

Oct. 7, 1941.

A. FOLGMANN

2,258,136

HYDRAULIC GOVERNOR

Filed June 5, 1939

2 Sheets-Sheet 1

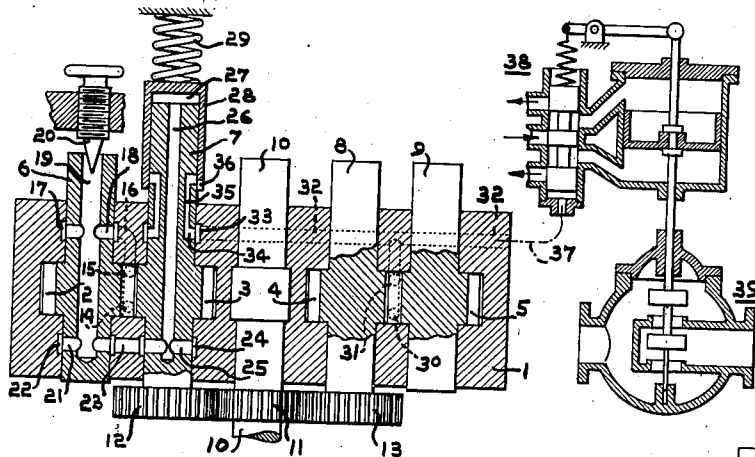


FIG. 1.

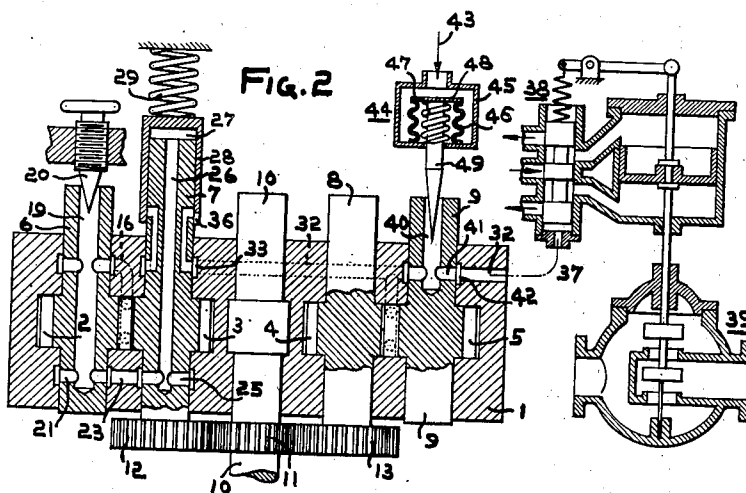


FIG. 2.

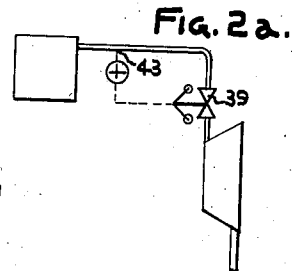


FIG. 2a.

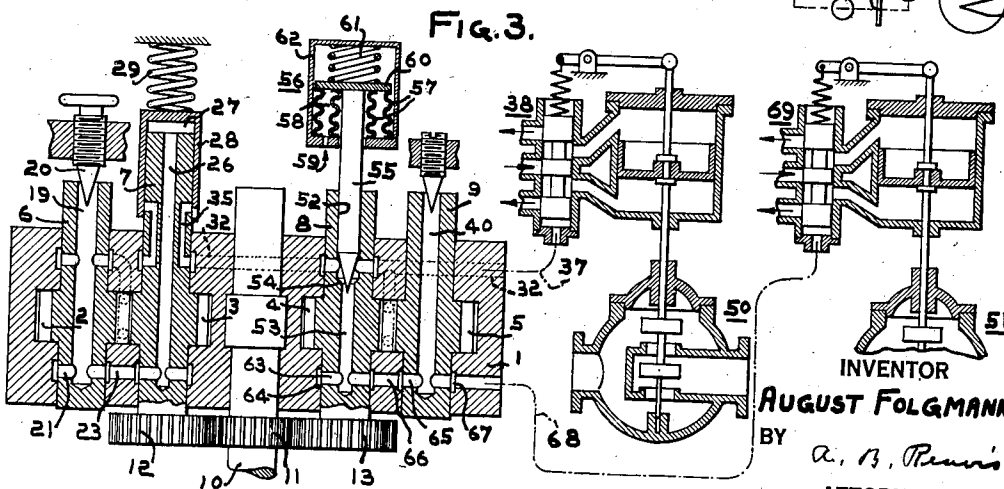


FIG. 3.

