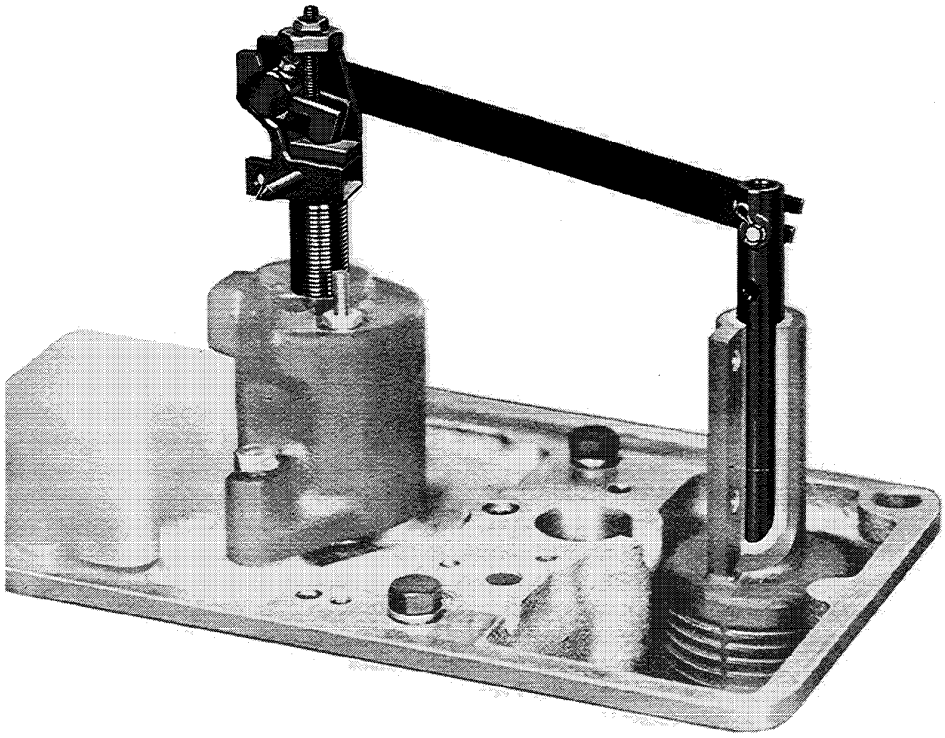
WOODWARD

Product Manual36621
(Revision E)
Original Instructions



PG Governor
Speed Droop Linkage

Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Warnings and Notices

Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

PG Governor Speed Droop Linkage

Introduction

There are three speed droop linkages covered in this manual. The turnbuckle style has been discontinued, however, it in included because of units still in use.

All three types perform the same function and are similar except for the linkage hook-up connecting the tailrod with the speed setting servo. One is a turnbuckle link, now obsolete. The second style (see cover photo) has a flat bar link for use with PG governors that have a fuel limiter and/or load control linkage. The third is a telescoping type that has a rod for its linkage, and is used when load control is not used.

Description

Speed droop is used in PG governors to permit loads to be divided among engines driving alternators which are being operated in parallel or between engines driving a common output shaft. Speed droop is defined as the decrease in speed which occurs, on an engine operating alone, as the governor output connection to the engine fuel racks (or valve) moves from its minimum to maximum fuel positions. This change in speed (speed droop) can be expressed in rpm or as a percentage of normal speed.

The change in engine and governor speed results from a change in governor speed setting. This change in speed setting is accomplished through the speed droop linkage.

The loading on the speeder spring determines the governor speed setting. The speed droop linkage is arranged to decrease the loading on the speeder spring as the governor power piston moves in the increase fuel (or load) direction; conversely, it increases the loading on the spring as the piston moves in the decrease fuel direction.

The upper portion of a governor equipped with the speed droop linkage described in this manual is shown on the front cover.

Operation

Refer to Figure 1. The speed setting servo piston and piston rod have a unique position for each speed adjustment setting. The fulcrum block is attached to the servo piston rod; the fulcrum pin is located in the fulcrum block.

The speed droop plunger is free to move up and down within the servo piston rod. The lower end of the droop plunger is always in contact with the speeder spring. Changing the position of the droop plunger changes the loading on the speeder spring. The speed droop cam, acting on the droop plunger cap, positions the droop plunger.

