Oct. 15, 1929. H. H. THOMPSON 1,731,879

CONTROL SYSTEM

Filed Feb. 20, 1926 2 Sheets-Sheet 1

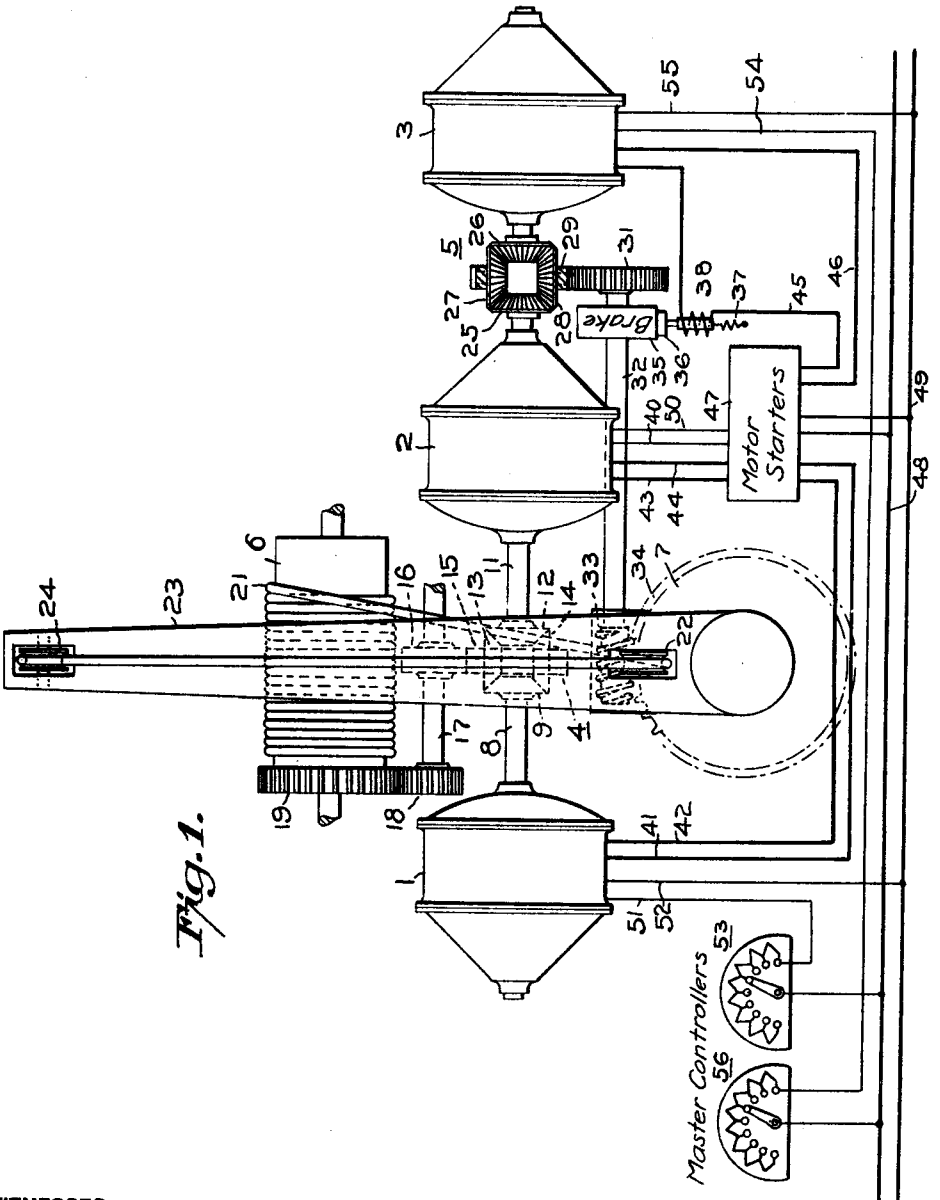

Fig. 1.

