No. 779,157. PATENTED JAN. 3, 1905.

H. GRONWALD.

MEANS FOR EXTINGUISHING FIRES ON SHIPS OR THE LIKE.

APPLICATION FILED SEPT. 24, 1900.

2 SHEETS—SHEET 1.

Fig 1

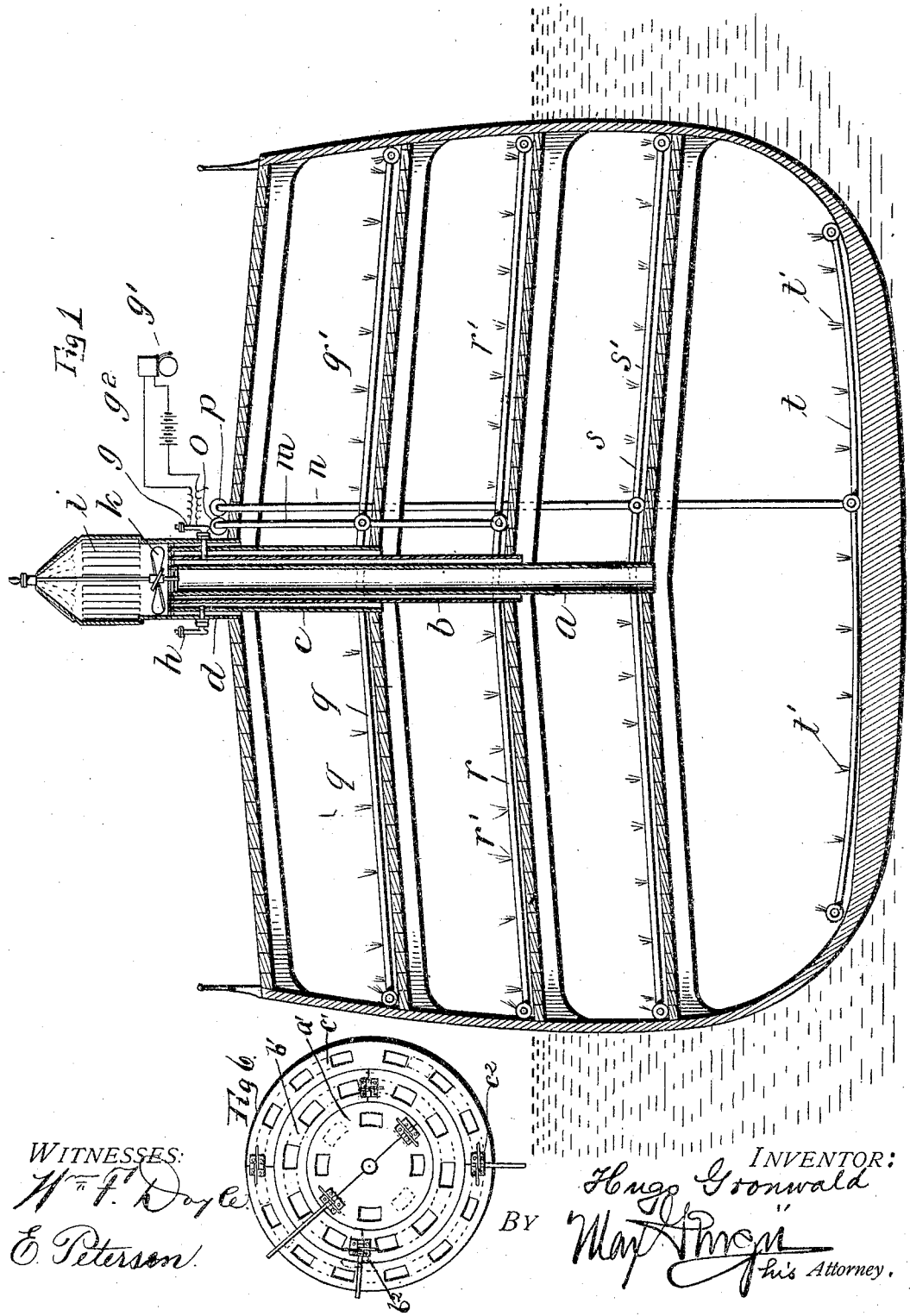


Fig 6.

