Jan. 11, 1944. J. W. LIVINGSTON 2,338,859

SPEED RESPONSIVE DEVICE

Filed Dec. 11, 1941 2 Sheets-Sheet 1

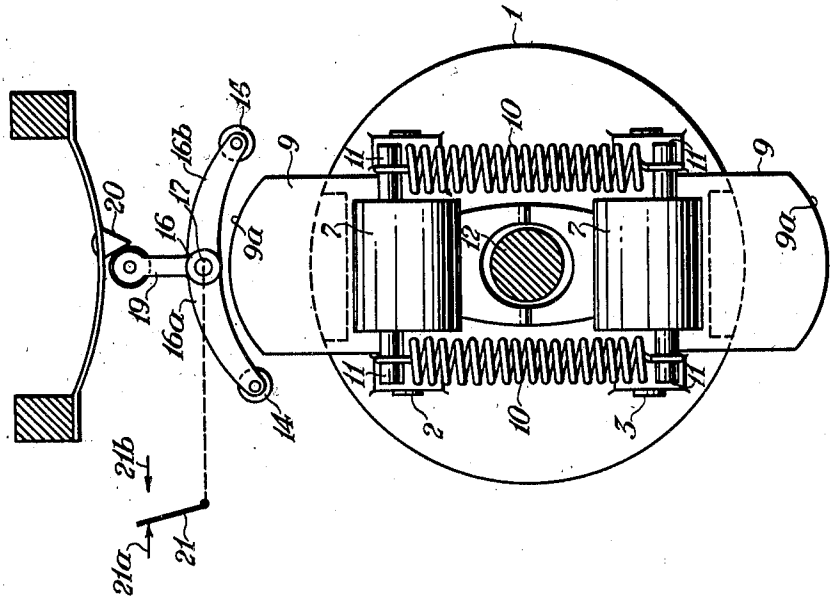


Fig. 2.

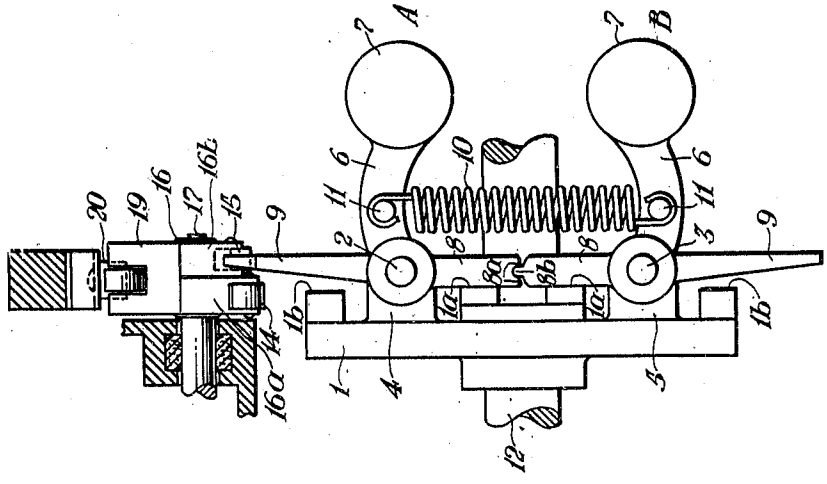


Fig. 1.

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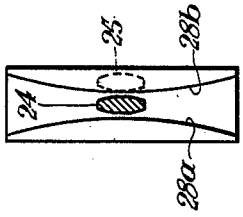


Fig. 5.

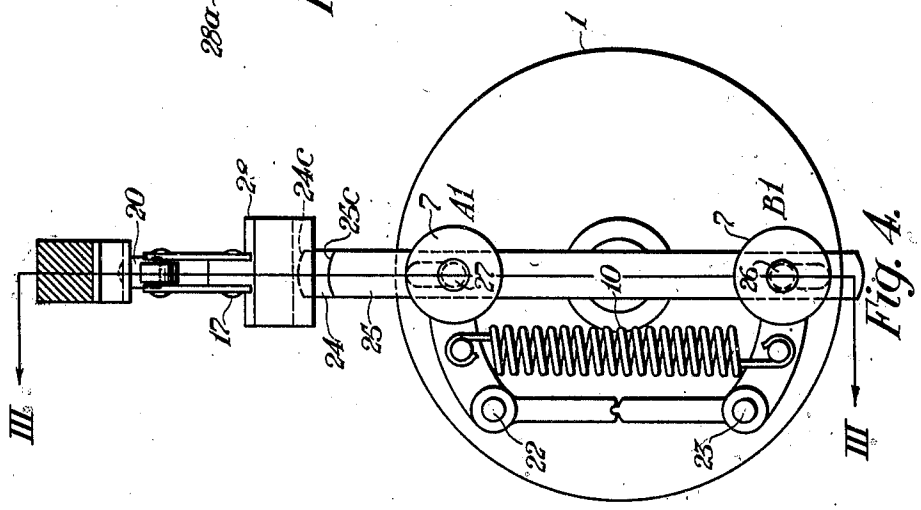


Fig. 4.

