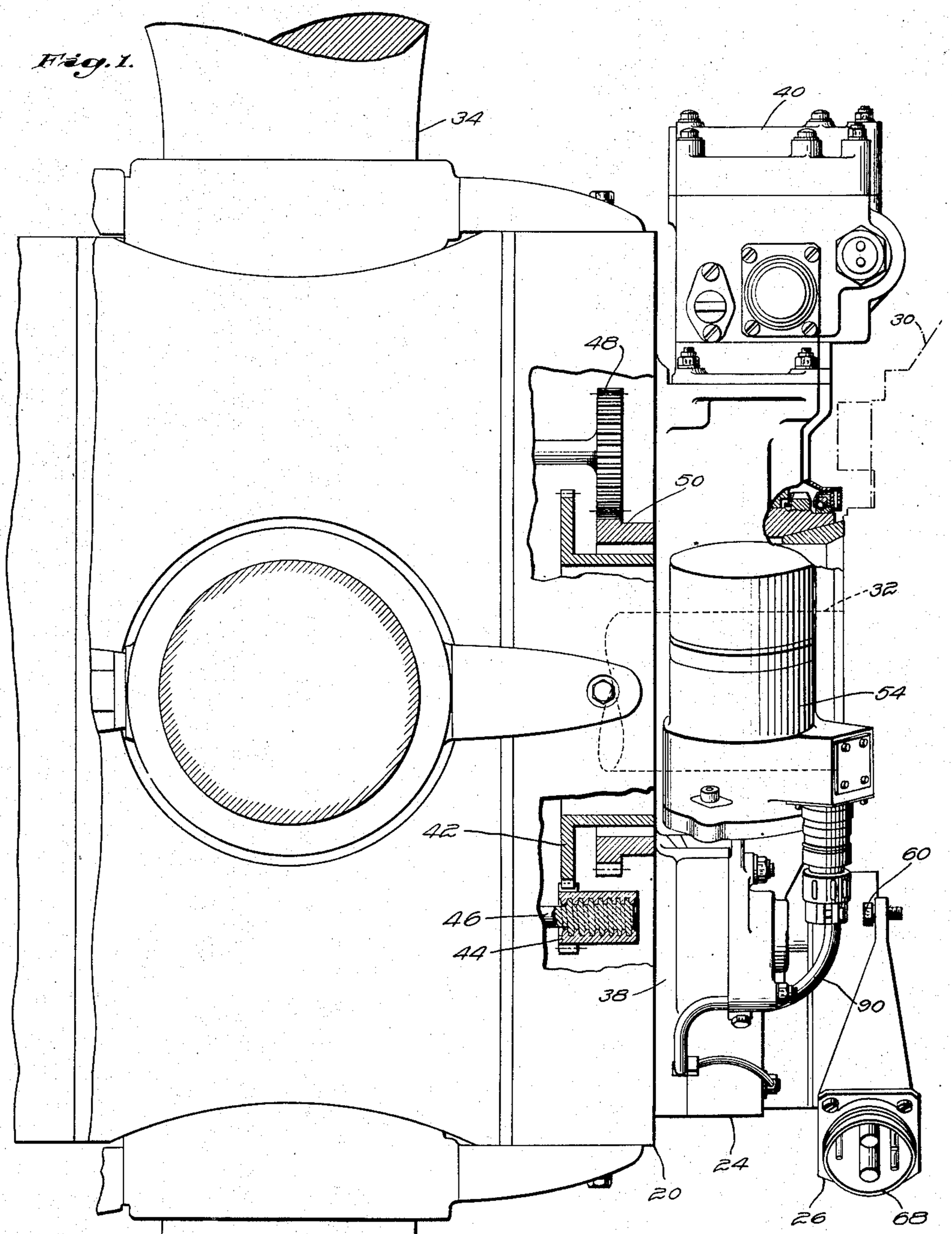
Feb. 17, 1953 E. W. RADTKE ET AL 2,628,794

PROPELLER ELECTRICAL CONNECTOR SYSTEM

Filed May 26, 1950 6 Sheets-Sheet 1

Fig. 1.

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Filed May 26, 1950 6 Sheets-Sheet 2

Fig. 2.

