out, raising pilot-valve plunger, Fig. 5. Raising the plunger opens control ports so oil under pressure can flow through port to upper side of power piston. Oil pressure forces piston down to reduce fuel supply. Oil under piston escapes through the lower port to the sump.

As power piston moves down it pulls the speed-droop lever down, increasing the speeder-spring force. Larger force pushes the ball arms in, lowering the pilot-valve plunger and slowing the further downward motion of power piston. When ball arms reach the vertical position, control ports are closed and power piston has stopped moving.

Since speeder-spring force is increased as load is reduced, it requires more weight force—that is, a higher engine speed—to balance the spring force. Increase of engine steady speed caused by load decrease is the speed droop. It prevents hunting by stopping the *corrective movement of the power* piston *before* the engine returns to its previous speed.

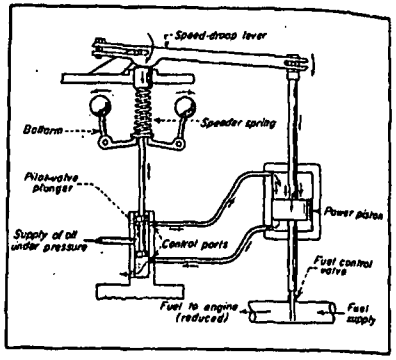
Advantages of this type hydraulic governor include: (1) relatively inexpensive (2) accurate and sensitive, giving good speed control (3) simple for a hydraulic governor, has few parts (4) more powerful than a mechanical governor of *similar dimensions*.

Disadvantages include: (1) not isochronous (2) speed-droop adjustment is inconvenient because it is made inside the governor.

Fig. 6 shows the internal construction of a commercial hydraulic governor employing permanent speed droop to obtain stability. Its parts are labeled to correspond with those in Fig. 3, 4 and 5. In addition, Fig. 6 shows the pump that supplies oil at 120 psi and the accumulator or reservoir that keeps the oil at constant pressure.

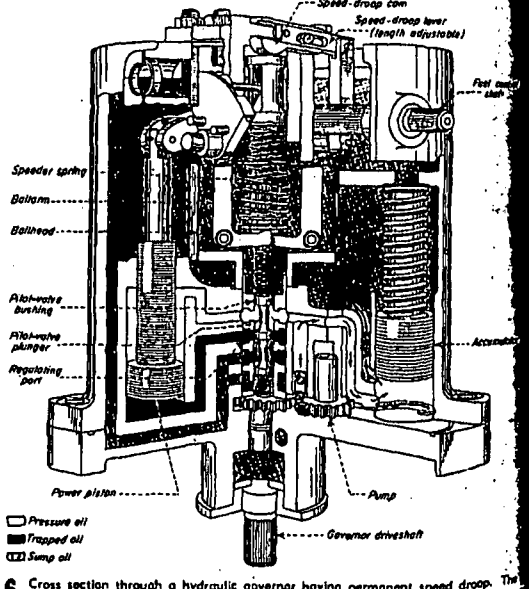
Ball head is rotated by the governor drive shaft through the pilot-valve bushing. Amount of speed droop may be changed by adjusting the length of the 2-part speed-droop lever. Speed adjustment is provided by a knob (not shown), which raises or lowers the upper seat of the speeder spring.

Our next article will discuss isochronous hydraulic governors and how they work in modern diesel engines.



5 Load decrease causes flyweights to move out and raise the pilot valve to push the power piston down and reduce fuel

Governor, Below, Has Adjustable-Speed Droop



6 Cross section through a hydraulic governor having permanent speed droop. The oil pump maintains a pressure of 120 psi for the operation of the servomotor

World's largest pumped-storage hydro project in Austria over 4100-ft head from reservoirs 6700 ft above sea It will have two of the powerful pelton turbines highest-powered pumps

by BARBARA JEAN TUFTY
Paris Correspondent



1 Mountainous terrain where there are no roads required use of six cableways to handle men and materials. Limberg Dam can be seen across valley in background

Little Rivers Plus Pumped Storage and High Head Make Big Peak-Load Power

On the Kaprun River in Austria, world's largest and most outstanding pumped-storage hydroelectric power project—450,000 hp—is under construction. Most of the flow in Austria's rivers comes from high mountains where temperatures drop to 50 F below zero, and snow and ice pile up 30 to 40 ft deep. As a result, runoff in winter is only about 12% of the summer flow. But, in the fall and winter months the base and peak loads are highest, when runoff to rivers is the lowest.

Glockner-Kaprun Project. Hydroelectric plants on the power system require large storage capacity for the high summer flow from melting mountain snow and ice so water will be available for the heavy winter load when runoff is low. If this is not done, the power deficiency from hydro plants must be supplemented by burning expensive fuel in steam or diesel plants.

It is to compensate for the lack of water for winter power generation that the Glockner-Kaprun development is being made. Melting snow from the Grossglockner Mountains, two miles above sea level, will be stored in a series of reservoirs and used to generate power for all Austria.

When this project is completed and pumping plants are operating in 1955, it will supply more than 800 million kwhr per year, over 10% of Austria's total power use. Of this, 75% (600 million kwhr) will be available in winter, 25% (200 million kwhr) in summer. The latter is power generated from water for which reservoir capacity is not available. With Marshall Plan economic aid the largest part of the main power project has been completed.

Project Outline. The project includes 15.6 miles of tunnels, three storage reservoirs with 142,000 acre-ft storage capacity, two power-generating stations and two pumping plants. By pumped storage a maximum static head of over 4100 ft is made available in the two power plants. Even if the water quantities are comparatively small and collected from several small drainage areas, they are valuable for power production because of the high head. Further, about 75% of the total power will be generated in the six winter months to supply high-cost peak loads, when water flow to other plants is low.

Fig. 2 shows a profile of the project: