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C. H. KINDL.

FREQUENCY REGULATOR SYSTEM.

FILED MAR. 31, 1920.

Fig. 1.

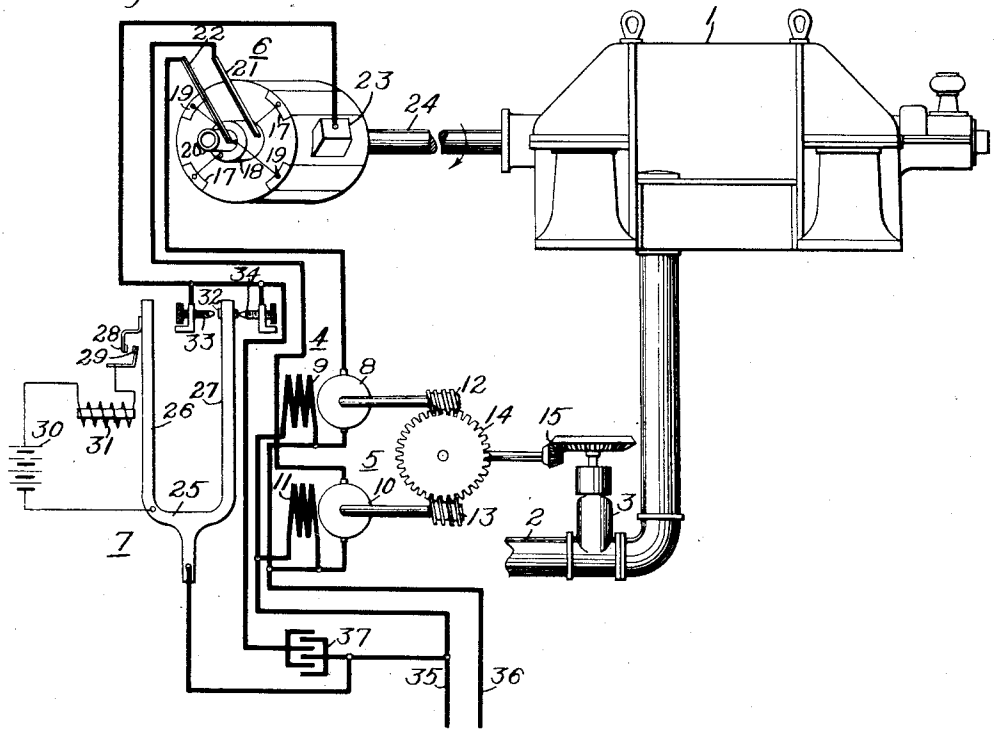
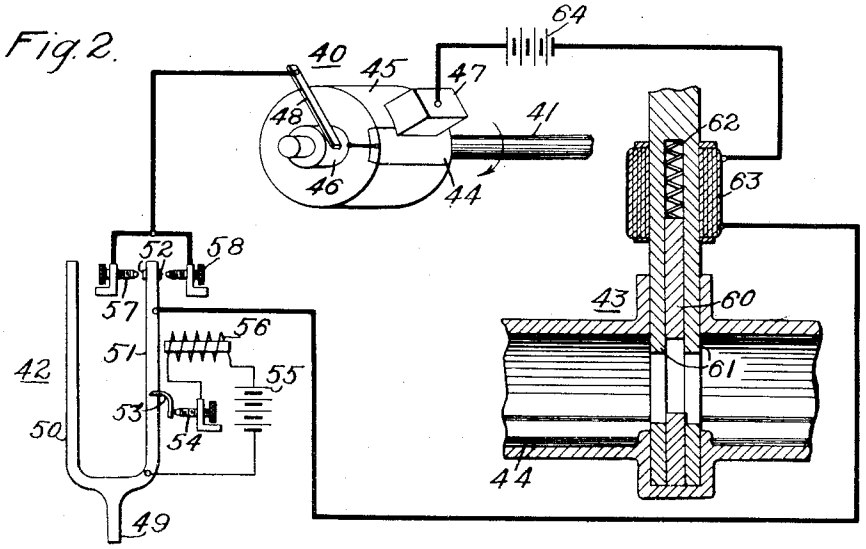


Fig. 2.



