A. SUNDH.

UNIFORM MOVEMENT DEVICE.

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994,212.

Patented June 6, 1911.

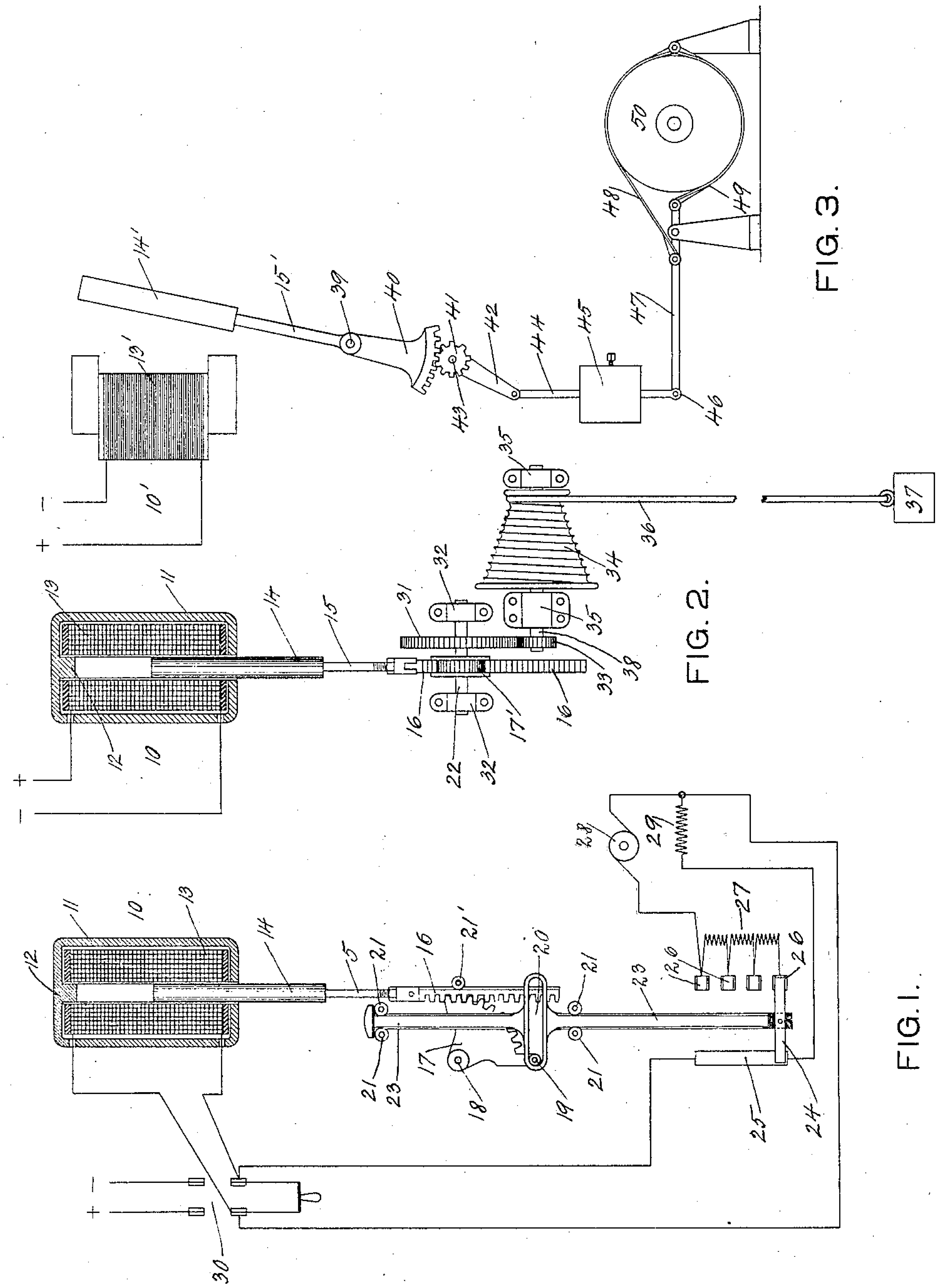

FIG. 1. FIG. 2. FIG. 3.

