No. 845,002. PATENTED FEB. 19, 1907.

A. HILLISCH.

STEAM HEATING SYSTEM FOR RAILWAY CARS.

APPLICATION FILED AUG. 22, 1906.

4 SHEETS—SHEET 1.

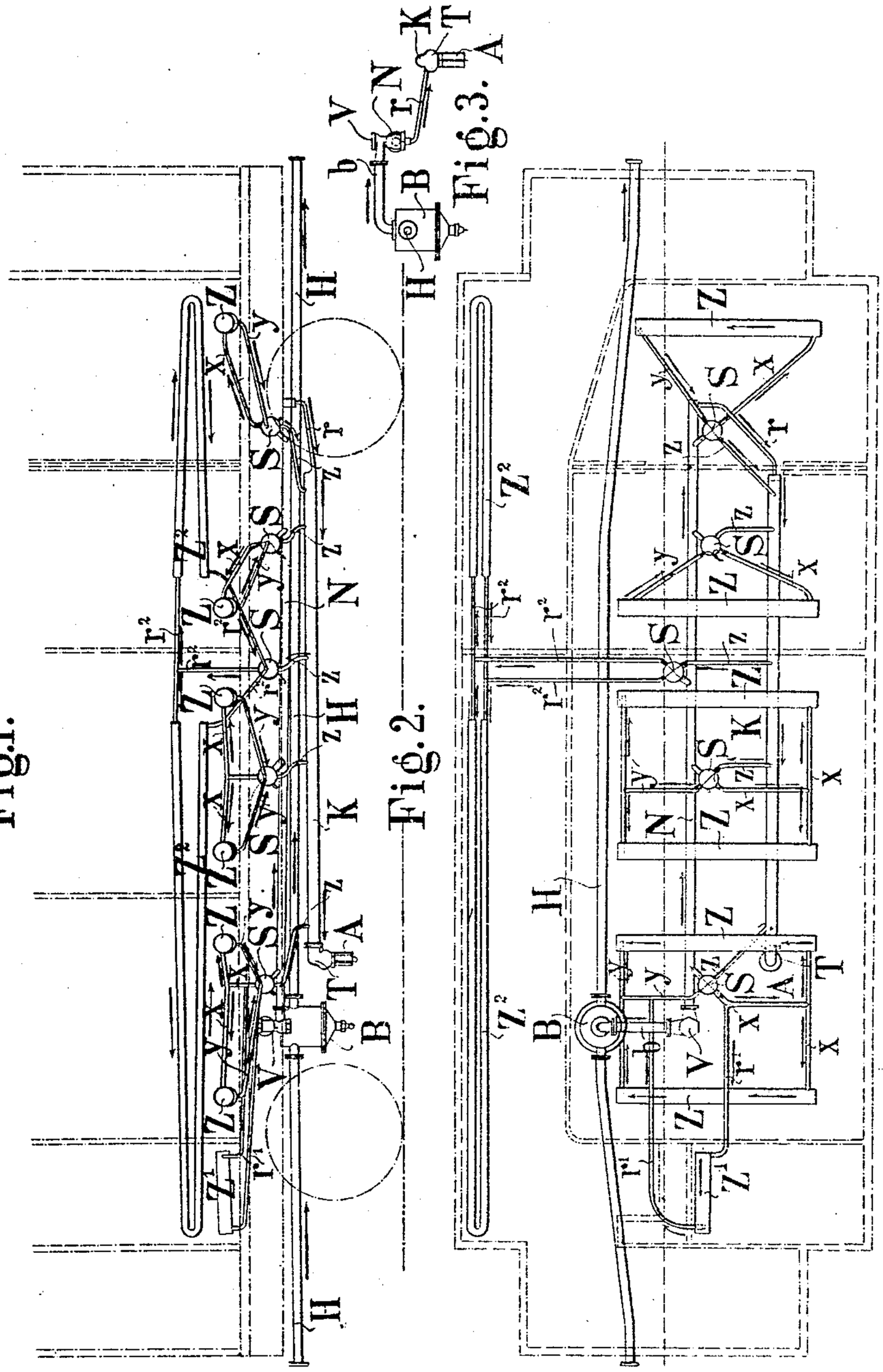

Fig. 1.

Fig. 2.

Fig. 3.

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4 SHEETS—SHEET 2.

Fig. 5.

