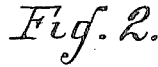


1,208,607.

3 SHEETS--SHEET 2.



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 MULTIPLE CAR ELEVATOR SYSTEM.
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 3 SHEETS—SHEET 3.

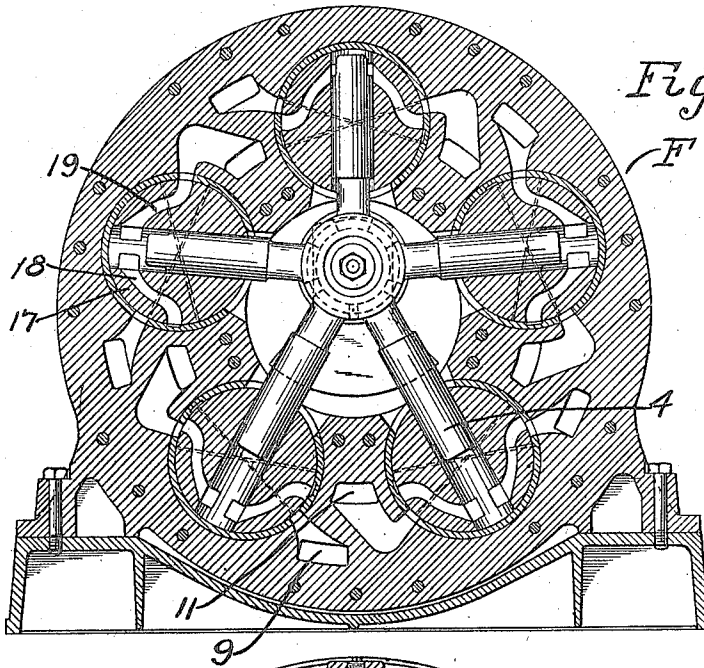


Fig. 3.

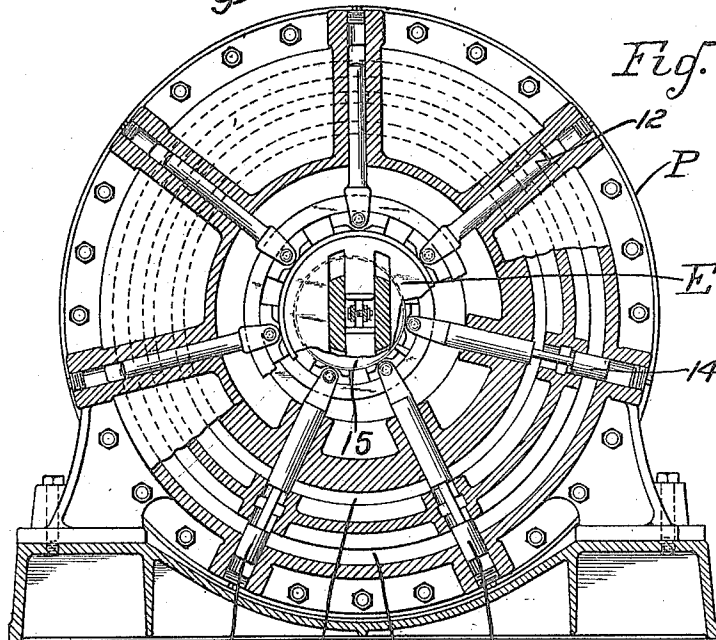


Fig. 4.

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MULTIPLE-CAR ELEVATOR SYSTEM.

1,208,607.

Specification of Letters Patent.

Patented Dec. 12, 1916.

Application filed May 20, 1914. Serial No. 839,755.

To all whom it may concern:

Be it known that we, WALDEMAR F. MAYER, and AUGUST SUNDH, citizens of Switzerland and the United States, respectively, residing at Hoboken, Hudson county, State of New Jersey, and Hastings-upon-Hudson, county of Westchester, and State of New York, respectively, have invented a new and useful Improvement in Multiple-Car Elevator Systems, of which the following is a specification.

Our invention relates to a multiple car elevator system, and more particularly to improved power mechanism for operating the same.

One of the objects of the invention is the provision of means whereby a plurality of cars can be operated independently in either direction of travel and at variable rates of speed, from a single prime mover, adapted to run continuously, said means comprising variable speed hydraulic power transmission mechanism of an improved type, and having a torque and speed characteristic which vary in inverse ratio, which feature makes the same particularly applicable to elevator service.

