March 5, 1940. C. H. HAVILL 2,192,790

PROPELLER PITCH INDICATOR

Filed June 27, 1934

Fig. 1.

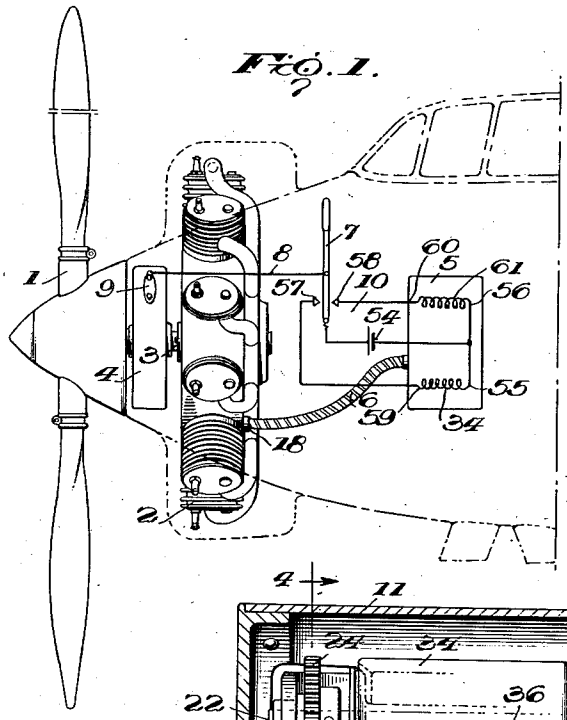


Fig. 4.

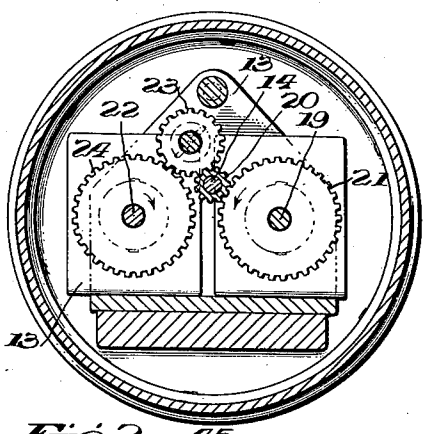


Fig. 2.

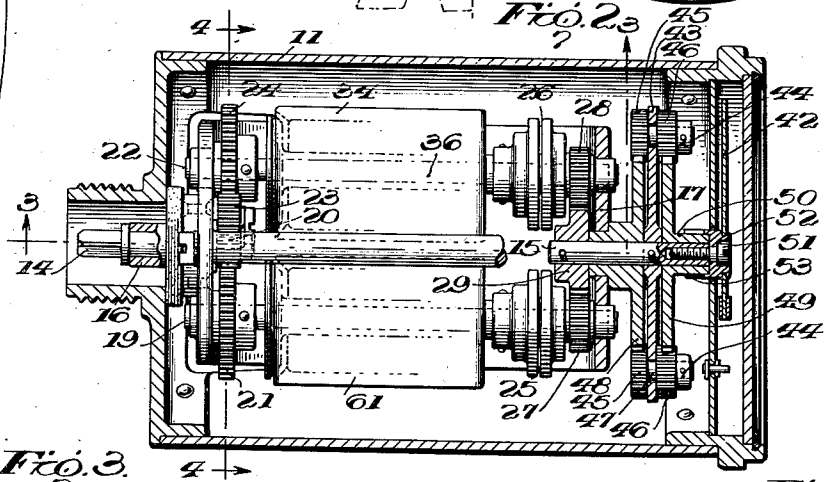


Fig. 3.