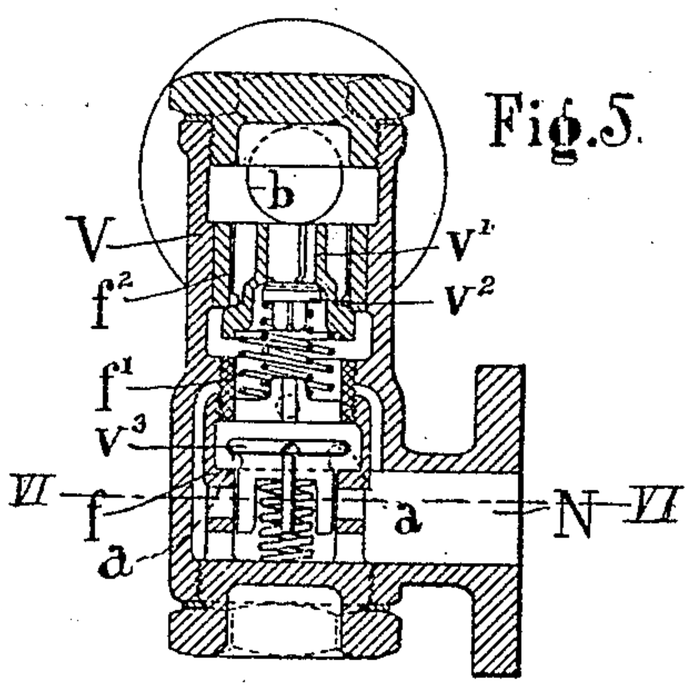


Fig. 7.

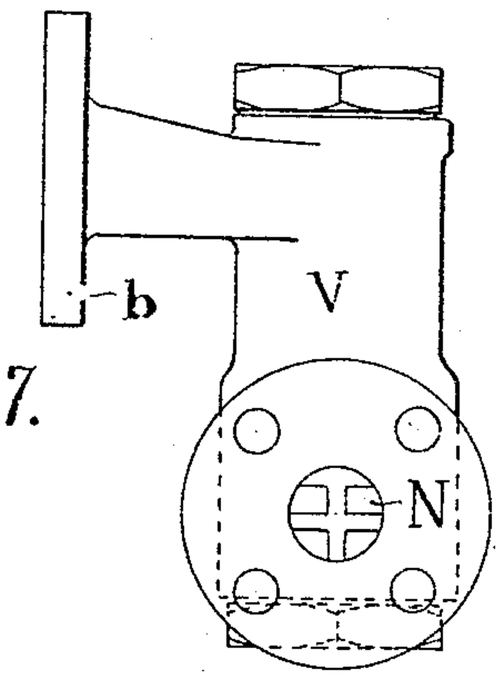


Fig. 4.

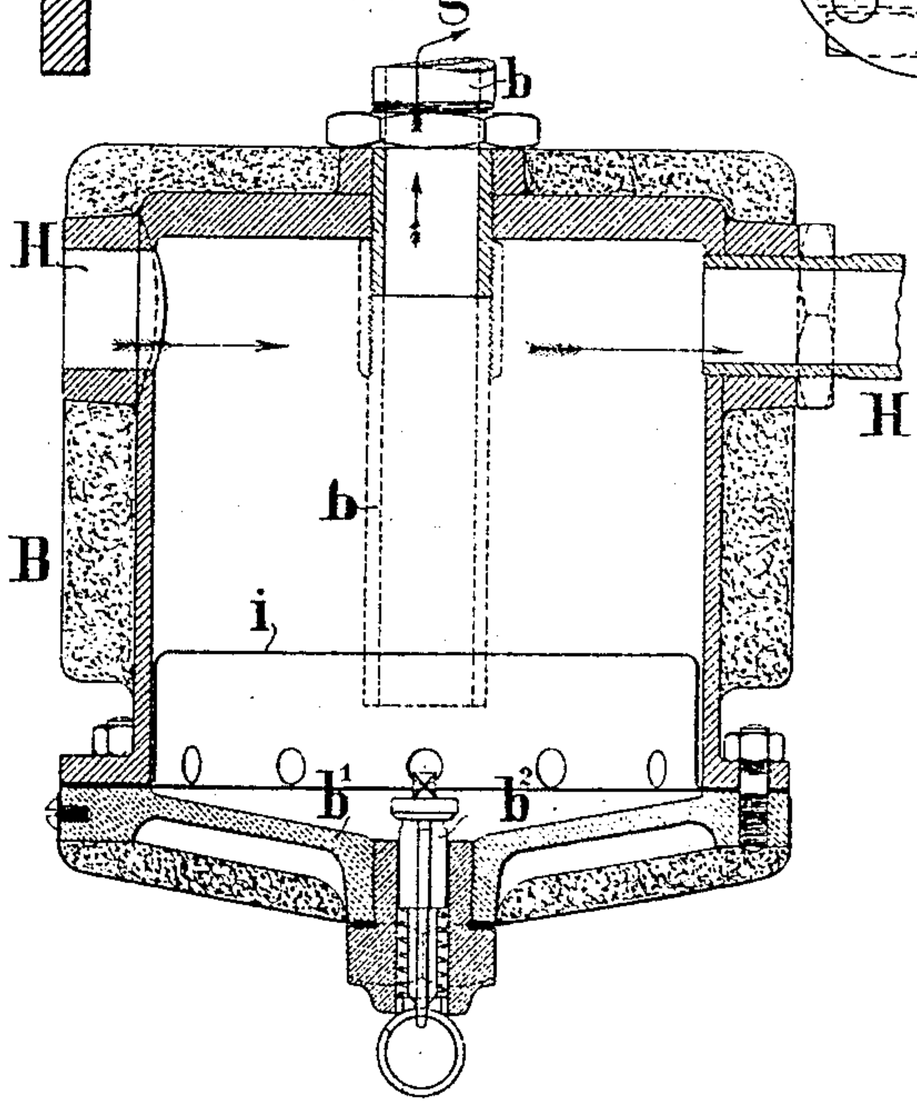
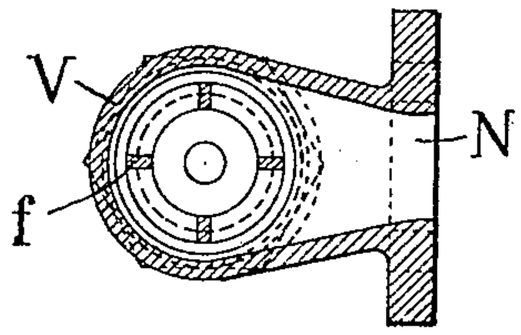


