June 24, 1930. V. R. BROWN 1,767,739

MAGNETIC DEVICE FOR INITIATING MOVEMENT

Filed June 4, 1928

Fig. 1.

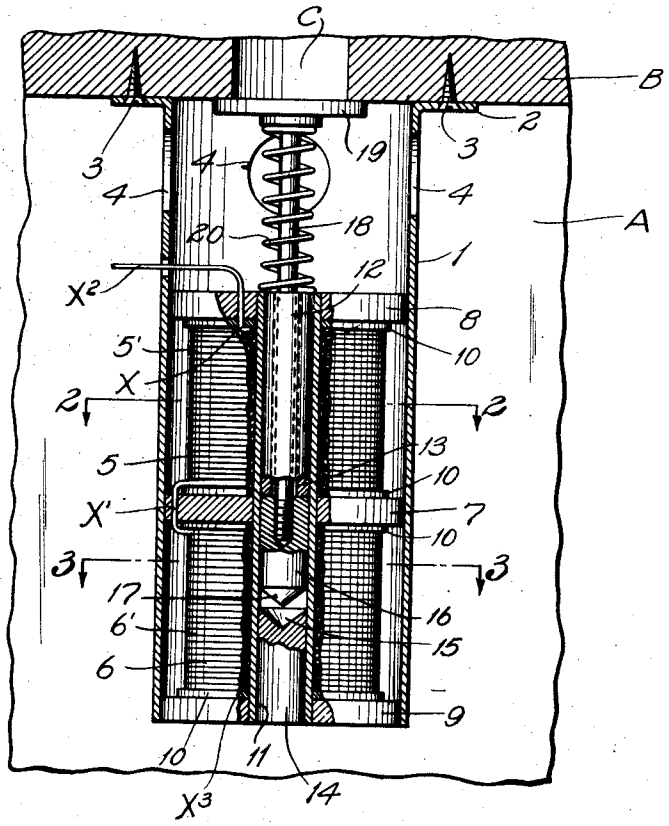


Fig. 2.

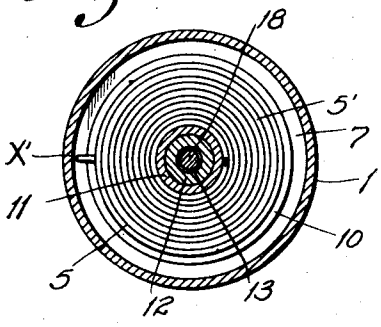


Fig. 3.

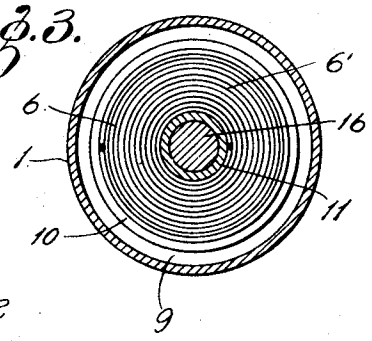
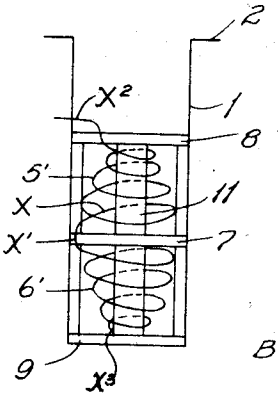


Fig. 4.



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UNITED STATES PATENT OFFICE

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MAGNETIC DEVICE FOR INITIATING MOVEMENT

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This invention relates generally to magnetic means for initiating movement, and more specifically to a device of this type which includes as parts thereof a solenoid and a movable core, the predominant object of the invention being to so construct a movement-initiating device of the type mentioned that the movable core thereof is capable of a relatively long stroke and is subjected to the maximum strength of magnetism and moves at an approximately uniform rate of speed throughout its entire stroke. It is a well-known fact that in the case of the ordinary solenoid, the strength of the magnetism exerted upon the movable core of said solenoid and speed of movement of said core which results from said magnetism vary slightly during movement of the core in response to the influence of the solenoid. Ordinarily, the maximum strength of magnetism exerted upon the movable core and the resultant maximum speed of movement of said movable core are realized during the early portion of the stroke of said movable core, and this strength of magnetism and speed of movement of said core gradually diminish as the stroke of the core progresses from the beginning to the end thereof.

The prime object of the present invention is to construct a movement-initiating device involving the use of a solenoid which is capable of producing a substantial stroke and which is so constructed and arranged that the approximate maximum strength of magnetism of which the device is capable is exerted upon the movable core during the entire stroke or movement of said core, whereby the speed of movement of the movable core is approximately uniform during the entire stroke of the core.

