

UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR HEAT INSULATION.

1,301,675.

Specification of Letters Patent.

Patented Apr. 22, 1919.

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To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Methods of and Apparatus for Heat Insulation, of which the following is a specification.

My invention relates to methods and apparatus for preventing the flow of heat; especially from spaces where the temperature is high; and more especially still, from the cylinders of heat engines; particularly engines of the type shown in U. S. Patent 1,132,465.

My invention consists in the use of certain types of alloys which I have discovered possess properties which make them particularly efficient for purposes of heat insulation; and also generally in increasing the efficiency of heating chambers and thermal engines.

The drawing forming a part of this specification shows, partly diagrammatically and partly in section, an application of the method and apparatus to a heat engine, of the type shown in U. S. Patent 1,132,465.

Here 11 is the cylinder and 17, 17 the pistons. These are covered by the heat insulating liners 13, 14, 14, formed of the alloys described later in this specification. Between the liners and the cylinder and piston bodies are also heat insulating laminae 12, 15, 15; of air or magnesia, or chrome oxid, or tungsten oxid, of cement or lime or thin strips of alloy or layers of mica covered with alloy strip, or other suitable material, for example enamel or porcelain, or steel wool, or slag wool, or alloy wool.

The scavenging receiver 20 delivers air into the cylinder 11 through the ports 18, 18. The burnt gases escape through the exhaust ports 19, 19. The piston rods, 21, 21' drive the cranks 22, 22' and the crank-shafts 23, 23' are synchronized by the chain belt 25 and pulleys 24, 24'.

Oil from the pipe 27 is injected into the cylinder through the injection valve 26, by means of air, or burnt gaseous products of combustion, or steam, preferably generated by the heat of the exhaust gases of the engine, and super-heated from the pipe 28, and the valve 26 is operated electromag-

netically by means of the commutator consisting of the insulating part 32, and the conducting segment 33, mounted on the shaft 23'. 30 and 31 are brushes, 29 is a battery, and when the circuit is completed by the conducting segment 33 passing under the brushes 30, 31, the battery 29 actuates the magnet of the electromagnetic injection valve 26, lifting the valve seat, and the oil is injected. The time of injection may be varied by shifting the brushes 30, 31, and the lift of the valve 26 by varying the strength of the current flowing from the battery 29.

The liners of a thermal motor should have the following properties, among others:—

1. They should not be easily fusible.
2. They should not be oxidizable or acted on by the products of combustion.
3. They should not take up heat readily from the hot gases resulting from the ignition of the combustible.

There are numbers of metals which fulfil the first two conditions, for example, gold, silver and platinum. Tungsten fulfils the first, but not the second. But applicant has never been able to find any description of any materials suitable for the purpose which fulfil all three.

Applicant has however discovered that certain well known and other unknown, alloys fulfil all three, and has tested same experimentally.

Broadly speaking these alloys consist of a metal of high melting point combined with a metal whose oxid or carbid insulates heat well at high temperatures. So much appears from the applicant's experiments. And the theory which applicant has formed as the result of his experiments is that the alloy is acted on by the hot gases at its surface and that the high melting point metal is oxidized and carried away, and the metal with the heat insulating oxid is oxidized and the oxid remains on the surface, sometimes in so thin a film as to be transparent or yellowish or brownish, or bluish, and resists the further transfer of heat from the burning combustible to the liner. This theory may not be correct, but it appears to account for the facts, so far observed.

Suitable alloy forming high melting point metals are those of the iron group, though others may be used. Suitable metals

of the thermally resisting oxid class are chromium, magnesium, aluminium and tungsten, though others may also be used.

The alloys are not limited to two elements, as several may be used.

A suitable way to test the alloys is to take a six inch square plate, stand it on edge and apply a high temperature blow pipe to its center and see how long it takes to get red hot on the opposite side. Many metals and alloys will resist even the acetylene-oxygen blow pipe, especially if water cooled at the back, for example platinum and platinum-irridium and some of the alloys used for making safes. But the alloys forming the liners used by applicant have the additional property, discovered by applicant, that they not only resist the action of the blow pipe, but also, in addition, do not take up heat readily from the hot gases of the blow pipe, as is shown by their taking a longer time by far to become red hot on the opposite side to the blow-pipe.

Some of the alloys which have shown this new property are well known, others not. A very suitable alloy is one consisting of iron, nickel, or cobalt, with about 10% of chromium, and the addition of a few per cent. of tungsten seems to still further improve the heat insulating properties of the alloy. Possibly because the double oxid of chromium and tungsten is a better heat insulator at high temperatures than the alloy of chromium or chromium and iron or nickel is. Whatever the reason I have found this alloy particularly suitable, though the admixture of small amounts of other materials such as manganese etc. does not seem to render it less heat insulating, *i. e.* it is not necessary that it should be chemically pure.

Where the heating is many times repeated and mechanical strength is necessary, it is better to have a pure material alloy, for example nickel alone and about 10% to 15% chromium, or cobalt alone and chromium. Up to 40% chromium or 45% may be used, but the effect does not increase so rapidly above 10%.

Instead of operating the valve 26 by a battery, it may be actuated by the discharge of condensers, first charged and then discharged through the circuit, the number of condensers used depending on the time the valve is required to be open. The cylinder liners may be conical, instead of cylindrical, as also the cylinders.

The alloy wool is made by blowing the alloys, such as chrome-nickel, chrome-iron, chrome-cobalt, or magnesium bronze, into fine filaments, like slag wool or steel wool. Not only does the thin film of alloy oxid insulate the heat, but, being almost transparent in thin layers, it reflects the heat also. Consequently the heat from the hot gases is not readily convected or absorbed into the alloy liner of the engine or gun or other thermal motor.

What I claim is:—

1. The combination of a high temperature chamber and a thermo insulator for said chamber, consisting of a coating formed by heating an alloy of a high temperature point metal and a metal whose oxid is a good thermal insulator at high temperatures.

2. A heat insulating liner for thermal motors consisting of a coating formed by heating an alloy of a metal of the iron group and chromium.

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