Fig. 6.



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4 SHEETS—SHEET 3.

Fig.8.

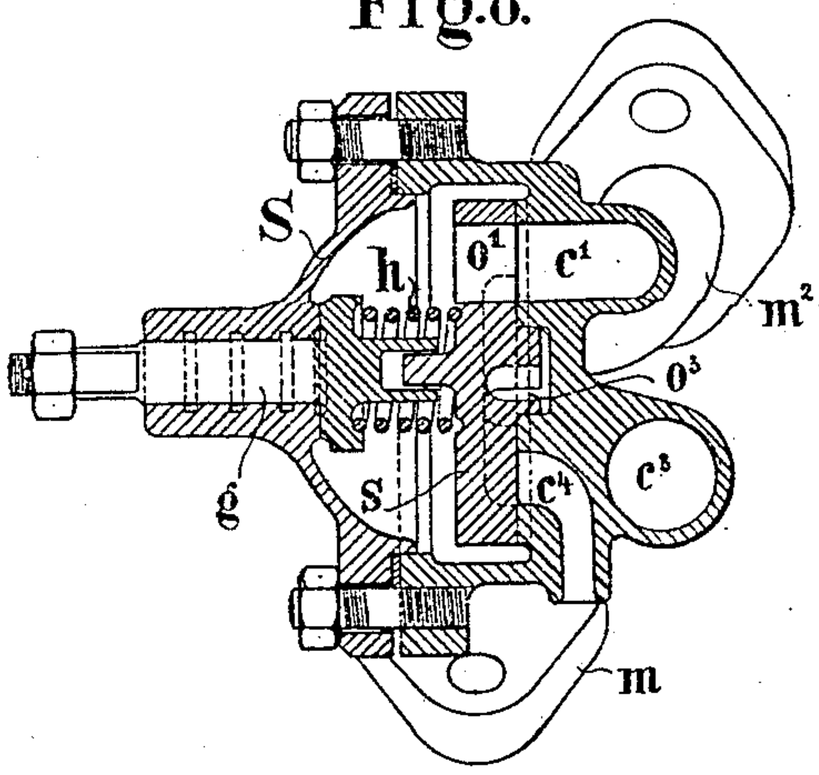


Fig.10.

