No. 647,239. Patented Apr. 10, 1900.

F. J. SPRAGUE.

ELEVATOR.

(Application filed July 27, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

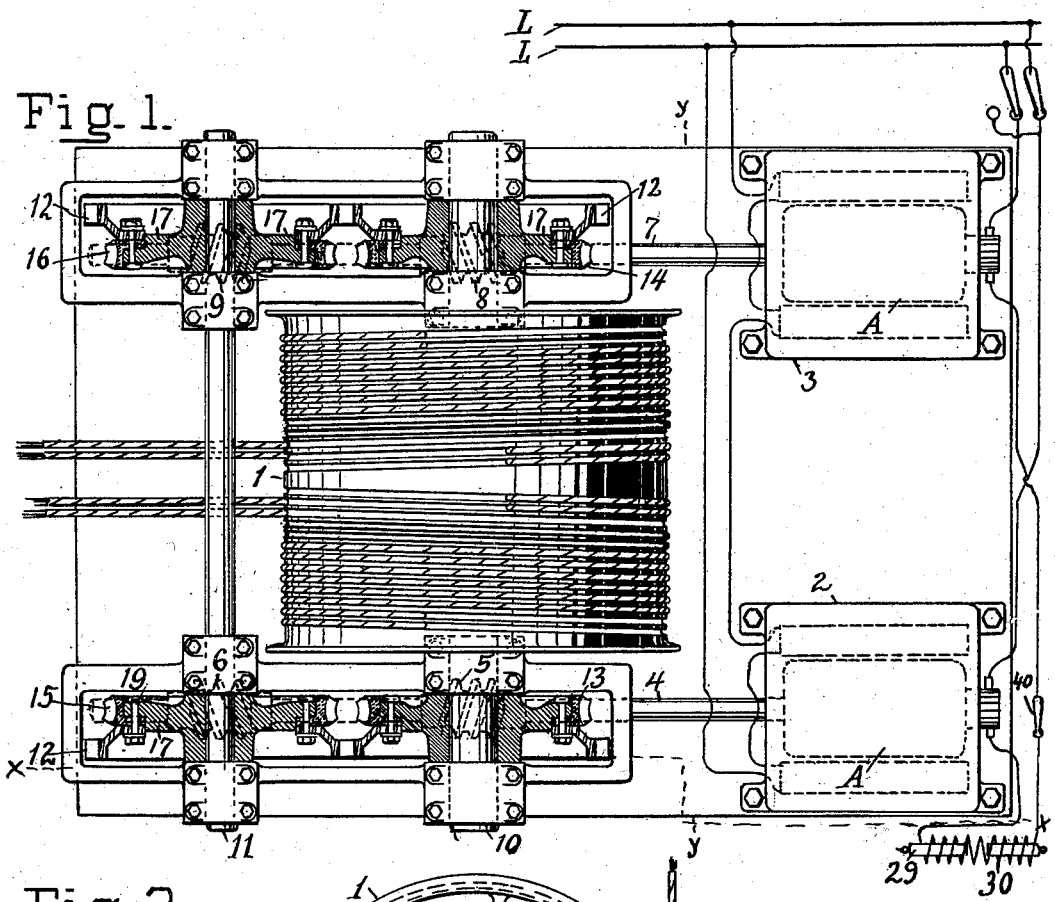

Fig. 2.

