HANDBOOK OF INSTRUCTIONS WITH PARTS CATALOG

CONSTANT SPEED PROPELLER GOVERNORS AND CONTROLS FOR COUNTERWEIGHT PROPELLERS

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

MARSHALL-WHITE, CHICAGO
DECEMBER, 1944 – 20,100

20 DECEMBER 1944

THIS PUBLICATION MAY BE USED BY PERSONNEL RENDERING SERVICE TO THE UNITED STATES OR ITS ALLIES

Instructions Applicable to AAF Personnel.

Paragraph 5.*d.* of Army Regulation 380-5 relative to the handling of restricted printed matter is quoted below:

"*d.* Dissemination of restricted matter.—The information contained in restricted documents and the essential characteristics of restricted material may be given to *any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work,* but will not be communicated to the public or to the press except by authorized military public relations agencies."

Instructions Applicable to Navy Personnel.

Navy Regulations, Article 75½, contains the following paragraphs relating to the handling of restricted matter:

"*(b) Restricted* matter may be disclosed to persons of discretion in the Government service when it appears to be in the public interest.

"*(c) Restricted* matter may be disclosed, under special circumstances, to persons not in the Government service when it appears to be in the public interest."

The Bureau of Aeronautics Circular Letter No. 12-43 further states:

"Therefore, it is requested that all naval activities check their own local regulations and procedures to make sure that handbooks, service instructions and other *restricted* technical publications are actually being made available to both civilian and enlisted personnel who have use for them."

General.

These instructions permit the issue of restricted publications to civilian contract and other accredited schools engaged in training personnel for Government work, to civilian concerns contracting for overhaul and repair of aircraft or aircraft accessories, and to similar commercial organizations.

LIST OF REVISED PAGES ISSUED

NOTE: A heavy black vertical line, to the left of the text on revised pages, indicates the extent of the revision. This line is omitted where more than 50 percent of the page is revised.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

AAF ACTIVITIES.—Submit requisitions through the Air Inspector, Technical, whenever practicable, in accordance with T. O. No. 00-25-3 to the Commanding General, Fairfield Air Service Command, Patterson Field, Ohio. Attn: Publications Distribution Branch, as outlined in AAF Regulation 5-9. For details of Technical Order distribution, see T. O. No. 00-25-3.

NAVY ACTIVITIES.—Submit requests to the Chief, Bureau of Aeronautics, Navy Department, Washington, D. C. Also, see NavAer 00-500 for details on distribution of technical publications.

BRITISH ACTIVITIES.—Submit requirements on Form 294A, in duplicate, to the Air Publications and Forms Store, New College, Leadhall Lane, Harrogate, Yorkshire, England.

TABLE OF CONTENTS

SECTION I
INTRODUCTION

1. This handbook contains the basic technical instructions for the equipment involved.

2. It includes a detailed description of parts, installation and removal procedure, a description of operation, service instructions, and overhaul instructions for Constant Speed Controls used with Hamilton Standard Counterweight type propellers. Throughout this handbook the terms "Constant Speed Control" and "Governor" will be used interchangeably to describe the same unit. "Governor Control" and "Propeller Control" are the same, and a governor used with a Counterweight type propeller is the same as a Counterweight governor. These variations in nomenclature are mentioned because they are in current use by Field personnel.

3. The governors involved are manufactured by the Woodward Governor Company under license agreement with United Aircraft Corporation.

SECTION II
DESCRIPTION

1. GENERAL DESCRIPTION.

a. GENERAL.

(1) The constant speed control used with the Hamilton Standard Counterweight type propeller is a self-contained governor which automatically directs the adjustment of propeller blade angle necessary to maintain a constant engine speed under varying flight conditions. It is limited in doing this only by the blade angle range available in the propeller. Its several designs permit mounting on the engine nose pad, the gun synchronizer pad, or the rear auxiliary pad used on certain engines.

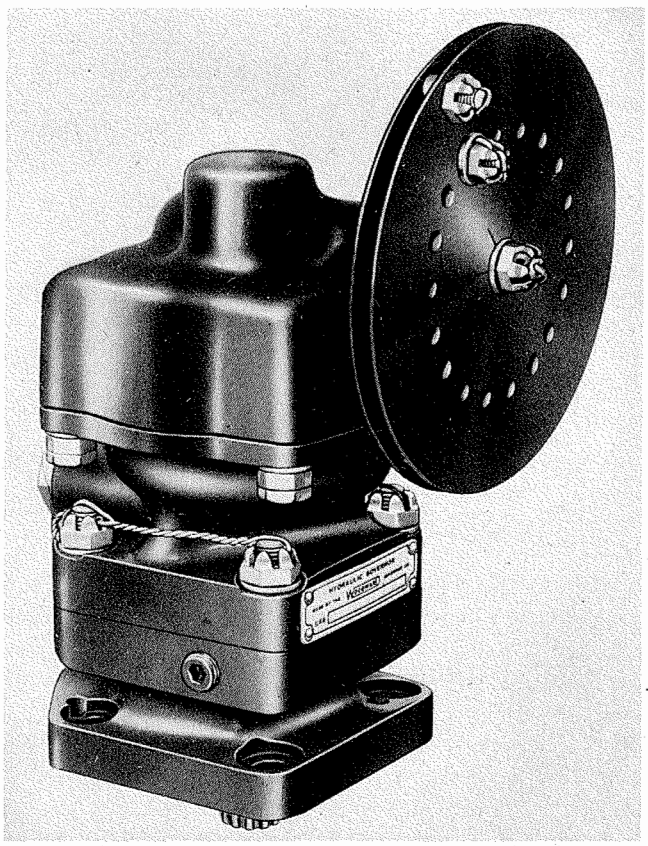


Figure 1—Front View of Single Capacity Governor

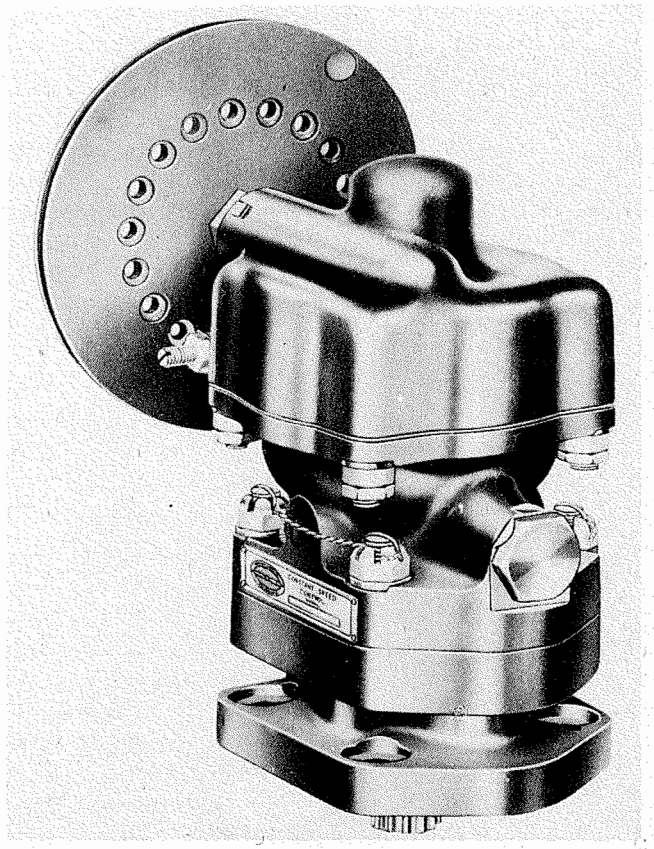


Figure 2—Rear View of Single Capacity Governor

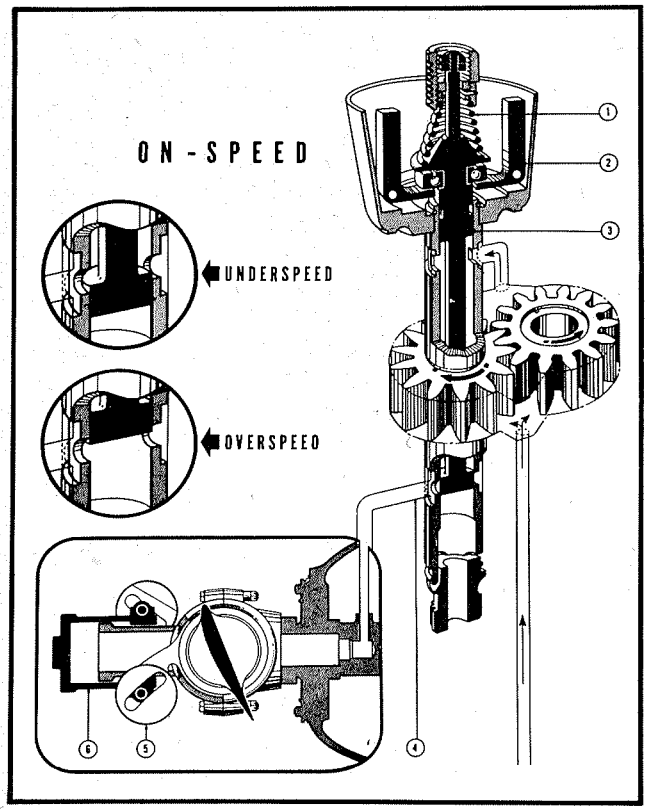


Figure 3—Basic Operating Diagram

1 SPEEDER SPRING
2 FLY-WEIGHT
3 PILOT VALVE
4 PROPELLER-GOVERNOR LINE
5 PROPELLER COUNTERWEIGHT
6 PROPELLER CYLINDER

(2) A governor consists of: a gear type pump which boosts oil from the engine lubricating system to the pressure required to operate the propeller pitch changing mechanism; a pilot valve actuated by spring balanced fly-weights which controls the flow of oil to and from the propeller; a relief valve system which limits the output pressure of the gear pump; and a pulley arrangement which regulates the compression of the spring.

b. BASIC OPERATING PRINCIPLES.

(1) In order to understand better the operation of the Counterweight governor, it is advantageous to understand the basic operating principles of the Counterweight propeller. The Counterweight type propeller changes pitch by the use of two forces: an inherent twisting moment toward high pitch due to the action of centrifugal force on counterweights fastened by rigid brackets to the blades, and an opposing and controlling twisting moment acting also on the counterweight brackets applied by a hydraulic piston-cylinder arrangement. This piston-cylinder mechanism is so designed that, when oil is forced into the piston chamber, the cylinder moves outward on the piston (which is screwed onto the propeller shaft) and, by use of a sliding cam arrangement in the counterweight brackets, turns the blades toward a lower pitch. The oil used to move the cylinder is metered to the propeller by the constant speed control. Operation is completely described in section IV.

(2) If the engine speed drops below the rpm for which the governor is set (see figure 3), the rotational force on the engine driven governor fly-weights (*2*) becomes less. This allows the speeder spring (*1*) to move the pilot valve (*3*) downward. With the pilot valve in the downward position, oil from the gear type pump flows through passage (*4*) to the propeller and moves the cylinder (*6*) outward. This, in turn, decreases the blade angle and permits the engine to return to the on-speed setting. If the engine speed increases above the rpm for which the governor is set, the fly-weights (*2*) move against the force of the speeder spring (*1*) and raise the pilot valve (*3*). This permits the oil in the propeller to drain out through the governor drive shaft. As the oil leaves the propeller, the centrifugal force acting on the counterweights (*5*) turns the blades to a higher angle, which decreases the engine rpm. When the engine is exactly at the rpm set by the governor, the centrifugal reaction of the fly-weights (*2*) balances the force of the speeder spring, positioning the pilot valve (*3*) so that oil is neither supplied to nor drained from the propeller. With this condition, propeller blade angle does not change. Note that the rpm setting is made by varying the amount of compression in the speeder spring. Positioning of the speeder rack is the only action controlled manually, all others being controlled automatically within the governor.

c. TYPICAL APPLICATIONS.

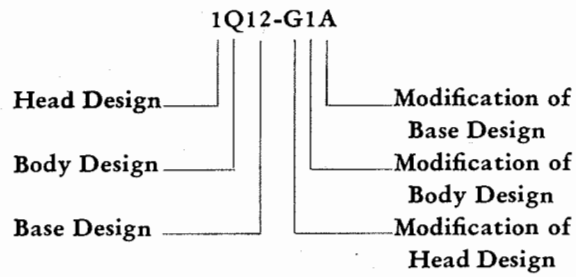
(1) SINGLE CAPACITY.—The single capacity type constant speed control for Counterweight type propellers is used on aircraft requiring an average rate of propeller response. A typical installation would be the trainer aircraft currently used by the military.

(2) DOUBLE CAPACITY.—The double capacity type was developed to meet the higher rate of pitch change found desirable in certain more highly maneuverable military aircraft.

d. MODEL DESIGNATION SYSTEM.

(1) The Hamilton Standard Propellers model designation system for Constant Speed Controls is arranged so that the three main assemblies, namely, head, body, and base, and the modifications of each are shown in the identification symbols. The numbers and letter group preceding the dash indicate the basic design of head, body, and base (in that order) used in the governor, and the letters and number group following the dash indicate the modification of each, again in the order named.

(2) For example, in a governor designated as model 1Q12-G1A the first number "1" indicates the model 1 head; the first letter "Q" indicates the model Q body; and the second number "12" indicates the model 12 base. In the modification group following the dash, the first letter is the modification of the model head, in this case being modification "G". In other words, the model 1 head used in this governor has been manufactured to modification "G". When speaking of this head assembly alone, it is referred to as a model 1-G head. The other assemblies are similarly named: in this case they are a model Q-1 body and a model 12-A base.



(3) In addition to the number and letter designation system, the major assemblies are also identified by Hamilton Standard Propellers assembly drawing numbers; e.g., model 1-G head assembly is 58014. It is to be noted, however, that this assembly number does not actually appear on the head assembly itself.

(4) If no modifications have been made on the head, body, or base assemblies, the second designation group is omitted; a governor of this type would be model 1A4. If the body assembly, for example, is the only major component not modified, the body modification designation is shown as a "0". In model 1P12-G0A no modifications have been incorporated in the body assembly.

2. DETAILED DESCRIPTION.

a. SINGLE CAPACITY GOVERNORS.

(1) COMPLETE UNIT.—The constant speed control for Counterweight propellers basically consists of a self-contained gear pump which boosts engine oil to a pressure limited by a relief valve, a pilot valve controlled by spring balanced fly-weights which regulates the flow of oil to and from the propeller, and a rack and pinion arrangement through which the compression of the speeder spring can be varied by the pilot to select the desired engine rpm.

(2) HEAD ASSEMBLY.

(*a*) HEAD.

1. The head is manufactured from an aluminum casting, and all external surfaces of the finished part are anodized and covered with a baked enamel finish. As shown in figure 22, four positions of the head relative to the body are possible because of the symmetric design of the parting surfaces of both. The speeder rack bore is machined into the head perpendicular to the head-body parting surface. Four steel studs screwed into the head, together with washers, nuts, and palnuts, serve to attach the head to the body. These studs need not be removed except for replacement.

2. The control shaft bore is incorporated in the top of the head perpendicular to the speeder rack bore. The outer end of the control shaft bore is threaded to fit the control shaft packing nut, and the bronze control shaft bushing is pressed into the opposite end. A boss tapped for the external high rpm adjustment screw is an integral part of the head. Early head models did not incorporate this boss.

(*b*) CONTROL SHAFT & PULLEY GROUP.

1. Integral with the control shaft is a flange which locates the control shaft packing and a pinion gear which meshes with the speeder rack and so determines the speeder rack position. The position of the

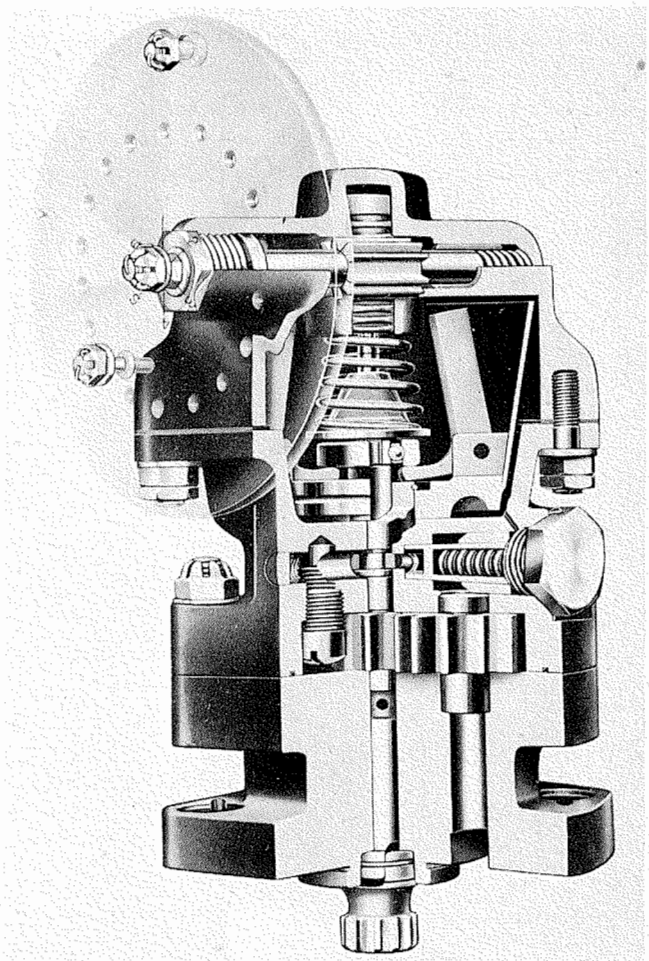
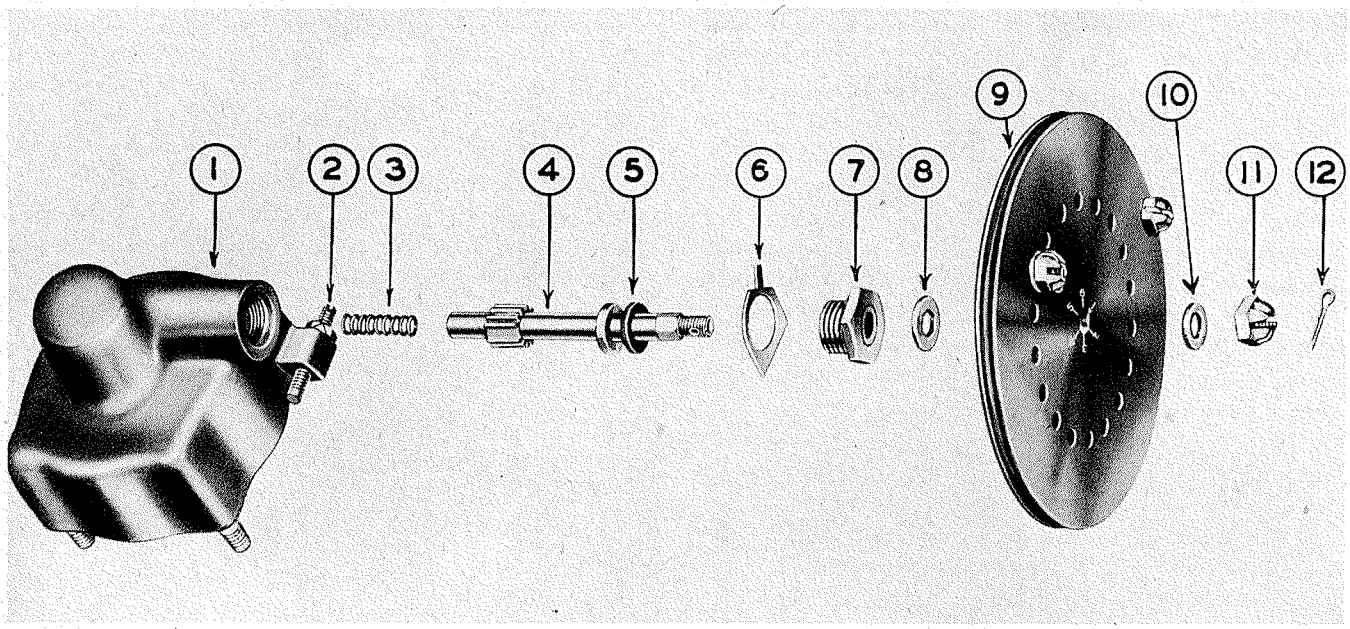


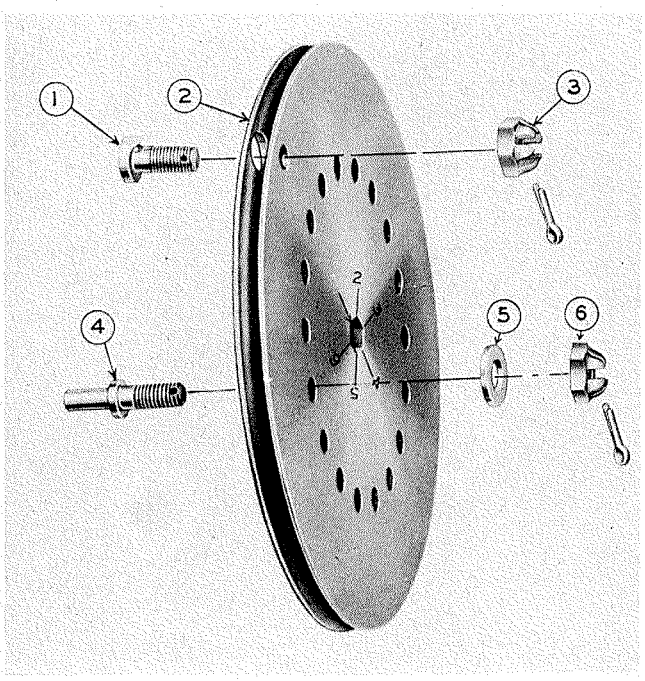
Figure 4—Cutaway View of Single Capacity Governor



1 GOVERNOR HEAD
2 HIGH RPM ADJUSTMENT SCREW
3 CONTROL SHAFT SPRING
4 CONTROL SHAFT
5 CONTROL SHAFT PACKING WASHER
6 PACKING NUT LOCK GASKET
7 CONTROL SHAFT PACKING NUT
8 CONTROL SHAFT INNER WASHER
9 PULLEY ASSEMBLY
10 CONTROL SHAFT OUTER WASHER
11 CASTELLATED NUT
12 COTTER PIN

Figure 5—Extended View of Head Assembly

speeder rack controls the amount of compression in the speeder spring and, consequently, governor setting. At the outboard (threaded) end of the control shaft a scribe mark located in line with the wide space of the missing pinion gear tooth indicates the angular position of the pinion gear at any rpm setting, and also is a reference point for locating the pulley with respect to the control shaft. A hexagonal section at the outer end matches a hexagonal hole in the pulley to locate the pulley in respect to the shaft.



1 CABLE CLAMP
2 PULLEY
3 CASTELLATED NUT
4 PULLEY STOP PIN
5 WASHER
6 CASTELLATED NUT

Figure 6—Extended View of Pulley Assembly

2. The control shaft is supported on the inboard end by a bronze bushing pressed into the head and on the outboard end by a self-lubricating bushing pressed into the control shaft packing nut. To make the control shaft oil tight, a leather packing washer is included between the control shaft packing flange and the packing nut. This packing is held tightly against the packing nut by a spring between the inner end of the control shaft and the corresponding end of the control shaft bore. The packing nut assembly is safetied and sealed against oil seepage by the control shaft packing nut lock gasket. The bottom corners of the gasket are bent over the hex flats of the packing nut and the tab is bent into a lock recess in the head. On an older model of governor head, having two slots in the packing nut, the packing nut was locked by inserting a cotter pin through one of two holes in the head. The tapered thread of this type nut provided the required seal.

3. The governor is controlled from the cockpit by a cable or a rod attached to an aluminum pulley on the governor control shaft. This pulley is available in several diameters, with the 4-inch diameter pulley being most commonly used. The center of the pulley incorporates a hexagonal hole, the corners of which

are numbered as shown in figure 22, so that a definite relationship between the pulley and a scribed line on the end of the control shaft can be noted. On certain aircraft, the pulley is replaced by a special lever which is usually furnished by the aircraft manufacturer.

4. The maximum rpm setting is regulated by contact between a stop pin on the pulley and the high rpm adjustment screw on the head. Moving the pin from one hole to an adjacent hole shifts its angular position 20 degrees, thereby varying maximum governing speed approximately 250 rpm. (Some earlier pulleys did not have the high rpm stop pin, and in such cases, a stop on the control system was used.) The high rpm adjustment screw is located in the tapped boss on the head. The thread of this screw is such that one complete turn of the screw will change the maximum setting by approximately 25 rpm. The tab lock plate located between the boss and the securing nut locks the adjustment screw to the head as shown in figure 7.

5. The pulley incorporates a cable clamp fitting into a recess at the edge of the disc. Tightening the castellated nut secures the control cable in the pulley groove.

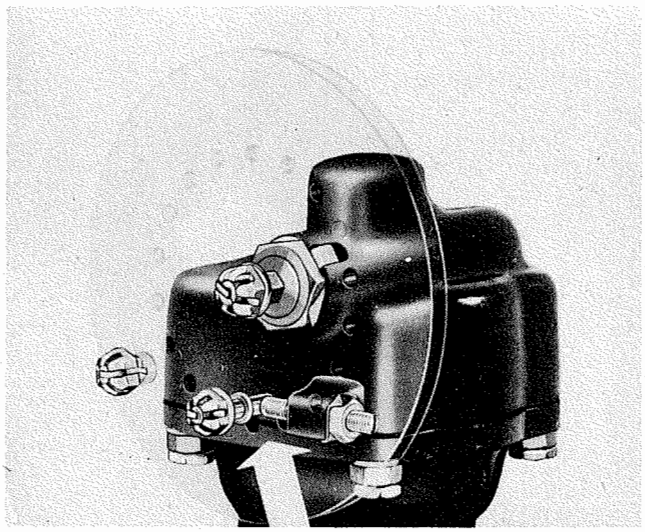


Figure 7—High RPM Stop Arrangement

6. The pulley is held in place by the control shaft washer and castellated nut safetied by a cotter pin. To prevent damage to the aluminum pulley disc from the broaching effect of the shoulders inboard of the control shaft hex section, a steel washer with a hexagonal hole is placed inboard of the pulley.

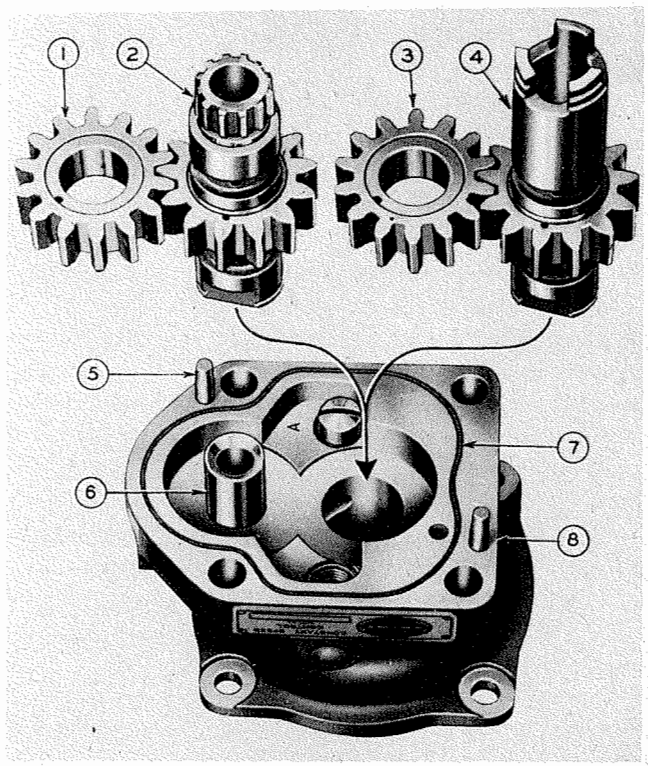
(*c*) SPEEDER RACK ASSEMBLY.—Although the speeder rack assembly is considered a part of the head assembly in the parts lists, it is functionally used in conjunction with the body assembly, and is physically a part of the pilot valve, speeder spring, and rack assembly. The detailed description of the rack assembly is given in this section, paragraph 2.a.(3)(c).

(3) BODY ASSEMBLY.

(*a*) BODY.—The body, which includes the gear pump recess, the drive gear shaft bore, the relief valve recess, and other oil passages necessary for governing control, is made of a material and finished in a manner similar to the head. The flat surface on the relief valve boss provides clearance between the pulley and the boss when the head is in the No. 1 position. The body incorporates the necessary flange extensions and washer recesses for the eight base and head studs, washers, and nuts. The body-base parting surface includes a groove to accommodate the body & base gasket. A drain passage from the fly-weight chamber to the lower surface joins a similar passage in the base.

(*b*) BOOSTER GEAR PUMP.

1. The gear type pump boosts engine oil pressure to that required for propeller operation with a minimum capacity of 8 quarts per minute at 200 p.s.i. and 1750 rpm. The drive gear of this pump is an integral part of the drive shaft, which is made of an alloy steel hardened and accurately ground. End thrust caused by unequal oil pressures between the



1 IDLER GEAR
2 ONE-PIECE DRIVE GEAR SHAFT
3 IDLER GEAR
4 EXTENDED DRIVE GEAR SHAFT
5 BODY & BASE DOWEL
6 IDLER GEAR SHAFT
7 BODY & BASE GASKET
8 BODY

Figure 8—Bottom View of Single Capacity Body Showing Short and Extended Drive Gear Shafts

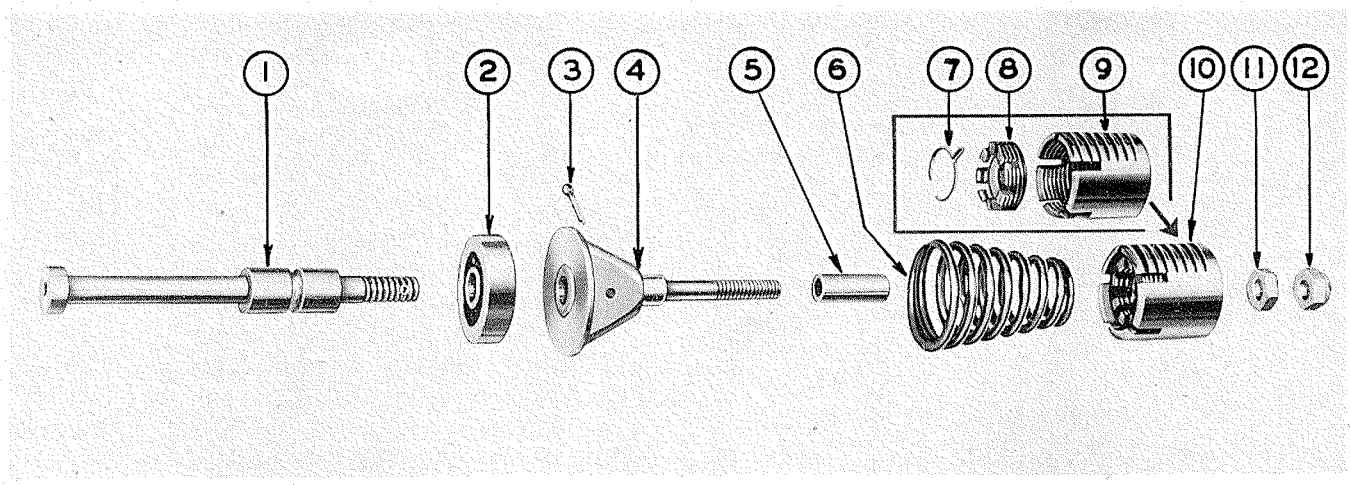


Figure 9—Extended View of Pilot Valve, Speeder Spring, and Rack Group

1 PILOT VALVE
2 PILOT VALVE BALL BEARING
3 COTTER PIN
4 SPRING COLLAR
5 SPRING COLLAR SPACER
6 SPEEDER SPRING
7 ADJUSTING SCREW LOCK WIRE
8 SPEEDER RACK ADJUSTING SCREW
9 SPEEDER RACK
10 SPEEDER RACK ASSEMBLY
11 PILOT VALVE NUT
12 PILOT VALVE LOCK NUT

top and bottom faces of the gear is prevented by circular grooves on each gear face connected by an oil hole through the gear. The center of the drive gear shaft is very accurately honed to provide a close fit with the pilot valve. Recesses and oil ports incorporated in the drive gear shaft in conjunction with lands on the pilot valve serve to control oil flow between the governor and the propeller.

2. The idler gear is quite similar to the drive gear except that it is separate from its shaft. Also, it has 14 teeth as compared with 13 teeth on the drive gear. Consequently, any two teeth on these mating parts contact one another only once in 14 revolutions, thereby tending to distribute tooth wear evenly.

3. The idler gear shaft is a cast iron part which is usually a light press fit in the body. It not only serves as a shaft for the idler gear but also acts as a passage for relief oil returning to the engine pressure system. Radial holes in this shaft provide lubrication for the idler gear.

4. The drive coupling is attached at the lower end of the drive gear shaft in governors with model 12 bases by means of a lock ring which fits into grooves provided in both the coupling and the drive gear shaft. Three lugs on the coupling engage with three matching lugs on the drive gear shaft and provide a flexible drive joint between the engine and the governor. The other end of the coupling is a 12-tooth external spline which fits a matching internal spline in the engine-governor drive. The coupling is made of an alloy steel case hardened to provide better wear characteristics.

5. The bodies used with base models 1, 2, 3, and 4 have a short one-piece drive gear shaft in which the drive splines are integral.

(*c*) PILOT VALVE, SPEEDER SPRING, AND RACK GROUP.

1. The pilot valve is made from low carbon steel, case hardened, and ground to highly accurate dimensions. The inherent design of the pilot valve prevents end thrust from being set up by oil pressure of the gear pump. The upper end of the valve fits a ball bearing assembly and is threaded to hold the speeder spring collar.

2. The fly-weight ball bearing assembly is a conventional ball bearing. The fly-weights bear against the outer race, thereby allowing rotation of the fly-weight assembly without rotation of the pilot valve assembly. The speeder spring collar is tapped to fit the upper end of the pilot valve stem. It locks to the pilot valve by means of a cotter pin inserted through a small hole in each. The flange on the base of the spring collar supports the large end of the conical speeder spring and serves to locate it centrally between the pilot valve and the adjusting screw in the rack. One type of spring collar flange has a lip into which the speeder spring should be screwed. A spring collar spacer fitting over the shank of the spring collar determines the initial compressed length of the speeder spring as assembled and thereby its minimum low rpm setting. A nut and a lock nut hold the rack to the pilot valve & speeder spring assembly.

3. Since directional flow of governor oil is regulated by the pilot valve position which is determined by the speeder spring and fly-weight forces, varying the compression of the speeder spring by changing the speeder rack position changes the rpm setting of the governor.

4. The use of various spring collar spacers and speeder springs produces several governor rpm

ranges. Spring collar spacer No. 53393 and speeder spring No. 50665 allow 1400 minimum rpm, but a different spring collar spacer No. 53392 with the same spring allow 1600 minimum rpm. This is more fully shown in figure 32.

Note

These rpm ranges are *governor* rpm ranges and are related to engine rpm only by the gear ratio of the engine-governor drive.

5. The speeder spring adjusting rack assembly is composed of the rack, the speeder rack adjusting screw, and the snap ring. To minimize wear, the rack is hardened and ground. Teeth on one side of the rack mesh with the pinion gear teeth of the control shaft. The double width tooth at the top of the rack serves as a positive means of engaging the rack with the control shaft pinion gear in a known relation. This end is inserted into the speeder rack bore first and matched with the blank tooth of the control shaft pinion gear. The adjusting screw is threaded to fit the inside bore of the speeder rack. In combination with a spring collar spacer, it sets the initial compression of the speeder spring. The relation of adjusting screw to speeder rack determines the angle of the control shaft (and hence the pulley angle) at which positive high pitch occurs. Fitting inside the adjusting screw, the snap ring provides a positive lock by securing it to the speeder rack. Five slots in the rack and eight in the adjusting screw permit locking adjustment in small angular increments.

(*d*) FLY-WEIGHT ASSEMBLY.

1. The fly-weight assembly consists of the fly-weight head, the fly-weight cup, two fly-weights, and two fly-weight hinge pins. The fly-weights are secured to the head by the hinge pins. These hinge pins are locked in place by the fly-weight cup which fits the fly-weight head to form one unit. The cup is spot-welded to the head at two points. This assembly is driven by the upper end of the drive gear shaft, and is locked in place by a lock ring fitting a groove on the shaft.

2. The cup design is used so that normal oil leakage into the assembly past the drive gear shaft and pilot valve will be rotated at the same speed as the fly-weights. This feature lessens side loads and minimizes turbulence of the oil which would interfere with the action of the fly-weights.

(*e*) RELIEF VALVE ASSEMBLY.

1. The relief valve assembly consists of the plunger, the spring, the plug, and the locking gasket. Not a part of the assembly, but essential to it, is the soft steel bushing which is a press fit in the relief valve bore of the governor body. This bushing is very accurately aligned in the bore to provide proper support for the relief valve plunger, which is a hardened steel part ground to provide a close fit with the bushing. A spring, backed against the relief valve plug, fits into the plunger and establishes the relief valve setting. The relief valve plug with its recess supporting the spring is locked to the governor body by a tab type lock washer. Because this lock washer is of soft metal, it also serves to seal against leakage.

2. A small vent hole from the relief valve rear chamber to the fly-weight chamber prevents pressure build-up due to leakage past the plunger, which would otherwise make the valve inoperative. Since the function of the relief valve is to limit the

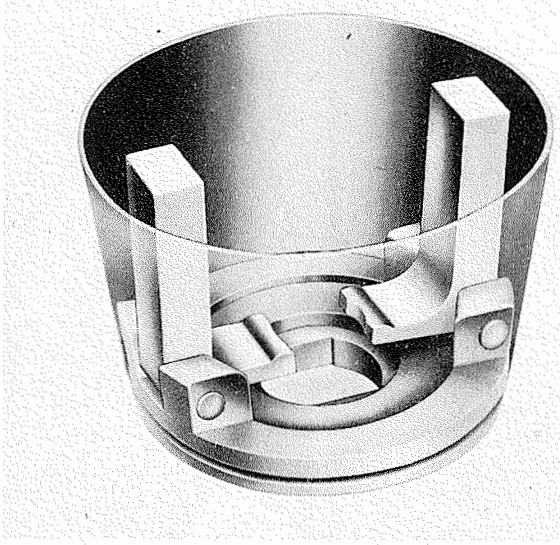
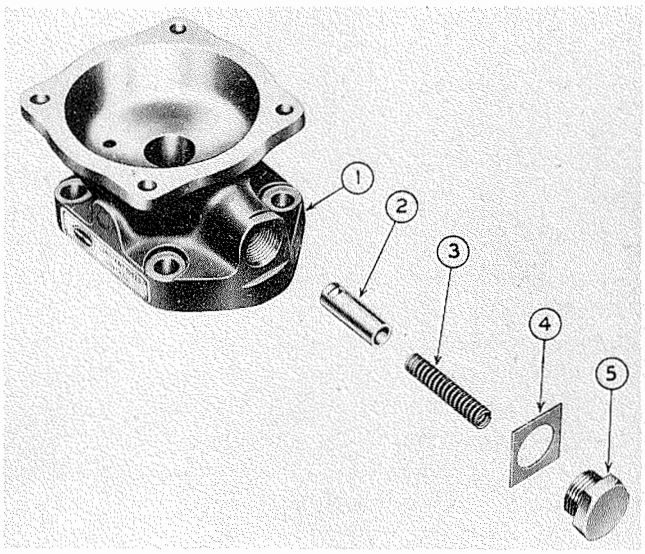


Figure 10—Phantom View of Governor Fly-Weight Assembly



1 GOVERNOR BODY
2 RELIEF VALVE PLUNGER
3 RELIEF VALVE SPRING
4 RELIEF VALVE GASKET
5 RELIEF VALVE PLUG

Figure 11—Single Capacity Relief Valve

operating pressure of the governor oil, the strength of the spring is the determining factor. It is designed to maintain a pump output pressure of 180-200 p.s.i.

(*f*) MISCELLANEOUS PARTS.

1. Oil control plugs are provided in the governor so that the booster pump may be adapted for either clockwise or counterclockwise engine-governor drive rotation. There are two such plugs: one in the body and one in the base. If the direction of the engine-governor drive is clockwise when viewed looking at the engine pad, the oil control plugs are screwed into the holes marked "B". Likewise, when the engine-governor drive is counterclockwise, holes "A" are plugged. The only exception to this is the 35-degree angular base, which will be discussed in paragraph 2.a.(5) of this section.

2. The body housing incorporates a taper screw plug which should never be removed during governor disassembly. In machining certain internal oil passages, it is necessary for the drill to pierce the outer casing. The plug seals this passage permanently.

3. To maintain accurate alignment between the base and the body and thereby avoid binding of the drive gear shaft, two locating dowels are press fit into the lower face of the body. These dowels fit into slightly larger holes in the base when the governor is assembled. Oversize dowels are provided to take care of enlargement of the body and base dowel holes brought about by repeated disassembly of the governor. No dowels are used in governors having base model 2, 3, or 4. When used with base model 1, the body has a special dowel hole to accommodate the body & base holding screw. The following tabulation lists the oversize parts available.

Body & Base Locating Dowel	Body & Base Locating Screw	Amount Oversize
53166	53401	.0000"
53166-15	53401-15	.0156"
53166-31	53401-31	.0313"

4. Since the booster gear pump must operate in a very accurate gear pocket, metal to metal contact must be maintained between the body and the base. To meet this requirement and still make the governor oil tight, a groove is provided in the parting surface of the body and a synthetic rubber gasket is fitted into this recess. The cross section of this gasket has been changed from a circular to a trapezoidal shape in order to improve its sealing qualities.

5. A composition gasket provides the oil seal between the governor head and body.

(4) BASE ASSEMBLY—MODEL 1.

(*a*) BASE.—This base housing, made of the same material as the body and head and with the same finish, is designed to be mounted on the standard governor mounting pad located on the engine nose. In order to align the governor drive shaft with the engine-governor drive shaft, a pilot boss is provided on the bottom surface of the base to fit into a circular recess in the engine pad. Also located in the bottom surface is an arcuate groove which forms the inlet passage for engine oil supplied to the governor. The two threaded holes, one at each end of the groove, connect the groove to both sides of the gear pump. As previously discussed, one of these holes must be plugged according to the direction of the drive. The center hole of the groove extends up through the hollow idler gear shaft to provide a passage for relief oil. The base includes four holes for the engine pad mounting studs, two dowel holes for the aligning dowels, a drain passage which connects with a similar passage in the body, and a port connecting the pump outlet to the propeller passage on the mounting pad. It also incorporates a bronze bushing in the drive gear shaft bore. Because of its low height, it must be used with the older type engine mounting studs (1-11/16 inch high) which extend through the base and lower body flange. A short one-piece drive gear shaft is used. This base cannot be used with the newer type studs (15/16 inch high).

(*b*) MISCELLANEOUS PARTS.

1. The body & base locating screw is a fillister head screw which extends up through the base and lower body flange and is secured by a washer, nut, and palnut. Together with the two body dowels this locating screw maintains the body and base in alignment. It is available in oversizes for use in dowel holes enlarged by repeated disassembly of the governor. The procedure for replacement is given in section VI, paragraph 3.c.(2)(e).