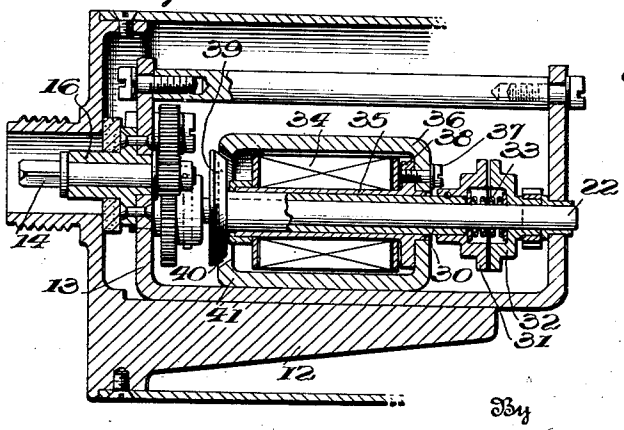
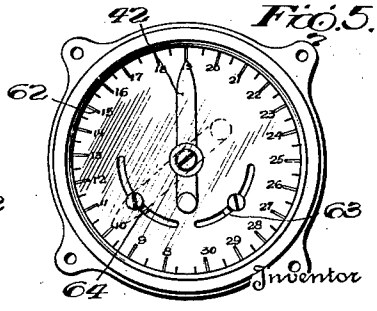


Fig. 5.



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PROPELLER PITCH INDICATOR

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3 Claims. (Cl. 170—163)

This invention relates to indicators, and more particularly to indicators of the type adapted to register the displacement of power-operated devices.

One of the objects of the present invention is to provide, in a controllably-operated power-driven device, an indicating mechanism therefor, so constituted as to be simultaneously controllably operated with the power-driven device.

Another object is to provide, in a system such as that outlined above, novel means for the simultaneous control of both the power-driven mechanism and of the indicator, so that the indicator will proportionately reproduce the motion of the power-operated device.

A further object is to provide an indicating mechanism of the above type which is especially adapted to indicate the pitch of a variable pitch propeller.

A further object is to provide a variable pitch propeller construction and an indicating mechanism therefor, in which both the pitch-changing and the indicating mechanisms are driven by separate controllable driving connections from the propeller shaft, and wherein a common control means is employed for simultaneously controlling both driving connections.

A further object is to provide, in a system such as that outlined above, novel electric control means for controlling the driving connection from the engine to the indicating mechanism.

A further object is to provide automatic calibrating means for the indicator of a system of the above character.

The above and other objects of the invention will appear more fully hereinafter from the following detailed description when taken in connection with the accompanying drawing. 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, wherein similar reference characters refer to like parts throughout the several views:

Fig. 1 is a side view of a portion of an airplane embodying the present invention;

Fig. 2 is a horizontal view, partly in section, of an indicating mechanism constructed in accordance with the invention;

Fig. 3 is a vertical section on line 3—3 of Fig. 2;

Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 2, and

Fig. 5 is a view of the dial and pointer mechanism embodied in the indicating device.

Referring more particularly to Fig. 1, the present invention is disclosed therein as being associated with a variable pitch propeller 1, suitably driven by an engine 2 through a propeller shaft 3, the latter being preferably employed to actuate any suitable pitch-changing mechanism 4 for varying the pitch of the propeller in either direction. Pitch-indicating mechanism shown diagrammatically at 5 is provided for indicating the pitch of the propeller and preferably such mechanism may be selectively drivably connected with the propeller shaft or any suitable engine driven member such as the tachometer take-off, for example, through a flexible cable 6. Preferably the mechanism 5 is drivably connected with the driving cable 6 only when the pitch-changing mechanism 4 is actuated, and to this end a control member 7 is provided which effects operation of the pitch-changing mechanism 4 in either direction through links 8 and 9 and simultaneously establishes a driving connection between the indicating device 5 and the driving cable 6 through any suitable means such as an electrical circuit 10, to be described hereinafter more in detail.