My improved movement-initiating device is capable of a great variety of applications, and hence I do not wish to limit its use to any particular field. However, it has been found that the device is particularly well adapted for use as a means for actuating movable parts of electrically-controlled pipe organs, such as the valves for controlling the passage of air from the air-chest of an organ to the pipes thereof, stop keys, switches, etc., and it is this application of the invention which I have elected to illustrate in the drawing and specifically describe in the specification forming parts of the present invention.

Figure 1 is a fragmentary vertical section of an air-chest of a pipe organ showing my improved movement-initiating device as a part of a valve action;

Figure 2 is a cross-section on line 2—2 of Fig. 1;

Figure 3 is a cross-section on line 3—3 of Fig. 1;

Figure 4 is a view illustrating diagrammatically the wiring of the device.

In the drawing, which shows merely one embodiment of my invention, A designates the air-chest of a pipe organ, which is provided with a top wall B through which an air passageway C is formed. The air passageway C leads to an orifice formed in the toe portion of a pipe (not shown) which is located at the upper end of said air passageway.

Secured to the top wall of the air-chest at the lower face thereof is an action housing 1 comprising a hollow member preferably, though not necessarily, cylindrical in cross-section, said member being provided at its upper end with a laterally turned annular flange 2 having apertures formed therethrough through which screws or other suitable fastening devices 3 are passed to secure said housing to the top wall of the air-chest. The housing 1 is extended downwardly from the lower face of the top wall 2 of the air-chest A, as shown in Fig. 1, and said housing is provided with a plurality of apertures 4 through which air may pass from the interior of the air-chest A to the interior of the upper portion of the housing 1.

Arranged within the housing 1 at the lower portion thereof is a pair of solenoids positioned one above the other, the upper solenoid being designated by the reference character 5 and the lower solenoid being designated by the reference character 6. The two solenoids 5 and 6 constitute elements of a unitary valve action structure, said unitary

structure including an intermediate metallic washer 7 which is interposed between the solenoids 5 and 6, an upper metallic washer 8 at the upper end of the solenoid 5, and a lower metallic washer 9 at the lower end of the solenoid 6. The unitary structure referred to also includes fibre washers 10 which are interposed between the metallic washers 7, 8, and 9 and the coils 5′ and 6′ of the respective solenoids 5 and 6. Extended through the solenoids 5 and 6 in longitudinal alinement with the major axes thereof is a cylindrical element 11 which is formed of a suitable non-magnetic material, such, for instance, as brass, the opposite ends of said cylindrical member terminating at the top and bottom faces of the metallic washers 8 and 9, respectively, and said washers 8 and 9, together with the intermediate washer 7, being fixed to said cylindrical member to aid in producing the unitary solenoid structure already referred to. Also, an electrical conductor X, which forms the coils 5′ and 6′ of the solenoids 5 and 6, is wound or coiled upon the cylindrical member 11, between pairs of fibre washers 10.

Arranged within the portion of the cylindrical member 11 which is located within the solenoid 5 is a fixed core 12, said fixed core extending approximately from the top face of the metallic washer 8 to the top face of the metallic washer 7, as shown in Fig. 1, and said fixed core 12 is provided with an opening 13 formed longitudinally therethrough from end to end thereof. Also, within the lower portion of the cylindrical member 11, I provide a second fixed core 14 which has a conical-shaped recess 15 formed at its upper end. Interposed between the lower end of the fixed core 12 and the upper end of the fixed core 14 is a movable core 16, the space between the lower and upper ends of the fixed cores 12 and 14 being greater than the length of the movable core 16, so that said movable core may move longitudinally of the cylindrical member 11. At the lower end of the movable core 16, said movable core is provided with a conical portion 17, the shape and dimensions of said conical portion being such that when the movable core 16 moves downwardly into close proximity with the fixed core 14, said conical portion 17 will be extended into the conical recess 15 at the upper end of said fixed core 14.

18 designates a valve stem which is secured to the movable core 16, for instance, by having its lower end screwed into a threaded aperture in said movable core, said stem 18 being extended longitudinally through the opening 13 in the fixed core 12, as shown in Fig. 1. The relative dimensions of the diameters of the opening 13 in the fixed core 12 and the valve stem 18 are such that the faces of said opening and said valve stem are not in contact with each other. The stem 18 has a valve head 19 fixed to it at its upper end, which valve head is arranged to close the air passageway C in the top wall of the air-chest A, and in this manner prevent passage of air through said air passageway from the interior of the air-chest A to the pipe which is arranged in communication with said air passageway C at the upper end thereof. 20 designates a coil spring which is arranged about the valve stem 18, the opposite ends of said coil spring being in contact with the valve head 19 and the top face of the solenoid 5, respectively, whereby said coil spring tends to move the valve head 19 into contact with the lower face of the top wall B of the air-chest A.

