G. GIORGI.

RAILWAY TRACTION.

APPLICATION FILED NOV. 27, 1906.

924,056.

Patented June 8, 1909.

2 SHEETS—SHEET 1.

Fig. 1

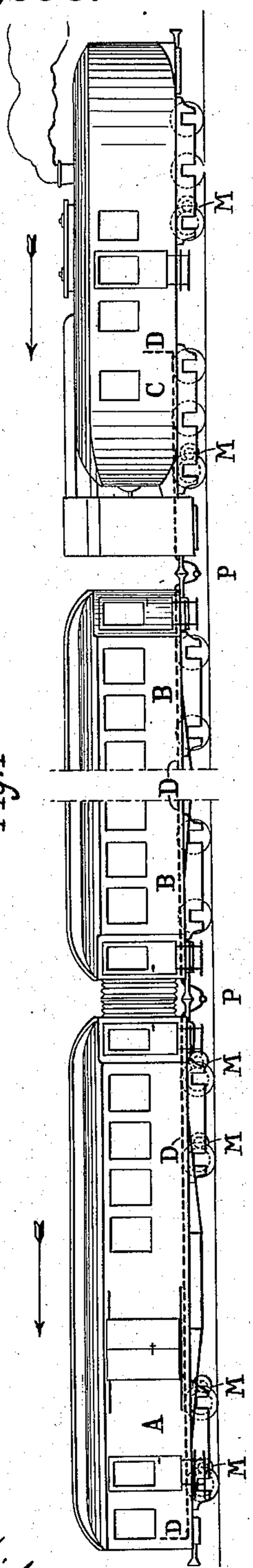


Fig. 6

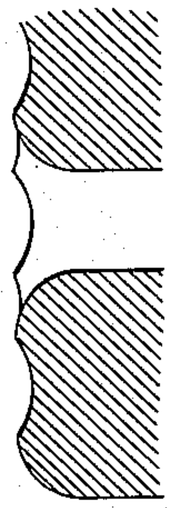


Fig. 7

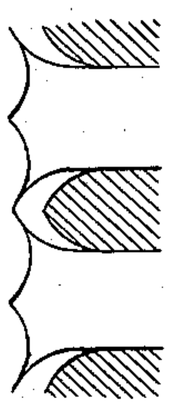


