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ESCALATOR CONTROLLING SYSTEM.

APPLICATION FILED MAR. 10, 1913.

1,167,602.

Patented Jan. 11, 1916.

2 SHEETS—SHEET 1.

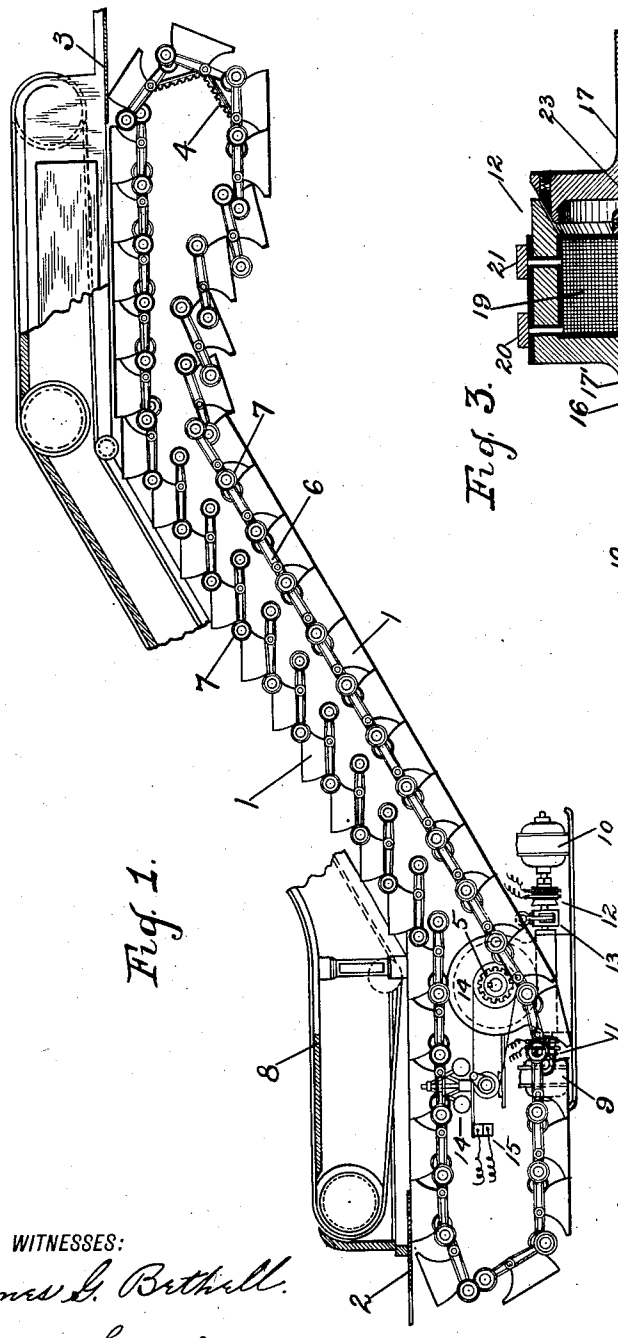


Fig. 1.

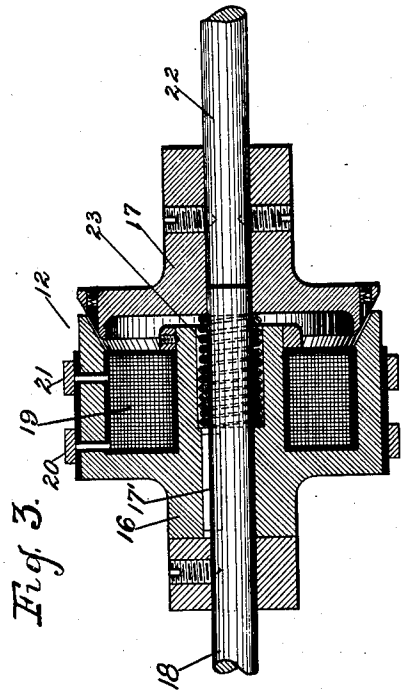


Fig. 3.