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2 SHEETS—SHEET 2.

Fig. 4.

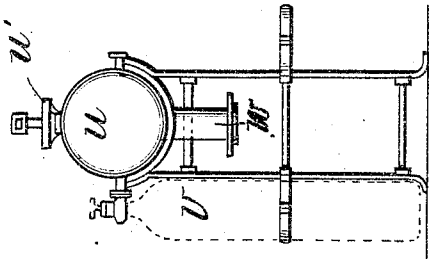


Fig. 5.

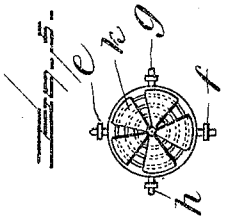


Fig. 3.

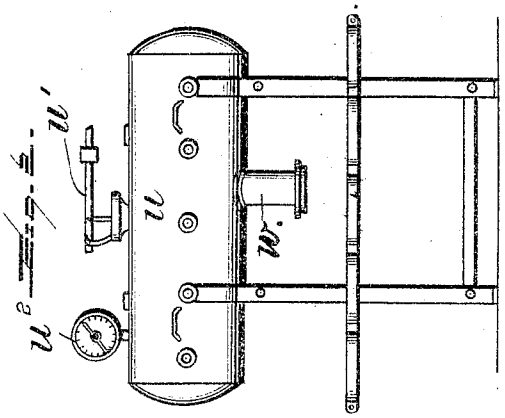
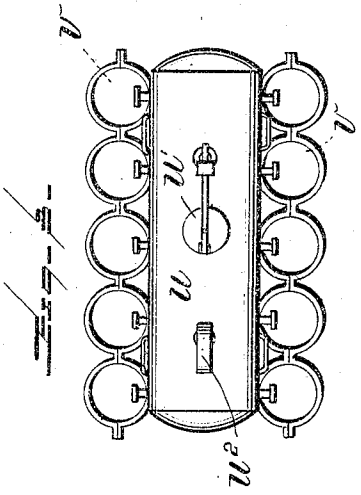


Fig. 2.



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No. 779,157. Patented January 3, 1905.

UNITED STATES PATENT OFFICE.

HUGO GRONWALD, OF BERLIN, GERMANY.

MEANS FOR EXTINGUISHING FIRES ON SHIPS OR THE LIKE.

SPECIFICATION forming part of Letters Patent No. 779,157, dated January 3, 1905.

Application filed September 24, 1900. Serial No. 31,002.

To all whom it may concern:

Be it known that I, HUGO GRONWALD, chemist, a subject of the King of Prussia, German Emperor, residing at Berlin, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Means for Extinguishing Fires on Ships or the Like, of which the following is a specification.

This invention relates to the art of extinguishing fires on vessels—such as boats, ships, and similar structures—and in particular to the extinguishment of such fires with the aid of carbonic-acid gas or equivalent mediums for checking combustion. In this art it has long been endeavored, without success, to devise means and methods for extinguishing fires which originate in the cargoes of ships promptly and with certainty. It was believed at first that carbonic-acid gas was an effective agent for this purpose. However, the use of the same has not been carried into actual practice for the reason that it required the transportation of very large quantities of carbon dioxid, whose quantity and weight made the use of the same impracticable.

In order to make carbon dioxid practicable for the extinguishment in the holds of vessels or in the cargo, special apparatus is necessary, as I have found.