Fig. 5

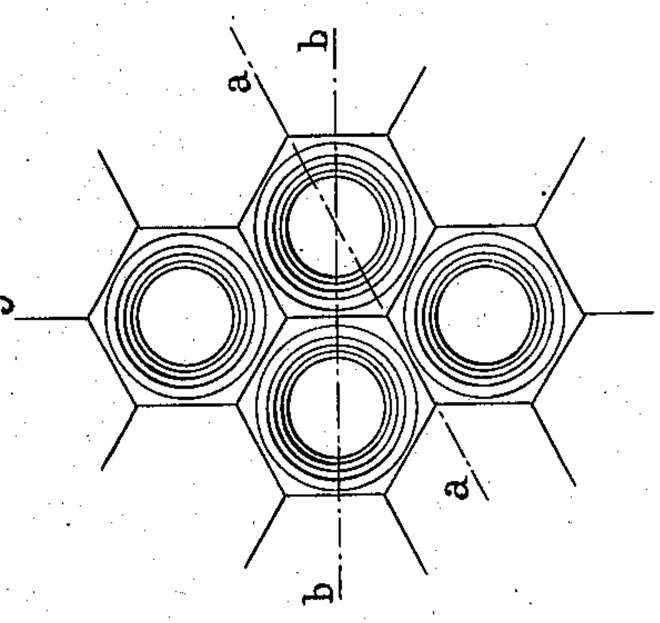


Fig. 4

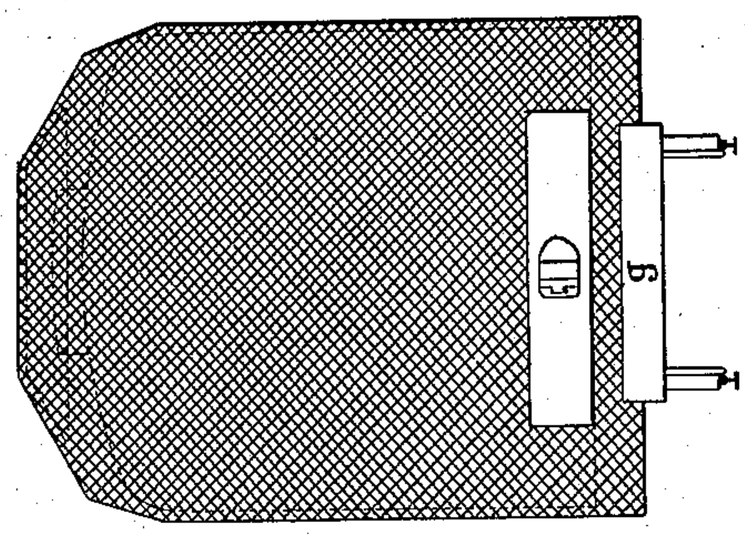
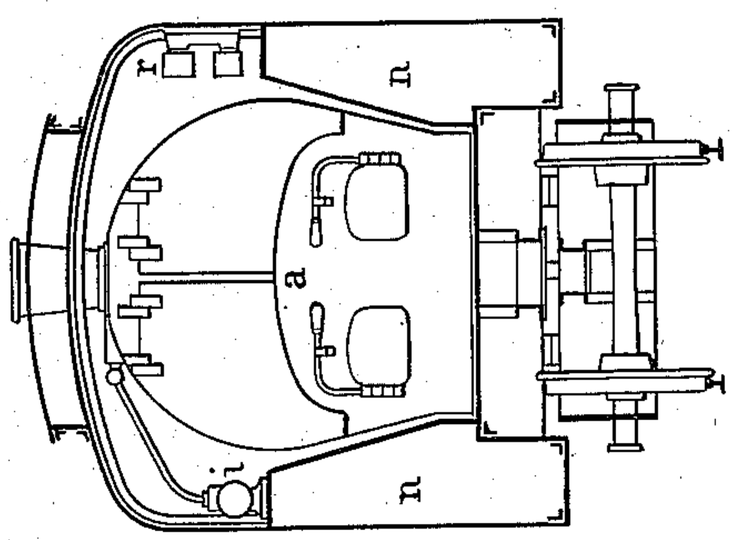


Fig. 3



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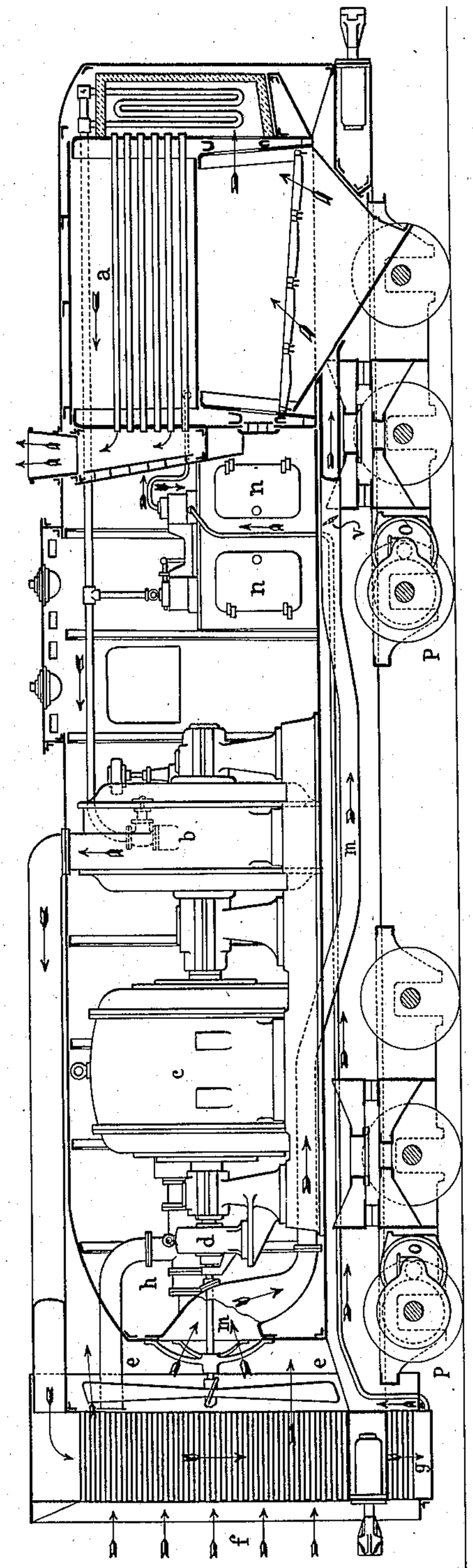
2 SHEETS—SHEET 2.

