(No Model.) 3 Sheets—Sheet 1.

R. R. ZELL.

METHOD OF OPERATING MOTORS.

No. 457,832. Patented Aug. 18, 1891.

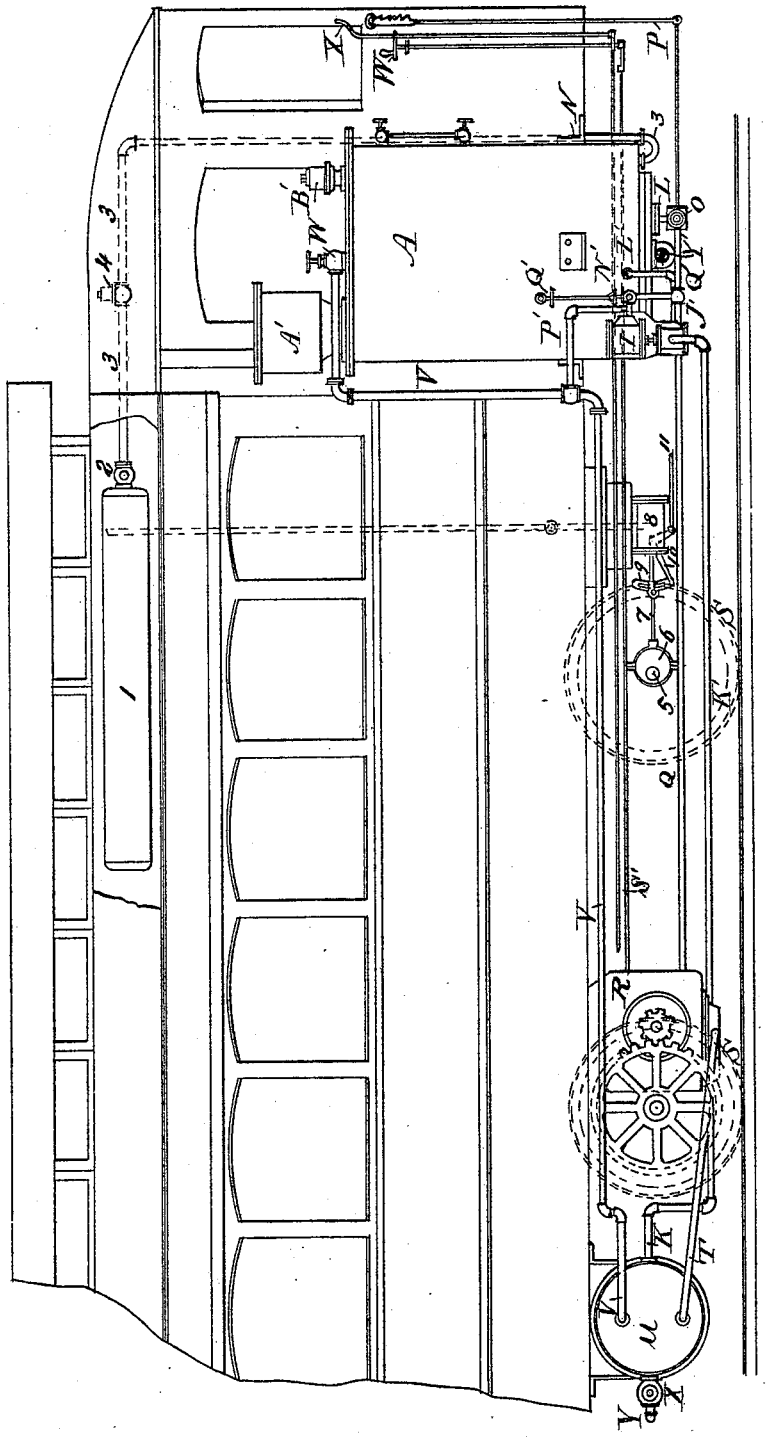


Fig. 1.

Witnesses
Vernon Campbell
J. B. Evans

Inventor
Robert R. Zell
By J. Stuart Page
Atty

(No Model.) 3 Sheets—Sheet 2.

