No. 676,739. Patented June 18, 1901.

S. S. EKMAN.

SPEED GOVERNING SYSTEM.

(Application filed Mar. 7, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

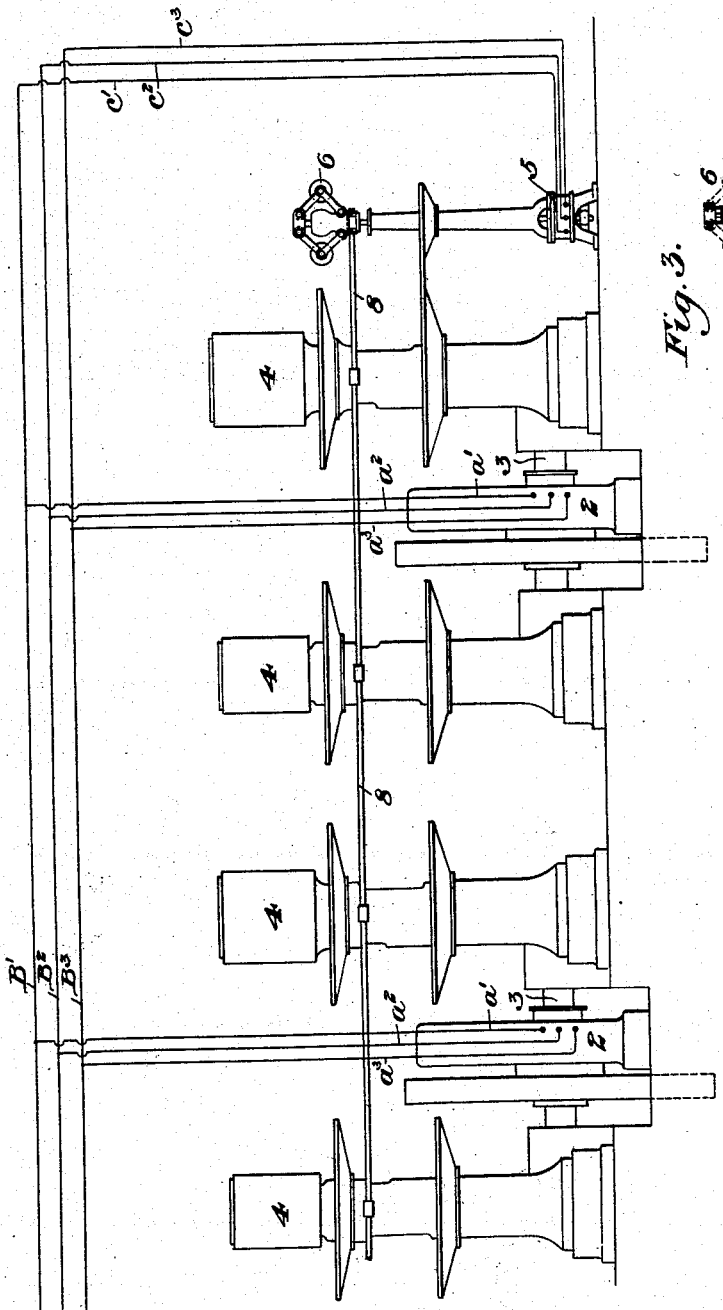

Fig. 3.