This invention is based upon my discovery that it is not necessary to introduce pure carbonic-acid gas into the seat of the fire, but that a mixture of air and carbonic acid containing as low a quantity as twenty-five per cent. of carbonic acid is sufficient to extinguish any fire promptly and with certainty. Based on this discovery I have devised means and apparatus whereby the extinguishing operation is performed not by pure carbonic acid, but by a mixture of the same with air. In order to attain this result, I find that it is necessary that the air which has been rarefied by expansion due to the fire will neither exert too great a pressure nor escape too rapidly through the ventilators, for example, when the carbonic-acid gas is introduced. Neither of these conditions can be satisfied with the arrangements and constructions existing at present on vessels, for the following reasons: If the hold is not connected with the outer air by means of ventilators or air-shafts, as is the general rule on sailing vessels, for example, and carbonic acid were conducted into the space where the fire has occurred, the introduction of such carbonic acid, on the one hand, and the increased expansive action of the air in the hold due to the increased temperature would exert a very strong pressure upon the hatches, which may become strong enough to burst the same. If, however, the hatches do not close sufficiently tight, it has been shown by extensive experiments which have been conducted that an extinguishment of the fire by means of carbonic acid is impossible, for the reason that by the strong current of air induced by the fire the carbonic acid is carried out through the hatch-openings and is, moreover, so strongly diluted by the fresh outer air which pours into the hatchways by convection that the extinguishing qualities of the carbonic acid are entirely lost. The bursting of the hatches would, moreover, increase the danger of communicating the fire to other parts of the vessel. It follows from these considerations that an extinguishment of fires on vessels by means of carbonic acid or other extinguishing gases can only be successfully carried out if the ventilation of the space wherein the fire occurs can be regulated in such a manner that too great an air or gas pressure cannot take place. Further experiments which have been made in this direction have, moreover, shown that carbonic acid and other fire-extinguishing gases cannot be used as a fire-extinguisher on vessels which are provided with the usual ventilators or air-shafts. These ventilators are of far too great a diameter, and in case of fire in the hold or in the cargo they would enable the air expanded by the increased heat to escape rapidly upwardly through the decks. If this occurs, a danger of too great a pressure is eliminated, it is true; but at the same time another danger is incurred which is of still greater bearing on the question of extinguishing fire. This danger consists in the fact that where the air is caused to escape rapidly from the space of combustion the carbonic-acid gas has no opportunity to combine

and mix with the same sufficiently to produce the proper extinguishing mixture. At any rate such a condition of things would require a very large quantity of carbonic acid to properly fill the space of the fire. This is the main reason why the carbonic-acid gas, although known to be the most certain and most effective fire-extinguisher, has not been available for this purpose on vessels, and yet this gas is particularly desirable for this purpose, because not only does it penetrate every part of the cargo, killing the fire in every portion of the same, but will not spoil the cargo, as is the case where water and steam are employed.

The present invention makes it possible to use this desirable extinguisher, in that it makes it possible for the first time to produce a proper mixture of carbonic acid and air which will not only quickly and effectively extinguish the fire, but will be sufficiently economical, in that it saves both carbonic acid and storage-space.

My invention is carried into practice by providing each hold of the vessel with a pipe system for introducing carbonic acid, the said system being preferably so arranged that the carbonic acid or extinguishing-gas will rise from the floor of the hold or space, in combination with exit-pipes having substantially the same discharge capacity or whose areas in cross-section are substantially the same as those of the aggregate carbonic-acid-gas inlets to the respective compartments or holds of the vessel. Such pipes are preferably provided at the upper ends with safety-valves which are adapted to be properly adjusted. The exit-pipe is to serve also to let off the smoke and hot air arising in the case of a fire only to such an extent as is necessary to prevent injurious pressure, but not in such a measure as to prevent the formation of a proper mixture of air and carbonic acid. These safety escape or exit tubes preferably extend to the upper deck and are there provided with suitable thermometers and alarm devices, so that said pipes will serve also for announcing the existence of the fire and facilitating the proper observation of the condition of the same, while the extinguishing operation is proceeding from the deck.

Referring to the accompanying drawings, Figure 1 is a vertical cross-section through a ship furnished with a plant constructed according to my invention. Fig. 2 is a side view of an expansion vessel forming a part of said plant. Fig. 3 is a plan view of said vessel; Fig. 4, the front of the same, and Figs. 5 and 6 are detail views in plan of the upper ends of the escape-pipes and of the throttle-valves or dampers on the same, respectively.

In the form of construction shown in Fig. 1 the vessel has four cargo-holes and each of the decks separating the holds from each other has an escape pipe or tube leading from that deck to the outer air above the uppermost deck. All these tubes *a b c d* are concentrically arranged, and the upper ends of them are provided with electric thermometers *e f g h*, that take into the various circular or annular spaces through which the smoke escapes. The indicator for said thermometers may be located upon the bridge-deck or conning-deck or at any other suitable place.

