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POWER RESPONSIVE DEVICE

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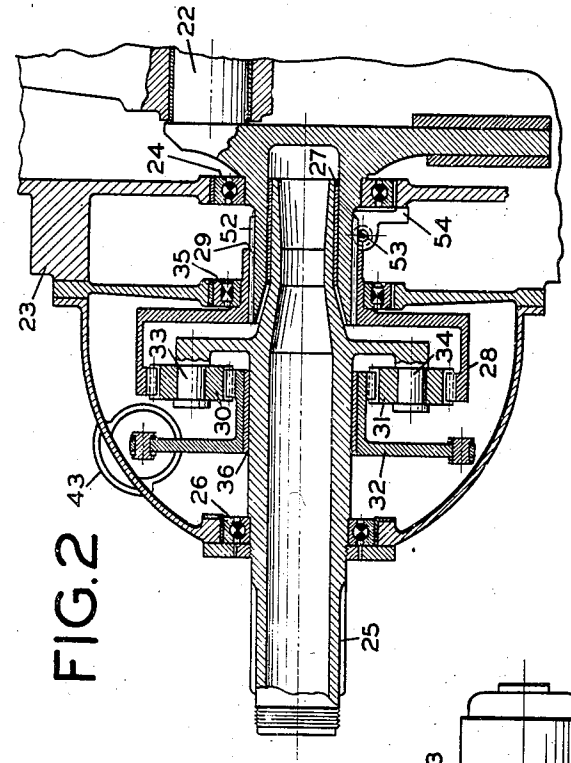

FIG. 2

FIG. 1

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POWER RESPONSIVE DEVICE

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2 Claims. (Cl. 265—25)

This invention relates to power responsive devices for engines, more particularly internal combustion engines such as are used on aircraft.

It is an object of this invention to provide an improved device which will respond to, or indicate, the actual power output of the engine irrespective of changes in conditions or factors under which the engine may operate. Such factors may be quantity of fuel, temperature and pressure of the combustion air, or moisture and oxygen content of the same.

The invention thus aims at providing a reliable device for indicating or controlling the true power output of an engine. This object is of particular importance in the operation of long range aircraft where fuel economy and maintenance of a predetermined power output at which the engine operates most efficiently is essential.

It is a further object of this invention to provide a power responsive device utilizing two impulses derivable from the engine, a first impulse proportional to the speed of the engine, the second impulse proportional to the engine torque. Both impulses are utilized for jointly operating a movable member which may either be a pointer or, equally, a movable member of a control relay.

More particularly this invention aims at providing an electrically operated power responsive instrument including means for generating measurable electric impulses, the magnitude of which is proportional to the engine speed and including further means for varying the magnitude of such electrical impulses in response to the engine torque. In this manner a joint operation of a movable member, such as a pointer, is accomplished in dependence on engine speed and torque.

It is a further object of this invention to provide a power responsive instrument adapted for use in connection with an engine having means operable in response to the engine torque.

More particularly, this invention aims at providing a power meter suited for use with aircraft engines having pressure fluid operated means for measuring the torque of the engine, more specifically for engines having a planetary gear for driving the propeller including rotating driving and driven gears and a relatively stationary sun gear, the reaction torque on which is determinable by pressure fluid operated means.

The invention thus aims at providing a power responsive device utilizing as one of its operating impulses a pressure impulse produced by a pressure fluid operated device of the character mentioned.

The invention further aims at providing a power responsive device, simple of construction, easy to manufacture and reliable in operation requiring no further compensating means for changes in operating conditions of the engine such as the aforementioned changes in atmospheric temperature, pressure, humidity, oxygen content and the like.

Further aims, objects and advantages of this invention will appear from a consideration of the description which follows with accompanying drawing showing for purely illustrative purposes an embodiment of this invention. It is to be understood, however, that the description is not to be taken in a limiting sense, the scope of this invention being defined in the appended claims.

Referring to the drawing:

Fig. 1 is an illustration, partly in perspective view, of an embodiment of this invention; and

Fig. 2 is a side view of an element shown in Fig. 1, a section being taken on line 2—2.

A purpose of this invention is to actuate the movable member such as the actuating arm of a relay or an indicator in response to changes in the power output of an engine.

In Fig. 1 the movable member is shown by way of illustration in the form of a pointer 10 movable relatively to a graduated dial 11 and forming part of an electric meter 12 which may in principle be of the bulb or ammeter type.

For the purpose of this description, the engine may be assumed to be an internal combustion engine of the type used on aircraft.

Two impulses are derived from the engine for actuating the aforementioned movable member or pointer in response to the engine power.

In the illustrated embodiment a first impulse proportional to the speed of the engine is created by an electric impulse transmitter which may be in the form of a single phase A. C. generator 13 having output terminals 14 and 15.

According to the present invention, the magnitude of the transmitter output is modified in response to the engine torque by output modifying means of any suitable form. This may be accomplished by providing an adjustable potentiometer which may be in the form of a variable impedance 16 connected to the transmitter by means of leads 17 and 18. The output terminals of the output modifying means are connected to the electric meter 12 by means of leads 19 and 20.

If the meter is of a type sensitive to changes in frequency, for example by reason of an inductance forming part of the meter, a network 21 of conventional structure may be connected

in the meter circuit to counteract changes in the indication of the meter caused by changes in frequency which normally occur at an increase in driving speed of the transmitter 13.

The output modifying means, in the illustrated embodiment the potentiometer 16, is adjusted in response to engine torque.

The device for deriving a torque impulse may be of any suitable form and is shown in the illustrated embodiment as being of the pressure fluid type responsive to the reaction exerted by the engine on its support.

