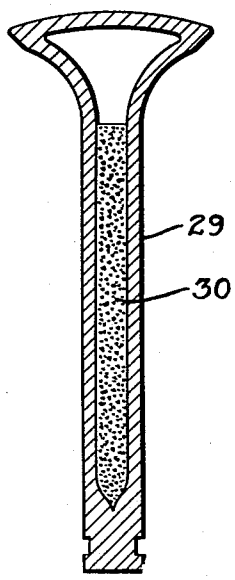
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VALVE

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VALVE

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This invention relates to valves and other reciprocating parts which operate at substantial temperatures, and to cooling material for use with such parts.

One object of the invention is the provision of a valve or other reciprocating engine part or the like adapted to operate at rather high temperatures, having a closed chamber containing a cooling medium adapted for the rapid transfer of heat from one portion to another by turbulent circulation of the medium in a liquid state, the cooling medium having an extremely low melting point and an extremely high vaporizing or decomposing temperature, the cooling medium furthermore having the property of wetting steel and being comparatively light in weight.

A further object of the invention is the provision of a cooling medium for valves and the like, composed essentially of mercury and sodium in the proportions, by weight, of about 40% sodium to about 60% mercury.

Other objects and advantages of the invention will be apparent from the following description and the appended claims.

In the drawing, the single view illustrates a valve embodying the present invention.

In accordance with the prior Patent No. 1,670,965 granted May 22, 1928, to S. D. Heron, valves and other parts such as are adapted to operate back and forth at high operating temperatures are cooled by a cooling medium contained therein in sufficient quantity so as to provide for heat transfer by the turbulent circulation of the medium in a liquid state. The present invention, which is an improvement on the said patent, provides a valve or other operating part having a cooling medium which has an unusually low melting point, is comparatively light in weight and has a very high vaporizing temperature, and which can be readily handled in the manufacture of the valves or other parts. In accordance with the present invention in its preferred form, which is applicable to exhaust valves of the character shown in the drawing in which reference numeral 30 is applied to the cooling medium and reference numeral 29 is applied to the valve member, and to operating parts such as pistons of internal combustion engines and the like, or any other hot operating part in which the effective transfer of heat is desirable, the closed chamber in which the cooling medium is sealed is partly filled with an amalgam of mercury and sodium in which the proportions, by weight, are about 60% mercury and 40% sodium. The quantity used is such as to fill approximately 60% or 70% of the total volume of the liquid containing chamber of the valve or other operating part, and the heat is transferred rapidly from one portion of the part, from the head of the valve for example, to another and cooler portion such as the stem portion by the turbulent circulation of the cooling medium in a liquid state as the valve or other operating part reciprocates rapidly to and fro, and throws the cooling medium from one end of the part to the other.

Mercury alone is not a satisfactory cooling medium for engine valves and the like which operate at high temperatures of the order of several hundred degrees Fahrenheit, as mercury has a comparatively low vaporizing point, and would create high pressures at high operating temperatures. Furthermore mercury does not have the property of wetting or clinging to iron or steel. Another objection to mercury is its unusually high specific gravity. Sodium alone operates quite satisfactorily under certain conditions when used as a cooling medium, but sodium is rather sluggish as a liquid, and has a melting point quite considerably above normal room temperatures, and also presents certain problems of handling.

The sodium mercury amalgam of the present invention is an extremely satisfactory cooling medium for use in engine exhaust valves and the like. This amalgam has a very low melting point of about 75° F., varying comparatively slightly in accordance with the particular percentage of mercury employed, and has a very high vaporizing point far above the operating temperature of the hot portions of internal combustion engine valves, which in many cases ranges from about 800° F. up to a temperature of the order of 1600° F. A very wide operating range of from about 75° F. to above 1900° F. is therefore provided so that anything containing the medium will not be distorted under operating conditions due to the creation of high internal pressures. And at very low operating temperatures the effective transfer of heat will commence promptly, and as soon as there is an increase of temperature, of a portion of the containing part, since the cooling medium is a liquid at normal warm room temperatures and it is unnecessary to heat up the valve or other part to liquefy the cooling medium. Inasmuch as the amalgam is a liquid at ordinary temperatures it can be very readily handled in the manufacture of valves and the like.

This amalgam is a very mobile liquid that will readily flow inside a valve or other container, and functions effectively in the transfer of heat from the hot portions to the cold portions of the containing part. This amalgam furthermore has the ability to wet or cling to the surface of steel and therefore acts efficiently as a heat conductor in intimate heat contacting relationship with the walls of the valve or other containing part.