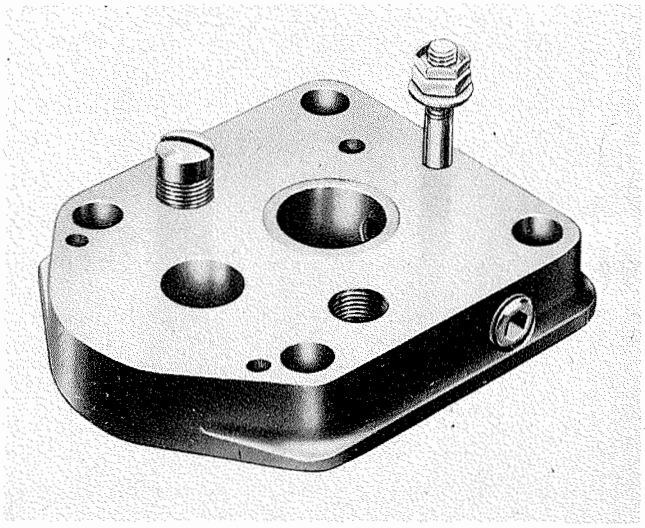


Figure 12—Model 1 Base Assembly

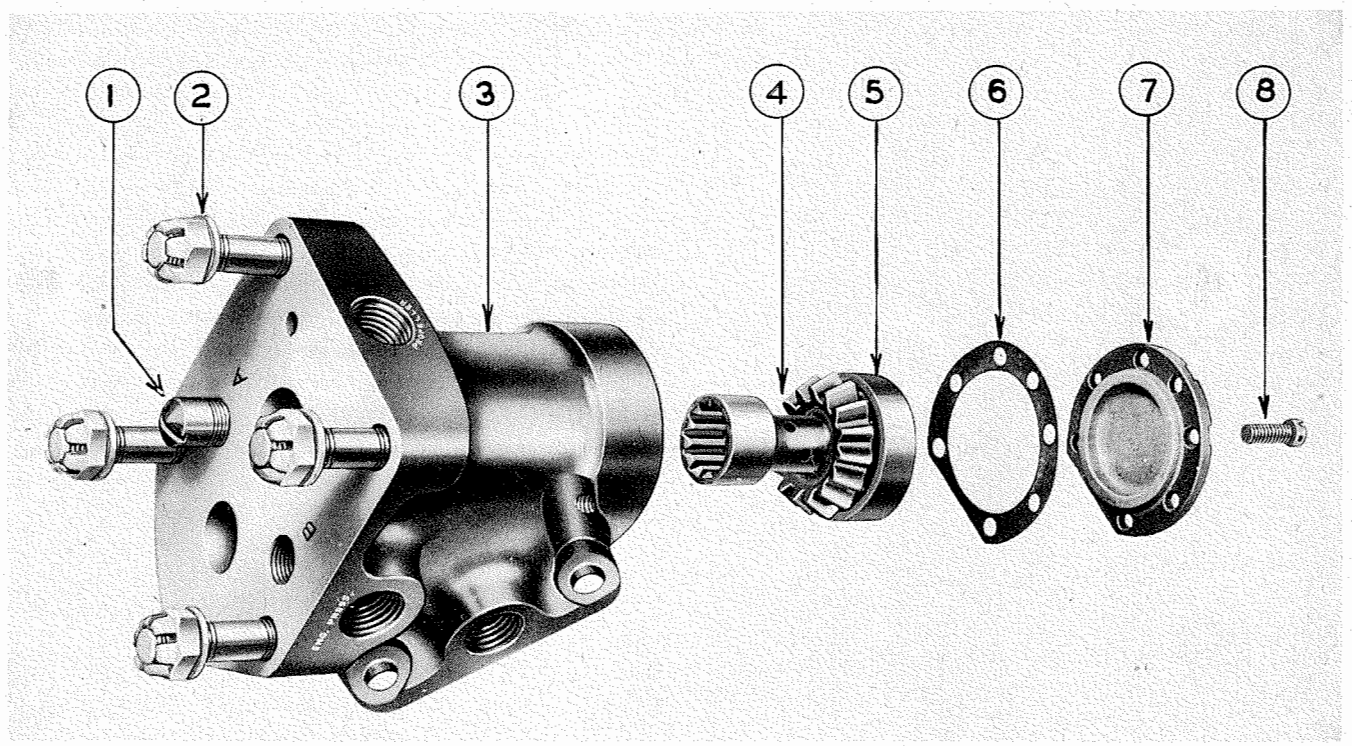


Figure 13—Extended View of Model 2 Base Assembly

1 OIL CONTROL PLUG
2 BODY & BASE NUT AND WASHER
3 BASE
4 UNIT DRIVE GEAR
5 UNIT DRIVE GEAR THRUST BEARING
6 BEARING THRUST COVER GASKET
7 BEARING THRUST COVER
8 BEARING THRUST COVER SCREW

2. Because an internal oil passage is drilled through the outer surface, a pipe plug is fitted as a permanent seal into the opening. An oil control plug is used to seal one of the oil inlet ports.

3. To avoid malfunctioning due to foreign particles entering the governor mechanism through the engine oil, a screen is molded into the governor mounting gasket which fits between the governor and the mounting pad. This slightly curved brass screen fits over the entire arc of the engine oil inlet. Special care should be taken not to confuse the proper mounting gasket with the engine shipping gasket or the run-in gasket which are very similar in appearance. As shown in figure 26, the hole in the shipping gasket and in the run-in gasket corresponding to the arcuate groove in the governor base is considerably longer than that in the correct mounting gasket. As a result, if the incorrect gasket is used, the governor high and low pressure oil passages will be interconnected, thereby permitting only sluggish governing action.

(5) BASE ASSEMBLY—MODEL 2.

(*a*) BASE.—This base is likewise of the same material and finish as the other bases. The base-body parting surface and the mounting surface are 35 degrees to one another. The mounting surface is designed to fit the gun synchronizer pad (using a bevel drive gear) on the rear accessory section of certain aircraft engines. External ports are provided for propeller drain oil, engine supply oil, and governor output oil lines.

(*b*) DRIVE SHAFT AND BEARING.—A hardened steel shaft is fitted into the housing to link the engine auxiliary drive gear with the governor drive gear shaft. Its upper end has internal splines to match the drive gear shaft splines and the lower end has a bevel spur gear to match the auxiliary drive gear. A ball bearing supports the lower end of the shaft in the housing. A cover plate and gasket seal the opening through which the shaft is inserted.

(*c*) MISCELLANEOUS PARTS.

1. Provided in the upper surface are four steel studs to which the governor body is attached by castellated nuts. These are removed only when replacement is necessary.

2. An oil control plug seals the unused oil inlet passage, as determined by the direction of drive.

Note

Because of the type of linkage between the auxiliary drive gear and the governor drive gear shaft, an additional caution in determining which holes are to be plugged for a given direction of rotation must be observed. In this case, the direction of rotation is determined when viewing the angular face of the base rather than the engine pad. If this gear turns clockwise, holes "B" are plugged, and if it turns counterclockwise, holes "A" are plugged.

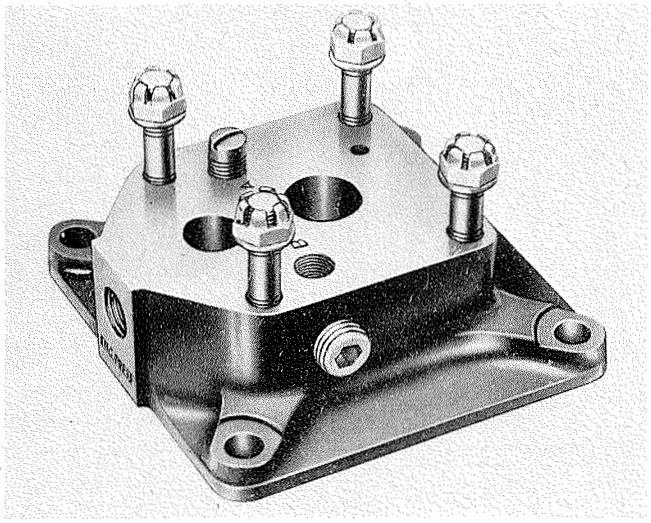


Figure 14—Model 3 Base Assembly

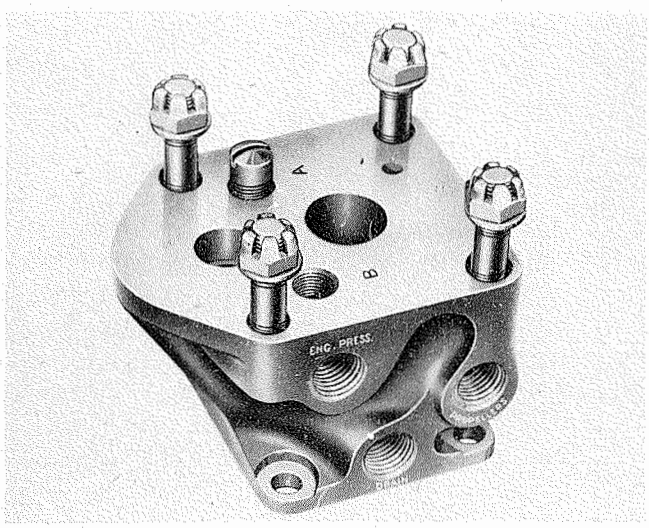


Figure 15—Model 4 Base Assembly

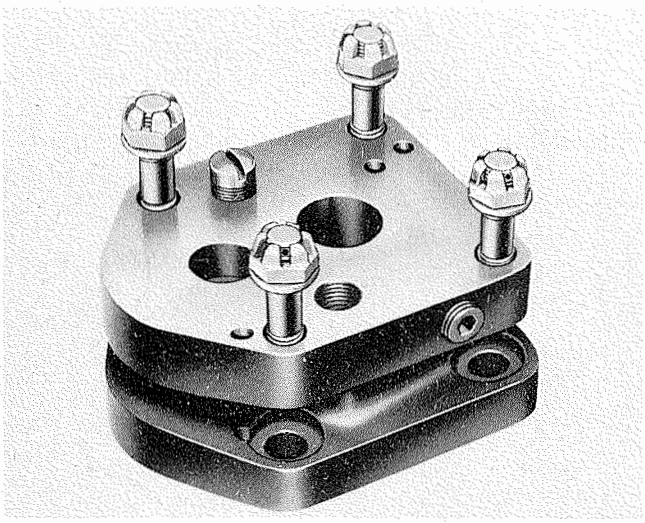


Figure 16—Model 12 Base Assembly

3. Pipe plugs are provided to seal off the external outlets not used. These plugs are inserted tightly during governor installation on the engine. Two special stud nuts are needed in fastening the base to the engine mounting studs, because part of the housing interferes with the use of standard nuts.

4. The engine-governor drive (gun synchronizer drive) employs a bevel gear to drive the model 2 base. To maintain the accurate alignment of gears required by this drive system, an assembly liner is used. This liner fits over the ball bearing of the auxiliary drive and aligns the governor base with both the engine pad and the auxiliary drive shaft. At the same time it prevents the bevel gear from lifting up and exerting excessive pressure on the base drive gear.

(6) BASE ASSEMBLY—MODEL 3.

(*a*) BASE.—This aluminum housing is designed with a special mounting surface to fit the rear auxiliary pad used on certain engines. The housing is finished in a manner similar to the other housings. There are external threaded ports connected by passages to the internal oil passages. The bottom flange is drilled to accommodate four mounting studs of the rear auxiliary pad.

(*b*) MISCELLANEOUS PARTS.—An oil control plug is used to close off the unused oil inlet port. The unused external ports are sealed with pipe plugs. Four mounting studs screwed into the upper surface serve to secure the body to the base. These need never be removed except for replacement.

(7) BASE ASSEMBLY—MODEL 4.

(*a*) BASE.—This base is made of the same material and finished in the same manner as the heads, bodies, and bases previously mentioned. Its upper surface is designed to fit the lower surface of the body. The mounting surface is designed to fit the gun synchronizer pad (using an internal spline drive gear) on the rear section of certain aircraft engines. There are a number of passages connecting the internal oil passages to external threaded ports. External lines for propeller drain oil, engine supply oil, and governor output oil are needed when the governor is mounted on the rear of the engine.

(*b*) MISCELLANEOUS PARTS.—Four steel studs are provided on the upper surface to secure the body to the base. These are permanently inserted and are removed only if damaged. An oil control plug is provided to plug either hole "A" or "B" as the installation requires. Plugs are provided to seal the holes not used by the external lines and are inserted during governor installation. Three are necessary since there are two holes each for engine pressure oil, governor

output oil, and propeller drain oil. Because of the interference fit of the threads used in the plug and the part, no other lock is necessary.

(8) BASE ASSEMBLY—MODEL 12.

(*a*) BASE.—This housing is designed to fit the standard mounting pad having studs 15/16 inch high. It is about one inch higher than the model 1 base, and has an upper and a lower flange to accommodate attaching and mounting studs. Two dowel holes mate with the body locating dowels to maintain body-base alignment.

(*b*) MISCELLANEOUS PARTS.—Four steel studs screwed into the upper flange together with washers and castellated nuts fasten the body to the base. These studs are removed only for replacement. An oil control plug is provided to seal an engine oil inlet port as determined by the direction of governor rotation. For counterclockwise governor drive rotation, the hole marked "A" is plugged, and for clockwise rotation, the hole marked "B" is plugged. Direction of drive rotation must be determined looking down on the governor mounting pad. See section III, paragraph 1.c. A pipe plug permanently seals the end of an internal passage drilled through the outer surface. A neoprene gasket with an integral brass screen in the oil inlet groove is placed between the governor and the mounting pad at installation.

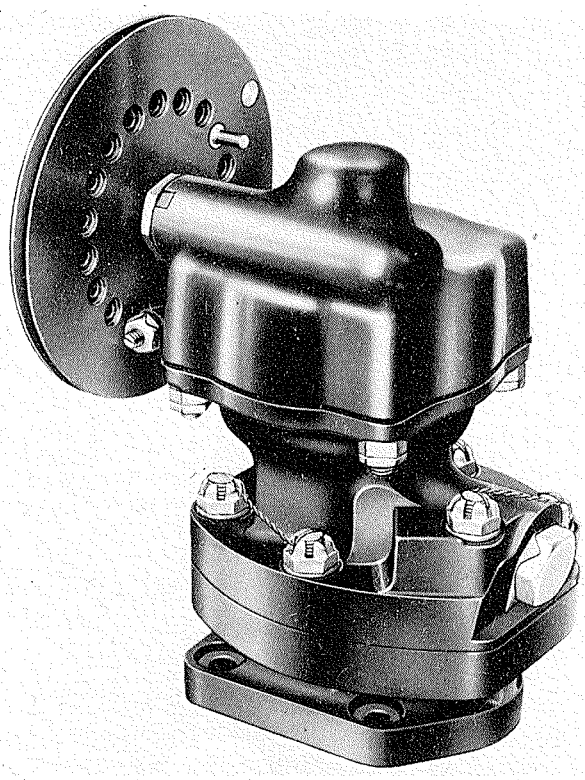


Figure 17—Rear View of Double Capacity Type Governor

b. DOUBLE CAPACITY GOVERNORS.

(1) COMPLETE UNIT.—The double capacity type constant speed control is similar in most respects to the single capacity type except that it incorporates a larger pump to produce approximately twice the oil flow (nominally 16 quarts per minute at 1750 rpm). The oil passages and relief valve are necessarily larger. For purposes of detailed description, only the differences will be discussed, everything else being similar.

(2) HEAD ASSEMBLY.—The head model used on the double capacity governor is exactly the same as that used on the single capacity governor which was described in paragraph 2.a. of this section.

(3) BODY ASSEMBLY.

(*a*) BODY.—The double capacity type housing does not include the gear pump recess which, for this governor, is in the base. The drive shaft bore and the relief valve bore are larger to accommodate the larger units needed. The body has six holes for the base attaching studs, instead of four.

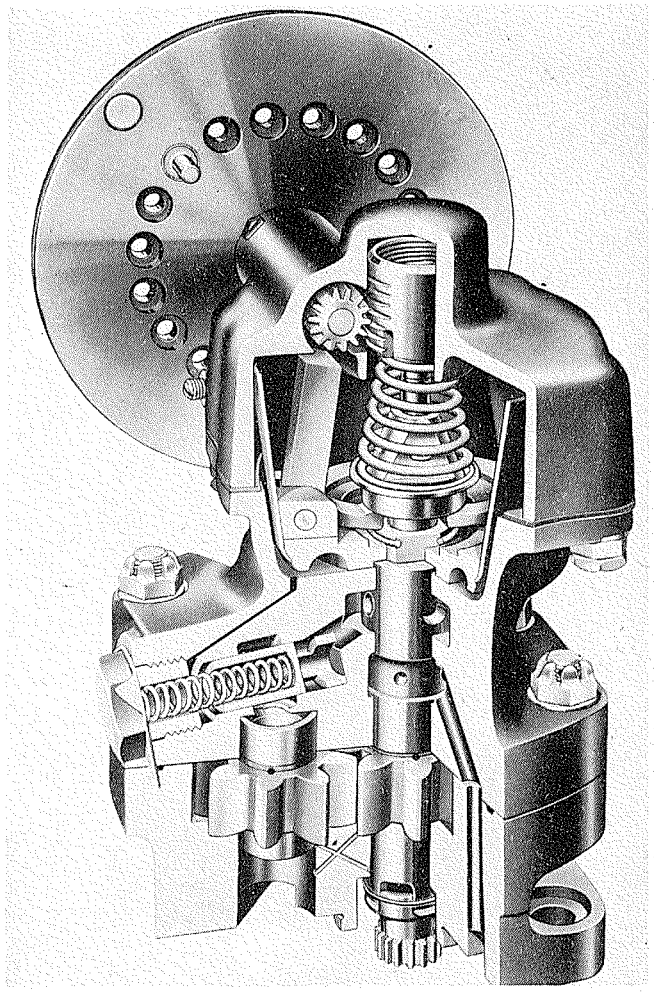


Figure 18—Cutaway View of Double Capacity Governor

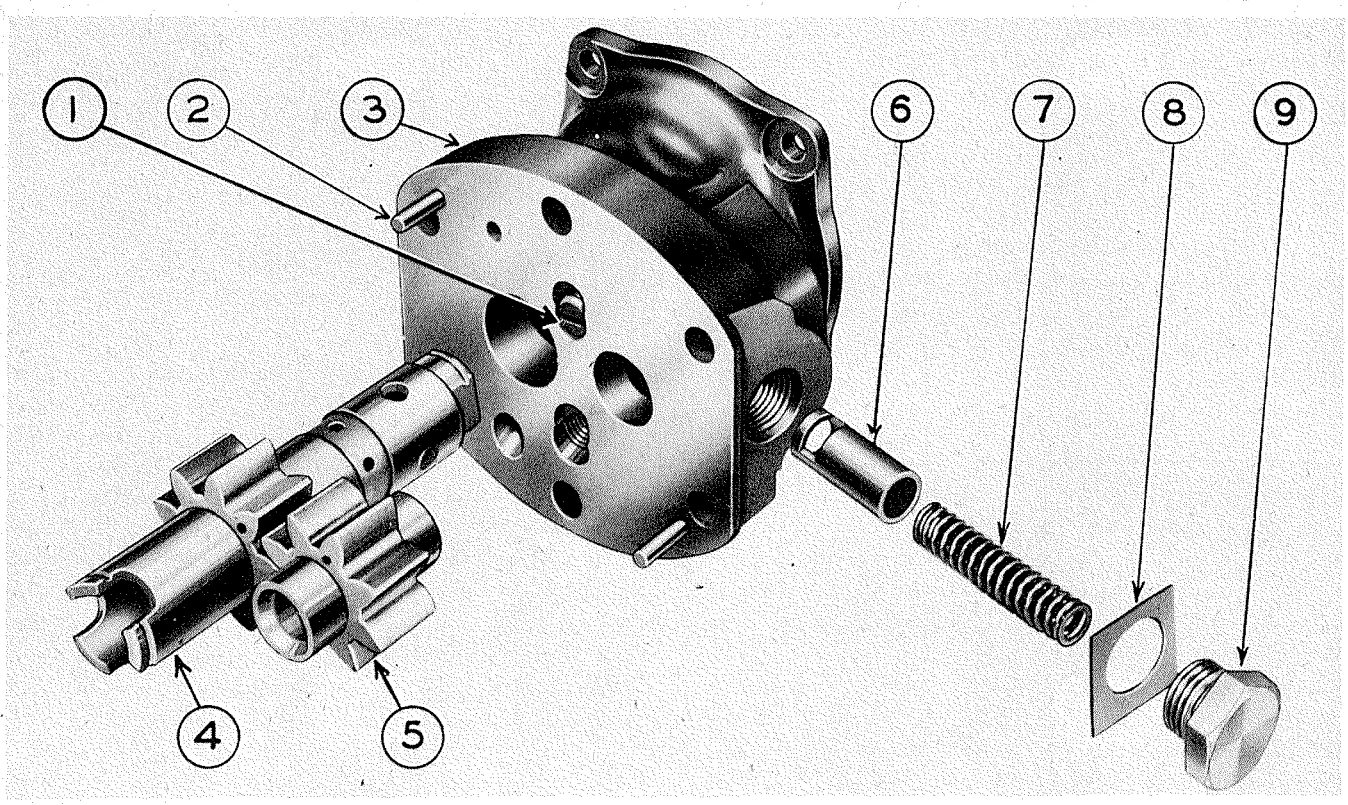


Figure 19—Extended View of Double Capacity Governor Body

1 OIL CONTROL PLUG
2 BODY & BASE DOWEL
3 BODY
4 DRIVE GEAR SHAFT
5 IDLER GEAR
6 RELIEF VALVE PLUNGER
7 RELIEF VALVE SPRING
8 RELIEF VALVE PLUG GASKET
9 RELIEF VALVE PLUG

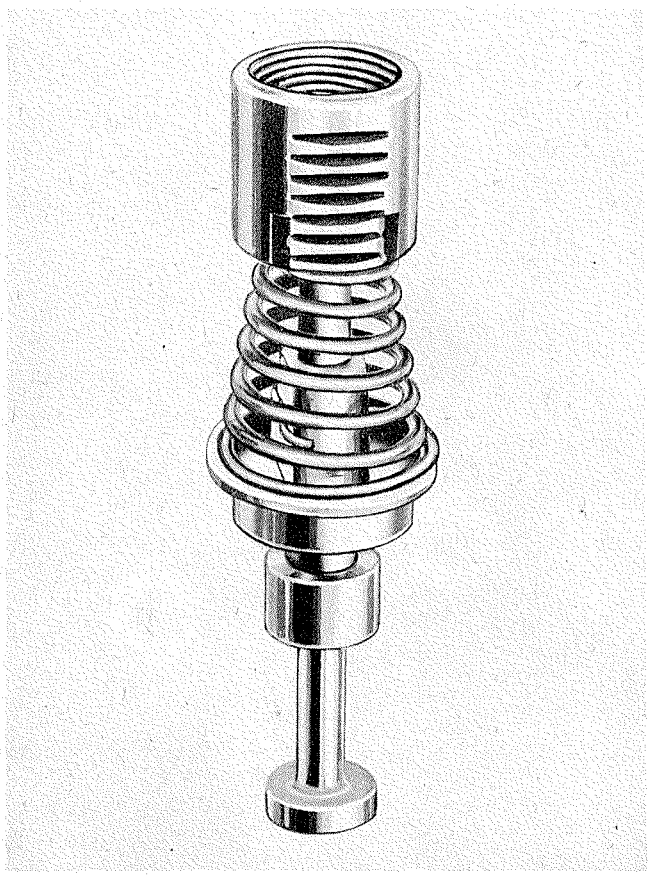


Figure 20—Double Capacity Pilot Valve Group

(*b*) BOOSTER GEAR PUMP.—The booster gear pump is essentially the same type of construction as the single capacity except that the gears are larger to provide the higher oil flow. The number of gear teeth is reduced to eight on the idler gear and nine on the drive gear. The idler gear shaft is integral with the idler gear. The center of the drive gear shaft is larger to accommodate the additional quantity of oil.

(*c*) PILOT VALVE, SPEEDER SPRING, AND RACK GROUP.—Although the pilot valve is shorter and has larger diameter lands, the other parts of the assembly are identical with those in the single capacity governor.

(*d*) FLY-WEIGHT ASSEMBLY.—This assembly is identical with that of the single capacity type.

(*e*) RELIEF VALVE ASSEMBLY.—This assembly differs from that used in the single capacity in that no body bushing is required. The relief valve plunger is larger in diameter and elongated to such an extent that the body itself can act as a bushing.

(*f*) MISCELLANEOUS PARTS.—There are no permanent sealing plugs. The double capacity body contains two locating dowels. As in the single capacity, these dowels are available in two oversizes to take care of enlargement due to repeated disassembly. Pro-

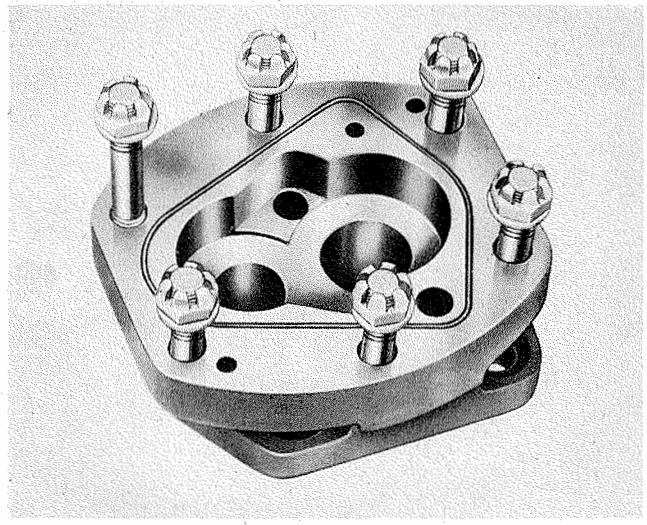


Figure 21—Model 10 Base Assembly

cedure for replacing these dowels is given in paragraph 3.c.(2)(e) of section VI.

(4) BASE ASSEMBLY.—This differs from the model 12 single capacity type in its somewhat larger shape to accommodate the larger gears and in the fact that it contains the recess for the gear pump. Six studs are used to hold the body and base together. The base also has the groove for the body & base gasket. The latest model incorporates a conical screen strainer in the passage connecting to the propeller. Oil control plugs are provided in order that the booster pump may be adapted for clockwise or counterclockwise engine drive rotation. If the rotational direction of the governor drive is clockwise as viewed when looking at the governor mounting pad, the oil control plug is inserted in the hole in the base marked "B." Similarly, for counterclockwise rotation of the governor drive, the oil control plug is inserted in the hole marked "A." This procedure is more fully described in section III, paragraph 1.c. This plug is safetied in position by virtue of the interference fit of the threads in the tapped recess in the base.

3. MODEL VARIATION SUMMARY.

a. As explained in section II, paragraph 1.d., a Counterweight governor is composed of three major assemblies, namely, the head, body, and base. In a governor designated as 1Q12-G1A, the head is model 1-G, the body is model Q-1, and the base is model 12-A.

b. The following Model Variation Summary lists in tabular form the components in the various models of heads, bodies, and bases, and also includes a short description on each unit pointing out its similarity to another model.

GOVERNOR HEAD MODELS

Model	Assembly Number	Pulley Diameter (Inches)	Improved Shaft Packing Nut	External High RPM Adjustment Screw	Remarks
1	51885	4	No	No	
1-A	53298	4	No	Yes	Same as model 1 (No. 51885) except has high rpm adjustment screw.
1-B	54939	1-1/4	No	No	Same as model 1 except uses 1-1/4 inch pulley and rack assembly No. 53390.
1-C	54120	3	No	Yes	Same as model 1-A except with 3-inch pulley.
1-F	58013	4	Yes	No	Same as model 1 except has improved type control shaft packing nut.
1-G	58014	4	Yes	Yes	Same as model 1-A with improved control shaft packing nut.
1-H	58015	1-1/4	Yes	No	Same as 1-B with improved type control shaft packing nut.
1-J	58016	3	Yes	Yes	Same as 1-C with improved type control shaft packing nut.

GOVERNOR BODY MODELS

Model	Assembly Number	Nominal Capacity (Qts. Per Min.)	Spring Collar Spacer	Speeder Spring	Extended Gear Shaft	Nominal Minimum Governor RPM	Remarks
A	51888	8	51884	50665	No	1730	
A-5	53394	8	53392	50665	No	1600	Same as model A except spacer changed for use on 1-A head.
C	51891	8	52146	SK-1651-1	No	2050	
C-5	53395	8	53393	SK-1651-1	No	1150	Uses different spacer, otherwise same as model C.
C-6	54096	8	53392	SK-1651-1	No	1400	Same as C-5 except uses spacer 53392.
E	52150	8	52146	50665	No	1850	
E-5	53425	8	53393	50665	No	1400	Uses different spacer.
M	54017	8	53392	50665	Yes	1600	Same as A-5 except has extended gear shaft for use with model 12 base.
P	54018	8	53393	SK-1651-1	Yes	1150	Same as C-5 except for use on model 12 base.
Q	54019	8	53393	50665	Yes	1400	Same as E-5 except uses model 12 base.
Q-1	54949	8	52146	50665	Yes	1850	Has 52146 spacer for use with model 1-A head.
S	54465	16	53393	SK-1651-1		1150	Used with direct drive Cyclone.
S-1	54574	16	53392	SK-1651-1		1400	Same as model S except uses spacer 53392.
S-4	57685	16	53392	50665		1600	Same as S-1 except speeder spring 50665 is used.

GOVERNOR BASE MODELS

Model	Assembly Number	Capacity (Qts. Per Min.)	Engine Mounting Pad	Remarks
1	52713	8	Standard (1-11/16 inch studs)	Flat with flange for use on standard nose pad.
2	50830	8	Gun Synchronizer	35 Degree angular drive.
3	50842	8	Rear Auxiliary	
3-A	54265	8	Rear Auxiliary	Pressure connections not tapped.
4	50840	8	Gun Synchronizer	Straight drive.
10-A	54494	16	Standard (15/16 inch studs)	Used with double capacity governor.
10-E	58676	16	Standard (15/16 inch studs)	Same as 10-A except has high pressure strainer.
12	53967	8	Standard (15/16 inch studs)	Used with model M, P, and Q bodies.
12-A	55609	8	Standard (15/16 inch studs)	Modified to provide ignition harness clearance on a specific installation.

SECTION III
INSTALLATION

1. PREINSTALLATION CHECKS.

a. GENERAL.—The following section is a discussion of a typical governor installation (either the single capacity or the double capacity type) on an aircraft. Except for the general precautions and notes listed in the following paragraphs, the manual provided by the aircraft manufacturer should be consulted for specific instructions concerning each individual installation. It is assumed that the governor is fitted with a mechanical type head and is controlled from the cockpit by a cable type system. For aircraft using some other type of control system, these instructions must be modified. It is also assumed that the correct position of the governor head relative to the body is known for the particular aircraft. This is determined by the manner in which the control system is installed. Figure 22 indicates the possible positions.

b. CHECKS.—The following checks should be made before installation of any governor, either single or double capacity.

Note

The double capacity governor is exactly like the single capacity nose-mounted governor in manner of installation, adjustment, and removal.

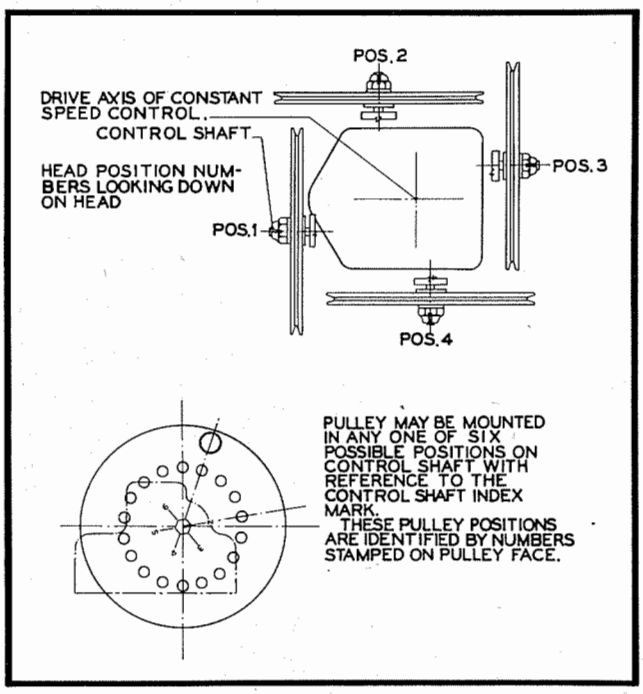


Figure 22—Chart of Head and Pulley Positions

(1) The governor should be checked externally to note any obvious damage. All gaskets should be in place and the governor mounting gasket should be of the proper type. See figure 26.

(2) There should be no doubt as to the satisfactory operation and correct rpm setting of the governor. If there is doubt, check it on a governor test stand in accordance with the test procedures outlined in section VII.

(3) Determine the freedom of movement of the governor by turning it with the drive gear shaft coupling. Governors with base models 2 and 4 may be more easily checked by removing the head and turning the fly-weight cup, since the head should be removed during installation in any case. Abnormal binding or dragging due to improper fit or foreign particles in the mechanism will usually be revealed by this preliminary test. In cold weather the increased viscosity of the oil surrounding the parts may cause increased resistance to rotation. In a new governor, a similar condition due to corrosion preventive compound may exist.

Note

It is not necessary to remove the corrosion preventive (meeting specification No. AN-VV-C-576a) from the governor as it does not interfere with proper operation and should cause no undesirable compounds when it is absorbed into the engine lubricating oil system.

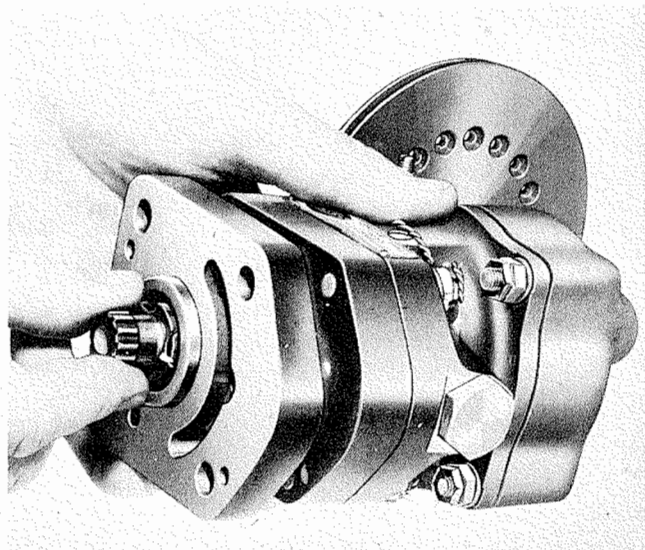


Figure 23—Checking Freedom of Movement

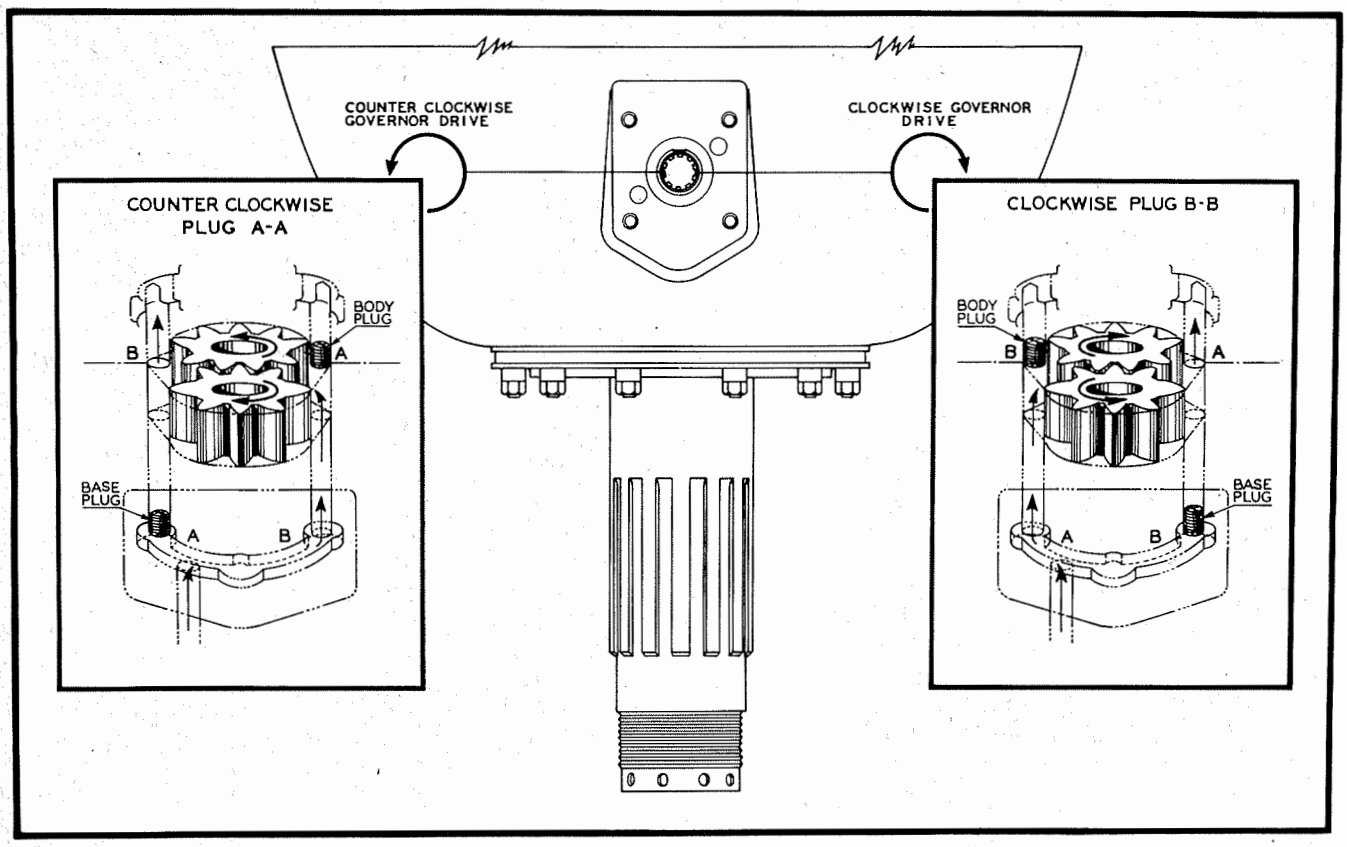


Figure 24—Diagram of Body and Base Oil Control Plugging System

(4) It is not necessary to disassemble the governor for any of the preceding checks, except as noted for those governors having model 2 and 4 bases. The unit should always be left assembled unless binding or other serious trouble is found.

c. OIL CONTROL PLUGGING.—Check the governor for proper direction of rotation by noting the position of the oil control plugs. In an assembled governor having base model 1, 10 or 12, the location of both the body and base oil control plugs can be checked by looking into the passages in the base. In governors having other bases, it is necessary to partially disassemble the governor by separating the body and base in order to determine the plugging. It is assumed that the direction of engine-governor drive has been correctly determined.

(1) Since each governor incorporates a gear type pump, it is necessary that the oil inlet and outlet passages be on the correct sides of the pump, according to the direction of pump gear rotation.

(2) As shown in figure 24, two threaded ports are incorporated in the passages from the engine oil pick-up passage in the base to the pump recesses. One hole is marked "A", and the other "B". The governor body has similar ports, also marked "A" and "B", which form high pressure outlet passages.

(3) Direction of governor drive rotation is determined looking at the drive gear in the engine-governor mounting pad except base model 2 as noted below. To adapt a governor for counterclockwise direction of engine-governor drive rotation, plug the hole "A" in the base and the hole "A" in the body. Since this is a pipe thread, the interference fit will hold the plug securely in place once it has been tightened. To adapt a governor for clockwise direction of rotation, plug the holes "B" in the base and body.

(4) Governors which use the 35-degree angular base (model 2) are plugged in a similar manner except that the direction of governor drive is determined by viewing the angular face of the base rather than the engine mounting pad. If the direction of rotation of the shaft *in the governor base* is clockwise, holes "B" are plugged, and if the direction is counterclockwise, the holes "A" are plugged. This procedure is necessary because the direction of governor drive is reversed by the auxiliary gear in the base.

2. INSTALLATION PROCEDURE.

a. NOSE PAD INSTALLATION.

(1) The governor mounting pad cover must be removed along with its gasket. The engine shipping gasket, usually included between this cover and the mounting pad, is very similar to the mounting gasket

used between the governor and the mounting pad; however, it can be readily identified by the absence of the large central opening through which the drive coupling fits. The run-in gasket (used when running in an engine with a club propeller and no governor) is similar to the shipping gasket except that it has the central hole. All three are shown in figure 26. Also, the more recent governor mounting gasket incorporates a brass screen in the arcuate section which matches the groove in the governor base.

(2) Clean the mounting pad thoroughly making very certain that there are no foreign particles in the recess around the drive shaft. Check the engine-governor drive shaft for freedom of movement within whatever amount of backlash may be present.

(3) Place the governor mounting gasket in position with the raised portion of the brass screen facing

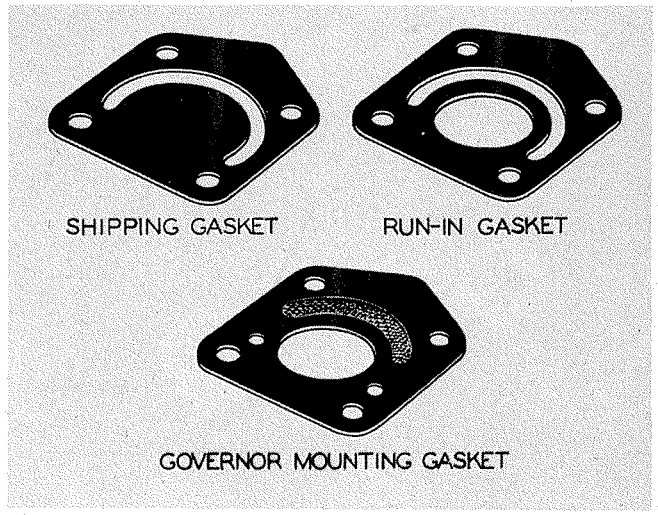


Figure 26—Comparison of Shipping, Run-In, and Mounting Gaskets

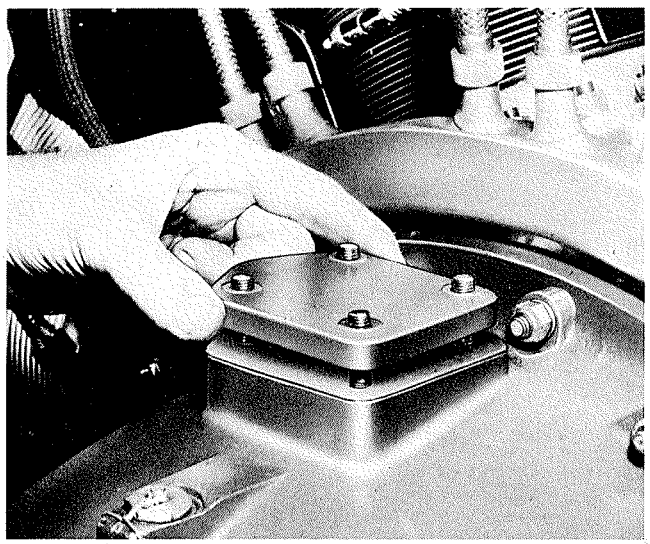


Figure 25—Removing Nose Pad Cover

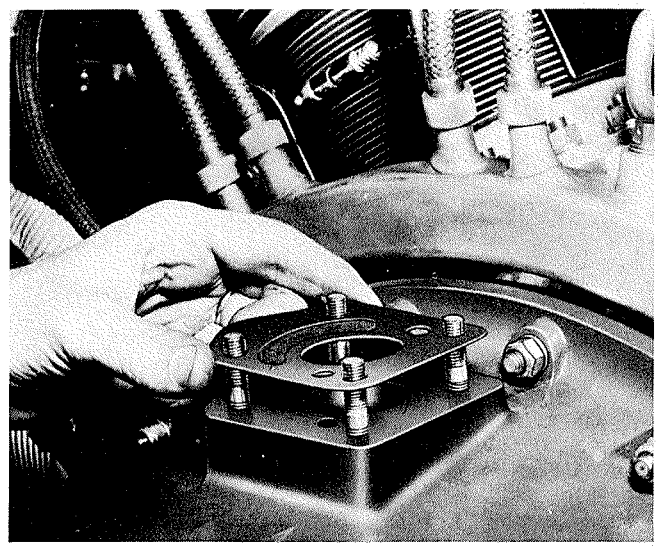


Figure 27—Installing Governor Mounting Gasket

upward into the governor base, as it is placed down onto the pad. The one proper position of the governor on the mounting pad is indicated by the shape of the joining surfaces. Care must be taken that the governor drive coupling splines enter properly into the engine-governor drive shaft internal splines. Should they not align, it is possible to force the engine-governor drive shaft out of position as the governor is installed. With the governor all the way down on its studs, the circular pilot boss should fit into the recess of the pad.

(4) With the governor in position install one washer and one self-locking nut on each mounting stud. The upper flange of the base will interfere if the governor is resting on the pad. Therefore, the unit should be raised sufficiently to allow the placing and initial tightening of the securing nuts on the mounting studs. Again, extreme care should be taken that the governor does not force the engine-governor drive

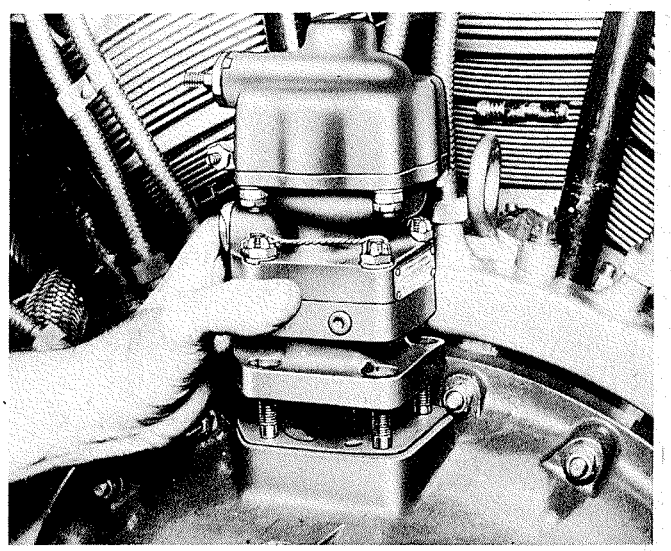


Figure 28—Placing Governor Into Position on Engine Pad

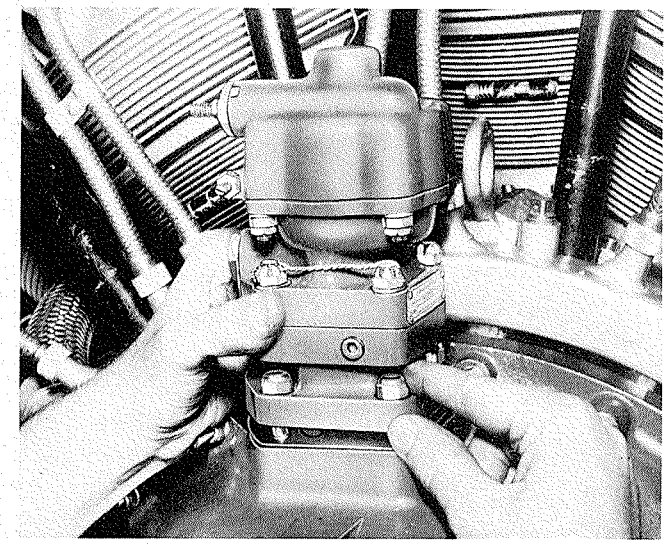


Figure 29—Installing Hold-Down Nuts

shaft out of position. As the wrench is used, it is essential that the nuts be tightened evenly but not drawn down excessively as this may cause displacement of the gasket material in the vicinity of the mounting studs resulting in warping of the governor base and subsequent leakage. If self-locking nuts are not available, use castellated nuts and safety them in pairs.