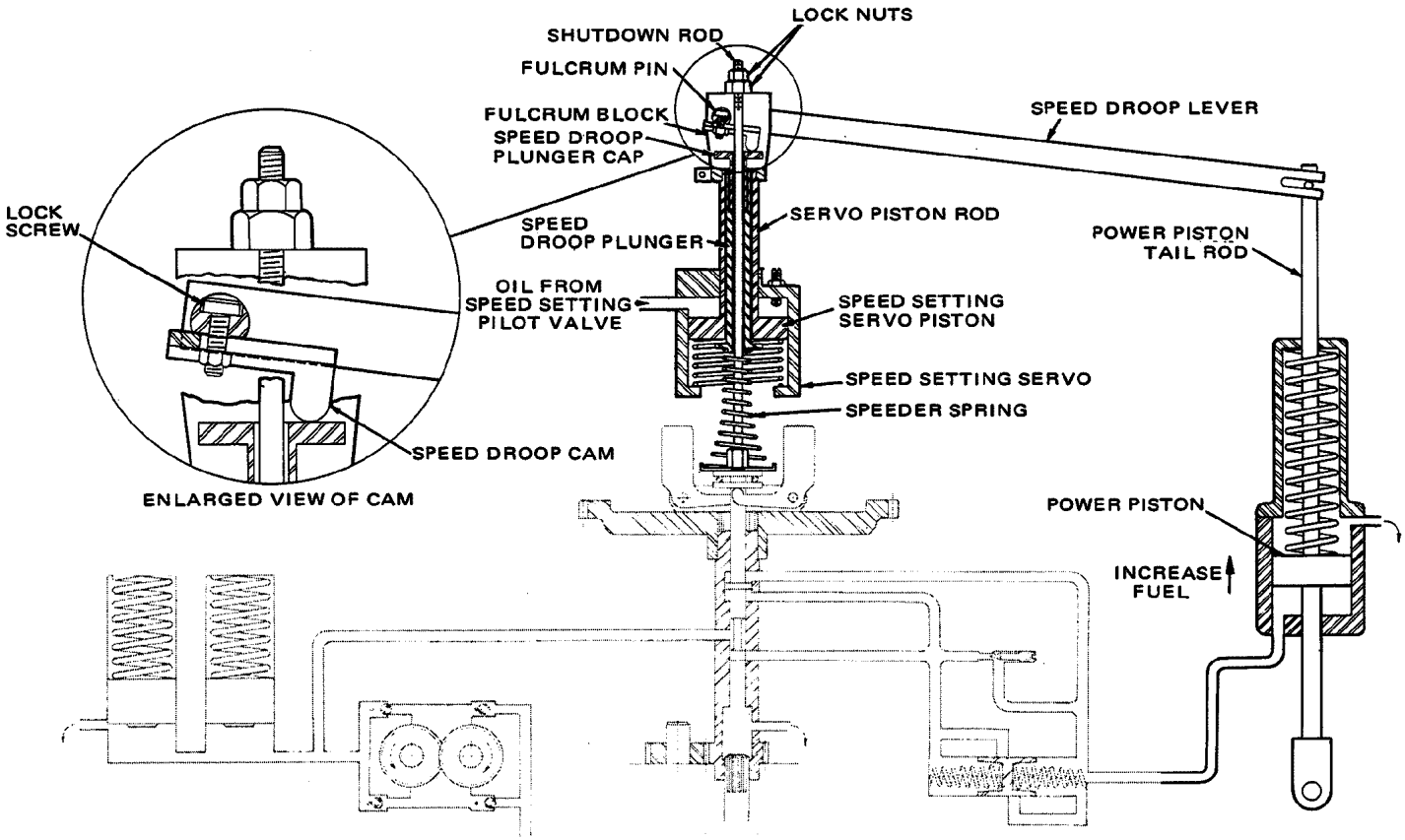

Figure 1. Schematic Diagram, Speed Droop Linkage Assembly (Flat Bar Type)

One end of the droop linkage is attached to the power piston tailrod. This end of the linkage moves up and down with the governor power piston. The speed droop cam is attached to the opposite end of the droop linkage and pivots about the fulcrum pin as the power piston moves.

If the droop linkage is adjusted so that the droop cam is on the same centerline as the fulcrum pin, there is no change in the compression of the speeder spring as the power piston moves. This setting is termed the “zero droop” setting. With the droop cam at a position other than the “zero droop” setting, the loading on the speeder spring is changed as the power piston moves.