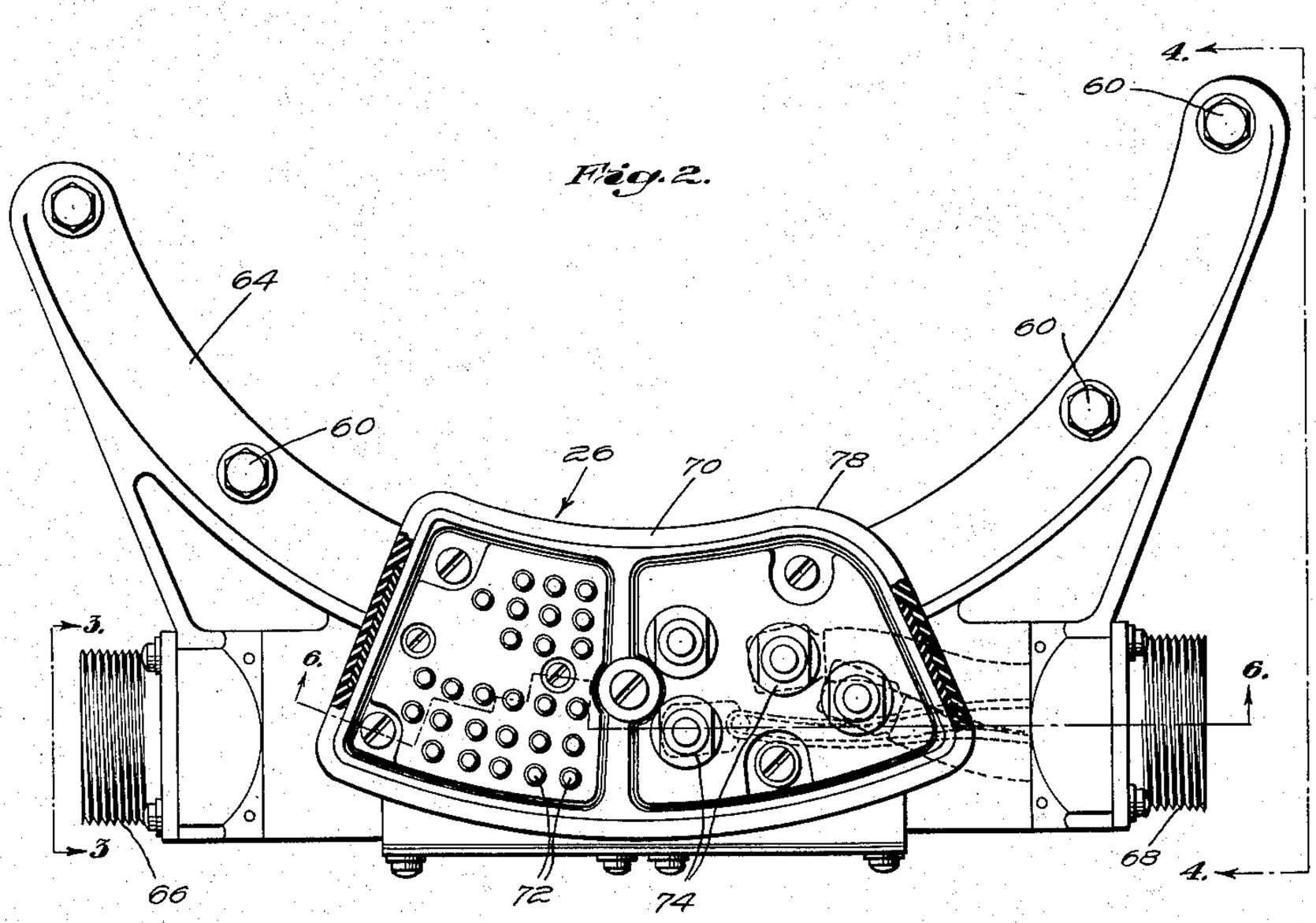



Fig. 3.

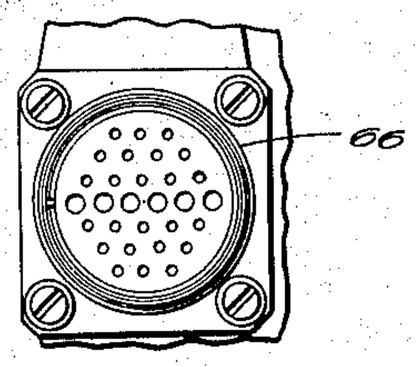
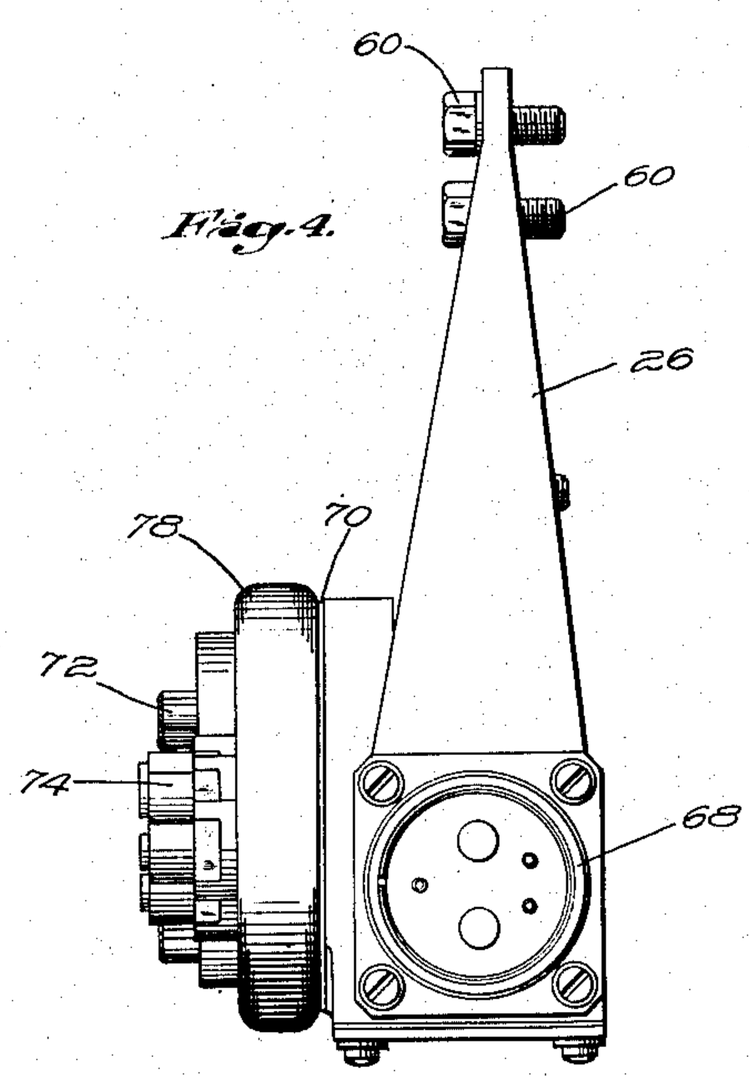



Fig. 4.