Note

When a governor using the model 1 base and the single piece drive gear shaft is installed, another check for binding must be made. Remove the head from the governor and turn the fly-weight cup to check if the original backlash of the engine-governor drive is still present. If there is binding, loosen the securing nuts and then retighten, checking backlash continually. Do not tighten excessively. As an additional precaution, turn the engine crankshaft to several different positions and check the backlash of the control at these points.

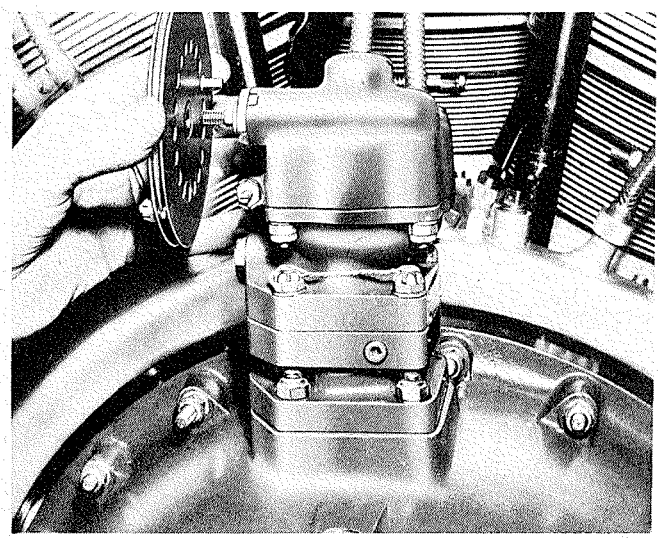


Figure 30—Installing Pulley Onto Control Shaft

(5) If the pulley has not been previously installed on the governor, it should be put on at this point. Making certain that the hex washer is on the inboard side, place the pulley onto the hex section of the control shaft in its correct angular position for the particular aircraft. If the correct pulley position is not known, it may be determined with the aid of figures 22 and 31. The pulley position must permit the governor to operate through the required range (from the positive high pitch setting established by the adjusting screw in the rack assembly to the high rpm setting established by the high rpm adjustment screw on the governor head) with the cable always tangent to the pulley on both sides of the cable clamp. Whenever the pulley is removed from the control shaft, its

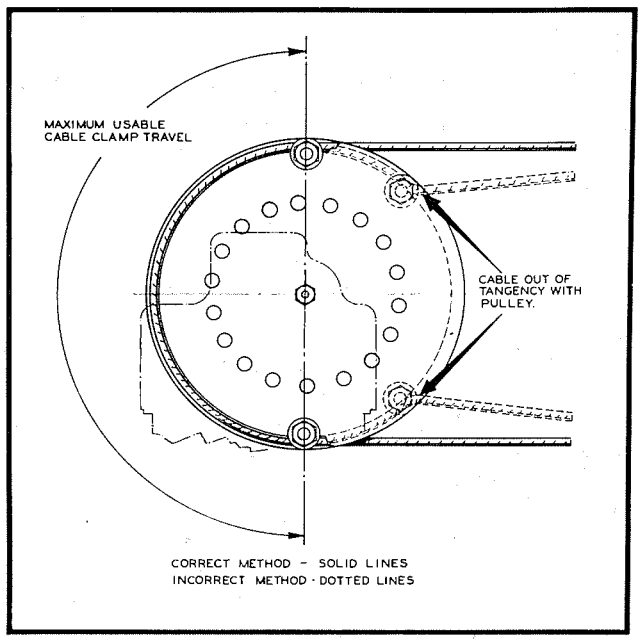


Figure 31—Correct and Incorrect Method of Attaching Cable to Pulley

angular position relative to the index line on the end of the shaft should be noted to avoid the necessity of redetermining the correct position. After the pulley has been placed onto the control shaft, the outboard washer and castellated nut should be put on. Tighten the castellated nut with a torque of 60 pound-inches, and lock it to the control shaft with a cotter pin.

(6) If it is necessary to change the pulley position on a governor which has previously been set for maximum rpm, care must be taken to shift the stop pin in the pulley the required number of holes to maintain the original setting. For example, if the governor were set with the pulley in No. 1 position and it was found necessary at installation to change it to No. 2 position, it would be necessary to shift the stop pin three holes clockwise (when facing the pulley) to

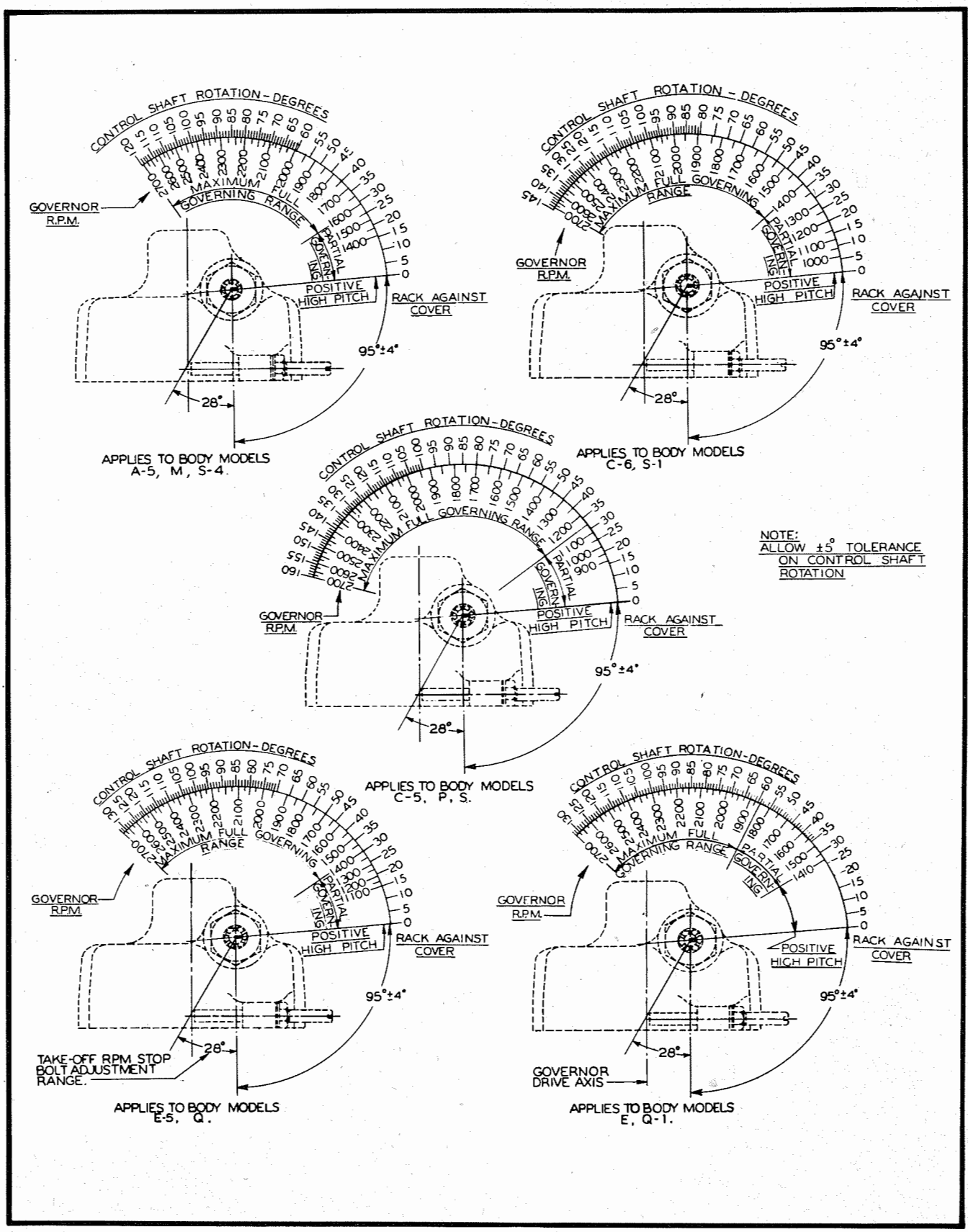


Figure 32—Pulley Travel Chart

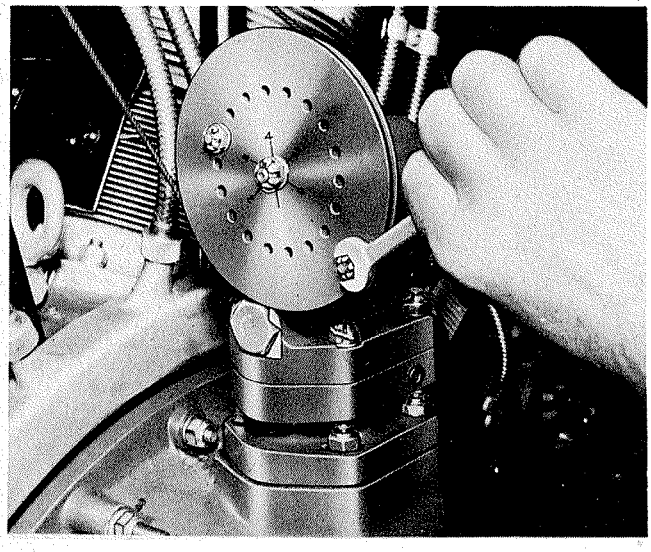


Figure 33—Tightening Cable Clamp

preserve the same maximum rpm setting. This is necessary because reindexing the pulley one position corresponds to a change of 60 degrees, and repositioning the stop pin in an adjacent hole corresponds to a change of 20 degrees.

(7) If a governor test stand is not available and it is necessary to set the maximum rpm on the aircraft, a trial setting may be made by reference to the diagrams in figure 32, which shows the relationship between governor pulley travel in degrees and governor rpm setting. To use these diagrams, first multiply the desired maximum engine rpm by the governor-engine drive ratio. For example, if maximum engine rpm is 2700, and the governor-engine drive ratio is .958:1, the maximum governor rpm would be approximately 2590. If the governor has a model Q body, figure 32 indicates a maximum pulley travel of 125 degrees. A tolerance of ± 5 degrees may be necessary in determining the correct pulley position. The pulley travel thus determined should be set by repositioning the pulley stop pin and/or turning the high rpm adjustment screw. Make final adjustments in accordance with the instructions in paragraph 3. of this section.

CAUTION

Whenever the positive high pitch setting is adjusted, the maximum rpm setting must also be readjusted. However, when the maximum rpm setting is adjusted, the positive high pitch setting remains unchanged. Adjustment of positive high pitch setting should be made only by authorized personnel in accordance with the instructions contained in section VII, paragraph 1.b.(1)(a). Usually it is unnecessary to readjust the positive high pitch setting once it has been established during test.

(8) Turn the governor pulley to its high rpm position and move the cockpit control to a point 1/8 inch from its full forward position. Secure the pulley control cable to the pulley by tightening the cable clamp over it and safetying with a cotter pin. This operation locates the cockpit control angular range with respect to the pulley angular range so that full governor control will be possible.

(9) The control cable should never be excessively tight as this will result in undue wear on the control shaft bushing. Satisfactory operation is usually obtained when the cable is under a tensile load of approximately 20 pounds. In adjusting control cable tension it is necessary that an allowance be made for the movement of the engine on its mount. Certain installations compensate for this movement by a constant load device at some point in the control system.

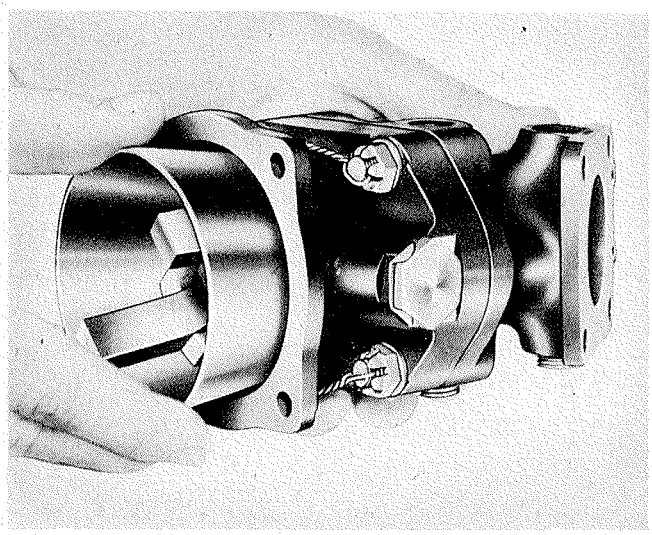


Figure 34—Checking Freedom of Movement With Fly-Weight Cup

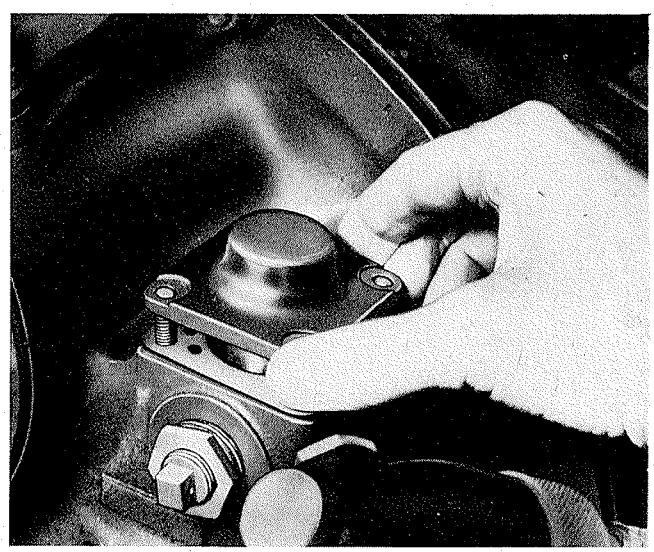


Figure 35—Removing Gun Synchronizer Pad Cover

b. GUN SYNCHRONIZER PAD INSTALLATION.

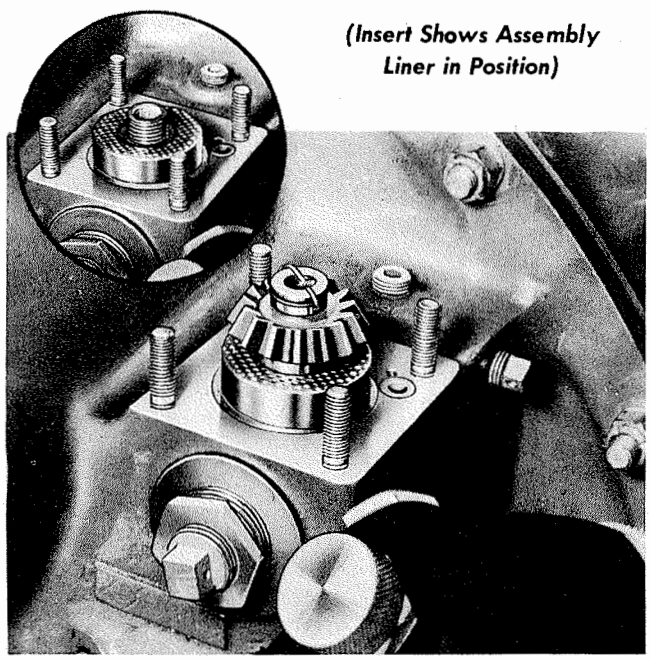
(1) Check the oil control plugging. Refer to paragraph 1.c. of this section for a more complete discussion of governor plugging.

(2) Check the governor for freedom of movement. This is more easily done by removing the head and turning the fly-weight cup. When removing the head, take extreme care not to damage the pilot valve. During installation a further check for binding is made in a similar manner, and the head should be left off at this point.

(3) The pad cover and gasket should be removed and the pad cleaned thoroughly. Since no gasket is used with the model 2 base, the mounting pad surface must be free from all irregularities. If a governor with a model 4 base is to be installed, place the mounting gasket on the pad. If a governor with a model 2 base is to be installed, the assembly liner should be put into position over the gun synchronizer drive ball bearing. Then the bevel gear should be installed and safetied.

Note

The type of drive to be used is determined by the model of governor base. If a model 2 base is used, a bevel gear adapter is attached to the drive shaft. This bevel gear adapter is either screwed or splined to the gun synchronizer shaft depending upon shaft design. When a model 4 base is used, an internally splined adapter is inserted into the end of the drive shaft.



(Insert Shows Assembly Liner in Position)

Figure 36—Drive Used With Model 2 Base

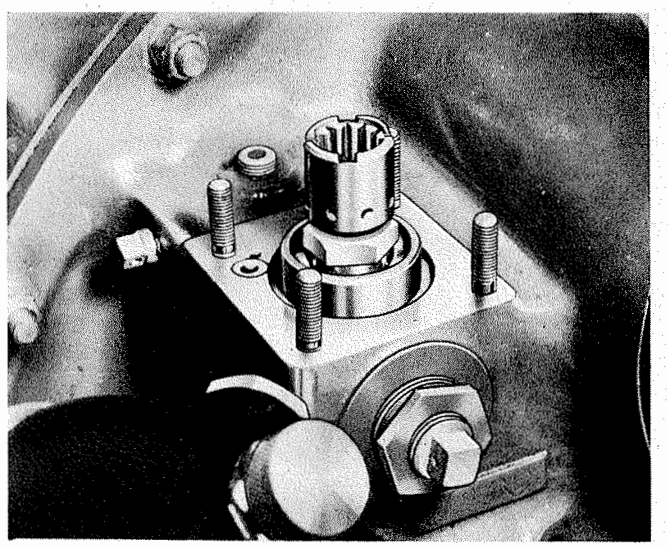


Figure 37—Drive Used With Model 4 Base

Base Model	Adapter Part No.	Remarks
2	50441	Threaded bevel gear. Uses sleeve No. 50635 and assembly liner No. 52880.
2	51219	Splined bevel gear. Assembly liner No. 52880 must be used.
3	50835	Drive coupling for rear auxiliary pad.
4	50839	Hex section drive coupling.
4	51535	Square section drive coupling.

(4) Place the governor into position being careful to align the governor drive shaft with the auxiliary drive shaft. The symmetrical design of the mounting pad permits mounting of the governor in

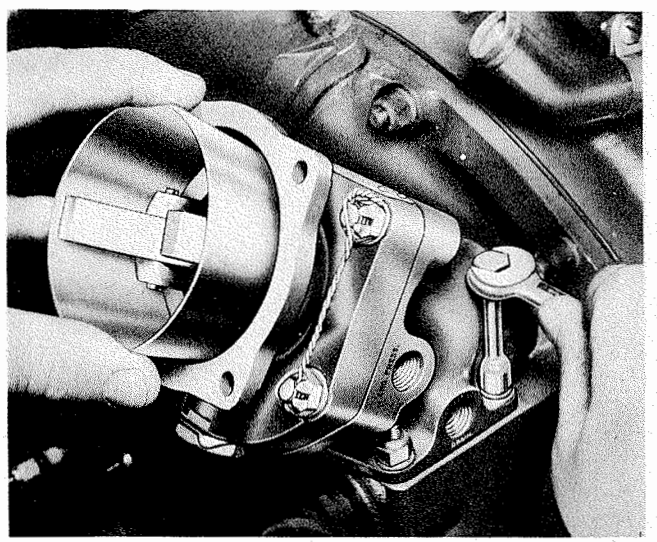


Figure 38—Checking Backlash With Fly-Weight Cup

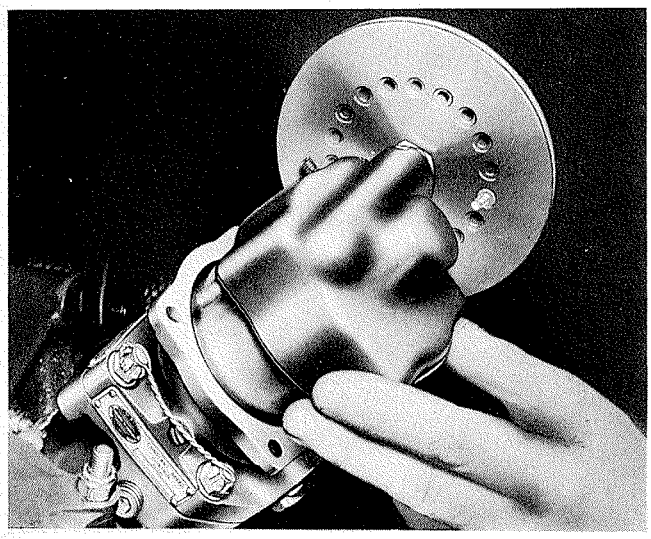


Figure 39—Installing Head on Rear Mounted Governor

several positions. The position of base to be used is determined for the particular aircraft by the aircraft manufacturer. Tighten the hold-down nuts evenly and snugly. Two special stud nuts are needed with the model 2 base. Safety the nuts in pairs. Self-locking nuts may be used when available, except for the two special stud nuts on the model 2 base.

CAUTION

Since all governors used on rear auxiliary pads have one-piece drive gear shafts, an additional check for binding should be made. Remove the governor head assembly, if this has not been done, and check the governor for freedom of movement (backlash) by turning the fly-weight cup during the tightening procedure. As an additional precaution, check the governor for freedom with the engine shaft turned to several different positions. When the base is secure, reinstall the governor head assembly.

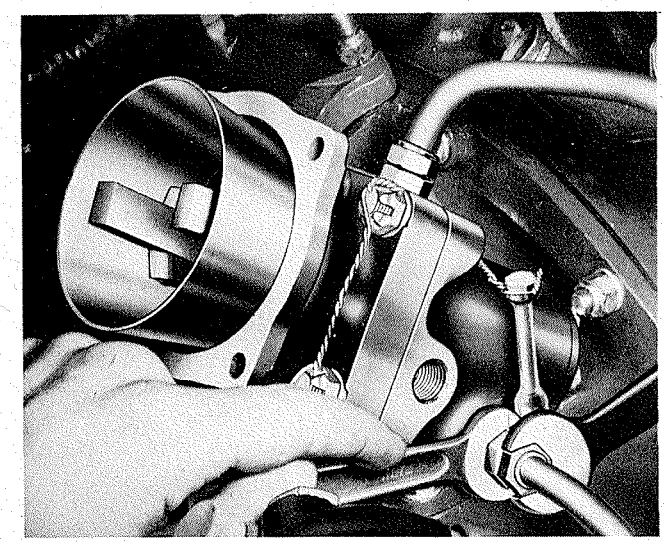


Figure 40—Connecting External Oil Line to Base

(5) Make certain the pulley is in its correct position. The correct relationship of pulley to control shaft allows full angular motion with the cable at all times tangent to the pulley on both sides of the cable clamp. Refer to this section, paragraph 2.a.(5) for further details concerning pulley alignment. The hex washer must be on the inboard side of the pulley to prevent broaching by the steel control shaft. The securing nut should be tightened with a maximum torque of 60 pound-inches and safetied by a cotter pin.

(6) With the governor pulley at the high rpm position and the cockpit control 1/8 inch from its full forward position, secure the control cable to the pulley with the cable clamp and safety it. This locates the pulley angular range with respect to the cockpit control range.

(7) A tensile load of 20 pounds is usually sufficient to insure adequate control as excessive tension may cause undue wear of the control shaft and its bushing. Allowance should always be made for movement of the engine on its mount.

(8) Three external oil lines are required: one leading from the engine oil system (at engine oil pressure) to the governor inlet port, a second from the governor to the propeller, and a third from the governor drain port to the engine sump or scavenge system. The engine generally requires special outlet connection plugs to accommodate these oil lines. Pipe plugs are inserted into the unused base outlet ports. Anti-seize compound meeting Specification No. AN-C-53 should be coated on the pipe plugs to facilitate removal and to minimize leakage. All external oil lines must be carefully installed with particular attention being paid to avoid sharp bends. As with all such external lines which carry oil under pressure, failure due to fatigue must be guarded against by the use of adequate supports closely spaced along the line. Generally, 3/8-inch inside diameter tubing is used, although the aircraft manufacturer's installation instructions should be consulted in each case. Copper, steel, or flexible type tubing should be satisfactory if properly installed.

Note

The importance of properly installing these external oil lines cannot be overemphasized inasmuch as failure may result in a serious accident. If the oil line leading from the engine lubricating system to the governor should fail, the engine oil supply might be entirely pumped out and engine seizure would result. For this reason, it is desirable to have the oil line take-off from the engine oil system so arranged that the oil pressure indicator will give an immediate warning of

Note—Continued

failure. If failure occurs in the line from the governor to the propeller, excessive leakage can be prevented by shifting the constant speed control to the positive high pitch position which completely shuts off governor pressure oil to the propeller.

c. REAR AUXILIARY PAD INSTALLATION.—Installing a model 3 base governor on this pad is similar to the gun synchronizer pad installation except that the pad itself is larger. Otherwise the instructions in paragraph 2.b. of this section should be followed.

3. CONTROL ADJUSTMENTS.

a. GENERAL.

(1) Hamilton Standard Counterweight type propellers are available with pitch ranges up to 20 degrees. Shorter ranges are adequate for many aircraft installations since the pitch range necessary is that which provides low enough low pitch to permit full take-off rpm on the ground and high enough high pitch to permit governing while descending under power from altitude. It is generally unnecessary and undesirable to employ a greater pitch range than that required to satisfy these two extreme conditions. However, the low pitch should be high enough to permit level flight without exceeding the engine's rated rpm, and the high pitch should be low enough to permit level flight without exceeding the engine's rated manifold pressure. Adjustable stops are incorporated in the pitch changing mechanism so that the high and low pitch limits can be definitely set.

(2) It is extremely important in the maintenance of manually controlled governors that the control system permit the pilot accurate and convenient rpm adjustment. When servicing cable type installations, use 3/32 inch cable because the pulley and cable clamp are designed for this size.

(3) The control system should be adjusted so that the propeller will reach take-off rpm when the cockpit lever is 1/8 inch from its full forward position, and so that the propeller will be at positive high pitch when the cockpit control is 1/8 inch from the extreme rear position. It is usually only necessary to adjust the high rpm setting of the governor control system, as this action automatically takes care of the positive high pitch setting. It is assumed that all installations are made with the forward cockpit control position corresponding to high rpm, no matter what the head position is. Figure 32 shows the relation between control shaft (or pulley) rotation and the corresponding rpm range on Counterweight type governors. It should be remembered that in figure 32 when a governor body is specified as Q-1, for example, these numbers represent the second and fifth units of the governor model designation. A 1Q12-C1A incorporates a Q-1 body.

b. ADJUSTMENT TESTS.—The following suggestions for checking and adjusting the constant speed control system assume that a cable control system is used. For any control system, the purpose is to have the cockpit control 1/8 inch from its full forward position when the governor is set to govern at take-off rpm, and the governor in the positive high pitch position when the cockpit control is 1/8 inch from its full rear position. In the high rpm condition the pulley stop pin would be against the high rpm adjustment screw on the head, and in the positive high pitch condition the rack would be against the top of the head.

(1) GROUND TEST.—If the propeller has just been installed, the governor control should be moved slowly through its entire range several times with the engine running at approximately half throttle in order to eliminate air from the oil system. The low pitch stops in the propeller should have been set for the desired low blade angle. This usually permits the engine to develop take-off rpm at take-off manifold pressure with the aircraft stationary.

Note

With some installations, and depending upon the altitude of the field, the correct low blade angle prevents the engine from reaching take-off rpm without exceeding take-off manifold pressure when the aircraft is stationary. But as airspeed increases during the take-off run, a condition occurs when the engine is developing take-off rpm and manifold pressure and the blades are against the low pitch stops. As the airspeed increases further, the blade angle increases to maintain constant rpm. In such cases the flight test procedure described in following paragraph 3.b.(2) of this section must be used. It should be remembered that in propeller installations the low pitch setting should not be so low as to prevent maintaining flight in case the propeller goes to full low pitch. As a rule in low powered installations, the low pitch angle giving take-off manifold pressure at take-off rpm on the ground will permit level flight at reduced power.

(*a*) If, with the low pitch stops in the correct position and with the cockpit control in the full forward position, the engine speed exceeds take-off rpm as the throttle is opened, the propeller blades are in full low pitch and the governor is incorrectly adjusted to govern at a higher rpm than required. To adjust the system, pull the cockpit control back slowly until the engine tachometer indicates a drop in rpm. This shows that the governor is operating

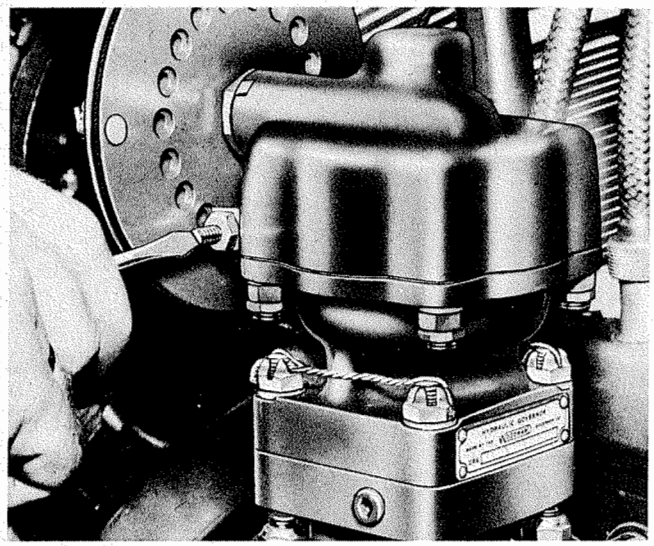


Figure 41—Adjusting High RPM Adjustment Screw

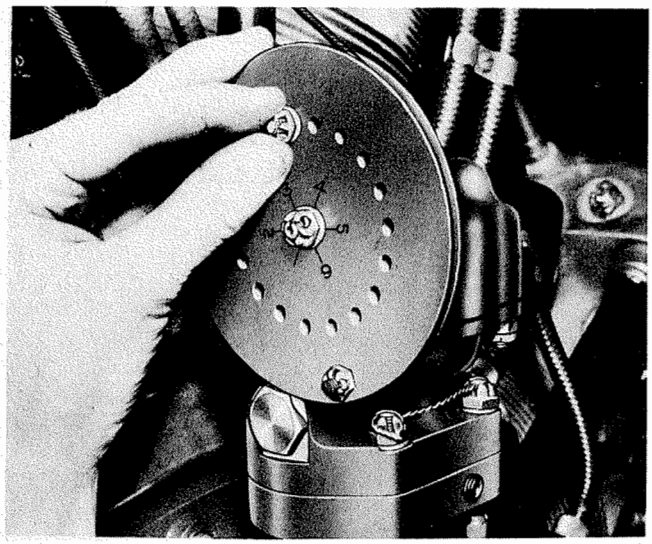


Figure 42—Repositioning Pulley Stop Pin

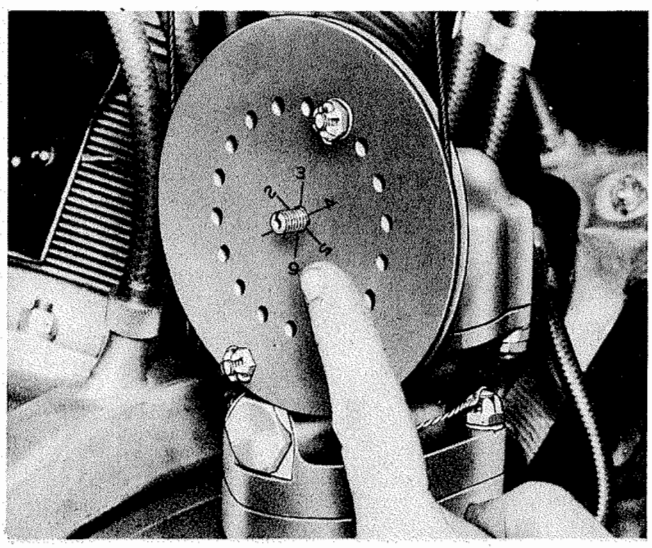


Figure 43—Reindexing Pulley on Control Shaft

correctly and can be set to govern at the indicated rpm. Adjust the governor control so that the tachometer reads take-off rpm. With no further adjustment of the propeller controls, shut down the engine. Then turn the high rpm adjustment screw on the governor head as shown in figure 41 until it just touches the pulley stop pin, and lock this assembly. One turn of the adjustment screw will change the rpm setting by approximately 25 rpm. If the correct setting cannot be obtained within the limit of this screw, the stop pin on the pulley must be repositioned as in figure 42. Moving the stop to the next adjacent hole changes the angular relationship 20 degrees or approximately 250 rpm. Always make certain that the cable is tangent to the pulley on both sides of the clamp at all points of its travel. If it is not, it will be necessary to reindex the pulley on the control shaft. Without changing the position of the pulley, readjust the control system by slipping the cable so that the cockpit control is within 1/8 inch of its full forward position. This setting of the pulley stop pin against the high rpm adjustment screw should be the take-off rpm setting for the installation. However, flight testing may indicate minor readjustments.

Note

If the engine speed exceeds the proper take-off rpm setting when the cockpit control is moved to its full forward position, it is possible for the governor setting to be too high and for the blade angle setting to be too low. To check this, reduce the throttle, leaving the governor control in the full forward position, and shut down the engine. Insure that the blades are in full low pitch position, and then check the low blade angles either by the stops in the counterweight assembly or by using a protractor at the blade reference station (42-inch station). If the low pitch is incorrectly set, reset and recheck the take-off rpm setting.

(*b*) If the engine will not reach take-off rpm with the governor control full forward as the throttle is advanced to the engine manifold pressure limit, there are several possible causes (or combination of causes). One, the governor control system may be incorrectly set; two, the engine may not be able to develop enough power to turn the propeller at take-off rpm; and three, the blade angle may be set too high. It should be remembered that with some installations it is not possible to obtain take-off rpm on the blocks. The following procedure should be followed in checking these conditions.

1. Leaving the governor control full forward (allowing for the 1/8 inch *pinch)*, stop the engine. If the pulley stop pin does not contact the high rpm adjustment screw, loosen the cable clamp,

turn the pulley until the stop pin contacts the adjustment screw, and then tighten the cable clamp. If the pulley stop pin does contact the adjustment screw, unsafety the screw, turn it counterclockwise (each turn is equivalent to about 25 rpm) and safety it again. If a large adjustment is necessary, reposition the pulley stop pin. Then, as before, readjust the cable-pulley relationship so that the pulley stop pin will contact the high rpm adjustment screw.

2. Check the propeller blade angle and reset if wrong. Consult the proper handbook.

3. Start the engine, and when warmed up, try the high rpm setting again. If the engine rpm limit is not appreciably higher than before, the engine is not developing enough power possibly due to poor carburetion or faulty ignition. Check the engine for correct operation. If the rpm limit increases but does not reach the desired take-off rpm setting, readjust the high rpm adjustment screw and try again. If the engine exceeds its rpm limit, readjust the control system as in paragraph 3.b.(1)(a) of this section.

Note

In making any of these adjustments, take care that at no position of the pulley does the cable clamp cut into the cable.

(*c*) If, with the cockpit control set at its full rear position, the engine operates at constant speed as the throttle is reduced, the positive high pitch setting has not been made. The positive high pitch adjusting screw in the speeder rack should be adjusted so that when the rack is against the top of the head, the propeller port in the drive gear shaft is open to drain at least .010 inch. Adjustment of positive high pitch should be made by authorized personnel only, in accordance with the instructions in section VII, paragraph 1.b.(1)(a). Thus, with the cockpit control in the full rear position, the propeller will be against its positive high pitch stop no matter what the setting of the throttle. However, as a result of the flight test, adjustments may be necessary on the propeller to prevent the high pitch limit from being too high.

(2) FLIGHT TEST.

(*a*) If the low blade angle setting is such that take-off rpm at take-off manifold pressure is not possible during ground run-up, it is necessary to make a flight test to determine the control system adjustment. This is accomplished by initially setting the governor high rpm well above the take-off rpm position, and "jogging" the cockpit control lever in flight until the engine turns at full take-off rpm as indicated by the tachometer. When this condition has been obtained, the aircraft should be landed without

Figure 44—Adjusting Positive High Pitch Adjusting Screw

changing the position of the control. Then reset the high rpm adjustment screw until it just touches the pulley stop pin, and readjust the cable system until this pulley position is attained with the cockpit control lever 1/8 inch from its full forward position.

(*b*) If take-off rpm cannot be obtained in the test flight, even with the cockpit control in the full forward position, it is an indication that the governor is governing at some rpm lower than take-off rpm, and that it will be necessary to readjust the system to a greater extent than was done initially.

(*c*) The high pitch limit should, in general, permit governing at cruising power descent from altitude. It is undesirable to have the high pitch limit higher than is required by operating conditions, as excessive high pitch makes it difficult to maintain level flight should the propeller be accidentally or purposely placed in the positive high pitch position.

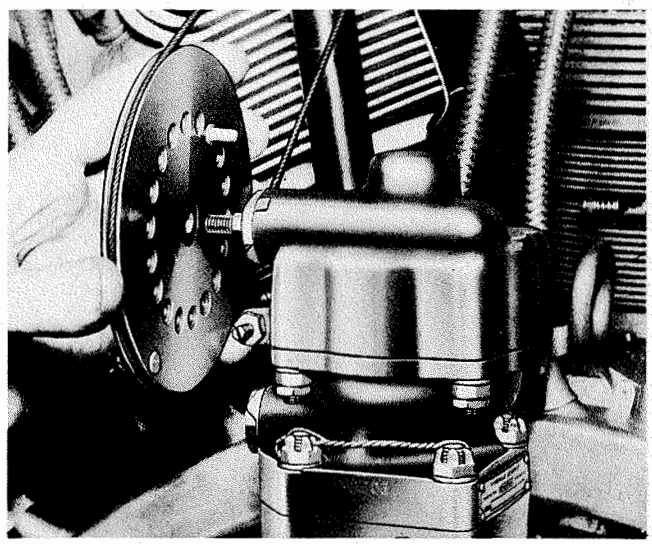


Figure 45—Leaving Pulley on Cable at Governor Removal

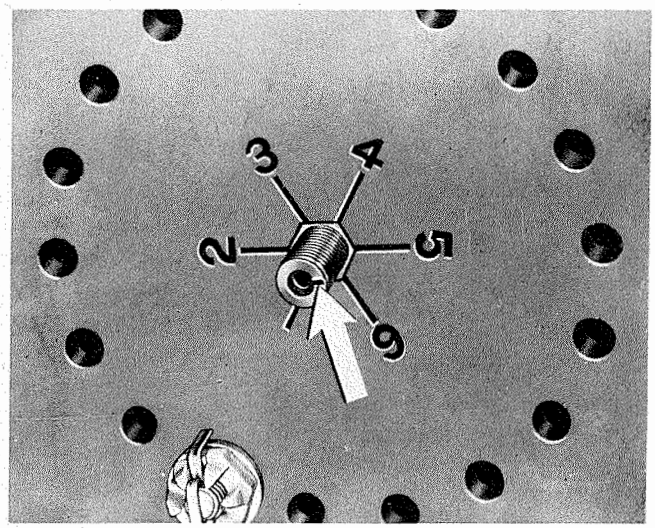


Figure 46—Control Shaft Scribe Mark and Pulley Index Numbers

4. REMOVAL OF GOVERNOR FROM ENGINE.

a. Disconnect the cockpit control from the governor. To help in reestablishing the same relationship between cockpit control and governor pulley when the unit is reinstalled on the same aircraft, follow one of the two procedures outlined below. Either of these procedures will reduce to a minimum the amount of rpm adjustment necessary when the unit is reinstalled.

(1) If the pulley is to be removed with the governor, the cockpit control cable should be marked at the point where it attaches to the cable clamp on the pulley. At governor reinstallation, insert the marked section of the cable again under the pulley cable clamp and secure it. The pulley and the cable should be in the same positions as before governor removal.

(2) It may be more convenient to leave the pulley attached to the control cable at the time of governor removal. Note the pulley position number (marked on the outer pulley face adjacent to the center hex hole) with respect to the scribed index line on the end of the control shaft. The cockpit control should be moved to the extreme rear position before the pulley is removed as at that position the speeder spring will have no compression. Therefore, the control shaft will not rotate after the pulley has been removed. At reinstallation the pulley with the cables attached need only be replaced on the control shaft in the previously noted position.

b. Remove the governor mounting stud nuts. Interference of the governor base or body for some models prevents complete removal of these nuts with the governor resting on the pad. It is necessary, therefore, to raise the governor as the nuts are being removed before the nuts can be completely removed.

c. If the governor is mounted on the engine rear section with the external lines, these lines must be disconnected, taking care not to damage them by bending or kinking. The ends of these pipes should be protected when not connected to the governor.

d. Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to replace the pad cover on the engine to prevent damage caused by foreign matter.

SECTION IV
OPERATION

1. PRINCIPLES OF OPERATION.

a. GENERAL.—The constant speed control (or governor) used with Counterweight type propellers is designed to provide the high pressure oil necessary for propeller pitch changing operation and also to provide automatic regulation of the oil flow so that the propeller will operate at a constant speed. The essential units of the governor are: a gear type pump which, supplied with engine oil at engine oil supply pressure, boosts this oil to the pressure necessary for propeller pitch changing operation; a relief valve system which limits the pressure developed by the gear pump to the value required for propeller operation; a pilot valve controlled by a fly-weight and speeder spring system (the fundamental governor mechanism) which directs the flow of oil to and from the propeller; and a rack and pinion device which controls the compression of the speeder spring. The following description of governor operation applies to both the single capacity and double capacity types since they are identical in this respect.

b. GOVERNOR CONTROL.

(1) The only manual control the pilot has over the propeller is control of the speeder rack in the governor head by operation of the cockpit control. Therefore, by means of the pulley the pilot may choose any available position of the speeder rack. This, in turn, controls the compression of the speeder spring. Centrifugal force acting on the fly-weights is changed into a vertical force upwards on the pilot valve due to the construction of the mechanism. This fly-weight force and the speeder spring force on the pilot valve oppose each other to determine the position of the pilot valve. If the speeder spring force is greater, an underspeed condition results. That is, the speed of the engine as measured by the fly-weight force is not sufficient to balance the speed desired, as set by the strength of the speeder spring. An overspeed condition exists when the opposite is true. When the two forces just balance each other and the pilot valve is in its middle or neutral position, the engine is exactly on-speed. Because of the time required for pilot valve movement and propeller controlling oil flow, it cannot be expected that propeller response to overspeed and underspeed corrections will be instantaneous. If the throttle is advanced suddenly, the engine may momentarily overspeed before sufficient oil can drain from the propeller to increase the blade angle to absorb this increase in power.

(2) The position of the speeder rack is controlled through a pulley mounted on the end of a shaft which has been inserted into the governor head. A pinion gear integral with the control shaft meshes with the speeder rack. Moving the pulley by means of the control cable turns the control shaft and so adjusts the position of the rack in the head. This varies the compression in the speeder spring and, therefore, the rpm setting.

(*a*) The limit of pulley travel in the low rpm direction is reached when the top of the rack contacts the head. As the rack moves upward, the nut on the upper end of the spring collar attached to the pilot valve contacts the positive high pitch adjusting screw inside the rack. Thus, the rack directly raises the pilot valve, and opens the propeller line to drain. When the rack contacts the head, the pilot valve should open the propeller port at least .010 inch to drain.

(*b*) The limit of pulley travel in the high rpm direction is reached when the stop pin located in one of 18 holes in the pulley strikes the end of the high rpm adjustment screw in the external boss on the governor head. Coarse rpm adjustment is made by moving the stop pin to another hole. Shifting the stop pin from one hole to the next varies pulley rotation 20 degrees with a consequent change in the high rpm setting of approximately 250 rpm. Fine adjustment is made with the adjustment screw in the head, one turn of which varies the rpm setting approximately 25 rpm.

c. OPERATING CONDITIONS.

