

PG Governor
Preloaded Buffer Springs

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

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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 Out-of-date translations are marked with .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 Preloaded Buffer Springs

General Information

Introduction

Preloaded buffer springs are often installed in PG governors used on two-cycle spark ignition engines and on some engines driving reciprocating pumps. As a result of preloading, the governor minimizes fuel linkage movements resulting from changes in speed due to misfiring or pump strokes. The use of preloaded buffer springs does not affect the capability of the governor to recognize and respond to speed changes. Preloaded buffer springs do retard the rate at which the governor output piston (or shaft) moves when responding to small or momentary off-speeds. The output piston moves at the normal rate for large speed changes.

Construction

Figure 1 is a sectional view of the preloaded buffer spring. The outer end of each spring rests against an adjustable spring seat. The inner end of the spring rests against a spring retainer which has a fixed position. The two inner spring retainers are positioned so that each just touches the center web of the buffer piston. As oil pressure moves the piston in either direction, the spring toward which the piston moves is compressed. The other spring is not affected.

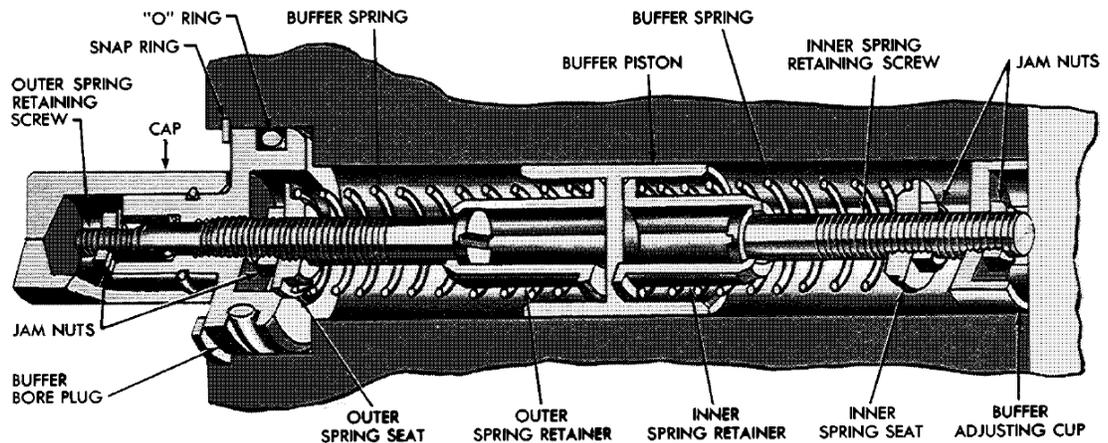


Figure 1. Preloaded Buffer System

Principles of Operation

Preloaded buffer springs in a governor affect only the compensating system in the governor. The following description presumes one is familiar with the operation of the basic elements of the governor as described in manuals 36600 or 36602.

Refer to Figure 2 and assume that a misfire creates a speed drop momentarily. The flyweights move in, and the pilot valve plunger lowers below its centered position. Pressure oil flows through the pilot valve bushing to the buffer area where it attempts to move the buffer piston to the right. However, the pressure on the left side must be high enough to overcome the trapped pressure on the right side and the preload on the right hand buffer spring before the piston moves. During this short period, pressure is building up on the left side of the buffer piston, and oil leaks through the needle valve opening, moving the governor power piston at a slow rate. The increased pressure on the left side of the buffer piston is also transmitted to the lower side of the compensation land on the pilot valve plunger. The force from this increased pressure on the lower side of the compensation land combines with the flyweight force to return the pilot valve plunger to its centered position. For a momentary off-speed, the pilot valve plunger re-centers, and stops the power piston movement before the power piston has moved very far.