Another object of the invention is the provision of an electro-hydraulic multiple car elevator system, embodying the perfect control of what is known as the differential system, with the flexibility and economy of operation of the elevators of what is known as the friction drive or traction type.

Essentially the invention consists of a plurality of independently operable elevator cars, each car being connected through a variable speed fluid motor to a single prime mover preferably an electric motor, the latter running continuously in one direction at substantially constant speed, and being adapted to drive pumping mechanism associated with each one of the fluid motors. The pumps are of the variable stroke type, and are adapted to deliver fluid under pressure to their associated fluid motor. The speed of the latter and consequently that of the elevator car is controlled from the latter and is effected by varying the fluid output of the pump to the fluid motor, and the operation of the cars in reverse direction is effected by reversing the direction of flow of fluid between the pump and fluid motor.

Other novel features of the invention will be pointed out hereinafter, the novel combinations of elements and arrangements of parts being set forth in the appended claims.

Referring now to the drawings, Figure 1 shows an electro-hydraulic multiple car elevator system arranged in accordance with our invention; Fig. 2 is a sectional view showing in detail the particular type of fluid motor and variable stroke pumping mechanism, such as is associated with each elevator car, together with controlling apparatus therefor; also a portion of the prime mover and clutch mechanism for controlling a connection between the prime mover and the pump; Fig. 3 is a front sectional view of Fig. 2, taken on the line *a-a*, in the direction of the arrows *b-b*; Fig. 4 is a sectional front view of the pump shown in Fig. 2; Fig. 5 is a plan view showing a silent drive connection such as is made between the prime mover and each one of the pumps, together with clutch mechanism for controlling the said connection.

The particular type of hydraulic transmission mechanism herein shown and associated with each one of the elevator cars, forms the subject matter of co-pending applications of August Sundh, Serial Nos. 764,994, filed May 2, 1913; 794,829, filed October 13, 1913; 826,168, filed March 21, 1914; 828,190, filed March 30, 1914, and in view thereof, the same will be described only briefly hereinafter.

The system illustrated in Fig. 1 is of the well known friction drive or traction type, and comprises a plurality of elevator cars *A*, *A'* and *A''*, each car having an associated counterbalance weight *B*, *B'* and *B''*. The cars together with their associated counterweights are each suspended from overhead traction sheaves 2, 2' and 2'', by means of a set of cables 3. The sheaves are operatively connected with the prime mover *M*, through the intermediation of the hydraulic power transmission units *X*, *X'* and *X''*, which are independently associated with sheaves 2, 2' and 2'', respectively. Any of the well known types of power mechanism may be employed as a prime mover, such as for example, a reciprocating steam engine, a steam turbine, an internal combustion engine, or the electric motor designated *M* and which is

shown herein simply for the sake of illustration.

The hydraulic power transmission units X, X', etc., are all similar in construction and a description of one will suffice for all.

Generally speaking each unit comprises a fluid motor F² (see Fig. 2) whose pistons 4 are operatively connected to a crank shaft 5, to which the traction sheave, such as 2" is keyed or otherwise suitably connected. The pump such as P² is of the variable stroke type, and pipes 6 and 7 form a fluid passage between the pump and fluid motor, the pipe 6 connecting one of the circular ports 10 of the pump, with a pressure chamber 9 for the fluid motor, and the pipe 7 connecting the circular port 8 of the pump with a discharge chamber 11 for the fluid motor. As before stated herein, the operation of the fluid motor in reverse directions is effected by reversing the direction of flow of fluid between the pump and fluid motor, and it will be here noted that with the operation of the fluid motor in one direction, the said chambers 9 and 11 will serve as the pressure and discharge, respectively, and upon the operation thereof in a reverse direction, these connections are reversed, the chamber 11 serving as the pressure, and 9 the discharge. The rate of speed at which the fluid motor operates is dependent on the quantity of fluid delivered thereto by the pump. The quantity of fluid delivered by the pump to the fluid motor, or in other words, the output of the pump, can be varied as desired by varying the stroke of the pump pistons designated 12. In order to accomplish this result a balanced center shifting device E is provided, which is carried by the pump shaft 13 around which the pump pistons are radially disposed. By means of this center shifting device the stroke of the pump pistons can be varied as desired between a minimum and maximum. In this manner it will be seen that the speed of the fluid motor between predetermined limits can be varied as desired. Piston valves 14 are operatively connected to a cam 15 fixed on the shaft 13, said valves serving to properly direct the fluid to and from ports 16 in the pump cylinders. Likewise with the fluid motor, the fluid is directed to and from the motor piston 4 by means of oscillating disks 17 which are provided with ports 18 and 19, said disks upon being oscillated by the motor pistons which have a reciprocatory movement therein, communicating with the chambers 9 and 11 to properly direct fluid to and from the motor pistons.