When a fire arises in one or the other cargo-hold, the hot gases, &c., escaping through the respective tube act upon the respective thermometer and cause it to indicate upon the indicator in which hold the fire is. This indicator in the present instance consists of an electric alarm-bell g', in a circuit g^2, which is closed whenever a thermometer g indicates a certain temperature, as will be readily understood. The tubes are preferably provided with dampers, throttle-valves, or the like, permitting of closing the respective tube or all the tubes, so as to prevent an escape of the carbonic-acid gas through them while below a predetermined pressure after the place of the fire has been ascertained and carbonic-acid gas has been led to that place.

Besides the tubes *a b c d* the plant comprises in the example shown pipes *m* and *n*, serving for leading the carbonic-acid gas down into the cargo-holds. The upper ends of these pipes are furnished with connecting-pieces *o p* for the attachment of the gas-flasks, and the ends or other parts of the pipes *m n* inside the ship are connected with horizontal or somewhat inclined pipes *q r s t*, branching from said pipes to all sides to the various parts of the various holds and having apertures upon their upper sides for the exit of the gas. This latter may thus be led to every part of the cargo; but it is a matter of course that the arrangement of the pipes may vary according to the particular conditions of every single case. The cross-sectional area of each of the tubes *a b c d* is substantially equal to the aggregate area of the outlets for the extinguishing-gas from the pipes *q*, *r*, *s*, and *t*.

Figs. 2, 3, and 4 show a front view, a side view, and a plan, of the expansion vessel *u*, which is connected in Fig. 4 with some gas-flasks V. Said vessel has, as already stated, a safety-valve u', a manometer u^2, and other necessary fittings, and a piece of tube *w* serves for connecting the vessel *u* with the connecting-pieces *o p* of the pipes *m n*. All the parts for putting the plant in operation, as well as the gas-flasks, &c., are preserved in a special cabin or the like, so located as not to be able to impede the free movements of the people on board.

In operation whenever a fire occurs in one of the holds of the vessel the carbonic-acid gas is introduced into that hold through one of the pipes *m* and *n* and thence through one of

the pipes q, r, s, or t, the gas finally issuing through jet or escape orifices arranged in said latter pipes. These pipes q, r, s, and t being arranged at the bottom of the hold, the carbonic-acid gas being heavier than the air contained in the hold accumulates at the bottom of the hold and gradually rises in the same, thus expelling the air through one of the pipes a, b, c, and d. Since the cross-sectional area of these tubes is substantially equal to the cross-sectional area of the outlet or jet orifices q' r' s' t', the air will escape from the hold as fast as the carbonic-acid gas is introduced and no resistance will be offered to the entry of the same. When the carbonic-acid gas has reached a certain level, corresponding according to the best practice to about one-fourth ($\frac{1}{4}$) of the quantity of air which formerly filled the compartment, the escape-tube a, b, c, or d corresponding to the hold to be operated on is closed by closing the damper a', b', c', or d' The compartment is now closed and the carbonic-acid gas will now mix with the air contained in the hold by diffusion and convection and by the increased circulation of gases occurring in the hold in case of a fire. The dampers a' b' c' d' are, however, made yielding, so as to act as safety-valves by the arrangement of spring-hinges a^2 c^2, &c., as shown, so that when the pressure reaches a certain limit they will be thrown open to ease the pressure. Under all circumstances the mixture of air and extinguishing-gas is confined within the hold, and so permitted to do its work of extinguishment without any loss and in the most economical manner possible. The safety-valve u' on the expansion-chamber u also aids in preventing an excess of pressure in the hold, as will be readily understood. Substantially the same operation takes place when in lieu of an extinguishment of fire it is desired to introduce a mixture into any or all of the holds for the purpose of preventing the occurrence of a fire. The ventilating-cowl l with its fan k are only effective when the holds are open and when there is no fire or no danger of fire.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. An apparatus for preventing and extinguishing fires, which consists of means for introducing an extinguishing-gas to the space where a fire is to be prevented or extinguished, in combination with means for preventing the escape of the gas mixture produced while below a predetermined pressure and operating automatically to permit its escape when such degree of pressure is reached.

