

May 22, 1928.

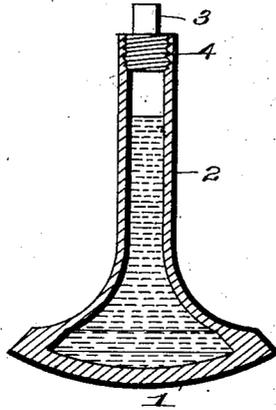
1,670,965

S. D. HERON

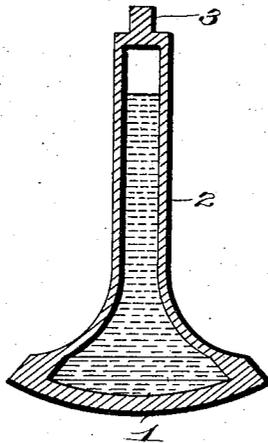
COOLING OF EXHAUST VALVES OF INTERNAL COMBUSTION ENGINES

Filed June 9, 1923

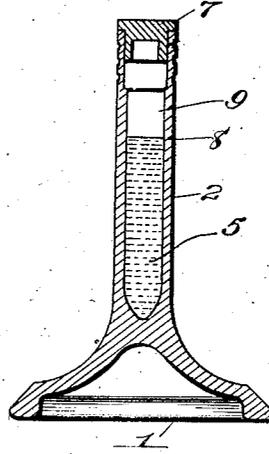
*Fig. 1*



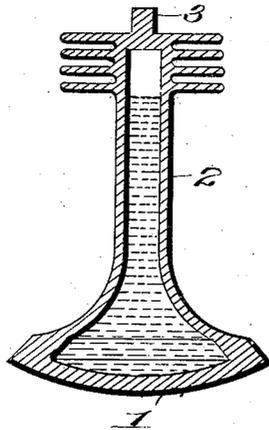
*Fig. 2*



*Fig. 4*



*Fig. 3*



Inventor

*Sam D. Heron,*

By

*Robert H. Young*  
Attorney

# UNITED STATES PATENT OFFICE.

SAM D. HERON, OF DAYTON, OHIO.

COOLING OF EXHAUST VALVES OF INTERNAL-COMBUSTION ENGINES.

Application filed June 9, 1923. Serial No. 644,480.

This invention relates in general to engine valves and is especially applicable for cooling the exhaust valves of internal combustion engines.

5 I am aware that it is not new in the art to provide such a valve with a hollow valve stem and to partially fill the hollow portion of the stem with some liquid for the purpose of cooling the valve. I am aware that the use  
10 of a very small quantity of mercury or water for such a cooling liquid has been proposed, the cooling being accomplished by the boiling of the fluid in the lower part of the valve and the subsequent condensation at the upper  
15 part of the valve stem. Mercury and water are, however, open to the objection that they volatilize below the working temperature of the valve and thus develop a vapor pressure within the valve which is difficult to hold  
20 and loss of the cooling medium thus frequently results. Furthermore, the effectiveness of such a cooling medium is materially altered by the position or attitude of the valve. When such a cooling medium is to  
25 be used it is essential that the attitude of the valve being vertical, or nearly so, and that the valve head be lower than the valve stem.

30 It is the object of my invention to obviate the difficulties above enumerated by supplying such a valve with a cooling medium with the four following most important characteristics: first, it shall have a fusing point lower than the average working temperature  
35 of the valve; second, it shall have a vaporizing or decomposing temperature greatly in excess of the normal working temperature of the valve; third, it shall have the property of wetting the hot surface of the interior of  
40 the valve and neither assume the spheroidal form as does water on hot iron or behave as does heated mercury in a closed container; and fourth, a sufficient quantity of the medium must be used so that the interior of the  
45 valve will be filled with a mixture of liquid and gaseous material in which the volume of the liquid is predominating.