The indicating mechanism 5 as disclosed in Figs. 2 and 3 more particularly includes a casing 11, a bracket 12 secured to the rear wall of the casing, and a suitable frame 13 which is secured to the bracket and supports certain parts of the indicating mechanism. Preferably, a reversing transmission forms the first part of the indicating mechanism and includes a driving shaft 14 and a driven shaft 15 journalled respectively in bushings 16 and 17 supported by the frame. The driving shaft 14 is constantly rotated in a clockwise direction as seen in Fig. 4 at a speed proportional to the speed of the propeller shaft by any suitable means, such as the flexible cable 6 extending from the tachometer take-off 18 to the said shaft 14. The latter in turn constantly drives a countershaft 19 in a counter-clockwise direction, for example, as viewed in Fig. 4, by means of the meshing gears 20 and 21 secured respectively to the said shafts 14 and 19, the said shaft 14 also constantly driving a countershaft 22 in a clockwise direction as viewed in said figure by means of the gear 20, an idler gear 23 rotatably mounted on the frame 13, and a gear 24 mounted on the shaft 22.

Means are provided whereby the constantly-rotating countershafts 19 and 22 may selectively drive the driven shaft 15 in opposite directions.

As shown, such means comprise normally disengaged clutches 25 and 26, respectively mounted on the countershafts 19 and 22, said clutches, when engaged, respectively driving the gears 27 and 28 meshing with gear 29 carried on the driven shaft 15. When the clutches are disengaged, however, the gears 27 and 28 are freely rotatable upon their respective shafts 19 and 22. In the event that clutch 25 is engaged, the shaft 19, which rotates in a counter-clockwise direction as viewed from the left, in Fig. 2, will drive the shaft 15 in a clockwise direction by means of the gears 27 and 29. If the other clutch 26 is engaged, however, the shaft 22, which rotates clockwise, will drive the shaft 15 in a counterclockwise direction through the gears 28 and 29.

The clutches 25 and 26 are selectively engaged by any suitable means simultaneously with the actuation of the pitch-controlling member 7. As shown, such means is electrically controlled and includes a sleeve 30 splined upon the shaft 22 so as to rotate therewith and to slide freely longitudinally thereof. A driving clutch member 31 is secured to the sleeve 30, while a driven clutch member 32 is mounted for free rotation upon the shaft 22, in operative relation to the driving clutch member 31. Thrusting the sleeve 30 to the right in Fig. 3 will carry the driving clutch member 31 into engagement with the driven clutch member 32. In normal position, however, a spring 33, encircling the shaft 22, holds the clutch members 31 and 32 in disengaged position.

The electromagnetic means further comprise a solenoid 34 wound upon a stationary core 35 which encircles the revolving sleeve 30. A pole piece 36 is mounted on the frame 19 and supports the solenoid core 35 by means of a screw 37 passing through the pole piece and threaded in an ear 38 formed on the core 35. Cooperating with the pole piece 36 and solenoid 35 is an armature 39 formed coaxially with the sleeve 30 and rotating therewith. Energizing the solenoid 34 will draw the sleeve 30 to the right as seen in Fig. 3, so as to engage the driving clutch member 31 with the driven clutch member 32, such movement of the armature 39 and sleeve 30 to the right being arrested, however, by the contact of the clutch member 31 with the clutch member 32 before the air gap 40 is completely closed, this arrangement preventing the scraping of the rotating armature 39 against the stationary horns 41 of the pole piece 36. A similar solenoid mechanism 61 is provided for actuating the other clutch device.

Suitable indicating means including a pointer 42 are drivably connected with the shaft 15 through a reduction gear train which more particularly includes a planet-carrying disk 43 secured to the shaft 15 and carrying a plurality of double planet gears 44 at its periphery. Each of these last referred to planets comprises two identical gears 45 and 46 secured to a common shaft 47 which is journalled on the planet carrier 43 which separates the two gears. The gears 45 and 46 mesh respectively with a fixed gear 48 secured to the frame 13 and with a driven gear 49 coaxial with and freely rotatable upon the shaft 15, the last named gear having one more tooth than the fixed gear 48 in order that each revolution of the planet carrier 43 will advance the gear 49 by the width of one tooth. In this manner, a great speed reduction is provided between the shaft 15 and the gear 49. The gear 49 drives the pointer 42 through a hub 50.