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UNITED STATES PATENT OFFICE.

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FREQUENCY-REGULATOR SYSTEM.

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To all whom it may concern:

Be it known that I, CARL H. KINDL, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Frequency-Regulator Systems, of which the following is a specification.

My invention relates to frequency-regulator systems and particularly to regulator systems for governing the speeds of prime movers that are operatively connected to alternating-current generators.

One object of my invention is to provide a frequency-regulator system of the above-indicated character that shall govern the power supplied to a prime mover in a simple and efficient manner for so controlling the speed of the associated generator as to maintain the frequency of the generated current substantially constant.

In operating an alternating-current generator, it is essential, in many cases, to operate the generator at a constant speed to produce a current of a constant frequency. In operating a turbo-generator, trouble is often experienced in controlling the turbine in accordance with the frequency of the generated current.

In a frequency-regulator system constructed in accordance with my invention, a constant-speed vibratory member, as a contact-making tuning fork, is provided for so controlling the speed of a turbo-generator as to maintain the generated current at a constant frequency. The amount of steam which is supplied to the turbine is controlled by two motors which, in turn, are governed by the contact-making tuning fork and a commutator device. The commutator device is rotated in accordance with the speed of the turbo-generator and the conducting segments thereof are alternately connected to the two motors. The contact-making tuning fork is connected in circuit with the motors and a brush member which consecutively engages the conducting segments of the commutator device.

When the turbo-generator and the commutator device are operating synchronously with the tuning fork, the segments of the commutator device do not make contact with the main brush member at the time the tuning-fork contact members are in engagement. Consequently, no circuit is completed through the motors to operate the throttle valve and to vary the amount of steam supplied to the turbine. However, if the speed of the turbo-generator is raised above or lowered below normal value, the contact segments, which are connected to the one or the other of said motors, engage the main brush member when the tuning-fork contact members are in engagement with each other. One of the motors is operated to increase or to decrease the amount of steam supplied to the turbo generator.

In the accompanying drawing, Figure 1 is a diagrammatic view of a regulator system constructed in accordance with my invention, and Fig. 2 is a diagrammatic view of a modification of the system shown in Fig. 1.

Referring to Fig. 1 of the drawing, a turbo-generator 1 is supplied with steam from the main 2 under the control of a throttle valve 3. The throttle valve 3 is controlled by two motors 4 and 5, and the two motors are controlled by a commutator device 6 and a contact-making tuning fork 7.

The motor 4 comprises an armature 8 and a field-magnet winding 9, and the motor 5 comprises an armature 10 and a field-magnet winding 11. The armature shafts of the motors 4 and 5 are respectively provided with worm members 12 and 13 which engage a worm wheel 14. The worm wheel 14 is connected to the throttle valve by means of a gear system 15. The worm members are reversible so that operation of one will have no effect on the other worm, except to cause a backward rotation of the de-energized armature. The motor 4 serves to open the throttle valve 3 in order to increase the speed of the turbo-generator 1 and, accordingly, the frequency of the generator current. The motor 5 serves to decrease the speed of the turbo-generator and the frequency of the generated current.

The commutator device 6 comprises conducting segments 17 which are connected to a collector ring 18 and conducting segments 19 which are connected to a collector ring 20. Collector rings 18 and 20 are respectively connected to the motors 5 and 4 by means of brushes 21 and 22. A main brush

member 23 is provided for consecutively engaging the contact segments. The commutator device 6 is operated, in any suitable manner, in accordance with the speed of the turbo-generator 1, as by means of a shaft 24.

