invention is to provide an indicating system including a synchroscope and means for causing said synchroscope to assume a definite position or condition when the subjects of study, such as the internal combustion engines above suggested, are operating in synchronism, and to display a different type of indication when said engines are rotating at different speeds.

This and other objects and advantages will appear more fully from a consideration of the detailed description which follows, with reference to the accompanying drawing, wherein is illustrated one embodiment of the invention. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawing:

Fig. 1 is a schematic representation of the invention as applied to two internal combustion engines; and

Figs. 2, 3 and 4 show other embodiments thereof.

Referring first to Fig. 1, reference characters D_1 and T_1 designate rotatable parts of the ignition system of engine No. 1 and D_2 and T_2 designate the corresponding rotatable parts (distributor arm and timer, respectively) of engine No. 2, the primary and secondary windings of the induction coils being indicated at P_1 and S_1, P_2 and S_2.

Branching from the primary ignition circuits, wires 5, 6 lead to the primary windings 7, 8 respectively, of transformers having secondary windings 9, 10 connected by leads 11, 12 the latter having a voltmeter or equivalent instrument inserted therein to reflect the time difference, if any, between the peak values of the E. M. F. of circuits 5 and 6, which in turn coincide with the periods of interruption of current flow at the points B_1 and B_2 of the respective ignition timers.

It is intended that the windings 7 and 8 will have sufficiently high resistance to prevent shunting of any material amount of energy from the ignition circuit; that is, even though they provide a theoretical momentary path to ground (13, 14) at the moment of current interruption at B_1 and B_2, these windings 7 and 8 are a practical barrier to loss of the primary circuit current during such moment, while nevertheless effective to indicate (through induction into the secondary circuit 11, 12) the timing of the interrupting of current flow in the two ignition circuits.

It follows that indicator 15 will remain steady, indicating synchronism in the speeds of engines 1 and 2, when the interrupting impulses, or "beats" in circuits 5 and 6 coincide to thereby produce induced currents of equal potentials in transformer windings 9 and 10.

Fig. 2 shows a second embodiment of the invention, using a single transformer in place of the two indicated at 7 and 8 in Fig. 1. This single transformer has its primary winding 21 connected so as to receive the opposing pulsations of each of the two ignition circuits, and when these opposing pulsations are so synchronized as to have the effect of nullifying one another, the result will be an absence of any potential gradient in the circuit through the secondary winding 22 and the indicator (voltmeter or its equivalent) 23. A condenser 24 may be provided to by-pass those components of the current which are not necessary to a determination of the actual value of the E. M. F. impulses in the meter circuit, and the fundamental frequency thereof.

In Fig. 3 a filter unit is substituted for the transformer 21, 22 of Fig. 2, and an aural indicator 27 (head-phones, for example) for the visual indicator 23 of Fig. 2. The filter unit may include suitably proportioned inductances and capacitors connected as shown at 29 and 30; the windings 31 of Figs. 2 and 3 corresponding to the windings P_1 and P_2 of Fig. 1.

In Fig. 4 the circuit interrupters 33, 34 (corresponding to the circuit interrupters T_1 and T_2 of Fig. 1 and to the circuit interrupters 40 of Figs. 2 and 3) are placed directly in series with the primary windings 43 of the transformers whose secondary windings 44 are connected through indicator 45 in the same manner as are windings 9 and 10 of Fig. 1; 46 being a source of direct current corresponding to 47 of Fig. 1. With this arrangement of Fig. 4 the interrupters 33, 34 may be units separate and distinct from the ignition elements of Figs. 1–3, but nevertheless rotatable in synchronism with the associated engines (not shown, but corresponding to engines 1 and 2 of Fig. 1).

What is claimed is:

1. Means for indicating the speed relationship between two engines, each equipped with an engine driven periodic circuit interrupter, said means comprising a pair of circuits including said interrupters, and a secondary circuit containing a single index element responsive to the difference, if any, in the frequencies of current interruption in said first-named circuits.

2. Means for indicating the speed relationship between two engines, each equipped with an engine driven periodic circuit interrupter, said means comprising a pair of circuits including said interrupters, and a secondary circuit containing a single index element responsive to the difference, if any, in the frequencies of current interruption in said first-named circuits and means in said secondary circuit for coupling said first-named circuits to produce energization of said index element.

3. In a signaling system for indicating synchronous operation of two internal combustion engines, each having an ignition system including an ignition induction coil and primary circuit interrupter, the combination of an electrical signal device and a circuit connecting the signal device and both of the primary windings of the induction coils in series independently of said interrupters.

4. In a signaling system for indicating the speed of operation of an internal combustion engine having an ignition system including an ignition induction coil and primary circuit interrupter therefor, the combination of an electrical signaling device and a circuit connecting the signaling device and the primary winding of the induction coil in series independently of said interrupter.

JOHN C. FRANKLIN.
DON C. McRAE.