R. R. ZELL.

METHOD OF OPERATING MOTORS.

No. 457,832. Patented Aug. 18, 1891.

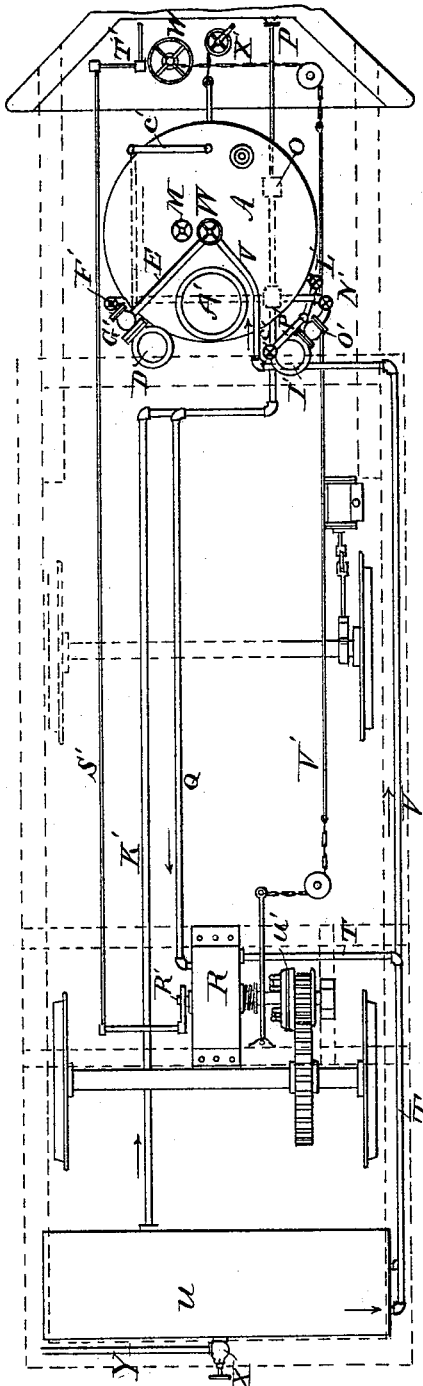


Fig. 2.

Witnesses
Vernon Campbell
A. B. Evans

Inventor
Robert R. Zell
By J. Stuart Tack
Atty

(No Model.) 3 Sheets—Sheet 3.

R. R. ZELL.

METHOD OF OPERATING MOTORS.

No. 457,832. Patented Aug. 18, 1891.

Fig. 4

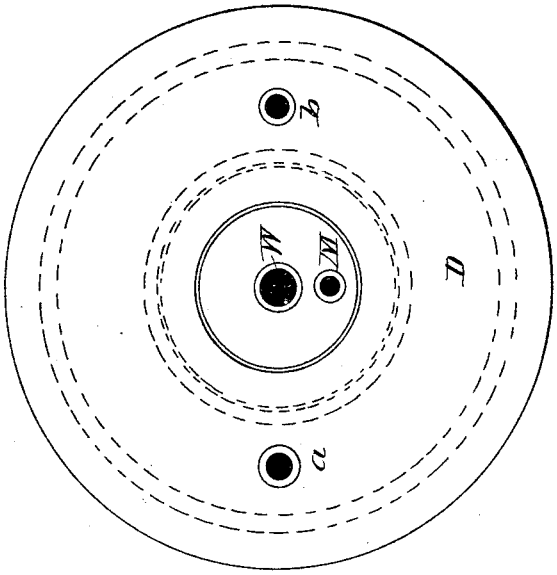
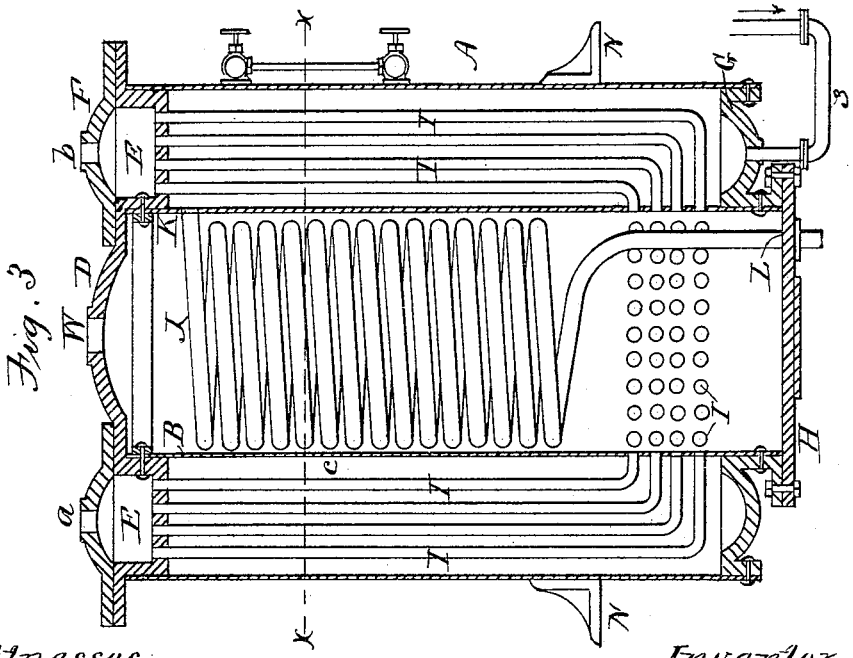