2. An apparatus for preventing and extinguishing fires, which consists in means for introducing carbonic-acid gas to the space wherein a fire is to be prevented or extinguished, in combination with means for preventing the escape of the gas mixture produced while below a predetermined pressure and operating automatically to permit its escape when such degree of pressure is reached.

3. An apparatus for preventing or extinguishing fires, which consists in means for introducing carbonic-acid gas to the bottom of the space wherein a fire is to be prevented or extinguished, in combination, with means for preventing the escape of the gas mixture produced while below a predetermined pressure and operating automatically to permit its escape when such degree of pressure is reached.

4. The combination, with the hold of a vessel or other space, and a feed-pipe for introducing extinguishing-gas, said feed-pipe leading to the bottom of said hold or space, of an escape-pipe for gases having a discharge capacity substantially equal to the capacity of the feed-pipe, means for closing the escape-pipe, and means operating automatically to open the escape-pipe when a predetermined degree of pressure within the hold is reached.

5. An apparatus for preventing or extinguishing fires, which consists in means for introducing an extinguishing-gas to the space wherein the fire is to be prevented or extinguished, in combination with means for withdrawing the gases from said space, and automatic means for proportioning such withdrawal to the pressure within such space.

6. The combination, with the hold of a vessel or other space, of a feed-pipe for introducing extinguishing-gas heavier than air, said feed-pipe leading to the bottom of said hold or space and an escape-pipe for heated gases whose cross-sectional area is substantially equal to the area of the inlet or inlets, in the aggregate, from the feed-pipe.

7. The combination with the hold of a vessel or other space, of a feed-pipe for introducing extinguishing-gas heavier than air, said feed-pipe leading to the bottom of said hold or space, an escape-pipe for heated gases whose cross-sectional area is substantially equal to the area of the inlet or inlets in the aggregate from the feed-pipe, and a damper controlling said escape-pipe.

8. The combination, with the hold of a vessel or other space, with a feed-pipe for introducing extinguishing-gas heavier than air, said feed-pipe leading to the bottom of said hold or space and an escape-pipe for heated gases whose cross-sectional area is substantially equal to the area of the inlet or inlets, in the aggregate, from the feed-pipe, said escape-pipe being, moreover, provided with a safety-valve.

9. An apparatus for extinguishing or preventing fires in vessels which consists in receivers for carbonic acid under pressure, a pipe, or pipes for feeding the carbonic-acid gas therefrom to the lower portion of the space where a fire is to be extinguished or prevented and an expansion vessel arranged between and communicating with the gas-receiver and the feeding pipe or pipes, in combination with

exit-passages from the upper portion of said space corresponding substantially in capacity with the inlet-pipes.

10. An apparatus for extinguishing or preventing fires in vessels which consists in receivers for carbonic acid under pressure, a pipe, or pipes for feeding the carbonic-acid gas therefrom to the lower portion of the space where a fire is to be extinguished or prevented and an expansion vessel arranged between and communicating with the gas-receiver and the feeding pipe or pipes, said expansion vessel being provided with a safety-valve, in combination with exit-passages from the upper portion of said space corresponding substantially in capacity with the inlet-pipes.

11. An apparatus for extinguishing or preventing fires in vessels, which consists in means for closing the space in which a fire is to be extinguished or prevented, in combination, with a receiver for carbonic acid, a pipe, or pipes for feeding the carbonic acid from the receiver to the lower portion of said space and an expansion vessel arranged between and communicating with the receiver and the feeding-pipes, in combination with automatically-operable means for affording egress from the upper portion of said space when the pressure of the gases therein exceeds a certain limit.

12. An apparatus for extinguishing or preventing fires in vessels, which consists in means for closing the space in which a fire is to be extinguished or prevented, in combination, with a receiver for carbonic acid, a pipe, or pipes for feeding the carbonic acid from the receiver to the lower portion of said space and an expansion vessel arranged between and communicating with the receiver and the feeding-pipes, said expansion vessel being provided with a safety-valve, in combination with automatically-operable means for affording egress from the upper portion of said space when the pressure of the gases therein exceeds a certain limit.

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

HUGO GRONWALD.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.