By referring to Fig. 4, it will be noted that the conductor X, which is coiled about the cylindrical member 11 to produce the coils 5′ and 6′ of the solenoids 5 and 6, respectively, is so arranged that while the respective coils are wound in the same direction, the polarities of said solenoids 5 and 6 are reversed. This effect is attained by connecting the like poles of the solenoids 5 and 6, this connection being effected by the portion of the conductor X which is designated by the reference character X′. The conductor X is coiled about the cylindrical member 11 so that the lead wire X^2 connects with the coil of the solenoid 5 at the inner layer of said coil, and the opposite end of the conductor X is grounded on the cylindrical member 11 at the lower end of the coil of the solenoid 6, as indicated by the reference character X^3.

Due to the fact that the polarities of the solenoids 5 and 6 are reversed, it is obvious that the solenoid 5 will repel or push the movable element 16 away from said solenoid and in a downward direction, while the solenoid 6 will pull said movable core 16 or draw same into the interior of said solenoid 6. This condition results from the well-known law of magnetics, that like poles repel while unlike poles attract. On energization of the solenoids 5 and 6, the movable core 16 will immediately receive the maximum force of magnetism of which the solenoid 5 is capable, due to the fact that said movable core is in direct contact with the lower end of the fixed core 12 of said solenoid, and, therefore, said movable core will be pushed forcibly away from the solenoid 5. As the movable core 16 moves away from the lower end of the fixed core 12 of the solenoid 5, the strength of the magnetic force which is pushing said movable core gradually diminishes, but at this same time, during said movement of said movable core, the lower end thereof is approaching the fixed core 14 associated with the solenoid 6, and because of this fact, the magnetic force exerted on the movable core by said solenoid 6 will be gradually increased as said movable core moves downwardly.

The result of this condition is that while the strength of the magnetic force exerted by the solenoid 5 is diminishing during the stroke of the movable core, the strength of the magnetic force exerted by the solenoid 6 is increasing as said stroke of the movable core progresses. Hence, the approximate maximum magnetic force of which the device is capable is exerted against the movable core at all times during the stroke thereof, and, therefore, an approximately maximum and uniform speed of movement of the movable core is attained during the entire stroke of said movable core.

When the device is used as a means for actuating a valve for a pipe organ, as shown in the drawing, the maximum force realized immediately on energization of the solenoids effectively overcomes the effect of the air pressure within the air-chest A acting against the lower face of the valve 19 to close same, and because of this maximum force exerted by the solenoid 5, said valve 19 is quickly pulled away from its seat and is moved downwardly to the end of its stroke at the maximum and at a uniform rate of speed, whereby air from the air-chest A may pass freely through the air passageway C into the pipe associated therewith without hindrance from the valve 19.

A very important feature of the present invention resides in the fact that the solenoids 5 and 6 are connected in series and hence there will be no increase of current consumption because of the use of two solenoids.

I claim:

1. A device for initiating movement comprising a movable element, a solenoid for pushing said movable element, and a second solenoid for pulling said movable element in the same direction in which it is moved by the first mentioned solenoid.

2. A device for initiating movement comprising a movable element, a solenoid for pushing said movable element, and a second solenoid for pulling said movable element in the same direction in which it is moved by the first mentioned solenoid, the first mentioned solenoid and the second mentioned solenoid being simultaneously actuated.

3. A device for initiating movement comprising a movable element, a solenoid for pushing said movable element, and a second solenoid for pulling said movable element, the polarities of the first mentioned and the second mentioned solenoids being reversed.

4. A device for initiating movement comprising a movable element, a solenoid for pushing said movable element, and a second solenoid for pulling said movable element in the same direction in which it is moved by the first mentioned solenoid, the first and second mentioned solenoids being simultaneously actuated and each thereof exerting a force which varies slightly in strength during the progress of the stroke of said movable element, said first mentioned solenoid attaining its maximum force during the early portion of the movement of said movable element, and said second mentioned solenoid attaining its maximum force during the latter portion of the movement of said movable element.

5. A device for initiating movement comprising a movable element, a solenoid for pushing said movable element, and a second solenoid for pulling said movable element in the same direction in which it is moved by the first mentioned solenoid, the first and second mentioned solenoids being electrically connected together in a manner to cause the polarities thereof to be reversed, and said first and second mentioned solenoids being simultaneously actuated.

6. In combination with a movable part of a pipe organ, a magnetic device for imparting movement to said movable part comprising a movable element, a solenoid for pushing said movable element, and a second solenoid for pulling said movable element in the same direction in which it is moved by the first mentioned solenoid, said movable element and said movable part of the pipe organ being co-operatively connected together.

In testimony whereof, I have hereunto set my hand.

VERNIE ROY BROWN.