50 It is thus the object of my invention to provide a cooling medium in which the heat transfer is obtained by the use of a non-volatile liquid which is maintained in a violent state of turbulence by the motion of the valve and which acts as a heat carrier by virtue of this turbulence. It is essential that  
55 this substance have the property of wetting

the valve material to be efficient in the transfer of heat from the hot surfaces to the comparatively cooler surfaces of the valve. The benefits of this system over the prior art is that the heat transfer is not affected  
60 by the position or attitude of the valve, and further that the difficulty of keeping high pressure vapors in the valve stem is obviated.

In order that those skilled in the art may more readily practice the invention which I have made, I have described the same in the accompanying specifications and illustrated the same in the accompanying drawings in  
70 which:

Fig. 1 is a central vertical section of a valve showing means for inserting a cooling medium into its hollow valve stem.

Fig. 2 is a modification showing a closed valve.

Fig. 3 is a modification of Fig. 1 showing cooling fins in the valve stem, and;

Fig. 4 is a modification showing the cooling medium in the stem only.

Referring more particularly to the drawings and reference being had first to Fig. 1, it will be seen that I disclose a valve 1 having a hollow stem 2. The valve near its upper end may be interiorly screw threaded and adapted to receive plug 4, or a plug may be inserted in either end of the valve in any desirable manner. The plug 4 is provided with the usual valve tappet bearing surface 3 and when inserted, may be fixed in any manner (not shown) against rotation relative to the valve stem. In Figure 2 is shown a closed valve which may be filled with the cooling medium through an opening at the bottom or side of the valve, the cooling medium being supplied, in the valve head as  
95 well as in the stem. In Figure 3 is shown a modification in which cooling fins 6 are provided on the stem of the valve. In Fig. 4 is shown a valve in which the cooling medium is provided only in the stem of the  
100 valve and in which the plug number 7 is adapted to be driven into the stem with a mallet or arbor press. In this modification the level of the liquid when the valve is at normal air temperature is indicated at 8,  
105 and numeral 9 indicates the level of the liquid at the normal working temperature.

I propose to fill the hollow portion of the stem with a considerable quantity of the cooling medium 5 leaving a sufficient degree of  
110

space enough to care for the expansion of the materials due to the heat, and to allow of development of turbulence incident to the operation of the valve.

5 As a cooling medium I propose to use a substance which shall have the three following characteristics:

1. A fusing point lower than the working temperature of the valve.
- 10 2. A vaporizing or decomposing temperature greatly in excess of the working temperature of the valve.
3. It shall have the characteristic of being adapted to wet the surface of the hot metal
- 15 of the valve.

Such substances as potassium nitrate, sodium nitrate or lithium nitrate or any mixture thereof, or of metallic potassium, lithium or sodium, or of metallic potassium, 20 lithium or sodium, and their salts, or of any combination of the alkaline metals and their salts, have been found to satisfy the above conditions.

I have found that a mixture of 55% potassium nitrate and 45% sodium nitrate is 25 exceptionally well suited as a cooling medium as it has a melting temperature of about 425° F. which is well below the working temperature of the portions of the valve in contact with the cooling medium. The 30 valve is filled with the liquid salt mixture at about 750° F. An ejector rod is then inserted temporarily in order to force out a suitably quantity of the liquid so that when 35 the ejector rod is removed the level of the liquid (see Fig. 4) will be as shown in the dotted lines designated 9. The plug 7 is then driven home with a mallet or arbor press. After the valve cools the liquid level 40 will be at 8. The valve is filled at 750° F. as this is approximately the working temperature of the valve, and there will therefore be no material internal pressure on the valve stem when the same is operating.

45 The length of the internal chamber in Fig. 4 which is not filled with the liquid is from 1 to 2 times the distance travelled by the valve in its reciprocating motion, so that a proper turbulent action will be produced in 50 the liquid.

From the above description it will be readily seen that I will have avoided to a large extent the formation of vapor pressure inside the valve and that I will have provided for a cooling which shall be entirely 55 due to the turbulent circulation of a cooling liquid formed, this circulation being produced by temperature gradients in the cooling medium and by the motion of the valve rather than by boiling and subsequent condensation as has heretofore been the practice.

