D. THOMA.

INDIRECTLY ACTING GOVERNOR FOR GROUPS OF POWER ENGINES.

APPLICATION FILED JUNE 22, 1907.

943,849. Patented Dec. 21, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

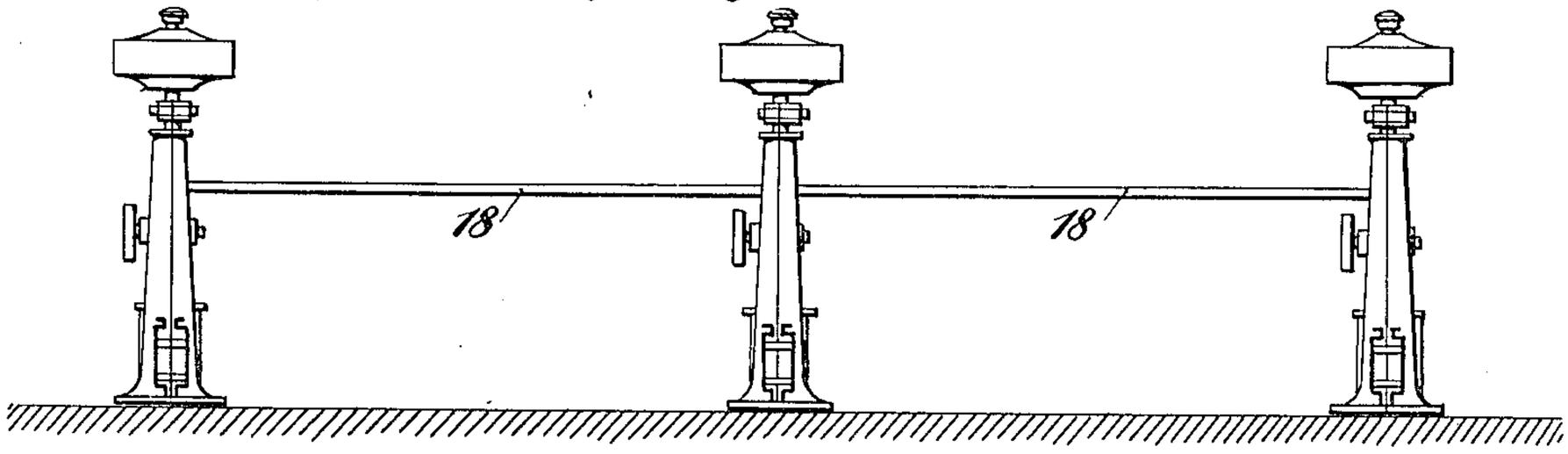
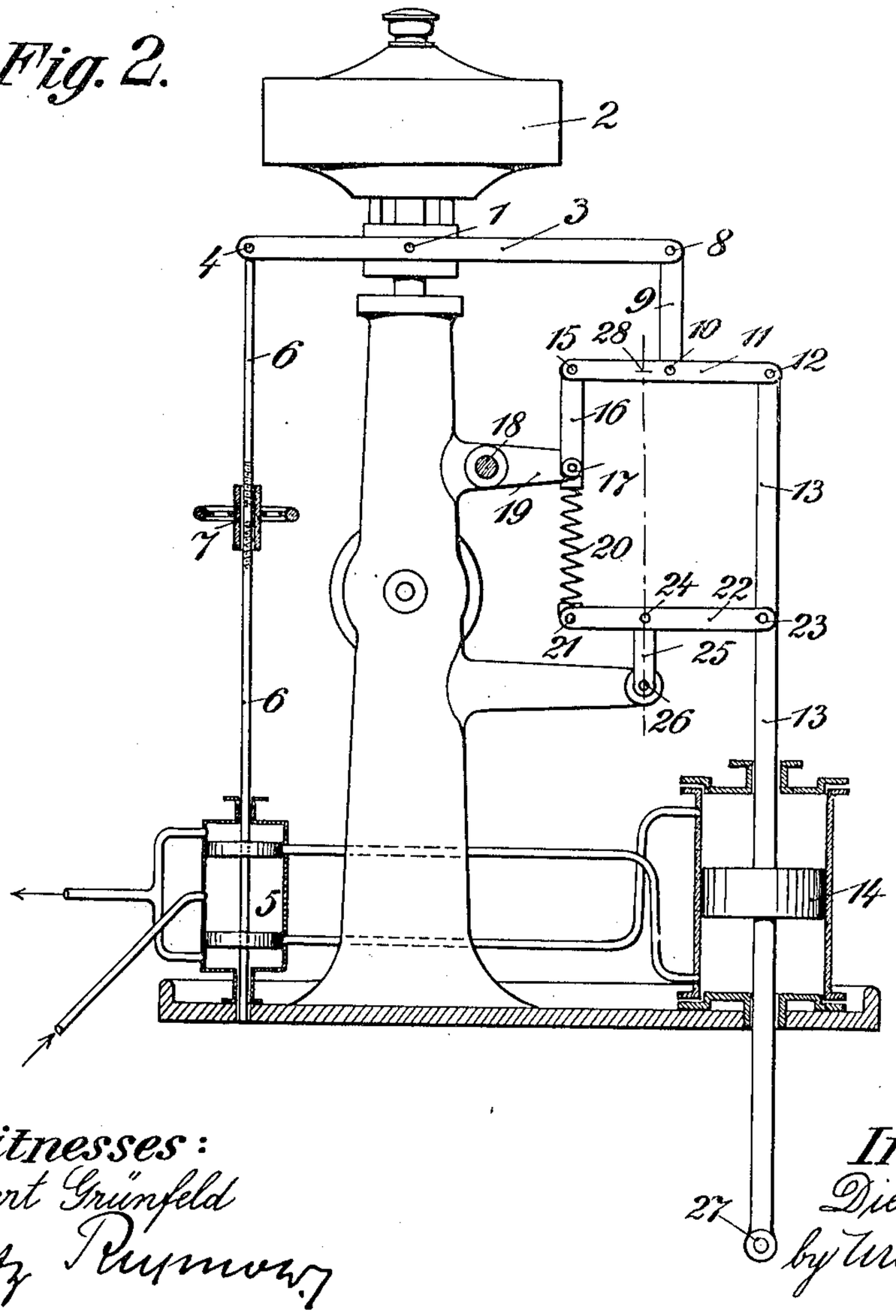


