No. 704,689. Patented July 15, 1902.

C. & A. MUSKER & W. G. HAY.

STEAM GENERATOR.

(Application filed Mar. 5, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

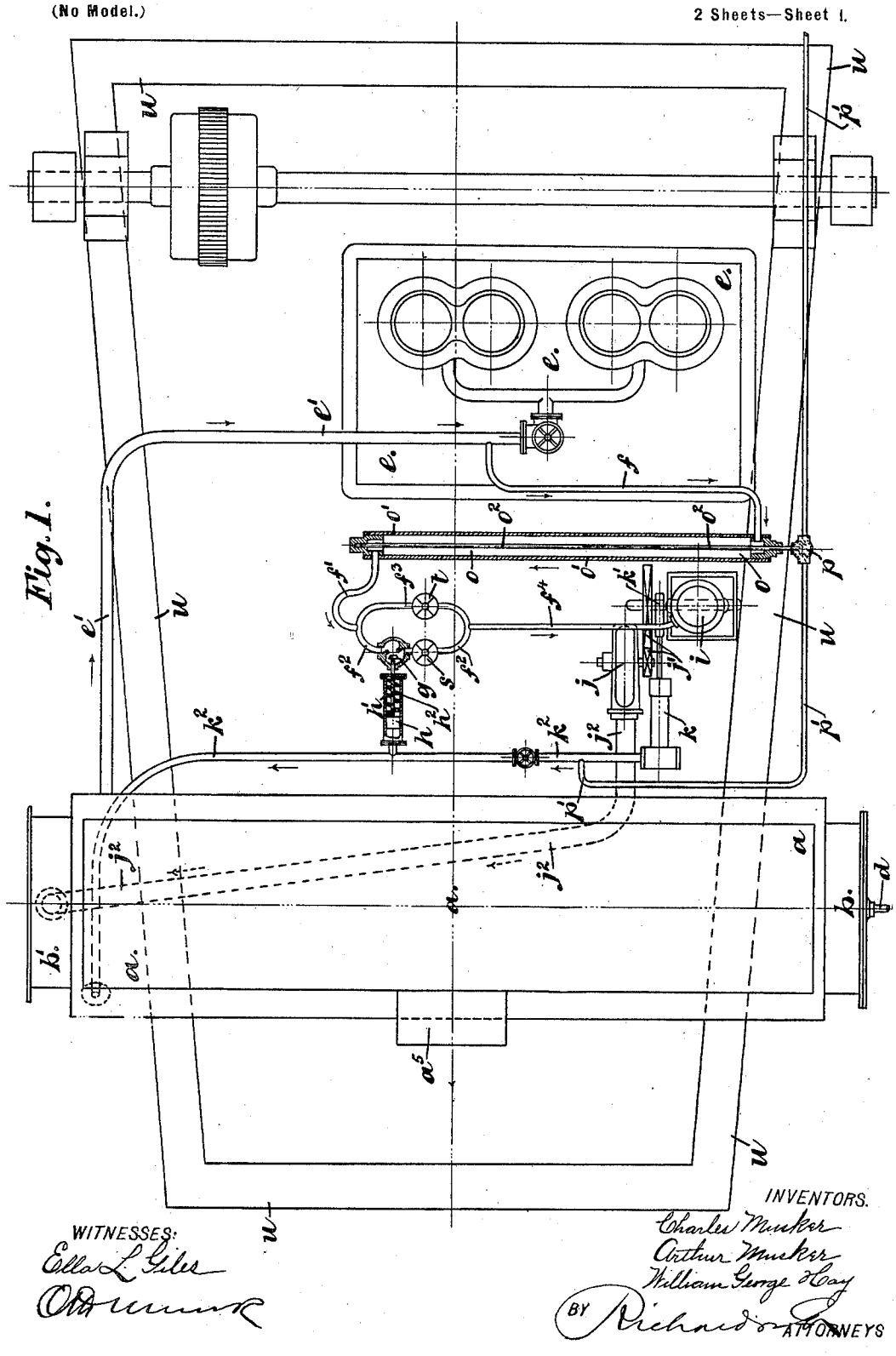

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Fig. 3.