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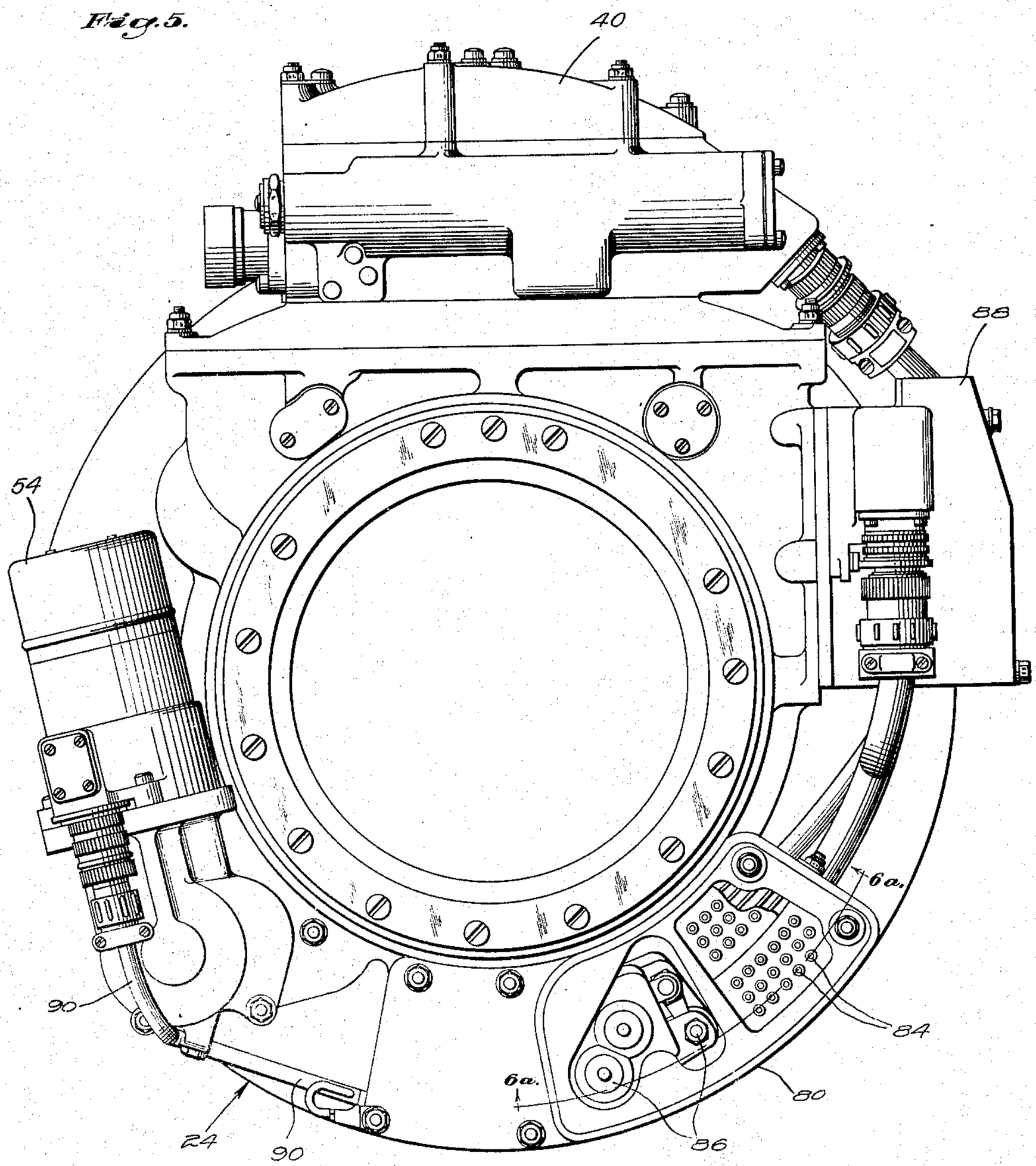
PROPELLER ELECTRICAL CONNECTOR SYSTEM

Filed May 26, 1950 6 Sheets-Sheet 3

Fig. 5.