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UNIFORM-MOVEMENT DEVICE.

994,212. Specification of Letters Patent. Patented June 6, 1911.

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To all whom it may concern:

Be it known that I, AUGUST SUNDH, a citizen of the United States, residing in Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Uniform-Movement Devices, of which the following is a specification.

My invention relates to electromagnetic apparatus, and has for an object the provision of means whereby the load upon an electromagnet is varied in proportion to the pull of said magnet.

A further object is to provide means whereby a smaller magnet may be used to perform a given duty, than with the usual construction.

Other objects will appear more fully hereinafter, the novel combinations of elements being set forth in the claims hereunto annexed.

In electrical apparatus in which electromagnets are employed to do useful work it is customary to use one or more magnets of comparatively large size and of considerable magnetizing power, for, not only does the pull of a magnet vary for different positions of its core depending largely upon its design, but usually such magnet has to overcome the static friction of its load when in its most inefficient or weakest position. For these and other reasons such magnet must be made sufficiently powerful to do its greatest duty when in its most inefficient position. Furthermore, such a magnet must necessarily be of relatively large size and consume much current.

In order to economize in electric current as much as possible it is customary to reduce the current flowing in said magnet after the same has done its work by inserting a resistance element in series with the magnet winding. By utilizing a system of leverage I am enabled to employ a magnet of relatively small size and having a minimum current consumption.

Referring to the accompanying drawing Figure 1 is a diagrammatic representation in side elevation of an electromagnetic apparatus made according to my invention and applied to an electrically actuated motor-starting rheostat or resistance-varying device; Fig. 2 shows a modification of my invention, applied in this case to lift a weight, and Fig. 3 is a further modification of my invention applied to an electrically actuated brake.

Like characters of reference denote corresponding parts in all of the figures.

Referring to Fig. 1, 10 designates an electromagnet which comprises a frame 11 with a pole piece 12, and a winding or solenoid 13, which when energized will lift a core or armature 14. This core 14 is connected by a rod 5 to a rack 16 guided in its movement by an anti-friction roller 21′ and meshing with a segmental gear 17 which is pivoted at 18. A roller 19 is carried upon the gear 17 and is normally in vertical alinement with the pivot 18 and is arranged to travel in a slot 20 provided in the vertical bar or rod 23. This bar is suitably guided by rollers 21 and carries at its lower end insulated therefrom, a sliding contact 24 which is arranged to slide over and electrically engage a contact strip 25 and a series of contacts 26.

27 is a sectional resistance normally in series with the armature of an electric motor 28. While 29 represents the shunt field windings, and 30 designates a manually operated circuit closing switch connected to the current supply mains.

Before describing the construction illustrated in the other figures, I will point out the operation of the apparatus above described.

Upon closing the main line switch 30 a circuit is closed through the resistance 27 and the armature 28 of the motor and also to the shunt field winding 29. The motor will now start, its current being limited by the starting resistance 27. The switch 30 also closes a circuit through the winding 13 of the magnet 10 and the same is energized to lift the core 14 and its connected rack 16. As the rack 16 moves upwardly the segmental gear 17 is turned about its pivot 18 causing the roller 19 to move in a right hand direction in the slot 20 and at the same time moving the arm 23 upwardly guided by the rollers 21. As the arm moves upwardly the sliding contact 24 moves over the contact 25 and 26 thereby cutting out of the motor armature circuit the starting resistance 27 in successive steps, permitting the motor to accelerate to full speed, the sliding contact 25 finally coming to rest on the top contact 26 at which time the magnet core 14 has reached its uppermost position and is substantially in contact with the pole piece 12. The upward movement of the core 14 is opposed by gravity acting upon the various parts connected therewith, through the mechanical connections above described. The load upon the core 14 when in the position shown on the drawing is a minimum because the weight of the bar 23 is carried by the roller 19 on the segmental gear 17, and since the roller 19 is in vertical alinement with the pivot 18 the latter supports the entire weight of the bar 23 and the greater portion of the weight of the segmental gear 17. As the core 14 and rack 16 move upwardly however, a portion of the weight of the gear 17 is gradually transferred from the pivot 18 to the rack 16 while at the same time a portion of the weight of the bar 23 is also gradually transferred from the pivot 18 to the rack 16 as the roller 19 carries the bar 23 upwardly.