(1) GOVERNOR ON-SPEED CONDITION.—The on-speed condition, shown in figure 47, exists when the factors of flight affecting propeller operation are constant; for example, when the aircraft is flying level through stable air. In this condition the force of the fly-weights (*5*) just balances the speeder spring force on the pilot valve (*10*). The lower land on the pilot valve (*10*) shuts off completely the line (*13*) connecting to the propeller, thus preventing the flow of oil to or from the propeller. The pressure oil from the pump is relieved through the relief valve (*6*) and is recirculated to the inlet side of the pump. Because the propeller counterweight force toward high pitch is balanced by the oil force, the cylinder (*14*) is prevented from moving, and the propeller does not change pitch. Under actual conditions a slight amount of leakage usually occurs at the engine

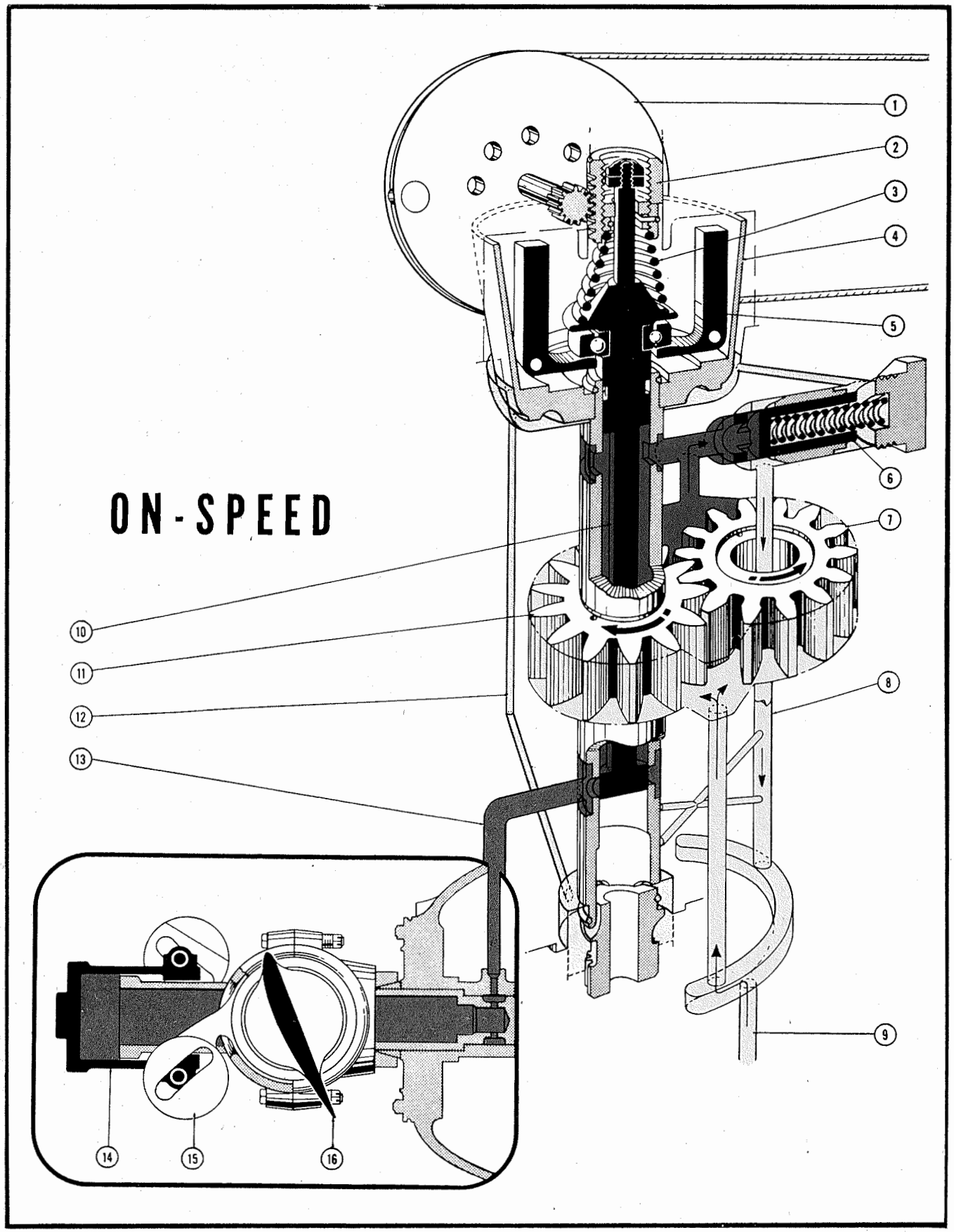
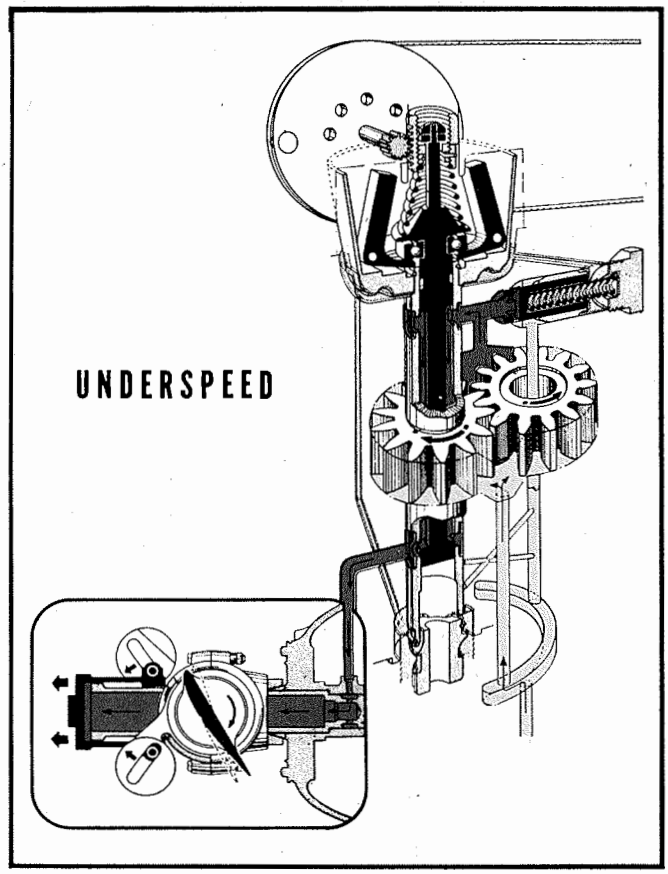
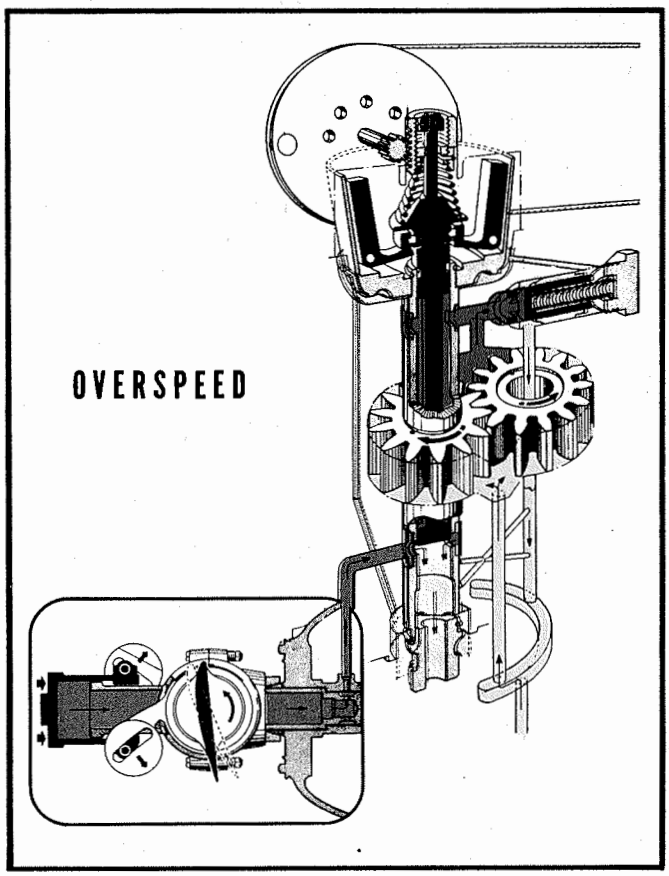


Figure 47—Governor Operating Diagram (See figure 48 for nomenclature and color key)





ENGINE OIL
GOVERNOR OIL
DRAIN OIL
PROPELLER OIL

1 PULLEY
2 SPEEDER RACK ASSEMBLY
3 SPEEDER SPRING
4 FLY-WEIGHT CUP
5 FLY-WEIGHT
6 RELIEF VALVE
7 IDLER GEAR
8 RELIEF VALVE DRAIN PASSAGE
9 ENGINE OIL SUPPLY PASSAGE
10 PILOT VALVE & SPRING COLLAR ASSEMBLY
11 DRIVE GEAR & SHAFT
12 FLY-WEIGHT CHAMBER DRAIN PASSAGE
13 PROPELLER-GOVERNOR LINE
14 PROPELLER CYLINDER
15 PROPELLER COUNTERWEIGHTS
16 PROPELLER BLADE

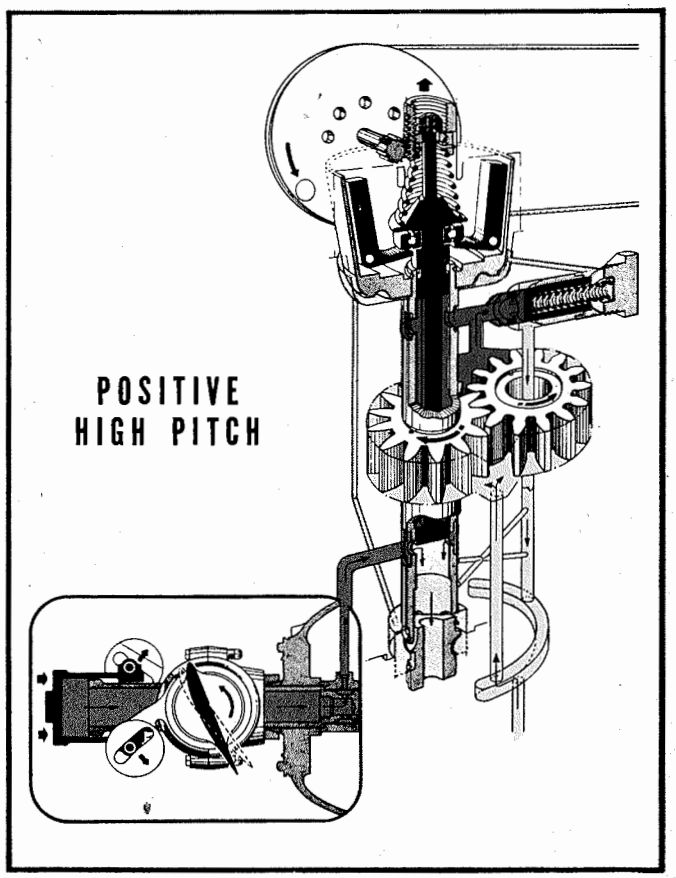


Figure 48—Governor Operating Diagrams

transfer rings. This is compensated by the governor assuming a slight underspeed condition. The pilot valve is lowered enough to meter oil at relief valve pressure to the propeller at a rate of flow which will neutralize the leakage.

(2) GOVERNOR UNDERSPEED CONDITION.—The underspeed condition, shown in figure 48, is a result of change in aircraft attitude, loss of engine power, or governor control movement toward a higher rpm. Since the force of the fly-weights (5) is less than the speeder spring force, the pilot valve (*10*) is forced down. Oil from the booster pump flows through the line (*13*) to the propeller. This forces the cylinder (*14*) outward, and the blades (*16*) turn to a lower pitch. As the blade angle decreases, less power is required to rotate the propeller and, therefore, the engine can turn the propeller faster. As the engine rpm increases, the fly-weight force increases, the pilot valve is raised, and the on-speed condition is resumed. The balance of the oil which is not flowing to the propeller is bypassed through the relief valve.

(3) GOVERNOR OVERSPEED CONDITION.—Figure 48 shows the overspeed condition which occurs when the aircraft attitude changes, the engine power is increased, or the governor control is moved towards a lower rpm. In this condition the force of the fly-weights (5) overcomes the speeder spring force and raises the pilot valve. The lower land of the pilot valve (*10*) opens the propeller line (*13*) to drain, thus permitting the counterweight force in the propeller to turn the blades towards a higher pitch. With a higher pitch, more power is required to turn the propeller, and since no more power is made available, the engine slows down. As the speed is reduced, the fly-weight force lessens and becomes equal to the speeder spring force, the pilot valve is lowered, and the governor resumes its on-speed condition.

(4) GOVERNOR POSITIVE HIGH PITCH CONDITION.—For certain operating conditions of an aircraft, it is desirable to have the propeller in a fixed pitch position, so that engine rpm is responsive to throttle control only. With a Counterweight propeller, this condition is possible when the governor (and propeller) is set into a positive high pitch position. To place the propeller into its high pitch position, the governor control is moved to its extreme rear position. This rotates the pulley (*1*) and raises the speeder rack (*2*) so that it contacts the top of its bore in the governor head. With the rack in this position, the nut on the upper end of the spring collar strikes the adjusting screw inside the rack, and is lifted as the rack is raised. Since the spring collar is screwed onto the pilot valve (*10*), the pilot valve is also raised into an overspeed position, with the propeller line (*13*) open at least .010 inch, allowing the propeller oil to drain. As the oil drains, the centrifugal force on the propeller counterweights (*15*) moves the counterweights outward and turns the blades to extreme high pitch. This blade angle will be maintained as long as the pilot valve is held mechanically in its upward position.

(5) GOVERNOR PARTIAL GOVERNING CONDITION.—Partial governing occurs in that portion of the pulley angular range between the minimum full-governing position and the positive high pitch end of the range. This range is shown in figure 32. In this condition the pilot valve is free to move an amount downward limited by the spring collar nut contacting the speeder rack adjusting screw, and an amount upward limited by the speeder spring compression. In this partial governing condition the pilot valve cannot descend far enough to allow the required governor oil to flow to the propeller during underspeed operation. Thus, only an overspeed condition can be corrected automatically. As the speeder rack is moved downward, the limit provided by the spring collar nut-speeder rack adjusting screw contact is also moved downward until contact is no longer possible. This is the minimum full-governing position.

2. OPERATION INSTRUCTIONS.

Note

The procedures outlined in this section are suggestions for the operation of Counterweight type propeller governors. However, the engine or aircraft manufacturers' operating handbooks should be consulted for each particular aircraft.

a. GROUND TEST.—To check the governing action on the ground, start the engine in the normal manner with the cockpit control in the full rear position. With the governor set in this positive high pitch position, the propeller will operate as a fixed pitch propeller, and the engine will be controlled by the throttle only. As soon as oil pressure is indicated, move the control to the high rpm position. If the governor is *not* operative, shut down immediately, and check the governor for correct plugging. Running an inoperative governor may cause failure of the unit.

CAUTION

The Counterweight type propeller should always be stopped in the high pitch position. The primary purpose of this is to protect the piston from accumulating particles of foreign matter on its bearing surface. Secondly, the propeller cylinder chamber will

CAUTION—Continued

be emptied of oil. Any oil remaining in the cylinder is subject to congealing in cold weather due to its exposed position. Thirdly, if the propeller is stopped in its low pitch position, the oil in the cylinder may gradually leak into the engine through the transfer rings of the propeller shaft. Then, if the engine is started with the control in a high rpm position, the propeller will require oil to maintain low pitch. This will mean a premature drain of engine oil through the governor which may cause starvation at certain engine bearings.

When the engine is sufficiently warmed up, move the governor control slowly through its range several times. This permits the escape of any trapped air in the propeller system, and at the same time checks governor operation. Move the control to the high rpm position, advance the throttle, and make the customary check of engine manifold pressure and rpm. If it is so desired, the engine magneto check may be made while the propeller is in the positive high pitch position.

b. FLIGHT TEST.—No flight test is required except those tests previously mentioned in section III to check control system adjustment.

c. FLIGHT OPERATION.

(1) TAKE-OFF.—Place the governor control in the full forward position. Gradually advance the throttle to the take-off manifold pressure desired. Engine rpm will increase until it reaches the take-off rpm for which the governor has been set. Normal overspeeding is to be expected with rapid control movement. From this point on, the rpm will be held constant by the governor, which means that full power is available during take-off and climb without excessive engine speed. Soon after take-off it is generally desirable to reduce power and then rpm. All changes in governor control and throttle setting should be made smoothly.

Note

If the power and rpm are to be increased, increase the governor control first and then the throttle. If power and rpm are to be decreased, reduce the throttle first and then the governor control. This will prevent excessive manifold pressure.

(2) CRUISING.—Once the cruising rpm has been set, it will be held constant by the governor. All changes in attitude of the aircraft, altitude, and engine manifold pressure can be made without affecting the rpm as long as the blades do not contact the pitch limit stops.

(3) FIXED PITCH OPERATION.—If it is desired, the propeller can be set in the positive high pitch position for engine checking or for any other reason.

(4) POWER DESCENT.—Power descent operation in which the power absorption limits of the propeller are not exceeded is fully controlled by the governor. As the air speed increases during descent, the governor will move the propeller blades to a higher pitch in order to hold the rpm at the desired value. If the high pitch limit of the propeller is high enough, the rpm will remain constant. If, however, the blades contact this stop, the propeller rpm will not remain constant and will be responsive to any increase in air speed or change of throttle setting. Since an increase in rpm, a decrease in manifold pressure, or a decrease in air speed requires a decrease in blade angle, it is possible for the governor to regain control by increasing the rpm with the governor control, decreasing the manifold pressure, or decreasing the air speed.

(5) APPROACH AND LANDING.—Adjust the governor to its maximum cruising rpm position, and control the engine by means of the throttle. In this position, emergency requirements can usually be met by throttle adjustment alone. Upon landing, the control should be placed in the high rpm position. This moves the blades to full low pitch which affords better ground control in taxying and more satisfactory operation of the engine.

(6) STOPPING THE ENGINE.—The propeller should always be shifted to the high pitch position before stopping the engine. The primary purpose is to protect the piston from accumulating foreign matter on its bearing surface. Secondly, the cylinder will be emptied of oil. Oil remaining in the cylinder chamber may congeal in cold weather due to its exposed position. Thirdly, if the propeller is stopped in low pitch, the oil in the cylinder chamber may gradually leak into the engine through the transfer rings of the propeller shaft. Then, if the engine is started with the control in the high rpm position, the propeller will require oil to maintain low pitch. This may cause premature drain of engine oil through the governor and oil starvation at certain engine bearings.

(7) MIXTURE CONTROL.—Since the constant speed control holds engine rpm constant regardless of power output, the mixture cannot be adjusted by watching the tachometer except when the governor and propeller have been placed in a positive high pitch position. Under certain operating conditions such as climb and power descent, it is inconvenient and undesirable to put the blades into full

high pitch in order to check the mixture. Because it is under these conditions that constant speed action is most desired and that mixture control needs most frequent adjustments for best economy, many aircraft include an automatic means of regulating the fuel-air ratio such as an automatic carburetor or a fuel-air ratio analyzer.

(8) ENGINE FAILURE.—It is very desirable to reduce engine speed to a minimum in case of engine failure. As positive high pitch is the position of least drag and minimum rpm, the propeller should be placed in this position if the engine becomes inoperative.

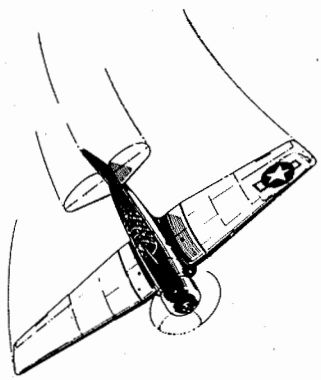
(9) OIL LINE FAILURE.—On those installations which use external oil lines there is always the possibility of failure in one of those lines. Obviously, it may be extremely difficult or impossible to discover any of these failures due to the inclosed structure of the aircraft. The best preventive is a well supported installation of oil lines.

(*a*) If failure should occur in the high pressure line leading from the governor to the propeller, leakage may be minimized by placing the governor control in the positive high pitch position. In this position the pilot valve is mechanically held above the propeller port, and effectively prevents the flow of oil to the propeller. All of the oil in the propeller will, however, be lost.

(*b*) If the oil line leading from the oil supply to the governor should fail, the engine oil may all be pumped out and engine seizure would result. As mentioned in section III, paragraph 2.b.(8), it is desirable to have the oil pressure gage so located that this type of failure would be immediately indicated. Should this failure occur, the engine should be stopped as soon as possible.

(*c*) If the external line leading from the governor drain to the engine sump should fail, all drain oil would be lost. This would eventually result in the complete loss of all oil going to the propeller. To prevent this, operate the propeller in a continuous underspeed condition by setting the governor control to its high rpm position, and reducing the throttle so that the engine cannot develop that speed. Also, the positive high pitch position will limit the loss of oil.

(10) COLD WEATHER OPERATING INSTRUCTIONS.—On aircraft equipped with provisions for dilution of the engine oil system, operate the propeller control to obtain a change of 400 rpm, and repeat this operation three times during the last two minutes of the oil dilution operation. This provides diluted oil in the propeller control system.



SECTION V
SERVICE INSPECTION, MAINTENANCE, AND LUBRICATION

1. SERVICE TOOLS REQUIRED.—There are no tools other than standard wrenches, pliers, screw drivers, etc. required for servicing governors.

2. SERVICE INSPECTION.

Note

Inspection periods established for Army Air Forces and Navy service organizations are not identical. Therefore, the inspection periods specified in this section in terms of hours consist of two figures; i.e., 25–30 Hour Inspection. The first figure indicates the Army Air Forces inspection period, and the second figure is the comparable Navy inspection period. In accordance with T. O. No. 00-20A-2, a summary of the period inspections prescribed below will be entered by Army Air Force Personnel on the Master Airplane Maintenance Forms maintained in the back of Form 41B for the airplanes affected.

—COLUMN NO. 28—
PROPELLERS AND ACCESSORIES

a. PREFLIGHT INSPECTION.

(1) Check for external oil leakage at the governor. When necessary, replace damaged gaskets and tighten the securing nuts.

(2) Make certain the control system is free from lost motion.

(3) Place the governor control in the positive high pitch position, and start the engine. As soon as oil pressure is indicated, shift the control to the high rpm position and warm up the engine in accordance with the manufacturer's recommendations. With the engine running at reduced throttle, move the governor control several times between the high and low settings and check operation of the system.

b. DAILY INSPECTION.—On those installations which have external oil lines from the governor to the propeller, check the lines for chafing and leakage, and check that all supports are in good condition, and safetied. If any union leaks, correct this trouble immediately. Inspect the lines for chafing at any points where they pass close to the structure of the engine and aircraft.

c. 25-30 HOUR INSPECTION.—Check the control shaft packing nut to see that it is securely locked. When insufficient wrench torque is used, the nut can loosen during subsequent operation and cause the gasket locking tab to chatter and chew through the slot in the head. If the lock tab does become loose, the nut may back out far enough to allow the control shaft to disengage from the speeder rack. As a result, the governor rack will be positioned by the speeder spring at a low rpm setting, and a small amount of drain oil will be lost from the head. Check the control system for security of mounting, and make certain that the cable or push rod is not chafed at any point.

d. 50-60 HOUR INSPECTION.—For each succeeding 25-hour and 30-hour period, Army and Navy personnel shall accomplish the 25-Hour and 30-Hour Inspection Forms respectively and any additional checks prescribed by local technical publications.

e. 100-120 HOUR INSPECTION.—Disconnect the governor pulley, bend back the locking tabs on the control shaft packing nut, and then remove the nut. Check for wear on the control shaft packing nut bushing, and replace the bushing or nut assembly if it is badly worn. This condition results mainly from an excessively tight control cable. Tensile load on this cable should not exceed 20 pounds.

f. 200-240 HOUR INSPECTION.

(1) Remove the pulley from the control shaft. Take off the four palnuts, nuts, and washers from the head & body attaching studs, and then lift off the governor head.

(2) Remove the rack assembly and check the rack and governor cover for scoring, galling, and corrosion. If necessary, remove this damage with crocus cloth, and lubricate the head and rack with Tulc VH grease, or grease to Specification No. AN-G-3.

g. OVERHAUL.—The maximum operating time between overhauls is the same as for Counterweight propellers.

3. MAINTENANCE.

a. LEAKAGE.—Replace damaged gaskets, or tighten the securing nuts if external leakage is detected.

b. CONTROL SYSTEM.—On a cable system, the tension adjustment should be regulated to give about 20 pounds pull in the cable. An allowance must be made for an increase in cable tension due to engine movement on its mounts. On a rigid control system, adjust the linkages to provide positive control without imposing an excessive load on the control shaft.

With either system the loading should be sufficient to provide positive control and freedom from lost motion, but not heavy enough to cause undue wear on the control shaft packing nut bushing. The cockpit governor control quadrant should be tight enough to prevent its creeping during operation, but not so tight as to prevent ease of movement when the rpm setting is changed.

c. EXTERNAL OIL LINES.—Replace any line which is damaged due to chafing. Damage and consequent failure of any external line can cause complete failure of the engine due to the loss of lubricating oil. Replace any support that is damaged or is evidently too weak.

d. LOCKING.—If any external lock wire, cotter pins, palnuts, etc. are damaged or missing, make the necessary replacement.

4. LUBRICATION.

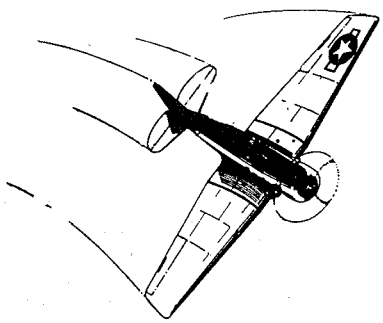
a. Since the governor operates with its moving parts constantly in oil under pressure, no additional lubrication is required.

b. The upper surfaces of the speeder rack may be corroded under certain operating conditions. To minimize this recurring, smooth down the damage with crocus cloth, thoroughly clean the parts, and then coat the speeder rack with Tulc VH lubricant, manufactured by the Universal Lubricating Company, Cleveland, Ohio, or grease manufactured to Specification No. AN-G-3.

5. SERVICE TROUBLES AND REMEDIES. — The following information in its condensed table form lists the troubles, the probable causes, and the remedies most frequently encountered in governor Field servicing work. It is to be understood that some of these troubles might also be the result of malfunctioning of the propeller, the engine, or other accessories in the aircraft; however, the remedies listed here assume the governor to be at fault and deal only with corrections to this unit. This information supplemented by a thorough understanding of the principle of operation of the governor should make trouble-shooting relatively simple. Careful and accurate determination of the troubles, their related causes, and remedies will reduce to a minimum the time required for servicing and will aid in extending the life of the equipment.

TROUBLE	PROBABLE CAUSE	REMEDY
LEAKAGE		
Between control shaft packing nut and head.	Damaged packing nut lock gasket.	Replace packing nut lock gasket.
	Loose control shaft packing nut.	Tighten control shaft packing nut.
Between control shaft packing nut and control shaft.	Damaged packing nut bushing.	Replace packing nut bushing or packing nut assembly.
	Damaged packing washer.	Replace packing washer.
Between head and body.	Damaged head & body gasket.	Replace head & body gasket.
	Loose head & body attaching nuts.	Tighten attaching nuts and palnuts.
Between relief valve plug and body.	Damaged relief valve plug lock gasket.	Replace gasket.
	Loose relief valve plug.	Retighten plug.
Between body and base.	Damaged body & base gasket.	Replace body & base gasket.
	Loose body & base stud nuts.	Retighten body & base attaching stud nuts.
Between governor base and engine mounting pad.	Damaged governor mounting gasket.	Replace governor mounting gasket.
	Loose governor attaching nuts.	Retighten nuts and palnuts.
	Warped governor base.	Lap governor base.
	Warped engine mounting pad.	Consult engine manual.
	Damaged base mounting surface.	Replace damaged part.
Between pipe plug and base on base models 2 and 4.	Loose pipe plug.	Tighten or replace pipe plug.
Between bearing cover and model 2 base.	Damaged cover gasket.	Replace gasket.
	Loose cover.	Tighten cover securely.
INABILITY TO ATTAIN TAKE-OFF RPM ON THE BLOCKS. (See section III.) NOTE With take-off manifold pressure, it is impossible in some installations to obtain take-off rpm on the blocks.	Wrong high rpm setting on governor.	Reset governor external high rpm adjustment screw. Reset on test rig if available.
	Incorrect rigging of control system.	Adjust control system.
	Low engine power.	Consult engine manual.
	Erroneous reading tachometers or manifold pressure gages.	Calibrate or replace instruments.
	Sticky pilot valve.	Remove head, clean pilot valve with crocus cloth. Maintain sharp corners of pilot valve land. Check for straightness of pilot valve, and if bent, replace.
	Sticky relief valve.	Inspect for burrs, and clean.
POOR SYNCHRONIZATION	Sludge in governor pilot valve or relief valve.	Disassemble and clean.
	Burrs on pilot valve lands.	Disassemble and clean with crocus cloth.
	Backlash in governor control system.	Rerig or adjust control system.
	Short control lever making fine adjustments of speed impossible.	Rerig control system.
	Sticky relief valve.	Inspect for burrs, and clean.
	Erroneous reading tachometers.	Calibrate or replace instruments.

TROUBLE	PROBABLE CAUSE	REMEDY
POOR SYNCHRONIZATION (Cont'd)	Sticky pilot valve bearing.	Remove head and pilot valve. Clean or replace bearing. (Check speeder spring ends for burnishing.)
	Bent pilot valve.	Remove head and replace pilot valve.
	Excessive internal leakage in governor.	Check on rig and make necessary part replacement.
	Galled or corroded speeder rack and bore.	Remove head, clean up and lubricate rack and bore.
EXCESSIVE OVERSPEEDING ON TAKE-OFF	Wrong setting on governor.	Reset governor. Use test rig if available.
	Too rapid opening of throttle.	Advance throttle evenly and slowly.
	Damaged or incorrect gasket between governor base and engine mounting pad.	Install correct new gasket.
	Sticky governor pilot or relief valve.	Disassemble, clean, and check for burrs. Replace pilot valves if found bent.
	Erroneous reading tachometers or manifold pressure gages.	Calibrate or replace instruments.
INABILITY TO ATTAIN POSITIVE HIGH PITCH	Pilot valve does not open propeller port.	Adjust screw higher in speeder rack so that pilot valve opens propeller port .010 inch when rack contacts top of head.
	Rack fails to contact top of head.	Check control system and readjust to obtain full rack travel.



SECTION VI
DISASSEMBLY, INSPECTION, REPAIR, AND REASSEMBLY

1. OVERHAUL TOOLS REQUIRED.

No tools other than standard wrenches, pliers, screw drivers, etc. are required for disassembling and assembling Counterweight governors.

2. DISASSEMBLY.

a. DISASSEMBLY OF GOVERNOR INTO SUBASSEMBLIES.

(1) Remove the palnuts, hold-down nuts, and washers from the studs in the head. Lift the head straight off evenly and slowly taking care that the pilot valve does not bind in the drive gear shaft. Do not use force, as that would dull the sharp edges of the pilot valve lands. Remove the head-body gasket.

(2) Remove the fly-weight assembly by freeing the snap ring which holds the assembly to the end of the drive gear shaft and lifting the fly-weight assembly off. The fly-weight assembly is, for all practical purposes, an integral assembly, and no attempt should be made to remove the fly-weights from the cup or the cup wall from the base.

(3) To separate the body from the base, first remove the drive gear coupling and the lock ring. This operation may be assisted by holding the coupling in a soft-jawed vise. On governors having the model 1 base, remove the body & base locating screw, lock nut, nut, and washer. Remove the lock wire, the securing nuts, and the included washers from the studs which hold the body assembly to the base assembly. Holding the body firmly in one hand, lightly tap the upper end of the drive gear shaft with a non-ferrous or a non-metallic hammer. This will drive the base away from the body. Remove the drive gear shaft and the idler gear. Leave the single capacity idler gear shaft in whichever housing it remains when the parts are separated.

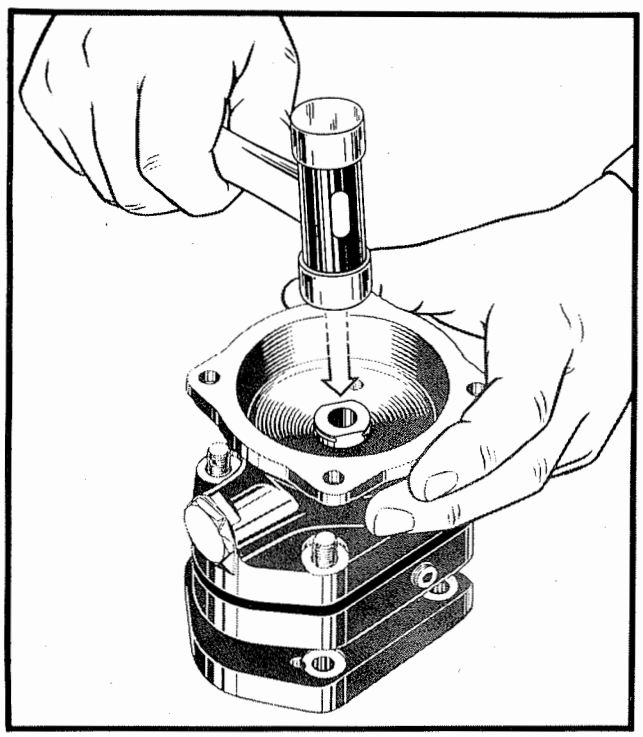


Figure 49—Separating the Body From the Base

Note

The idler gear shaft will usually remain in the body. However, manufacturing tolerances are such that the shaft may be a light press fit in the base, and as a result, remain fixed in the base at governor disassembly. In any event, the shaft should be left as it is found since repeated removals will cause enlargement of the recess in the housing. Refer to section VI, paragraph 3.c.(2)(f) for a rework procedure for loose idler gear shafts. At governor reassembly, the shaft should be checked to ascertain that it is properly seated.

b. DISASSEMBLY OF HEAD ASSEMBLY.

(1) Note the position of the pulley relative to the scribed line on the control shaft. Remove the cotter pin, nut, washer, pulley, and hex washer. Pull the speeder rack-pilot valve assembly straight out

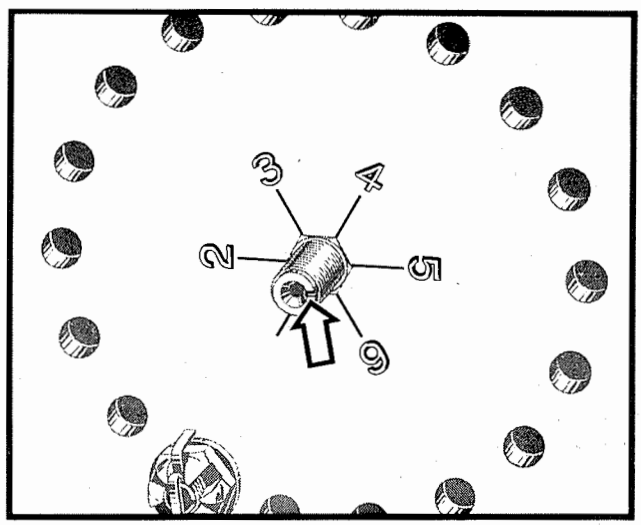


Figure 50—Note Position of Pulley Before Removal

from the head bore. Bend back the control shaft packing nut tab lock gasket. Then the control shaft packing nut, the control shaft with its packing washer, and the control shaft spring should be taken out.

(2) It is usually unnecessary to remove the high rpm adjustment screw from the head unless it is damaged.

(3) To disassemble the speeder rack-pilot valve assembly, remove the lock nut and hold-down nut from the end of the spring collar. Lift off the rack, speeder spring, and spring collar spacer. In certain models the speeder spring is screwed into a lip on the spring collar lower flange. It is easily removed by unscrewing. If necessary, unsafety and remove the spring collar and the pilot valve bearing from the pilot valve. This should not be done unless the parts are damaged since the hole in the pilot valve used for safetying is drilled at assembly and correct realignment of spring collar and pilot valve cotter pin holes may be difficult.

c. DISASSEMBLY OF BODY ASSEMBLY.

(1) Unsafety the relief valve plug tab lock gasket, unscrew the relief valve plug, and remove the relief valve spring and plunger. The relief valve bushing in the single capacity governor is a press fit and should not be removed except for replacement.

(2) The oil control plug is left in the body unless it is desired to reverse the direction of governor rotation before reinstallation.

Note

A small plug is incorporated in the body housing of single capacity governors at the end of the high pressure passage. During the manufacture of the governor it is necessary to pierce the casting wall, and this plug is merely used to seal the wall of the housing. It has no functional purpose and should never be removed during routine governor disassembly.

(3) A small neoprene gasket is included in the body parting surface of single capacity governors and in the base parting surface of double capacity governors, in both cases encircling the gear pump recess. In general, if inspection indicates that the gasket has not been damaged, it will not be necessary to remove it. In order to avoid possible leakage between the body and the base, some operators consider it desirable to replace this gasket during governor overhaul regardless of its apparent condition.

(4) On those body models which have body & base locating dowels, it is ordinarily not necessary to remove these dowels at disassembly. However, if they are loose in the body or do not fit snugly in the base, replace them with oversize dowels according to the procedure outlined in section VI, paragraph 3.c.(2)(e).

d. DISASSEMBLY OF BASE ASSEMBLY.

(1) Base models 1, 3, 4, 10, and 12 are not disassembled. All studs, permanent sealing plugs, and the bushing in the model 1 base are left in the housing unless damaged. Unless the direction of rotation is to be reversed, the oil control plug is not removed. However, the oil line strainer in the newer double capacity base model should be removed and cleaned.

(2) On the model 2 base, remove the safety wire, bearing cover screws, bearing cover plate, and gasket. Then push out the shaft and bearing. The bearing should be a slip fit in the housing recess.

3. CLEANING, INSPECTION, TESTING, AND REPAIR.

a. CLEANING.—Governor parts are to be thoroughly cleaned with kerosene, non-leaded gasoline, or some other suitable non-caustic cleaning solution. All parts must be completely free of grease and oil prior to inspection.

b. INSPECTION.—Unless otherwise specified, any worn parts which do not impair functioning of the unit or cause it to fall below the oil test specification requirements of section VII are to be considered satisfactory for future use. Unless neoprene and composition gaskets are in exceptionally good condition, replace them at reassembly.

(1) VISUAL.—Examine all parts carefully for galling, cracks, damage, etc.

(2) MAGNETIC.—The drive gear & shaft, idler gear, and drive coupling are to be inspected by an approved magnetic process.

c. REPAIR AND REPLACEMENT.

(1) HEAD ASSEMBLY.

(*a*) SPEEDER RACK AND BORE.—The speeder rack should be free from corrosion, and any metal pick-up is to be polished off with fine emery or crocus cloth. Make certain that the part is absolutely clean before it is reassembled into the governor. The speeder rack bore should also be polished if it is corroded, galled, or scored. Tulc VH grease (or a grease to Specification No. AN-G-3) applied on the rack, and the rack bore, is recommended as a corrosion preventive. The maximum diameter of the bore is .878 inch, and a larger diameter is cause for replacement of the head housing. Similarly, the minimum rack diameter is .873 inch.

(*b*) CONTROL SHAFT AND PACKING NUT.—The control shaft should be replaced if its packing nut bearing surface is worn enough to cause oil leakage or faulty operation. The shaft may be salvaged according to the procedure in paragraph 3.c.(1)(c) of section VI. Before replacing the control shaft, make certain neither the packing nut bushing nor control shaft packing washer is worn sufficiently to cause leakage. Wearing off of the plating on the control shaft gear teeth should not be confused with actual wearing of the teeth. When the shaft is pushed into the head (at any angular position), it should spring out freely. Sticking is an indication of a cocked bushing in the control shaft packing nut, or a bent control shaft. If the packing nut bushing is worn or damaged enough to cause oil leakage or poor operation, replace either the bushing itself or the packing nut assembly.

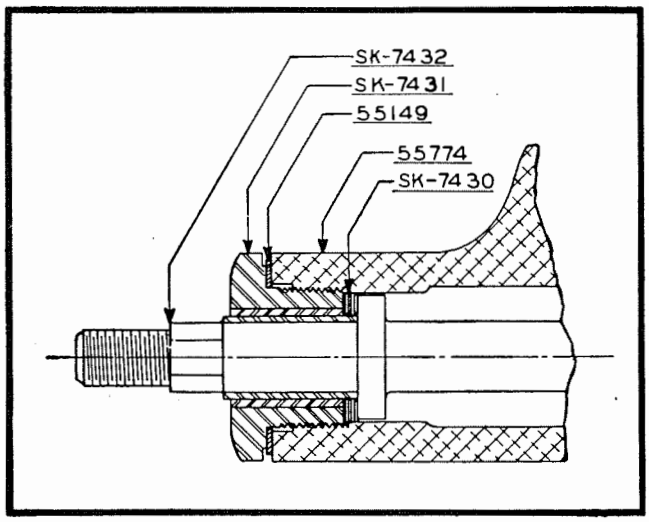


Figure 51—Assembled View of Reworked Control Shaft

(*c*) SALVAGE OF WORN CONTROL SHAFTS.

1. Governor control shafts No. 53345 which are worn at the packing nut bearing surface can again be made serviceable by fitting a steel sleeve (figure 53) over the worn end of the shaft.

2. Wear on the shaft does not usually take place over the entire bearing length (from the inboard end of the hex to the .578 inch diameter shoulder), and hence there remains approximately 1/16 inch at each end of this bearing length which is still to the original .311 inch diameter. These unworn sections serve as a pilot to center the steel sleeve.

3. Figure 52 shows a reworked control shaft assembly with the steel sleeve in place. To accomplish this, make up a steel sleeve in accordance with part No. SK-7433 (shown in figure 53), and make certain that the ID and OD of the sleeve are

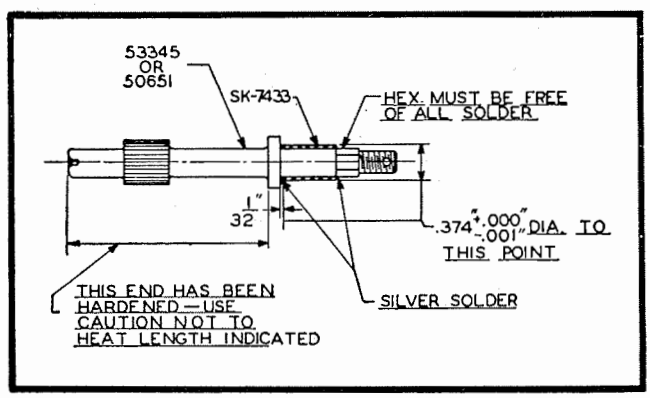


Figure 52—Control Shaft With Sleeve

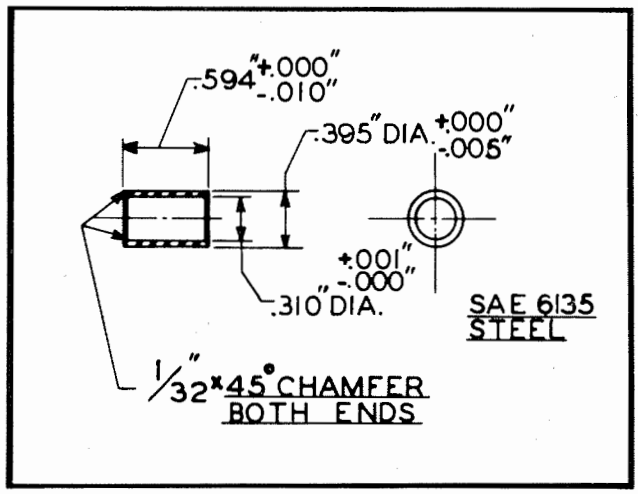


Figure 53—Control Shaft Sleeve

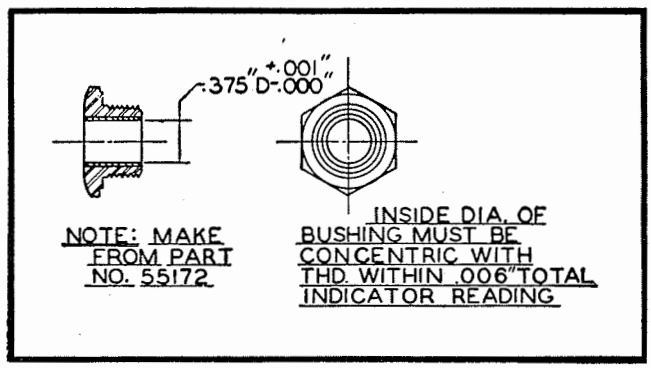


Figure 54—Reworked Packing Nut

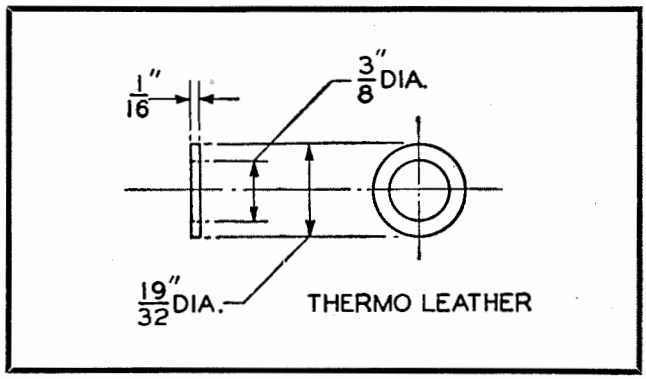


Figure 55—Packing Nut Leather Washer

concentric. Use steel to specification No. AN-S-16, or No. SAE 6135. Solder this sleeve onto the control shaft as shown in figure 52. There is no need to grind the sleeve OD concentric with the remainder of the shaft; however, if it is desired to finish the sleeve after it has been soldered in place, the shaft may be set on centers and the sleeve ground to the required size. The packing nut used on a reworked shaft is made by reaming out the bushing to .375 $^{+.001}_{-.000}$ inch diameter as shown.