In Figs. 1 and 2 the end of the engine crankshaft 22 is shown as mounted in motor casing or support 23 by means of a bearing 24. The engine crankshaft drives a propeller shaft 25 mounted in bearings 26 and 27 through a reduction gear.

The reduction gear comprises a driving gear 28 keyed to the crankshaft at 29, a set of planetary gears, two of which are shown at 30 and 31, and a relatively stationary sun gear 32. The planetary gears 30 and 31 are mounted on arms 33 and 34 of the propeller shaft 25 to drive the same. The driving gear 28 may be supported in the engine casing 24 by means of a further bearing 35.

The relatively stationary sun gear 32 may be mounted on the propeller shaft by means of a bearing 36 and provided with two arms or lugs 37 and 38 for bracing the sun gear against rotation relatively to the engine casing.

In operation the driving gear 28 causes the planetary gears to revolve about the sun gear, thereby exerting a reaction torque on the sun gear which is proportional to the engine torque. From this reaction torque a pressure impulse may be derived by any suitable means, one convenient form being shown in Fig. 1.

The pressure fluid operated device of the illustrated embodiment comprises two pistons 39 and 40 connected to the arms 37 and 38 by means of piston rods 41 and 42. The pistons are movable in cylinders 43 and 44 mounted on, or forming part of, the housing 23. The spaces in the cylinders above the pitsons are connected by a duct 45.

Pressure fluid from a suitable source (not shown) is supplied to the device through a supply duct 46 terminating at an intake port 47. The intake port is controlled in response to movements of the pistons relatively to the cylinders. In the illustrated embodiment, a sleeve valve is shown comprising a valve member 48 connected to, or forming part of, the piston 39. The sleeve valve has a control edge 49 cooperating with the intake port 47. The space above the control valve may be vented through a suitable vent hole 50.

The pressure fluid operated torque device operates as follows:

Reaction on the sun gear in the direction of the arrow 3 in Fig. 1 causes the piston 39 to move into the cylinder, thereby opening the intake port 47 to admit pressure fluid into the cylinder. The entering pressure fluid forces the piston in the opposite direction until the supply of pressure fluid is shut off. The pressure existing within the cylinder 43 is communicated to the cylinder 44 through the duct 45 and is proportional to the reaction on the sun gear and, accordingly, the torque of the engine.

The pressure impulse is transmitted to a pressure responsive device of suitable form through a duct 51 for modifying the action of the speed impulse on the movable member or indicator of the power responsive device.

A rotary motion proportional to the speed of the engine may also be derived at the device of Fig. 2, there being shown a helical gear train for driving a flexible shaft. A first helical gear 52 is cut into or mounted on the crankshaft meshing with a second gear 53 mounted on a shaft 55 journaled in a bracket 54. The shaft 55 terminates at 56 in a suitable shaft coupling to which a flexible shaft 57 may be connected for actuating the shaft 58 of the transmitter 13.

Returning now to the second or torque impulse, there is shown in the illustrated embodiment a Bourdon tube 59 connected to the pressure duct 51. The movable end of the Bourdon tube has linked thereto at 60 the mechanism 61 of the potentiometer.

An expansion of the Bourdon tube in the direction of the arrow 4 in response to an increase in fluid pressure representing an increase in engine torque will cause an increase in the output modifying means to which the meter 12 responds with an increase in deflection of the pointer 10.

The operation of the power meter shown in Figs. 1 and 2 is as follows:

The output of the transmitter 13 is the greater the greater the engine speed. Assuming the adjusting position of the output modifying means to be fixed, the pointer 10 will respond to an increase in engine speed by an increase in the deflection of the pointer.

The deflection of the pointer is further increased or decreased depending on the engine torque in response to which the output modifying means is adjusted. The pointer is thus jointly operated by the torque and speed responsive means causing a total deflection of the pointer which becomes a measure of the engine power. The dial 11 may, accordingly, be graduated in horsepower units.

The indication is at all times a correct measure of the engine power and is evidently not affected by such operating conditions of the engine as quality of fuel, moisture or oxygen content of the combustion air, changes in pressure, timing of ignition, etc.

Obviously the present invention is not limited to the particular embodiments herein shown and described. Other forms of electrical devices for deriving or creating impulses proportional to engine speed and torque may be used. Moreover, it is not indispensable that all the features of this invention be used conjointly since they may advantageously be employed in various combinations and sub-combinations.

What is claimed is:

1. A power meter for internal combustion engines having a planetary gear including a rotatable driving, a rotatable driven, and a substantially stationary sun gear, said meter comprising, in combination, pressure fluid operated means for producing a fluid pressure which is a function of the reaction torque exterted on said sun gear; an alternating current generator driven by said engine for generating an alternating electromotive force, which is a function of the speed of the engine; a variable impedance connected parallel to said generator; an indicator responsive to changes in potential, said indicator being graduated in units of horepower; and means responsive to said fluid pressure for connecting said indicator parallel to a greater or lesser portion of said impedance in dependence on said pressure, where-

by the potential at said meter becomes a measure of the horsepower of said engine.

2. A power meter for internal combustion engines having a planetary gear including a rotatable driving, a rotatable driven, and a substantially stationary sun gear, said meter comprising, in combination, fluid pressure operated means for producing a fluid pressure which is a function of the reaction torque exerted on said sun gear, a single phase alternating current generator driven by said engine for generating an electromotive force which is a function of the engine speed, an impedance connected across the output of said generator, a slider on said impedance, a voltmeter graduated in terms of power, the terminals of said voltmeter being connected respectively to one end of said impedance and to said slider, and gear means connecting said slider and said fluid pressure operated means, whereby the potential applied to said voltmeter varies directly with the power delivered by said engine.

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