Fig. 2.



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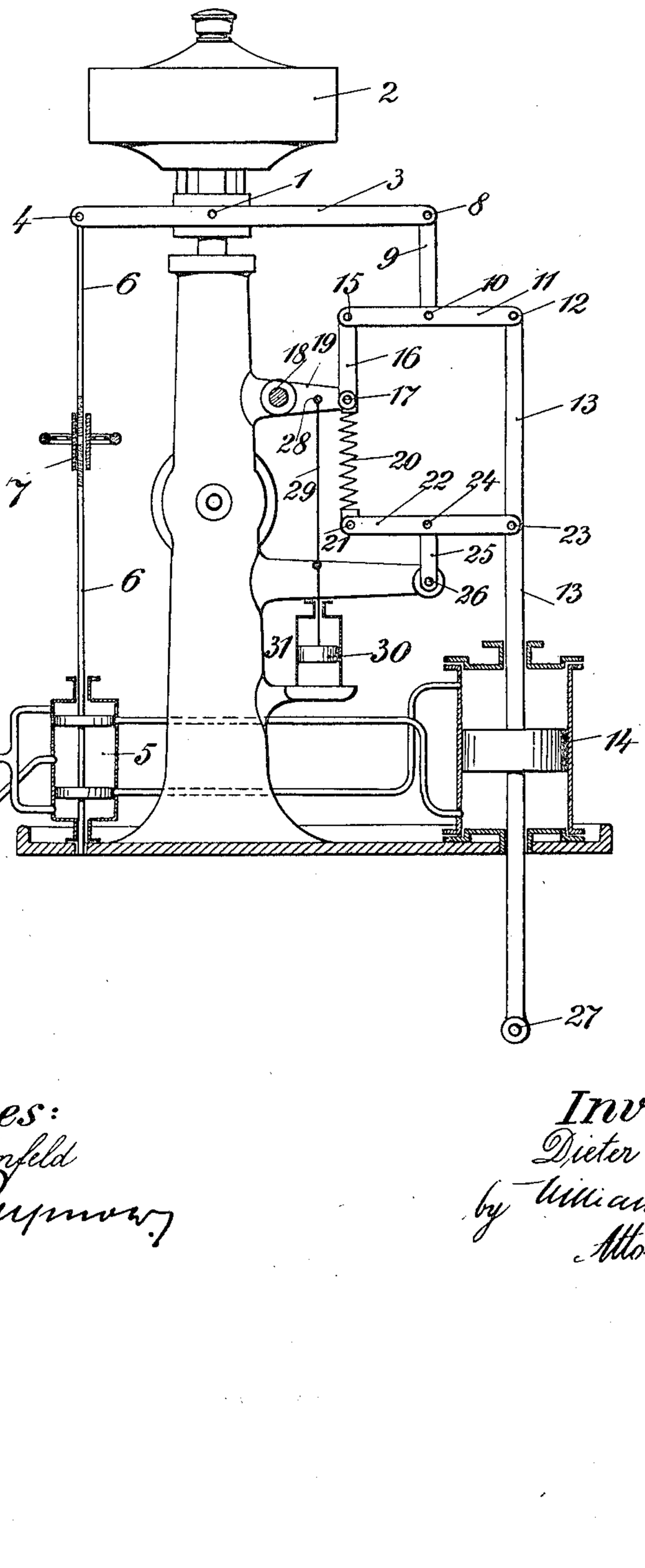
2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

DIETER THOMA, OF GOTHA, GERMANY, ASSIGNOR TO THE FIRM OF BRIEGLEB, HANSEN & CO., OF GOTHA, DUCHY OF GOTHA, GERMANY.

INDIRECTLY-ACTING GOVERNOR FOR GROUPS OF POWER-ENGINES.

943,849. Specification of Letters Patent. **Patented Dec. 21, 1909.**

Application filed June 22, 1907. Serial No. 380,367.

To all whom it may concern:

Be it known that I, DIETER THOMA, a subject of the Emperor of Germany, residing at Gotha, in the Empire of Germany, have invented certain new and useful Improvements in Indirectly-Acting Governors for Groups of Power-Engines, of which the following is a specification.

The improvements to which this application relates has reference to indirectly acting governors attached to groups of power engines, wherein the parts which give out energy are connected in such manner that by the external conditions there is determined only the total output of all the engines of the group. This is the case for instance, in the case of turbines working upon a common shaft or of electric generators connected up to the same network. In such cases it is the function of the governors to divide the work demanded between all the power engines either uniformly or in a ratio which may be adjusted as required. This object in the case of governors as heretofore constructed, has been attained by means of a ratio of inequality of regulation which to be of use had very often to be much greater than was necessary for the fulfilment of the other requirements demanded of a governor. Moreover a ratio equal to zero which can be obtained by means of an indirectly acting governor so long as it governs only a single power engine which is independent of any other such engine cannot be obtained for groups of such engines, if use is made of the regulation ratio. In the case of such groups, the mutual dependence of the governors on each other would as soon as the ratio of regulation of the separate governors approaches or becomes equal to zero, becomes so small as to cause the division of the work demanded from the group of engines between the various engines to be no longer definitely determined.

The object of the present invention is to secure that the governors should exercise even in cases wherein the ratio of regulation of the governors is very small, a powerful mutual dependence. This is effected in accordance with this invention by a mechanical connection of the separate governors.