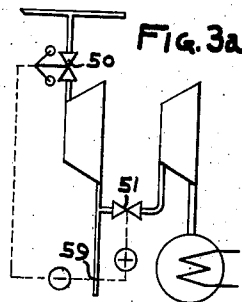


FIG. 3a.

INVENTOR  
AUGUST FOLGMANN  
BY  
A. B. Pomeroy  
ATTORNEY

Oct. 7, 1941.

A. FOLGMANN  
HYDRAULIC GOVERNOR

2,258,136

Filed June 5, 1939

2 Sheets-Sheet 2

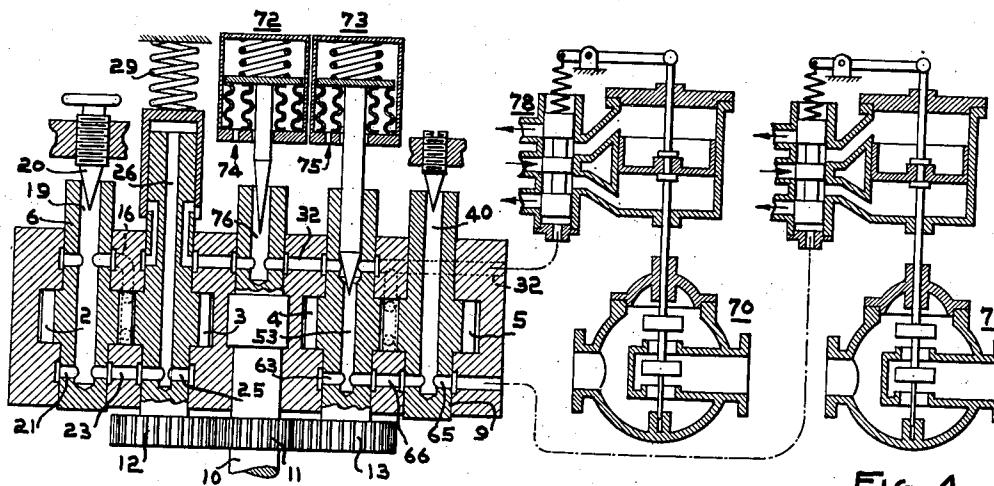


FIG. 4.

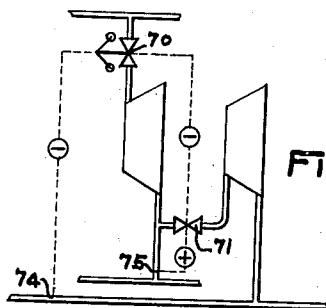


FIG. 4a.

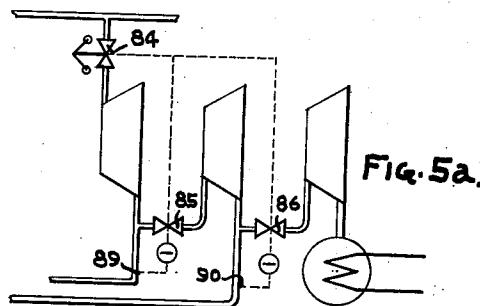


FIG. 5a.