Fig. 2



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UNITED STATES PATENT OFFICE.

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RAILWAY-TRACTION.

No. 924,056. Specification of Letters Patent. Patented June 8, 1909.

Application filed November 27, 1906. Serial No. 345,286.

To all whom it may concern:

Be it known that I, GIOVANNI GIORGI, subject of the King of Italy, residing at Rome, Italy, professor and civil engineer, have invented certain new and useful Improvements in and Relating to Railway-Traction, of which the following is a specification.

The object of the present invention is to provide some improvements in the traction of railway trains, by using electricity as a medium of power transmission, and consist of:—installing in a special car at the rear end of a train a power generating plant, comprising a steam boiler, a steam turbine driving an electric generator, a special air-cooled condenser, and all other accessory devices;—and furthermore in providing with electric motors the axles of the front car of the train and also the axles of any other car;—in transmitting the electric current generated by the electric generator to the driving motors by a cable running all along the train;—and finally in controlling the speed of the train by means of a controller placed in a compartment at the head of the train. By this combination, particularly adapted for passenger trains over long distances, the following improvements in steam traction are aimed at: 1. The separation of motor shafts from the power generating plant, whereby all cars of the train are relieved from the annoyance of the smoke, owing to the power plant being placed at the rear end of the train. This advantage is not obtainable with steam power as ordinarily used, and will add greatly to the comfort of the travelers and make the cleaning and maintenance of the rolling stock much easier. 2. The high economical efficiency obtainable by the use of steam turbines and economically working boilers and furthermore by the use of condensation which is rendered possible only on account of the fact that in this system the condenser is capable of utilizing the whole amount of air draft available in a train, as it will be hereafter described. 3. The possibility of using for lighting and auxiliary services the electric energy generated in the power plant; the possibility of making any number of the axles of the train to become driving axles; and all other advantages common to the other electro-steam traction systems from which, however, this present system is distinct by the difference of the purposes aimed at, which are fundamental.

An illustration of our present invention is shown diagrammatically in the annexed drawings, wherein:

Figure 1 is a view showing the manner of forming the train; Fig. 2 is a longitudinal section of the power generating plant; Fig. 3 is a cross section of the power generating plant; Fig. 4 is a front view of the condenser; Fig. 5 is a full size detail of the holes in the front and back plates of the condenser leading to the pipes; Figs. 6, 7 are sections on lines *a*—*a* and *b*—*b*, respectively of Fig. 5.

In Fig. 1,—A is an electric motor car placed at the head of the train. This car, which in our instance is half luggage and half passenger car, is carried upon two bogies driven by electric motors. At the front of the car is placed the wattman's compartment equipped with a master controller for the train and all usual accessory apparatus generally provided in electric cars; it is however understood that instead of the above an electric motor car of any other type may be used. B are the other vehicles which may be cars of any ordinary kind. A cable D is running under the body of each car and is provided at both ends with suitable plugs P to obtain the electric connections all along the train between the power generating plant and the electric motors.

C is the power generating plant which in the present example, is shown in detail in Figs. 2 and 3, as consisting of a double truck car on which are carried the appliances hereafter described.

a is a boiler of any suitable type, for instance a return flame boiler with large grate and heating surfaces and with superheating tubes. *b* is a steam turbine which is supplied with steam by said boiler and drives an electric generator *c*; this generator may be of the direct current, three phase, two phase, or single phase type, and in our example is supposed to be a single phase alternator, excited by an independent or directly coupled exciter *d*. A fan *e* is likewise represented as mounted on the shaft of the alternator but may also be independently driven by an auxiliary turbine or by an electric motor.

A condenser *f* is installed, in the fashion

of steam automobiles, in the front part of the car, and is intended to condense the exhaust steam of the turbine, using the air as a cooling medium. This condenser occupies transversely the whole available area allowed by the railway regulations of the country, so as to be capable of utilizing the highest possible amount of air impelled over it by the motion of the train and by the above mentioned fan *e*. Fig. 2 shows a section, and Fig. 4 a front view of this condenser, which consists of a metal case traversed by a bundle of brass or copper tubes fixed to the front and back plates. In the interior of the tubes flows the air, while outside of them and within the case the steam circulates. The condensed steam is collected in a case *g* at the bottom of the condenser.