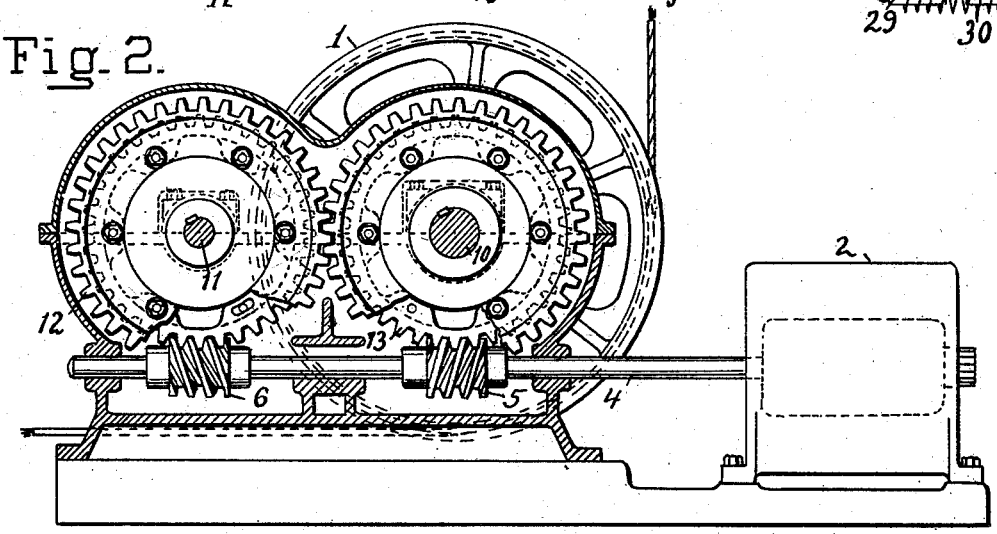

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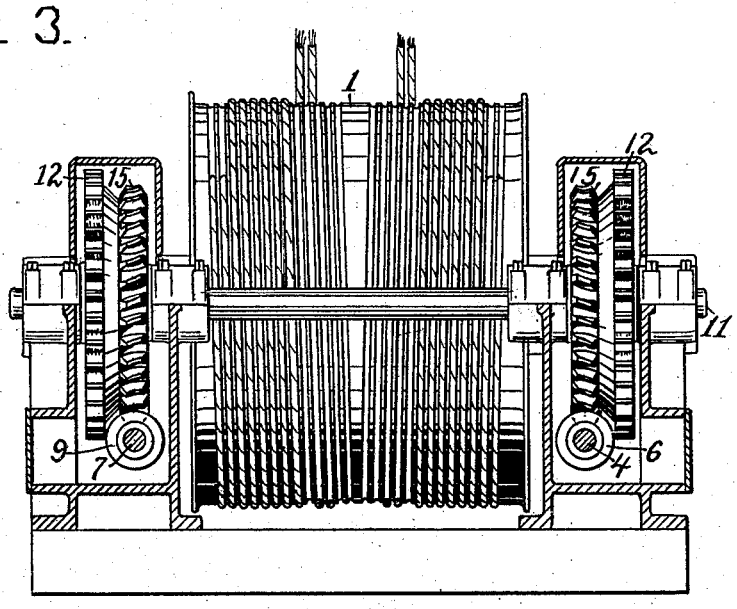
Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANK J. SPRAGUE, OF NEW YORK, N. Y., ASSIGNOR TO THE SPRAGUE ELECTRIC COMPANY, OF NEW JERSEY.

ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 647,239, dated April 10, 1900.

Application filed July 27, 1898. Serial No. 687,009. (No model.)

To all whom it may concern:

Be it known that I, FRANK J. SPRAGUE, a citizen of the United States of America, and a resident of the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Elevators, of which the following is a specification, for which I filed a provisional application in Great Britain on December 31, 1897, No. 30,923, and have received a patent in France on an application filed March 3, 1898, and issued June 13, 1898, No. 275,549.

These improvements relate to the hoisting-machines used in elevators driven by electric motors, and particularly to the machines employed in transmitting the power from the motors to the winding-drum of the hoisting-machine. There are two driving mechanisms separately driven by electric motors, each being positively connected to the drum. Each driving mechanism has a worm-shaft and two worm-wheel shafts, the drum being mounted on one of the worm-wheel shafts. Each worm-wheel shaft has a flange attached thereto, and a spur-gear ring and a worm-wheel ring are bolted to each flange. The spur-gear rings intermesh with each other, and the worm-wheel rings engage with the worms. The bolt-holes in one or more of the rings in each driving mechanism are elongated to permit of circumferential adjustment of the ring, and thus allow the worm-wheels to be brought into proper circumferential adjustment, so as to mesh properly with the worms, since proper meshing cannot be effected by endwise adjustment of the worm-shaft, owing to the worms being of the Hindley type. The same worm-wheel shafts are used for both driving mechanisms, and the two mechanisms are thereby interconnected, so that each will serve as a safety to the other. This mechanism affords a positive connection between the two motors which are employed, so that they are compelled to run synchronously, and their armatures can be placed in series connection with the leads without danger of one of the motors speeding up first and consuming the greater part of the energy of the current. This positive connection of motors with their armatures in series is believed to be broadly new in electrically-driven mechanism irrespective of whether the mechanism is employed in hoisting or for other uses.

In the accompanying two sheets of drawings, which form a part of this specification, Figure 1 is a plan view showing the hoisting-machine, in which the covers for the gearing are removed and the gearing is shown in section. Fig. 2 is a side elevation showing the hoisting mechanism, in which the base supporting the gearing is shown in section on the line $x\,x$ of Fig. 1. Fig. 3 is an elevation of the end of the machine, in which the base supporting the gearing is shown in section on the line $y\,y$ of Fig. 1.