The further the cam is away from the fulcrum pin centerline, the greater is the change in spring compression—and hence, speed setting—for a given movement of the power piston. The droop cam must never be positioned on the side of the fulcrum pin centerline which causes speed setting to be increased when the power piston moves in the increase fuel direction.

With the droop linkage adjusted for “zero droop”, the governor controls as an isochronous governor. An isochronous governor maintains a constant engine speed for all loads within the capacity of the engine, except momentarily during load transients.

No more than one governor on engines operating in parallel can be set on “zero droop”. All other units must have sufficient droop to prevent load interchanges between units. These are referred to as “droop governors”. A “zero droop” unit will maintain frequency of the system and will take all load changes on the system within its capacity. If the “zero droop” unit is unable to handle the load changes by itself, all units must have some amount of speed droop.

Changing the speed setting adjustments of the isochronous governor in a paralleled system changes the frequency or speed of the system. Changing the speed setting adjustment of a droop governor (presuming its engine is operating in parallel with an isochronous unit) has the effect of changing the amount of load that unit is carrying. This can be readily seen by following the sequence of governor moments when the speed setting is increased.

The increased spring force resulting from the increased speed setting pushes the governor pilot valve plunger down. Pressure oil flowing through the pilot valve causes the power piston to move in the increase fuel—and load—direction, As the power piston moves, the droop linkage rotates the speed droop cam in the direction which now decreases the loading on the speeder spring.

When the governor power piston has moved to its new fuel and load position, the droop linkage will, in effect, have exactly cancelled the increased spring force resulting from speed setting increase. Thus, a speed setting change on a droop governor controlling an engine operating in parallel with others (one of which is an isochronous unit) changes not the speed of the unit, but the load it is carrying. Speed of the system is controlled by the isochronous unit. If all governors on paralleled units are operating with droop, changing the speed setting of one governor will affect not only the load its engine is carrying, but the system speed as well.

Adjustment (Flat Bar or Rod Style)

Refer to Figure 1 or Figure 2. The speed droop cam may be repositioned by loosening the lock screw and sliding the cam along its slot in the fulcrum pin (attached to the droop lever assembly). Moving the cam away from the fulcrum pin centerline increases the droop.

⚠WARNING

The cam must never be moved beyond the “zero droop” position so that “negative” droop results. Negative droop is the condition existing when an increase in engine load results in an increase in speeder spring loading. A system with negative droop is inherently unstable.

The exact amount of droop used depends upon system and engine characteristics. There must be enough droop on the droop units to prevent interchange of load between the engines operating in parallel. Engines can be operated in parallel with differing amounts of droop. If the droop settings are different on such units, load changes taken by each during transients will vary inversely with the droop settings.