Each one of the hydraulic power transmission units X, X', etc., is controlled from its associated car by means of a manually operable hand lever device L, which lever device is connected through a well known

cable connection H, to a shipper sheave 20, the latter being supported by a bracket 21 which can be located at any convenient point for connection with the center shifting device E. The shipper sheave, through connections G and I, is arranged to actuate the center shifting device E so as to effect the operation of the pump pistons at any desired stroke. The operation of each of the cars in reverse directions is effected by reversing the direction of movement of the lever device L from its normal position as shown. Various other types of controlling apparatus can be employed to control the operation of the power mechanisms from the cars, as for example, by means of a car switch and associated electro-mechanical apparatus, such as disclosed in co-pending applications of August Sundh, Serial Nos. 824,780, 825,955, filed March 14, 1914, and March 20, 1914, respectively.

The shaft 13 of each pump is independently connected with the electric motor shaft 21, by means of a sprocket and chain connection 22, the connection employed for this purpose being preferably of the well known type known as the "Morse" silent drive. Manually operable clutches 23 are provided to control the connections between the countershaft and the pump shaft, whereby any desired pump can be connected or disconnected with the countershaft when desired.

The electric motor employed herein is preferably a shunt wound motor, the same in this instance being arranged to run continuously in one direction, and the shunt wound motor being preferable due to the well known characteristic in operating at a constant speed under varying loads. Suitable switches are of course provided to control the current supply to the electric motor, the same not being illustrated herein as they are well known in the art.

Thus far in the description, it will be seen that with the electric motor in operation, power is thus available to effect the operation of any one, or all of the hydraulic power units, and consequently any one or all of the elevator cars can be put in operation in a desired direction and controlled to run at any desired speed between predetermined limits. It is to be here pointed out that no friction or other brake is required to bring the elevator cars to rest, other than that provided by the action of the hydraulic motors. When it is desired to bring a car to a full stop, the hand lever device L is moved to a central or normal position, which effects, through the center shifting mechanism, a movement of the pump pistons to a no-stroke position. Thus during such movement of the pump pistons the circulating fluid produces a retarding action on the fluid motor, which results in bringing the car to rest gradually. The electro-

hydraulic multiple car elevator system herein disclosed possesses numerous advantageous features over other systems, such as for example the present day systems wherein an electric motor or some other type of prime mover is employed for operating each one of the cars, and also over other multiple car elevator systems of which we have knowledge; employing a differential drive which is of a well known principle, and such advantageous features of our system over the present art will now be pointed out. First of all is the great saving in the first cost over the present day direct drive traction machines which as is well known necessitates the use of an abnormally large electric motor for driving each one of the cars, and furthermore the current consumption of these motors is very great as well as wasteful particularly in starting and stopping.

With our electro-hydraulic system, the employment of one large motor only is necessary, and the same being adapted to run continuously greatly reduces the operating expense thereof over the present day system wherein the prime mover is stopped every time it is desired to receive or discharge passengers from the elevator car.

Another feature is that with our arrangement an overloaded car, which as is well known is a frequent occurrence, will cause a generation of power by the fluid transmission mechanism, which power in turn is transmitted to the countershaft, thus assisting the electric motor in driving any of the other elevator cars which are being driven in an ascending direction. This result is apparent for the reason as follows: Say for example, the elevator car A is overloaded and traveling in a descending direction, with the hand lever device in said car moved in the proper direction to effect the operation of the car in said direction. In this instance, the load drives the motor F as a pump, said motor delivering fluid under pressure to the pump P, which as will be seen, acts as a motor, and this delivers power to the electric motor shaft, such power in amount being dependent of course on the degree of movement given to the hand lever device in the said car. Thus it will be seen that the power thus generated under the condition set forth, is useful, in that it serves directly to assist the prime mover in driving other cars of the system which are being driven in an ascending direction, and not being transformed into electrical energy as is now the case in the present day electrically operated elevator systems.