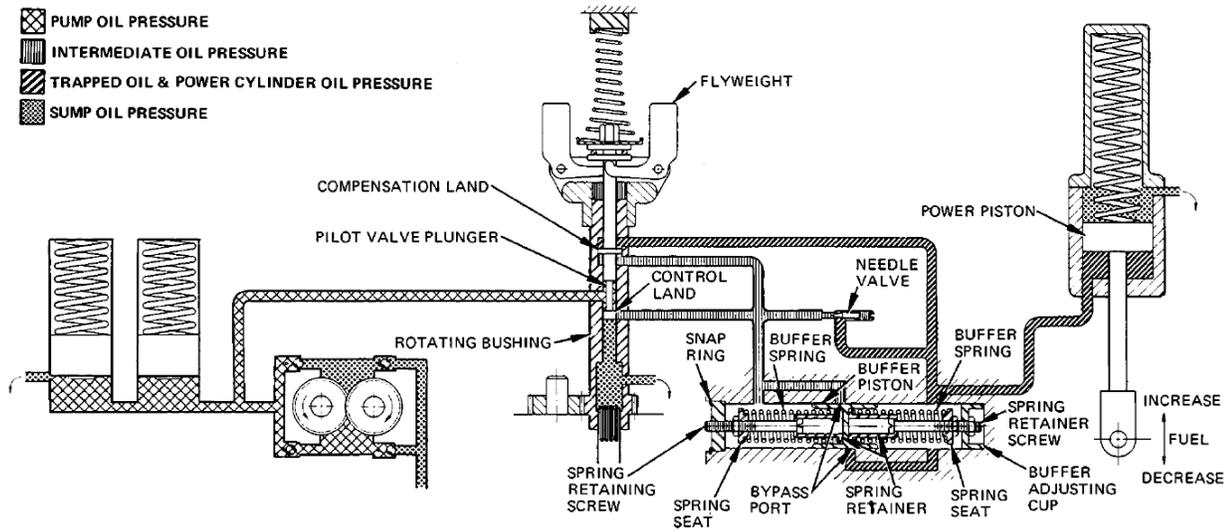


Figure 2. Schematic Diagram, PG with Preloaded Buffer Springs

Oil flowing through the needle valve provides the force for the initial movement of the power piston. Large changes in speed produce such a large change in flyweight force that the pressure differential across the compensation land before the buffer piston moves is not sufficient to re-center the pilot valve plunger. As the pressure to the left of the buffer piston continues to rise, the buffer piston is moved to the right, displacing a larger volume of oil, causing a faster movement of the power piston. The pilot valve plunger re-centers when the force from the pressure differential and the flyweight force (a function of speed) equal the speeder spring force.

The effect of preloaded buffer springs can be seen graphically in Figure 3 which plots speed change versus power piston velocity.

The needle valve opening determines the initial slope (OA) of the curve.

The preload on the buffer springs determines the point at which the curve “breaks” (point “A” at which the power piston velocity increases abruptly).

The rate of the buffer springs determines the final slope (AB) of the curve.

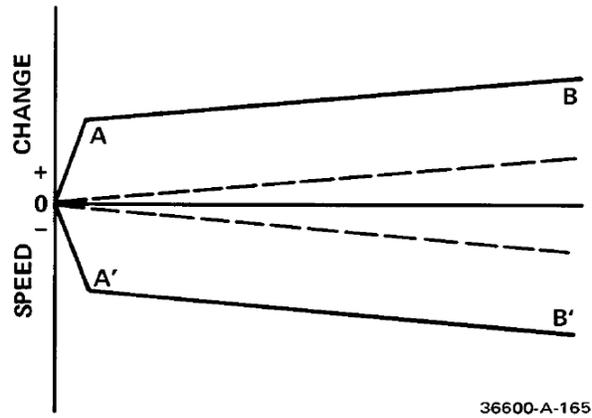


Figure 3. Preloaded Buffer Spring Effects

The dotted line curves are equivalent curves which result from the use of buffer springs not preloaded.



WARNING Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or

Adjustments

Preload Adjustment

All parts shown in Figure 4 may be taken out of the buffer bore after the cap and snap ring are removed. Use a screwdriver under each side of the cap to pry it off.