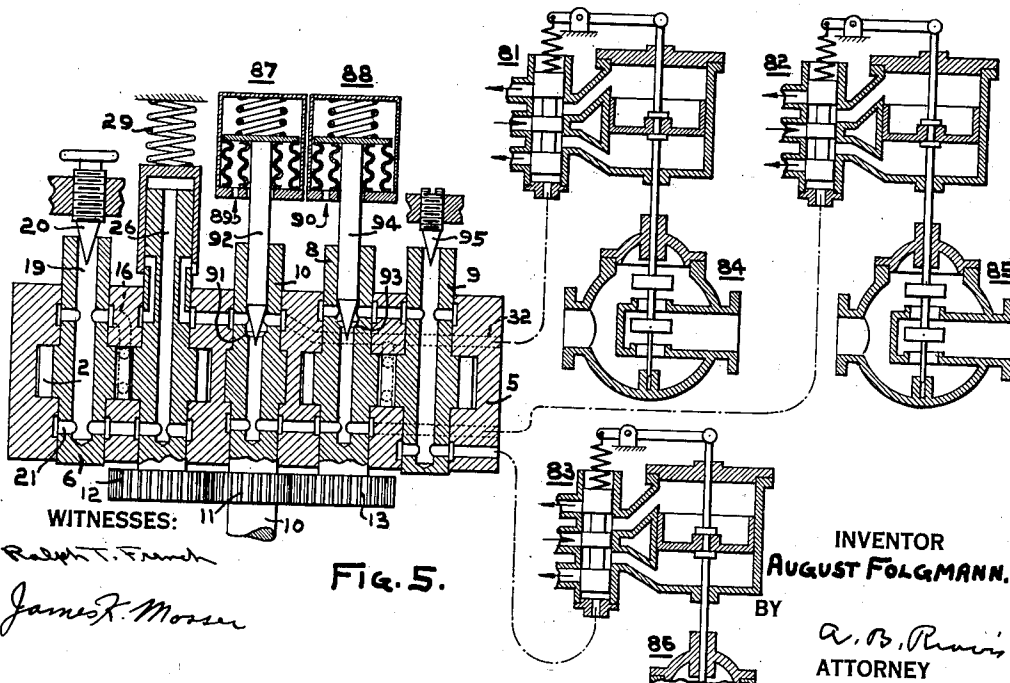


FIG. 5.

WITNESSES:  
Ralph T. French  
James F. Moser

INVENTOR  
AUGUST FOLGMANN.  
BY  
A. B. R. R. R.  
ATTORNEY

## UNITED STATES PATENT OFFICE

2,258,136

## HYDRAULIC GOVERNOR

August Folgmann, Berlin-Falkensee, Germany,  
 assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application June 5, 1939, Serial No. 277,509  
 In Germany June 4, 1938

13 Claims. (Cl. 264-3)

(Granted under the provisions of sec. 14, act of  
 March 2, 1927; 357 O. G. 5)

My invention relates to hydraulic governors for prime movers, and has for an object the provision of a governor construction which will be useful for all possible conditions of operation.

Heretofore, hydraulic governors for prime movers have been designed especially for each installation with which they are used, as the same operating conditions are seldom present in a plurality of such installations, and a governor designed for one prime mover would probably be unsatisfactory for another prime mover. Therefore, it is a further object of my invention to provide a governor which can be produced in quantities and kept in stock for use with any prime mover installation.

My invention relates to the use of a governor in which two gear pumps are operated by a common drive mechanism driven directly from the prime mover, the pumps delivering a pressure regulating fluid, and change in speed of the prime mover producing the corresponding change in the regulating fluid pressure. I so design my governor that a change of rate of discharge of fluid at the outlet side of one of the pumps, due to a change in prime mover speed, regulates the governing medium flow at the outlet of the other pump, whereby the pressure change at the outlet of this latter pump is utilized to regulate the steam admission valve of the prime mover.

My invention provides for the mounting of these pumps separately in a common chamber or housing, thereby providing, in a single structure, means for regulating prime movers under any or all operating conditions. To this end, I bore out the pump shafts and provide them with communicating passages together with adjustable closures for these bores, which closures may be operated by pressure at various sources associated with the prime mover.

If the pump gears were arranged as a planet drive, in any well known manner, wherein all of the gears are driven by a centrally located gear, one would have (if for instance two pumps were used) only three shafts or spindles which could be provided with bores for the purpose of controlling the regulating fluid pressure. However, with the arrangement which I propose, I have provided four pump shafts, as well as the shaft of the main driving gear, which may be bored out and provided with control mechanism. Thus, it is possible to bring into action as many as three additional regulating impulses. Consequently, my improved governor can actually meet all possible demands, which is impossible with

the planetary arrangement previously mentioned.

