

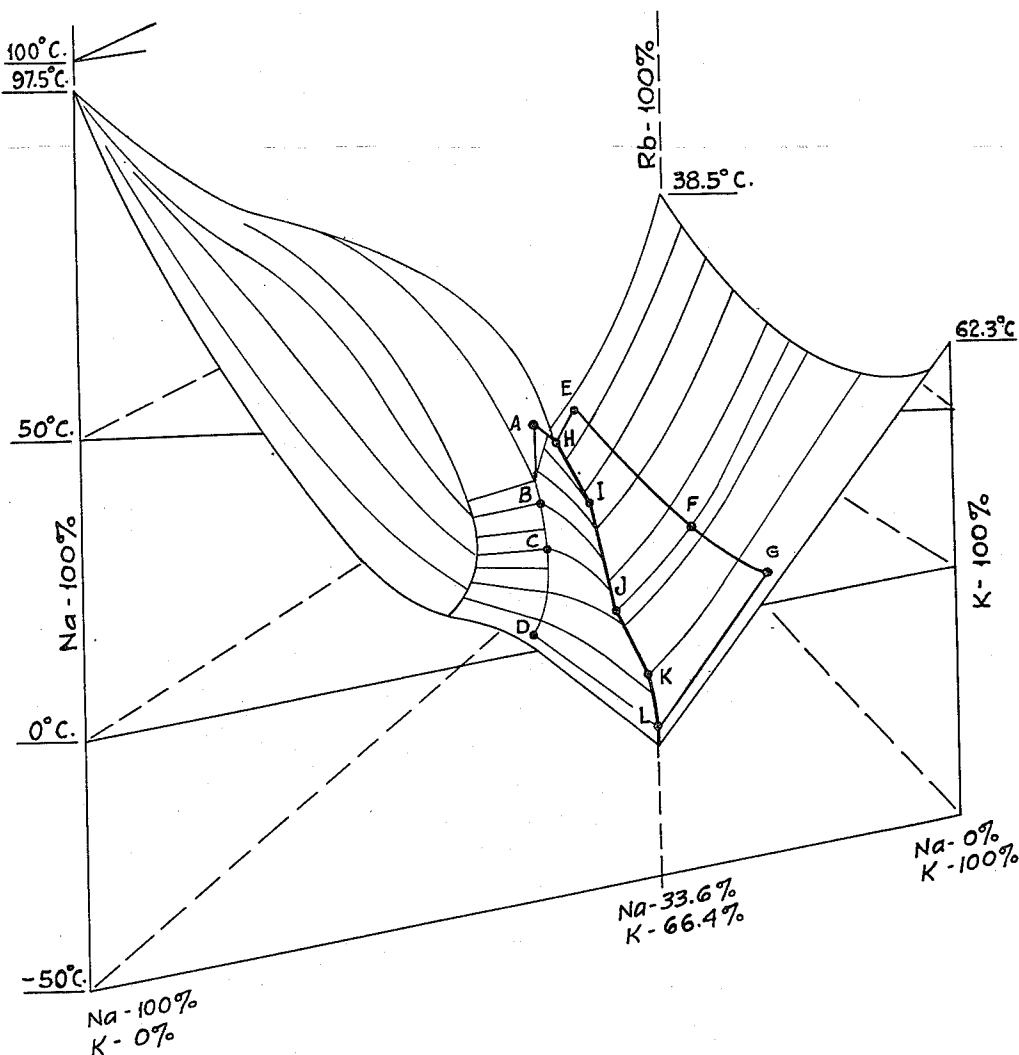
July 2, 1963

D. R. STERN
HEAT TRANSFER MEDIUM

3,095,698

Filed Sept. 18, 1957

2 Sheets-Sheet 1



Mol Per Cent of Component at point indicated.