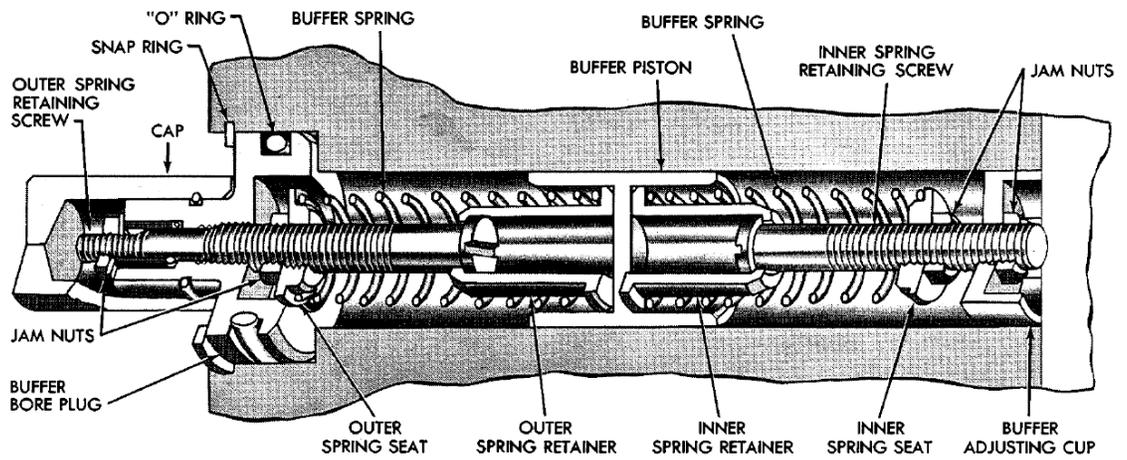


Figure 4. Preloaded Buffer System

If the parts are taken from a governor in which the spring preload has already been set properly, do not disturb the settings of the spring seats unless it is necessary to disassemble the components completely. If it is necessary to disassemble these parts completely, measure the distance from the spring seat to the spring retainer. The buffer piston can be removed to make these measurements. Record the measurements so the parts can be reassembled with the same spring preload.

If the exact preload requires is not known, proceed in this manner.

Assemble the inner spring retainer, buffer spring, inner spring retaining screw, inner spring seat, and adjacent jam nut. Tighten the spring seat until it begins compressing the buffer spring, then back it off until the spring is just free. The spring should not be compressed, nor should it have any free end play. Using a small scale, measure the distance from the spring seat to the spring retainer. Record this dimension. Now turn the spring seat compressing the spring 1/8 inch (3.2 mm). Lock the spring seat in place with the jam nut.

Thread the buffer adjusting cap onto the inner spring retaining screw so the overall length from the outside edge of the adjusting cap to the far edge of the spring retainer is 2 13/16 inches (71.4 mm). Use the jam nut to lock the adjusting cap in position.

Assemble the outer spring retainer, buffer spring, outer spring retainer screw, and outer spring seat and, using the same procedure, put 1/8 inch preload on the spring. Then screw the buffer bore plug and jam nut onto the retainer screw.

Install the parts, including the buffer piston, in the buffer bore as shown in Figure 4. Do not install the large O-ring around the buffer bore plug or the cap yet. Install the snap ring.

Loosen the jam nut on the outer end of the outer spring retaining screw. Push in on the buffer bore plug. Note whether it stays in and leaves a space between itself and the snap ring, or if the springs push it out so it touches the snap ring. If it stays in, as shown in Figure 5, the outer spring retaining screw is out too far, and the spring retainers are not touching the buffer piston. Loosen the small jam nut, and slowly turn the screw in. The buffer bore plug will start to move out until it just touches the snap ring. Tighten the jam nut and recheck, both by looking and by pushing in on the buffer bore plug and watching it as it touches the snap ring. It should just touch, but should not exert any force on the snap ring. Sometimes the adjustment changes slightly when the jam nut is tightened and a small correction is needed. After the adjustments are made, reassemble with the O-ring in place.

If the screw is in too far, as shown in Figure 6, there is no preload, and the power piston rod will move irregularly or jiggle as a result of irregular firing or a very rough drive. If it is not far enough, as shown in Figure 5, the same jerking or jiggling will be present, and the engine will wander, or hunt.