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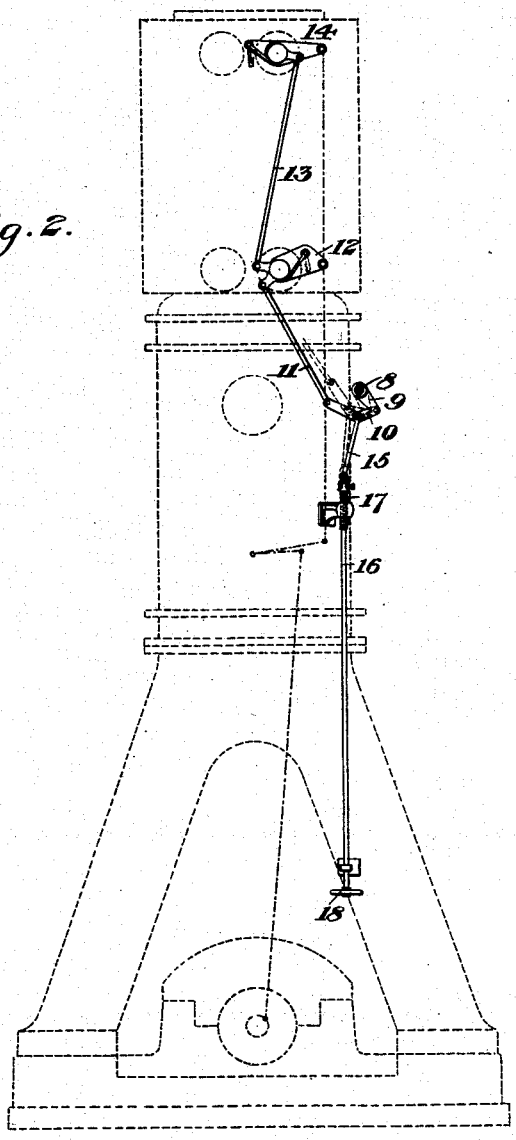
Fig. 2.



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SPEED-GOVERNING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 676,739, dated June 18, 1901.

Application filed March 7, 1901. Serial No. 50,158. (No model.)

To all whom it may concern:

Be it known that I, SVEN S. EKMAN, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Speed-Governing System, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a diagrammatic front elevation of my improved governing system, and Fig. 2 is an end elevation showing the connections.

My invention relates to the governing of prime movers, and is designed to provide mechanism which will control the motor in such a manner as to maintain it at a practically uniform speed under varying loads, avoiding some of the unfavorable influences due to common arrangements of speed-governors.

The invention is specially applicable to the driving of alternating-current dynamos where a plurality of such dynamos each driven by its own engine is connected up to the same line, and in this connection it is advisably designed to control the mean speed of the whole system of engines by connecting the force-regulating devices—for instance, the knock-off cam—for the different engines together, thereby securing a practically identical regulation of the work delivered by the different engines, and by connecting the force-regulating devices for all engines to one centrifugal governor directly connected to a synchronous alternating-current motor driven by the main electrical current from the dynamos.

In the drawings, in which I show one form of my invention applied to an alternating-current system, I show two alternating-current dynamos 2 2, each of which is mounted on a shaft 3, actuated by a compound steam-engine having two cylinders 4 4. Each alternating motor delivers the current through connections a' a^2 a^3 to the general line B' B^2 B^3. From the general line connections c' c^2 c^3 lead to a synchronous alternating-current motor 5, which is mounted to rotate upon a vertical shaft, to the upper end of which is secured a governor 6. This governor may be of any desired type, and I have shown the same as of a centrifugal ball type, having a collar or sleeve 7, the motion of which is adjusted by the speed and consequent centrifugal power of the balls. This sleeve is connected by a lever or other suitable connection with a rock-shaft 8, which extends past each engine and is preferably mounted in bearings supported thereon. The connections between this rock-shaft and the cut-off mechanism for each engine are illustrated in Fig. 2. As shown therein, at each engine the shaft is provided with a lever 9, to which is pivoted an elbow or bell-crank lever 10, the other arm of which is pivotally connected by a link 11 with the lower knock-off cam 12, and this knock-off cam is connected by link 13 with the upper knock-off cam 14. The bell-crank lever 10 is pivotally supported at its elbow by a pivotal link 15, which is pivoted at its lower end to a vertically-adjustable rod 16. This rod has an upper screw-threaded portion 17, engaging an innerly-screw-threaded bearing, while on its lower end is provided a hand-wheel 18. By turning the hand-wheel the bell-crank 10 and the knock-off cams may be adjusted as desired.