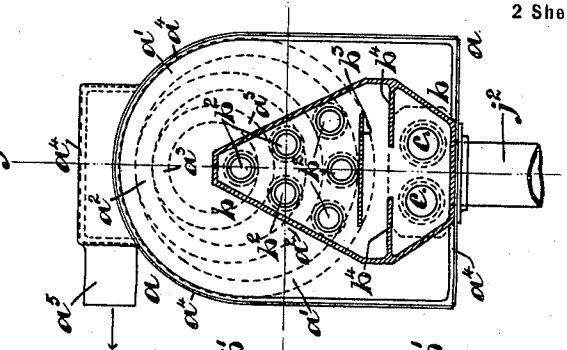
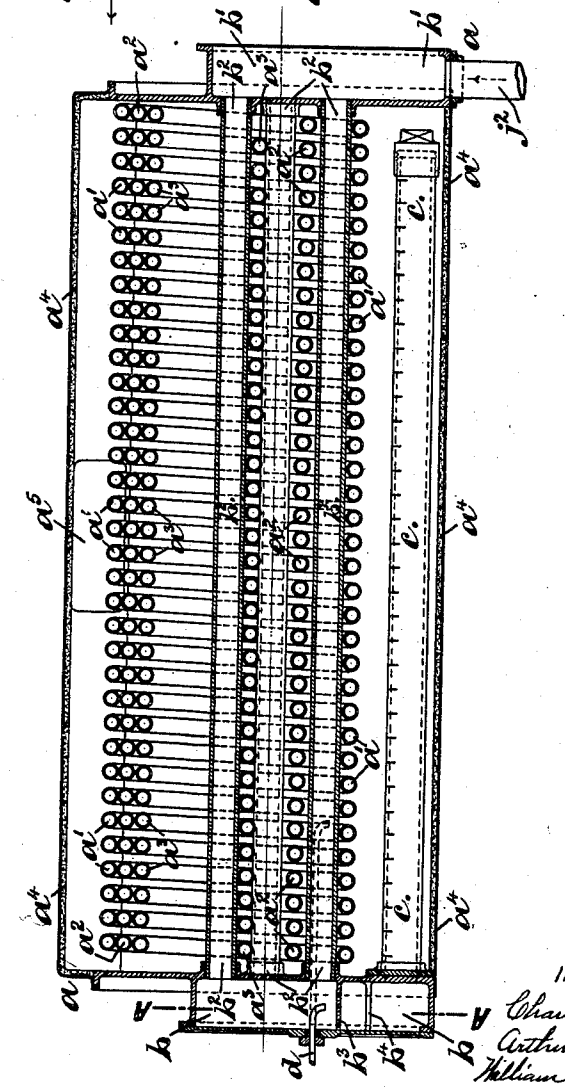


Fig. 2.



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UNITED STATES PATENT OFFICE.

CHARLES MUSKER, ARTHUR MUSKER, AND WILLIAM GEORGE HAY, OF LIVERPOOL, ENGLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 704,689, dated July 15, 1902.

Application filed March 5, 1901. Serial No. 49,863. (No model.)

To all whom it may concern:

Be it known that we, CHARLES MUSKER, ARTHUR MUSKER, and WILLIAM GEORGE HAY, subjects of the King of England, and residents of Tue Brook, Liverpool, in the county of Lancaster, England, have invented certain new and useful Improvements in Steam-Generators for Power Purposes, of which the following is a specification.

This invention has reference to machinery for propelling vehicles on common roads, in which the motive power or fluid is steam-generated by oil fuel; and it relates more particularly to this kind of machinery wherein the steam is generated at varying rates as and when required automatically and in which also all the air for burning the oil fuel is supplied by an air-forcing fan or blower operated by steam from the steam-generator and is employed for vaporizing the fuel. The invention, however, is also applicable to torpedo vessels and small craft.