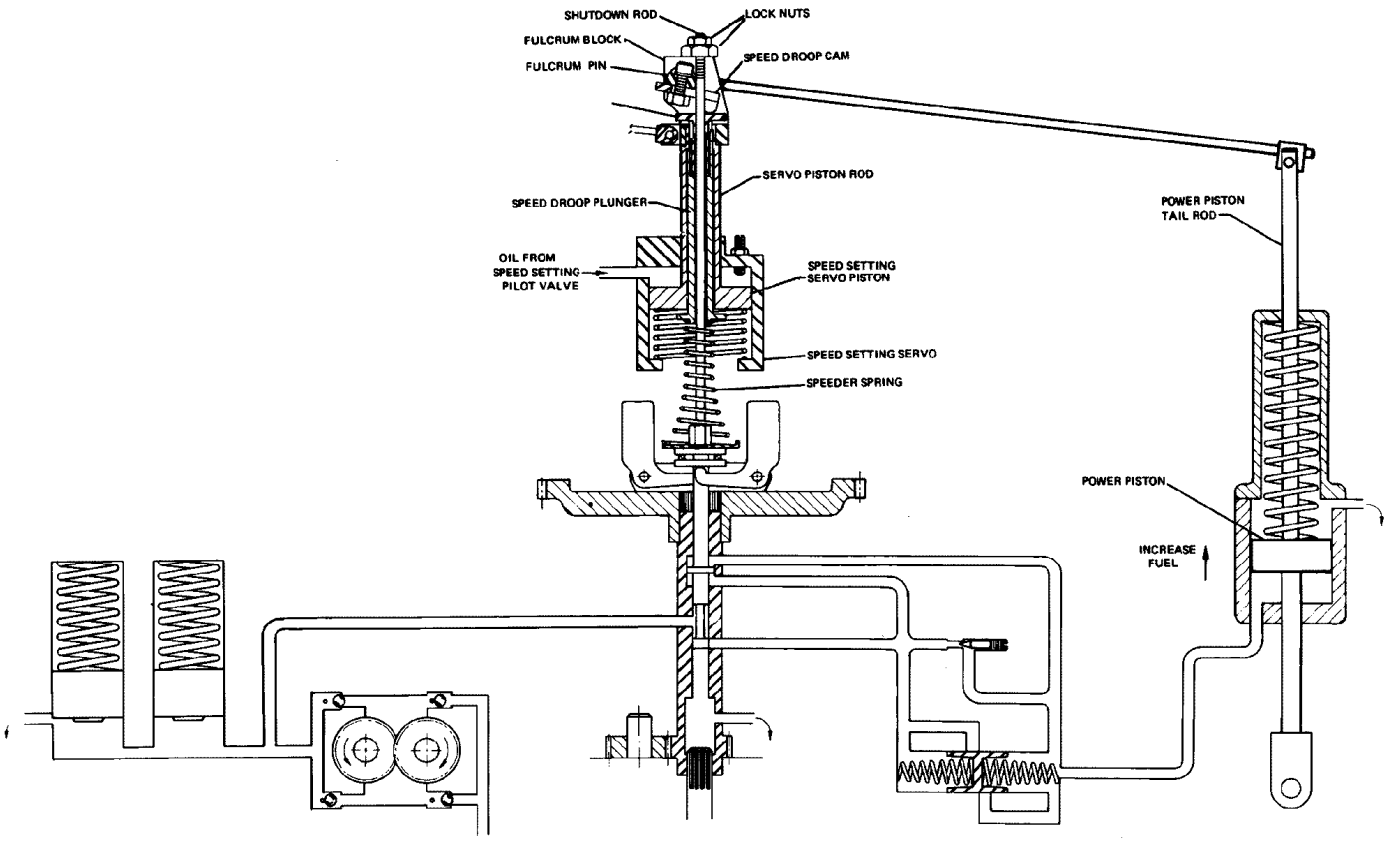

Figure 2. Schematic Diagram, Speed Droop Linkage (Rod Type)

Adjustment (Turnbuckle Style)

Refer to Figure 3. Reposition the speed droop cam by loosening the lock nut and turning the turnbuckle. Moving the cam away from the fulcrum pin centerline increases the droop.

⚠WARNING

Never move the cam beyond the "zero droop" position so that "negative" droop results. Negative droop is the condition existing when an increase in engine load results in an increase in speeder spring loading. A system with negative droop is inherently unstable.

The exact amount of droop used depends upon system and engine characteristics. There must be enough droop on the droop units to prevent interchange of load between the engines operating in parallel. Engines can be operated in parallel with differing amounts of droop. If the droop settings are different on such units, load changes taken by each during transients vary inversely with the droop settings.