The contact-making tuning fork comprises a yoke portion 25 and two prongs 26 and 27. The prong 26 carries a contact member 28 which intermittently engages a stationary contact member 29 to complete a circuit from a battery 30 through an electromagnet 31. The electromagnet 31 serves to maintain the tuning fork in constant vibration. The prong 27 carries a contact member 32 which intermittently engages the stationary contact members 33 and 34. The stationary contact members 33 and 34 are directly connected to the main brush member 23 of the commutator device 6 and the vibratory contact member 32 is connected to a supply circuit comprising conductors 35 and 36. A condenser 37 is connected across the contact members 33 and 34 and the contact member 32 to prevent sparking between such contact members. The field-magnet windings 9 and 11 of the motors 4 and 5 are directly connected across the supply conductors 35 and 36, and the armatures 8 and 9 of such motors are connected across the supply conductors in accordance with the operation of the contact-making tuning fork and the commutator device 6.

Assuming the turbo-generator 1 to be rotating in clockwise direction and the contact-making tuning fork and the commutator device 6 to be operating at synchronous speeds, the brush member 23 of the commutator device 6 engages a non-conducting segment when the contact member 32 of the tuning fork is in engagement with either of the stationary contact members 33 and 34. If the speed of the turbo-generator falls below normal value and generates a frequency below normal value, the commutator segments 19 engage the brush member 23 during a portion of the time that the vibratory contact member 32 is in engagement with one of the stationary contact members 33 and 34. Consequently, a circuit is completed from the supply conductor 35 through the contact members 32, 33 and 34, brush member 23, one of the contact segments 19, collector ring 20, brush member 22 and the armature 8 to the supply conductor 36. The motor 4 is operated to open the throttle valve 3 and increase the speed of the turbo-generator 1.

If the turbo-generator 1 is operating above normal speed and produces a current having a frequency above normal value, the brush member 23 engages the contact segments 17 during a portion of the time that the vibratory contact member 32 is in engagement with one of the stationary contact members 33 and 34. A circuit is completed from the supply conductor 35 through the contact members 32, 33 and 34, brush member 23, one of the contact segments 17, collector ring 18, brush member 21 and the armature 10 to the supply conductor 36. The motor 5 is operated to close the throttle valve 3 and, accordingly, to lower the speed of the turbo-generator 1 and to lower the frequency of the generated current.

Although only two commutator segments in the commutating device 6 have been shown associated with each motor, it is to be understood that any desired number of such conducting segments may be provided.

Referring to Fig. 2, a commutator device 40 is connected to a turbo-generator in any suitable manner, as by means of a shaft 41. The commutator device 40 and a contact-making tuning fork 42 control the operation of a throttle valve 43. The throttle valve 43 controls the amount of steam supplied from a steam main to the turbine (not shown).

The commutator device 40 comprises a conducting segment 44 which is mounted upon an insulating cylinder 45 and which is electrically connected to a collector ring 46. A brush member 47 is provided for engaging the contact segment 44. A brush 48 engages the collector ring 46.

The contact-making tuning fork comprises a yoke portion 49 and two prongs 50 and 51. The prong 51 carries two contact members 52 and 53. The contact member 53 intermittently engages a stationary contact member 54 for completing a circuit from a battery 55 through an electromagnet 56. The intermittent energization of the electromagnet 56 serves to maintain the tuning fork in constant vibration. The contact member 52 intermittently engages stationary contact members 57 and 58 for a purpose to be hereinafter set forth.

The throttle valve 43 comprises a gate portion 60 which is composed of any suitable magnetic material, as steel or iron. The gate portion 60 operates between two side portions 61 which are composed of any suitable non-magnetic material, such as brass. A spring member 62 is disposed between the side portions 61 for biasing the gate member 60 to a lower or a closed position, and an electromagnet 63 is provided for operating the gate member 60 to control the amount of steam supplied to the turbo-generator (not shown).

The electromagnet 63 is connected in circuit with a battery 64, under predetermined conditions, by means of the commutator device 40 and the contact-making tuning fork 42. The energization of the electromagnet 63 is varied in accordance with the joint operation of the commutator device 40 and the contact-making tuning

fork 42. In order to complete a circuit from the battery 64 through the electromagnet 63, it is necessary that the contact member 52 shall engage either the contact member 57 or the contact member 58 and that the brush member 47 shall engage the commutator segment 44. The length of the period during which the two sets of contact members are simultaneously in engagement with each other is varied in accordance with the speed of the turbo-generator and, consequently, in accordance with the frequency of the generator current.