The invention will be described with the aid of the accompanying drawings, in which—

Figure 1 is a plan illustrating diagrammatically the machinery according to this invention. Fig. 2 is a longitudinal section showing the construction of steam-generator and oil vaporizer and burner; and Fig. 3 is a cross-section at the line A A, Fig. 2.

Referring to the drawings, *a* generally designates the steam-generator. *e* is the main propelling-engine for the vehicle. *i* is an auxiliary motor for supplying all the air for combustion of the fuel in the generator *a*, and *o* is a superheat-temperature regulator.

Steam is supplied from the generator *a* to the main propelling-engine *e* through a pipe *e'*, and it is supplied to the auxiliary motor *i* through a pipe *f*, the interior of the superheat-regulator *o*, pipe *f'*, two branches f^2 f^3, leading from *f'*, and a pipe f^4, connecting f^2 f^3 with the motor *i*.

The motor *i* drives a fan *j* by spur-wheel gearing *j'* and the boiler feed-pump *k* by an eccentric *k'*, and the air from the fan *j* is supplied to the oil-vaporizing chamber *b* on the steam-generator *a* through an air-pipe j^2 and conduits, as hereinafter specified, while the feed-water is supplied from the pump *k* to the generator *a* by a pipe k^2.

On the steam-supply branch f^2 there is a valve *g*, which is pressed toward its seat by the pressure of the generator acting upon a piston *h* in the cylinder *h'*, the back of the piston being in communication with the steam-generator and acted upon by the pressure thereof by connecting it with the water-supply pipe k^2. A spring h^2 in the cylinder *h'* normally presses the piston *h* back and keeps the valve *g* off its seat and open, and this valve only closes when the pressure in the generator *a* exceeds greatly that required, in which action the piston *h* compresses the spring h^2.

Beyond the valve *g* on the branch f^2 is a regulating or pressure-reducing valve *s* of any known suitable type regulated to pass steam up to the full normal working pressure—say two hundred pounds—whereby the pressure of steam supplied to the engine *i* is never above the normal.

On the branch f^3, supplying the auxiliary motor *i*, is a reducing-valve *t*, which will reduce the pressure of steam from any pressure to a low pressure—say fifty pounds.

The superheat-temperature regulator *o* comprises an outer tube *o'*, an inner rod o^2 fixed at its back, and having at its other end, which projects through the end of the tube *o'*, a valve *p* on a pipe *p'* connected with the feed-water-supply pipe k^2 of the pump *k*. This valve is adapted to be normally open, so as to always allow a portion of the water forced by the pump *k* to escape. The pipe *f* for supplying superheated steam to the small engine *i* is entered in at one end of the regulator *o*, and the pipe *f'* is entered at the other end, and the steam from the pipe *f* passes into the annular space around the rod o^2 and then leaves by the pipe *f'*, and accordingly as the temperature of the superheated steam varies the length of the rod o^2 will vary, and it will be made to project more or less from the regulator end and open or close more or less the valve *p*.

u represents the frame carrying all the machinery, which will be carried by the motor-car in any known way.

In action if the steam-pressure in the generator *a* does not exceed a certain point—say two hundred and fifty pounds—the valve *g*

will be kept open by the spring h' and any pressure of steam up to two hundred pounds will pass through the pressure-regulating valve s, while if the pressure be above two hundred pounds it will reduce it to this pressure, which is the normal working pressure required in the steam-generator. If the pressure of two hundred and fifty pounds or over is reached, this pressure acting on the piston h of the pressure-governor valve g through the pipe k^2 closes this valve and stops the supply of steam to the engine i by way of the steam branch pipe f^2. Thereupon it passes by way of the pipe f^3 and through the reducing-valve t, and the steam of the reduced pressure—say of fifty pounds—passes to the engine i and so reduces the speed of it, and thereby the quantity of air supplied by the fan j and water supplied by the pump k. Consequently less steam is generated. When this pressure falls to normal steam-pressure—say under two hundred and fifty pounds—the spring h^2 presses the piston h back and opens the valve g and steam at the normal pressure of two hundred pounds is supplied to the motor i and its speed again increased. Consequently more air is supplied by the fan j and more steam generated, and as long as the steam does not exceed the maximum required the engine i will be worked by steam of two hundred pounds.