In order to facilitate the passage of the air through the condenser, the car front situated just behind the condenser, and advantageously also the rear part of the preceding car, are shaped like a torpedo boat; furthermore the holes of the front and back plates leading to the tubes are bored in hopper like fashion, as shown in Figs. 5, 6, 7. To better operate the condenser, the air may be moistened by a jet of water in the front of the condenser (not shown in the drawing). The vacuum in the condenser is maintained by the air pump *h*. The hot condensed water is used to feed the boiler by the electrically or steam operated feed pump *i*. To maintain the draft in the boiler, part of the hot air from the condenser is blown through pipe *m* into the fire box under the grate, the draft being regulated by a valve *v*. The fuel is stored in two compartments *n*—*n* at the sides of the boiler (Fig. 3). The device *r* seen on the top of the right hand compartment is the pump of the air brake. Although this power generating car may be pulled like an ordinary car by the motor car placed at the head of the train, it is to be understood that in order to make it self-moving for shunting and switching and similar purposes, it will be equipped with one or two or more electric motors *o* geared on the axles *p* of the bogies, the controlling apparatus (not shown in the drawing) being placed in the engineer's cabin. These motors, during the regular run, may contribute to the propulsion of the train, acting together with those placed in the front car. Similarly, any number of axles of the train, in addition to those of the front car, may be equipped with electric motors, whenever it may be desirable, and all these motors M will then act together for the propulsion of the train. In any case the control of the train will be executed by the same means used in any other electric train, and most suitably by the well-known multiple-unit systems, whereby all motors of the train are simultaneously controlled by the master controller placed in the motorman's compartment at the front of the train; these systems would enable to control the motors by simply regulating the excitation of the alternator (in the case of the single phase system) thereby securing a result not obtainable with ordinary electric trains. It is always supposed that the turbine rotates with constant speed, regulated by its own regulator.

Alternatives.—Turbines with free exhaust may be used, thus doing away with the condensing plant and renouncing the economy thereby realized. In this case the exhaust steam will be led to the flue to increase the draft. Instead of a regular constant speed turbine generator and an ordinary controller, a turbine generator without regulator may be used, controlling the train by means of any suitable device (for instance a driven motor, etc.) which from the front cabin permits of directly acting on the steam admission to the turbine. Supplies of fuel and water might be carried on a separate tender. The draft in the boiler may be maintained by an ejector. A separate turbine may be used for the motor acting on the axle *p* and for lighting and auxiliary services etc. etc.

What I claim is:—

1. The combination with the cars of a railway train, of electric motors arranged to act upon the axles of the front car and also on the axles of other cars, an electric power plant carried by the car at the rear end of the train and comprising a boiler, a steam turbine, and an electric generator, driven by said turbine, and a cable running all along the train and adapted to supply the electric current to said motors from said generator, and an air-cooled condenser inserted between the rearmost car and the preceding one, substantially as described.

2. The combination with the cars of a railway train, of electric motors arranged to act upon the axles of the front car and also on the axles of other cars, an electric power plant carried by the car at the rear end of the train and comprising a boiler, a steam turbine, and an electric generator driven by said turbine, and a cable running all along the train and adapted to supply the electric current to said motors from said generator, an air-cooled condenser inserted between the rearmost car and the preceding one, and having the front and rear plates bored and shaped in a hopper-like fashion to facilitate admission and exhaust of air, substantially as described.

3. The combination with the cars of a railway train, of electric motors arranged to act upon the axles of the front car and also on the axles of other cars, an electric power plant carried by the car at the rear end of

the train and comprising a boiler, a steam turbine, and an electric generator driven by said turbine, and a cable running all along the train and adapted to supply the electric current to said motors from said generator, an air-cooled condenser inserted between the rearmost car and the preceding one, and having the front and rear plates bored and shaped in a hopper-like fashion to facilitate admission and exhaust of air, means to produce and maintain a vacuum in said condenser when necessary, and a fan to maintain or increase the draft of air through the condenser, substantially as described.

In testimony whereof I have affixed my signature in presence of two witnesses.

GIOVANNI GIORGI.

Witnesses:

A. RAGY,

D. NARDONI.