Point	A	B	C	D	E	F	G	H	I	J	K	L
K	1.0%	38.5%	43.3%	49.2%	1.0%	53.9%	73.5%	1.0%	38.0%	51.4%	56.5%	65.8%
Na	26.6%	33.2%	35.6%	49.8%	16.6%	16.1%	25.5%	24.3%	22.2%	20.7%	25.5%	33.2%
Rb	72.4%	28.3%	21.1%	1.0%	83.4%	30.0%	1.0%	74.7%	39.8%	27.9%	18.0%	1.0%
T	2.5°C	2.5°C	2.5°C	2.5°C	2.5°C	2.5°C	2.5°C	-7°C	-17°C	-21°C	-19°C	-11°C

Fig. 1

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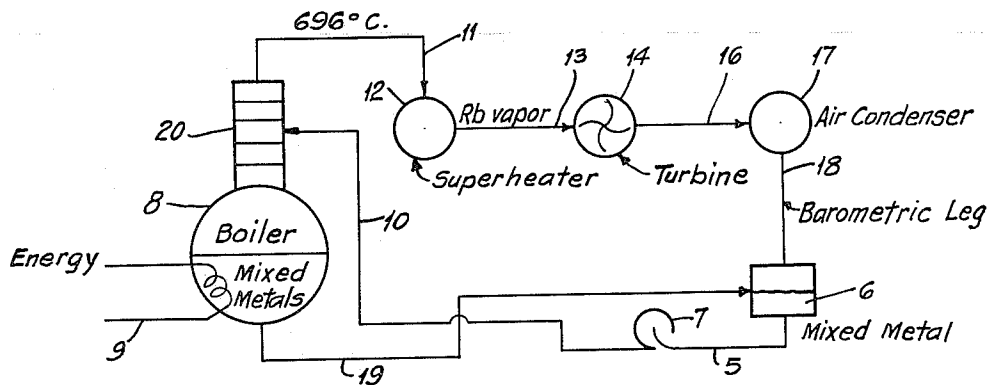


Fig. 3

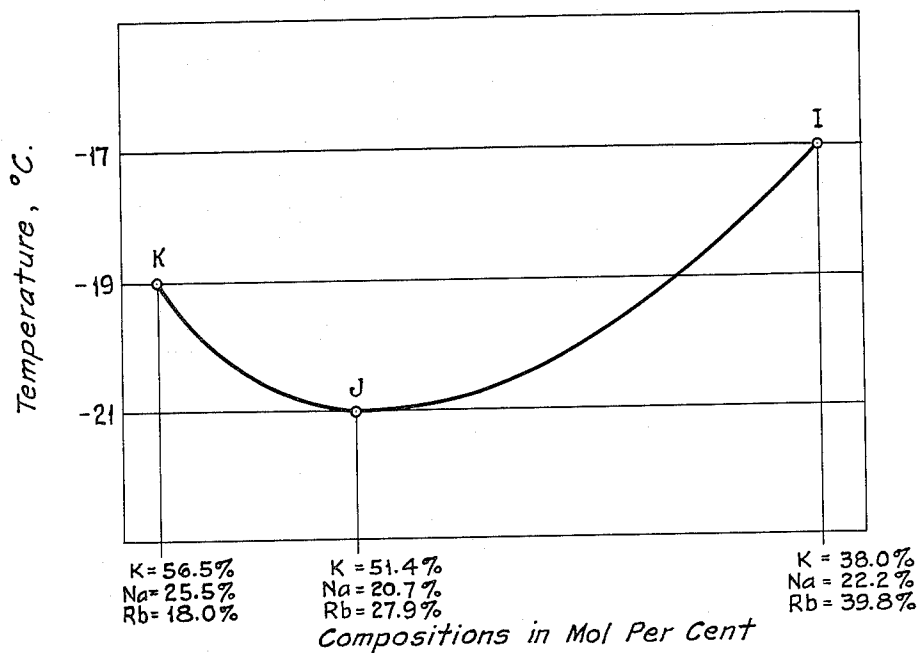


Fig. 2

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3,095,698
HEAT TRANSFER MEDIUM
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2 Claims. (Cl. 60—36)

This invention relates to heat transfer and particularly to a new and novel non-aqueous heat transfer composition having certain valuable properties.

There are many advantages in the use of a non-aqueous heat transfer composition and such materials as sodium, potassium, lithium, mercury, and various mixtures of these, have been proposed for utilization in power cycles. However, each of these suffers from a number of disadvantages which are absent from the composition of this invention. For example, they are either solids at ambient temperatures, have objectionable viscosities, or possess low thermal conductivity.