Fig. 3



Witnesses
Vernon Campbell
J. B. Evans

Inventor
Robert R. Zell
By J. Stuart Lysk
Atty

UNITED STATES PATENT OFFICE.

ROBERT R. ZELL, OF BALTIMORE, MARYLAND, ASSIGNOR TO THE ZELL STORED POWER COMPANY, OF SAME PLACE.

METHOD OF OPERATING MOTORS.

SPECIFICATION forming part of Letters Patent No. 457,832, dated August 18, 1891.

Application filed March 18, 1891. Serial No. 385,506. (No model.)

To all whom it may concern:

Be it known that I, ROBERT R. ZELL, of Baltimore, in the State of Maryland, have invented a new and useful Improvement in the Method of Operating Motors, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to improvements in the method of operating soda-motors, and particularly with relation to those used to propel street-cars, such, for example, as have been fully described in my applications for Letters Patent filed November 6, 1890, Serial Nos. 370,512 and 370,513.

My present invention consists in utilizing compressed air to mingle with the steam generated by the soda-absorption generator described in my above-named applications, the compressed air acting as a vehicle for the water of the exhaust-steam to the absorber, as a starting reserve power, and as an efficient, well-lubricated, and inexpensive motor-fluid.

The nature of my improvement upon the methods set forth in my before-mentioned applications will fully appear in the annexed specification, as illustrated in the accompanying drawings, which form a part thereof, and in which—

Figure 1 is a vertical longitudinal section of a motor-car, disclosing the apparatus employed. Fig. 2 is a plan of the apparatus as arranged beneath the car-platform. Fig. 3 is a vertical section of the motor-generator, and Fig. 4 is a plan of the same.

Referring to Figs. 3 and 4, A is the exterior shell of the generator. B is the interior shell, leaving an annular water-space C between the two shells.

G is an annular cover forming the bottom of the annular water-space, and D is the upper head of the generator provided with the annular pocket E.

F is a cover over the circular pocket E.

I I I represent pipes leading from the space E downward through the water-space and then bending inwardly to connect with the interior of casing B.

H is a bottom for the soda-space contained within the shell B.

x x represent the water-line and also the soda-line when there is no pressure in the apparatus.

K is an opening to the steam-space, to which connects the steam-pipe J, which is in the form of a coil, passing down through the soda and out through the bottom H at L.

N N are the flanges or brackets by means of which the generator is secured in place upon the car.

O is a throttle-valve in the steam-pipe J, and it is operated by means of the handle P. From the throttle-valve O the pipe Q leads steam to a motor R.

R′ is the reversing-valve for the motor, and it is provided with the rod S′ and the reversing-lever T′.