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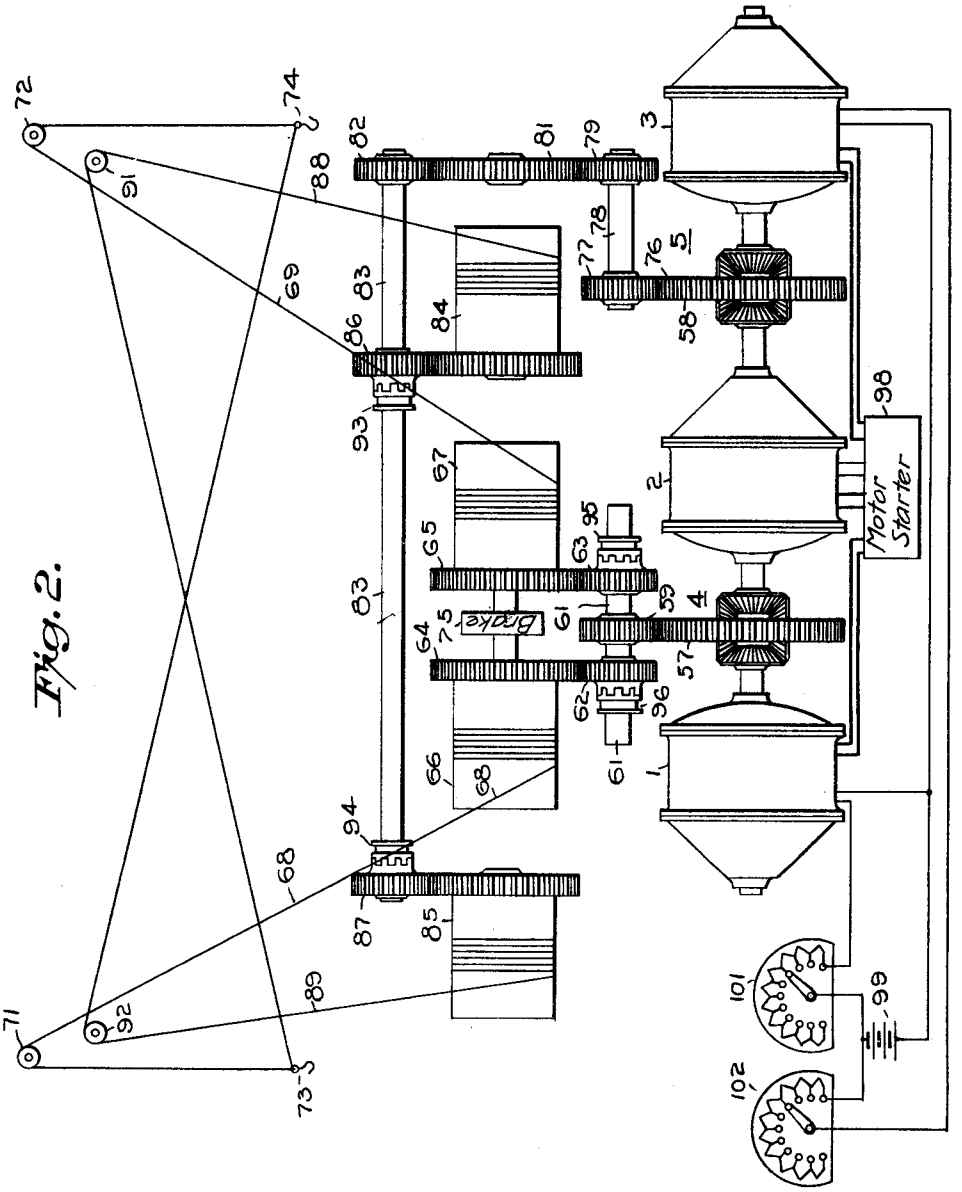

Fig. 2.

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UNITED STATES PATENT OFFICE

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CONTROL SYSTEM

Application filed February 20, 1926. Serial No. 89,658.

My invention relates to control systems and more particularly to a control system for a hoist or winch.

An object of my invention is to provide a control system for a hoist or winch that is reliable in its operation and flexible in its control.

My proposed scheme comprises three motors connected through two differential systems of gear-wheels one of these motors operating at substantially constant speed and the other two motors being provided with master controllers or rheostats to vary their speed. When the two end motors vary in speed from that of the middle or constant-speed motor, the corresponding differential mechanism will rotate in the one or in the other direction, depending upon whether the variable speed motor is operated above or below the speed of the constant-speed motor. The two differential devices control two corresponding hoist operations such as lifting and swinging the load.