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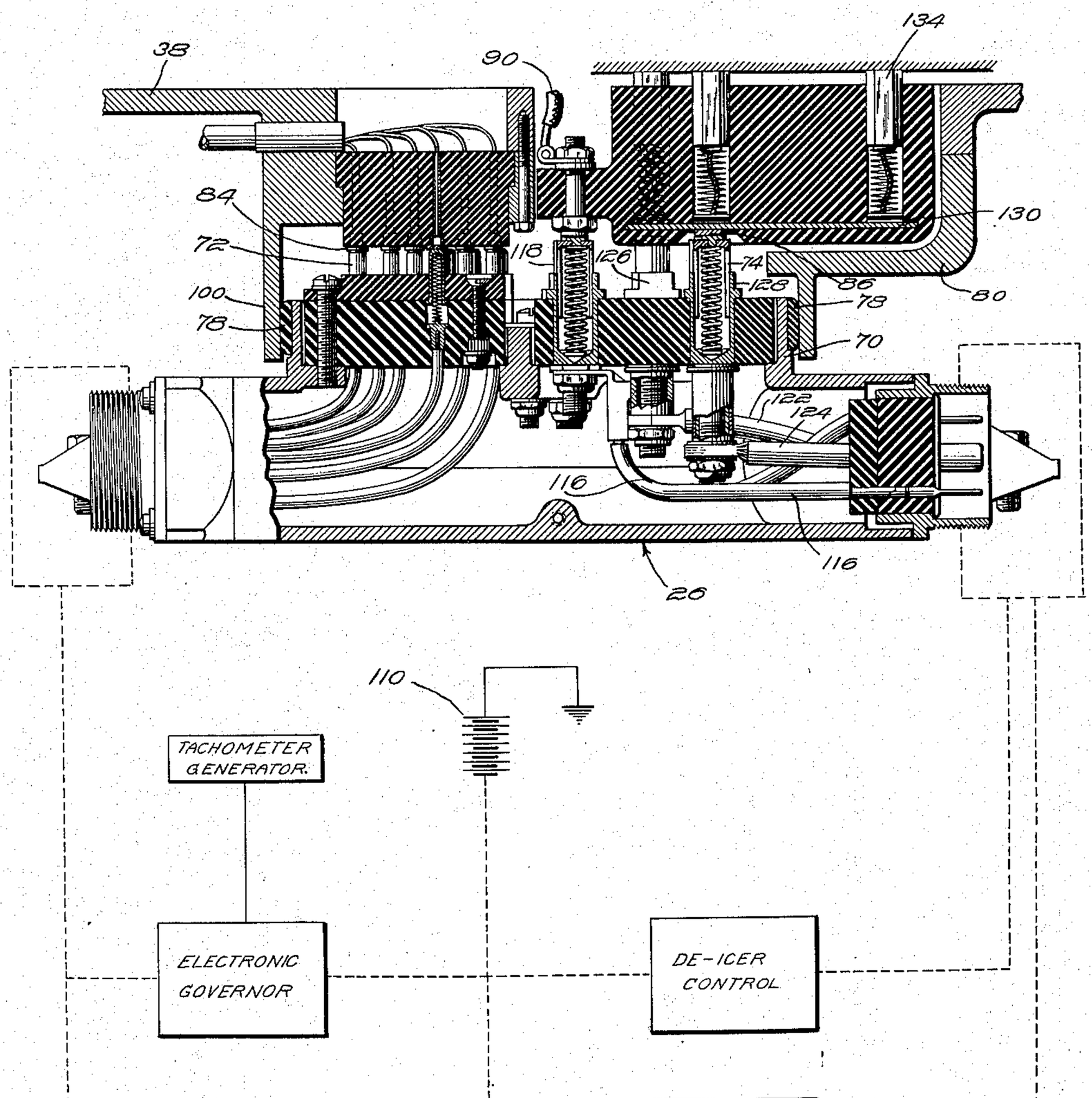
PROPELLER ELECTRICAL CONNECTOR SYSTEM