4. Clean all parts thoroughly, and then assemble them into the governor head with a leather washer (figure 55) installed between the packing nut and the control shaft flange, and a tab lock gasket between the packing nut and the governor head.

(*d*) PULLEY.—When the hex hole washer has been omitted inboard of the pulley, the hard steel control shaft may broach through the comparatively soft pulley during operation of the governor. In such a case, or if the hex hole in the pulley has worn such that it no longer gives positive control, replace the pulley.

(2) BODY ASSEMBLY.

(*a*) GENERAL.—Make certain that all oil passages are open and free from sludge and dirt. Replace seals, gaskets, and washers which are not satisfactory for further service. All parting surfaces are to be free from nicks and burrs, and the oil control plug must be tight and correctly located for the installation (see section III, paragraph 1.c.).

(*b*) RELIEF VALVE SYSTEM.—Check that the plunger and bore are in good condition. These may be cleaned with crocus or fine emery cloth so long as the governor will pass the operational oil test requirements of section VII.

(*c*) PUMP.—Make certain the drive and idler gear shaft bores are free from irregularities. Burrs or local high spots may be removed by careful use of a bearing scraper so long as the pump meets the capacity requirements of section VII, and the governor leakage specifications are not exceeded. Check that the pump parts do not bind by hand turning the drive gear shaft.

(*d*) PILOT VALVE ASSEMBLY.—The pilot valve ball bearing should spin freely. If, after cleaning the bearing thoroughly, binding is noticed, replace the bearing. Check to see that the pilot valve fits in the drive gear shaft in any angular position without binding. This valve may be dressed down lightly with crocus cloth, but the edges on the valve lands must be maintained sharp and square. Rounded edges on the pilot valve lands will cause poor operation of the governor. Replace any valves which bind because they are bent. The speeder spring should be free from corrosion and discoloration. If the pilot valve ball bearing binds, the speeder spring will turn during governor operation and excessive heat will be generated between the speeder spring and the adjustment screw in the rack, and in some cases, the speeder spring collar at the bottom. This condition is evidenced by discoloration of the spring, and the result is permanent set in the spring and/or a change in the spring characteristics. Replace speeder springs damaged in this way.

(*e*) INSTALLATION OF OVERSIZE BODY & BASE LOCATING DOWELS.

1. GENERAL.—When a governor has been disassembled a number of times, the dowel holes in the body and base tend to become enlarged, causing loose dowel fits and consequent chance of misalignment. These locating dowels and the body & base locating screw used with the model 1 base are available in .0156 inch and .0313 inch oversize diameters.

2. REWORK PROCEDURE.

a. With the drive gear shaft and idler gear and shaft installed, bolt the body and base together. Rotate the drive gear while tightening the nuts evenly, to insure free movement of the gears.

TABLE NO. 1

	Dowel 53166-15	Dowel 53166-31	Screw 53401-15	Screw 53401-31
Diameter of dowel or fillister head screw (inch)	.2031 $^{+.0002}_{-.0001}$	.2188 $^{+.0002}_{-.0001}$	.2339 $^{+.0000}_{-.0005}$	.2496 $^{+.0000}_{-.0005}$
Size of drill (inch)	#12 (.189)	13/64	7/32	15/64
Depth of drill hole in body (inch)	7/16	7/16	drill through	drill through
Ream body and base to (inch)	.2028 $^{+.0000}_{-.0003}$	.2185 $^{+.0000}_{-.0003}$	.2343 $^{+.0003}_{-.0002}$	.2500 $^{+.0003}_{-.0002}$
Depth of reamed hole in body (inch)	3/8	3/8	through	through
Ream base only to (inch)	.2033 $^{+.0005}_{-.0000}$	.2190 $^{+.0008}_{-.0000}$	not relieved	not relieved

b. Using the base holes as a guide, drill into the body dowel holes to a depth of 7/16 inch. Use a No. 12 (.189 inch) drill if a .0156-inch oversize dowel is to be installed, or a 13/64-inch drill if a .0313-inch oversize dowel is to be installed.

Note

Both flanges of the model 10 and 12 bases are drilled during manufacture to facilitate the doweling operation. The flange on the bottom of the base incorporates 13/64-inch holes through which all doweling operations should be performed. This insures squareness of the dowels with the parting surfaces of base and body.

c. Ream the holes in the body to .2028 $^{+.0000}_{-.0003}$ inch diameter and 3/8 inch depth if a .0156 oversize dowel is to be installed, or .2185 $^{+.0000}_{-.0003}$ inch diameter and 3/8 inch depth if a .0313 inch oversize dowel is to be installed.

d. Then ream the holes *in the base only* to .2033 $^{+.0005}_{-.0000}$ inch diameter or .2190 $^{+.0005}_{-.0000}$ inch diameter depending upon the size of dowel to be used.

CAUTION

Be sure that the reamer completely cleans up the holes in the base, but still does not remove any material from the body.

e. Without disturbing the relationship between governor body and base, drive whichever size dowels are to be used through the base and into the body to a depth of 3/8 inch. Be sure that the tapered ends of the dowels are facing outward through the base.

f. When an oversize body & base locating screw is required in the model 1 base, the hole through the body and base is reamed to the same size, and in this case the hole in the base is not further relieved.

(*f*) REWORK OF IDLER GEAR SHAFT.

1. After repeated disassembly of a single capacity governor, the idler gear shaft may become loose in the body and base bores, thus permitting rotation of the shaft and increased wear. Usually the idler gear shaft is a light press fit in the body bore only; however, it is possible for it also to be a light press fit in the base bore and still be within limits. When the governor is disassembled, the shaft usually remains with the body but can remain with the base under certain tolerance conditions. It is recommended that in order to minimize enlargement of either bore, the shaft be left in that part of the governor in which it is found upon disassembly. At reassembly, make certain that the shaft is seated firmly, for it may have been partly pulled out during disassembly.

2. Idler gear shafts which have been found to be a loose or slip fit in both body and base shaft bores may be reworked. As the base has the deeper bore and, therefore, the larger shaft bearing surface, it is desirable that the idler gear shaft be reworked to provide a light press fit in the base.

3. To rework the idler gear shaft, mask the shaft with a suitable material such as masking tape, leaving exposed the amount of the lower end of the shaft which enters the bore. Flash plate with copper the exposed portion of the shaft and then cadmium plate to a diameter of .565 $^{+.000}_{-.005}$ inch. If the shaft is plated oversize, it may be ground down to the proper diameter.

4. Upon reinstallation in the governor base, care should be taken that the fit is not so tight as to deform the surface against which the idler gear bears and that the shaft is perpendicular to the parting surface of the base. Since only the end of the shaft which is inserted into the base has had an increase in diameter, no difficulty should be encountered in installing the idler gear over the idler gear shaft.

(3) BASE ASSEMBLY.

(*a*) If the model 1 body & base locating screw is loose, replace it with an oversize screw according to the instructions in section VI, paragraph 3.c.(2)(e).

(*b*) Check to see that the base oil control plug is secure and properly located for the direction of governor drive rotation incorporated in the installation. A complete description of governor plugging procedure is given in section III, paragraph 1.c.

(*c*) Check to see that the drive and idler gear shaft bores and the pump chamber are smooth. If necessary, rework these surfaces with fine emery and crocus cloth.

(*d*) Make certain all oil passages are open and free from dirt or sludge. Clean the strainer in the double capacity base.

(*e*) Check all parting surfaces for nicks and burrs.

(4) INSTALLATION OF NEW GOVERNOR BASES ON USED GOVERNOR BODIES.

(*a*) GENERAL.—The following information covers installation of new governor bases *of the same type* on used governor bodies. If the drive gear shaft hole in the new replacement base is reamed to the finished size, only the instructions given in paragraph 3.c.(2)(e) of this section are to be followed.

(*b*) LINE REAMING DRIVE GEAR SHAFT HOLE.

1. Remove present dowels from the body.

2. Install the idler gear and shaft in the body. The single capacity governor has idler gear and shaft separate, and in the double capacity the shaft is integral with the gear.

3. Bolt the body and base together loosely. Then insert the alignment bar into the drive shaft bore from the body side.

Note

Before reaming the drive gear shaft hole in the base to the correct size, manufacture locally an 8-inch hardened and ground alignment bar which is inserted into the body and base to obtain proper alignment. The bar has two different diameters, each being about 4 inches long. One end of the bar should be .750 inch in diameter, and the other turned down to .740 inch diameter. The two surfaces must be parallel.

4. Tighten the body & base holding nuts evenly and securely, and then remove the alignment bar.

5. Using the body to pilot the reamer, line ream the drive gear shaft hole in the base to .7507 $^{+.0005}_{-.0000}$ inch diameter.

6. Disassemble and clean the parts.

(*c*) INSTALLING OVERSIZE DOWELS.—When the drive gear shaft hole in the base has been reamed to size, install oversize body & base locating dowels according to the directions given in this section, paragraph 3.c.(2)(e).

4. REASSEMBLY.

a. ASSEMBLY OF BASE.

(1) Install an oil control plug in the base. This plug should be screwed into the hole marked "B" for governors when the drive rotation is clockwise (looking toward the engine-governor mounting pad), and for counterclockwise drive rotation, the hole marked "A" should be plugged. Since this is a pipe plug, the interference fit between the plug and base threads will be sufficient to lock the plug if it is securely tightened. This procedure is more fully explained in section III, paragraph 1.c.

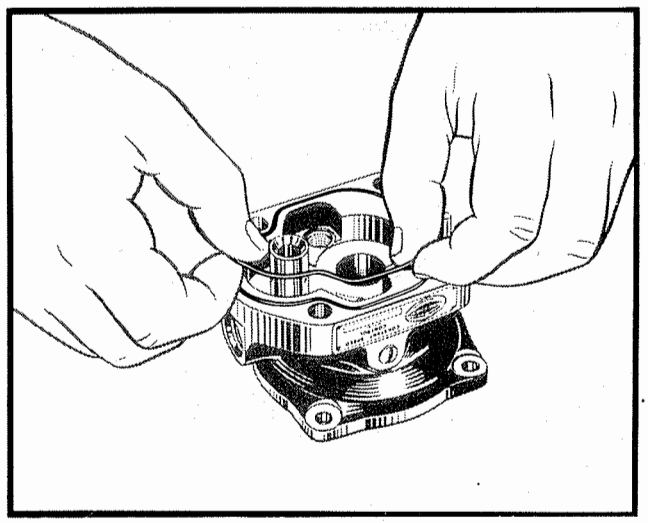


Figure 57—Placing Body & Base Gasket Into Position

(2) When base model 2 is used, insert the shaft and bearing. Then put on the gasket and bearing cover, holding them in place with the seven screws. It is necessary to file or grind off part of the two screw heads which project into the mounting surface.

b. ASSEMBLY OF BODY.

(1) Thoroughly clean all parts and use a light oil (SAE 10) to provide ease in assembly. If the body & base locating dowels are loose in the body, or if they were removed during disassembly, replace them with oversize dowels according to the following tabulation.

Body & Base Locating Dowel	Body & Base Locating Screw	Amount Oversize
53166	53401	.0000 inch
53166-15	53401-15	.0156 inch
53166-31	53401-31	.0313 inch

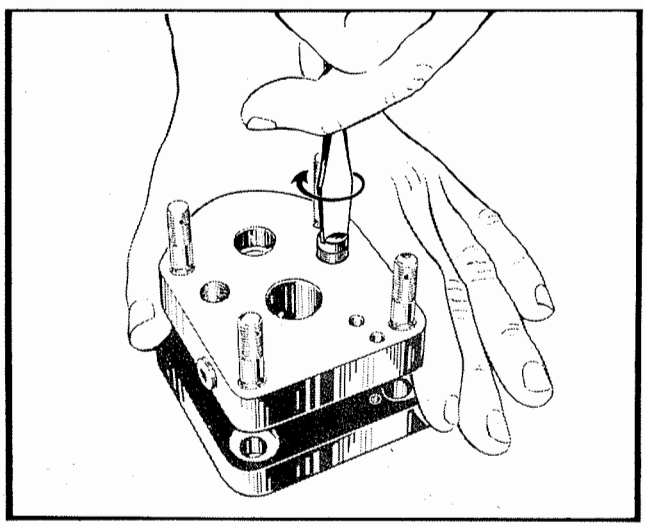


Figure 56—Tightening Oil Control Plug in Base

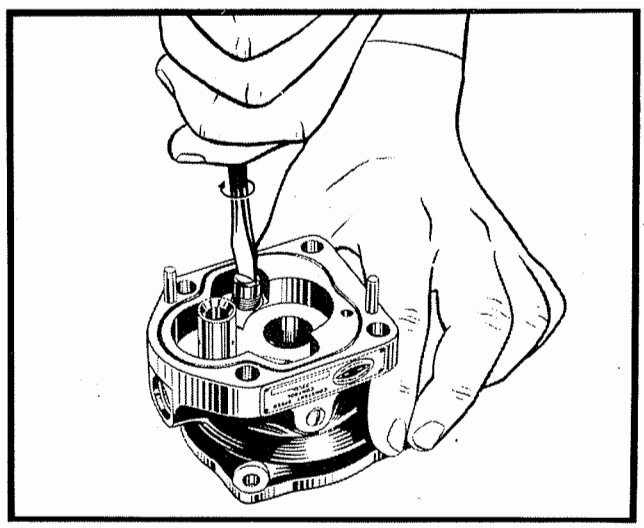


Figure 58—Tightening Oil Control Plug in Body

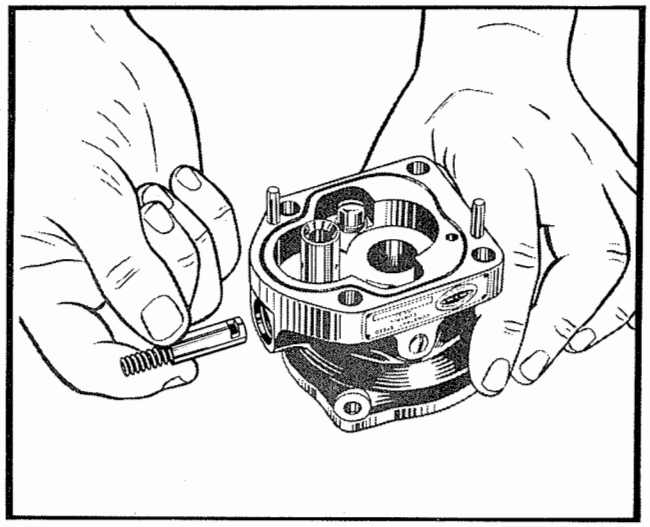


Figure 59—Inserting Relief Valve Plunger and Spring into Governor Body

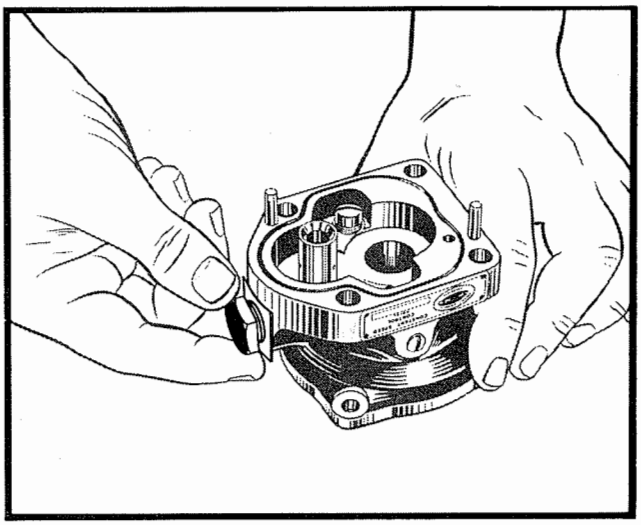


Figure 60—Inserting Relief Valve Plug and Tab Lock Gasket

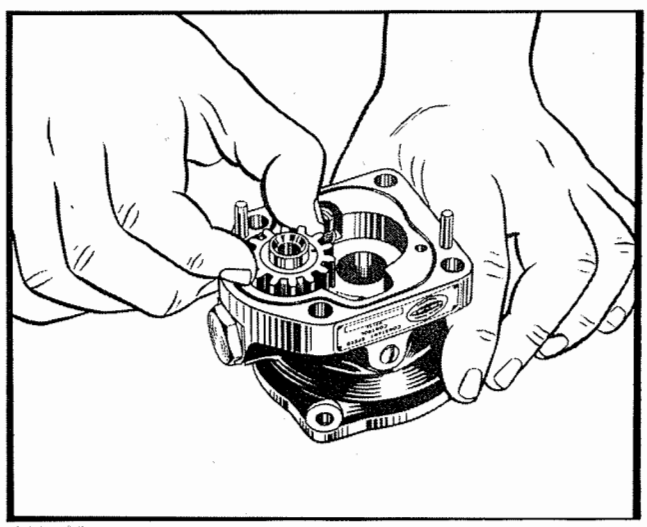


Figure 61—Placing Idler Gear Into Position

(2) If the small gasket between the governor body and base had previously been removed, reinstall (or replace) the gasket in the body of the single capacity governor and in the base of the double capacity governor. This gasket may have a trapezoidal cross section, and if so, make sure that the wider section enters the bottom of the groove.

(3) Install an oil control plug in the body pump recess. Body and base plugging should always be identical; i.e., A-A or B-B. Install the conical strainer in the double capacity base. See paragraph 1.c. in this section for more complete instructions.

(4) To assemble the booster pump relief valve, insert the relief valve plunger, slotted end first, into the relief valve bore with the spring inside the plunger bore. Add the relief valve gasket over the outer face of the relief valve bore in such a way that the wide

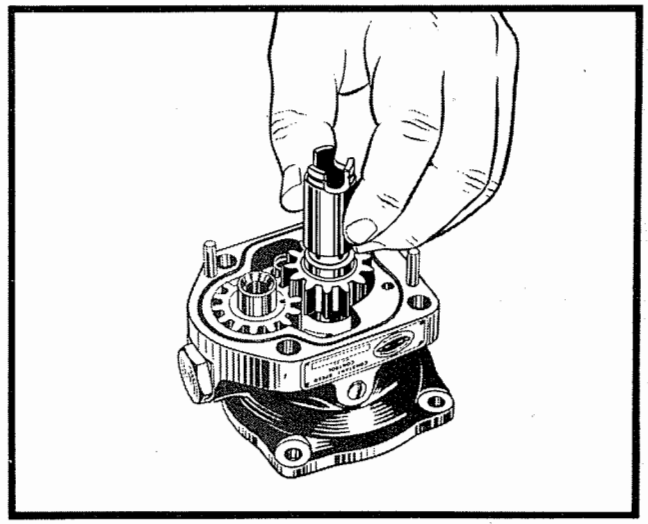


Figure 62—Placing Drive Gear Shaft Into Position

border section of the gasket rests on the gasket ledge incorporated in the body. Insert the relief valve plug and turn it down securely into place. Lock the assembly by bending the upper two corners of the relief valve plug locking gasket over the hex flats of the plug.

(5) Install the idler gear on the idler gear shaft in the pump recess.

(6) Insert the drive gear shaft (pronged or splined end pointing upward) next to the idler gear.

Note

If the idler gear shaft remained in the base at disassembly, reverse the pump assembly procedure described in the two preceding paragraphs and install the idler gear and drive gear shaft (pronged or splined end first) in the base.

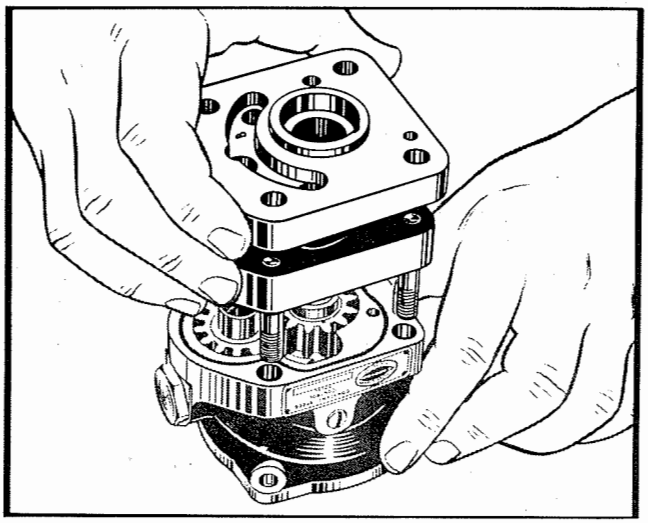


Figure 63—Installing Base Onto Body

c. ASSEMBLY OF BODY TO BASE.

(1) Invert the base and carefully start it in place on the drive gear shaft. Move it along until the studs enter the proper holes in the body, and the dowels are started. Press the body and base together allowing about 1/4 inch at the parting surfaces.

(2) Because of space requirements, it will usually be necessary to add the washers and castellated nuts over the studs before the body and base are finally closed. Draw these nuts down evenly and snugly, and then wire them together in sets of two. When base model 1 is used, install the body & base locating screw, washer, nut, and palnut.

(3) Place the fly-weight cup over the exposed portion of the drive gear shaft at the top of the body, and lock the assembly by adding the fly-weight cup snap ring on the end of the drive gear shaft.

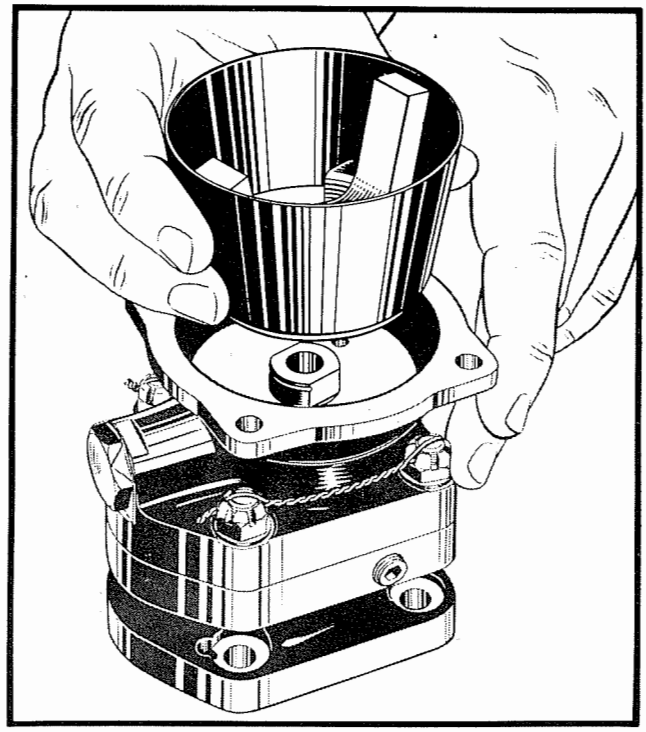


Figure 65—Installing Fly-Weight Assembly

(4) Because one model of the double capacity base incorporates a conical type strainer in the propeller line, it is necessary to use additional precautions when assembling the base to the body. In this case, the base should not be inverted as that might permit the strainer to fall out of position; instead, the drive gear and idler gear should be inserted into the base and the body then put into position. As the body and base are tightened together, take care that the body & base gasket and the conical strainer are in position.

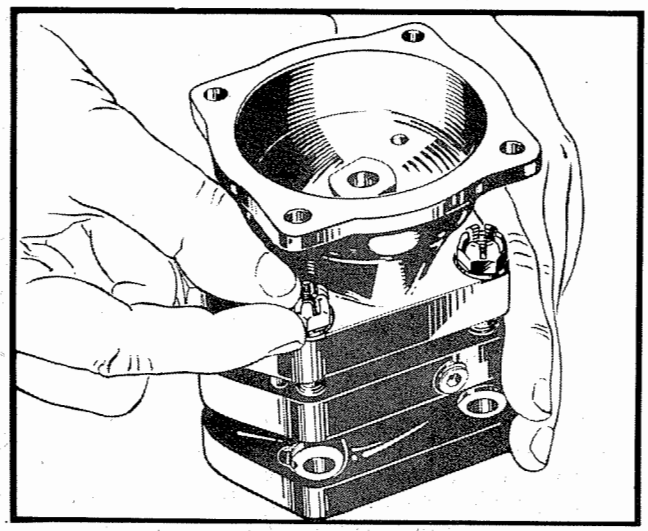


Figure 64—Tightening Body to Base With Securing Nuts

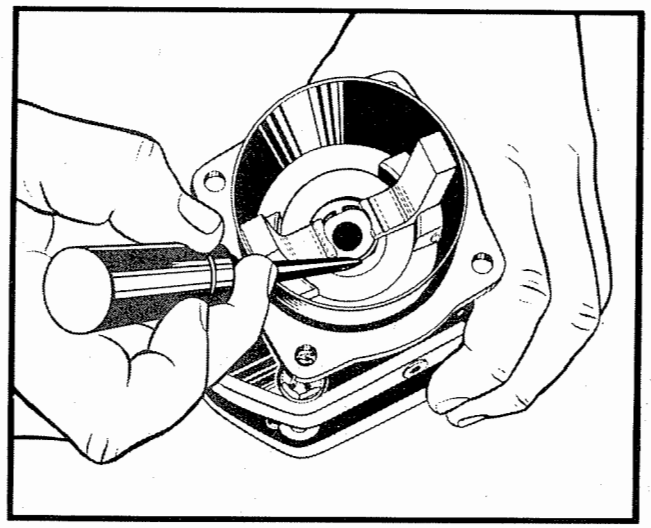


Figure 66—Inserting Fly-Weight Assembly Lock Ring

d. ASSEMBLY OF HEAD.

(1) Install the control shaft spring in the governor head control shaft bore. Start the control shaft packing washer over the threaded section of the shaft, and move it along until it rests against the circular packing boss on the control shaft. Insert the control shaft (and washer) on top of the spring. Complete the assembly by placing the control shaft packing lock gasket and packing nut over the control shaft, and then move the control shaft into the head against the force of the spring and start the packing nut in the threads. Line up the gasket tab with the slot incorporated in the top of the head, and after the packing nut has been tightened in place, bend the lock tab into the head slot and the two lower tabs over the packing nut.

CAUTION

To prevent loosening of the control shaft packing nut, make certain that it is securely tightened in place and that the tabs on the lock gasket are properly bent over. Loosening of the control shaft packing nut can result in serious trouble since the control shaft is thereby allowed to back out enough to disengage the pinion teeth and hence render the cockpit control inoperative. For the same reason, more than one packing washer should never be used since the control shaft would then be pushed into the head far enough to allow the hex washer to contact the packing nut which tends to loosen it as the pulley is turned.

(2) If the high rpm adjustment screw was removed from the head during disassembly, reinstall it in the head boss so that the slotted end of the screw faces away from the head. Final positioning of this screw is determined by the requirements of the installation, and specific instructions for adjustment are given in section III, paragraph 3.b. Assemble the lock plate and nut over the slotted end of the adjustment screw, but do not fully tighten the nut or bend over the edges on the locking plate until final adjustment has been made.

(3) In certain earlier head models a control shaft was used which did not have the blank tooth on the pinion gear. This head also used a speeder spring adjusting rack which did not incorporate the double tooth at the upper end. This arrangement made it possible at assembly to mesh the two parts in several different positions.

(4) Another older type of governor head used a control shaft packing nut which was screwed into the end of the control shaft bore on a taper thread. It was locked into position by inserting a cotter pin through one of two holes in the head and extending into one of two slots in the outboard end of the packing nut. When assembling a head which has this type of packing nut, turn down the nut until it is tight, and then turn it just enough further to align the slot in the nut with one of the cotter pin holes in the head.

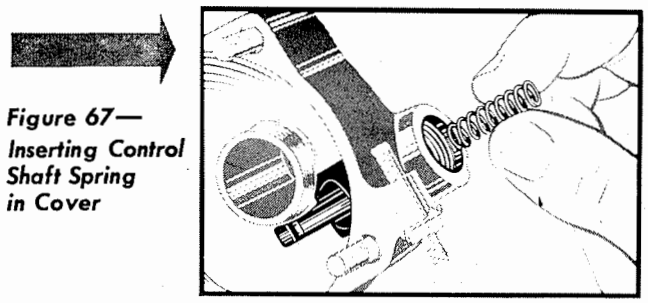


Figure 67—Inserting Control Shaft Spring in Cover

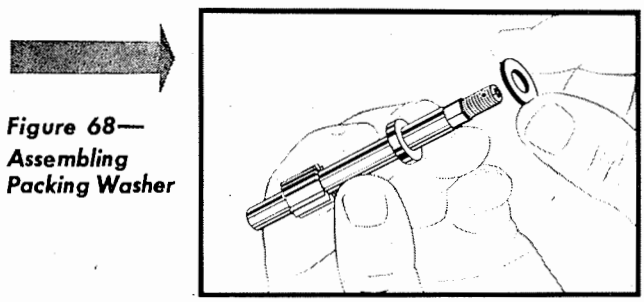


Figure 68—Assembling Packing Washer

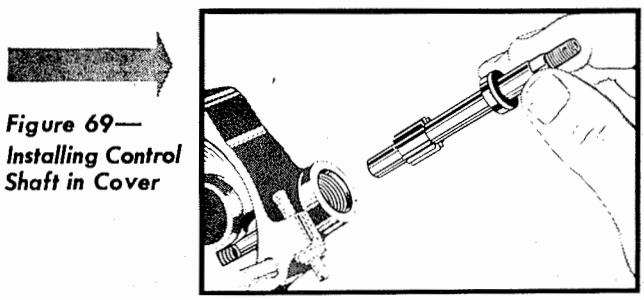


Figure 69—Installing Control Shaft in Cover

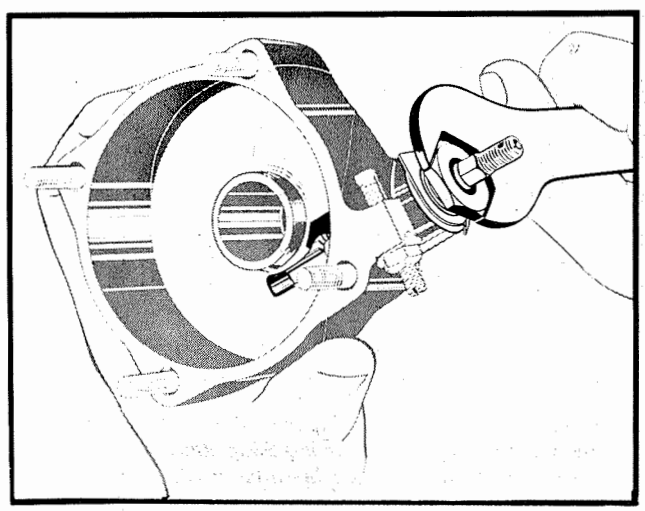


Figure 70—Tightening Control Shaft Packing Nut

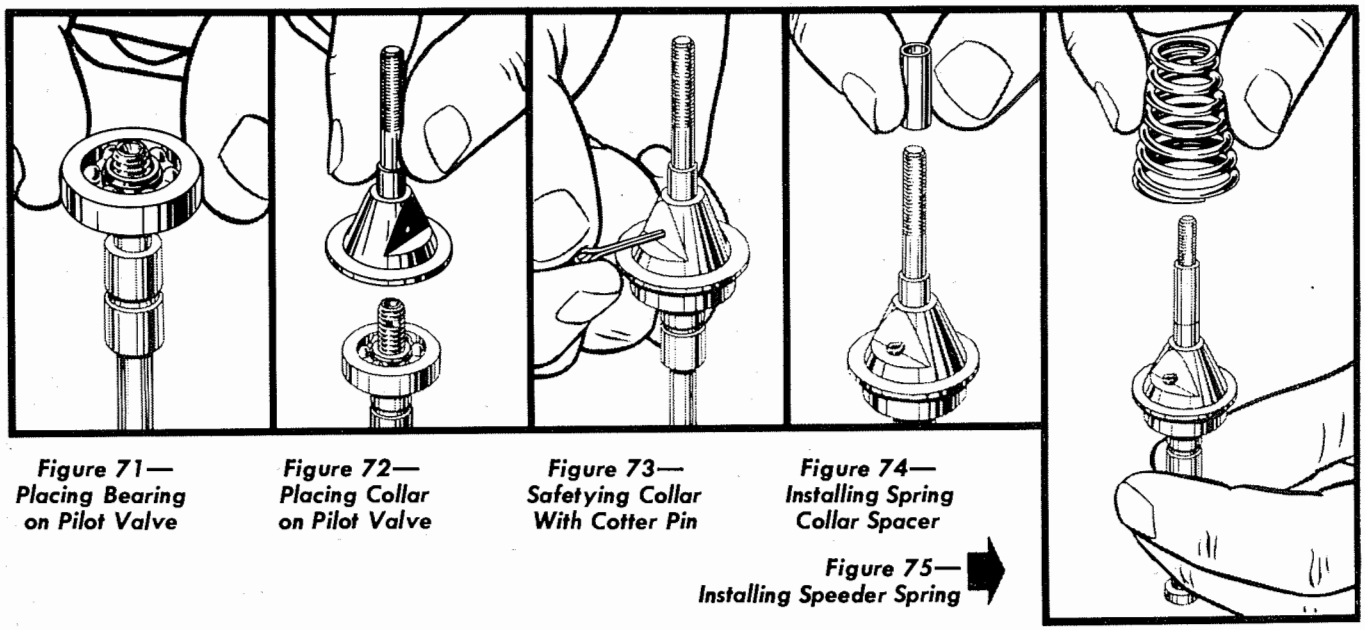


Figure 71— Placing Bearing on Pilot Valve

Figure 72— Placing Collar on Pilot Valve

Figure 73— Safetying Collar With Cotter Pin

Figure 74— Installing Spring Collar Spacer

Figure 75— Installing Speeder Spring

(5) To reassemble the speeder rack-pilot valve assembly, replace the pilot valve bearing on the pilot valve making certain it does not bind. Then screw on the spring collar tightly and safety it to the pilot valve with a cotter pin. Install the correct spring collar spacer on the stem of the spring collar, and then place the speeder spring into position. On those models which have a lip on the spring collar lower flange, the speeder spring should be screwed counterclockwise until securely seated inside the lip. Screw the positive high pitch adjusting screw (with slotted end outward) into the slotted end of the speeder rack and safety it in position with the snap ring. Then place the speeder rack assembly (slotted end first) onto the spring collar so that the threaded end of the spring collar stem will protrude through the center of the adjusting screw. Screw on the nut until it seats against the spring collar spacer, and then install the self-locking nut.

(6) Coat the head rack bore and the rack with Tulc VH or grease meeting Specification No. AN-G-3. Next, insert the speeder rack assembly into the governor head. The unslotted portion of the rack assembly enters the head first, and the wide tooth on the rack matches the blank tooth on the control shaft pinion. Rotate the control shaft enough to hold the speeder rack-pilot valve assembly in the head.

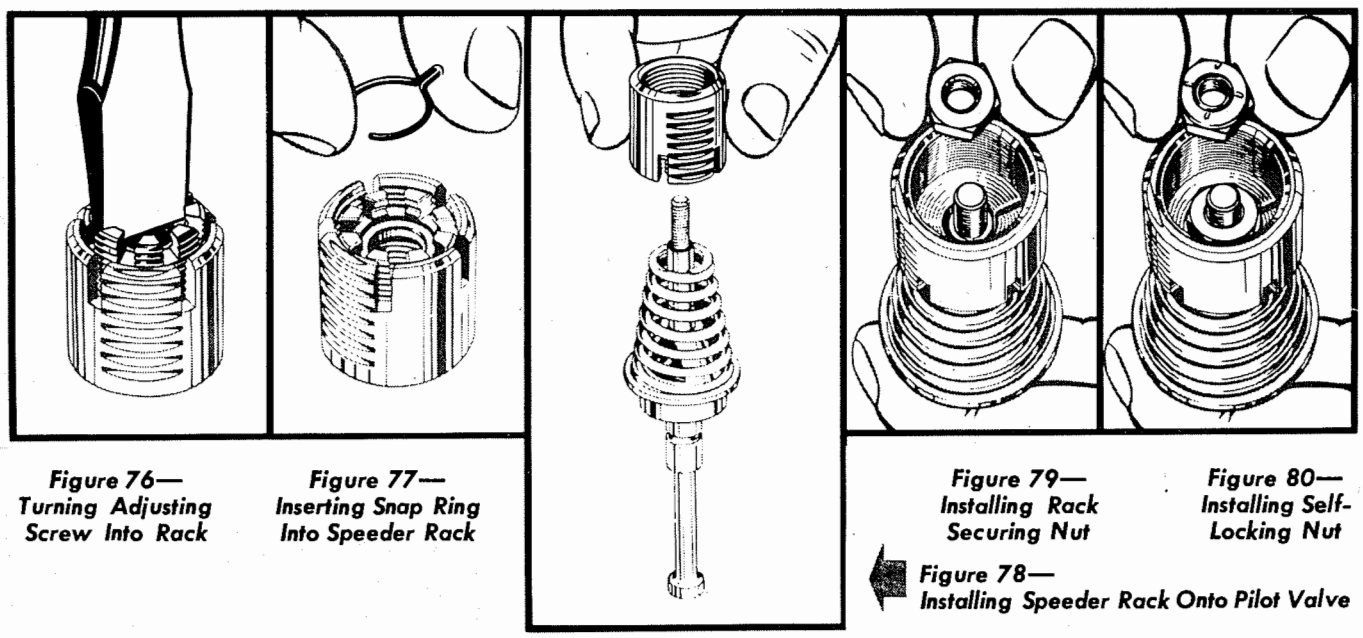


Figure 76— Turning Adjusting Screw Into Rack

Figure 77— Inserting Snap Ring Into Speeder Rack

Figure 78— Installing Speeder Rack Onto Pilot Valve

Figure 79— Installing Rack Securing Nut

Figure 80— Installing Self-Locking Nut

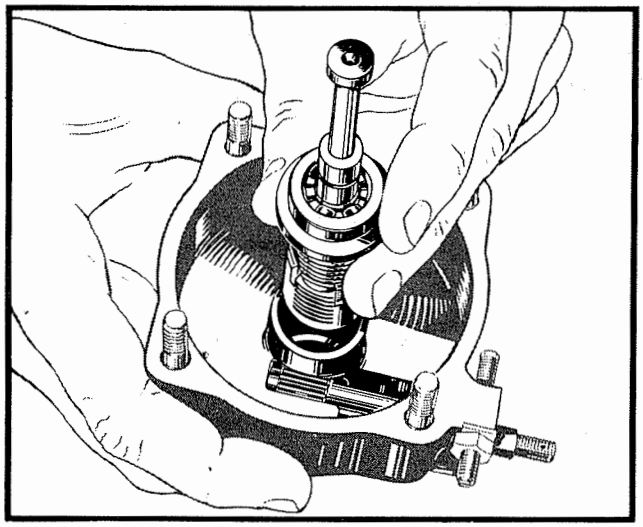


Figure 81—Inserting Speeder Rack Into Head

(7) It is not usually necessary to remove the pulley stop pin and cable clamp during governor disassembly; however, if they were taken off, insert the cable clamp in the single hole near the outer periphery of the pulley in such a way that the threaded portion is on the numbered face of the pulley, attach a castellated nut, and temporarily insert a cotter pin. Final tightening and securing of the nut is accomplished during installation of the governor on the engine. Install the pulley stop pin in the same hole previously used, or in any of the 18 holes which would give a position approximating that required by the installation. See section III, paragraph 3.b. for specific instructions regarding positioning of this pin. Assemble a washer, a castellated nut, and a cotter pin on the pulley stop pin. These parts, as in the case of the cable clamp nut and cotter, should be on the numbered side of the pulley.

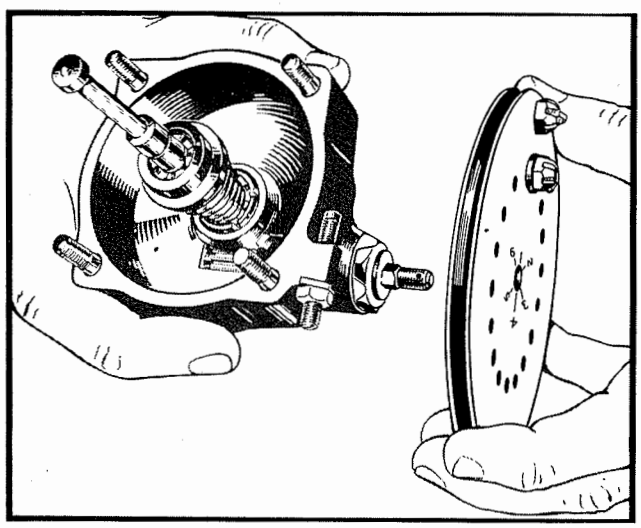


Figure 82—Installing Pulley Onto Control Shaft

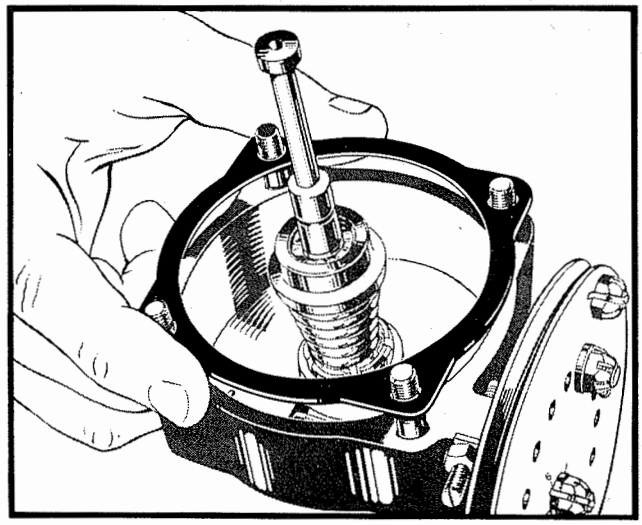


Figure 83—Installing Head & Body Gasket

(8) Install the hex washer on the control shaft and then put the pulley in place. To duplicate original installational requirements, make certain that the same numbered pulley position with respect to the index mark on the control shaft is obtained. If the pulley was not removed from the aircraft with the governor but was left attached to the control system, it is obviously impossible to install the pulley at this point. Assemble the washers, securing nut, and cotter pin on the control shaft ready for final installation.

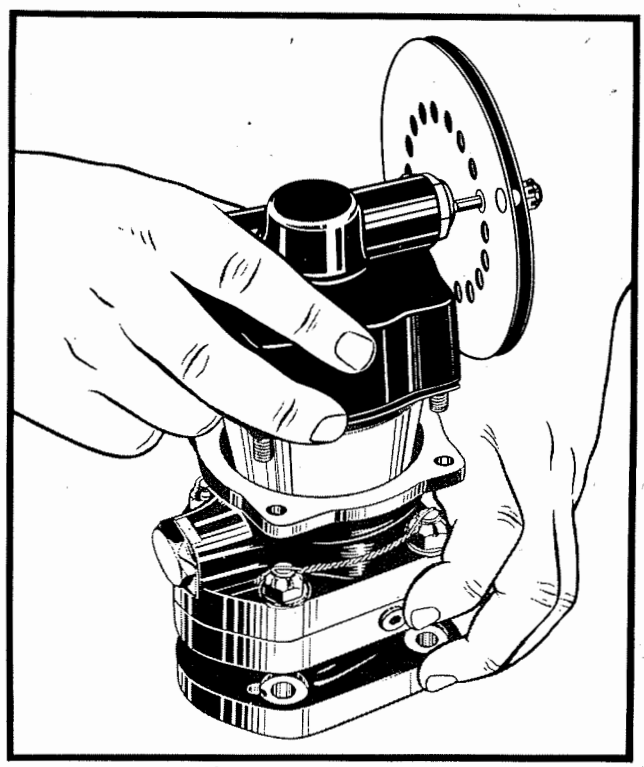


Figure 84—Installing Head Assembly Onto Governor

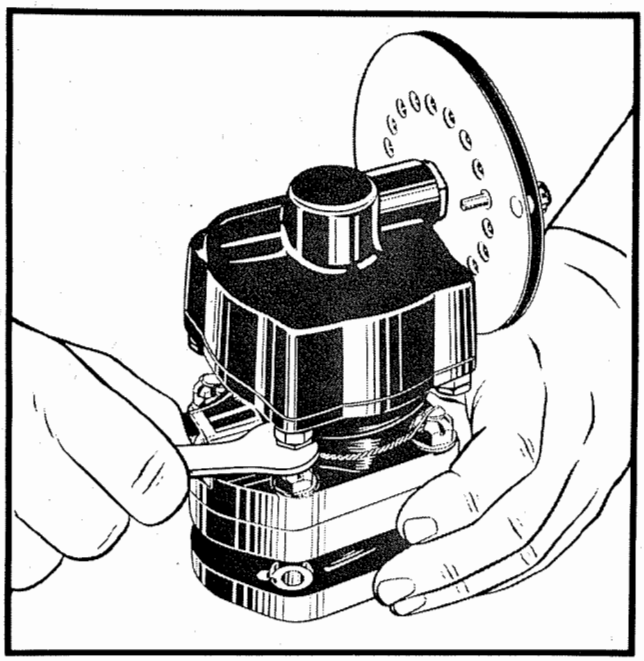


Figure 85—Tightening Head-Body Securing Nuts

CAUTION

It is important that the steel hex washer be placed on the control shaft inboard of the pulley. If this is not done, the hardened steel control shaft will butt up against the softer aluminum pulley and the resulting broaching action may loosen the pulley assembly. This action may allow the pulley to contact and loosen the control shaft packing nut.