When the handle of the master controller governing either of the variable speed motors is in its mid-position, the motor will rotate at the same speed as that of the middle or constant speed motor, thus causing the associated differential device to be at rest, and a variation of the handle of the motor controller in the one or the other direction will cause the motor to increase or decrease its speed, thereby operating the associated differential device and causing the corresponding movement of the hoist.

My invention will be better understood by reference to the accompanying drawing in which,

Fig. 1 is a diagrammatic view of a crane-type hoist embodying my invention, and

Fig. 2 is a diagrammatic view of a double hoist operating in accordance with my invention and having a plurality of winch drums to control the hoist and the swinging of the load.

Referring to Fig. 1 of the drawing, motors 1, 2 and 3 are connected in tandem relation through differential devices 4 and 5, respectively. The differential device 4 is responsive to the difference in speed of the motors 1 and 2, while the differential device 5 is responsive to the difference in speed of the motors 2 and 3. The variable speed motor 1 is connected by means of shaft 8 to the end gear-wheel 9 of the differential device 4, and the constant speed motor 2 is connected by means of shaft 11 to the opposite end gear-wheel 12 of the differential device 4. The gear-wheels 9 and 12 engage planetary gear-wheels 13 and 14, which are adapted to rotate about the axes of the shafts 8 and 11, in accordance with a familiar practice, and to carry with them a gear ring or casing member 15, which is provided with gear teeth that are adapted to engage a gear-wheel 16. A drum 6 is operated through the gear-wheel 16, shaft 17 and gear-wheels 18 and 19, to wind and unwind a cable 21. The cable 21 passes through a sheave 22 at the foot of a suitably located crane boom 23 and through a sheave 24 at the outer end of the boom, and may be attached to the load.

The differential device 5 is provided with end gear-wheels 25 and 26 that are respectively connected to the motors 2 and 3 and engage planetary gear-wheels 27 and 28. The planetary gear-wheels are adapted to rotate about the axis of the motors and to actuate a gear ring 29, which engages a gear-wheel 31 that is mounted on a shaft 32 and actuates a worm 33. The worm 33 engages a worm gear 34, which is mounted upon a table 7, to cause the table and the boom 23 to rotate. Upon the shaft 32 a brake drum 35 is provided to be engaged by a brake shoe 36 in accordance with the effective tension of a spring member 37. An electromagnet 38 is connected in series-circuit relation with the armature circuit of motor 3 for releasing the brake shoe 36 when the motor load reaches a predetermined value.

The motor 1 is provided with an armature circuit that is supplied with current through conductors 41 and 42. The armatures of motors 2 and 3 are similarly supplied with current though conductors 43 and 44, and 45 and 46, respectively. The several armature circuits are connected through a suitable motor starting device 47, which is connected to supply-circuit conductors 48 and 49. The motor

1 is provided with a field winding that is energized through conductors 51 and 52, which are connected through a master controller or rheostat 53 to the supply conductors 48 and 49. The motor 3 is provided with a field winding that is connected through a master controller 56 and conductors 54 and 55 to the supply conductors 48 and 49. The motor 2 is provided with a field winding that is connected through the starting device 47 and conductors 40 and 50 to the supply conductors 48 and 49.

When the master controllers 53 and 56 are in such positions that the control motors 1 and 3 are rotating at the same speed as the constant-speed motor 3, the planetary gear-wheels of differential devices 4 and 5 will not revolve. When it is desired to raise or lower the load attached to the cable 21, the master controller 53 is operated, thereby causing the motor 1 to change its speed in the proper direction, so that the differential device 4 will be operated, causing the drum 6 to rotate, thus winding up or paying out more of the cable 21. When it is desired to swing the load, the master controller 56 will be operated, thereby varying the speed of the motor 3 and causing the differential device 5 to rotate, thus rotating the table 7 and swinging the boom 23 in the one or the other direction. When the starting current of the motor 3 reaches a predetermined value, the magnetic action of coil 38 will release the brake shoe 36, thus permitting the shaft 32 to revolve.

Referring to Fig. 2 of the drawing, my invention is illustrated as applied to a double hoist control system. The motors, 1, 2 and 3 are connected to the differential devices 4 and 5 as in Fig. 1, these devices respectively having revolving gear rings 57 and 58. The gear ring 57 engages a gear-wheel 59 that is mounted on a shaft 61, upon which are also mounted gear-wheels 62 and 63, which engage gear-wheels 64 and 65, respectively, for operating a pair of drums 66 and 67, respectively. A brake 75 may be provided, the brake being released upon a predetermined load on the motor 1. The drums 66 and 67 are mechanically independent and respectively control cables 68 and 69 which travel over the pulleys 71 and 72 and are attached to the hooks 73 and 74.