Filed May 26, 1950 6 Sheets-Sheet 4

*Fig. 6.*

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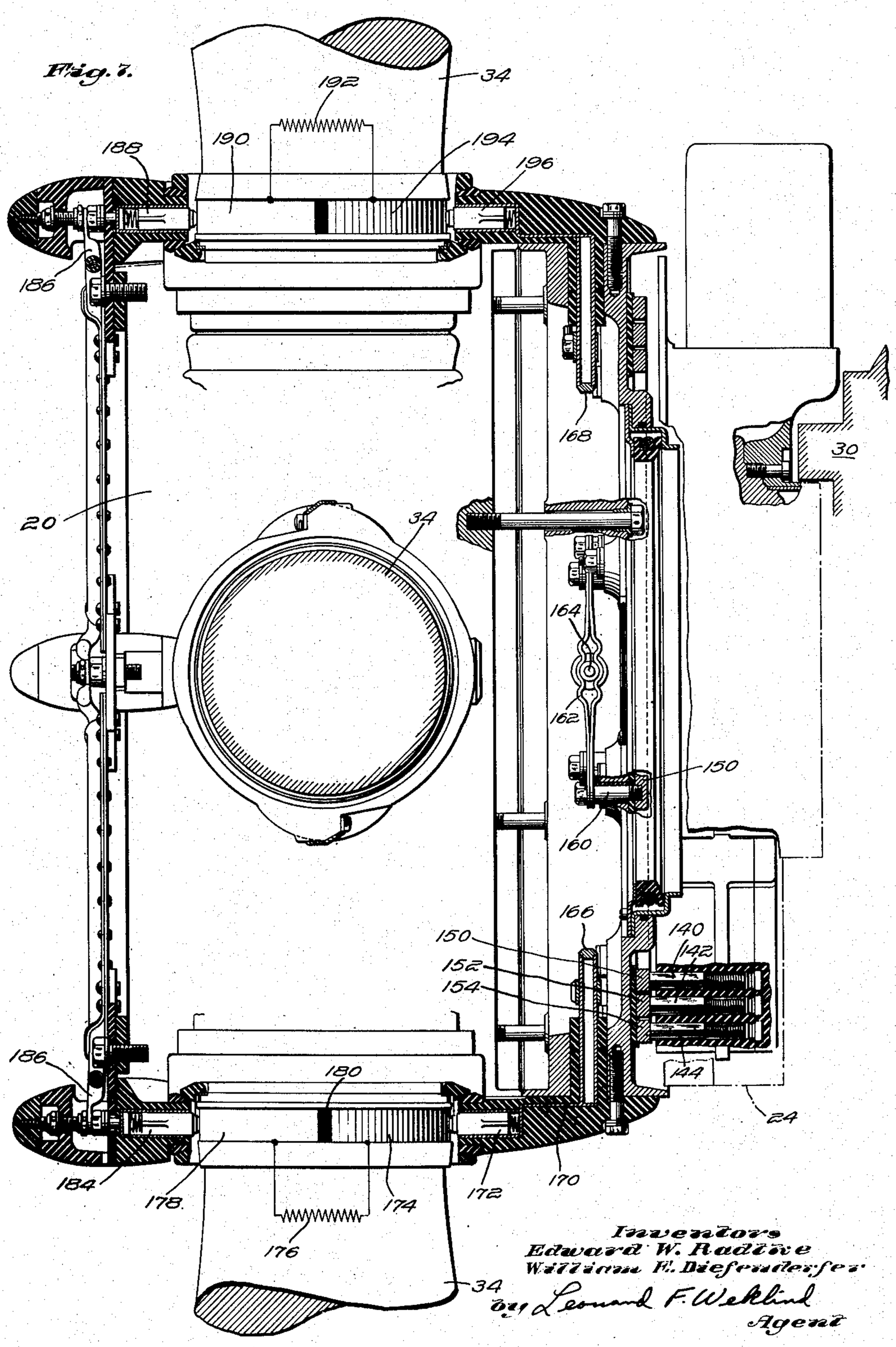
PROPELLER ELECTRICAL CONNECTOR SYSTEM

Filed May 26, 1950 6 Sheets-Sheet 5

Fig. 7.

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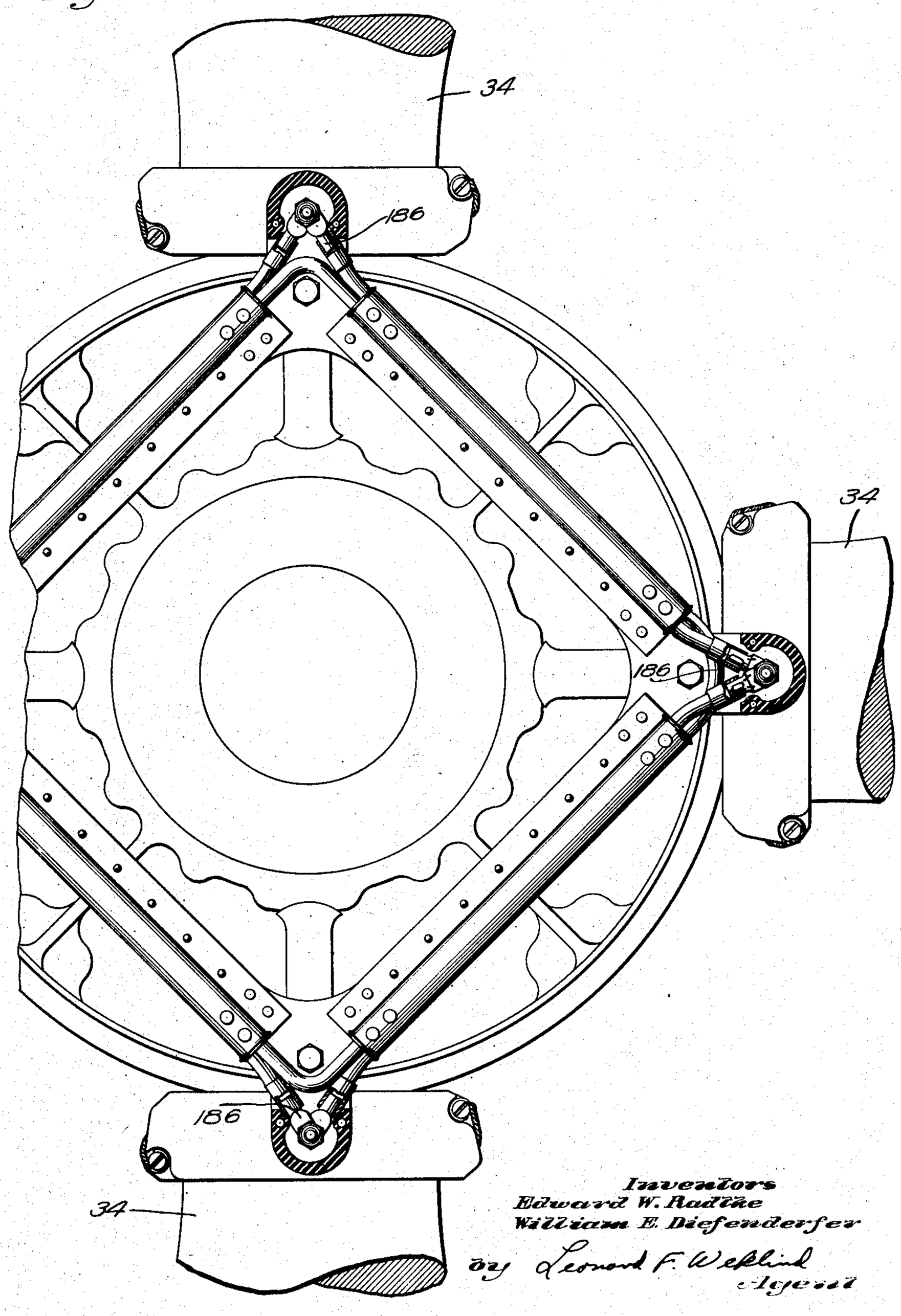
PROPELLER ELECTRICAL CONNECTOR SYSTEM