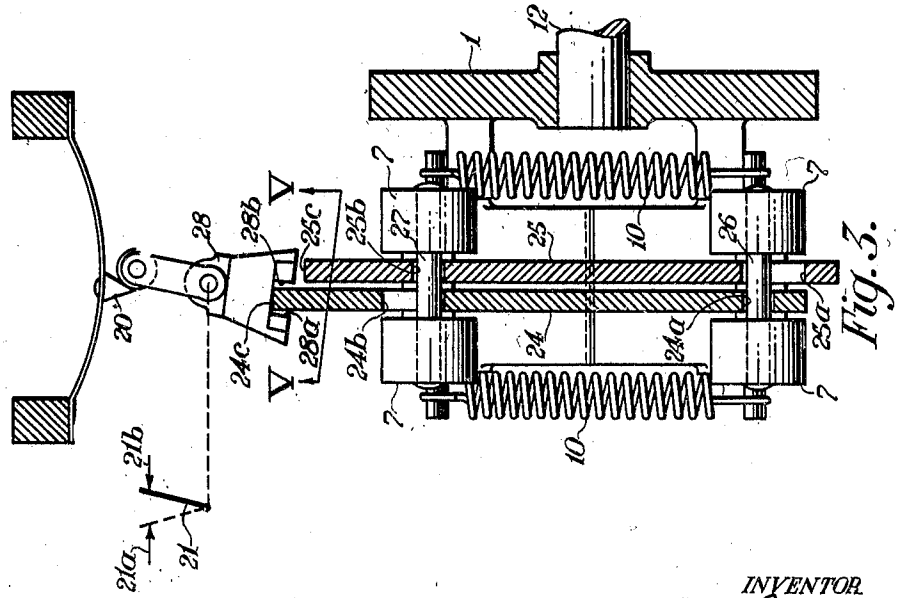


Fig. 3.

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Patented Jan. 11, 1944

2,338,859

UNITED STATES PATENT OFFICE

2,338,859

SPEED RESPONSIVE DEVICE

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Application December 11, 1941, Serial No. 422,467

7 Claims. (Cl. 200—80)

My invention relates to speed responsive devices, and particularly to governors which are adapted for use on trains in connection with automatic train control equipment to limit the speed at which the trains may operate under certain conditions.

One object of my invention is the provision of a governor which has a high degree of sensitivity at predetermined critical speeds both accelerating and decelerating.

Another object of my invention is the provision of a governor in which the force resulting from the centrifugal force of the centrifuge members and the centripetal force of the springs is used only to move cam means between two contact operating positions, and in which the force necessary to operate the governor contacts by the cam means is never in a direction to oppose the motion of the centrifuge members resulting from the difference between the centrifugal and centripetal forces.

Governors embodying my invention are an improvement upon the governor shown and described in an application for Letters Patent of the United States, Serial No. 412,665, filed on September 27, 1941, by Herbert L. Bone, for Speed responsive devices.

According to my invention, the motion of weighted centrifuge members which are biased by spring means to one position and are movable to another position in response to centrifugal force is utilized to operate cam means between two contact operating positions. The cam means when moved from either contact operating position to the other engage contact operating members to thereby actuate contacts, the parts being so arranged that the forces exerted by the cam means in actuating the contact operating members are applied substantially at right angles to the plane in which the centrifuge members oscillate, and that none of the force components which are developed are in a direction to oppose the motion of the centrifuge members resulting from the difference which then exists between the centrifugal and centripetal forces.

Other objects and characteristic features of my invention will become apparent as the description proceeds.