I claim:

1. A hollow valve containing a cooling medium within the same under substantially 60 normal atmospheric pressure at the average

working temperature of the valve in sufficient quantity to provide violent turbulence under operating conditions.

2. A hollow metal part adapted to operate back and forth rapidly at a high normal 70 temperature, having a cooling medium therein under substantially atmospheric pressure at the normal working temperature of the part, and having a lower fusing point and higher vaporizing point than the operating 75 temperature of the part, said medium only partially filling the space within said part to permit a turbulence of the medium, said medium having the property of wetting the material of the part under operating con- 80 ditions.

3. A hollow metallic part adapted to operate rapidly back and forth at a temperature of several hundred degrees Fahrenheit having a cooling medium therein containing a 85 nitrate of an alkali metal under substantially atmospheric pressure at the normal working temperature of the part, and having a lower fusing point and higher vaporizing point than the operating temperature of the part, 90 said medium only partially filling the space within said part to permit a turbulence of the medium, said medium having the property of wetting the interior of the part under operating conditions. 95

4. A hollow metal part adapted to operate back and forth rapidly at a temperature of several hundred degrees Fahrenheit, having a cooling medium therein which will not attack the part under operating conditions, said 100 medium being under substantially atmospheric pressure at the normal working temperature of the part, and having a lower fusing point and higher vaporizing point than the operating temperature of the part, said 105 medium only partially filling the space within said part to permit a turbulence of the medium, said medium having the property of wetting the interior of the part under operating conditions. 110

5. A metal engine part adapted to operate back and forth rapidly at a normal working temperature of several hundred degrees F., having a closed chamber partly filled with a 115 cooling medium which has a specific gravity less than iron and remains liquid at the normal working temperature of the part to provide for heat transfer by the turbulent circulation of the medium in a liquid state. 120

6. A metal part adapted to operate back and forth rapidly at a normal working temperature of several hundred degrees F., having a closed chamber therein containing a cooling medium which fills a large part of the chamber without completely filling it, 125 the medium having a specific gravity less than mercury and being liquid at the normal working temperature of the part to provide for heat transfer by the turbulent circulation of the medium in a liquid state, 130

the medium having the property of wetting the interior of the part without chemically attacking it in an objectionable degree.

7. A metal part adapted to operate back and forth rapidly at a high normal working temperature having a closed chamber therein containing a cooling medium which fills a large part of the chamber without completely filling it to provide a turbulent action, the medium comprising a substance of the alkali metal group having a specific gravity less than iron and remaining liquid at the normal working temperature of the part to provide for heat transfer by the turbulent circulation of the medium in a liquid state.

8. A metal valve adapted to operate back and forth rapidly at a working temperature of several hundred degrees F., having a closed chamber therein containing a cooling medium which fills a large part of the chamber without completely filling it to provide a turbulent action of the medium under operating conditions, the medium comprising a mixture of alkali metal salts, and being a liquid at the normal working temperature of the valve to provide for heat transfer by the violent circulation of the medium in a liquid state.

9. An exhaust valve for internal combus-

tion engines adapted to operate back and forth rapidly at a high normal working temperature, having a closed chamber therein containing a cooling medium only partly filling the chamber to provide a turbulent action of the medium under operating conditions, the medium comprising an alkali metal substance and having a higher decomposing or vaporizing temperature than 750° F., having a specific gravity considerably less than mercury and being liquid at the normal working temperature of the valve to provide for heat transfer by the turbulent circulation of the medium.

10. An engine valve adapted to operate back and forth rapidly while having the valve head subjected to temperatures of a high order, said valve having a closed chamber therein containing a cooling medium the vaporization temperature of which is above the usual operating temperature of the valve parts which fills a large part of the chamber without completely filling it to provide for heat transfer from the valve head to the cooler valve stem by transfer by the turbulent circulation of the cooling medium in a liquid state.

In testimony whereof I affix my signature.  
SAM D. HERON.