Filed May 26, 1950 6 Sheets-Sheet 6

*Fig. 8.*

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# UNITED STATES PATENT OFFICE

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## PROPELLER ELECTRICAL CONNECTOR SYSTEM

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Application May 26, 1950, Serial No. 164,412

8 Claims. (Cl. 244—134)

1

This invention relates to aircraft propellers and more particularly to improvements in variable pitch propeller installations.

It is an object of this invention to provide a propeller assembly having improved electrical connector mechanism for transmitting power from fixed structure to the rotating propeller.

Another object of this invention is to provide an electrical connector mechanism of the type described including stop means for holding a control housing stationary relative to the propeller upon assembly of the propeller on the engine drive shaft, the control housing having elements thereof operatively connected to the rotatable propeller portion.

A further object of this invention is to provide a propeller installation comprising a hub unit, a control unit operatively connected thereto and mechanism for transmitting electrical power from the engine to the control and hub units including stop means for fixing the control unit against rotation upon assembly of the propeller on the engine drive shaft.

Another object of this invention is to provide an improved propeller mechanism which can be installed with great facility without the necessity of making numerous manual connections for the electrical circuits or control unit stop. This is particularly advantageous in propellers having enclosing spinners.

These and other objects will become readily apparent from the following detail description of the drawings in which:

Fig. 1 is a side elevation of the propeller in mounted position.

Fig. 2 is an enlarged view in partial cross-section illustrating the electrical connector or adaptor of this invention.

Figs. 3 and 4 are opposing side views taken along the lines 3—3 and 4—4, respectively, of Fig. 2.

Fig. 5 is an illustration of the inboard side of the propeller control unit, i. e., a view looking outboard from the engine nose.

Fig. 6 is a schematic and cross-sectional illustration of the electrical connecting system with the cross-section portion of the figure being a composite of cross-sections taken along the lines 6—6 of Fig. 2 and 6*a*—6*a* of Fig. 5. This figure illustrates the assembled position of the electrical connecting mechanism.

Fig. 7 is a partial cross-section similar to Fig. 1 illustrating the hub carried electrical connections including a schematic showing of the blade deicing elements.

2

Fig. 8 is a partial view of the outboard or nose end of the propeller.

Referring to Fig. 1, a propeller assembly is shown comprising a hub 20, a control unit 24 and an electrical adaptor 26 with the entire assembly being mounted in position on an engine 30 illustrated partially in phantom which engine by means of its shaft 32 drives the hub portion 20 of the propeller.

The hub 20 carries a plurality of blades 34 mounted for pitch changing movement relative thereto. The pitch of the blades 34 may be varied by any number of well-known means as for example by hydraulic pitch changing motors carried within the base of each of the blades.

The control unit 24 comprises a housing 38 which both carries and encloses various pitch control mechanisms which for purposes of this description need not be dealt with in detail. It will suffice, however, to indicate that a speed responsive servo unit 40 imparts controlling movements to a gear train mechanism within the housing which results in controlled rotation of the gear 42 and a worm drive nut 44 carried within the hub 20. The drive nut 44 in turn imparts reciprocating motion to an element 46 which controls a distributor valve (omitted for convenience) for directing fluid under pressure to the pitch changing motors to accordingly vary the pitch of the blades 34. The fluid under pressure may be provided by one or more pumps carried by the hub 20 and driven via a gear 48 by a pump drive gear 50 extending within the hub and having an operative connection to the control unit 24. The pump drive gear 50 normally remains stationary so that the hub carried pumps are normally driven as a result of propeller rotation. An auxiliary motor 54 carried by the control unit is operatively connected to the pump drive gear 50 so that the hub carried pumps may be driven when the propeller is stationary by rotating the normally stationary gear 50. The entire control unit mechanism and the pitch changing mechanism carried by the hub are described in detail in co-pending patent Application Serial No. 159,736, filed May 3, 1950, by Melvin E. Longfellow.