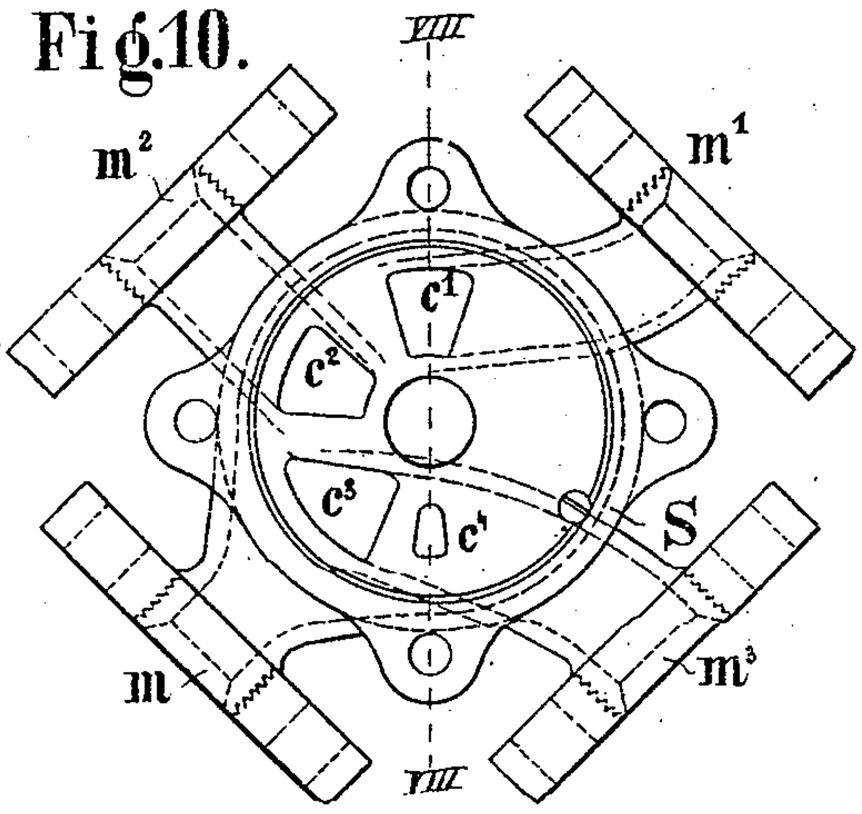


Fig.9

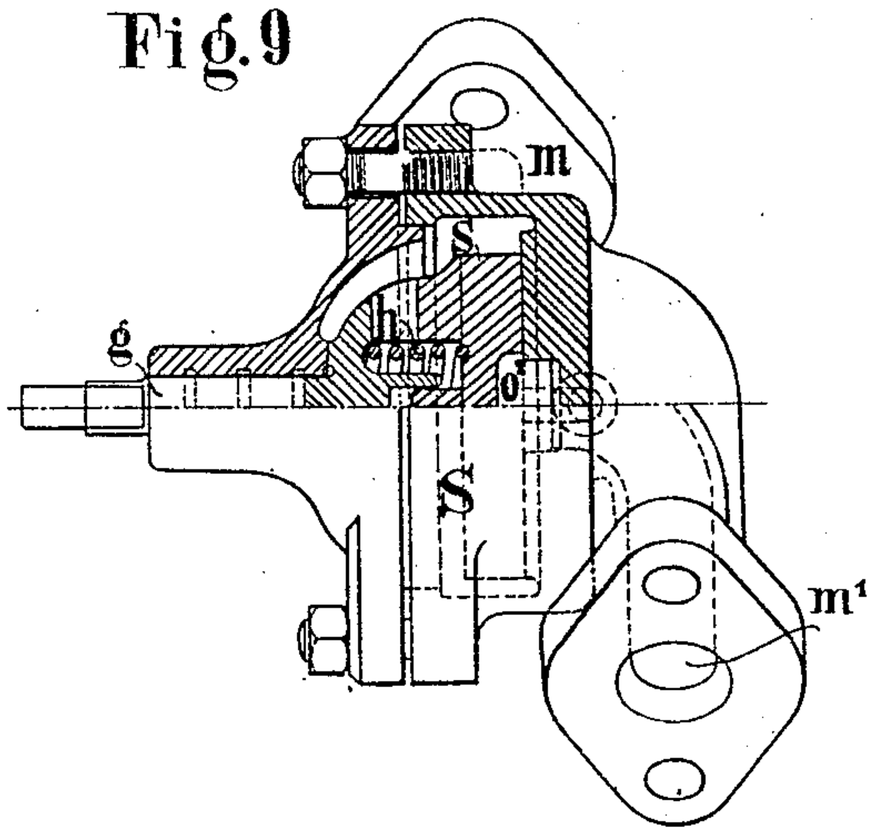


Fig.11.

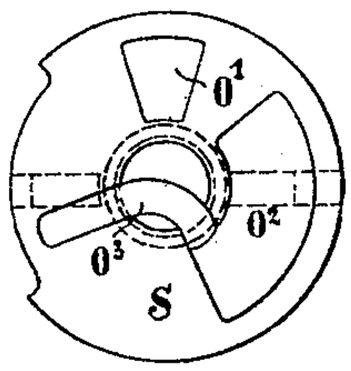
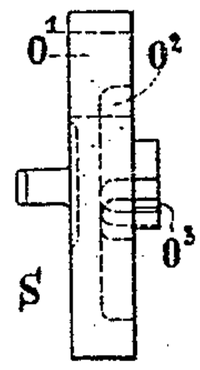


Fig.12



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No. 845,002. PATENTED FEB. 19, 1907.

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STEAM HEATING SYSTEM FOR RAILWAY CARS.

APPLICATION FILED AUG. 22, 1906.

4 SHEETS—SHEET 4.

Fig13

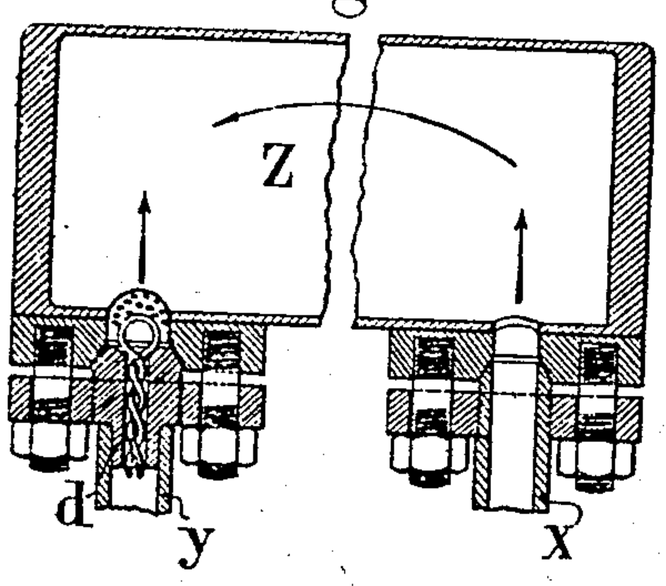


Fig.14.