T is the exhaust-pipe of the motor, which leads through a condenser and feed-water heater U.

X Y are the valve and pipe by means of which the tank U is charged with water at the station.

V is the pipe leading the exhaust-steam after having passed through the water-tank U to the valve W, which permits it to enter into the space above the concentrated alkali, such as soda, potash, chloride of calcium, &c.

At *a* a gas-absorber A′ is attached, and at *b* there is a pipe C′, leading to a vacuum-pump, whose steam-cylinder is at G′, steam coming from the main steam-pipe Q through the branch pipe E′ and valve F′. The exhaust-steam of this vacuum-pump passes to the valve W and to the soda-space. The heated feed-water from tank U passes by pipe K to a pump I′, and then by pipe L′ into the water-space of the generator. The steam for the steam-cylinder I′ of the feed-pump comes from a branch pipe leading from main Q, the branch pipe being provided with a throttle-valve N′ and handle Q′. The exhaust-pipe P′ from the feed-pump leads into the engine exhaust-pipe V, and thus the exhaust-steam from the pump also passes into the soda. The absorption of the exhaust-steam by the soda liberates the heat of absorption, which generates steam in the water-space surrounding the soda. The steam operates the engine and the vacuum and feed pumps. The vacuum-pump acts to draw the steam downwardly through the soda, thus

making a more ready absorption and at the same time maintaining a better vacuum and reducing the back-pressure upon the various motor-pistons. In passing through the tank U the feed-water is heated and the exhaust-steam is partially cooled and condensed, rendering it more readily absorbed by the soda.

So far the devices described are the same as those already described in my above-mentioned applications, Serial Nos. 370,512 and 370,513, and the methods for operating are the same, and I do not herein claim the *per se* in this application.

The devices constituting my present improvements are the air-tank 1, conveniently located in the roof of the car. A stop-valve and branch pipe 2 are used for charging the tank with compressed air from the stationary compressors at the terminals and way-stations. 3 is a pipe leading from the tank 1, and 4 is any desired form of pressure regulator or "reducer." The pipe 3 leads to the bottom of the water-space, as shown in Fig. 3. A stop-valve may be inserted in the pipe 3, if found desirable.

5 is one of the car-axles, and to it is attached an eccentric 6, which operates the rod 7 through a link or other device 9 for throwing the eccentric into operation. This link may be shifted by means of the bell-crank 10 and the rod 11, which leads to the working-platform.

The mechanism just described operates when thrown into gear to compress air by means of the compressor-cylinder 9 and to deliver it through the pipe 12 by check-valve 13 to the tank 1.

At the station the water and soda spaces of the generator are filled, respectively, with highly-heated water and concentrated alkali. The water-tank is filled with cool water and the air-tank is filled with comprsssed air at any desired pressure, depending upon the strength and size of the tank. The pressure-regulator 4 is set to control the flow of air at a working-pressure of, say, seventy-five pounds per square inch. The air flows from the regulator to the water-space of the generator and fills the steam-space with air at the working-pressure, so, instead of charging the generator with highly-heated water which liberates steam under pressure, cold water even may be used, the air-pressure taking the place of the liberated steam until, through the action of absorption of the exhaust from the motor, steam is generated. The compressed air in passing through the body of the water becomes thoroughly saturated with moisture, so that on passing through the motor the exhaust contains sufficient water to liberate the heat of absorption to generate steam in the generator. The compressed air being thus moistened, is also in good condition to lubricate the motor, and thus do away with excessive friction. The compressed air thus acts as a carrier for the particles of water-vapor, both for use as a lubricator and for the generation of steam through absorption. After steam has been generated in the water-space the combined air and steam will pass to the motor, the compressed air being greatly increased in pressure by the addition of the heat of the steam, and the exhaust-steam, which is cooled by passing through the condenser-feed heater and which assumes the "vesicular" state, is still more readily carried to the absorber-generator by the compressed air. Should the engine be stopped, the back-pressure in the generator immediately rises, and as the working-pressure is exceeded the pressure-reducer valve 4 closes and retains the pressure in the air-tank. On operating the engine again this pressure will flow from the tank to the steam-space and thus to the motor. While going downhill the momentum of the car is usually wasted by applying brakes, and by throwing the air-pump 8 into operation a part of the energy of the car may be saved by compressing air into tank 1, thus keeping it supplied with the maximum pressure. Proper pressure-gages (not shown) will indicate the safe pressure to be used.