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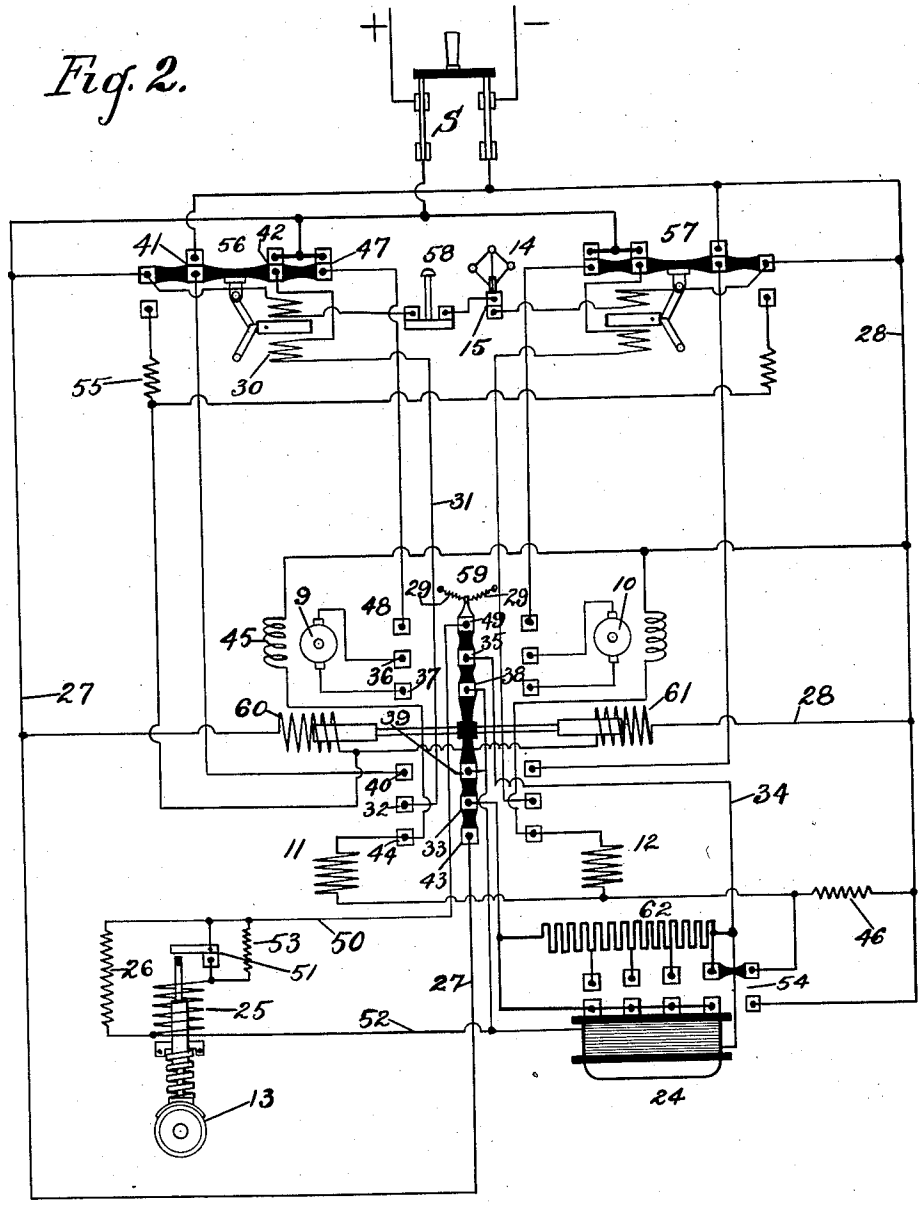
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2 SHEETS—SHEET 2.

Fig. 2.



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ESCALATOR-CONTROLLING SYSTEM.

1,167,602. Specification of Letters Patent. Patented Jan. 11, 1916.