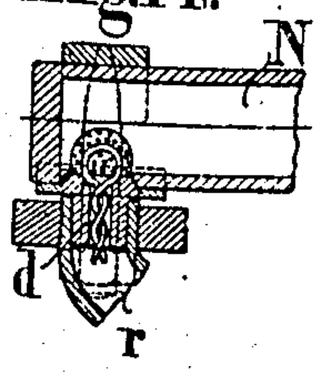


Fig.15.

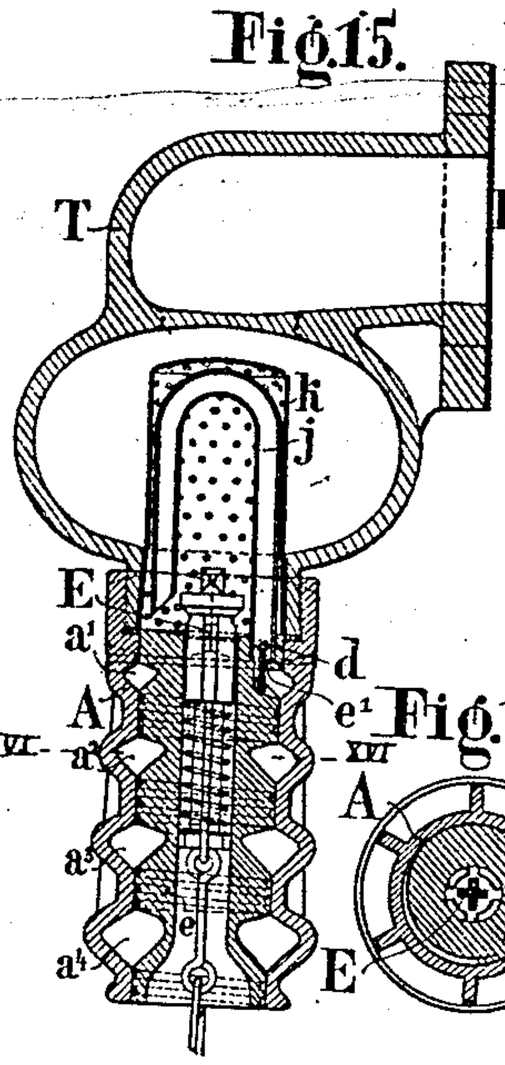
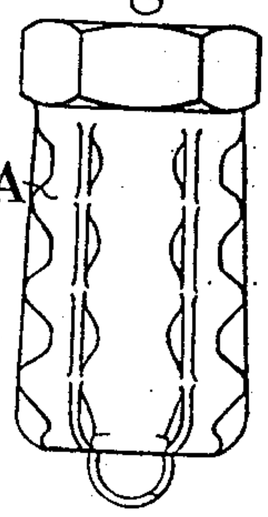


Fig.16.

Fig.17.

Fig.18.



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UNITED STATES PATENT OFFICE.

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STEAM-HEATING SYSTEM FOR RAILWAY-CARS.

No. 845,002. Specification of Letters Patent. Patented Feb. 19, 1907.

Application filed August 22, 1906. Serial No. 331,547.

To all whom it may concern:

Be it known that I, ALEXANDER HILLISCH, a subject of the Emperor of Austria, residing at Innsbruck, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Steam-Heating Systems for Railway-Cars, of which the following is a specification.

This invention relates to a steam-heating system for railway-trains by means of which it is rendered possible to heat in a uniform manner all the carriages of one train, to heat long trains from the locomotive alone, and to separate completely the water of condensation for the purpose of quick preliminary heating of the train, as well as to bring about circulation of steam in all portions of the heating installation. Moreover, it is possible during the operation of the system to disconnect the train-pipe from the source of supply without cold atmospheric air at once penetrating into the heating bodies. The heating can be easily regulated at any moment and in a reliable manner and the regulating-levers always remain easily movable. In addition to these features, which are essential and advantageous for the proper working of a heating system of this kind and the absence of which means a number of important drawbacks, the arrangement according to this invention makes it possible to do without the otherwise necessary closing-cock at the end of the drain-pipe, as the steam circulates in the interior of the heating system itself.

The steam-heating installation fulfilling the above objects chiefly comprises a main steam-pipe containing a steam-trap and capable of being supplied, closed, and drained from the locomotive; auxiliary steam-pipes arranged under each carriage and branching off from the main steam-pipe, as well as pipes for water of condensation also arranged under each carriage and connected to the said auxiliary steam-pipe. The heating bodies are connected to the auxiliary steam-pipe. The connection of the main and auxiliary steam-pipe is effected by means of a regulating and check valve connected to the steam-trap of the main steam-pipe and the connection of the heating bodies to the auxiliary steam-pipe and to the pipe for the water of condensation by means of a regulating-valve, while the throttling of steam required at certain points of the pipe is effected by means of loosely-inserted twisted wires. The pipe for the water of condensation terminates in a steam-trap or water-separator.

