Dec. 29, 1942. J. W. HALE 2,306,696

SPEED RESPONSIVE CONTROL DEVICE

Filed Sept. 15, 1938

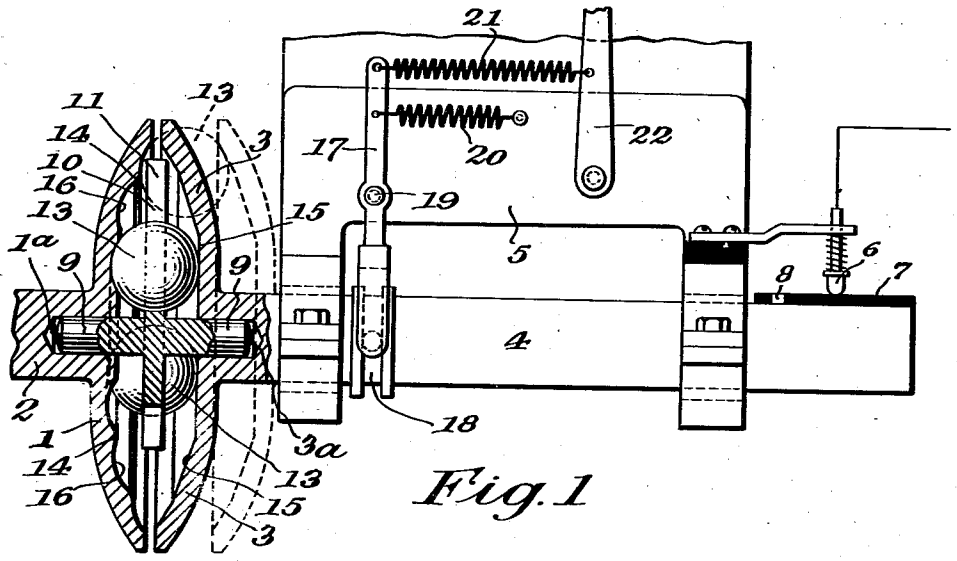

Fig. 1

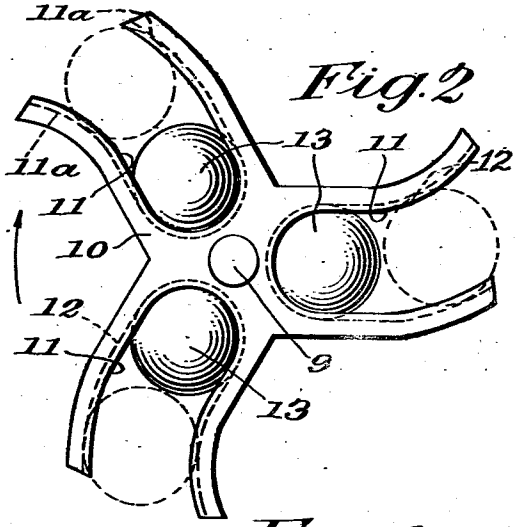

Fig. 2

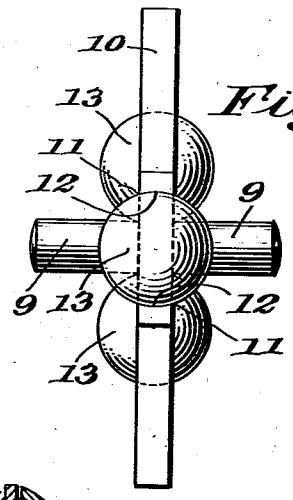

Fig. 3

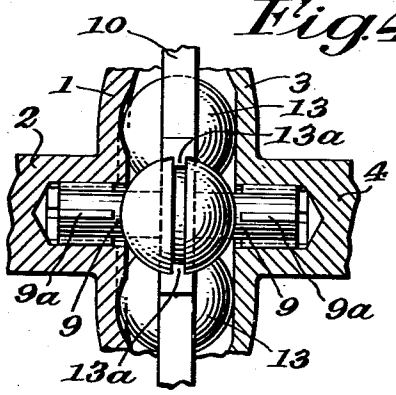

Fig. 4

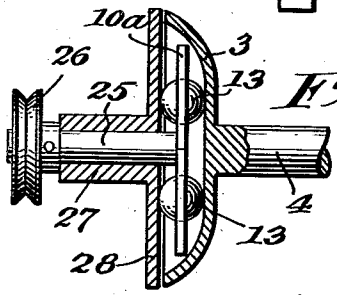

Fig. 5

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SPEED RESPONSIVE CONTROL DEVICE

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Application September 15, 1938, Serial No. 230,046

4 Claims. (Cl. 264—17)

My present invention relates to a novel speed responsive control operating device.

In my copending application, Serial No. 225,963, filed August 20, 1938, now Patent No. 2,247,492, I have shown a speed responsive control for use in actuating valves, switches and the like where it is desired that the speed responsive control be effective in proportion to increases in speed rather than to the square of the speed. As I have stated in the above mentioned co-pending application, the necessity of resiliently opposing the action of speed responsive devices and the frequent desirability of varying the opposition to its action makes essential a device wherein the centrifugal force of the speed responsive means is controlled to be effective substantially in direct proportion to the variations in speed of the driving member.

In my present invention, I am concerned with a simple and effective speed responsive device in which the desired results may be readily accomplished by the use of weights confined between a reaction member and a control operating member so that when the weights are subjected to centrifugal force, they move outwardly. I employ means to cause the outward movement of the weights to actuate the control operating member in desired relation to variations in speed of the reaction member.

In the drawing I have shown an embodiment of my invention from which its advantages will be readily apparent. In the drawing:

Fig. 1 is a partly sectional view of the speed responsive control device.

Fig. 2 is an end view of one form of weight retainer.