Figure 86—Installing Snap Ring Onto Drive Coupling

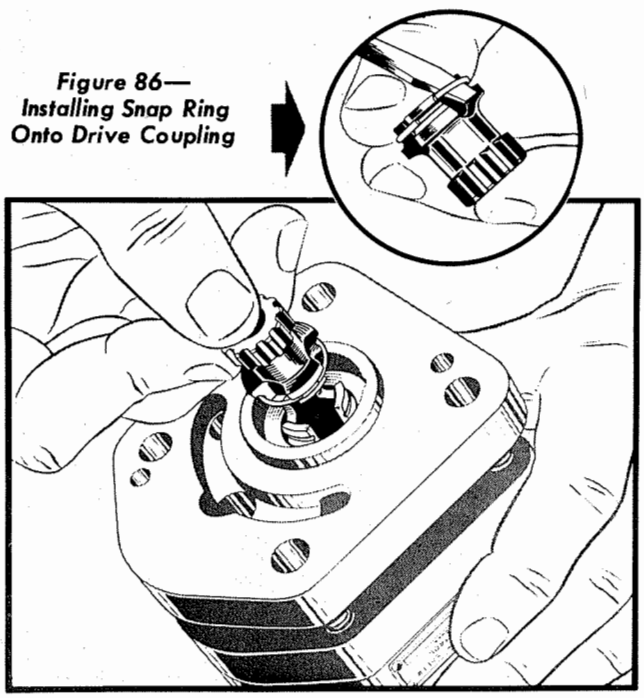


Figure 87—Installing Drive Coupling Onto Shaft

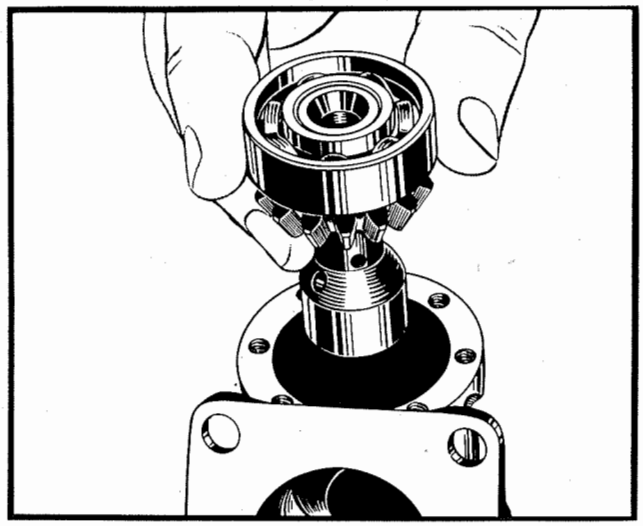


Figure 88—Inserting Shaft & Bearing Into Model 2 Base

(9) To secure the pulley in place, add a washer and a castellated nut on the control shaft. Draw down the nut with 60 pound-inch torque, and lock with a cotter pin.

e. ASSEMBLY OF HEAD TO BODY.

(1) Place the head & body gasket over the four studs.

(2) Install the complete head assembly on the body assembly. Secure it in place with four washers, nuts, and palnuts fitted onto the studs. In general, the head may be placed in any one of four angular positions with respect to the body, depending upon the requirements of the particular aircraft installation.

(3) If a drive gear shaft coupling is used, attach the lock ring onto the pronged end of the drive gear shaft which protrudes into the circular lining boss recess on the bottom of the base. Then drive the

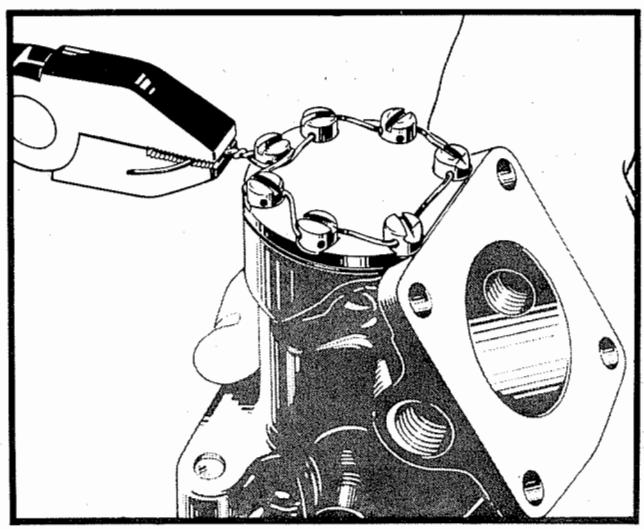


Figure 89—Wiring Cover on Model 2 Base

gear shaft coupling into place with a sharp hand blow, and, if necessary, reposition the lock ring in the groove incorporated in both the coupling and the drive gear shaft.

(4) When the model 2 base is used, the unit drive gear and bearing are inserted through the circular opening. The bearing and shaft should be slip fits in the base. Attach the gasket and cover into position with seven screws. It is necessary that the two screw heads nearest to the mounting surface be filed or ground so that they do not protrude beyond the plane of the mounting surface. It is usually possible to re-use the screws removed during disassembly. Then safety these screws with lock wire.

(5) When the governor is completely assembled, check it for freedom of movement by turning the drive shaft with the fingers.

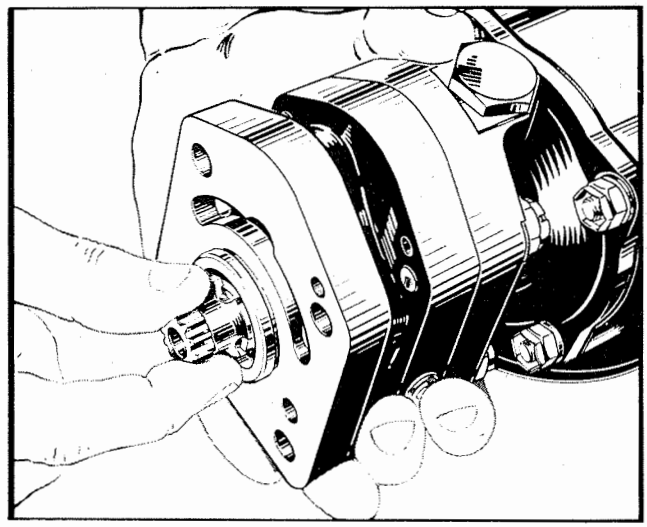
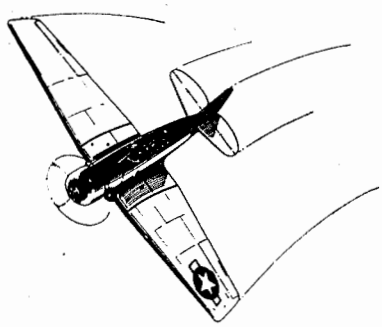


Figure 90—Checking Governor for Freedom of Movement



SECTION VII
TEST PROCEDURE

1. GOVERNOR TEST SPECIFICATION.

a. GENERAL.—The following tests to be performed on new and overhauled governors should be run on an approved test rig using SAE No. 10 oil, oil which fulfills the requirements of Specification No. AN-O-6, or oil of equivalent viscosity, at 21° to 27° C (70° to 80° F). Equivalent viscosity in this instance, with reference to SAE classifications of lubricating oil viscosity limits, is 225-475 SSU (Saybolt Seconds Universal). In general, any SAE oil may be used if it is operated within the temperature limits given in table II.

b. GOVERNING TESTS.

(1) RPM STOP SETTINGS.

(*a*) Maximum governing rpm and the positive high pitch (.010 inch minimum port opening) should be set and checked in accordance with the applicable control travel chart (figure 32). The maximum governing rpm should be set within ±5 rpm of the required setting.

Note

The minimum output port opening of .010 inch is checked by the use of a .010-inch feeler wire which is inserted through the lower end of the drive gear shaft. The speeder rack must be firmly against the head (the pulley in the extreme low rpm position) for this check.

(*b*) The high rpm adjustment screw should be locked at the setting specified. The nut should be tightened firmly and the tab lock plate bent over the nut and over the boss to prevent turning.

(2) TRANSFER BEARING LEAKAGE.—To simulate transfer bearing leakage, the above test should be run with the leakage bleed in the propeller line set for 60±5 quarts per hour (12.6 Imperial gallons per hour) at a pressure differential of 100 pounds per square inch.

c. PRESSURE, LEAKAGE, AND CAPACITY TESTS.—These tests should be made with the unit running at 1750 rpm.

(1) CAPACITY TEST.—The pump capacity should be determined with the unit operating at a back pressure of 150 p.s.i. and at a supply pressure of 40 ±15 p.s.i. The capacity should be as specified in table III.

(2) RELIEF PRESSURE TEST.—The relief valve when discharging the full governor pump output should maintain the pressure specified in table III.

(3) EXTERNAL LEAKAGE TEST.—There should be no external leakage when the oil passages and pump chamber on the outboard side of the pump are subjected to a pressure of 400 p.s.i. for approximately one minute.

(4) INTERNAL LEAKAGE TEST.—When operating at a back pressure of 150-200 p.s.i. and a supply pressure of 40 ±15 p.s.i., the rate of internal leakage should not exceed the value specified in table III.

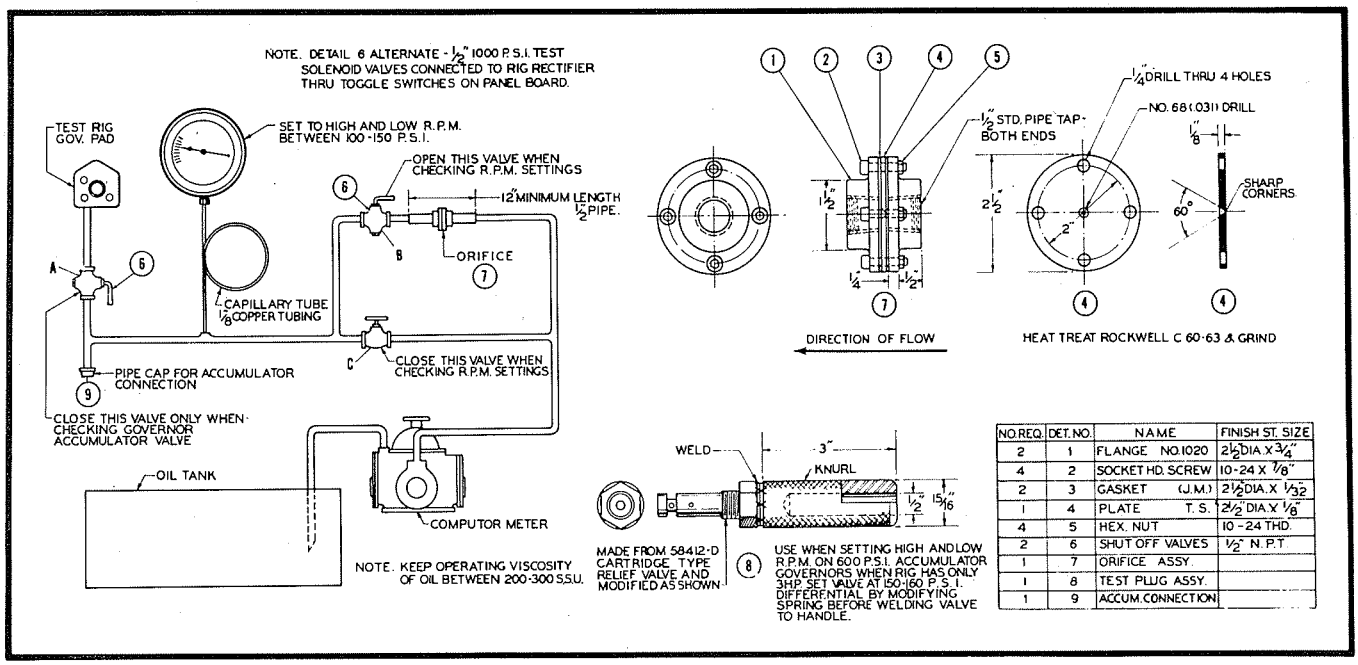
d. RUN-IN TEST.—The following tests should be made with the governor running at 1750 rpm. Units having bases in agreement with the standard engine mounting pad (base models 1, 10, and 12) should be subjected to a one-hour run-in test at relief valve pressure. Units having bases for rear auxiliary pad mounting (base models 2, 3, and 4) should be subjected to a one-half hour run-in test at relief valve pressure.

e. CORROSION PREVENTION.—Upon completion of the above tests, each control should be coated internally with a corrosion preventive in accordance with Specification No. AN-VV-C-576a by spraying, dipping, or supplying the corrosion preventive to the intake side of the pump while the unit is running at 1750 rpm.

2. ACCEPTANCE TEST FOR CONSTANT SPEED CONTROLS USING NON-GOVERNING TYPE COMMERCIAL TEST RIGS.

Note

These instructions are provided to establish a standard Field method of testing governors to meet the test specification requirements of section VII, paragraph 1. With the exception of the rpm settings, these instructions deal only with the *methods* to be used when testing governors. For leakage, pressure, capacity, and all other test values, refer to section VII, paragraph 1. Army Air Forces personnel will use these instructions for general information only, and in testing governors will follow the procedure given in the Technical Orders and AN Handbooks applicable to the particular model of test stand used.



NO. REQ.	DET. NO.	NAME	FINISH ST. SIZE
2	1	FLANGE NO. 1020	2½ DIA. X ¾"
4	2	SOCKET HD. SCREW	10-24 X ⅞"
2	3	GASKET (J.M.)	2½ DIA. X 1/32
1	4	PLATE T. S.	2½ DIA. X ⅛"
4	5	HEX. NUT	10-24 THD.
2	6	SHUT OFF VALVES	½" N.P.T.
1	7	ORIFICE ASSY.	
1	8	TEST PLUG ASSY.	
1	9	ACCUM. CONNECTION	

Figure 91—Piping Layout for Modifying Non-Standard Governor Test Rigs

a. GENERAL.—The following tests shall be run with SAE No. 10 oil, oil meeting the requirements of Specification No. AN-O-6, or oil of equivalent viscosity at 21°-27° C (70°-80° F). Equivalent viscosity in this instance, with reference to SAE classifications of lubricating oil viscosity limits, is 225-475 SSU (Saybolt Seconds Universal). In general, any SAE oil may be used if it is operated within the temperature limits given in table II.

(1) Before all tests can be made satisfactorily, commercial rigs should meet the requirements outlined in figure 92, or should be modified by the hydraulic layout shown in figure 91. A rig constructed in accordance with figure 92 includes the modifications shown in figure 91. Note that this test rig accommodates both Counterweight and Hydromatic type governors.

(2) It is usually difficult to hold a set pressure for one minute while checking the rig tachometer against the clock counter. This is caused by fluctuation of the output pressure brought about by peculiarities inherent in different rig designs. Therefore, when setting or checking rpm, any value between 100 and 150 p.s.i. is satisfactory. If the output line pressure cannot be held between 100 and 150 p.s.i., it is generally indicative of a sticky relief valve, in which case the valve should be removed and lightly polished with crocus cloth, being careful to maintain sharp corners on the lands.

(3) The tolerance of ±10 rpm on the high rpm setting applies only to the non-governing type commercial test rigs. This tolerance is not to be confused with the ±5 rpm specified in section VII, paragraph 1. which must be used when setting new governors.

Note

To avoid repetition in the following instructions, it will be assumed that all valves except the feathering valve of the test rig are normally open.

b. RPM SETTING.—Close output valve (C), and make certain orifice valve (B) is open. To simulate transfer bearing leakage, the following tests shall be run with a leakage bleed in the propeller line set for 1 to 2 quarts per minute. This leakage should be established by use of the orifice, detail 7 in figure 91.

(1) HIGH RPM SETTING.

(*a*) Adjust rig speed to the desired high rpm setting.

(*b*) Adjust the high rpm stop until a pressure between 100 and 150 p.s.i. is indicated on the output gage.

(2) HIGH RPM CHECKING.

(*a*) Hold the control pulley firmly against the high rpm stop.

(*b*) Adjust the rig speed until a pressure between 100 and 150 p.s.i. is indicated on the output gage.

(*c*) Check rpm with rig tachometer timer for *one minute*. If the indicated speed is within 10 rpm of the desired take-off setting, it is satisfactory.

(3) POSITIVE HIGH PITCH SETTING.—This minimum output port opening is checked by the use of a .010 inch thick feeler wire inserted through the lower end of the drive gear shaft. The speeder rack must be firmly against the head (the pulley in the extreme low rpm position) for this check.

c. PRESSURE, LEAKAGE, AND CAPACITY TESTS.—Unless otherwise specified, these tests shall be made with the governor test rig running at 1750 rpm with the input pressure to the governor set at 40 ±15 p.s.i.

(1) RELIEF PRESSURE TEST.

(*a*) Place the governor rack in the high rpm position.

(*b*) Close the output valve (C), and the orifice valve (B). (See figure 91.)

(*c*) The indicated output pressure is the relief valve setting.

Note

When making this test, allow the governor to operate against full relief valve pressure for 30 seconds, or until the indicated output pressure levels off.

(2) EXTERNAL LEAKAGE TEST.

(*a*) Place the governor rack in the high rpm position. Then close the output valve (C).

(*b*) Increase the input pressure until 400 p.s.i. is indicated on the output gage.

(*c*) Run the unit for approximately one minute under these conditions, and visually check for external leakage.

(3) INTERNAL LEAKAGE TEST.

(*a*) Place the governor rack in the high rpm position.

(*b*) Adjust the output valve (C) until a pressure of 150-200 p.s.i. is indicated on the output gage. Check internal leakage for one minute.

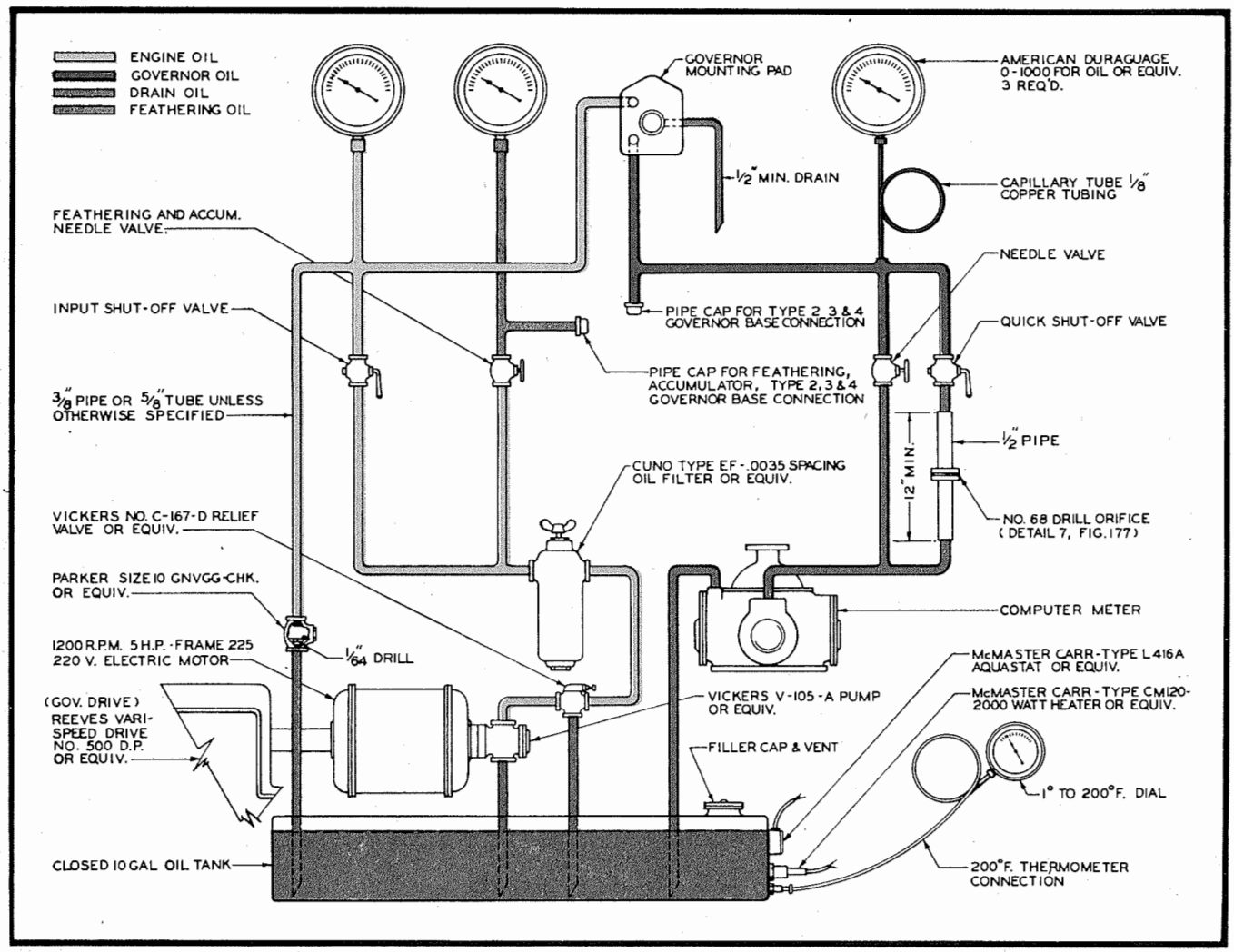


Figure 92—Piping Layout for Standard Type Governor Test Rig

(4) CAPACITY TESTS.

(*a*) With the governor rack in the high rpm position, adjust the output valve (C) until a pressure of 150 p.s.i. is indicated on the output gage.

(*b*) Check the flow of oil for one minute on rigs incorporating commuting type meters.

(*c*) On rigs incorporating flow meters or similar direct reading meters, the indication of quarts per minute output will be instantaneous and the direct reading is used.

Note

The following tabulation shows the approximate Imperial gallon equivalents for the U.S. quarts specified in this section.

U. S. Quarts	Imperial Gallons
1	.21
4	.83
8	1.67
12	2.50
15	3.12
16	3.33
20	4.16
40	8.32
60	12.49

TABLE NO. II

GENERAL CLASSIFICATION		
SAE No.	Temperature °C	Temperature °F
10	21-27	70-80
20	32-38	90-100
30	41-49	105-120
40	46-57	115-135
50	57-63	135-145
60	63-74	145-165
70	68-79	155-175

EXAMPLE OF SPECIFIC CLASSIFICATIONS		
Esso Motor Oil No.	Temperature °C	Temperature °F
1	21-38	70-100
3	38-60	100-140
5	57-74	135-165
7	68-85	155-185
Esso Aviation Oil (100 SSU at 210° F)	54-71	130-160

Texaco Aviation Grade No.	SAE Equivalent	Temperature °C	Temperature °F
80	40	46-63	115-145
100	50	54-71	130-160
120	60	63-79	145-175
140	70	68-85	155-185

TABLE NO. III

Governor Body Model	Pump Capacity (Qts. Per Min.)	Relief Pressure P.S.I.	Internal Leakage (Qts. Per Hour)
A	8-12	180-200	15
A-5	8-12	180-200	15
C	8-12	180-200	15
C-5	8-12	180-200	15
C-6	8-12	180-200	15
E	8-12	180-200	15
E-5	8-12	180-200	15
M	8-12	180-200	15
P	8-12	180-200	15
Q	8-12	180-200	15
Q-1	8-12	180-200	15
S	16-20	180-200	20
S-1	16-20	180-200	20
S-4	16-20	180-200	20

PARTS CATALOG

This parts catalog includes the various models of the Counterweight type governor listed below.

1A1	1A4-A5	1P12-A
1A1-A5	1A4-G5	1P12-A0A
1A1-B5	1C2	1P12-G
1A1-C5	1C2-A5	1P12-G0A
1A1-F5	1C2-G5	1Q12-A
1A1-G5	1C2-G6	1Q12-G
1A1-H5	1E1	1Q12-G1
1A1-J5	1E1-A5	1S10-G0A
1A2-A5	1E2-A5	1S10-A1A
1A2-G5	1E3-A5	1S10-A4A
1A3-G5	1M12-A	1S10-G1A
1A3-G5A	1M12-G	1S10-G4E

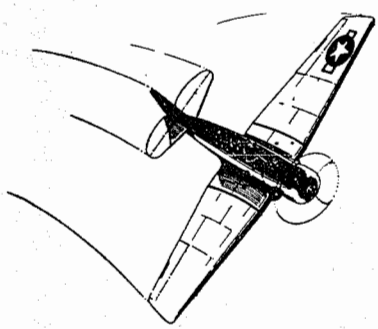


TABLE OF CONTENTS

INTRODUCTION

1. The Hamilton Standard Counterweight type governor is composed of three major assemblies; the head assembly, the body assembly, and the base assembly. Each of these major assemblies is in turn made up of separate parts and subassemblies. Because these separate parts, subassemblies, and even major assemblies are very frequently fitted together in various combinations to form the different governor models, this parts catalog is based on major assemblies rather than complete models. This procedure eliminates duplication in listing, and at the same time points out the valuable interchangeability which exists among these governor parts and assemblies.

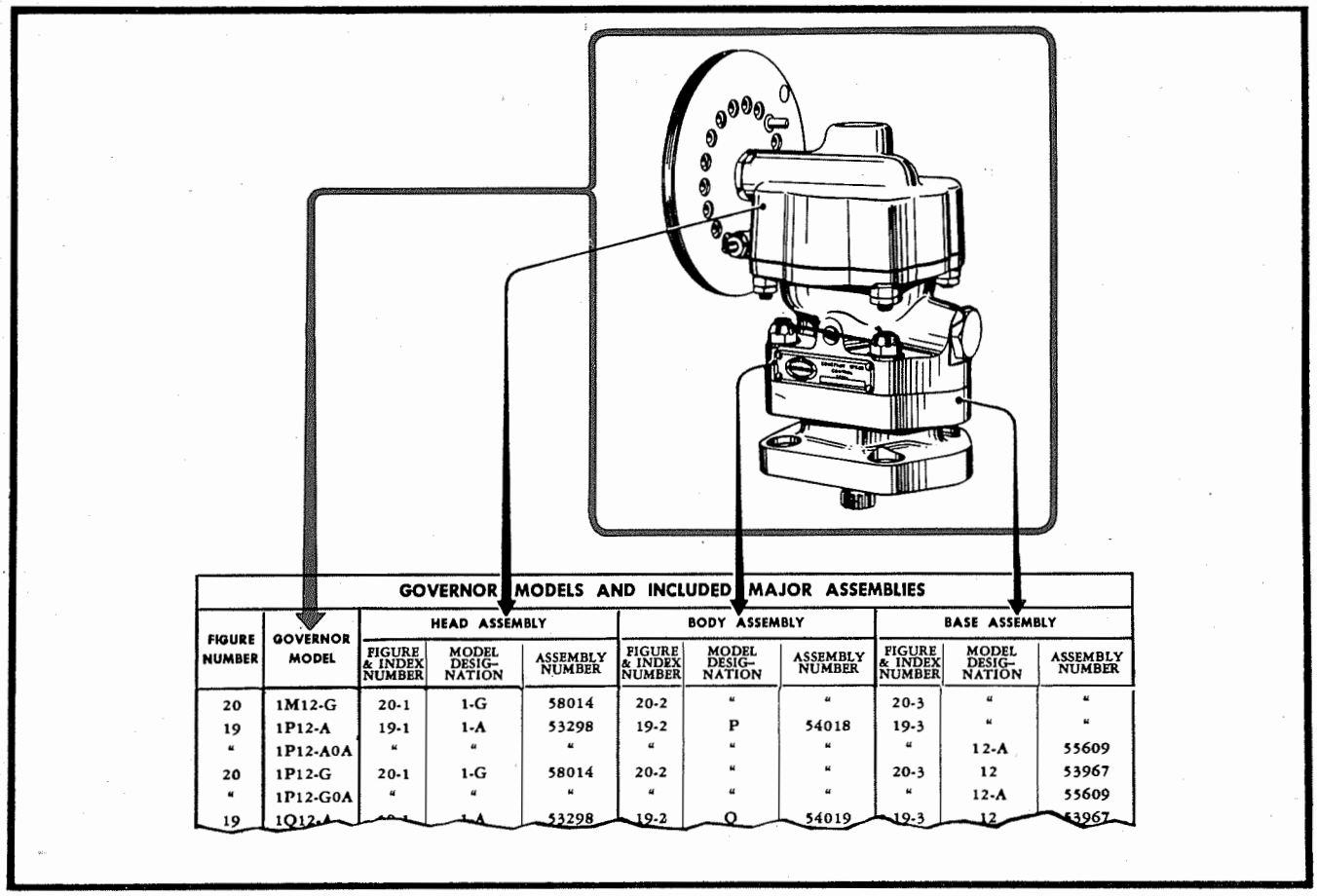
2. The Hamilton Standard model designation system for governors is set up so that the three main assemblies of the governor, namely the head assembly, the body assembly, and the base assembly are shown, along with the modifications of each. For example, in a governor designated as a model 1S10-G4E, the numbers and letter group preceding the dash show the basic model head, body, and base (in that order) used in the governor, and the letters and number group following the dash indicate which modification of that model head, body, and base is incorporated. Continuing with the same example, the first digit, "1", indicates the model 1 head, the first letter, "S", indicates the model S body, and the second number, "10", indicates the model 10 base. In the letters and number group following the dash, in this case "G4E", modifications of the basic model head, body, and base are listed in that order.

3. The first letter of the second group shows the head modification and should therefore be interpreted in conjunction with the first number of the first group. In other words, the basic head used in this governor is a model 1, but it has been manufactured to modification "G". Therefore, when speaking of the head alone it is referred to as a model 1-G head.

4. The body assembly is designated by a letter in the first group, and a number in the second group. In this case, the second group number, namely "4", should be read in conjunction with the "S" in the first group to indicate that the body used in this governor is a basic model "S" modified to incorporate all revisions up to and including number "4". Therefore, the body alone is referred to as a model S-4 body.

5. The base is designated by the last number of the first group interpreted in conjunction with the last letter of the second group. In this case, the base is a basic model "10" and as used in this governor it is modified to incorporate changes up to and including "E". The base, then, is referred to as a model 10-E base.

6. Besides a number and letter designation system, governor major assemblies are also identified by assembly drawing numbers. Each major unit in the governor has a corresponding assembly number, and continuing with the model 1S10-G4E, the head is a model 1-G which is head assembly No. 58014, the body is a model S-4 which is body assembly No. 57685, and the base is a model 10-E which is base assembly No. 58676.



GOVERNOR MODELS AND INCLUDED MAJOR ASSEMBLIES

FIGURE NUMBER	GOVERNOR MODEL	HEAD ASSEMBLY			BODY ASSEMBLY			BASE ASSEMBLY		
		FIGURE & INDEX NUMBER	MODEL DESIG-NATION	ASSEMBLY NUMBER	FIGURE & INDEX NUMBER	MODEL DESIG-NATION	ASSEMBLY NUMBER	FIGURE & INDEX NUMBER	MODEL DESIG-NATION	ASSEMBLY NUMBER
20	1M12-G	20-1	1-G	58014	20-2	"	"	20-3	"	"
19	1P12-A	19-1	1-A	53298	19-2	P	54018	19-3	"	"
"	1P12-A0A	"	"	"	"	"	"	"	12-A	55609
20	1P12-G	20-1	1-G	58014	20-2	"	"	20-3	12	53967
"	1P12-G0A	"	"	"	"	"	"	"	12-A	55609
19	1Q12-A	[illegible]	1-A	53298	19-2	Q	54019	19-3	12	53967

Figure 1—Breakdown of Complete Governor in Section I

This parts catalog shows the major assemblies and identifies them both by the designation system and the corresponding assembly drawing number.

7. In case no modifications have been made on the head, body, or base, the second group is omitted; a governor so designated would be the model 1A1. If the body assembly is the only major component not modified, the body designation is shown with a "0" modification. For example, in the model 1P12-G0A, the head is model 1-G, the body is model P-0, and the base is model 12-A. In this example it was necessary to include the "0" in the body designation (although the body model used is a basic type and incorporates no modifications) in order that the base modification letter "A" will follow in its proper position.

8. In a governor designated as model 1M12-G, the head used is model 1-G, the body model M, and the base model 12. In this example, no "0" modification need be shown on the body since no base modification letter follows.

9. The catalog itself is divided into four sections with the drawings applicable to each illustrated section preceding the proper tabulation. As shown in figure 1, the governor models and included major assemblies are illustrated and tabulated in section I. The tabular form is divided into four main columns. The first main column includes a listing of all the governor models in the catalog with a figure number reference to the applicable illustration. The other three main columns include a listing of the three major assemblies in each model, with a figure and index number reference to the proper illustration. By comparing identical assembly numbers, it is possible to determine from section I, without checking each individual part in an assembly, whether or not that assembly listed for one model governor is directly interchangeable with any other model. Section II, in turn, is composed of illustrations and listings of each of the parts and subassemblies contained in the major assemblies previously assigned in section I to the various governor models. In section II, each part number is listed with figure and index number references to the illustrations where it is shown. As shown in figure 2, the quantity of each part or subassembly required in each major assembly is also shown in section II. This section is subdivided into three main parts which are identical in form except that the first part lists head

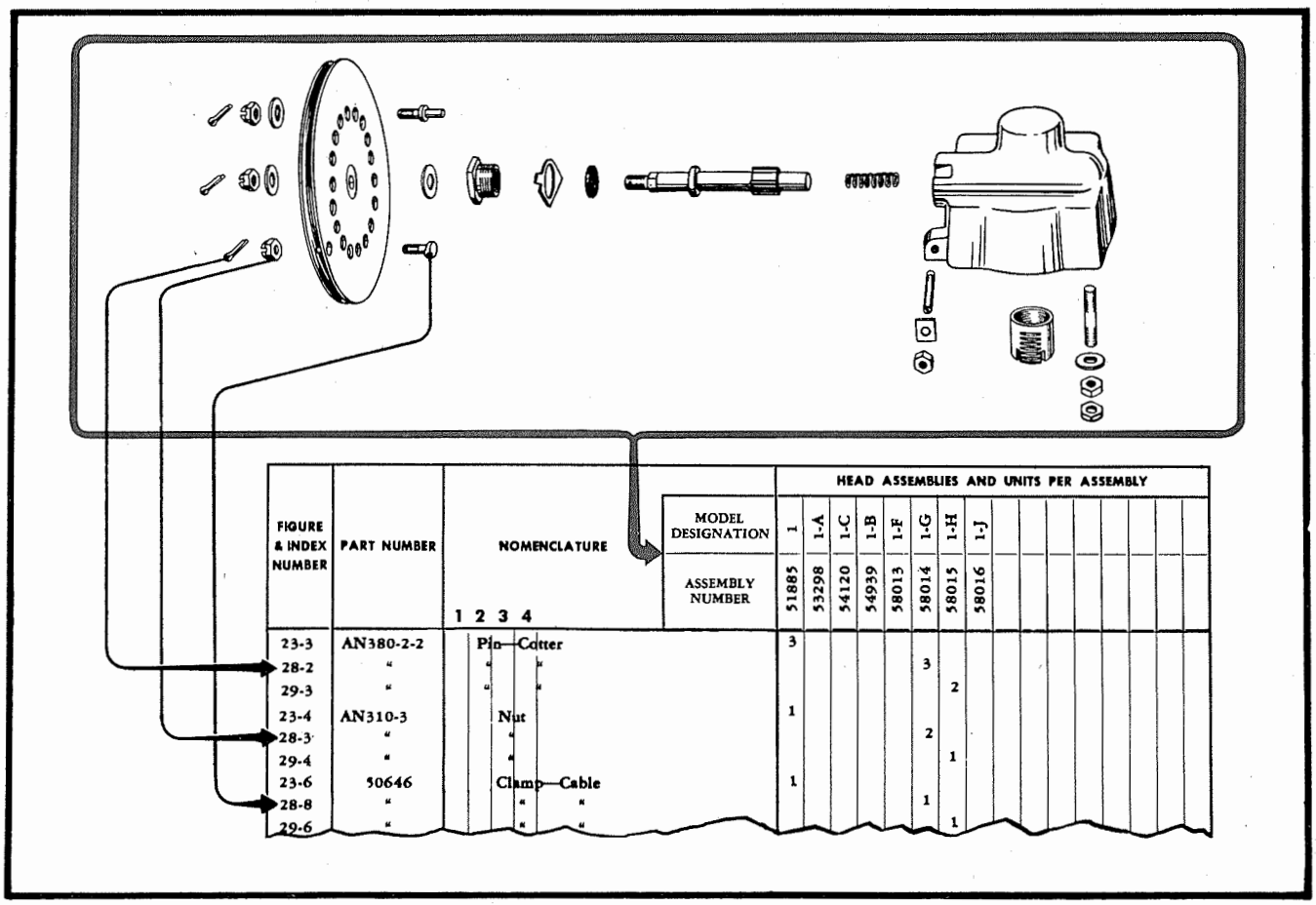


FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	HEAD ASSEMBLIES AND UNITS PER ASSEMBLY														
MODEL DESIGNATION			1	1-A	1-C	1-B	1-F	1-G	1-H	1-J							
ASSEMBLY NUMBER			51885	53298	54120	54939	58013	58014	58015	58016							
23-3	AN380-2-2	Pin—Cotter	3														
28-2	"	"						3									
29-3	"	"							2								
23-4	AN310-3	Nut	1														
28-3	"	"						2									
29-4	"	"							1								
23-6	50646	Clamp—Cable	1														
28-8	"	"						1									
29-6	"	"							1								

Figure 2—Breakdown of Assemblies in Section II

assemblies only, the second lists body assemblies, and the third lists base assemblies. Each part is preceded by the proper group of illustrations. The order of parts listed is determined as nearly as possible by their sequence of assembly. Reference to this section makes it possible to determine in how many assemblies a part may be used, and the exact quantity required in each of these assemblies. All procurable parts and assemblies are shown and indexed in this catalog. In cases of procurable subassemblies, the subassembly index number is shown at the center of a bracket which includes the separate part index numbers which make up the assembly. As an example, the pulley assembly index number 9 in figure 2 is composed of the separate parts shown as index numbers 1, 2, 3, 6, 7, and 8. Section II also includes a short listing and one illustration on governor drive adapters. A drive adapter is not considered to be part of the governor, and therefore its use does not change the governor model number. These adapters are not included in section I, but they do appear in section III. Section III is a listing in numerical order of all the parts, subassemblies, and major assemblies included in sections I and II, with figure and index number references to each illustration where they are pictured. Total quantity per illustration is also shown in section III. Section IV is the same type of tabulation except that it includes only Army-Navy (AN) standard parts. Section V on tools is omitted from this catalog since there are no special service tools used with Counterweight type governors.

10. The symbol + is used in this catalog to indicate oversize parts. In every such case, the numbers of the oversize parts are shown directly under the basic part number. A + preceding a part listed in section III indicates that the part is oversize, or available as an oversize part, and a — indicates the same thing for an undersize part. The symbol "ar" is used to indicate that the quantity used is "as required."