The accompanying drawings show in Figures 1 and 2, in elevation and plan, respectively, portions being in diagram, the bottom portion of a carriage provided with this heating installation, the outlines of the carriage being shown in dotted lines. Fig. 3 shows in elevation a portion of the heating system in a plane transverse to the carriage. Fig. 4 shows the steam-trap for discharging water of condensation from the main steam-pipe in vertical central section. Figs. 5, 6, and 7 show, respectively, the regulating and check valve in vertical central section and horizontal section on the line VI VI of Fig. 5 and its casing in side elevation. Figs. 8, 9, and 10 show the casing of the regulating-valve in two longitudinal sections normal to each other (Fig. 8 being a section on line VIII VIII of Fig. 10) and in elevation, the latter with the cover removed, and Figs. 11 and 12 are respectively plan and side elevation of the valve alone. Fig. 13 shows one of the throttling parts inserted, by way of example, into one of the heating-body pipes. Fig. 14 shows the same in the auxiliary steam-pipe; and Figs. 15 and 16 are respectively vertical and horizontal sections of the steam-trap at the end of the pipe for water of condensation, Fig. 16 being taken on line XVI XVI of Fig. 15. Figs. 17 and 18 show details of the same.

As will be seen from Figs. 1—3, the main steam-pipe or train-pipe H, which is of the same cross-section throughout, is arranged rising from both ends of the carriage toward the center and provided at the highest point with a trap B, from which a connection-pipe *b* leads to the regulating and check valve, (indicated in a general way by V,) from which branches off the auxiliary steam-pipe N for the carriage in question. This auxiliary steam-pipe, which is also inclined and is shorter than the main pipe portion, carries all the casings S of the regulating-valves *s*. At the lowest point of the pipe N branches off a connection-pipe *r* to the pipe K for water of condensation, which is also inclined and has the same diameter as the pipes H and N. The pipe for water of condensation terminates at the lowest point in a trap T with an adjoining drainage-valve, (shown in a general way by A.) Each heating-cylinder Z, located in an inclined position in the carriage-compartments, is connected at the top by means of a

pipe x, supplying live steam and having the same cross-section throughout, to the corresponding regulating-valve casing S, which latter, on the other hand, is connected by a pipe y to the bottom end of the heating-cylinder. This pipe y is, however, provided with a reduced portion produced by the insertion of a throttling part. From each regulating-valve casing S a pipe z leads to the pipe K for water of condensation. To some of the pipes x y or to some of the valve-casings S can be connected, if desired, pipes r' r' or r^2 r^2, leading to the heating bodies Z' Z^2, arranged in the additional compartments, such as lavatory and corridor.

The trap B, Fig. 4, serves for separating from the train-pipe H water of condensation formed in the beginning of the heating and quickly cooled. This trap is also intended to receive any foreign matters passing into the main steam-pipe and also enables the carriage with the heating installation according to this invention to be used in trains with heating installations of other systems. This trap consists of a cylindrical tank surrounded with some non-conducting material, and its detachable bottom b' is provided with a valve b^2 for discharging water of condensatin and foreign matter. Between the tank and the bottom is inserted a sieve i. The branch pipe b, leading to the regulating and check valve V, passes through the cover of the tank and can project down to the sieve i, as shown by dotted lines, if in one and the same train is used only the heating installation according to this invention. Otherwise the pipe branch screwed into the cover and shown in full lines would be sufficient. In the first case water of condensation contained under pressure in the trap B is expelled through the branch pipe b in order subsequently to be separated by the drainage-valve A.

The regulating and non-return or check valve V, Figs. 5, 6, and 7, is, on the one hand, intended to delay the admission of steam into the auxiliary steam-pipe, and thus into the heating-cylinder or to regulate it, and thus to accelerate further conveyance of steam in the main steam-pipe, and, on the other hand, it is intended to prevent the escape of steam from the auxiliary steam-pipe when the train-pipe is uncoupled. It consists to that end of three spring-controlled valves—the non-return or check valve v', the high-pressure valve v^2, and the regulating or retarding valve v^3, which are all arranged in the casing of valve V, which is closed by a screw-cover and contains the guide branch f, the intermediate part f', and the guide-sleeve f^2. The arrangement of the valve is such that the regulating-valve v^3 is guided in an inwardly-projecting branch f of the bottom casing-cover and the non-return valve v' in the sleeve f^2 separated from the branch f by a screwed intermediate part f', the high-pressure valve v^2 being guided in the valve v'. The regulating-valve is provided with two lateral recesses a, which afford a small passage for steam when the valve is closed.