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To all whom it may concern:

Be it known that I, WALTER C. STRANG, 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 Escalator-Controlling Systems, of which the following is a specification.

My invention relates to a controlling system for escalators or moving stairways, and has for an object the provision of automatic means for cutting out a disabled driving motor and connecting in another motor so that in the event of anything happening to the driving motor the other motor will immediately take up the load without any interruption of service or loss of time.

In the class of apparatus to which my invention is particularly adapted, to wit, an escalator or moving stairway, it is very essential that there be no interruption of service due to a disabled driving motor. In fact it is customary to provide an additional motor for the escalator so that in case the driving motor becomes disabled the latter may be both mechanically and electrically disconnected from the machine and the additional or reserve motor connected or clutched to the driving mechanism and started up. This arrangement requires a skilled attendant to make the proper change-over, and the escalator will be out of service while this change-over is being made and much valuable time is lost.

My invention provides means for automatically making this change-over whenever the conditions warrant it and moreover makes it substantially instantaneously so that the escalator continues in operation without any cessation whatever.

The invention may best be understood by reference to the drawing accompanying this specification in which—

Figure 1 represents an escalator or moving stairway containing an embodiment of my invention; Fig. 2 is a diagram of the electrical system of circuits: Fig. 3 is a detail view of a magnetic clutch.

Similar reference characters denote similar parts in all the figures.

Referring to Fig. 1, the escalator there shown is merely typical in character and comprises a series of connected steps 1 having arms 6 carrying rollers such as 7 which are adapted to roll on appropriate tracks (not shown) so as to guide and support the various steps during transit between the lower and upper levels 2 and 3, respectively. Links such as 4 connect adjacent steps and these links are in the form of racks having an equal number of teeth and are engaged by a pinion 5 which is driven by a suitable electric motor such as 9 or 10 through the intermediate worm gearing contained in the gear casing 14. A hand rail 8 moves in synchronism with the stairs and may be driven by the same motor mechanism if desired. The power driving shaft carrying the worm extends through both ends of the gear casing 14 and is connected through the clutches 11 and 12 to either of the motors 9 or 10, a brake 13 being arranged to operate on a brake pulley secured to the worm shaft when it is desired to stop the motion of the stairway, the brake being normally released at other times. A governor 14 is arranged to be driven from some moving part of the apparatus such as the worm wheel shaft and controls a pair of normally closed contacts 15 which are arranged to be opened by the governor to stop the machine in case the speed of the escalator becomes excessive from any cause.

The clutch used to couple and uncouple the motors with the worm shaft may be of any desired character such as a mechanical or electrical clutch and the same is preferably electrically controlled. I prefer, however, to use a magnetic clutch similar to that shown in detail in Fig. 3, the same comprising a member 16 driven by the motor shaft 18 through a key or feather 17' and movable toward a co-acting clutch member 17 secured to the shaft 22 but normally moved out of driving engagement therewith by means of a clutch releasing spring 23. The clutch member 16 contains an annular recess in which reposes a magnet winding 19, the terminals of which are led out to a pair of slip rings such as 20 and 21 insulated from

the metal parts of the clutch. Suitable brushes are adapted to bear upon these slip rings and to convey current to the winding 19 when it is desired to energize the clutch.

Referring now to Fig. 2, I will point out the system of electrical circuits and explain the operation thereof in case one of the driving motors becomes disabled for any cause. The system comprises a pair of no-voltage overload circuit breakers 56 and 57 arranged to be closed by hand in the usual way and adapted to protect the motors 9 and 10, respectively. A change-over switch 59 is controlled by magnets 60 and 61 and is adapted to establish a circuit to either of the motors 9 and 10, depending on the direction in which it is moved. The brake 13 is adapted to be spring-applied to the worm shaft so as to stop the motion of the escalator regardless of which motor may be connected at the moment of application. This brake is applied in the usual way by means of a spring and is released by means of an electro-magnet 25 having a high resistance winding connected in shunt thereto so that when the magnet circuit of the brake is interrupted, the brake takes an appreciable length of time before it becomes effective to stop the rotation of the worm shaft. A resistance 53 is introduced into the circuit of the brake magnet by the contacts 51 after the same has done its work and it is for the purpose of keeping the brake magnet cool and for economy in current consumption. An accelerating magnet 24 is for the purpose of bringing the motor automatically and gradually to full speed.