In its general features the hoisting mechanism consists of a winding-drum 1, suitably mounted and driven by two electric motors 2 3 through the agency of positive gearing consisting of worm-gearing and spur-gearing. There are two driving mechanisms, one located at each side of the hoisting-machine, with the winding-drum between them. The mechanism to be seen at the right when the machine is viewed as shown in Fig. 3 will be termed the "right-hand" driving mechanism, and the mechanism to be seen at the left will be termed the "left-hand" driving mechanism. The armature-shafts of the motors are directly coupled to the worm-shafts of the hoisting mechanism. In the right-hand driving mechanism is a worm-shaft 4, which carries a left-hand worm 5 and a right-hand worm 6. In the left-hand driving mechanism is a worm-shaft 7, which carries a right-hand worm 8 and a left-hand worm 9. The left-hand worm of the right-hand driving mechanism is opposite the right-hand worm of the left-hand driving mechanism, and the other worms are likewise opposite to each other and of opposite hand. The worms engage with worm-wheels, which are mounted on two parallel worm-wheel shafts, one of which is the drum-shaft 10 and the other of which is the gear-shaft 11. The shafts are common to both driving mechanisms and are geared together by two pairs of spur-gears 12, so that they will run synchronously.

The power from each motor divides equally between the two worms on the worm-shaft coupled to its armature-shaft, and half the power reaches the drum through the worm-

wheel on the drum-shaft, and the other half of the power is transmitted to the worm-wheel on the gear-shaft and from thence through the train of two spur-gears to the drum-shaft.

The right-hand and the left-hand driving mechanism are positively connected by both the drum-shaft and gear-shaft, and in each driving mechanism these are positively geared together. In consequence of this duplication of the pairs of spur-gears the power from each motor will pass to the drum through the gearing of both driving mechanisms, and the omission or failure of either pair of intermeshing spur-gears would still leave both worm-wheels of both driving mechanisms positively geared to the drum. The motors being positively geared to the drum are in consequence positively geared to each other and will invariably run at identical speeds.

The worm-wheels are cut right or left hand, according as they are to engage with the right or left hand worms. On the drum-shaft the worm-wheel 13 is left hand to engage with the left-hand worm 5, and the worm-wheel 14 is right hand to engage with the right-hand worm 8. On the gear-shaft the worm-wheels are also of opposite hand, the worm-wheel 15 being right hand and the worm-wheel 16 being left hand. The teeth of these wheels which are on the same shaft consequently incline in opposite directions, as shown in Fig. 3. Since the two worms on each worm-shaft are of opposite hand, their end thrusts will be in opposite directions, and since they are geared to give the same ratio of speed between the worm-shaft and the drum the end thrusts of the worms are completely balanced and no thrust-bearings are necessary on the worm-shafts. Likewise the end thrusts in the direction of the length of the worm-wheel shafts arising from the obliquity of the teeth of the worm-wheels are also balanced, because the teeth of the two wheels on each shaft are inclined in opposite directions. Since the corresponding worms and worm-wheels of the two driving mechanisms are of opposite hand, the motors must drive the worm-shafts in contrary directions.

With the worm-wheels duplicated as described it is necessary to so mount some or all the gears that they can be adjusted with respect to their shafts such slight amount as may be necessary to bring the teeth of the several gears into proper mesh. In order to do this, the worm-wheels and spur-gears are not directly keyed fast to their shafts, but are made in the form of rings and bolted to flanges 17, which are keyed to the shafts. Each flange serves as a support for both a worm-wheel and the adjoining spur-gear. The bolts 19 pass through holes in the flanges, spur-gears, and worm-wheels. The bolt-holes through some or all of the worm-wheel rings and spur-gear rings are elongated, so that the rings may be slipped around such slight amount as may be necessary for the proper intermeshing of the spur-gears, worm-wheels, and worms. After the rings have been adjusted the bolts are screwed up tight.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a hoisting mechanism, the combination with a hoisting-drum, of two gear-trains connected therewith, positive connections between the driving-gears of the gear-trains, and independent driving mechanism for driving each of the driving-gears, substantially as described.

2. In a hoisting mechanism, the combination of two worm-wheel shafts, two worm-wheels mounted on each worm-wheel shaft, two worm-shafts, two worms on each worm-shaft in engagement with the worm-wheels, the two worms on each worm-shaft being of opposite hand, and the two worm-wheels on each worm-wheel shaft being of opposite hand, and means for driving each worm-shaft, substantially as described.

3. In a hoisting mechanism, the combination of a winding-drum, a worm-shaft with two worms carried thereby, two worm-wheel shafts, a flange attached to each shaft, a spur-gear ring and a worm-wheel ring bolted to each flange, the bolt-holes in one of said rings on one of the flanges being elongated to admit of circumferential adjustment, the spur-gears intermeshing and the worm-wheels engaging with the worms on the worm-shaft, substantially as described.

Signed by me in New York city, New York, this 25th day of July, 1898.

FRANK J. SPRAGUE.

Witnesses:
THOMAS EWING, Jr.,
SAMUEL W. BALCH.