A further advantage is that with the provision of a continuously running prime mover such as for example an electric motor, the rotating mass, which in this in-

stance comprises the motor armature, produces a fly wheel action, and the kinetic energy thereof effectually overcomes the fluctuation of driving power occasioned in overcoming inertia of the various elevator cars from their state of rest.

Another feature of the invention which has heretofore not been mentioned, is the provision of means for accumulating the leakage from all of the power transmission units, and for returning the same to the fluid operating systems of the said mechanism. The apparatus employed for this purpose comprises a tank T, which receives the leakage, the latter being communicated from the pump casings to the tank T by means of the various pipe connections designated 24, the latter pipes connecting with a common pipe 25, which connects directly with the tank T. An auxiliary pressure pump L, driven by an electric motor M' is adapted to deliver this leakage from the tank T into an air-tight receptacle or fluid pressure distributor K. The pipes 26 and 27 form fluid passages between the pump and tanks T, K, respectively. A switch 28 operatively connected with a float 29, controls the electric motor in its operation of the pump L, to effect the delivery of the leakage from the tank T into the receptacle K, in direct proportion to the amount of said leakage. A pipe 30 is connected at a point near the bottom of the receptacle K, and branching therefrom are a set of pipes 31 which connect with the pipes 6 and 7, associated with each one of the power units X, etc. It will now be seen that the fluid in the receptacle K will be under a constant air pressure, and through the pipe connections herein just described, a certain predetermined amount of fluid pressure will be delivered to the fluid chambers connected by the pipe connection 6 and 7. It will be here noted that check valves 32 are provided in each one of the branch pipes 31, these valves being arranged to close and prevent the admission of fluid pressure into the receptacle K when the pressure in any of the fluid chambers of the system exceeds that of the fluid in the receptacle K.

We desire not to be limited to the precise construction and arrangement of parts as herein shown and described, since various changes could readily be made in the apparatus set forth by those skilled in the art, without departing from the spirit and scope of the invention.

What we claim as new and desire to have protected by Letters Patent of the United States is:

1. In an electro-hydraulic elevator system of the class described, the combination with a number of cars, electro-hydraulic apparatus arranged to drive the cars, means to accumulate the leakage from the hydraulic ap-

paratus, and means for returning the said leakage under pressure to the fluid operating system of said mechanism.

2. In an electro-hydraulic elevator system of the class described, the combination with a plurality of elevator cars each having a fluid transmission unit associated therewith, means for accumulating the leakage from all of said units, means for automatically effecting the return of the said leakage under pressure to the fluid operating system of the said transmission units.

3. In an electro-hydraulic elevator system of the class described, the combination with a plurality of elevator cars, each having a fluid transmission unit independently associated therewith, a receptacle for accumulating the leakage from all of the said units, a fluid pressure distributor connected by fluid passages with the fluid operating system of all the said units, an auxiliary pump for delivering the leakage from the said receptacle to the pressure distributor, and automatic mechanism for controlling the pump to deliver fluid from the receptacle to the pressure distributor in direct proportion to the amount of leakage.

4. In an electro-hydraulic elevator system of the class described, the combination with a plurality of cars, each having a fluid transmission unit independently associated therewith, a receptacle for accumulating leakage from all of the said units, a fluid pressure distributor connected by fluid passages with the fluid operating system of all of the said

units, an auxiliary pump for delivering the leakage to the pressure distributor, means for driving the auxiliary pump, and means comprising a float actuated switch for controlling the electric motor in its operation of the pump, to effect a delivery of fluid from the receptacle to the said distributor in direct proportion to the amount of leakage from all the units.

5. The combination with a plurality of independently operable cars each having a fluid power transmission device associated therewith, and means for maintaining an equalized pressure in the fluid operating systems of all the said units.

6. In a multiple car electro-hydraulic elevator system, the combination with a plurality of fluid power transmitting devices, an air-tight tank connecting with the fluid chambers in all of the transmitting devices, means for accumulating the leakage from the transmitting devices and for delivering the same into the said air-tight tank, and valves for controlling the said connections between the air tight tank and the said fluid chambers for the purpose substantially as described.

In testimony whereof, we have signed our names to this specification in the presence of two subscribing witnesses.

WALDEMAR F. MAYER.
AUGUST SUNDH.

Witnesses:

WALTER C. STRANG,
ARTHUR TREZISE, JR.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."