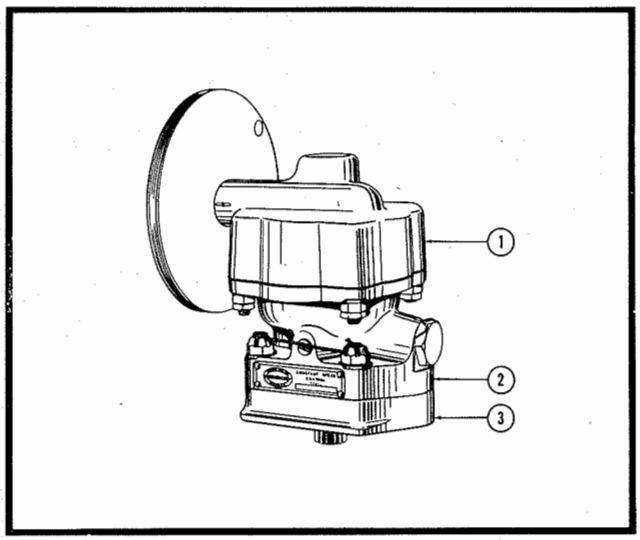


Figure 3—Complete Governor

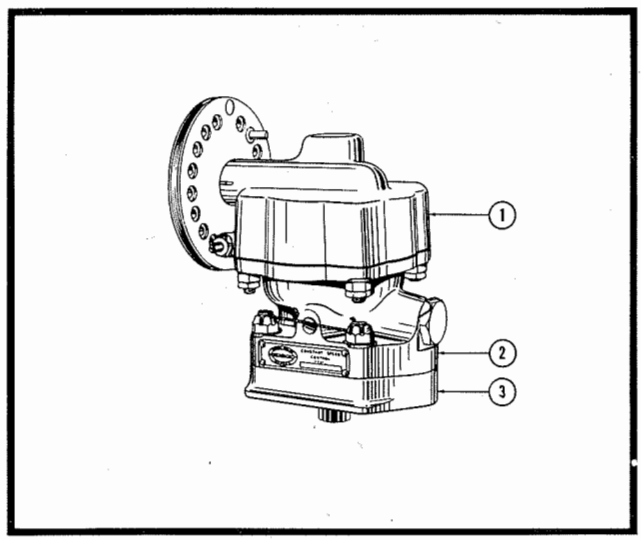


Figure 6—Complete Governor

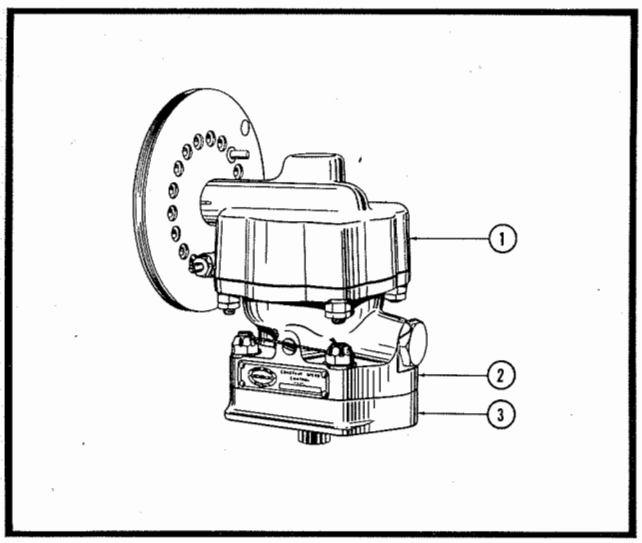


Figure 4—Complete Governor

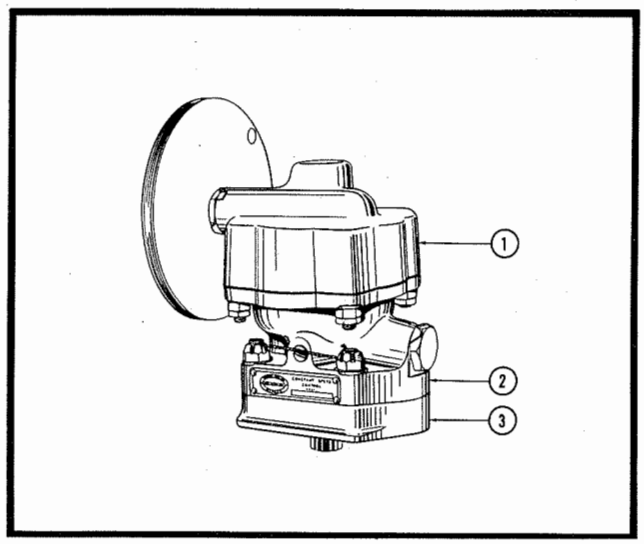


Figure 7—Complete Governor

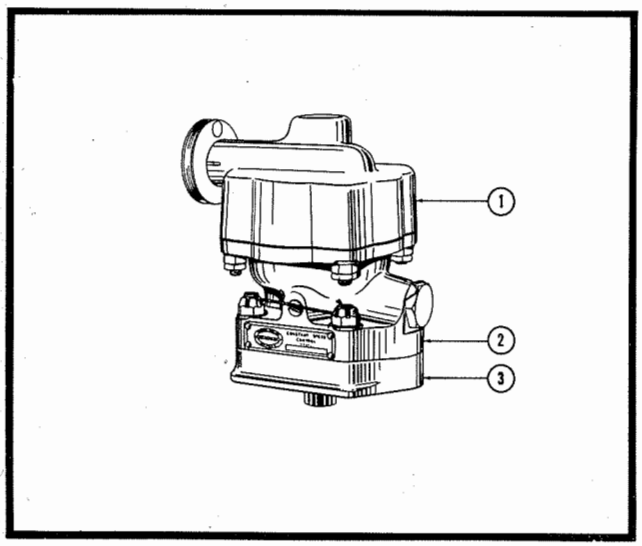


Figure 5—Complete Governor

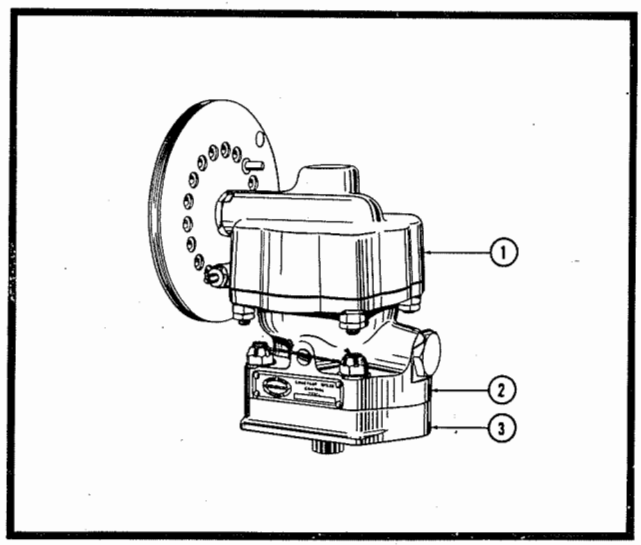


Figure 8—Complete Governor

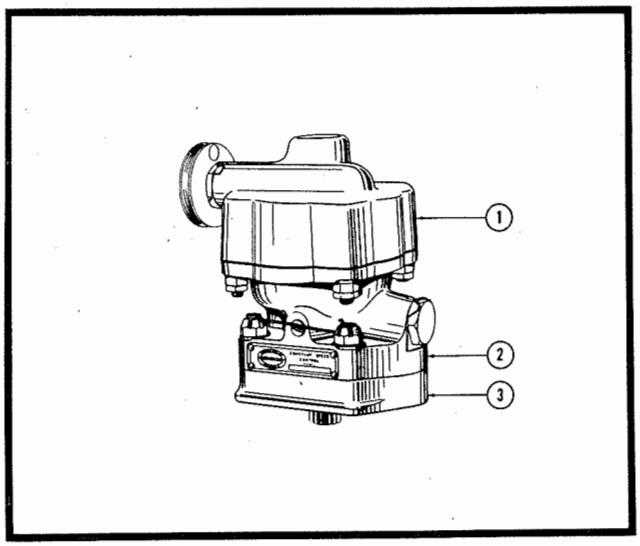


Figure 9—Complete Governor

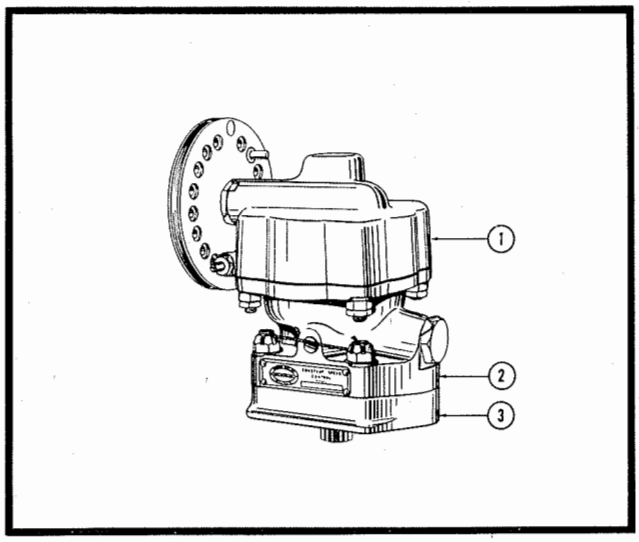


Figure 10—Complete Governor

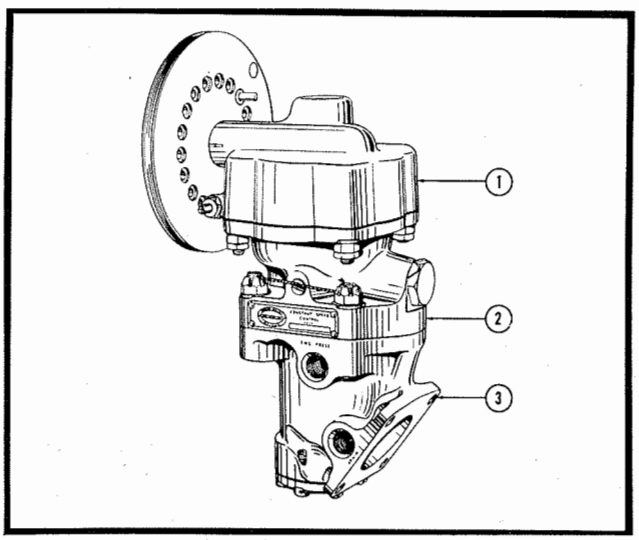


Figure 11—Complete Governor

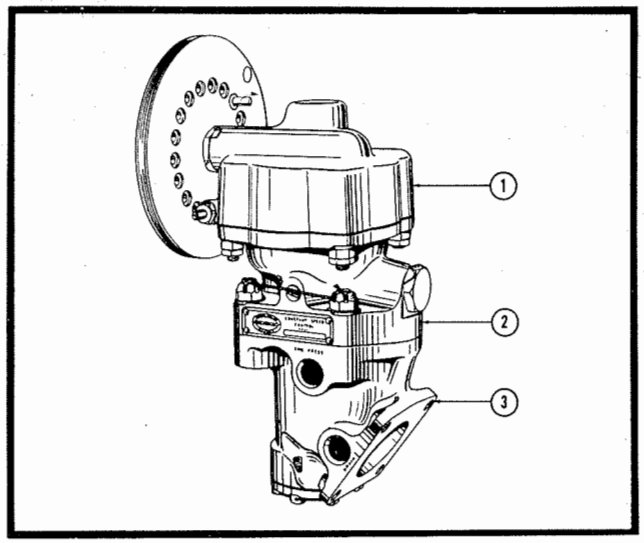


Figure 12—Complete Governor

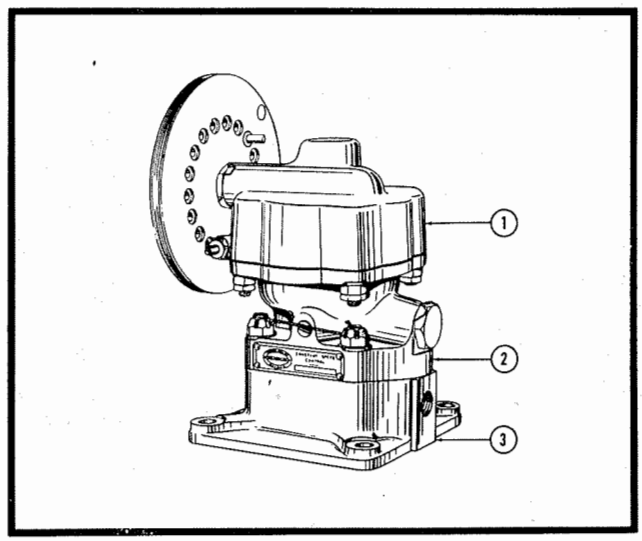


Figure 13—Complete Governor

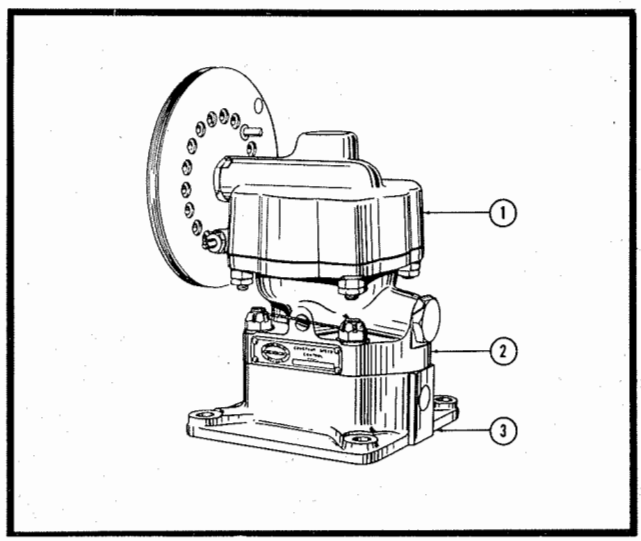


Figure 14—Complete Governor

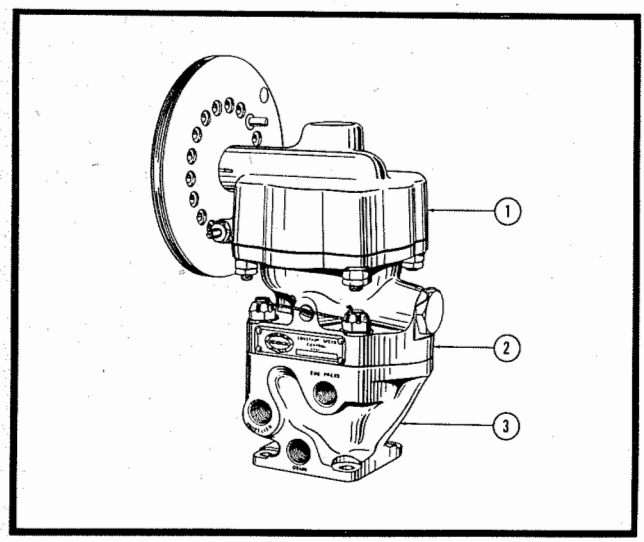


Figure 15—Complete Governor

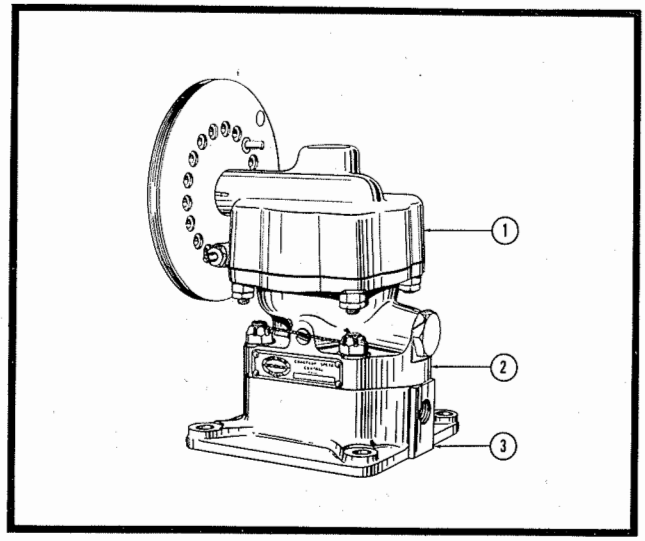


Figure 18—Complete Governor

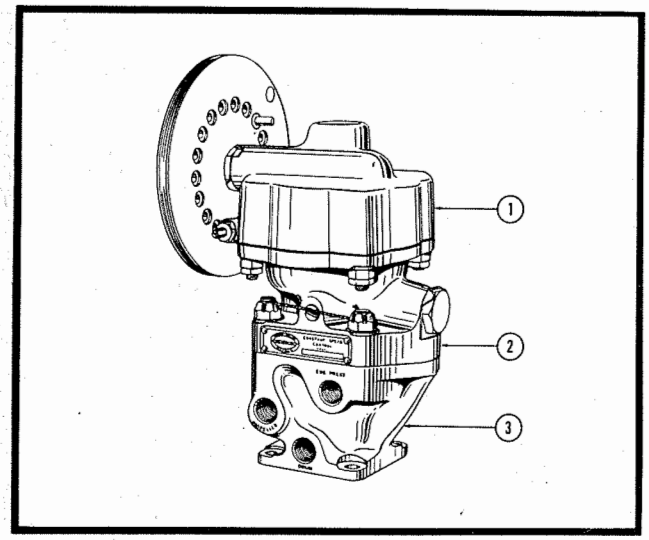


Figure 16—Complete Governor

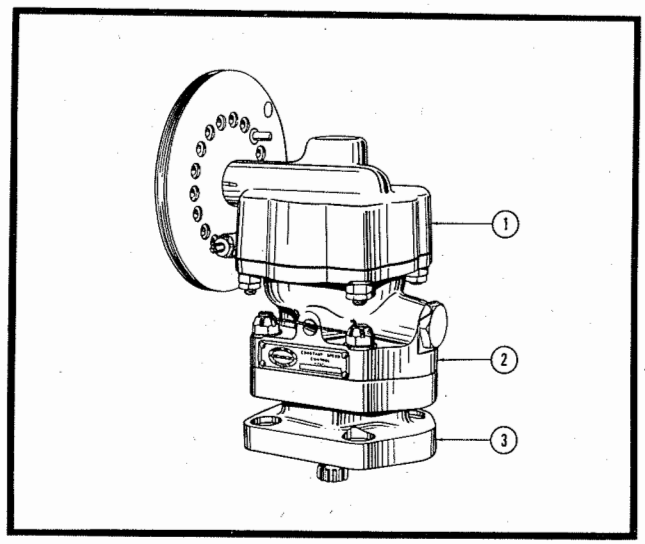


Figure 19—Complete Governor

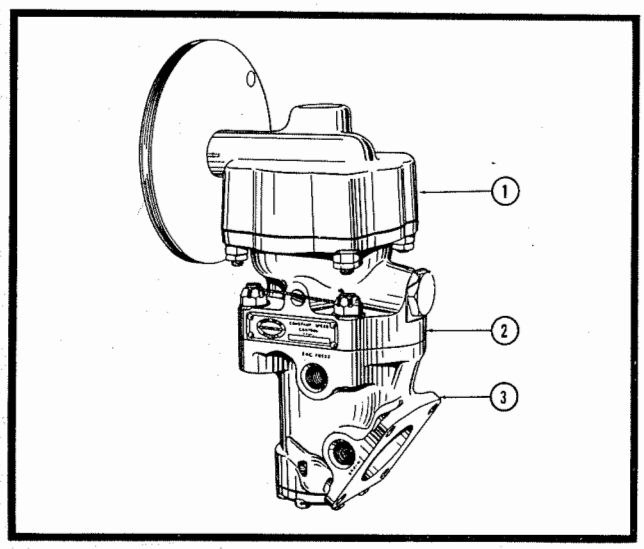


Figure 17—Complete Governor

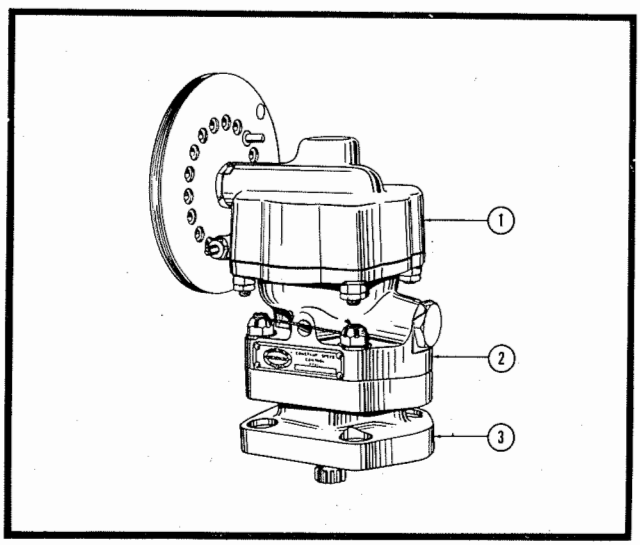


Figure 20—Complete Governor

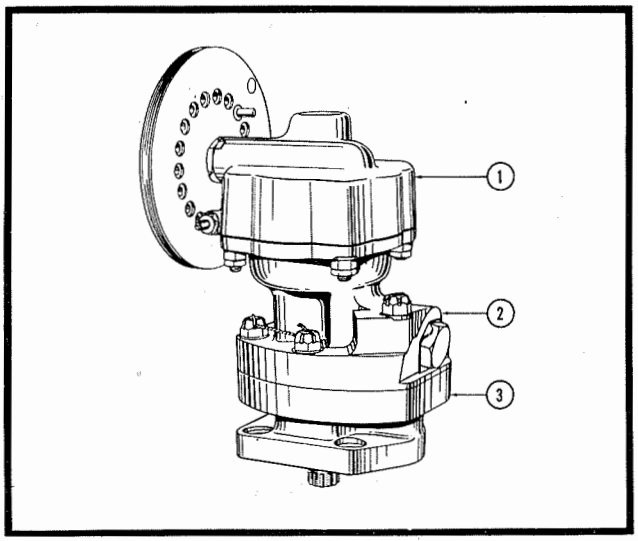


Figure 21—Complete Governor

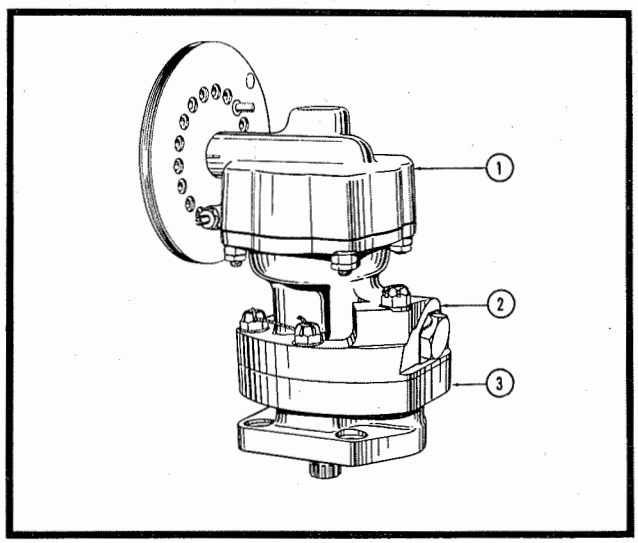


Figure 22—Complete Governor

GOVERNOR MODELS AND INCLUDED MAJOR ASSEMBLIES

FIGURE NUMBER	GOVERNOR MODEL	HEAD ASSEMBLY			BODY ASSEMBLY			BASE ASSEMBLY		
		FIGURE & INDEX NUMBER	MODEL DESIG-NATION	ASSEMBLY NUMBER	FIGURE & INDEX NUMBER	MODEL DESIG-NATION	ASSEMBLY NUMBER	FIGURE & INDEX NUMBER	MODEL DESIG-NATION	ASSEMBLY NUMBER
3	1A1	3-1	1	51885	3-2	A	51888	3-3	1	52713
4	1A1-A5	4-1	1-A	53298	4-2	A-5	53394	4-3	"	"
5	1A1-B5	5-1	1-B	54939	5-2	"	"	5-3	"	"
6	1A1-C5	6-1	1-C	54120	6-2	"	"	6-3	"	"
7	1A1-F5	7-1	1-F	58013	7-2	"	"	7-3	"	"
8	1A1-G5	8-1	1-G	58014	8-2	"	"	8-3	"	"
9	1A1-H5	9-1	1-H	58015	9-2	"	"	9-3	"	"
10	1A1-J5	10-1	1-J	58016	10-2	"	"	10-3	"	"
11	1A2-A5	11-1	1-A	53298	11-2	"	"	11-3	2	50830
12	1A2-G5	12-1	1-G	58014	12-2	"	"	12-3	"	"
13	1A3-G5	13-1	"	"	13-2	"	"	13-3	3	50842
14	1A3-G5A	14-1	"	"	14-2	"	"	14-3	3-A	54265
15	1A4-A5	15-1	1-A	53298	15-2	"	"	15-3	4	50840
16	1A4-G5	16-1	1-G	58014	16-2	"	"	16-3	"	"
17	1C2	17-1	1	51885	17-2	C	51891	17-3	2	50830
11	1C2-A5	11-1	1-A	53298	11-2	C-5	53395	11-3	"	"
12	1C2-G5	12-1	1-G	58014	12-2	"	"	12-3	"	"
"	1C2-G6	"	"	"	"	C-6	54096	"	"	"
3	1E1	3-1	1	51885	3-2	E	52150	3-3	1	52713
4	1E1-A5	4-1	1-A	53298	4-2	E-5	53425	4-3	"	"
11	1E2-A5	11-1	"	"	11-2	"	"	11-3	2	50830
18	1E3-A5	18-1	"	"	18-2	"	"	18-3	3	50842
19	1M12-A	19-1	"	"	19-2	M	54017	19-3	12	53967
20	1M12-G	20-1	1-G	58014	20-2	"	"	20-3	"	"
19	1P12-A	19-1	1-A	53298	19-2	P	54018	19-3	"	"
"	1P12-A0A	"	"	"	"	"	"	"	12-A	55609
20	1P12-G	20-1	1-G	58014	20-2	"	"	20-3	12	53967
"	1P12-G0A	"	"	"	"	"	"	"	12-A	55609
19	1Q12-A	19-1	1-A	53298	19-2	Q	54019	19-3	12	53967
20	1Q12-G	20-1	1-G	58014	20-2	"	"	20-3	"	"
"	1Q12-G1	"	"	"	"	Q-1	54949	"	"	"
21	1S10-G0A	21-1	"	"	21-2	S	54465	21-3	10-A	54494
22	1S10-A1A	22-1	1-A	53298	22-2	S-1	54574	22-3	"	"
"	1S10-A4A	"	"	"	"	S-4	57685	"	"	"
21	1S10-G1A	21-1	1-G	58014	21-2	S-1	54574	21-3	"	"
"	1S10-G4E	"	"	"	"	S-4	57685	"	10-E	58676

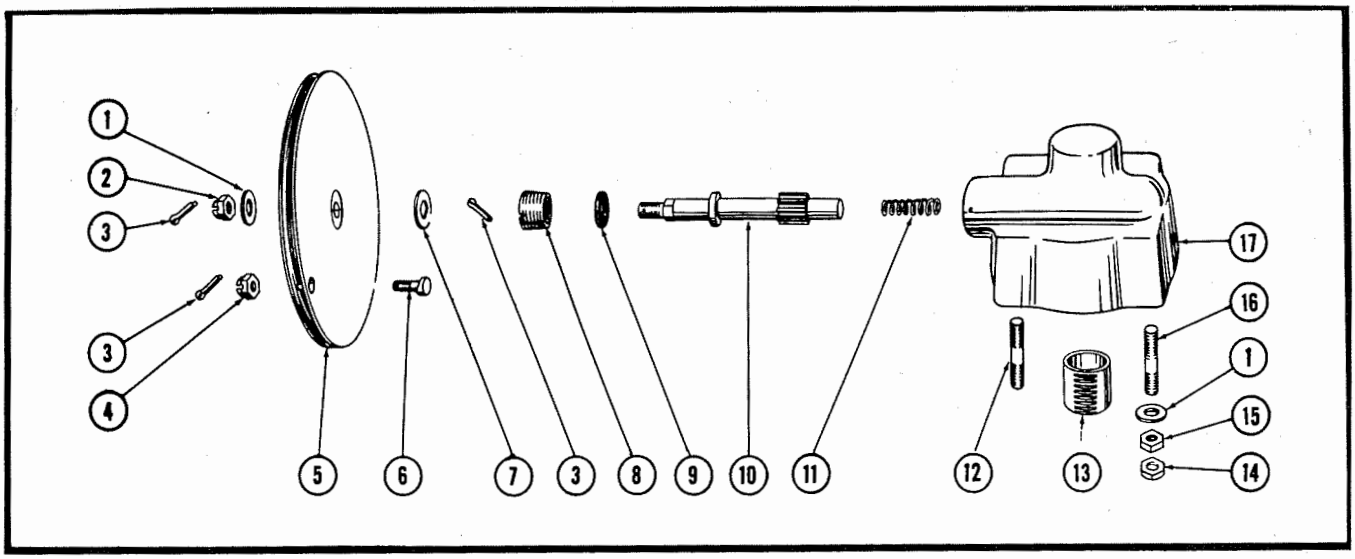


Figure 23—Head Assembly

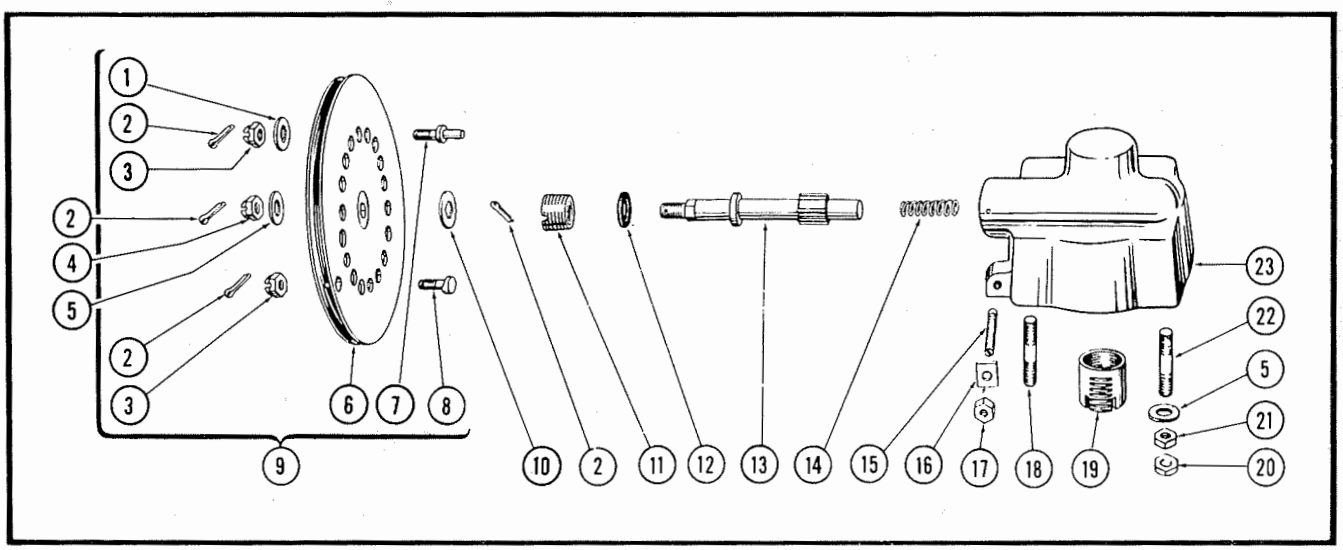


Figure 24—Head Assembly

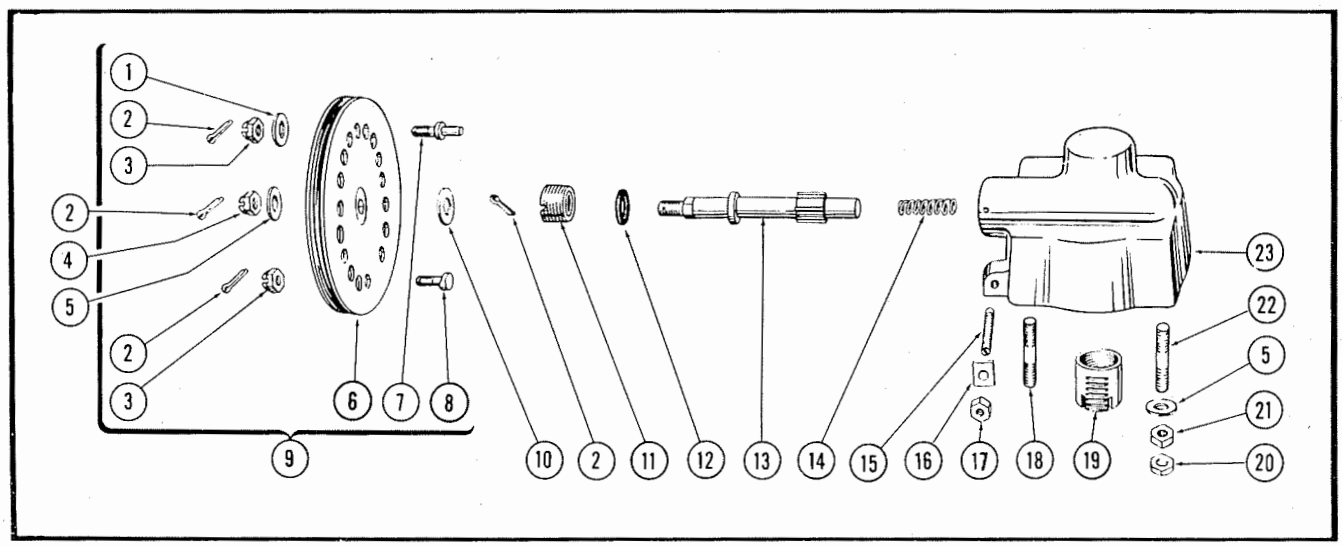


Figure 25—Head Assembly

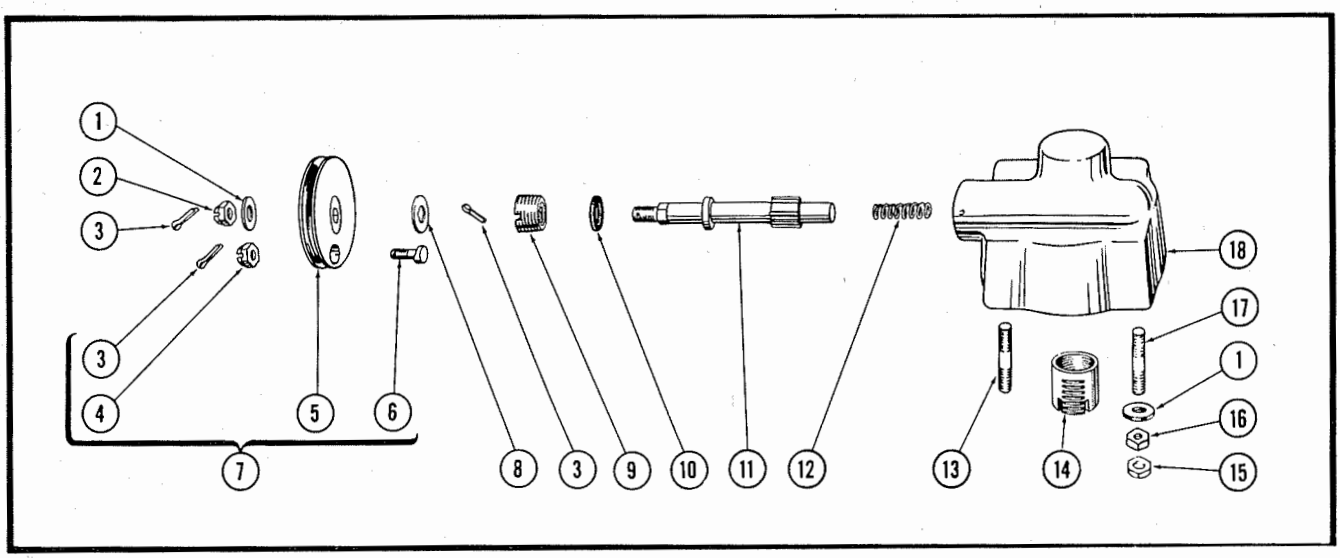


Figure 26—Head Assembly

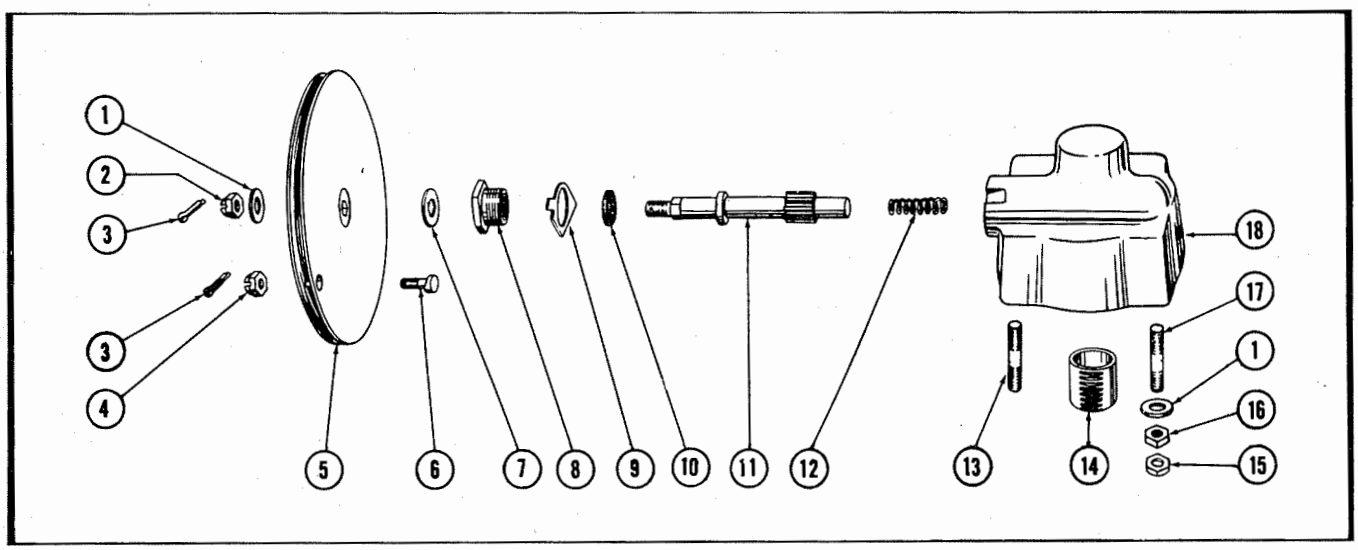


Figure 27—Head Assembly

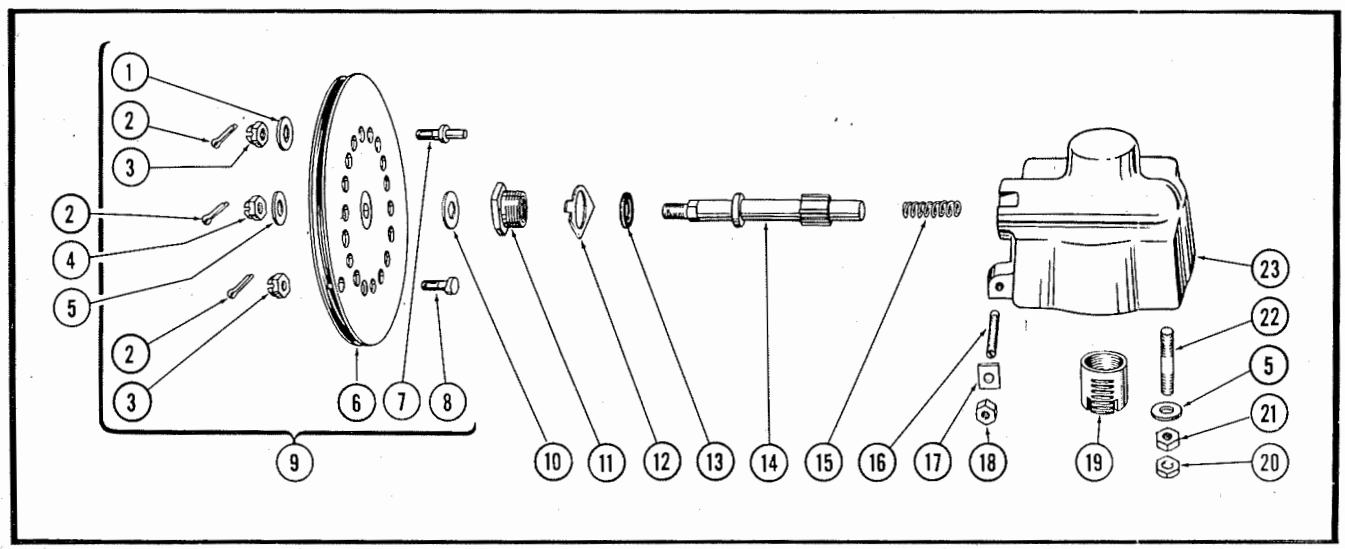


Figure 28—Head Assembly

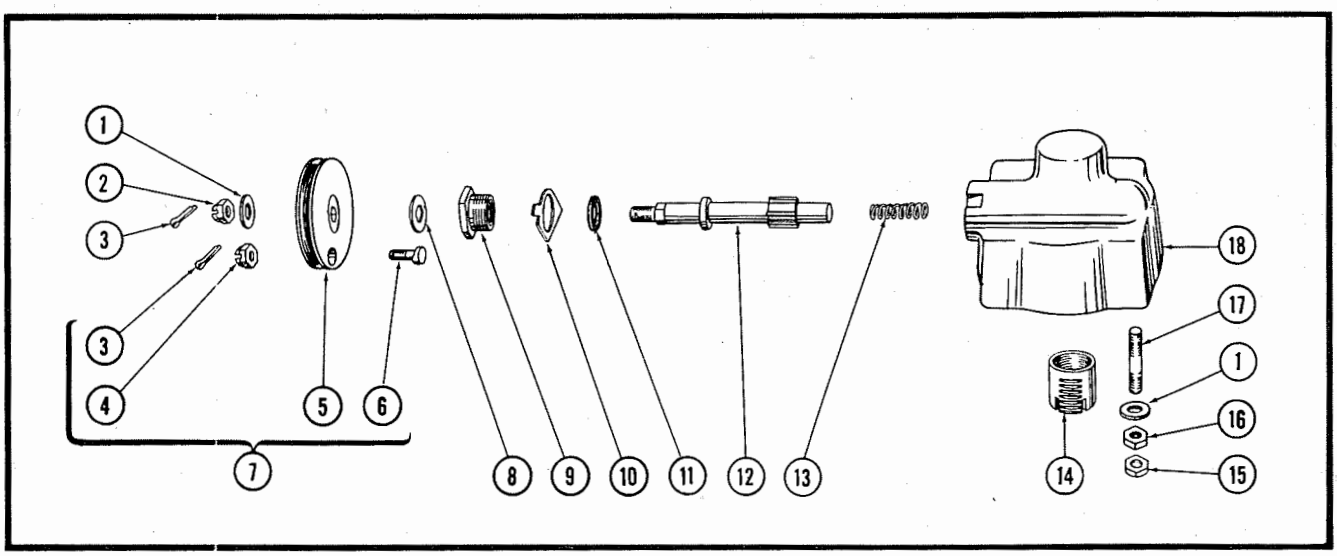


Figure 29—Head Assembly

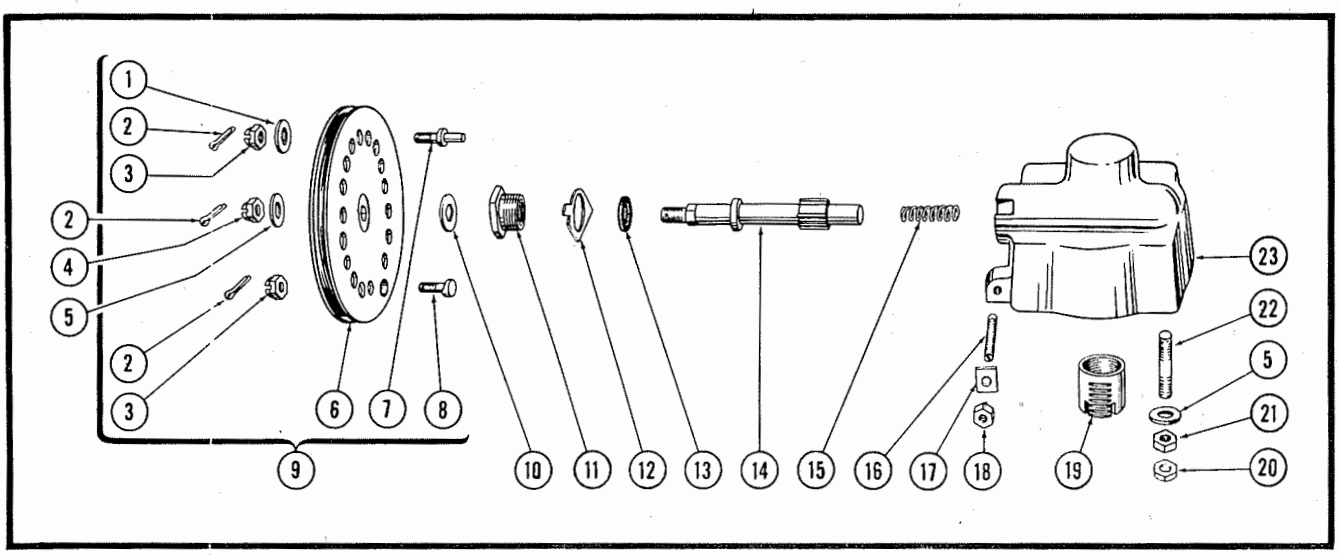


Figure 30—Head Assembly

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	MODEL DESIGNATION	HEAD ASSEMBLIES AND UNITS PER ASSEMBLY														
				1	1-A	1-C	1-B	1-F	1-G	1-H	1-J							
			ASSEMBLY NUMBER	51885	53298	54120	54939	58013	58014	58015	58016							
3-1, 17-1	51885	Head Assembly—Model 1		1														
4-1, 11-1, 15-1, 18-1, 19-1, 22-1	53298	Head Assembly—Model 1-A			1													
6-1	54120	Head Assembly—Model 1-C				1												
5-1	54939	Head Assembly—Model 1-B					1											
7-1	58013	Head Assembly—Model 1-F						1										
8-1, 12-1, 13-1, 14-1, 16-1, 20-1, 21-1	58014	Head Assembly—Model 1-G							1									
9-1	58015	Head Assembly—Model 1-H								1								
10-1	58016	Head Assembly—Model 1-J									1							
23-17	50648	Head		1														
26-18	"	"					1											
24-23	53295	Head			1													
25-23	"	"				1												
27-18	58008	Head						1										
29-18	"	"								1								
28-23	58009	Head							1									
30-23	"	"									1							
23-12	51180	Stud—Head & Body		2														
24-18	"	" " " "			2													
25-18	"	" " " "				2												
26-13	"	" " " "					2											
27-13	"	" " " "						2										
23-16	51692	Stud—Head & Body		2														
24-22	"	" " " "			2													
25-22	"	" " " "				2												
26-17	"	" " " "					2											
27-17	"	" " " "						2										
28-22	"	" " " "							4									
29-17	"	" " " "								4								
30-22	"	" " " "									4							
23-1	AN960-416	Washer		5														
24-5	"	"			5													
25-5	"	"				5												
26-1	"	"					5											
27-1	"	"						5										
28-5	"	"							5									
29-1	"	"								5								

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	HEAD ASSEMBLIES AND UNITS PER ASSEMBLY															
		MODEL DESIGNATION	1	1-A	1-C	1-B	1-F	1-G	1-H	1-J								
		ASSEMBLY NUMBER	51885	53298	54120	54939	58013	58014	58015	58016								
30-5	AN960-416	Washer								5								
23-15	AN315-4R	Nut	4															
24-21	"	"		4														
25-21	"	"			4													
26-16	"	"				4												
27-16	"	"					4											
28-21	"	"						4										
29-16	"	"							4									
30-21	"	"								4								
23-14	AN356-428	Palnut	4															
24-20	"	"		4														
25-20	"	"			4													
26-15	"	"				4												
27-15	"	"					4											
28-20	"	"						4										
29-15	"	"							4									
30-20	"	"								4								
23-13	51686	Rack—Speeder Spring Adjusting	1															
27-14	"	" " " "					1											
24-19	53390	Rack Assembly–Speeder Spring Adjusting		1														
25-19	"	" " " " " "			1													
26-14	"	" " " " " "				1												
28-19	"	" " " " " "						1										
29-14	"	" " " " " "							1									
30-19	"	" " " " " "								1								
23-11	50661	Spring—Control Shaft	1															
24-14	"	" " "		1														
25-14	"	" " "			1													
26-12	"	" " "				1												
27-12	"	" " "					1											
28-15	"	" " "						1										
29-13	"	" " "							1									
30-15	"	" " "								1								
23-10	50651	Shaft—Control	1															
27-11	"	" "					1											
24-13	53345	Shaft—Control		1														
25-13	"	" "			1													
26-11	"	" "				1												
28-14	"	" "						1										
29-12	"	" "							1									
30-14	"	" "								1								
23-9	53265	Washer—Control Shaft Packing	1															
24-12	"	" " " "		1														
25-12	"	" " " "			1													
26-10	"	" " " "				1												
27-10	"	" " " "					1											
28-13	"	" " " "						1										
29-11	"	" " " "							1									

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	HEAD ASSEMBLIES AND UNITS PER ASSEMBLY														
		MODEL DESIGNATION	1	1-A	1-C	1-B	1-F	1-G	1-H	1-J							
		ASSEMBLY NUMBER	51885	53298	54120	54939	58013	58014	58015	58016							
30-13	53265	Washer—Control Shaft Packing								1							
27-9	55149	Gasket—Packing Nut Lock					1										
28-12	"	" " " "						1									
29-10	"	" " " "							1								
30-12	"	" " " "								1							
27-8	55172	Nut Assembly—Packing					1										
28-11	"	" " "						1									
29-9	"	" " "							1								
30-11	"	" " "								1							
23-8	55831	Nut Assembly—Packing	1														
24-11	"	" " "		1													
25-11	"	" " "			1												
26-9	"	" " "				1											
23-3	AN380-2-2	Pin—Cotter	3														
24-2	"	" "		4													
25-2	"	" "			4												
26-3	"	" "				3											
27-3	"	" "					2										
28-2	"	" "						3									
29-3	"	" "							2								
30-2	"	" "								2							
23-7	50674	Washer—Control Shaft (Inner)	1														
24-10	"	" " " "		1													
25-10	"	" " " "			1												
26-8	"	" " " "				1											
27-7	"	" " " "					1										
28-10	"	" " " "						1									
29-8	"	" " " "							1								
30-10	"	" " " "								1							
26-7	51434	Pulley Assembly				1											
29-7	"	" "							1								
24-9	53301	Pulley Assembly		1													
28-9	"	" "						1									
25-9	54113	Pulley Assembly			1												
30-9	"	" "								1							
26-5	50645	Pulley				1											
29-5	"	"							1								
23-5	51243	Pulley	1														
27-5	"	"					1										
24-6	53242	Pulley		1													
28-6	"	"						1									
25-6	54109	Pulley			1												
30-6	"	"								1							
24-7	53243	Pin—Pulley Stop		1													
25-7	"	" " "			1												
28-7	"	" " "						1									
30-7	"	" " "								1							
24-1	AN960-10	Washer		1													