Where a magnetic circuit includes an air gap the electrical energy necessary to force the required magnetic lines through such circuit is greatly in excess of the energy required to force the same number of lines through the same magnetic circuit in which there is little or no air gap. Now, since the electrical energy supplied to the magnet 10 depends upon the resistance of its winding and the pressure of the electrical supply mains, and these two elements are constant, it follows that the number of available magnetic lines produced in the magnetic circuit of the magnet 10 depends upon the air gap between the pole piece 12 and the core 14. As the core moves upwardly this air gap is lessened and the number of available magnetic lines increases and continues to increase until the core 14 finally reaches the pole piece 12 at which time the circuit contains a maximum amount of lines and the upward pull upon the core 14 is greatest. While the magnetic pull on the core is not inversely proportional to the length of air gap in every type of magnet, in the magnet illustrated in Figs. 1 and 2, the pull on the core is substantially in inverse proportion to the length of air gap for all positions within the limit of practical working.

From the foregoing it is seen that the farther the core 14 moves into the solenoid winding 11 the greater its upward pull becomes, while the load upon the magnet core is at first a minimum and gradually increases to a maximum as the core is drawn upwardly, and the various parts are so designed that the relation between the load and the magnetic pull upon the magnet core is substantially constant. By this arrangement of parts I am enabled to use a much smaller magnet than is generally used to perform the same duty, and the electrical energy consumed by said magnet is reduced to a minimum, making it unnecessary to employ any resistance element to cut down the current flow after the magnet has done it work.

In Fig. 2 the rack 16 connected to the magnet armature 14 meshes with a gear 17′ carried upon a shaft 22 free to turn in bearings 32. A relatively large gear 31 is also carried upon this same shaft and meshes with a smaller gear 33 which is rigidly connected to a shaft 38 turning in the bearings 35. A spirally grooved hoisting drum 34 frusto-conical in shape or of constantly increasing diameter, is firmly fixed upon this shaft 38 and is driven by the magnet core 14 through the train of multiplying gearing just pointed out. A cord or other flexible means 36 is fastened to the drum 34 at its smallest diameter and has connected to it a weight 37. Since the weight 37 is connected to the drum 34 at its smallest diameter when in the position shown, corresponding to the deënergized position of the magnet 10, the effort required to turn the drum and thereby lift the weight 37 is relatively small. As soon, however, as the magnet 10 is energized and the core 14 is drawn upwardly with constantly increasing power, the drum 34 is rotated through the train of multiplying gearing so as to wind up the cord 37 and as the cord is wound up the same travels lengthwise of the drum or from a minimum diameter to a maximum diameter. The effort or torque necessary to rotate the drum 34 and its connected load here represented by the weight 37 is proportional to the varying diameter of the drum for different positions of the cord thereon, neglecting friction losses, and the taper of this drum is so proportioned that the varying torque or turning effort required to lift the weight for different positions of the cord on the drum is proportional to the varying pull of the magnet 10 upon its core.

Fig. 3 illustrates the application of my invention to a magnetic brake apparatus, in which 10′ is the operating magnet, 13′ the magnet coil, and 14′ a movable armature. This armature is connected by a rod 15′ to a segmental gear 40 pivoted at 39 and meshing with a small gear 41 pivoted at 43. The gear 41 is connected to a lever arm 42 which in turn is connected to a rod 44, upon which is secured a weight 45. The rod 44 is connected at 46 to a brake lever 47 to which is fastened in a well-known way brake bands 48 and 49 adapted to manually engage a friction pulley 50. These brake bands are caused to grip the friction pulley 50 by the weight 45 bearing down upon the lever 47, and the same are released by means of the magnet 10′ acting through the armature 14′ and intermediate mechanical connections. Thus, as soon as the magnet 10′ is energized to move the armature to the left, the gear 40 rotates the gear 41 and lever 42 in a clockwise direction. The weight 45 is thereby lifted and the brake bands released from engagement with the brake pulley 50 and the latter is free to turn. The effort or power required to rotate the lever 42 varies as the same changes its position about its pivot 43, and this effort is at a minimum when in the position shown and constantly increases as the lever is moved in a direction to release the brake-bands. The pull upon the magnet armature 14′ is also at a minimum when in the position shown and this pull increases as the same approaches the magnet pole pieces. Thus it is seen that by properly proportioning the various parts, the load or power required to operate the brake apparatus may be substantially proportional to the pull of the armature 14′.