The valve regulating the steam-heating is arranged in a two-sectioned casing S, Figs. 8, 9, and 10, and consists of a circular valve s, Figs. 11 and 12, fitted in a steam-tight manner to the valve-face of one part of the casing, the said valve s being capable of being turned by means of a fork g, supported in the other cover-shaped part of the casing and forming a tight joint by means of metal packing and grooves. As the packing is effected without a stuffing-box, merely by metal contact, (by steam-presure and the pressure of a spring h,) the regulating-lever placed on the fork can be easily moved at any moment. Into the valve-face of the casing open four ports c' c^2 c^3 c^4, the valve s being provided with an opening o' and with a recess o^2, provided with an extension o^3. The valve can be turned by means of the regulating-lever into three main positions, "hot," "half-hot," and "cold;" but it can also be placed in any desired intermediate position. When the lever is turned to the position hot, steam from the auxiliary steam-pipe N passes through the branch m of the valve-casing, through the valve-opening o' and the port c' into the branch m', to which is connected the pipe x, leading to the upper portion of the heating-cylinder. From the heating-cylinder the steam passes through the pipe y, containing the throttling part d, Fig. 13, and through the branch m^2 back again into the valve-casing S, whence it escapes through port c^2, recess o^2 of the valve into the port c^3, and through the latter and the branch m^3 into the pipe z, leading to the pipe K for water of condensation. If the heating installation is placed by turning the valve to half-hot, then the port c' is closed by the valve, and no live steam can get into the heating-cylinder. On the contrary, the ports c' c^2 c^3, are connected together by the recess o^2 of the valve, and the steam contained in the pipe for water of condensation escapes from the port c^3 into the ports c^2 and c', and thus into the heating-cylinder. The steam is not live steam and does not circulate in the heating-cylinder, so that the heating effect is smaller. By continuing to turn the valve in the same direction into the position cold the port c^3 is closed. The port c' and c^2 are then connected by the recess o^2 and its extension o^3 to the port c^4, leading into the atmosphere and conveying steam from the heating-cylinder direct into the atmosphere, so that finally cold atmospheric air can get in.

The drainage-valve, Figs. 15–18, arranged at the end of the pipe K for water of condensation, consists of a device A, provided with a number of superposed chambers a' a^2, &c., closed by a slightly-conical

valve member *e*, provided with grooves at the circumference. The valve E, operated from the outside and held open by spring-pressure, the opening of which is screened from the trap T by a perforated cap *k*, allows water of condensation to escape direct as long as the pressure of the spring has not been overcome, while when the valve is closed water can escape only through a pipe *j* and through a perforation *e'*, reduced by means of a throttling part *d* in the upper chamber *a'*. In order to pass from one chamber into the next and finally to the outlet-opening of the valve member, water of condensation and steam must then repeatedly pass through the grooves of the said valve member between each two chambers, so that finally all steam is condensed, and no escape of steam takes place. The throttling parts used for reducing the cross-section of various parts of the heating installation are constituted by a loosely-inserted twisted metal wire *d*, Figs. 13 and 14 or 15, which arrangement has the advantage that the width of the pipe or conduit can be made comparatively large and that clogging is prevented by the mobility of the wire. Fig. 13 shows such a wire in the pipe leading from the heating-cylinder to the regulating-valve. In Fig. 14 the throttling part is shown in a pipe *r*, (or *z*,) leading from the auxiliary steam-pipe to the pipe for water of condensation, and in Fig. 15 such a wire *d* is shown in the water-separator A. Such throttling parts can also be arranged at other suitable points, if required.

The working of the circulating heating installation is as follows: Steam admitted from the locomotive into the train-pipe H passes to the steam-trap B and from it through the pipe *b* to the regulating and check valve V and tries to pass through the latter into the auxiliary steam-pipe N of the first carriage, a portion of the steam continuing to flow in the main pipe. Water of condensation, formed owing to the rapid cooling of the steam at the beginning of each heating operation, escapes through the open valves of the steam-heating hose-pipes between the carriages, but passes to the greatest extent into the steam-trap of the main steam-pipe, through the valve of which it escapes into the atmosphere. Steam separated from water and impurities first passes with a small pressure into the branch pipe for the first carriage; but there its pressure quickly increases, as the steam coming after it is not conveyed farther as quickly as it comes from the locomotive-boiler into the main pipe. The steam tries, therefore, to enter quickly through the check-valve *v'*. As, however, in the casing there is little or no back pressure, the valve *v'* (at about half-atmosphere) will be pressed against the upper surface of the intermediate part *f''*, the admission of steam for the moment stopped, and the steam forced to continue to flow farther in the main steam-pipe. The high-pressure valve v^2, which is also closed, opens only when the pressure of steam has reached one and one-half atmospheres. Steam violently entering at that moment passes through the regulating-valve v^3 into the auxiliary steam-pipe, flows for a certain time, and finally closes the said valve. Then it can only pass into the auxiliary steam-pipe through leakages at the point of rest of the valve and through the lateral recesses *a* of the latter. In this way the pressure of the steam entering through the valve v^2 very quickly becomes so high that the pressure of steam in the space between the valves v^2 and v^3, together with the pressure of the spring of the first valve, overcomes the pressure of steam in the main pipe and then closes the valve v^2. At the next moment the valve v^3 opens, however, again, as the pressure at once falls, and almost simultaneously the valve v^2 is opened. Steam enters again, and the same thing is repeated. By this continued opening and closing of the two valves v^2 and v^3 the admission of steam is delayed in such manner that steam in the main steam-pipe in the meantime reaches the last carriage.