In order to provide electrical power for the various electrically responsive units which have

been described and are to be described, the adaptor 26 is provided and is fixed to the engine 30 by means of bolts 60. As seen in Figs. 2, 3 and 4, the adaptor 26 comprises a semi-circular bracket 64 which supports the adaptor on the nose of the engine and carries threaded type electrical couplings 66 and 68 which are adapted to receive cooperating couplings leading to conduits carried by the engine and fixed aircraft structure. The adaptor 26 further includes an extending portion 70 which protrudes in an outboard direction toward the propeller and is composed of a plurality of spring loaded contact plungers 72 and 74 which are adapted to engage cooperating contact points carried by the control unit 24. The extending portion 70 forms a wall which surrounds the contacts 72 and 74 and has fixed thereto a resilient seal 78 adapted to engage a cooperating cup-like extension 80 (Fig. 5) which protrudes in an aft direction from the rear side of the control unit 24.

Referring to Fig. 5, the control unit 24 carries a plurality of contact points 84 and 86 which cooperate with the contact plungers 72 and 74, respectively, carried by the adaptor 26. The contacts 84 conduct electricity to the various electrical elements of the servo control unit 40 and a pitch limit switch unit 88 as well as a reversing solenoid (not shown). The servo control unit includes a controlling proportional solenoid (not shown) which responds to a signal from the propeller governor. The detail electrical system for these various units is described in the above-mentioned co-pending patent application. At least one of the contacts 86 provides an electric connection by means of a conduit 90 to the auxiliary motor 54.

The extending portion 70 of the adaptor 26 and the cooperating cup-like portion 80 carried by the control unit 24 are more clearly illustrated in their assembled position by referring to Fig. 6. As herein illustrated, it can be seen that the extending portion 70 protrudes within the confines of the wall 100 of the cup-like portion 80 so that the contact plungers 72 engage the contacts 84 and the plungers 74 engage the contacts 86 while at the same time the seal 78 engages the wall 100 to prevent moisture or dirt from entering and accumulating on the electrical contacts.

The particular leads from the aircraft to the adaptor 26 are illustrated schematically in Fig. 6 so that detail description thereof is not necessary.

It is apparent that the extending portion 70 on the adaptor 26 forms a male stop which cooperates with the wall 100 so as to position the control unit casing while also serving to hold the latter against rotation when the hub is driven by the engine. As a result upon installing the hub and control unit combination on the engine drive shaft the necessary electrical connections are automatically engaged while the control unit housing is simultaneously positioned and held against rotation since the latter is freely mounted relative to the drive shaft 32. However, it will be noted that a source of power or battery 110 is provided which has electrical connections to the electronic governor, the manual pitch controls, deicer control and auxiliary motor control each of which are carried by fixed aircraft structure. The tachometer generator is driven by the engine and feeds a variable voltage to the governor consistent with engine speed so that in turn the electronic governor passes a governing signal to the previously mentioned proportional solenoid and servo control 40 (carried by the control unit 24) via the electrical connections through the adaptor 26 and to the control housing 38.



Similarly, the auxiliary motor control can furnish electrical power via the line 116 to the contact plunger 118 and eventually to the conduit 90 (better seen in Fig. 5). The deicer control in turn provides electrical power via leads 122 and 124 to contact plungers 126 and 128 each of which are connected to a bus bar 130. For purposes to be described hereinafter, two bus bars are utilized for transmitting power to a plurality of brushes 134, groups of which contact slip rings carried by the propeller hub 20. Each slip ring has a number of brushes contacting it so that a high current load can be passed to the slip ring without necessarily utilizing a prohibitively large single brush.

The deicing power brushes 134 are better seen in Fig. 7 and for convenience are referred to as brushes 140, 142 and 144. As previously described, the control unit 24 is held stationary hence the brushes 140, 142 and 144 will also be stationary relative to the hub 20. Thus, slip rings 150, 152 and 154 are carried by the rotatable hub to conduct the current from the brushes 140, 142 and 144. The reason three brushes are utilized herein is that one of the brushes acts as a common ground return back to fixed aircraft structure while each of the other two brushes provides current for the deicing elements of two of the blades of the four-blade construction illustrated. The deicing elements of two blades only are energized at any one time in an intermittent manner so that the load on the aircraft electrical system will not be excessive at any one time. Each of the slip rings, taking for example the slip ring 150, has a bolt type electrical connection 160 to a spring type jumper 162 which engages one of the posts 164, 166 or 168. Assuming for the time being that current is being supplied to the post 166, current will flow via the line 170 to the brush 172 into the semi-circular slip ring 174 from which current is fed to the deicer element 176 and back again to a cooperating semi-circular slip ring 178. The semi-circular slip rings 174 and 178 form a cooperating pair separated by insulation 180 so that they surround the shank of the propeller blade 34. Current is subsequently fed from the slip ring 178 to the brush 184 and to a lead 186 which, as better seen in Fig. 8 connects with the opposite blade and permits current to flow to a brush 188 (Fig. 7), slip ring 190 and the deicing element 192 carried by such opposite blade. Current will then flow to the slip ring portion 194, through the brush 196 and back to the post 168 which will return the current to the common ground. It will be noted that the electrical path just described comprises a series connection between the deicing elements of opposite blades which insures simultaneous deicing of such blades to prevent any blade unbalance. Thus, if a deicing element of any one blade should become inoperative, current will be cut off automatically to the deicing element of the opposite blade.