Therefore, it is a further object of my invention to provide a governor mechanism including two separate gear pumps operated by a common driving gear, and in which the shaft of said driving gear, as well as the shafts of the pump gears, may be provided with bores and adjustable control means therefor, operable due to various prime mover conditions.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings forming a part of this application, in which:

Fig. 1 is a sectional, somewhat diagrammatic, view of my improved governor for operating the servo-motor of the steam admission valve of a single turbine;

Fig. 2 is a similar view with means provided for effecting an additional impulse to the governing mechanism;

Fig. 3 is a view similar to Fig. 2 but showing an additional means for varying the regulating fluid pressure to control two steam admission valves;

Fig. 3a is a diagrammatic view of the hook-up of Fig. 3;

Fig. 4 is a view similar to Fig. 3 but shows the governor mechanism provided with an additional impulse-producing means;

Fig. 4a is a diagrammatic view of the hook-up of Fig. 4;

Fig. 5 is a view similar to Fig. 4 but showing the mechanism arranged to regulate three steam admission valves; and,

Fig. 5a is a diagrammatic view of the hook-up of Fig. 5.

Referring now to the drawings more in detail, there is shown in Fig. 1 the simplest arrangement of my invention in which one valve, for instance the steam inlet valve of a turbine, is governed directly by the speed of the prime mover of the turbine. Numeral 1 indicates a governor housing in which are mounted two gear pumps, one being comprised by intermeshing gears 2 and 3 and the other by intermeshing gears 4 and 5. These gears are mounted on shafts 6 to 9, respectively, and are driven by a shaft 10 carrying a common driving gear 11 associated with the gears 13 and 14 of the two gear pumps, the last-named gears being mounted on the shafts 7 and 8, respectively.

For the sake of clearness, the pump comprised by gears 2 and 3 will be referred to as the number

1 pump and the other pump referred to as the number 2 pump. Pump number 1 draws regulating fluid, for instance oil, from any suitable source, such as an oil sump (not shown) in through the opening 14 and forces the same out through corresponding opening 15 to the passage 16. This passage terminates in the annular groove 17, surrounding the shaft 6, whereby communication is established with the passage 18 communicating with an axially-extending bore 19 in said shaft. This bore 19 provides, at one end of the shaft 6, a discharge opening controlled by a needle valve 20, providing for an adjustable discharge flow from the number 1 pump. The other end of the bore 19 is connected by a cross bore 21 with an annular passage 22 establishing communication, through the passage 23 with another annular passage 24, the latter in turn communicating through the cross bore 25 with one end of the axially-extending bore 26 in the shaft 7. The bore 26 terminates at one end of the shaft 7 in a space 27 defined by a sleeve cap 28 movable longitudinally of the shaft 7 under the influence of the compression spring 29, the latter tending to force the sleeve downwardly against the end of the shaft 7.

The number 2 pump is provided with an opening 30 through which regulating oil, from the same source as that used by the number 1 pump is drawn, to be discharged through a corresponding opening to the passage 31. This latter passage communicates with the passage 32 terminating in an annular passage 33 surrounding the shaft 7. A cross bore 34 in this shaft together with an axially-extending passage 35 provides for flow of fluid from the passage 32 to the port 36, the latter being controlled by the cap sleeve 28.

The passage 32 communicates with the line 37 connected with a servo-motor 38 controlling operation of the steam inlet valve 39.

In the operation of this form of my invention, just described, an increase in speed of the prime mover will result in a tendency for increased flow of regulating fluid through the pumps, but inasmuch as the needle valve 20 produces a constant discharge opening for the end of the bore 19, the pressure within this bore and the communicating bore 26 and space 27 will be increased, resulting in movement of the cap sleeve 28 to compress the spring 29 and enlarge the discharge opening 36 of the number 2 pump. The enlargement of this latter discharge opening permits a pressure drop in the passage 32 providing for downward movement of the piston of the servo-motor 38, resulting in movement of the steam admission valve toward closing position and return of the prime mover speed to its original value.