The amalgam has a comparatively low specific gravity, and therefore does not add excessive weight to the valve or other rapidly moving part, in which lightness is a desirable factor. While the specific gravity of mercury is greater than

13, the sodium is lighter than water, and the combination, in which there is about ten times as much sodium, by volume, as there is mercury, provides a liquid which is only a few times heavier than water. The specific gravity of an alloy in which there is, by weight, 40% sodium and 60% mercury is only slightly in excess of 2. While this is somewhat heavier than sodium itself, an engine exhaust valve containing this amalgam would be very little heavier than a valve in which sodium is present alone as a cooling agent.

The amalgam is a stable liquid having properties which are distinct from the properties of its two constituents. The liquid does not decompose or break up, under operating temperatures. The amalgam itself and its mercury constituent does not alternately condense and vaporize, and the amalgam may be heated from room temperature to about 1600° F. or 1800° F. without creating substantial internal pressures such as might tend to distort a valve or other containing part. And it is not affected by being subjected to high temperatures over long periods of time. A valve containing the mercury-sodium amalgam mentioned has been subjected for 400 hours to a temperature of about 1400° F., and at the end of the period the valve was opened and it was found that the amalgam poured from the cavity substantially in the same condition as when it was introduced.

The sodium-mercury amalgam can be very readily handled. The correct amounts of both ordinary sodium and mercury can be taken and placed in a vessel so fitted as to permit the vessel being flooded with nitrogen gas. The vessel can then be warmed up to about 200° F. and as this warmth develops the sodium and mercury combine with the evolution of considerable heat. The result of this reaction is the formation of the desired liquid alloy together with a certain amount of dross which can be readily disposed of. The liquid alloy can then be drawn off by means of tubing while preventing its contact with oxygen and placed in a suitable container from which it can be transferred directly into the valves. In handling the materials up to the time they are put in the vessel to be combined together, the sodium is protected by immersing it in a suitable liquid such as a volatile hydrocarbon distillate to prevent oxidation of the sodium.

Most combinations of sodium and mercury will not give a satisfactory cooling medium. If the sodium is present only to the extent of about 2% by weight of the mixture, the mixture is exceedingly heavy and has such a low vaporizing point that if used in amounts such as to about one-half fill a valve cavity, excessive distortion of the valve will take place at about 1500° F. and the valve will explode at about 1800° F. as has been found in an actual test. If the sodium is present to the extent of about 15% by weight the melting point will be far above 200° F. and the combination will also be quite heavy. It has been found, however, that where the sodium-mercury alloy is composed of from 40% to 45% sodium, by weight, with the remainder mercury the melting point is about 75° F., the exact melting point varying in accordance with the exact proportions of mercury employed, and the vaporizing point is very high. The melting point is low enough for satisfactory commercial use even if the amount of sodium present is as low as 35% or as high as 50% by weight, but if the sodium is less than about 35% or considerably more than about 50% the melting point of the mixture becomes quite considerably higher. It is, therefore, preferred that the amount of sodium present should be approximately in the range of 40% to 45% of the total weight, as that range gives what can be termed an eutectic combination, having a very low melting point and also providing a liquid throughout a very wide range of temperatures which operates as a single element in that it remains stable even up to temperatures in excess of 1900° F. without the release of free mercury such as could create internal pressures.

While sodium is preferably used as a constituent of the mercury alloy for the purpose herein set forth, it has been found that other metals of the alkali metal group can be used with mercury to provide a satisfactory cooling medium, as potassium or lithium, when combined with mercury in proportions to give an eutectic mixture of these two metals gives a cooling medium of satisfactory characteristics.

While the device herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a hollow metal part adapted to operate back and forth with one end thereof subjected to high operating temperatures and with another portion at a lower temperature, and having a closed chamber partly filled with a cooling medium in sufficient quantity to provide for heat transfer by the turbulent circulation of the medium in a liquid state, a cooling medium comprising an alloy of mercury and an alkali metal in the proportion, by weight, of about 65% to 50% mercury and 35% to 50% alkali metal, said cooling medium being a stable liquid between a range of temperatures from below 200° F. to above 800° F., and having the property of wetting steel and being only a few times heavier than water.

2. A hollow metal part adapted to operate back and forth with one end thereof subjected to high operating temperatures and with another portion at a lower temperature, and having a closed chamber partly filled with a cooling medium in sufficient quantity to provide for heat transfer by the turbulent circulation of the medium in a liquid state, said cooling medium comprising an alloy of mercury and an alkali metal in the proportions, by weight, of about 60% mercury and about 40% alkali metal, said cooling medium being a stable liquid between about 75° F. and 1600° F., having the property of wetting steel, and being only a few times heavier than water.

3. In a hollow metal part adapted to operate back and forth with one end thereof subjected to high operating temperature and with another portion at a lower temperature, and having a closed chamber partly filled with a cooling medium in sufficient quantity to provide for heat transfer by the turbulent circulation of the medium in a liquid state, a cooling medium comprising an alloy of mercury and sodium in which the proportions, by weight, are about 40% sodium and about 60% mercury.

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