Frictional means are provided whereby the pointer 40 is retained upon hub 50 but may be shifted angularly with respect thereto. Such means comprise a screw 51 passing loosely through the hub 52 of the pointer 42 and threaded into the shaft 15, the head of the screw lightly engaging the hub of the pointer so as to frictionally maintain the same in proper position. A plurality of fingers 53 integral with the hub 52 of the pointer grip the hub 50 and provide a yieldable frictional driving connection therewith.

Electrical interlocking means are shown in Fig. 1 which effect engagement of one or the other of the clutches 25 or 26 whenever the propeller pitch is changed. These means comprise a battery 54, one pole of which is electrically connected to the terminals 55 and 56 of the solenoid coils 34 and 61 respectively, the other pole of the battery 54 being connected to the lever 7 which is of conducting material. Contacts 57 and 58 are provided to cooperate with the lever 7 and are connected to the terminals 59 and 60 of the solenoids 34 and 61. When the lever 7 is shifted forwardly, a circuit will be completed through the contact 57, thus energizing the solenoid coil 34, and thereby causing engagement of the clutch 26. Similarly, when the lever 7 is shifted rearwardly, the solenoid coil 61 will be energized, and will cause engagement of the clutch 25.

In operation, assume for example that the pilot moves the lever 7 forwardly, engaging the pitch-changing gearing 4 to cause an increase in the propeller pitch. Simultaneously, the lever 7 will engage the contact 57, energizing the solenoid coil 34 to engage the clutch means 26 so as to cause the engine 1 to drive the indicating hand 40 clockwise as seen in Fig. 5 through the train including tachometer take-off 18, flexible shaft 6, shaft 14, gears 20 and 21, countershaft 19, clutch 26, gear 28, driven gear 29, shaft 15, reducing planetary gears 44, 48 and 49 and the collar 50 to the indicating pointer 42. Release of the lever 5 will disengage both the propeller shifting and indicating gear trains. The increase in pitch of the propeller during this operation will be proportional to the number of revolutions of the engine during the time in which the lever is held in its forward position. Also, since the gear train from the engine 1 to the indicating hand 42 is held engaged during the same time, the clockwise shift of the indicating pointer will likewise be proportional to the number of revolutions of the engine during which the lever 5 is held forward. Therefore, the angular clockwise displacement of the indicating pointer 40 will be proportional to the increase in pitch of the propeller.

Similarly, when the lever 5 is shifted rearwardly to decrease the propeller pitch, the clutch 25 is engaged so as to cause the indicating hand 40 to be driven counter-clockwise and the counter-clockwise shift of the indicating hand 40 will be proportional to the decrease in pitch of the propeller.

A suitable scale 62 is provided for the pointer 42, such scale being shown in Fig. 5, and being calibrated in degrees of propeller pitch. Thus, whenever the pitch of the propeller is increased or decreased by a certain number of degrees, the reading of the indicator is correspondingly increased or decreased. Obviously, if the pointer is once set so as to indicate the actual pitch of the propeller, it will thereafter contnue to indicate the pitch of the propeller.

Discrepancies between the control of the pitch-

changing and indicating mechanisms may in time cause an error in the indication. Accordingly, a correction is periodically applied to the indicator, as will now be explained.

As is common in pitch-changing devices, automatic means are provided in the pitch-changing mechanism 4 for arresting the change of pitch whenever the pitch has attained a predetermined maximum or minimum. Such means may operate independently of the lever 7, that is if the lever 7 is held in its forward position, the pitch of the propeller 1 will first increase to a certain maximum value, after which it will remain at that value even though the lever 7 is not released. Similarly, holding the lever 7 in its rearward position will cause the pitch to decrease to, but not below, the minimum value.