I have shown that this invention is applicable to several forms of apparatus, but it is by no means limited to those herein described. The weight designated by 37 in Fig. 2 represents a load of any kind and the cord 36 could just as well be connected to any desirable mechanism wherein mechanical work is to be accomplished. The same is true as to the construction shown in the other figures. The particular apparatus shown is for purposes of illustration merely, as my invention is capable of wide and various embodiments which will readily suggest themselves to those skilled in the art. Therefore it should be understood that I do not wish to be limited to the precise construction and arrangement of parts as shown since many and various changes could be made without departing from the spirit and scope of my invention.

What I claim is:—

1. The combination with a magnet and its armature, of a load device, and mechanical means to vary the effective power applied to said device to correspond with the relative positions of the magnet and armature, the extent of said variation being substantially proportional to the variations in the magnetic pull on the armature in such positions.

2. The combination with a magnet and its armature, of mechanism operated by said armature, and means for connecting the armature and said mechanism with a leverage varying with the position of the armature and substantially in proportion to the variation in the magnetic pull on the armature.

3. The combination with a magnet and its armature, of mechanism to be operated thereby, and connections between said mechanism and armature for increasing the relative speed of said mechanism as the armature approaches its magnet, said relative increase in speed being substantially in the same ratio as the increase in the magnetic pull on the armature.

4. The combination with a magnet and its armature attracted by the magnet with a force varying with the position of the armature, of a load device, and connections between the armature and load device for producing a substantially constant pull on said device.

5. The combination with a magnet and an armature movable toward the magnet under a constantly increasing pull, of a load device and connections between the armature and load device for so moving said device that its speed relative to that of the armature is substantially proportional to the pull on the armature.

6. The combination with a magnet and its armature, said magnet being constructed to exert a pull on the armature varying with its position, of a load device, and mechanical means for converting the varying magnetic pull to a substantially constant pull on the load device.

7. The combination with a magnet and an armature movable toward the magnet under a constantly varying magnetic pull, of mechanism operated by said armature, and connections between the armature and said mechanism having a leverage varying with the position of the armature and in proportion to the variation of the magnetic pull.

8. The combination with a magnet and its armature, of a load device and means between the armature and said device for so moving the latter that its speed relative to that of the armature is substantially proportional to the increased pull exerted by the magnet on its armature.

9. The combination with an electromagnetic coil and a core movable into the coil, under a constantly increasing magnetic pull, of a load device and connections between the core and load device for converting the variable pull on the core into a substantially constant pull on the load device.

10. The combination with an electromagnet and its armature, of a pivoted member connected to the armature for angular movement a second member having a sliding connection with the pivoted member, and means guiding the said second member and confining it to linear movement.

11. The combination with an electromagnet and its armature, of a pivoted member connected to the armature for movement through an angle proportional to the movement of the armature, a second member connected to the pivoted member for linear movement substantially proportional to the versed sine of the angle through which the pivoted member moves.

12. The combination with an electromagnet and its armature, of a rack bar carried by the armature, a pivoted member having gear teeth meshing with the rack bar, a load carrying device, means for guiding said

load carrying device and limiting it to a straight line movement, and a slot and pin connection between the said pivoted member and the load carrying device.

13. The combination with an electromagnetic coil, means for supplying the coil with electric current, and a core movable into the coil under a constantly increasing magnetic pull, of a rack connected to the core, a toothed quadrant meshing with the rack, a load carrying member parallel with the rack, a transverse slot in said member, a guide roller carried by the quadrant and engaging said slot, and means for guiding said member in its linear movement.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUST SUNDH.

Witnesses:

CHAS. M. NISSEN,

DAVID LARSON.