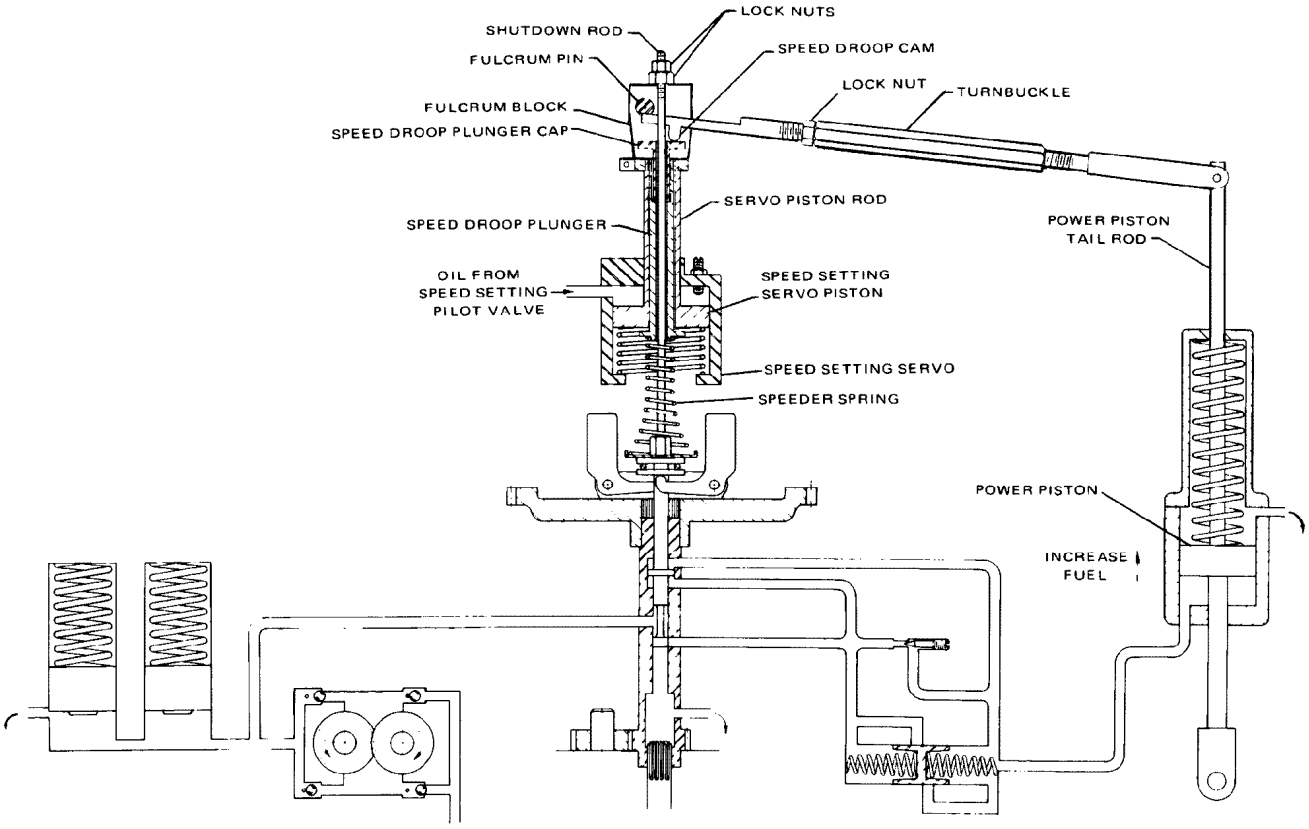

Figure 3. Schematic Diagram, Speed Droop Linkage (Turnbuckle Type)

Replacement Parts Information

When ordering replacement parts, it is essential to include the following information:

- Governor serial number and part number (shown on nameplate)
- Manual number (this is manual 36621)
- Parts reference number in parts list and description of part or part name

Figures 4, 5, and 6 illustrate and list all the replaceable parts for the PG speed droop linkage. The numbers assigned are used as reference numbers and are not specific Woodward pert numbers. Woodward will determine the exact part number for your particular governor.

Parts List for Figure 4

Ref. No.	Part Name	Quantity
36621-1	Cover screw	2
36621-2	Washer	2
36621-3	Oil cup	1
36621-4	Cover	1
36621-5	Cover gasket	1
36621-6	Hex nut	1
36621-7	Hex nut	1
36621-8	Shutdown rod	1
36621-9	Not Used	
36621-10	Fulcrum	1
36621-11	Speed droop cam	1
36621-12	Lock screw	1
36621-13	Speed droop lever assy	1
36621-14	Nut	1
36621-15	Washer	1
36621-16	Spacer	1
36621-17	Pin	1
36621-18	Cotter pin	1
36621-19	Tailrod	1
36621-20	Droop plunger cap	1
36621-21	Speeder spring servo cylinder	1
36621-22	Speeder spring servo piston	1
36621-23	Speed droop plunger	1
36621-24	Speeder spring servo spring	1
36621-25	Column	1
36621-26	Hex head screw	4
36621-27	Lockwasher	4
36621-28	Spring guard seal O-ring	1
36621-29	Spring guard seal ring	1
36621-30	Spring guard seal spring	1
36621-31	Spring guard	1
36621-32	Socket head screw	4
36621-33	Lockwasher	4
36621-34	Gasket	1
36621-35	Flexloc nut	1
36621-36	Tailrod lift nut	1
36621-37	Lockwasher	1
36621-36	Washer	1
36621-39 to -50 Not Used		