Fig. 3 is a fragmentary plan view of my device showing the retainer.

Fig. 4 is a fragmentary view of a modified form of retainer construction.

Fig. 5 is a fragmentary side view of another embodiment of my invention.

In accordance with my invention I employ a reaction member 1 mounted on a shaft 2 to be rotated to indicate the speed or speeds at which a control is to be operated. The control operating member 3 includes a rod 4 slidably mounted in a support 5 and preferably held against rotation. While any type of control may be operated by my device, I have shown as at 6 a contact adapted to travel over insulation 7 to register on predetermined movement of the control operating member 3 with a contact 8. Valves or other types of switches may obviously be used with my invention.

The members 1 and 3 are bored as at 1*a* and 3*a* to receive the ends of the shaft 9 of a carrier 10 which is formed with slots or pockets 11 the walls of the slots being concave to form guiding surfaces as at 12 (Fig. 3) to confine the balls 13 laterally while permitting their movement substantially radially along the slots 11.

The members 1 and 3 are in contact with the balls 13 when at rest as shown in the full line position in Fig. 1 and curve inwardly as at 14 to oppose any outward movement of the balls 13. Instead of curving the walls as at 14, the walls may be angularly disposed as at 15. If desired, either one of the members 1 and 3 may be formed with a flat surface. If the surface of the members 1 or 3 or both is curved, concentric grooves may be provided as at 16. If angular surfaces are employed, the abrupt change in angularity offers sharply increased resistance to the travel of the balls 13.

As the carrier 10 is rotatable independently of the member 1 and the control operating member 3 is not rotatable, the balls 13 will rotate and cause rotation of the carrier 10 at one half the speed of the shaft 2. On rotation of the carrier 10, the balls 13 are subjected to centrifugal force and hurled outwardly wedging the member 3 away from the member 1 as shown in dotted lines in Fig. 1.

Axial movement of the member 3 by the balls 13 is opposed by a forked lever 17 in the annular recess 18 on the rod 4. The lever 17 is fulcrumed as at 19 and under control of the tension members 20 and 21. The spring 20 has a fixed tension while the spring 21 is connected to a lever 22 which is adapted to be actuated by the operator as a brake, accelerator or both so that its tension, and accordingly, its opposition to the centrifugal action of the balls 13 may be varied.

The drive may be through the carrier 10a as shown in Fig. 5. For example, the carrier 10a may be carried by a shaft 25 including a driving wheel 26 or the like establishing a shoulder for the hub 27 of the reaction member 28. In this construction, the reaction member 28 will be rotated at twice the speed of the balls 13. The inertia of the member 28 is therefore effective to oppose movement of the weights 13.

If desired, the pockets 11 may be formed with curved portions 11*a* (Fig. 2). Since the carrier 10 is rotated by the balls 13, the carrier 10 will have inertia or momentum relative to the speed of the balls on acceleration or deceleration of their rate of rotation respectively. The portions 11*a* of the pockets 11 therefore tend to oppose

the action of the balls on acceleration and oppose their action on deceleration.

If greater centrifugal effect is desired, rotation of the balls 13 may be prevented as by splining them as at 13a in the pockets 11. In this embodiment of my invention, the shaft 3 of the carrier 10 is splined as at 9a to cause rotation of the member 3 and the carrier 10 with the member 1. With this form of my invention, the member 1 may be omitted and the carrier 10 driven by the shaft 2.

It will be appreciated that the curved or angular surface of the members 1, 3 or both are adapted to so oppose the action of the balls 13 that the centrifugal force is rendered relatively less effective as the speed of the shaft 2 increases so that movement of the control operating member 3 may be substantially in direct proportion to variations in speed of the drive member 1.

What I therefore claim and desire to secure by Letters Patent is:

1. In a speed responsive control operating device, a slidable control member, a rotatable reaction member, at least one of said members including a cam surface, weight elements, means to rotate said elements, said elements being in contact with said members and movable outwardly in response to centrifugal force and coacting with said cam surface to move said slidable member, said cam surface including a first portion offering a predetermined resistance to said movement of said elements, and a second portion offering a predetermined increasing resistance to further outward movement of said members, and the surface of another of said members is formed with concentric grooves intermediate each of said portions.

2. In a speed responsive control operating device, a slidable control member, a reaction member, at least one of said members including a cam surface, weight elements in contact with said members and movable outwardly in response to centrifugal force and coacting with said cam surface to move said slidable member, means to subject said weight elements to centrifugal force, said cam surface including a first portion offering a predetermined retarding effect upon outward movement of said weight elements, a second portion offering another predetermined retarding effect upon further outward movement of said elements and at least one of said members including surfaces disposed to engage and hold said weight elements adjacent either extremity of said cam surfaces until the weight elements are subjected to sufficient centrifugal forces to overcome definitely the retarding effect of the adjacent cam surface whereby said slidable member is subjected to a definite limited movement by each of said cam portions.

3. In a speed responsive control operating device, a slidable control member, a reaction member, weight elements in contact with said members and movable outwardly in response to centrifugal force, one of said members being so shaped that on said outward movement said weight elements coact with said shaped member to effect movement of said slidable member, guide means for said weight elements, means to subject said weight elements to centrifugal force, said shaped member offering a predetermined resistance to outward movement of said weight elements, one of said members being shaped to offer another predetermined resistance to further outward movement of said weight elements whereby said slidable member is subjected to two definite movements and means to engage with and hold said weight elements when they are adjacent either extremity of that part of the member offering resistance to movement of said weight elements until said weight elements are subjected to sufficient centrifugal force to overcome definitely the resistance offered thereby.

4. The device of claim 3, in which the weighted elements are balls and the guide means has ball receiving slots and is supported by said members for rotation independently thereof, the outer ends of said slots being curved.

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