The steam is superheated in the steam-generator a, as hereinafter described, and the degree of superheat delivered to the main engine e through the pipe e' is controlled by the regulator o, as follows: When the superheat is not above that required, the rod o^2 is adapted to hold the valve p open. Consequently some of the water forced by the pump k will escape past the valve p by the pipe p'. When, however, the temperature of the steam is higher than that required, the rod o^2 expands and diminishes the opening of the valve p or closes it, so that more water is forced into the generator, and as the heating-surface of the generator consists of a continuous series of coils (as hereinafter described with reference to Figs. 2 and 3) there will be less area of pipe-coils containing superheated steam and more area containing water, and more heat will be absorbed by the greater quantity of water and less heat by the steam.

The construction of oil-fired steam-generator a (shown in section in Fig. 2 and cross-section in Fig. 3) will be now described. The heating-surface consists of three coils of tubes a', a^2, and a^3 in the case a^4, joined up to form a continuous conduit, into and through which the water is forced, and the outer coil a^3 is the last through which the water or water and steam is passed and in which the steam is superheated. The vaporization of the oil is effected by highly heating the whole of the air used for burning the oil and passing it over and in contact with the oil introduced into the vaporizer. This air is forced by the air-blower j into the chamber b' at one end of the generator a while the vaporizing-chamber b is at the opposite end and thence through tubes b^2 from b' into the chamber b, these tubes being subjected to the heat of the flames issuing from slits or holes in the two horizontal burner-tubes c, extending all along the bottom of the case a^4 from the vaporizer b. Just below the lowest tube b^2 in the vaporizer b is a partial partition b^3, onto which oil introduced by the pipe d is dropped, (or the pipe d may be carried into the bottom tube b^2, as shown in dotted lines, and oil delivered into such tube,) and below the partition b^3 are two partial partitions b^4, and out of the space below these the two burner-tubes c lead. The oil will flow over the partition b^3 and then onto the partitions b^4, and the hot air passing over it vaporizes it, and the combustible mixture of air and oil-vapor passes to the burners c and is burned at the slits or holes all along same. If oil drops into the bottom chamber below the partitions b^4, the hot air will vaporize or absorb it. The water from the feed-pump k is delivered by the pipe k^2 into the water-tube coil a^2 or a^3, and before it enters the outer coil a' it is converted wholly or to a large extent into steam, and this steam in passing through the outer coil a' is dried and superheated, and this amount of superheat is regulated by the manner and means hereinabove described. The tubes b^2 being arranged between the convolutions of the water-tubes a' a^2 a^3, the superheated steam which passes through the outer coil a' will be regulated or tempered somewhat by the air passing through the lowest tubes b^2, and the heating of this air also will be tempered or regulated by its contiguity with the water-tubes, so that there is a mutual regulation of these temperatures. The heat from the burner-tubes c is distributed all over the water-tubes, and it may leave the upper part of the case a^4 through an outlet a^5.

What is claimed in respect of the herein-described invention is—

The combination with a water-tube steam-generator, of an oil-vaporizing chamber at one end, an air-chamber at the opposite end with means for feeding air thereto, air-pipes extending from said air-chamber to said vaporizing-chamber and a burner-tube extending from said vaporizing-chamber beneath the air and water tubes, substantially as described.

In witness whereof we have hereunto set our hands in presence of two witnesses.

CHARLES MUSKER.
ARTHUR MUSKER.
WILLIAM GEORGE HAY.

Witnesses:
JNO. D. BROWN,
FRANK E. FLEETWOOD.