In the operation of the system if the load on the main line B' B^2 B^3 should be increased the engines and dynamos will begin to slow down; but as the current sent through the line B' B^2 B^3 is an alternating one and the motor for the governor a synchronous one this motor 5 must follow the mean speed of the engines, and consequently actuate its governor correspondingly. Thus as the load increases the speed of the governor is lowered and the rock-shaft 8 is rocked thereby. This rocking of the shaft through the connected lever system swings the knock-off cams to give a longer cut-off, and all the engines are submitted to a simultaneous and equal change in the cut-off. The speed of the engines is thus governed and kept uniform and one engine is prevented from producing more or less work than the other engines spontaneously on account of unavoidable differences in the action of separate governors.

If one or more engines are running and another is to be started on the same line, the hand-wheel 8 of this engine is turned so as to force up the bell-crank lever 10 into the position shown by dotted lines in Fig. 2, thus giving a very short cut-off. In this position of the bell-crank lever the motion of the

rock-shaft has very little influence on the cut-off, and by adjusting the cut-off for this engine by the hand-wheel its speed is adjusted until the current can be closed, and when closed the hand-wheel is again actuated until the current is the same as for the other engines.

The governor proper may be of any desired type, whether directly acting by its own force or indirectly by means of external force, mechanical, hydraulic, or other force; whether pure centrifugal governor or inertia-governor; whether pendulum-governor or fly-wheel governor or other arrangement; whether pure weight-governor or spring-governor; whether directly connected to the shaft of its motor or driven by means of belt, gearing, or other connections with the motor; whether in governing the speed of one prime mover only or of a plurality of prime movers; whether acting alone or acting in combination with other speed-governors or speed-governing systems.

The motor driving the governor may be of any kind, whether a synchronous alternating-current motor or a steam-engine or a gas-engine or a turbine or any other kind, and this motor may be used exclusively for driving the governor or simultaneously for producing electric currents for the main line or used for any other purpose, and the speed of this motor may be controlled from any suitable alternating electrical current, whether taken from the main line or from a special dynamo or from any other line or produced specially for this purpose. This alternating current may control the speed of the motor driving the governor in any way, whether by means of a synchronous alternating motor or dynamo or by means of any other known method to control the speed of a motor by means of the number of alternations of an alternating electric current, and by the words "alternating current" I mean to cover also a pulsating current, where a direct current is given periodical variations in intensity, these alternations being of substantially the same nature as the alternations in an alternating current.

The governor may control the speed of one single motor or of a plurality of motors, and the controlling motion may be transmitted from the governor to the motors in any way, whether by means of a rocking shaft, by means of hydraulic connection, by means of wire connection, or any other known method to transmit motion or force from one place to another. The governor may act on the cut-off of a steam-engine or on a throttle-valve or on a mechanical or electrical brake or on any other known device for changing the speed of a prime mover.

The system may be connected with one single governor only or with a plurality of governors, and it may be equipped with special speed-adjusting devices for one or for a plurality of the motors. These speed-adjusting devices may be operated in any way, whether by hand directly or by means of mechanical, electrical, or any other power or by means of a special automatic governor, which may be of any kind, whether a common speed-governor or any other known mechanical, hydraulic, or electric speed-governor device.

I consider myself the first to govern a motor by driving its speed-governor by means separate from the motor, the speed of this governor being controlled by the number of alternations of an alternating or pulsating electric current.