The accompanying drawings illustrate in Figure 1 a view of a group of three governors while in Fig. 2 there is shown diagrammatically in elevation partially sectional the arrangement of each of these three governors. Fig. 3 is a view similar to Fig. 2 of a modified form of my improvement.

The sleeve of the centrifugal governor 2 engages at the point 1 (Fig. 2) with the lever 3, with which there is connected at 4 the valve rod 6 leading to the distributing valve 5. The valve rod 6 may be lengthened or shortened, as desired, by means of the handwheel 7. The other end of the bar 3 is connected by means of the link 9, pivoted to it at the point 8, with the point 10 of the lever 11. The lever 11 is connected at one end 12 with the prolonged piston rod 13 of the servomotor 14 which is actuated by the distributing valve 5 in the well-known manner. The other end 15 of the lever 11 is connected by means of the connection rod 16 with the end 17 of the lever 19 which is keyed on the shaft 18. The point 17 is connected by means of the spiral spring 20 with the end 21 of the lever 22, the other end 23 of which is pivoted on the prolonged piston rod 13, while the point 24 of the lever 22 is connected with the fixed point 26 by the connecting rod 25. The length of the spring 20 is such that the spring is free from tension when in the position shown in the drawing. The regulating mechanism of the power engine, such for instance, as the controlling apparatus of a turbine, a throttle valve or the like is connected at 27 with the servomotor 14. The shaft 18 connects all the governors of the group (Fig. 1), the lever arms 19 and the points 17 of all the regulators being consequently compelled to assume the same position at the same time.

The forces tending to rotate the shaft 18 are determined by the weights of the arms 19 and the weights of the lever connections to the distributing valves and further by the frictional resistance of the various flexible connections and in the distributing valves, while finally the forces due to the springs 20 act to turn the shaft 18. It is assumed however that the springs 20 are so constructed that, in comparison with the forces of these springs all the other forces referred to above may be neglected. For the sake of simplicity it may moreover be assumed that the connection of the regulating mechanism of each power engine with the servomotor of the governor at the point 27 is so effected

that there correspond to equal movements of the piston of the servomotor during all parts of its stroke, equal variations in the output of the regulated power engine. This being assumed, the position of the shaft 18, the lever arms 19 and the points 17 will be dependent solely on the total output of the group of power engines and not in the least on the manner in which this output is due to the separate engines constituting the group. For the purpose of explaining the mode of operation of the governors connected with each other in such manner it may for instance be assumed that governors shown in Fig. 3 control turbines which actuate alternating-current generators connected in parallel.

When the entire group of engines is to be loaded or unloaded and when none of the governors is caused, either through disturbing circumstances or through the adjustment of the handwheel 7, to move in a manner differing from that of the other governors, the shaft 18 will during the stroke of the piston of the servomotor rotate in such manner as not to vary the length of any of the springs 20, with the result that the distance separating the points 15 and 21 will approximately remain the same, while the movement of the lever 11 will be the same as if its point 28 which is situated perpendicularly above the point 24 were stationary. The movement of the point 8 of the lever 3 and consequently also the ratio of regulation is therefore, if the entire group is subjected to variation of its load, determined by the ratio of the distances between the points 28—12 and 28—10, while by decreasing the distance between 28 and 10, the ratio of regulation of the group can be diminished as desired. By thus diminishing the ratio of regulation the mutual dependence of the governors on each other is not affected. To prove this, let it be assumed that the load of the group remains constant; it follows that, as has already been stated, the position of the shaft 18 and of the points 17 will be invariable, that is to say, if there should be any variations in the aperture of the regulating mechanism of a turbine the lever 11 will rotate around the point 15 as a fixed point.