The ring 58 of the differential device 5 is provided with gears 76 that engage a gear-wheel 77 that is mounted upon a shaft 78, which actuates gear-wheels 79, 81 and 82 and a shaft 83. The shaft 83 governs the rotation of a pair of drums 84 and 85 by means of suitable gear mechanisms 86 and 87. The drums 84 and 85 respectively control cables 88 and 89 that travel over pulleys 91 and 92. These cables are connected to the hooks or other load-attaching means 73 and 74. Upon the shaft 83 suitable clutches 93 and 94 are provided for attaching the gear mechanisms 86 and 87, respectively, to the shaft, or for disconnecting them, as desired. Additional clutch members 95 and 96 are provided upon the shaft 61 for respectively connecting the gear-wheels 63 and 62 to this shaft.

The motors 1, 2 and 3 are connected to any suitable source of power supply through the motor starter 98. A source of energy supply 99 is provided for energizing the field windings of the variable-speed motors 1 and 3 through the master controllers 101 and 102, respectively.

The operation of the differential devices 4 and 5 controls the drums 66 and 67, and 84 and 85, respectively. Normally the load-attaching means 73 and 74 are hoisted by joint operation of the drums 66 and 67, while the load-attaching means are swung around in accordance with the operation of the differential mechanism 5.

Clutches 94 and 95 may be disengaged to render inoperative the drums 85 and 67 and the load-lifting means 74. Similarly, the clutches 93 and 96 may be disengaged to render inoperative the drums 84 and 66, which are associated with the load-lifting means 73. When both load-lifting means 73 and 74 are used, one may be lowered to receive a load while the other is lowering to receive a load, thus reducing the time necessary to load or unload. The speeds of the motors 1 and 3 and consequently the speeds and direction of rotation of the differential devices 4 and 5 are respectively controlled by means of the rheostats 101 and 102.

Many modifications may be made in the apparatus and arrangement of parts from that disclosed, and I do not wish to be limited other than by the scope of the appended claims.

I claim as my invention:

1. In a control mechanism, a pair of motive devices, means differentially responsive to the speeds of said devices for effecting one movement of said control mechanism, a third motive device, and means differentially responsive to the speed of said third motive device and one of said first-named motive devices for effecting a different movement of said control mechanism.

2. In a control system for a hoist comprising a cable drum and a swinging boom, in combination, a substantially constant-speed motor and a pair of variable-speed motors for operating the hoist, a differential device interposed between the constant-speed motor and each of the variable-speed motors, said differential devices being disposed to effect movements of the cable drum and swinging boom, respectively, and a speed controller for the variable-speed motors for governing the operation of the differential devices, thereby to provide for effecting separate

movements of the cable drum and the swinging boom simultaneously.

3. In a hoisting mechanism provided with load-lifting and load-swinging members, a substantially constant-speed motor and a pair of variable-speed motors for actuating the load-lifting and load-swinging members, means for controlling the relative speeds of the motors, and a differential device interposed between each of the variable-speed motors and the constant-speed-motor, said differential devices being individually connected to the load-lifting and load-swinging members for effecting lifting and swinging movements of the load in accordance with the relative speeds of the motors.

4. In a hoisting mechanism, a substantially constant-speed motor and a pair of variable-speed motors, a differential device between each of said variable-speed motors and said constant-speed motor, a hoist drum actuated in accordance with the operation of one of said differential devices, and means for effecting a swing motion of the load being hoisted in accordance with the operation of the second differential device.

5. In a hoisting mechanism, a substantially constant-speed motor, a pair of variable-speed motors, a differential device between each of said variable-speed motors and said constant-speed motor, means for governing the speeds of said variable-speed motors to control the operation of said differential devices in the one and in the other direction, means operative in accordance with the operation of one differential device to hoist a load, and means operative in accordance with the operation of the other differential device to swing the load.

In testimony whereof, I have hereunto subscribed my name this 5th day of February 1926.

HENRY H. THOMPSON.