The operation of the system is as follows: Assuming the circuit breakers 56 and 57 are both in closed position as shown, a circuit may be traced through both magnets 60 and 61 of the change-over switch 59. This circuit may be traced from the + main by conductor 27, through the windings 60 and 61 in series, and by the wire 28 to the — main. Since the cores of these magnets occupy the same relative positions with respect to their respective magnet windings and also due to the presence of the centering springs 29, 29, the switch 59 remains stationary in central position as shown. This switch is now given a movement by hand toward the right or left depending on which motor is required to operate. We will assume that the motor 9 is the required one and the switch is moved to the left, so that the contacts carried upon the insulated movable part of the switch are carried into electrical engagement with the coacting stationary contacts in alinement therewith. As the switch is thus moved to the left. the core of the magnet 60 is strongly magnetized, while the core of magnet 61 is moved substantially out of the magnetic field of the magnet 61, hence the switch will be firmly held in operated position against the action of the centering spring 29. The circuit to the motor 9 is now completed and may be traced as follows: from the + main by wire 27, contacts 42 of the switch 56, overload coil 30, wire 31, contacts 32 and 33, starting resistance 62, wire 34, contacts 35 and 36, through the motor armature, contacts 37 and 38, contacts 39 and 40, contacts 41 of the circuit breaker, and to the — main. The field 45 of the motor receives current from the wire 27, contacts 43 and 44, through the field 45, and to the — main by the conductor 28. The magnetic clutch 11 is energized by a circuit from the change over switch contacts 43 and 44, through a resistance 46 to the — main by wire 28. The brake releasing magnet 25 receives current from the circuit breaker contacts 47, change over switch contacts 48 and 49, wire 50, magnet winding 25, wire 52, contacts 39 and 40, and by contact 41 of the circuit breaker to the — main. The accelerating magnet 24 is connected across the motor armature by the contacts 38 and 37 and contacts 35, 36, and wire 34. The brake will be released and the motor will start up with the resistance 62 in circuit and the clutch only partially energized by reason of the resistance 46 in circuit therewith. As the motor accelerates, the accelerating magnet operates in a well known way to remove or short circuit the starting resistance 62 in proportion to the load and speed of the motor and thereby bring the motor up to full speed. As the last contact of the accelerating magnet closes, the resistance 46 is cut out of the clutch circuit by means of the auxiliary contacts 54 and the escalator moves at normal full speed.

In order to illustrate the automatic operation of the device in case of a defective motor, we will assume that the shunt field of the motor 9 is broken or the armature becomes short circuited. The abnormal rush of current through the circuit breaker winding 30 immediately causes the circuit breaker to open and cut off the circuit to the disabled motor and at the same time place the resistance 55 in parallel to the magnet 60 of the change-over switch 59. The current in this winding is thereby reduced to such an extent that the centering spring 29 assisted by the energization of the winding 61 which is now considerably more powerful than formerly owing to the greater current flow therethrough immediately moves the change over switch to its extreme right hand position and connects the motor 10 in circuit. The accelerating magnet becomes deënergized during this change-over and it inserts the starting resistance in the circuit of the motor 10 and energizes the clutch 12 through the resistance 46, the clutch 11 being now cut out of

circuit and the defective motor mechanically disconnected from the escalator. The reserve motor 10 very quickly comes automatically up to speed, the clutch 12 assumes its full power and the conditions once more become normal with the motor 10 bearing the load.