Fig. 2 illustrates an arrangement of the governor mechanism wherein an additional impulse can be brought into action, which impulse, for lack of a better name, may be called an "expected-value-transformer-impulse" in reference to the speed. This additional impulse may be, for instance, an overflow or a back-pressure impulse. The structure of this modification differs from that of Fig. 1 in that the shaft 9 of the number 2 pump is provided with a bore 40 communicating, through the cross bore 41 and annular passage 42, with the passage 32. This bore 40 provides a discharge or spill port for the passage 32 which is adjustably controlled by the "expected-value-transformer-impulse" acting as a force 43 upon the regulating mechanism 44; the latter consisting of a housing 45 enclosing a flexible dia-

phragm or bellows 46 which is held in tension against the force of the spring 47. This diaphragm is closed at its upper end by a plate 48 to which a valve or regulating pin 49 is attached, this pin serving to vary the area of the discharge opening of the bore 40 in the shaft 9. It will be apparent that change in the pressure at 43 will result in a change in the position of the valve 49 and a corresponding increase or reduction in the discharge flow through the outlet provided by the bore 40.

The "impulse" pressure acting at 43 is directed at the point marked 43 in Fig. 2a. Except for the arrangement of the bore 40, providing for the influence of the additional "impulse" pressure, the operation of this modification is the same as that of Fig. 1.

In Fig. 3, I have shown an arrangement of passages in my governor which provide for the regulation of a simple bleeder layout, as shown diagrammatically in Fig. 3a. The valves 50 and 51 in Fig. 3 correspond to the valves of Fig. 3a having the same reference characters.

In this arrangement, the shaft 8, as well as the shaft 9, is provided with an axial bore including an enlarged upper portion 52 and a small lower portion 53, the juncture point of these two portions defining a seat 54 adapted to cooperate with a needle valve 55 operated by an impulse mechanism 56.

The mechanism 56 is comprised by a pair of flexible concentrically-disposed cylindrical diaphragm members 57 defining a chamber 58, to the interior of which an impulse pressure (indicated by the arrow 59) may be supplied. The plate 60 closes one end of the chamber 58 and abuts against the compression spring 61, disposed within the housing 62, the plate 60 carrying the needle valve 55. It will be apparent from consideration of Fig. 3 that a change of pressure within the chamber 58 will cause vertical movement of the valve 55, and corresponding adjustment of the passageway between said valve and the seat 54, thereby regulating the flow of fluid from the passage 32 to the bore 53.

The lower end of the bore 53 communicates through a cross bore 63 with an annular passage 64, which in turn, connects with another annular passage 65 by means of a cross bore 66. The annular passage 65 communicates, through a cross bore 67, with the axial bore 40 of the shaft 9 and also with a line 68 connecting with the servo-motor 69 controlling the steam inlet valve 51.

The impulse acting on the supplemental impulse supplier 56 are taken at a point corresponding to the point 59 of Fig. 3a. Therefore, the pressure existing at this point exists also in the chamber 58 defined by the diaphragms 57 and serves, through the valve 55, to govern the steam admission valve 51.

Referring now to Fig. 4, I have shown an arrangement for governing a bleeder back pressure system. The corresponding steam piping arrangement is shown in Fig. 4a, the valves 70 and 71 in Fig. 4 corresponding to the valves in Fig. 4a which carry the same reference characters. The additional impulse suppliers 72 and 73 (Fig. 4) operate under the same pressures as exist at the points 74 and 75, respectively, in Fig. 4a.

In this arrangement the shaft 10 of the main drive gear likewise is bored axially at 76 to provide an outlet controlled by a mechanism 72 similar to the mechanism 73 and corresponding exactly to the impulse supplier 56 of the arrange-

ment shown in Fig. 3. As will be seen from Fig. 4, this additional regulating means acts directly upon the servo-motor 78 of the valve 70, the valve 71 being controlled in the same manner as the valve 51 of Fig. 3.

Fig. 5 covers a modification of the governor structure wherein the same may provide for the control of three servo-motors 81, 82 and 83. This provides a double extraction modification as indicated in Fig. 5a where the valves 84, 85 and 86 correspond to the valves having the same designations in Fig. 5.

The two suppliers 87 and 88 of the additional impulses obtain their pressure from the points in the steam lines which are marked 89 and 90, respectively, in Fig. 5a. No additional impulse acts on the pressure regulating the servo-motor 81. The pressure regulating the servo-motor 82 is influenced by the impulse supplier 87 which adjusts the passage area at 91 by raising or lowering the needle valve 92.

The pressure acting on the servo-motor 83 is under the influence of two additional impulses, namely, the impulse supplier 88 which regulates the flow passage area at the point 93 by raising or lowering of the needle valve 94, and the influence of the adjustable outlet point 95.