As in my former application, the vacuum-pump will reduce the back-pressure on the motor-pistons and cause the soda to be agitated as the exhaust is drawn through it, thus increasing the rapidity of absorption and its effectiveness. My methods may also be employed in operating stationary plants, as in machine-shop work, pumping, &c.

I do not herein claim the construction of the apparatus shown, as I have made application for the same in an application for Letters Patent filed February 20, 1891, Serial No. 382,269.

I am aware that it is not new to use compressed air carried in tanks upon a car as motive power for the car nor to pass the compressed air through hot water to increase its pressure for use as motive power. This I do not claim; but I believe myself the first to utilize the compressed air in connection with a soda-generator, as described above; and, therefore,

What I believe to be new, and desire to secure by Letters Patent, is—

1. The method of operating an alkali-motor, which consists of utilizing the heat of absorption of water-vapor in an alkali to generate steam from water exposed to its action, passing compressed air into contact with said steam, and then utilizing this air as a carrier to convey the steam to the alkali, substantially as described.

2. The method of operating an alkali-motor, which consists of utilizing the heat of absorption of water-vapor in the alkali to generate steam from water exposed to its action, passing compressed air into said steam, utilizing the mixed steam and air in a motor, and then utilizing the exhaust of the motor to generate heat of absorption, substantially as described.

3. The method of operating an alkali-mo-

tor, which consists in utilizing compressed air to convey water-vapor to an alkali to be absorbed therein, drawing said air and vapor through the alkali to increase the absorption, and then utilizing the heat thus liberated to generate steam from water exposed to its action, substantially as described.

4. The method of operating an alkali-motor, which consists in passing compressed air into a boiler to mingle with the vapor therein, passing the mixture to a motor, and then drawing the exhaust from the motor through an alkali in contact with the boiler, whereby the air acts as a carrier for the vapor to liberate heat of absorption, substantially as described.

5. The method of utilizing a mixture of compressed air and steam as motive power, which consists in mixing the air and steam, passing the mixture to a motor, passing the exhaust thereof through a feed-water heater, thereby cooling the steam, then drawing the compressed air and the cooled vapor contained therein through a caustic alkali which is in contact with the boiler in which the steam is generated, thereby liberating the heat of absorption, substantially as described.

6. The method of operating an alkali-motor, which consists in utilizing the movement of a car upon which the motor is mounted for compressing air into a tank, passing the air from the tank at a uniform pressure into a boiler, passing the mixed air and steam thus formed to the motor, and then utilizing the exhaust of the motor to generate heat of absorption by coming into contact with an alkali, and then utilizing this heat to generate vapor in the boiler, substantially as described.

7. The method of operating an alkali-motor mounted upon a car, which consists in utilizing the momentum of the car for compressing air into a receiver, passing the air at a regulated pressure into a steam-boiler, utilizing the mixed air and steam in a motor, cooling the exhaust of the motor, and then passing it into contact with an alkali, thus liberating heat of absorption for generating steam in said boiler, substantially as described.

8. The method of operating an alkali-motor, which consists in passing compressed air into a boiler to mingle with the vapor therein, passing the mixture to a motor, then passing the exhaust-steam and air into an alkali, where the air acts as a carrier of the vapor to the alkali to liberate heat, and utilizing the hot air after having passed through the alkali by passing it through a feed-water heater, substantially as described.

In testimony whereof I, ROBERT R. ZELL, have signed my name to this specification, in the presence of two subscribing witnesses, on this 25th day of February, A. D. 1891.

ROBERT R. ZELL.

Witnesses:

J. VERNON CAMPBELL,

I. B. EVANS.