It will be observed that while the change-over switch 59 is quickly moving from one side to the other, the circuit to the brake magnet 25 from the main line is momentarily interrupted, but, owing to the sluggish action of the brake in applying the brake shoe to the brake pulley due to the retarding effect produced by the parallel resistance 26, the brake does not have sufficient time to go on before its circuit is again completed by the change over switch. The accelerating magnet 24 will effect the opening of its contacts during the change over period so that the reserve motor will always start up with the starting resistance 62 in circuit and also with the resistance 46 in the clutch magnet circuit. The function of the resistance 46 is to couple the reserve motor up to the load through a yielding clutch so that the lattter will take care of any slight difference in speed which may exist between that of the reserve motor and that of the escalator during the period that the reserve motor is accelerating up to normal speed. The resistance 46 is always cut out of circuit by the time the reserve motor substantially attains full speed and the clutch at such time is powerful enough to carry the full load without slipping.

Should the escalator attain too great a speed, the governor switch 14 will open the no-voltage or retaining magnets of both of the circuit breakers 56 and 57 and the escalator will be brought to rest by the brake. The operation of the safety or emergency button 58 will effect the same result. It makes no difference which motor 9 or 10 be connected for operation to the escalator, the same will be disconnected and the reserve motor will always be automatically connected to the load in case the driving motor becomes disabled and effects the opening of its circuit breaker.

While I have described my invention as applied to an escalator, and while the invention is particularly adapted for the chosen purpose it is obvious the same may be used to advantage with other electrically driven apparatus in which it is desired to maintain a motor or power unit in reserve and in which it is desired to automatically disconnect one motor and connect in another motor without any appreciable loss of time or interruption of service.

What I claim is:—

1. In an escalator, the combination of a driving shaft, a plurality of motors, and automatic means independent of the speed of a motor for operatively connecting either motor to the said shaft.

2. In an escalator, the combination of a driving shaft, a plurality of motors, and an electro-responsive device adapted automatically to connect either motor to said shaft.

3. In an escalator, the combination of a driving shaft, a plurality of motors, and an automatically operated change-over switch adapted operatively to connect either motor with the said shaft.

4. In an escalator, the combination of a driving shaft, two motors, circuits for said motors, and automatic means for simultaneously connecting either one of the motors to the said circuits and driving shaft.

5. In an escalator, the combination of a driving shaft, two motors, circuits for said motors, and automatically operated means for connecting one motor and disconnecting the other motor with said circuits and driving shaft.

6. In an escalator, the combination of a driving shaft, two motors, circuits for said motors, and automatic means for connecting one motor and disconnecting the other motor with said circuits and driving shaft during the continuous operation of the escalator.

7. The combination with an escalator, of a shaft arranged to drive the same, a plurality of electric motors adapted to be connected to, and disconnected from, the said shaft, clutches for establishing said connections and automatic electromagnetic means for controlling said clutches.

8. The combination with an escalator, of a shaft arranged to drive the same, a plurality of electric motors adapted to be connected to, and disconnected from, the said shaft, clutches for establishing said connections, and automatic means for effecting the operation of one clutch and the release of the other clutch.

9. The combination with an escalator, of a shaft arranged to drive the same, a plurality of electric motors adapted to be connected to, and disconnected from, the said shaft, clutches for establishing said connections, and automatic means for clutching one motor to the said shaft and for declutching the other motor and for simultaneously controlling a circuit to both of said motors.

10. The combination with an escalator, of a shaft arranged to drive the same, a pair of electric motors, clutch mechanism arranged to form a driving connection between either of said motors and shaft, and automatic electromagnetic means for effecting the operation of the said clutch mechanism.

11. The combination with an escalator, of a shaft arranged to drive the same, a pair of electric motors, clutch mechanism

arranged to form a driving connection between either of said motors and shaft, and means controlled by a motor for effecting the operation of said clutch mechanism.

12. The combination with an escalator, of a shaft arranged to drive the same, a pair of electric motors, clutch mechanism arranged to form a driving connection between either of said motors and shaft, and means controlled by excess current for effecting the operation of said clutch mechanism to disconnect one motor from said driving shaft and connect another motor with said shaft.