I have discovered that a composition of sodium, potassium and rubidium, in which the rubidium is the principal component, has many advantages over previously proposed heat transfer media. I have determined that the rubidium should comprise the major component, that sodium should be present in from about 16.1 percent to 49.8 percent, potassium from about 1.0 percent to 73.5 percent, with the balance rubidium.

In the drawings accompanying and forming a part hereof, FIGURE 1 is a phase diagram illustrating the compositions of this invention which are defined by the region ABCDLGFEHA.

FIGURE 2 is a graphic showing of the values along a plane through points H, I, J and K in FIGURE 1.

FIGURE 3 is a schematic apparatus and flow sheet for use with the composition.

In the following table, I have set forth pertinent thermodynamic data, comparing a typical mixed metal composition of this invention with the thermodynamic properties of sodium, potassium, mercury and rubidium.

	K	Na	Hg	Rb	Mixed Metal	
					Point I	Point J
M.P. (° C.)	63.7	97.8	-38.87	39	-17	-21
B.P. (° C.)	760	883	357	696	767	753
ΔH _{vap} (cals./g.)	496	1,005	69.7	212	453	407
Heat Cap. (cals./g., ° C.)	0.183	0.31	0.0323	0.0913	0.1699	0.1577
ΔH _{fusion} (cals./g.)	14.6	27.1	2.8	6.1	12.8	11.66
Density (g./cc.)	0.711	0.891	13.6	1.475	1.08	1.062
Viscosity, 200° C. (centipoises)	0.26	0.381	1.01	0.3234	0.313	0.302
Thermal Conductivity (cal./sec.-cm.-° C.)	0.10	0.1974	0.0231	0.075	0.1189	0.1011

An examination of this data shows that the mixed metals of this invention have an extremely low melting point, -21° C., a high boiling point of 767° C., a high heat capacity, low viscosity and excellent thermodynamic properties. Further, the materials have reasonable density.

Referring to FIGURE 1, attention is called to another aspect of my invention which is that I discovered, namely,

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ly, that the bottom of the valley, defined as HIJKL in FIGURE 1, provides a series of low melting point compositions. The valley defined by the curves (A, B, C, D), (H, I, J, K) and (E, F, G) provides compositions which are liquid over the widest temperature range, the greatest differential existing along the valley floor, H, I, J, K, and being at point J; the composition of point J freezes at -21° C. and boils at 883° C., a 904° C. range.

If one considers the usual ambient temperature to be 25° C., a mixed metal composition within this invention (point J), is liquid over a range 46° C. below the usual ambient temperature; since this is a physical mixture, the composition is a liquid over a 904° C. range, from -21° C. to 883° C., the boiling point of pure sodium.

The mixed metal heat transfer composition can be typically utilized in a heat transfer cycle such as that set forth diagrammatically in the accompanying drawing, FIGURE 3. In this, a mixture of the metals is withdrawn through pipe 5 from a storage tank 6 and is transferred by a pump 7 to a fractionator 20 and a boiler, generally indicated at 8. The boiler is supplied by a suitable energy source, generally indicated at 9, e.g., a thermal or atomic source. The rubidium is vaporized from the mixture into the overhead fractionator 20. Under atmospheric pressure, the temperature of the rubidium vapor will be 696° C.

The enriched rubidium vapor may be superheated, as in the superheater 12. The heated vapor is then transferred to a suitable device for extracting heat from the rubidium vapor whereby work is accomplished, such as the turbine, generally indicated at 14. The cooled rubidium vapor issuing from the turbine is transferred from line 16 to an air condenser 17, and the condensed liquid rubidium is returned through barometric leg 18 to the mixed metals storage vessel 6. Rubidium lean mixed metal is withdrawn through line 19 and is also returned to the mixed metal tank 6; thus, the rubidium vapor can be utilized effectively as a heat source and yet one need not deal with pure rubidium as such.

I claim:
1. A method of heat transfer comprising heating a ternary mixture of sodium, potassium and rubidium to provide a stream of hot rubidium vapor and a liquid residue lean in rubidium, extracting energy from the rubidium vapor whereby the vapor is cooled, condensing the cooled rubidium vapor, and returning the condensed rubidium to said liquid residue to provide said mixture for reuse, said mixture having a percentage composition falling along the line connecting points I, J and K of the drawing.

2. A ternary heat transfer mixture of sodium, potassium and rubidium and of a composition falling along the line I, J and K of the drawing.

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