I shall describe two forms of speed responsive devices embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Figs. 1 and 2 are side elevational and front views, respectively, of speed responsive apparatus embodying my invention, some of the parts being shown in section and others being shown diagrammatically in the interest of simplicity. Figs. 3 and 4 are vertical sectional and front views, respectively, showing another form of speed responsive apparatus embodying my invention. Fig. 5 is a detail view of a portion of the apparatus illustrated in Figs. 3 and 4 taken on the line V—V of Fig. 3.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Figs. 1 and 2, the governor here shown comprises two centrifuge members A and B pivotally attached to a rotary member 1 for oscillation in a plane extending at right angles to the plane of the member 1 by means of pivot pins 2 and 3 mounted in diametrically opposite pairs of laterally projecting lugs 4 and 5. The centrifuge members A and B are similar, and each comprises a main arm 6 provided at its free end with a weight 7, a shorter arm 8 which extends substantially at right angles to the main arm 6, and a cam arm 9 which also extends substantially at right angles to the main arm 6 directly opposite the short arm 8.

The two short arms 8 of the centrifuge members A and B serve to connect the two centrifuge members together to cause them to operate in unison, and to this end, the free end of the arm 8 of the centrifuge member A is provided with bifurcations 8*a* which straddle a tongue 8*b* provided on the free end of the arm 8 of the centrifuge member B. The centrifuge members are free to swing between an inner position in which the arms 8 engage stop surfaces 1*a* provided on the rotary member 1, and outer positions in which the cam arms 9 engage other stop surfaces 1*b* provided on the rotary member 1, and are biased to their inner positions by means of coil springs 10 secured at their opposite ends to the main arms 6 by means of pins 11. The rotary member 1 is mounted on a drive shaft 12 which is adapted to be rotated at a speed which is proportional to the speed of a train or any other device to whose speed it is desired to have the governor respond.

The characteristics of the springs 10 and the angles at which they apply force to the centrifuge members are such that for all speeds of the rotary member 1 below a predetermined critical speed, the springs will act to hold the centrifuge members in their inner positions, but that, when the rotary member 2 is accelerated to this critical speed, the centrifuge members will immediately swing all the way from their inner to their

outer positions. The parts are further so proportioned that when the rotary member 1 is decelerating, and the proper critical speed is reached, the centrifuge members will immediately swing all the way from their outer to their inner positions. This latter critical speed will usually be slightly lower than the speed at which the centrifuge members move to their outer positions when the rotary member 2 is accelerating.

The cam arms 9 are secured to the centrifuge members A and B in such positions that they will be disposed on one side of the plane passing through the axes of the pivot pins 2 and 3 when the centrifuge members are swung to their inner positions, and on the other side of this plane when the centrifuge members are swung to their outer positions, and are provided at their outer ends with rounded cam surfaces 9a. These cam surfaces cooperate with rollers 14 and 15 mounted on the free ends of the laterally offset arms 16a and 16b of a contact operating rocker 16 secured to one end of a rocker shaft 17. The rocker 16 is free to oscillate between two extreme positions, and is biased by suitable toggle or detent mechanism 19—20 to its nearest extreme position, whereby when the rocker is moved from either extreme position to the other it will move with a snap action and will subsequently be held in whichever extreme position it is moved to until it is positively moved away from this position.

The movement of the rocker shaft 17 between two extreme positions resulting from movement of the rocker between its two extreme positions may be utilized to control suitable contact mechanism here shown diagrammatically as comprising a movable contact finger 21 which engages a fixed contact member 21a or a fixed contact member 21b to close a contact 21—21a or 21—21b according as the rocker 16 is rotated to its one or its other extreme position.

The parts are so proportioned that the roller 15 will project into the path of movement of the cam surfaces 9a when and only when the centrifuge members are rotated to their inner extreme positions and the rocker is rotated to the extreme position opposite to that in which it is shown in the drawings, and that the roller 14 will project into the path of movement of the cam surfaces 9a when and only when the centrifuge members are rotated to their outer extreme position and the rocker is rotated to the extreme position in which it is shown in the drawings. The parts are further so proportioned that when either roller projects into the path of movement of the cam surfaces 9a, the engagement of either cam surface with such roller in response to rotation of the rotary member 1 will act to move the rocker from the extreme position it then occupies to its other extreme position and thus operate the contacts 21—21a and 21—21b. It will be seen, therefore, that the contact 21—21a or the contact 21—21b will be closed according as the rotary member 1 is rotating below or above the critical speed at which the centrifuge members move to their outer positions.