In a manner corresponding to the above described action of the pitch-changing mechanism 4, the pointer 42 cannot shift above or below a certain range, even though the lever 7 is held in a forward or rearward position. This is accomplished by providing a pair of adjustable stops 63 and 64 placed to arrest the pointer 42 at the points on the scale indicating respectively the maximum and minimum possible values of propeller pitch. If the lever 7 is continuously held in its forward position, the pointer 42 will rotate into contact with the stop 63, which will prevent further clockwise rotation of the pointer 40. The yieldable frictional connection 53 between the indicating pointer 42 and the collar 50 permits the indicator gearing to continue rotation without injury to the pointer. Similarly, holding the lever 7 in its rearward position will decrease the reading of the indicator to, but not below, the value of the minimum possible pitch angle of the propeller.

The above described characteristics of the pitch-changing and indicating means produce an automatic calibration of the pitch-indicating means 5 whenever the pilot causes the propeller-pitch to assume its maximum value. For instance, if the pilot shifts the lever 7 forwardly and does not release it until he is sure that both the propeller pitch and the indication of the pointer 42 have reached their corresponding maximum values, the indicating hand 42 has been automatically reset to the correct value of the propeller-pitch angle; that is, the propeller-pitch is at its maximum value, and the pitch indicator indicates such maximum value. A similar resetting action will obviously occur when the pilot holds the lever 7 in its rearward position so as to decrease both the pitch of the propeller and the reading of the indicating pointer to their corresponding minimum values.

While there has been shown and described only one embodiment of the invention, it is to be understood that the same is not limited thereto but may be embodied in various mechanical forms. It is also to be understood that various changes may be made in the relative sizes, shapes and relative location of the parts without departing from the spirit of the invention, as well understood by those skilled in the art. Reference will therefore be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In combination, a variable pitch propeller, a propeller shaft, means for changing the pitch of the propeller, a controlling means for the pitch-changing means for increasing or decreasing the pitch of the propeller, and a pitch indicator comprising an indicating member, two driving connections from the propeller shaft to said indicating member, one of said driving connections tending to drive the indicating member in one direction and the other of said driving connections tending to drive the indicating member in the opposite direction, a clutch included in each of said driving connections, and electrical means governed by said controlling means for engaging one of said clutches when the pitch of the propeller is being increased and for engaging the other of said clutches when the pitch of the propeller is being decreased.

2. In combination, a variable pitch propeller, a propeller shaft, shaft-operated means for changing the pitch of the propeller in reverse directions, a pitch indicator comprising an indicating member, and means for connecting the propeller shaft and member comprising a pinion operatively connected with the propeller shaft and rotated thereby, a pair of gears operatively connected with said pinion and rotated in opposite directions, a shaft carrying each gear of said pair of gears, speed reduction gearing connected with said member and including a pair of clutch members, a sleeve surrounding each shaft and mounted thereon so as to be axially movable thereof but rotatable therewith, clutch members carried by the sleeves and adapted to respectively frictionally engage and drive said first named clutch members, electromagnetic means for selectively moving either of said sleeves axially of the respective shafts to move the clutch member carried by the sleeve into frictional driving engagement with the corresponding one of the first named clutch members, and common means for controlling said first means and said electromagnetic means.

3. In combination, a variable pitch propeller, a propeller shaft, shaft-operated means for changing the pitch of the propeller in reverse directions, a pitch indicator comprising an indicating member, and means for connecting the propeller shaft and member comprising a pinion operatively connected with the propeller shaft and rotated thereby, a pair of gears operatively connected with said pinion and rotated in opposite directions, a shaft carrying each gear of said pair of gears, a clutch member drivably connected with each shaft, speed reduction gearing connected with said indicating member and including a pair of driven clutch members mounted for cooperation with the first named clutch members, electrically operated means for selectively moving either of said first named clutch members into frictional driving engagement with the corresponding driven clutch member, and common means for controlling said first means and said electrically operated means.

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