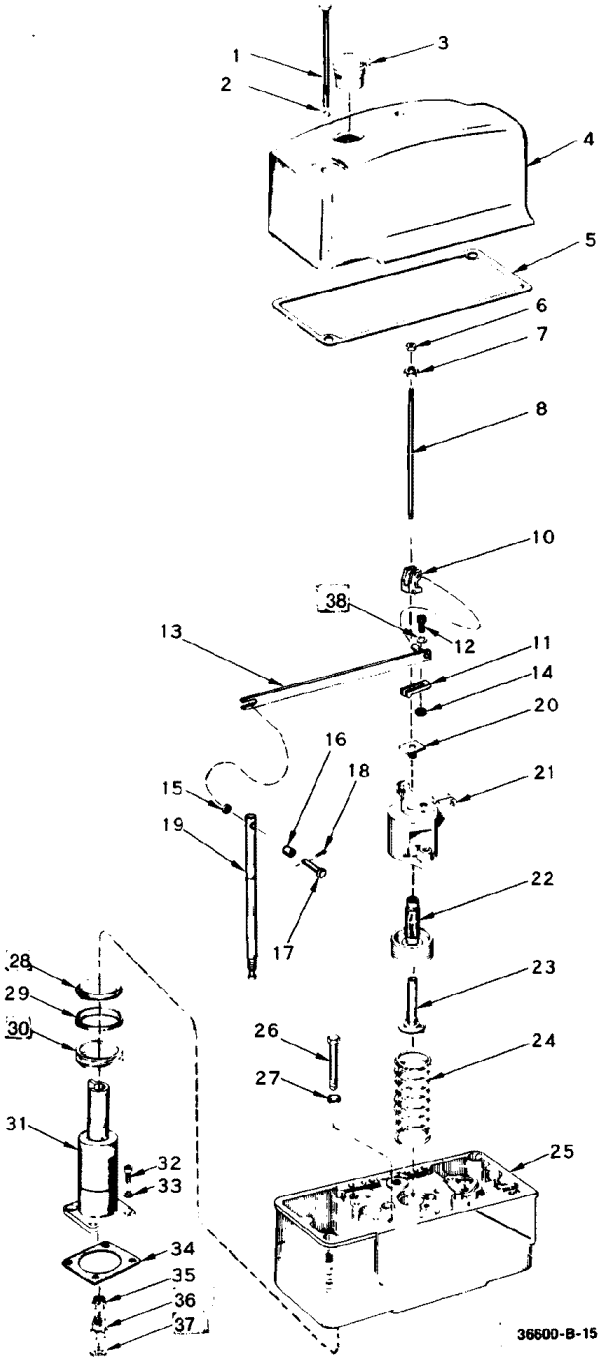

Figure 4. Exploded View, Speed Droop Linkage Assembly (Flat Bar Type)

Parts List For Figure 5

Ref. No.	Part Name ..... Quantity
36621-51	Shutdown lock nut..... 1
36621-52	Shutdown nut..... 1
36621-53	Cam seat..... 1
38621-54	Fulcrum..... 1
36621-55	Speed droop cam..... 1
36621-56	Nut 1
36621-57	Screw..... 1
36621-58	Washer 1
36621-59	Speed droop lever assembly..... 1
36621-60	Pivot block..... 1
36621-61	Spacer 1
36621-62	Washer 1
36621-63	Cotter pin 1