It should be particularly pointed out that when the cam surfaces 9a engage either one of the rollers 14 or 15, the force exerted by the cam arms 9 will be exerted in a plane which is parallel to the plane passing through the axes of the pivot pins 2 and 3, and it follows that when either one of the cam surfaces 9a engages the roller 15, the reactionary force exerted against the associated cam arm will be in the same direction as the force resulting from the difference which then exists between the centrifugal force of the weights and the centripetal force of the springs. Correspondingly, when either one of the cam surfaces 9a engages the roller 14, since the cam arms 9 are then rotated to the side of the plane passing through the pivot pins 2 and 3 opposite to that which they occupy when the cam surfaces 9a engage the roller 15, the reactionary force exerted against the cam arms 9 by the rollers 15 will again be in the same direction as the force resulting from the difference between the centrifuge and centrifugal forces. That is to say, the force exerted by the contact mechanism does not at any time oppose the force which is effective to move the centrifuge members to either their inner or outer positions.

Referring now to Figs. 3, 4 and 5, in the modified form of the governor here illustrated the centrifuge members, which are here designated A1 and B1, are pivotally attached by means of pivot pins 22 and 23 to the rotary member 1 in such manner that the centrifuge members are free to oscillate in a plane which extends parallel to, rather than at right angles to, the plane of the rotary member 1. The centrifuge members are interconnected to operate in unison, and are biased to inner positions by means of springs 10, in the same manner as in Figs. 1 and 2. These centrifuge members differ from the centrifuge members A and B shown in Figs. 1 and 2, however, in that the cam arms 9 have been omitted, and that the weights 7 are recessed for the reception of two cam rods 24 and 25 which take the place of the cam arms.

The cam rods 24 and 25 are held in place in the recesses by means of pins 26 and 27 carried by the weights 7. As best seen in Fig. 3, the pin 26 extends through a clearance hole 24a in the cam rod 24 and an elongated slot 25a in the cam rod 25, while the pin 27 extends through an elongated slot 24b in the cam rod 24 and a clearance hole 25b in the cam rod 25. The slots 24b and 25a have a length equal to the distance through which the pins 26 and 27 move in response to the movement of the centrifuge members between their inner and outer positions, and serve as stops to limit the motion of the centrifuge members. These slots also serve to permit the cam rods to move in opposite directions in response to the movement of the centrifuge members between their inner and outer positions. The rod 24 is made somewhat longer than the rod 25, and the parts are so proportioned that when the centrifuge members occupy their inner positions, the end 24c of the rod 24 will project beyond the ends 25c of the rod 25, but that, when the centrifuge members are swung to their outer positions, the end 25c of the rod 25 will then project beyond the end 24c of the rod 24 the same amount that the end 24c projects beyond the end 25c under the conditions first mentioned.

The ends 24c and 25c of the rods 24 and 25 are oval shaped, and cooperate with opposed cam surfaces 28a and 28b formed on a rocker 28 secured to the rocker shaft 17. As best seen in Fig. 5, the cam surfaces 28a and 28b converge toward the center from either end of the rocker but are spaced apart at their closest point a distance which is slightly greater than the width of the ends 24c and 25c of the cam rods 24 and 25. The parts are so proportioned that the cam surfaces 28a will project into the path of movement of the end 24c of the rod 24 when and only when the cam rod 24 is moved to its outer position, and the rocker is rotated to its one extreme po-

sition, and that, the cam surface 23b will project into the path of movement of the end 25c of the cam rod 25 when and only when the cam rod 25 is moved to its outer extreme position and the rocker 28 is rotated to its other extreme position. The parts are further so proportioned that when either cam surface projects into the path of movement of one of the cam rods, the engagement of the cam rod with such cam surface in response to rotation of the rotary member 1 will move the rocker from the extreme position it then occupies to its opposite extreme position whereupon the cam rod which caused the movement of the rocker will be free to swing between the cam surfaces without touching either surface as long as the rod remains in its projected position. The rocker 28 is held in either extreme position to which it is moved in the same manner that the rocker 16 in Fig. 1 is held in either extreme position to which it is moved.

It should be noted that since the movement of the rocker 28 between its two extreme positions is effected by engagement of the rocker with the sides of the push rods 24 and 25, the reaction forces which are set up when the rocker is reversed will be disposed substantially at right angles to the plane of the pivots 22 and 23, and will not therefore at any time oppose the force which is effective to move the centrifuge members to either their inner or their outer positions.