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	HEAD ASSEMBLIES AND UNITS PER ASSEMBLY															
		MODEL DESIGNATION	1	1-A	1-C	1-B	1-F	1-G	1-H	1-J								
		ASSEMBLY NUMBER	51885	53298	54120	54939	58013	58014	58015	58016								
25-1	AN960-10	Washer			1													
28-1	"	"						1										
30-1	"	"								1								
23-4	AN310-3	Nut	1															
24-3	"	"		2														
25-3	"	"			2													
26-4	"	"				1												
27-4	"	"					1											
28-3	"	"						2										
29-4	"	"							1									
30-3	"	"								2								
23-6	50646	Clamp—Cable	1															
24-8	"	" "		1														
25-8	"	" "			1													
26-6	"	" "				1												
27-6	"	" "					1											
28-8	"	" "						1										
29-6	"	" "							1									
30-8	"	" "								1								
23-2	AN310-4	Nut	1															
24-4	"	"		1														
25-4	"	"			1													
26-2	"	"				1												
27-2	"	"					1											
28-4	"	"						1										
29-2	"	"							1									
30-4	"	"								1								
24-15	53294	Screw—High RPM Adjustment		1														
25-15	"	" " " "			1													
28-16	"	" " " "						1										
30-16	"	" " " "								1								
24-16	53770	Plate—High RPM Screw Lock		1														
25-16	"	" " " " " "			1													
28-17	"	" " " " " "						1										
30-17	"	" " " " " "								1								
24-17	AN315-3R	Nut		1														
25-17	"	"			1													
28-18	"	"						1										
30-18	"	"								1								

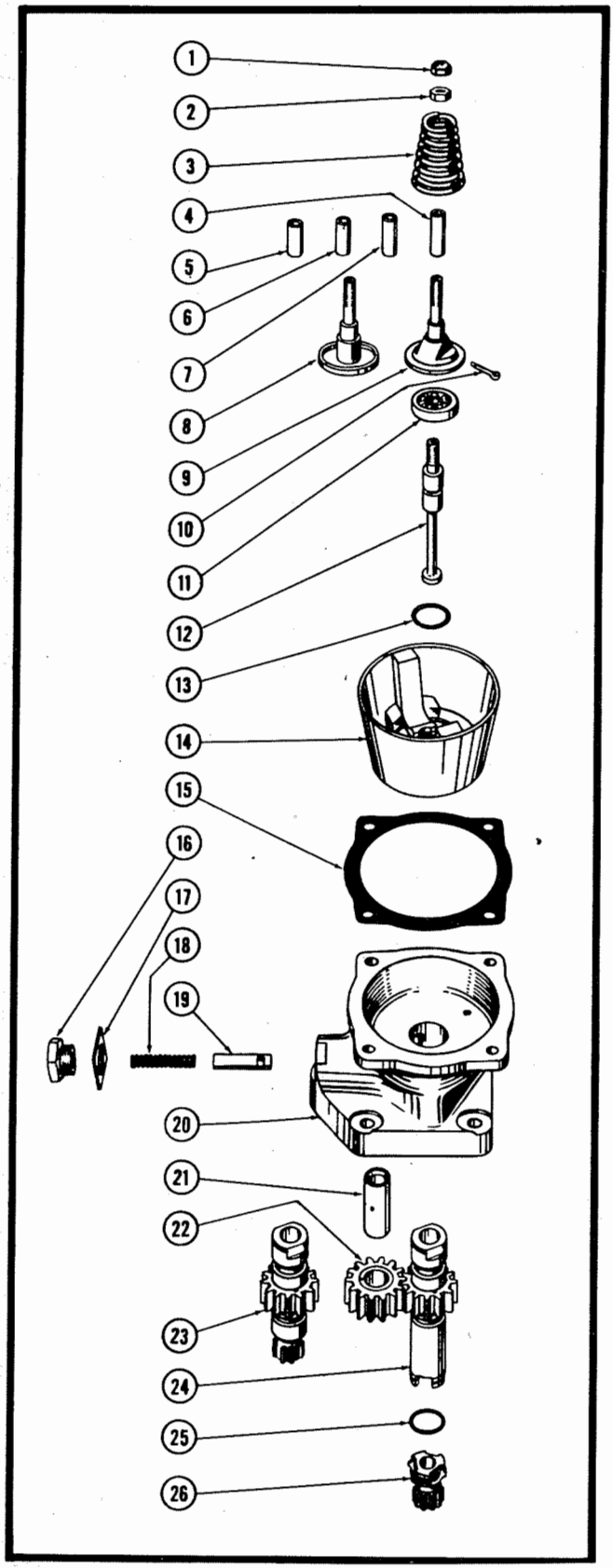


Figure 31—Body Assembly

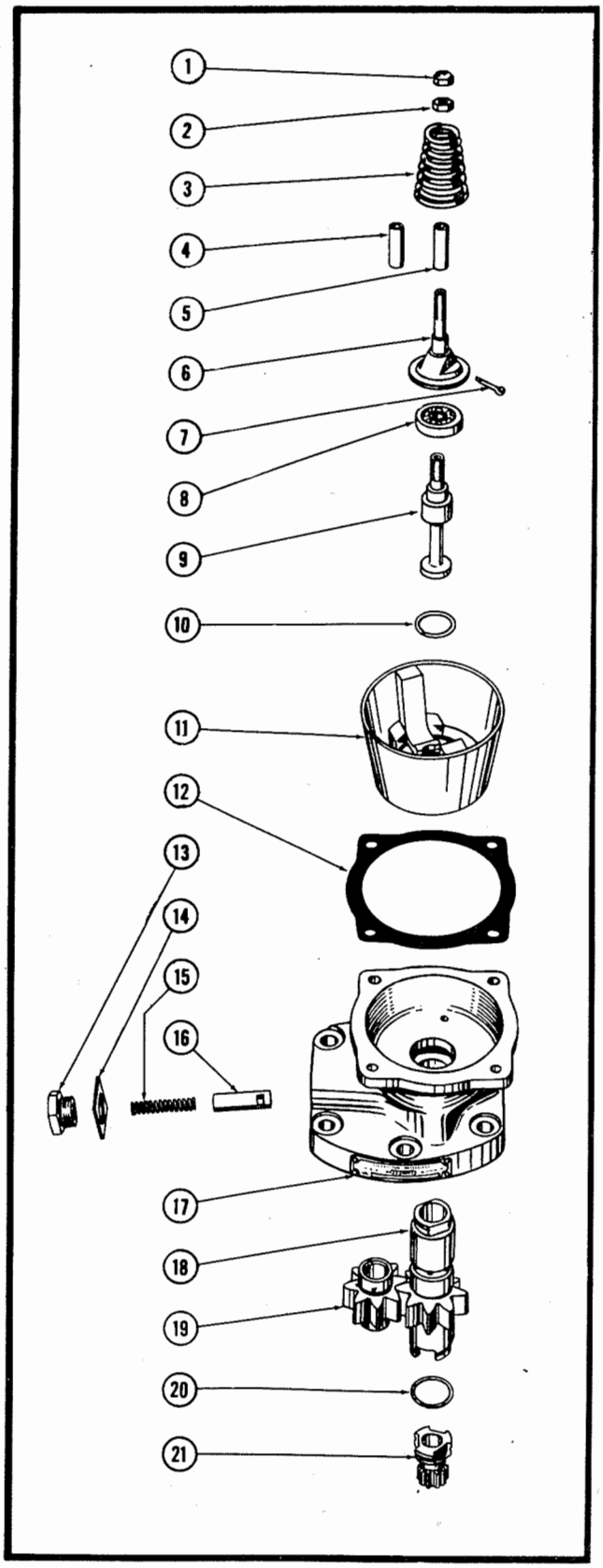


Figure 32—Body Assembly

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	BODY ASSEMBLIES AND UNITS PER ASSEMBLY																	
		MODEL DESIGNATION	A	C	E	A-5	C-5	E-5	M	P	Q	C-6	S	S-1	Q-1	S-4		
		ASSEMBLY NUMBER	51888	51891	52150	53394	53395	53425	54017	54018	54019	54096	54465	54574	54949	57685		
3-2	51888	Body Assembly—Model A	1															
17-2	51891	Body Assembly—Model C		1														
3-2	52150	Body Assembly—Model E			1													
4-2,	53394	Body Assembly—Model A-5				1												
5-2,																		
6-2,																		
7-2,																		
8-2,																		
9-2,																		
10-2,																		
11-2,																		
12-2,																		
13-2,																		
14-2,																		
15-2,																		
16-2																		
11-2,	53395	Body Assembly—Model C-5					1											
12-2																		
4-2,	53425	Body Assembly—Model E-5						1										
11-2,																		
18-2																		
19-2,	54017	Body Assembly—Model M							1									
20-2																		
19-2,	54018	Body Assembly—Model P								1								
20-2																		
19-2,	54019	Body Assembly—Model Q									1							
20-2																		
12-2	54096	Body Assembly—Model C-6										1						
21-2	54465	Body Assembly—Model S											1					
21-2,	54574	Body Assembly—Model S-1												1				
22-2																		
20-2	54949	Body Assembly—Model Q-1													1			
21-2,	57685	Body Assembly—Model S-4														1		
22-2																		
31-20	52203	Body	1	1	1	1	1	1	1	1	1	1			1			
32-17	54480	Body											1	1		1		
31-15	50672	Gasket—Head & Body	1	1	1	1	1	1	1	1	1	1			1			
32-12	"	" " " "											1	1		1		
31-23	52141	Shaft—Drive Gear	1	1	1	1	1	1				1						
31-24	53940	Shaft—Drive Gear							1	1	1				1			
32-18	54479	Shaft—Drive Gear											1	1		1		
32-20	53913	Ring—Drive Coupling Lock											1	1		1		
31-25	53942	Ring—Drive Coupling Lock							1	1	1				1			
32-21	53628	Coupling—Drive											1	1		1		
31-26	53939	Coupling—Drive							1	1	1				1			
31-21	50692	Shaft—Idler Gear	1	1	1	1	1	1	1	1	1	1			1			
31-22	50659	Gear—Idler	1	1	1	1	1	1	1	1	1	1			1			
32-19	53896	Gear—Idler											1	1		1		

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	BODY ASSEMBLIES AND UNITS PER ASSEMBLY																
		MODEL DESIGNATION	A	C	E	A-5	C-5	E-5	M	P	Q	C-6	S	S-1	Q-1	S-4		
		ASSEMBLY NUMBER	51888	51891	52150	53394	53395	53425	54017	54018	54019	54096	54465	54574	54949	57685		
31-14	52155	Fly-Weight Assembly	1	1	1	1	1	1	1	1	1	1			1			
32-11	"	" " "											1	1		1		
31-13	52121	Ring—Fly-Weight Assembly Lock	1	1	1	1	1	1	1	1	1	1			1			
32-10	"	" " " "											1	1		1		
31-12	50654	Valve—Pilot	1	1	1	1	1	1	1	1	1	1			1			
32-9	54478	Valve—Pilot											1	1		1		
31-11	50668	Bearing—Pilot Valve Ball	1	1	1	1	1	1	1	1	1	1			1			
32-8	"	" " " "											1	1		1		
31-8	52202	Collar—Spring		1														
31-9	53681	Collar—Spring	1		1	1	1	1	1	1	1	1			1			
32-6	"	" "											1	1		1		
31-10	AN380-2-2	Pin—Cotter				1	1	1	1	1	1				1			
32-7	"	" "											1	1		1		
31-10	AN380-2-3	Pin—Cotter	1	1	1							1						
31-6	51884	Spacer—Spring Collar	1															
31-5	52146	Spacer—Spring Collar		1	1										1			
31-7	53392	Spacer—Spring Collar				1			1			1						
32-4	"	" " "												1		1		
31-4	53393	Spacer—Spring Collar					1	1		1	1							
32-5	"	" " "											1					
31-3	50665	Spring—Speeder	1		1	1		1	1		1				1			
32-3	"	" "														1		
31-3	SK-1651-1	Spring—Speeder		1			1			1		1						
32-3	"	" "											1	1				
31-2	AN315-3R	Nut	1		1	1	1	1	1	1	1	1			1			
32-2	"	"											1	1		1		
31-2	51211	Nut		1														
31-1	AN365-1032	Nut	1	1	1	1	1	1	1	1	1	1			1			
32-1	"	"											1	1		1		
31-19	51710	Plunger—Relief Valve	1	1	1	1	1	1	1	1	1	1			1			
32-16	53906	Plunger—Relief Valve											1	1		1		
31-18	51737	Spring—Relief Valve	1	1	1	1	1	1	1	1	1	1			1			
32-15	54481	Spring—Relief Valve											1	1		1		
31-17	52205	Gasket—Relief Valve Plug	1	1	1	1	1	1	1	1	1	1			1			
32-14	"	" " " "											1	1		1		
31-16	52204	Plug—Relief Valve	1	1	1	1	1	1	1	1	1	1			1			
32-13	54482	Plug—Relief Valve											1	1		1		

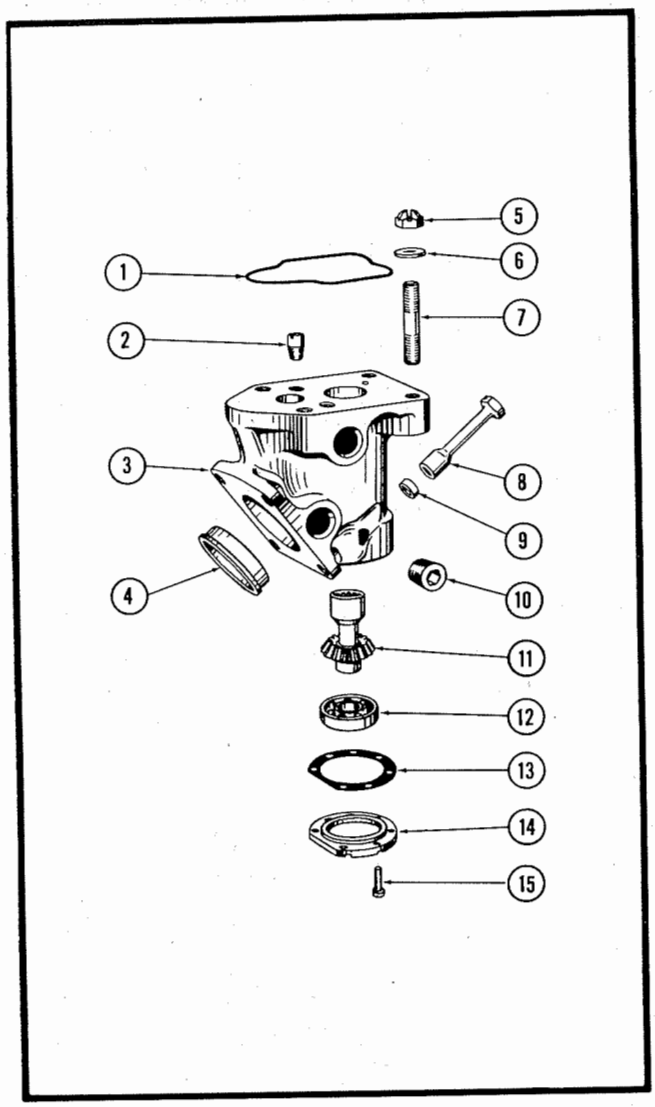


Figure 33—Base Assembly

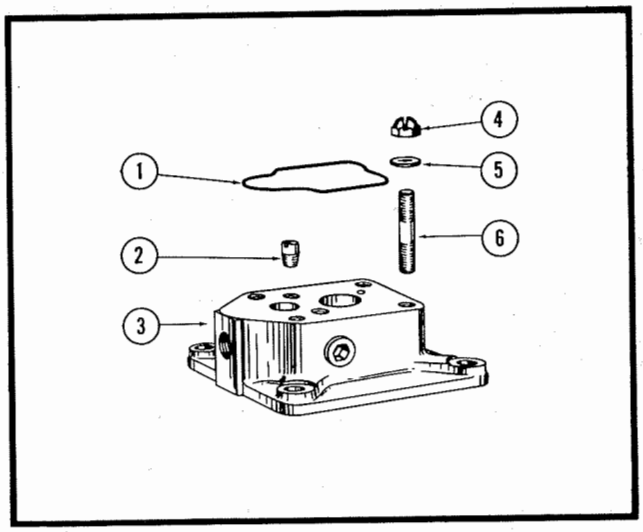


Figure 35—Base Assembly

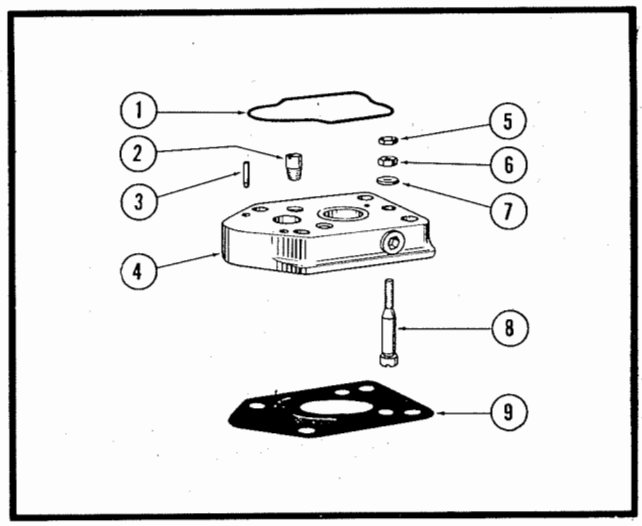


Figure 36—Base Assembly

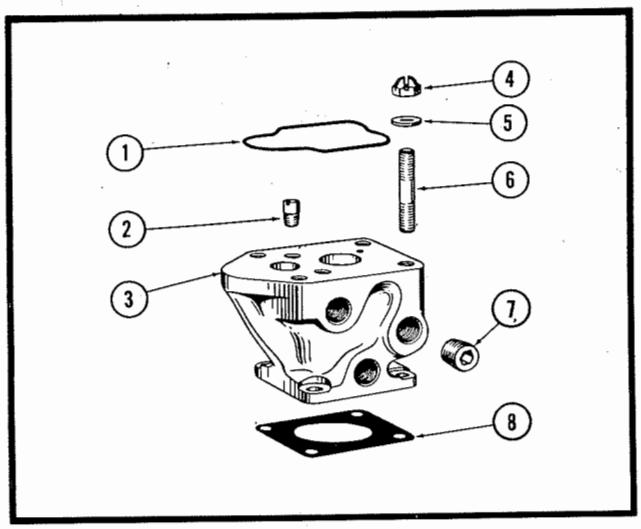


Figure 34—Base Assembly

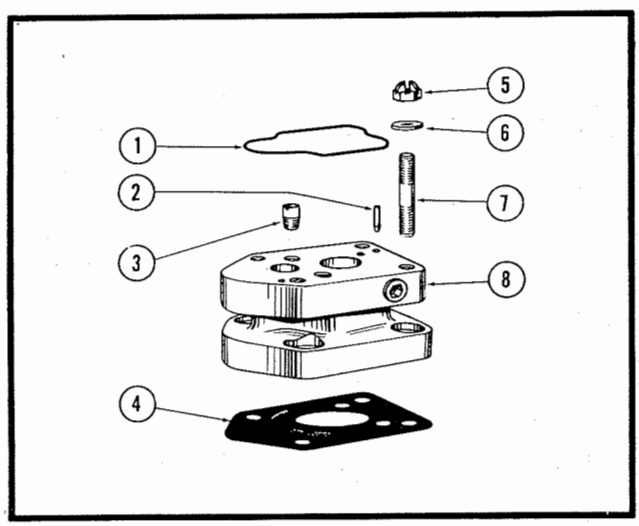


Figure 37—Base Assembly

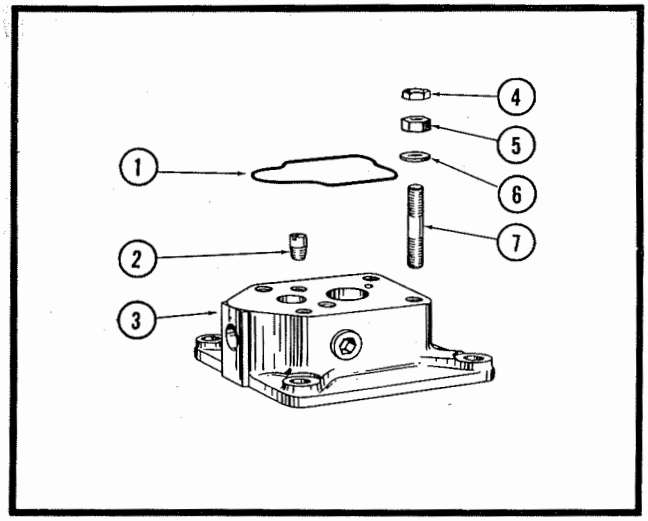


Figure 38—Base Assembly

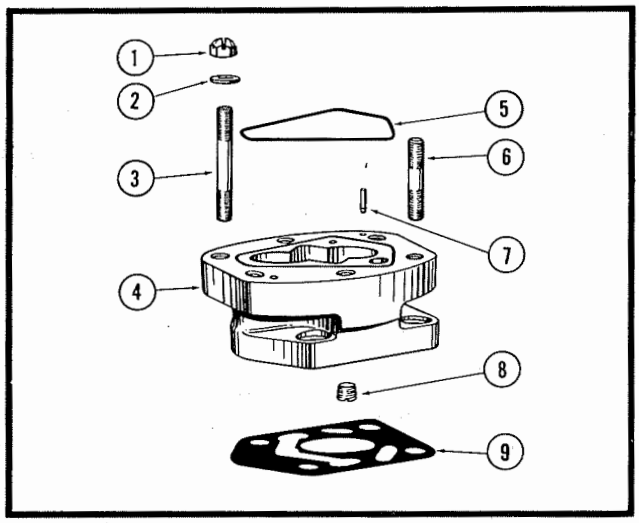


Figure 39—Base Assembly

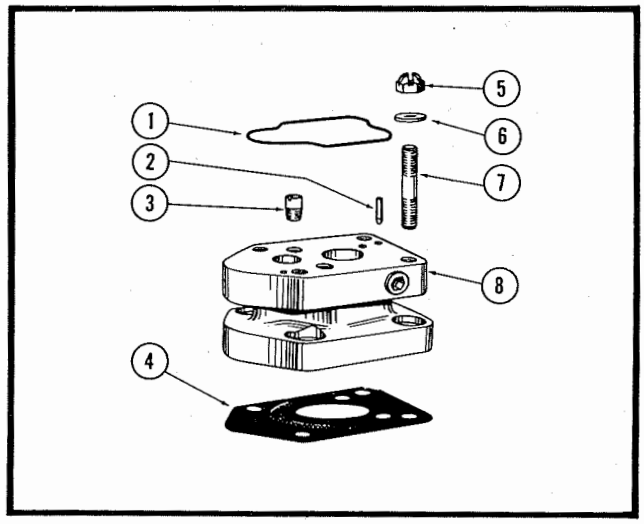


Figure 40—Base Assembly

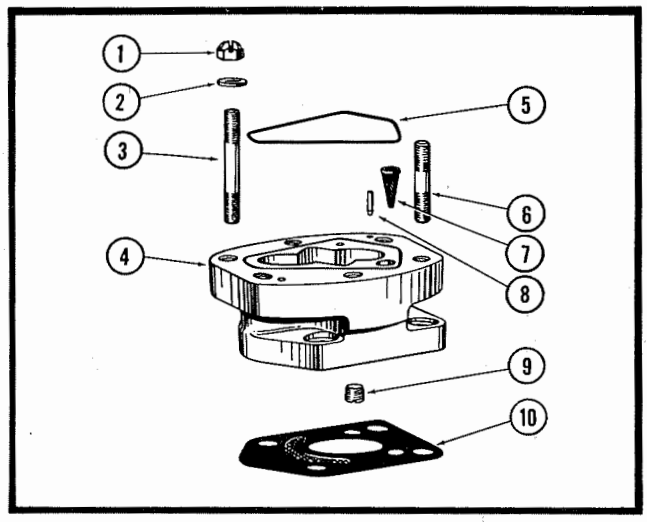


Figure 41—Base Assembly

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	MODEL DESIGNATION	BASE ASSEMBLIES AND UNITS PER ASSEMBLY														
				2	4	3	1	12	3-A	10-A	12-A	10-E						
			ASSEMBLY NUMBER	50830	50840	50842	52713	53967	54265	54494	55609	58676						
11-3, 12-3, 17-3	50830	Base Assembly—Model 2		1														
15-3, 16-3	50840	Base Assembly—Model 4			1													
13-3, 18-3	50842	Base Assembly—Model 3				1												
3-3, 4-3, 5-3, 6-3, 7-3, 8-3, 9-3, 10-3	52713	Base Assembly—Model 1					1											
19-3, 20-3	53967	Base Assembly—Model 12						1										
14-3	54265	Base Assembly—Model 3-A							1									
21-3, 22-3	54494	Base Assembly—Model 10-A								1								
19-3, 20-3	55609	Base Assembly—Model 12-A									1							
21-3	58676	Base Assembly—Model 10-E										1						
35-3	50822	Base				1												
34-3	50838	Base			1													
33-3	51742	Base		1														
36-4	52606	Base					1											
37-8	53773	Base						1										
38-3	54264	Base							1									
39-4	54518	Base								1								
40-8	55608	Base									1							
41-4	58666	Base										1						
38-7	51192	Stud—Body & Base							4									
33-7	53914	Stud—Body & Base		4														
34-6	"	" " "			4													
35-6	"	" " "				4												
37-7	"	" " "						4										
39-6	"	" " "								5								
40-7	"	" " "									4							
41-6	"	" " "										5						
39-3	53981	Stud—Body & Base								1								
41-3	"	" " "										1						
33-6	AN960-516	Washer		4														
34-5	"	"			4													
35-5	"	"				4												
37-6	"	"						4										
38-6	"	"							4									
39-2	"	"								6								

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	BASE ASSEMBLIES AND UNITS PER ASSEMBLY													
		MODEL DESIGNATION	2	4	3	1	12	3-A	10-A	12-A	10-E					
		ASSEMBLY NUMBER	50830	50840	50842	52713	53967	54265	54494	55609	58676					
40-6	AN960-516	Washer								4						
41-2	"	"									6					
33-5	AN310-5	Nut	4													
34-4	"	"		4												
35-4	"	"			4											
37-5	"	"					4									
39-1	"	"							6							
40-5	"	"								4						
41-1	"	"									6					
38-5	AN315-5R	Nut						4								
	51218	Wire—Safety	ar	ar	ar		ar	ar	ar	ar	ar					
33-10	55312	Plug—Pipe	3													
34-7	"	"		4												
33-2	50658	Plug—Oil Control	2													
35-2	"	"		2												
35-2	"	"			2											
36-2	"	"				2										
37-3	"	"					2									
38-2	"	"						2								
40-3	"	"								2						
39-8	53912	Plug—Oil Control							2							
41-9	"	"									2					
33-1	51471	Gasket—Body & Base	1													
34-1	"	"		1												
35-1	"	"			1											
36-1	"	"				1										
37-1	"	"					1									
38-1	"	"						1								
40-1	"	"								1						
39-5	53941	Gasket—Body & Base							1							
41-5	"	"									1					
40-4	57355	Gasket—Governor Mounting								1						
36-9	57354	Gasket—Governor Mounting				1										
37-4	"	"					1									
41-10	"	"									1					
39-9	53915	Gasket—Governor Mounting							1							
33-15	50558	Cover—Bearing Thrust	1													
33-13	50559	Gasket—Bearing Thrust Cover	1													
33-14	50693	Screw—Bearing Thrust Cover	7													
33-11	50794	Gear—Unit Drive	1													
33-12	51198	Bearing—Unit Drive Gear Thrust	1													
33-9	56109	Washer—Spacer	4													
33-8	51738	Nut—Stud	2													
33-4	52880	Liner—Assembly	1													
36-8	53401	Screw—Body & Base				1										
	+53401-15	Screw—Body & Base—(.0156 inch oversize)				+										
	+53401-31	Screw—Body & Base—(.0313 inch oversize)				+										
36-7	AN960-10	Washer				1										

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	MODEL DESIGNATION	BASE ASSEMBLIES AND UNITS PER ASSEMBLY														
				2	4	3	1	12	3-A	10-A	12-A	10-E						
			ASSEMBLY NUMBER	50830	50840	50842	52713	53967	54265	54494	55609	58676						
36-6	AN315-3R	Nut					1											
36-5	AN356-1032	Palnut					1											
36-3	53166	Dowel—Body & Base					2											
37-2	"	" " " "						2										
39-7	"	" " " "								2								
40-2	"	" " " "									2							
41-8	"	" " " "										2						
	+ 53166-15	Dowel—Body & Base—(.0156 inch oversize)					+	+		+	+	+						
	+ 53166-31	Dowel—Body & Base—(.0313 inch oversize)					+	+		+	+	+						
34-8	51212	Gasket—Governor Mounting			1													
38-4	51195	Palnut							4									
41-7	57276	Strainer Assembly										1						

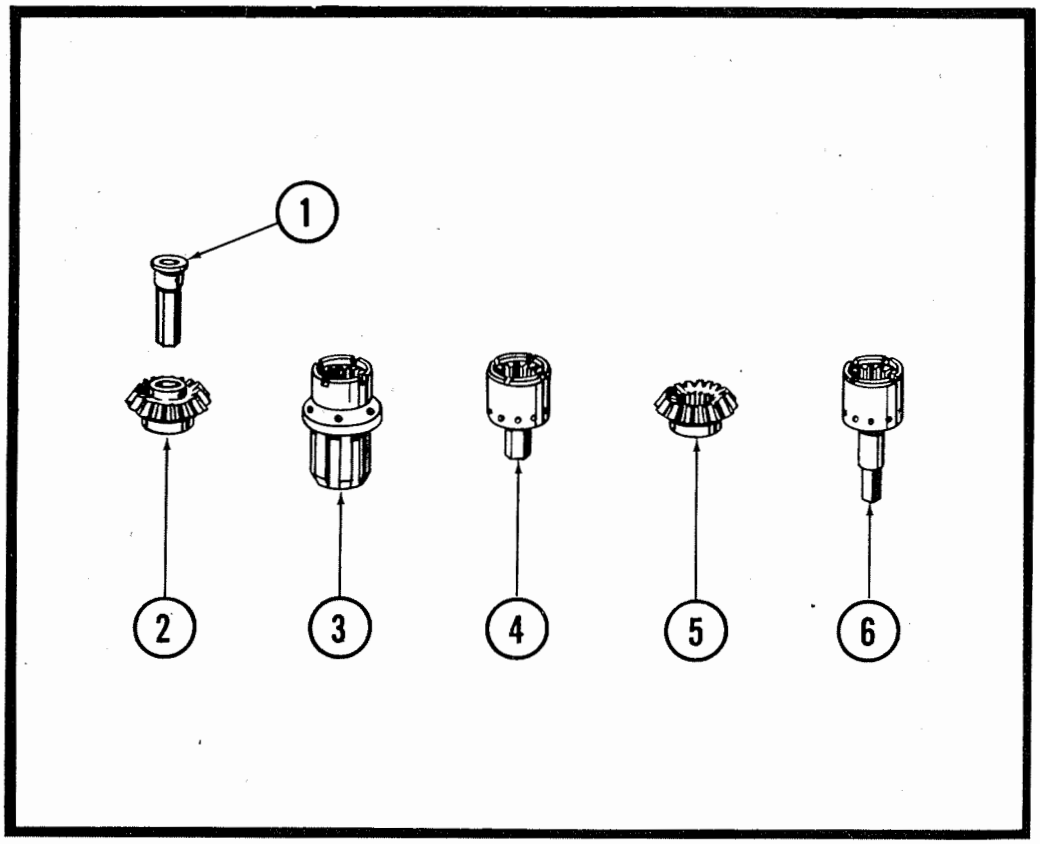


Figure 42—Drive Adapters

Note

A drive adapter is not considered to be a part of the governor base assembly, since it is sometimes furnished by the engine manufacturer. However, since adapters must be used with the base models listed, they are essential to the governor assemblies.

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	BASE ASSEMBLIES			
		MODEL DESIGNATION	2	4	3	3-A
		ASSEMBLY NUMBER	50830	50840	50842	54265
42-2	50441	Gear—Adapter Drive (Used on gun synchronizer drive having the threaded drive shaft. It locks with lock sleeve 50635.)	1			
42-1	50635	Sleeve—Adapter Drive Lock (Used to lock drive gear 50441.)	1			
42-3	50835	Coupling—Adapter Drive (Used on rear auxiliary drives.)			1	1
42-4	50839	Coupling—Adapter Drive (Used on gun synchronizer drive having a hexagonal internal spline.)		1		
42-5	51219	Gear—Adapter Drive (Used on gun synchronizer drive having the externally splined drive shaft.)	1			
42-6	51535	Coupling—Adapter Drive (Used on engines with square section internal drives.)		1		

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	6500	128	AN310-3	23-4	1
				24-3	2
				25-3	2
				26-4	1
				27-4	1
				28-3	2
				29-4	1
				30-3	2
	6500	128	AN310-4	23-2	1
				24-4	1
				25-4	1
				26-2	1
				27-2	1
				28-4	1
				29-2	1
				30-4	1
	6500	128	AN310-5	33-5	4
				34-4	4
				35-4	4
				37-5	4
				39-1	6
				40-5	4
				41-1	6
	6500	128	AN315-3R	24-17	1
				25-17	1
				28-18	1
				30-18	1
				31-2	1
				32-2	1
				36-6	1
	6500	128	AN315-4R	23-15	4
				24-21	4
				25-21	4
				26-16	4
				27-16	4
				28-21	4
				29-16	4
				30-21	4
	6500	128	AN315-5R	38-5	4
	6700	128	AN356-428	23-14	4
				24-20	4
				25-20	4
				26-15	4
				27-15	4
				28-20	4
				29-15	4
				30-20	4
	6700	128	AN356-1032	36-5	1
	6500	128	AN365-1032	31-1	1
				32-1	1
	6700	128	AN380-2-2	23-3	3
	6700	128	AN380-2-2	24-2	4
				25-2	4
				26-3	3
				27-3	2
				28-2	3
				29-3	2
				30-2	2
				31-10	1
				32-7	1
	6700	128	AN380-2-3	31-10	1
	6500	128	AN960-10	24-1	1
				25-1	1
				28-1	1
				30-1	1
				36-7	1
	6500	128	AN960-416	23-1	5
				24-5	5
				25-5	5
				26-1	5
				27-1	5
				28-5	5
				29-1	5
				30-5	5
	6500	128	AN960-516	33-6	4
				34-5	4
				35-5	4
				37-6	4
				38-6	4
				39-2	6
				40-6	4
				41-2	6
	4013	125L	SK1651-1	31-3	1
				32-3	1
	4013	125L	50441	42-2	1
	4013	125L	50558	33-14	1
	4013	125L	50559	33-13	1
	4013	125L	50635	42-1	1
	4013	125L	50645	26-5	1
				29-5	1
	4013	125L	50646	23-6	1
				24-8	1
				25-8	1
				26-6	1
				27-6	1
				28-8	1
				29-6	1
				30-8	1
	4013	125L	50648	23-17	1
				26-18	1
	4013	125L	50651	23-10	1
				27-11	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	4013	125L	50654	31-12	1
	4013	125L	50658	33-2	2
				34-2	2
				35-2	2
				36-2	2
				37-3	2
				38-2	2
				40-3	2
	4013	125L	50659	31-22	1
	4013	125L	50661	23-11	1
				24-14	1
				25-14	1
				26-12	1
				27-12	1
				28-15	1
				29-13	1
				30-15	1
	4013	125L	50665	31-3	1
				32-3	1
	4013	125L	50668	31-11	1
				32-8	1
	4013	125L	50672	31-15	1
				32-12	1
	4013	125L	50674	23-7	1
				24-10	1
				25-10	1
				26-8	1
				27-7	1
				28-10	1
				29-8	1
				30-10	1
	4013	125L	50692	31-21	1
	4013	125L	50693	33-15	7
	4013	125L	50794	33-11	1
	4013	125L	50822	35-3	1
	4013	125L	50830	11-3	1
				12-3	1
				17-3	1
	4013	125L	50835	42-3	1
	4013	125L	50838	34-3	1
	4013	125L	50839	42-4	1
	4013	125L	50840	15-3	1
				16-3	1
	4013	125L	50842	13-3	1
				18-3	1
	4013	125L	51180	23-12	2
				24-18	2
				25-18	2
				26-13	2
				27-13	2
	4013	125L	51192	38-7	4

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	4013	125L	51195	38-4	4
	4013	125L	51198	33-12	1
	4013	125L	51211	31-2	1
	4013	125L	51212	34-8	1
	6800	125L	51218		ar
	4013	125L	51219	42-5	1
	4013	125L	51243	23-5	1
				27-5	1
	4013	125L	51434	26-7	1
				29-7	1
	4013	125L	51471	33-1	1
				34-1	1
				35-1	1
				36-1	1
				37-1	1
				38-1	1
				40-1	1
	4013	125L	51535	42-6	1
	4013	125L	51686	23-13	1
				27-14	1
	4013	125L	51692	23-16	2
				24-22	2
				25-22	2
				26-17	2
				27-17	2
				28-22	4
				29-17	4
				30-22	4
	4013	125L	51710	31-19	1
	4013	125L	51737	31-18	1
	4013	125L	51738	33-8	2
	4013	125L	51742	33-3	1
	4013	125L	51884	31-6	1
	4013	125L	51885	3-1	1
				17-1	1
	4013	125L	51888	3-2	1
	4013	125L	51891	17-2	1
	4013	125L	52121	31-13	1
				32-10	1
	4013	125L	52141	31-23	1
	4013	125L	52146	31-5	1
	4013	125L	52150	3-2	1
	4013	125L	52155	31-14	1
				32-11	1
	4013	125L	52202	31-8	1
	4013	125L	52203	31-20	1
	4013	125L	52204	31-16	1
	4013	125L	52205	31-17	1
				32-14	1
	4013	125L	52606	36-4	1
	4013	125L	52713	3-3	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	4013	125L	52713	4-3	1
				5-3	1
				6-3	1
				7-3	1
				8-3	1
				9-3	1
				10-3	1
	4013	125L	52880	33-4	1
	4013	125L	+53166	36-3	2
				37-2	2
				39-7	2
				40-2	2
				41-8	2
	4013	125L	53242	24-6	1
				28-6	1
	4013	125L	53243	24-7	1
				25-7	1
				28-7	1
				30-7	1
	4013	125L	53265	23-9	1
				24-12	1
				25-12	1
				26-10	1
				27-10	1
				28-13	1
				29-11	1
				30-13	1
	4013	125L	53294	24-15	1
				25-15	1
				28-16	1
				30-16	1
	4013	125L	53295	24-23	1
				25-23	1
	4013	125L	53298	4-1	1
				11-1	1
				15-1	1
				18-1	1
				19-1	1
				22-1	1
	4013	125L	53301	24-9	1
				28-9	1
	4013	125L	53345	24-13	1
				25-13	1
				26-11	1
				28-14	1
				29-12	1
				30-14	1
	4013	125L	53390	24-19	1
				25-19	1
				26-14	1
				28-19	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	4013	125L	53390	29-14	1
				30-19	1
	4013	125L	53392	31-7	1
				32-4	1
	4013	125L	53393	31-4	1
				32-5	1
	4013	125L	53394	4-2	1
				5-2	1
				6-2	1
				7-2	1
				8-2	1
				9-2	1
				10-2	1
				11-2	1
				12-2	1
				13-2	1
				14-2	1
				15-2	1
				16-2	1
	4013	125L	53395	11-2	1
				12-2	1
	4013	125L	+53401	36-8	1
	4013	125L	53425	4-2	1
				11-2	1
				18-2	1
	4013	125L	53628	32-21	1
	4013	125L	53681	31-9	1
				32-6	1
	4013	125L	53770	24-16	1
				25-16	1
				28-17	1
				30-17	1
	4013	125L	53773	37-8	1
	4013	125L	53896	32-19	1
	4013	125L	53906	32-16	1
	4013	125L	53912	39-8	2
				41-9	2
	4013	125L	53913	32-20	1
	4013	125L	53914	33-7	4
				34-6	4
				35-6	4
				37-7	4
				39-6	5
				40-7	4
				41-6	5
	4013	125L	53915	39-9	1
	4013	125L	53939	31-26	1
	4013	125L	53940	31-24	1
	4013	125L	53941	39-5	1
				41-5	1
	4013	125L	53942	31-25	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	4013	125L	53967	19-3	1
				20-3	1
	4013	125L	53981	39-3	1
				41-3	1
	4013	125L	54017	19-2	1
				20-2	1
	4013	125L	54018	19-2	1
				20-2	1
	4013	125L	54019	19-2	1
				20-2	1
	4013	125L	54096	12-2	1
	4013	125L	54109	25-6	1
				30-6	1
	4013	125L	54113	25-9	1
				30-9	1
	4013	125L	54120	6-1	1
	4013	125L	54264	38-3	1
	4013	125L	54265	14-3	1
	4013	125L	54465	21-2	1
	4013	125L	54478	32-9	1
	4013	125L	54479	32-18	1
	4013	125L	54480	32-17	1
	4013	125L	54481	32-15	1
	4013	125L	54482	32-13	1
	4013	125L	54494	21-3	1
				22-3	1
	4013	125L	54518	39-4	1
	4013	125L	54574	21-2	1
				22-2	1
	4013	125L	54939	5-1	1
	4013	125L	54949	20-2	1
	4013	125L	55149	27-9	1
				28-12	1
				29-10	1
				30-12	1
	4013	125L	55172	27-8	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U. S. NAVY	U. S. ARMY	BRITISH			
	4013	125L	55172	28-11	1
				29-9	1
				30-11	1
	4013	125L	55312	33-10	3
				34-7	4
	4013	125L	55608	40-8	1
	4013	125L	55609	19-3	1
				20-3	1
	4013	125L	55831	23-8	1
				24-11	1
				25-11	1
				26-9	1
	4013	125L	56109	33-9	4
	4013	125L	57276	41-7	1
	4013	125L	57354	36-9	1
				37-4	1
				41-10	1
	4013	125L	57355	40-4	1
	4013	125L	57685	21-2	1
				22-2	1
	4013	125L	58008	27-18	1
				29-18	1
	4013	125L	58009	28-23	1
				30-23	1
	4013	125L	58013	7-1	1
	4013	125L	58014	8-1	1
				12-1	1
				13-1	1
				14-1	1
				16-1	1
				20-1	1
				21-1	1
	4013	125L	58015	9-1	1
	4013	125L	58016	10-1	1
	4013	125L	58666	41-4	1
	4013	125L	58676	21-3	1

PART NUMBER	NOMEN-CLATURE	FIGURE & INDEX NUMBER	TOTAL QUANTITY
AN310-3	Nut	23-4	1
		24-3	2
		25-3	2
		26-4	1
		27-4	1
		28-3	2
		29-4	1
		30-3	2
AN310-4	Nut	23-2	1
		24-4	1
		25-4	1
		26-2	1
		27-2	1
		28-4	1
		29-2	1
		30-4	1
AN310-5	Nut	33-5	4
		34-4	4
		35-4	4
		37-5	4
		39-1	6
		40-5	4
		41-1	6
AN315-3R	Nut	24-17	1
		25-17	1
		28-18	1
		30-18	1
		31-2	1
		32-2	1
		36-6	1
AN315-4R	Nut	23-15	4
		24-21	4
		25-21	4
		26-16	4
		27-16	4
		28-21	4
		29-16	4
		30-21	4
AN315-5R	Nut	38-5	4
AN356-428	Palnut	23-14	4
		24-20	4

PART NUMBER	NOMEN-CLATURE	FIGURE & INDEX NUMBER	TOTAL QUANTITY
AN356-428	Palnut	25-20	4
		26-15	4
		27-15	4
		28-20	4
		29-15	4
		30-20	4
AN356-1032	Palnut	36-5	1
AN365-1032	Nut	31-1	1
		32-1	1
AN380-2-2	Pin — Cotter	23-3	3
		24-2	4
		25-2	4
		26-3	3
		27-3	2
		28-2	3
		29-3	2
		30-2	2
		31-10	1
		32-7	1
AN380-2-3	Pin — Cotter	31-10	1
AN960-10	Washer	24-1	1
		25-1	1
		28-1	1
		30-1	1
		36-7	1
AN960-416	Washer	23-1	5
		24-5	5
		25-5	5
		26-1	5
		27-1	5
		28-5	5
		29-1	5
		30-5	5
AN960-516	Washer	33-6	4
		34-5	4
		35-5	4
		37-6	4
		38-6	4
		39-2	6
		40-6	4
		41-2	6