13. The combination with an escalator, of a shaft arranged to drive the same, a pair of electric motors, clutch mechanism arranged to form a driving connection between either of said motors and shaft, means controlled by excess current for effecting the operation of said clutch mechanism to disconnect one motor from said driving shaft and connect another motor with said shaft, and for substantially simultaneously controlling a circuit to said motors.

14. The combination with an escalator, of a driving shaft, a pair of clutches operatively connected with said shaft, a plurality of electric motors connected through said clutches to said shaft, and automatic means for effecting a disconnection of one clutch and at substantially the same time effecting a gradual connection or operation of the other clutch.

15. The combination with an escalator, of a driving shaft, a pair of clutches operatively connected with said shaft, a plurality of electric motors connected through said clutches to said shaft, and automatic means for controlling said clutches so as to form a driving connection between one motor and said shaft and to disconnect another motor from said shaft without interrupting the movement of the shaft.

16. The combination with an escalator, of a pair of electric motors, magnetic clutches adapted to form a driving connection between the escalator and either of said motors, a circuit for the motors, and automatic means for simultaneously controlling said clutches and circuit.

17. The combination with an escalator, of a pair of electric motors, magnetic clutches adapted to form a driving connection between the escalator and either of said motors, circuits for the motors, and automatic means for simultaneously energizing one of the said motors and its connected clutch.

18. The combination with an escalator of a pair of electric motors, magnetic clutches adapted to form a driving connection between the escalator and either of said motors, circuits for the motors, automatic means for simultaneously energizing one of the said motors, and its connected clutch, and means controlled by said motor for automatically accelerating the motor and increasing the power of its connected clutch.

19. The combination with an escalator, of two electric motors, magnetic clutches arranged to effect a driving connection between either of the said motors and the escalator, a change-over switch for said motors and clutches, circuits controlled by said switch to effect the energization of either one of said motors and of a clutch so as to cause one of said motors to operate the escalator, and simultaneously to open a circuit to the other of said motors and the clutch connecting the same to the escalator.

20. The combination with an escalator, of two electric motors, one of which is normally connected to drive the escalator, a circuit controlling device adapted to be moved in one position to complete a circuit to the normally connected motor, and when moved in another position to disconnect said last named motor and to connect the other motor in circuit, and automatic means for simultaneously effecting a driving connection between the escalator and the motor which is connected in circuit.

21. The combination with an escalator, of two electric motors, one of which is normally connected to drive the escalator, a circuit controlling device adapted to be moved in one position to complete a circuit to the normally connected motor, and when moved in another position to disconnect said last named motor and to connect the other motor in circuit, and automatic means controlled by excessive current for simultaneously effecting a driving connection between the escalator and the motor which is connected in circuit.

22. The combination with an escalator, of two electric motors, one of which is normally connected to drive the escalator, a circuit controlling device adapted to be moved in one position to complete a circuit to the normally connected motor, and when moved in another position to disconnect said last named motor and to connect the other motor in circuit, and automatic means controlled by one of said motors for simultaneously effecting a driving connection between the escalator and the motor which is connected in circuit.

23. The combination with an escalator, of two electric motors, circuit breakers for each motor, clutch mechanism associated with each other and adapted to effect a driving connection between the escalator and either of the said motors, and means controlled by a circuit breaker for operating the clutches to disconnect one motor from the escalator and connect in the other of said motors, substantially as described.

24. The combination with an escalator, of two electric motors, driving connections between each motor and escalator comprising electrically operated clutches, a change over switch adapted when in one position to close a circuit to one motor and the clutch connecting said motor to the escalator, and when in another position to close a circuit to the other motor and the clutch connecting it to the escalator, and automatic means for effecting the operation of the change over switch, substantially as described.

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

WALTER C. STRANG.

Witnesses:
ERNEST L. DALE, Jr.,
J. G. BETHELL.