If the speed of the turbo-generator falls below normal value, the commutator device 40 maintains the brush member 47 in engagement with the segment 44 a greater portion of the time during which the contact member 52 is in engagement with the contact members 57 and 58. Consequently, the energization of the electromagnet 63 is increased to open the throttle valve 43 and, consequently, increase the frequency of the generated current.

If the turbo-generator is operating above normal speed, the period of engagement between the brush member 47 and the segment 44 during which the contact member 52 is in engagement either with the contact member 57 or the contact member 58 is decreased to decrease the length of the impulses which are transmitted to the electromagnet 63. Consequently, the strength of the electromagnet 63 is decreased to permit the closing of the throttle valve 43. Thus, the speed of the turbo-generator is reduced to reduce the frequency of the generated current.

Although only one commutator segment 44 is shown in the drawing, it is to be understood that any number of such segments may be mounted upon the insulated drum 45. Moreover, the contact-making tuning fork may be replaced by any other suitable mechanism for producing impulses of constant frequency.

Modifications in the system and arrangement and location of parts may be made within the spirit and scope of my invention and such modifications are intended to be covered by the appended claims.

I claim as my invention:—

1. In a frequency regulator system for an alternating-current generator, the combination with a prime mover connected to said generator, and means comprising two motors for respectively increasing and decreasing the speed of said prime mover, of a commutator device rotated in accordance with the speed of said generator, and means comprising a vibratory member and said commutator device for controlling said motors to maintain the frequency of the generated current substantially constant.

2. In a frequency regulator system for an alternating-current generator, the combination with a steam turbine for operating said generator, and a plurality of motors for controlling the steam supplied to the turbine to govern the speed of the generator, of means comprising a contact-making tuning fork and a commutator device rotated in accordance with the speed of the generator for controlling said motors to maintain the frequency of the generator current substantially constant.

3. In a frequency regulating system for an alternating-current generator, the combination with a prime mover for operating the generator, and two motors for governing the power supplied to the prime mover, of a commutator device operated in accordance with the speed of said generator, the contact segments of said commutator being connected alternately to said motors, and a contact-making tuning fork for completing a circuit through said commutator to control said motors and to maintain the frequency of the generated current substantially constant.

4. In a frequency regulating system for an alternating-current generator, the combination comprising a commutator device operated in accordance with the speed of the generator, and a tuning fork electrically connected to said commutator device, of means controlled by said tuning fork and the commutator device for governing the frequency of the current generated by the generator.

5. In a regulator system, the combination with a rotating member, a prime mover for operating said member, and two motors for governing the speed of the prime mover of a commutator member operated in accordance with the speed of said member and a vibratory member for controlling said motors to maintain the speed of said member substantially constant.

6. In a regulator system, the combination with a rotating member and a prime mover for operating said member, of means comprising a commutator member operated by said prime mover and a vibratory member for controlling the speed of the rotating member.

7. In a regulator system, the combination comprising a rotating member, and means for operating said member, of means comprising a vibratory member and a commutator member for governing said operating means to maintain the speed of said member substantially constant.

8. In a regulator system, the combination comprising a rotating member, a prime mover for operating said member, and a contact-making tuning fork and a commutator device for controlling said prime mover to maintain the speed of said member substantially constant.

9. In a regulator system, the combination

with a prime mover and two motors for controlling the power supplied to said prime mover, of a commutator member operated by the prime mover and a contact-making tuning fork for completing the circuits of said motors to maintain the speed of the prime mover substantially constant.

10. In a regulator system, the combination with a steam turbine, motors for controlling the steam supplied to said turbine, and a commutator device operated by said turbine, of a contact-making tuning fork for completing circuits through said commutator to control said motors.

11. In a regulator system, the combination with a prime mover, of means comprising a commutator member operated by said prime mover and a vibratory member for controlling the speed of said prime mover.

In testimony whereof I have hereunto subscribed my name this 18th day of March, 1920.

CARL H. KINDL.