36621-64 to -100 Not Used

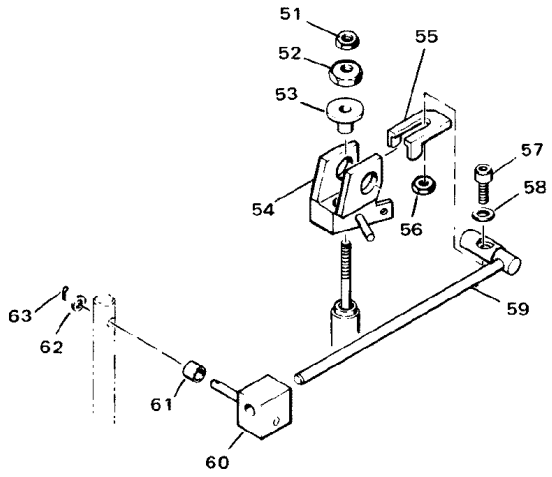

Figure 5. Exploded View of Rod Type Speed Droop Linkage

Parts List For Figure 6

Ref. No.	Part Name	Quantity
36621-101	Cover screw	2
36621-102	Washer	2
36621-103	Oil cup	1
36621-104	Cover	1
36621-105	Cover gasket	1
36621-106	Hex nut	1
36621-107	Hex nut	1
36621-108	Shutdown rod	1
36621-109	Not Used	
36621-110	Fulcrum	1
36621-111	Pivot pin	1
36621-112	Speed droop cam	1
36621-113	Lock nut	1
36621-114	Turnbuckle	1
36621-115	Speed droop fork	1
36621-116	Tailrod	1
36621-117	Pin	1
36621-118	Cotter pin	1
36621-119	Droop plunger cap	1
36621-120	Speeder spring servo cylinder	1
36621-121	Speeder spring servo piston	1
36621-122	Speed droop plunger	1
36621-123	Speeder spring servo spring	1
36621-124	Column	1
36621-125	Hex head screw	4
36621-126	Lockwasher	4
36621-127	Spring guard seal O-ring	1
36621-128	Spring guard seal ring	1
36621-129	Spring guard seal spring	1
36621-130	Spring guard	1
36621-131	Socket head screw (1/4”-28 x 3/4”)	4
36621-132	Lockwasher	4
36621-133	Gasket	1
36621-134	Flexloc nut (3/8”-24)	1
36621-135	Tailrod lift nut	1
36621-136	Lockwasher (3/8”)	1

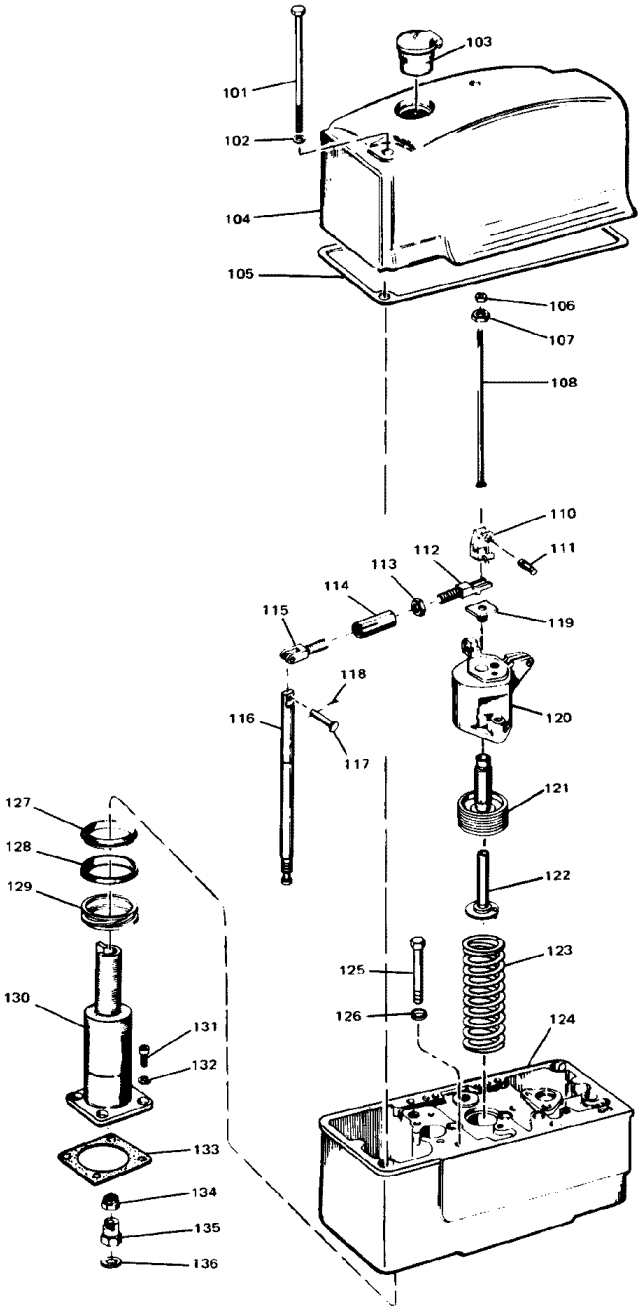

Figure 6. Exploded View of Turnbuckle Speed Droop Linkage

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 36621E.

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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2012/11/Colorado