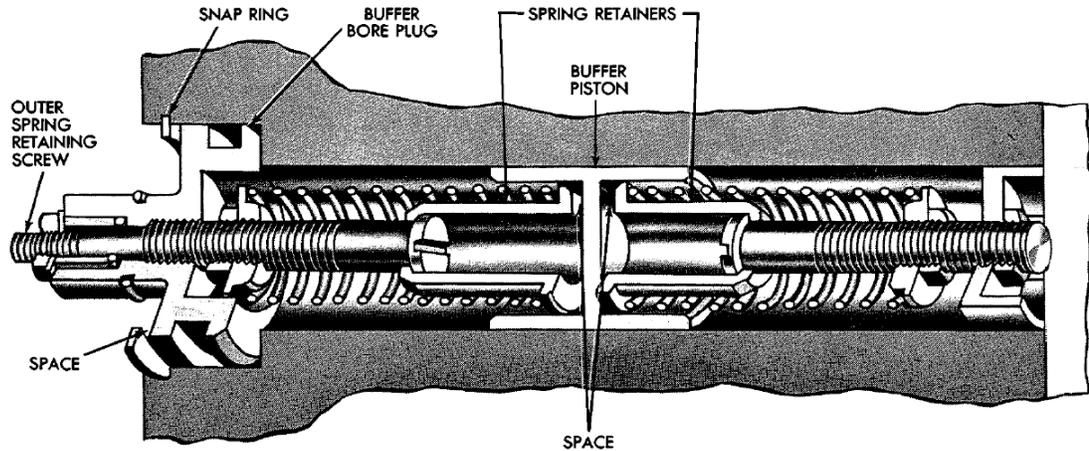


Figure 5. Preloaded Buffer Adjustment

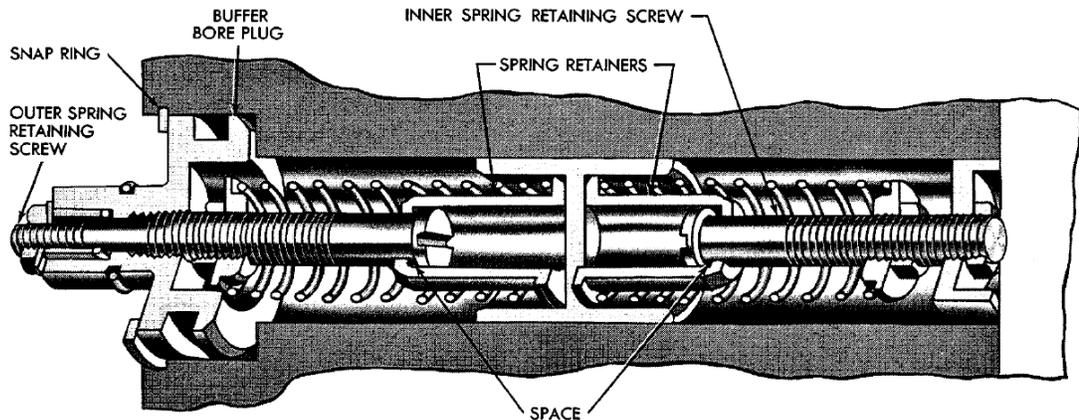


Figure 6. Preloaded Buffer Adjustment

If, after properly positioning the buffer bore plug, there is improvement but still erratic movement of the governor output piston (or shaft) continues, put a bit more preload on the springs using the same procedures. Do not put more than 3/8 inch (9.5 mm) preload on the buffer springs. If this is not sufficient, contact Woodward or your authorized dealer/distributor, as different buffer springs or other measures may be required.

IMPORTANT

Several different buffer springs are used; each has a different spring rate. The springs are color-coded for identification purposes. When reassembling a governor, be sure that the correct springs are installed.

Needle Valve

The needle valve of the governor must be adjusted to render optimum performance of the engine-governor combination. A needle valve opening of 1/16 to 1/8 turn usually gives best performance. Too great an opening will reduce the benefits of the preloaded buffer system. Do not close the needle valve tight. Once adjusted, the needle valve setting should not need to be changed unless there is a change in governor oil viscosity or engine operation.

When the engine or turbine is started for the first time, or after the governor has been drained and cleaned, the governor must be filled with oil, and any air trapped in the governor removed. To bleed off the trapped air, loosen the air vent plug far enough to establish a leak, and open the needle valve a couple of turns to allow the engine to hunt a sufficient length of time to permit all air trapped in the governor oil passages to escape at the vent plug. When no more air bubbles are apparent, tighten the vent plug and, if necessary, add oil to the governor to restore the correct level in the gauge glass.