It will be apparent that as a result of this invention a simple yet positive means of providing electrical connection for propellers is provided whereby the entire propeller and its control unit may be assembled separately and upon installation of the propeller on the engine all the necessary electrical connections will be automatically engaged while also the control unit will be positioned and held stationary during subsequent propeller operation.

Although only one embodiment of this invention has been illustrated and described herein, it will be apparent that various changes and modifications may be made in the construction and arrangement of the various parts without departing from the scope of this novel concept.

What it is desired to obtain by Letters Patent is:

1. In an aircraft, an engine including a propeller shaft, a source of electrical power fixed relative to said engine, an adaptor fixed to said engine adjacent said shaft including a plurality of electrical contacts operatively connected to said source of power, an abutment carried by said adaptor, a propeller assembly comprising a rotatable hub driven by said shaft and a control unit operatively connected thereto, said control unit comprising, a housing movable relative to said hub, and a stop carried by said housing, electrically responsive elements carried by said propeller assembly, and a plurality of members engageable with said contacts upon assembly of said propeller assembly on said shaft whereby said stop engages said abutment to fix said housing relative to said engine.

2. In an aircraft, the combination of, an engine including a propeller shaft, a source of electrical power including electrical connectors leading therefrom, an adaptor fixed relative to said engine having an operative engagement with said connectors including a plurality of electrical contacts, abutment means carried by said adaptor, a propeller control unit freely mounted relative to said shaft adapted to receive said electrical contacts including stop means cooperating with said abutment means whereby said control unit is held stationary during propeller rotation, multiple electrical elements carried by said control unit, a propeller hub mounted on said shaft and having a plurality of variable pitch blades carried thereby including electrically responsive elements, and means carried by said hub operatively engaging said electrical elements when said hub is in its assembled position on said shaft.

3. In a combination according to claim 2 wherein said electrically responsive elements include deicing means carried by said blades and having a continuous electrical connection with the engaging means carried by said hub.

4. In a combination according to claim 3 wherein the electrical connection between said blade deicing means and said hub comprises a brush and slip ring combination, and the engaging means carried by said hub comprises slip ring mechanism engageable with said multiple electrical elements.

5. In an aircraft, the combination of, an engine for the aircraft including a propeller shaft, a source of electrical power carried by the aircraft including connections to said engine, a propeller assembly having a control unit forming an operative part thereof and including electrically operated control mechanism carried thereby, stop means carried by said control unit for holding said unit stationary relative to the engine when the propeller is rotating, a removable electrical connector unit adapted to be fixed to the engine, multiple electrical connector means carried by said connector unit, and cooperating electrical connector means carried by said propeller control unit and adapted to receive said multiple connector means when the propeller is assembled on the engine shaft thereby providing a through connection between said propeller carried control unit and said electrical supply source, said removable connector unit including cooperating



abutment means thereon engaging said stop means for positioning said control unit with respect to said engine upon assembly of said propeller on said shaft.

6. In an aircraft comprising an engine and a propeller drive shaft, a source of power including operative connections to said engine, manual control means fixed relative to said engine, a removable electrical adaptor fixed relative to the engine having operative connections to said source of power and said control means including, a stop and a plurality of electrical conductors, a control unit surrounding said drive shaft and having abutment means cooperating with said stop whereby said control unit is fixed against rotation relative to the power plant, said unit comprising electrically operated units, electrical conduits and means for interconnecting said conduits with said electrical conductors upon assembly of said control unit over said shaft and adjacent said engine, a rotatable hub adapted to be mounted on said shaft including electrical mechanism carried thereby, and electrical transfer means carried by said hub and operatively engageable with said electrical conduits thereby providing an electrical path to said rotatable hub.

7. In an aircraft, an engine including a propeller shaft, a propeller adapted to be driven by said shaft comprising, a hub surrounding said shaft and having variable pitch blades carried thereby, and a control unit inboard of said hub and having operative connections to said hub, said control unit including an annular casing surrounding said shaft and adapted to be rotatable relative to said hub, electrically responsive elements carried by said hub, means providing an electrical path from said unit to said hub comprising cooperating slip rings and brushes, a source of power fixed relative to said engine, an adaptor fixed relative to said engine comprising operative connections to said source of power, a plurality of spring loaded electrical contacts, and a flange depending from said adaptor in an outboard direction and surrounding said contacts, electrical means carried by said unit engageable with said contacts, a cup-shaped stop carried by said unit and surrounding said electrical means, said cup-shaped stop protruding axially of said shaft in an inboard direction whereby said stop engages said flange and said electrical means engages said contacts upon assembly of said propeller on said shaft.

8. In an aircraft, an engine including a propeller shaft, a source of power fixed relative to said engine, an adapter fixed to said engine adjacent said shaft including connectors operatively connected to said source of power, an abutment fixed relative to said adapter, a propeller assembly comprising a rotatable hub driven by said shaft and a control unit operatively connected thereto, said control unit comprising, a housing movable relative to said hub, and a stop carried by said housing, power responsive elements carried by said propeller assembly, and means engageable with said connectors upon assembly of said propeller assembly on said shaft whereby said stop engages said abutment to fix said housing relative to said engine and operatively connect said power responsive elements to said source.

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WILLIAM E. DIEFENDERFER.

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