The advantages of my invention will be apparent to those skilled in the art, since the governor is not driven by the prime motor, the speed of which has to be governed, and consequently not bound to follow the speed of the same exactly, but as the governor can be driven in any desirable way by controlling its speed by a suitable alternating current; since a proper amount of rotating masses given to the motor driving the governor will practically release the governor from the impulse from the periodical variations which may occur in the alternating current on account of slight periodical variations of the speed of the generator producing the current; since this result can be obtained without any practical lessening of the power of the alternating current to control the speed of the governor according to the important variations of the speed; since on account of these reasons the speed of the governor is less exposed for periodical variations, and consequently the governor can be made more quick acting without danger of getting a hunting motion; since this advantage is still more obvious when the speed of the governor is controlled by the alternations of the main current from a plurality of dynamos, inasmuch as the periodical variations in question from the different dynamos in such a case may counteract each other, giving a current more even in this respect; since by using one governor for a plurality of engines the force delivered by the engines is changed simultaneously and proportionally for all of them, causing them to act together and to change their speed simultaneously within permitted limits, thereby releasing the dynamos from an excessive reliance to their power to control the speed of the engines driving them, as will be the natural result when the speed of the engines is governed by separate governors not acting exactly simultaneously or not changing the force of the engines proportionally to their respective loads or when the governors are permitted to assume a hunting motion, which sometimes may happen to be opposite for different engines, whereby the cut-off may be lengthened for one engine in the same time as the cut-off is shortened for another engine; since a speed-adjusting device for each engine permits the adjusting of the speed of each separate engine even when the engines are running with different loads, which allows the engines to be started one after the

other; since a speed-adjusting device for each separate engine permits the adjusting of a slightly-uneven action of the governor when the engines are running; since this speed-adjusting device may be adjusted automatically for each separate engine, and since the speed of the governor may be controlled by the main current, which is identically the same as to control the speed of the governor by the mean speed of all engines even when the engines are distributed in a plurality of power-stations, in which case each power-station is preferably provided with its own governor or governors.

It will be noted that the system is applicable only where the speed of the governor is controlled by the number of alternations of an alternating or pulsating current and not where the governor is driven by a direct-current motor, as the speed of such a motor is influenced by occasional variations of the intensity of the electric current or by occasional variations of the load to be overcome by the motor and is by no means really controlled by the current, as the speed may change independently of the current.

I claim—

1. A speed-governor for a prime mover, the speed-governor having connections for driving the same separately from the prime mover, the speed of the governor being controlled by the number of alternations of an alternating electric current; substantially as described.

2. A speed-governor for a prime mover, the speed-governor having connections for driving the same separately from the prime mover, the speed of the governor being controlled by the number of alternations of an alternating electric current, the alternations of which are synchronous with the motion of the prime mover, substantially as described.

3. A speed-governor for a prime mover, the speed-governor having connections for driving the governor separately from the prime mover, the speed of the governor being controlled by the number of alternations of an alternating electric current, the alternations of which are synchronously affected by the motion of the prime mover; substantially as described.

4. A speed-governor for a prime mover, the speed-governor having connections for driving the governor by a separate motor or prime mover in connection with an alternating-current electric motor or dynamo, the speed of which is controlled by the number of alternations of an alternating electric current; substantially as described.

5. A speed-governor for a prime mover, the speed-governor having connections for driving the governor by a separate alternating-current motor or dynamo, the speed of which is controlled by the number of alternations of an alternating electric current; substantially as described.

6. A speed-governor for a plurality of prime movers, the speed-governor having connections for driving the governor in connection with an alternating-current motor or dynamo, the speed of which is controlled by the number of alternations of an alternating electric current, the dynamos providing this current being driven by the prime movers; substantially as described.

7. A speed-governor for a prime mover, having driving connections for the same, separate from the prime mover, the speed of the governor being controlled by the number of alternations of an alternating electrical current, and a rock-shaft connection between the prime mover and the speed-governor; substantially as described.

8. A speed-governor for a prime mover having connections for driving the same, separately from the prime mover, the speed of the governor being controlled by the number of alternations of an alternating electric current, and mechanism for adjusting the speed of the prime mover by hand, independently of the speed-governor; substantially as described.

9. A speed-governor for a prime mover having a separate motor arranged to drive the same, and alternating-current connections arranged to control the speed of the motor for driving the governor; substantially as described.

10. The combination with a prime mover, of a speed-governor connected thereto and a separate motor or prime mover arranged to drive the speed-governor, the latter motor being controlled in speed by the number of alternations of an alternating electric current; substantially as described.

In testimony whereof I have hereunto set my hand.

SVEN S. EKMAN.

Witnesses:
H. M. CORWIN,
L. M. REDMAN.