In consequence of the electric coupling of the generators driven by the turbines in the example chosen, the number of revolutions of the turbines in the same period of time should always be the same, and if the governors were ideally perfect, the sleeves of the centrifugal governors should all occupy the same position at the same time. If now, for any reason whatever, the sleeve of a governor is caused to assume a somewhat different position and so to move the valve 5 out of its central position and to actuate the servomotor, a very small movement of the latter will cause the valve to return again to the central position, as the lever 11 will rotate around the point 15 as a fixed point. With respect to the mutual dependence of the governors this arrangement is consequently of equal efficiency with the arrangement of separate governors not mechanically connected with each other in the case of which the movements of the piston of the servomotor are transmitted to the point 8 in a ratio diminished in accordance with the lengths of the lever arms 15—12 to 15—10, that is to say, the arrangement is equally as effective as in the case of governors of a much higher ratio of synchronism than the actual ratio of the arrangement to which this invention relates not mechanically connected together. This actual ratio as already stated, is determined by the reduction in proportion to the lengths of the lever arms 28—12 to 28—10 with which the movements of the piston of the servomotor and transferred to the point 8, when the load is changed. The new arrangement renders it moreover possible to make use of the ratio zero without interfering with the mutual dependence of the governors. This ratio is obtained by allowing the distance between the points 28 and 10 in Fig. 2 to become equal to zero; if this is done the conditions will resemble those illustrated in Fig. 3, wherein corresponding parts are indicated by the same reference characters as in Fig. 2. To prevent as a result of making use of the zero ratio the whole plant from being subject to oscillations or hunting, it becomes necessary to clamp the movements of the shaft 18. This is effected by means of an oil dash pot 31, the piston 30 of which is attached to the lever 19 at the point 28 by means of the rod 29. This dash pot need only be attached to one of the governors of the group. The spring 20 may also be dispensed with in the case of some of the governors of the group, or it may be dispensed in the case of all except one governor and may in this case be replaced by a rigid connection. It is, moreover, not necessary that the governors should be connected by a shaft; the connection may be effected by any other suitable means, such for instance, as connecting rods, without interfering with the principle on which the invention is based, the essential feature of which is that there should be interpolated in the kinemetic chain between the servomotor 14, the sleeve 1 and the distributing mechanism 5 a link such as the lever arm 19 which, in consequence of the connection of the governors is, when the load is varied, compelled to move in the same sense in the case of every one of the governors.

By means of the handwheel 7 the new arrangement notwithstanding the low ratio of regulation admits of an extensive adjustability of the number of revolutions, that is

to say, in the case of mechanically or electrically coupled power engines of an accurate adjustment of the work of each engine.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an indirectly acting governor for groups of power engines, servomotor, an oscillating sleeve a distributing mechanism and a member to which the governors being connected, is compelled to move in the same sense, a plurality of levers connecting the servomotor with the oscillating sleeve and the latter with the distributing mechanism, substantially as described.

2. In an indirectly acting governor for groups of power engines, a servomotor an oscillating sleeve, a distributing mechanism and a member, including a lever arm which is secured to the common shaft of the governors of the group, this lever arm being connected with the oscillating sleeve and the servomotor by a plurality of levers substantially as described.

3. In an indirectly acting governor for groups of power engines, a servomotor an oscillating sleeve, a distributing mechanism and a lever arm secured to the common shaft of the governors of the group, the lever arm being connected with the prolonged piston rod of the servomotor and the oscillating sleeve by means of levers, a spring being arranged between the lever arm of the shaft of the governors and the lower lever connecting the spring with the prolonged piston rod, substantially as described.

4. In an indirectly acting governor for groups of power engines, a servomotor an oscillating sleeve, a distributing mechanism, a lever arm secured to the common shaft of the governors of the group, a plurality of levers connecting the oscillating sleeve with the servomotor, and adjustable hand wheel arranged between the sleeves and the distributing device on a rod, connecting the lever of the sleeve with the distributing device, the hand wheel regulating the spring arranged between the lever arm and the lower lever of the prolonged piston rod substantially as described and shown and for the purpose set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

DIETER THOMA.

Witnesses:
V. Graf,
Rudolf Müller.