Replaceable Parts

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

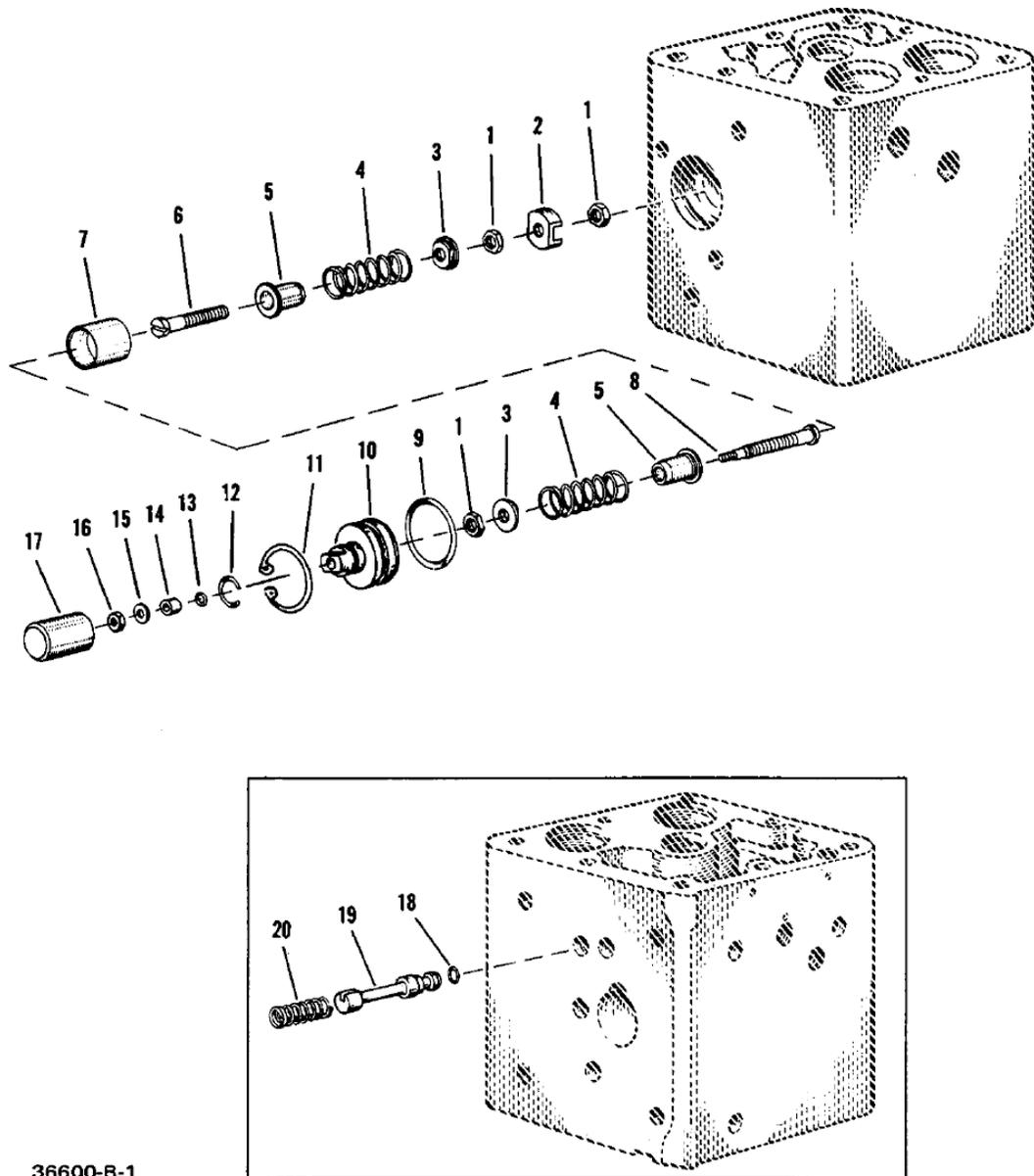
- Governor serial number and part number shown on nameplate
- Manual number (this is manual 36680)
- Part reference number, name of part, or description of part

The parts breakdown, Figure 7, illustrates and lists all the replaceable parts for the preloaded buffer system. The numbers assigned are used as reference numbers and are not specific Woodward part numbers. Woodward will determine the exact part number for your particular unit.

Ref. No.	Part Name	Quantity
36680-1	Lock nut (5/16"-24)	3
36680-2	Buffer adjusting cup	1
36680-3	Spring seat.....	2
36680-4	Buffer spring	2
36680-5	Spring retainer	2
36680-6	Inner spring retaining screw.....	1
36680-7	Buffer piston.....	1
36680-8	Outer spring retaining screw	1
36680-9	O-ring.....	1
36680-10	Buffer bore plug	1
36680-11	Snap ring	1
36680-12	Retaining ring.....	1
36680-13	O-ring.....	1
36680-14	Spacer	1
36680-15	Washer	1
36680-16	Jam nut (#10-32)	1
36680-17	Cap	1

The following parts are used if the holes in the pilot valve bushing for compensating oil pressure are 0.125" (3.18 mm) diameter. (The compensating oil pressure holes are the second and third holes below the flyweight head.)

Ref. No.	Part Name	Quantity
36680-18	O-ring.....	1
36680-19	Orifice plunger	1
36680-20	Spring	1



36600-B-1

Figure 7. Exploded View, Preloaded Buffer Springs

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **36680D**.



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