The process described is repeated at every carriage of a long train except the last one. In the latter the pressure of steam in the main steam-pipe does not increase so quickly as to depress the valve *v'* against the intermediate part *f''*, but, on the contrary, the increase of pressure in question is quite gradual. Steam continually flows through the valve *v'*, which is only slightly depressed, and produces behind it a counter or back pressure. The pressure of steam can therefore rise above one atmosphere without the valve *v'* closing the intermediate part *f''*. The valves v^2 and v^3 remain during that time completely inoperative. In the first carriage of the train the auxiliary steam-pipe has in the meantime become filled with steam and also the pipe for water of condensation; but in the latter the pressure of steam is still small. The pressure in the auxiliary steam-pipe of the said carriage will be about one and one-half atmospheres less than in the main steam-pipe, as the pressure of the spring of the valve v^2 is calculated accordingly. In order that at the beginning of the heating air and water of condensation should be completely expelled, the pipe for water of condensation must not become prematurely filled with steam. To that end the admission of steam is delayed by the throttling parts. The steam from the auxiliary steam-pipe passes through all the regulating-valves *s* placed into the hot position, into the heating-cylinders, and thence into the pipe for water of condensation, and carries with it air and water of condensation. These are expelled into the pipe for water of condensation through discharge-pipes ar-

rang d at the lowest point of the heating-cylinders and containing a throttling part. The air in the auxiliary steam-pipe and the water of condensation contained in it are expelled through a pipe *r*, connected to the end of the auxiliary steam-pipe and containing a throttling part, and from the pipe *r* into the pipe for water of condensation.

In the pipe for water of condensation the pressure of steam is always one-eighth to one-fourth of an atmosphere less than in the auxiliary steam-pipe, and the pressure in the heating-pipes of the auxiliary chambers is also slightly greater than in the pipe for water of condensation, so that a constant circulation of steam, considerably increasing the heating effect, is obtained.

The separator arranged at the end of the pipe for water of condensation allows air, water of condensation, and steam of small pressure to escape through its valve E. When the pressure of steam in the pipe for water of condensation increases to about $\frac{1}{4}$ - $\frac{1}{2}$ an atmosphere, the said valve closes and the water of condensation, as well as steam, must pass through the pipe *j* and through the chambers of the casing A and the helical grooves of the valve member *e* between each two such chambers, and therefore the steam is subjected to a repeated expansion and throttling, which results in such a strong condensation that finally only water escapes from the water-separator. As, owing to the arrangement of the water-drainage valve, no closing takes place, as in other systems, by means of a closing-cock at the end of the drain pipe, which has to be opened from time to time for discharging water of condensation, air, and steam, a continuous movement of steam toward the outlet is insured, and the closing-cock is done away with altogether. When stopping the heating, water of condensation automatically escapes from the chambers of the casing A.

When a carriage is cut out of the train, the valve *v'* is then at once raised and closed, so that neither can steam escape from the auxiliary steam-pipe, nor can cold atmospheric air pass into the same. The heating hose-pipes can therefore be removed without any danger. The duration of the valve closing depends on the pressure of steam in the auxiliary steam-pipe.

I claim—

1. In a steam-heating system for railway-carriages, in combination, a carriage supply-pipe, a drain-pipe operatively connected to said supply-pipe, a plurality of heaters, connections from said supply-pipe to said heaters and from said heaters to said drain-pipe, and valves in said connections adapted to admit steam to said heaters either from said supply-pipe or said drain-pipe.

2. In a steam-heating system for railway-carriages, in combination, a train-pipe, a steam-trap therein, an auxiliary carriage supply-pipe, a connection between said train-pipe and said auxiliary pipe, a combined, automatic regulating and check valve in said connection, heaters operatively connected to said auxiliary pipe, a drain-pipe for receiving water of condensation from said auxiliary pipe and said heaters, and valves constructed and arranged to independently control the supply of steam to said heaters, each valve being adapted to simultaneously regulate the supply to the corresponding heater and to permit the discharge of water of condensation therefrom.

3. In a steam-heating system for railway-carriages, in combination, a train-pipe, an auxiliary supply-pipe, a connection between said train and auxiliary pipes, a combined regulating and check valve in said connection, a plurality of heaters, a drain-pipe, connections from both said heaters and said supply-pipe to said drain-pipe, valves in the heater connections adapted to admit steam to the heaters from either the supply-pipe or the drain-pipe, and a terminal trap and drainage device for said drain-pipe.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ALEXANDER HILLISCH.

Witnesses:

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