While I have shown my governor mechanism provided with various arrangements and combinations of bores and passages, it will be apparent that the desired results may be obtained by other combinations of such bores and passages than those herein disclosed. Furthermore, if desirable, these shafts may be provided initially with all of the bores which might possibly be necessary, and any bores not needed may be closed with nipples or similar means, whereby the same standard construction can be adapted to the requirements of any situation. Likewise, the housing may be provided with the various longitudinal and cross passages in order to be prepared for any special requirements and, when not in use, these bores may be plugged in any desired manner.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. Apparatus for controlling the operation of a pressure-responsive device: said apparatus comprising gear pump means operable from a prime mover, a first passage supplied by the pump means and connected to a first pressure-responsive device, means providing a first spill orifice for the first passage, means for varying the flow area of the first spill orifice, a second passage communicating with the first passage and connected to a second pressure-responsive device, means providing a second orifice joining the first and second passages, means providing a third spill orifice for the second passage, and means for varying the orifice area of the third orifice.

2. Apparatus for controlling the operation of a pressure-responsive device: said apparatus comprising first and second gear pumps operable from a prime mover, a passage supplied by the first pump and connected to the pressure-responsive device, means providing a first spill orifice for the first passage, pressure-responsive

means for varying the flow area of said first orifice, a controlling passage supplied by the second pump and connected to the pressure-responsive means, means providing a second spill orifice for said controlling passage, and means for varying the flow area of the second orifice.

3. Apparatus for controlling the operation of a pressure-responsive device: said apparatus comprising first and second gear pumps operable from a prime mover, a passage supplied by the first pump and connected to the pressure-responsive device, means providing a first spill orifice for the passage, pressure-responsive means for varying the flow area of the first orifice, a controlling passage supplied by the second pump and connected to the pressure-responsive means, means providing a second spill orifice for said controlling passage, means for adjusting the flow area of the second orifice, means providing a third spill orifice for the passage, and means for varying the flow area of the third orifice.

4. Apparatus for controlling the operation of a pressure-responsive device: said apparatus comprising first and second gear pumps operable from a prime mover, a passage supplied by the first pump and connected to the pressure-responsive device, means providing a first spill orifice for the passage, pressure-responsive means for varying the flow area of the first orifice, a controlling passage supplied by the second pump and connected to the pressure-responsive means, means providing a second spill orifice for said controlling passage, means for adjusting the flow area of the second orifice, means providing a third spill orifice for the passage, and pressure-responsive means for varying the flow area of the third orifice.

5. Apparatus for controlling the operation of pressure-responsive devices: said apparatus comprising first and second gear pumps operable from a prime mover, a first passage supplied by the first pump and connected to a first pressure-responsive device, means providing a first spill orifice for the first passage, pressure-responsive means for varying the flow area of said first orifice, a controlling passage supplied by the second pump and connected to the pressure-responsive means, means providing a second spill orifice for said controlling passage, means for adjusting the flow area of the second orifice, a second passage communicating with the first passage and connected to a second pressure-responsive device, means providing a third orifice joining the first and second passages, and means for varying the flow area of the third orifice.

6. Apparatus for controlling the operation of pressure-responsive devices: said apparatus comprising first and second gear pumps operable from a prime mover, a first passage supplied by the first pump and connected to a first pressure-responsive device, means providing a first spill orifice for the first passage, pressure-responsive means for varying the flow area of said first orifice, a controlling passage supplied by the second pump and connected to the pressure-responsive means, means providing a second spill orifice for said controlling passage, means for adjusting the flow area of the last-named passage, a second passage communicating with the first passage and connected to a second pressure-responsive device, means providing a third orifice joining the first and second passages, and pressure-responsive means for varying the flow area of the third orifice.

7. Apparatus for controlling the operation of



nected to a second pressure-responsive device, means providing a third orifice joining the first and second passages, pressure-responsive means for varying the flow area of the third orifice, a third passage communicating with the second passage and connected to a third pressure-responsive device, means providing a fourth orifice

5 joining the second and third passages, pressure-responsive means for varying the flow area of the fourth orifice, means providing a fifth spill orifice for the third passage, and means for varying the flow area of the fifth passage.

AUGUST FOLGMANN.