One advantage of a governor constructed in accordance with my invention is that since the only force which it is necessary for the centrifuge members to exert is the force necessary to move the cam arms or cam rods between their two contact operating positions the governor is more sensitive than governors constructed in the customary manner, and is not subject to the unsatisfactory contact operation characteristics of previous design of governors.

Although I have herein shown and described only two forms of speed responsive devices embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a governor comprising a centrifuge member pivoted to a rotary member for oscillation between outer and inner positions in a plane disposed at right angles to the plane of rotation of said rotary member and biased to its inner position by spring means, a cam arm projecting from said centrifuge member and movable thereby to one side or the other of a plane extending through the pivotal axis of said centrifuge member parallel to the plane of rotation of said rotary member, a cam surface formed on the outer end of said cam arm, and a rocker movable between two positions by engagement of said cam surface with said rocker in response to rotation of said rotary member.

2. In a governor comprising a centrifuge member pivoted to a rotary member for oscillation between outer and inner positions in a plane disposed at right angles to the plane of rotation of said rotary member and biased to its inner position by spring means, a cam arm projecting from said centrifuge member and movable thereby to one side or the other of a plane extending through the pivotal axis of said centrifuge member parallel to the plane of rotation of said rotary member, a cam surface formed on the outer end of said cam arm, and a rocker movable between two positions by engagement of said cam surface with said rocker in response to rotation of said rotary member, said rocker being biased to remain in its last operated position.

3. In a governor comprising a centrifuge member pivoted to a rotary member for oscillation between outer and inner positions in a plane disposed at right angles to the plane of rotation of said rotary member and biased to its inner position by spring means, a cam arm projecting from said centrifuge member and movable thereby to one side or the other of a plane extending through the pivotal axis of said centrifuge member parallel to the plane of rotation of said rotary member, a cam surface formed on the outer end of said cam arm, and a pivoted rocker movable between two positions and provided with two laterally offset arms one of which projects into the path of movement of said cam surface when and only when said rocker occupies its one position and said centrifuge member is moved to its inner position and the other of which projects into the path of movement of said cam surface when and only when said rocker occupies its other position and said centrifuge member is moved to its outer position.

4. In a governor comprising a centrifuge member pivoted to a rotary member for oscillation between outer and inner positions in a plane disposed at right angles to the plane of rotation of said rotary member and biased to its inner position by spring means, a cam arm projecting from said centrifuge member and movable thereby to one side or the other of a plane extending through the pivotal axis of said centrifuge member parallel to the plane of rotation of said rotary member, a cam surface formed on the outer end of said cam arm, and a pivoted rocker movable between two positions and provided with two laterally offset arms one of which projects into the path of movement of said cam surface to be engaged thereby when and only when said rocker occupies its one position and said centrifuge member is moved to its inner position and the other of which projects into the path of movement of said cam surface to be engaged thereby when and only when said rocker occupies its other position and said centrifuge member is moved to its outer position, said rocker being biased to remain in its last operated position until positively moved away from such position.

5. In a governor comprising a centrifuge member pivoted to a rotary member for oscillation between outer and inner positions in a plane disposed at right angles to the plane of rotation of said rotary member and biased to its inner position by spring means, a cam arm projecting from said centrifuge member and movable thereby to one side or the other of a plane extending through the pivotal axis of said centrifuge member parallel to the plane of rotation of said rotary member, a cam surface formed on the outer end of said cam arm, a rocker operated at times by engagement with said cam surface, and contacts operated by said rocker.

6. A governor comprising a rotary member which is adapted to be rotated at different speeds, a pair of centrifuge members pivotally attached to said rotary member at diametrically opposite points for movement between inner and outer positions, said members being connected together to operate in unison and being biased to their

inner positions by spring means, cam arms secured to said centrifuge members and movable thereby to positions disposed on opposite sides of the plane passing through the pivotal axes of said centrifuge members, cam surfaces formed on the outer ends of said cam arms, and a rocker actuated between two positions by engagement of said cam surfaces with said rocker.

7. A governor comprising a rotary member which is adapted to be rotated at different speeds, a pair of centrifuge members pivotally attached to said rotary member at diametrically opposite points for movement between inner and outer positions, said members being connected together to operate in unison and being biased to their inner positions by spring means, cam arms secured to said centrifuge members and movable thereby to positions disposed on opposite sides of the plane passing through the pivotal axes of said centrifuge members, cam surfaces formed on the outer ends of said cam arms, a rocker actuated between two positions by engagement of said cam surfaces with said rocker, and contact mechanism operated by said rocker.

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