

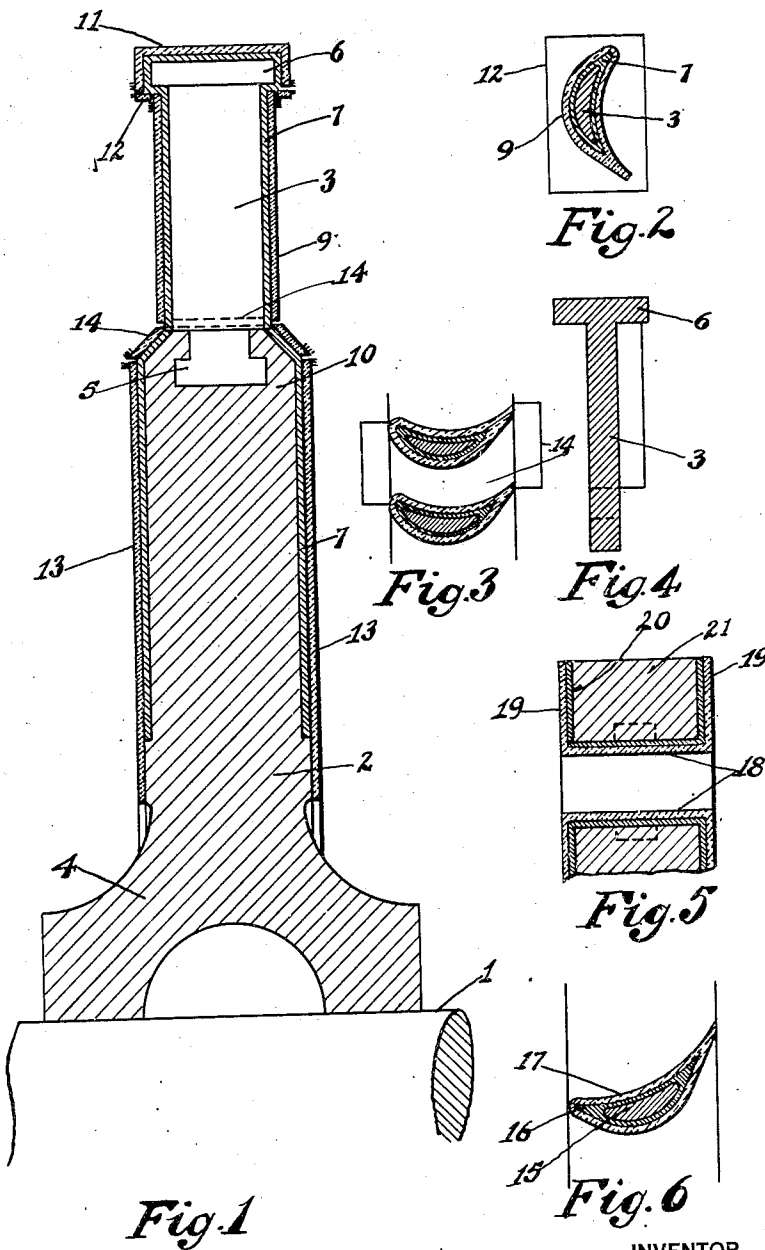
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ROTATING HEAT ENGINE

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ROTATING HEAT ENGINE

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The efficiency of heat engines is known to in-
crease with the temperature, and it is known
that in particular gas or hot-air turbines can
be operated economically only at working tem-
peratures of 500° to 600° C. The higher the
temperatures that may be employed the more
economical are such plants.

In order to be employed at high temperatures
in machines, materials must fulfill two important
conditions. In the first place they must be suffi-
ciently strong to take up the stresses occurring in
operation (e. g., in blades and wheel discs); in
the second place, they must be free from scale,
that is to say that at the contact surfaces be-
tween the material and the hot working sub-
stance no oxidation must take place which would
lead to the flaking of the material.

The employment of any desirable high tem-
peratures is prevented today by the properties
of the materials, as the strength of the latter is
not sufficient at temperatures over 600° C. (hot
strong materials), while as to freedom from scale
there are available today materials which give
satisfaction up to 1000° C. and over, however
only if they need not take up any stresses (heat
resisting materials).

Now, a commonly known expedient is to cool
the stressed materials, especially the blades of
turbines, with circulating water, thus keeping
their temperatures within admissible limits.
However, the cooling of the blades, especially the
moving blades, involves several disadvantages.
On the one hand it is difficult to seal the chan-
nels of the water supply, then again a great
drop of temperature occurs within the stressed
parts for a short distance when water is the cool-
ant, which is disadvantageous for the stressed
parts, and finally the extent of the cooling is
restricted by the great amount of heat to be
eliminated which may be a disadvantageous in-
fluence on the efficiency of the whole plant.

According to the present invention the mate-
rials subjected to mechanical stresses are cov-
ered with a layer of a heat-insulating material.
In this manner the main temperature drop on
the hot side is to be transferred outside the
stressed materials, which then exhibit a fairly
constant temperature over their whole extent
and can therefore now be stressed like ordinary
materials. Apart from the advantage offered by
the elimination of complicated cooling arrange-
ments it is possible to reduce heat losses to a
minimum by providing for generous dimensions
for the heat-insulating layers. The natural
heat removal by way of shaft and bearings may

suffice to maintain the temperature of said pro-
tected parts within admissible limits. Elimina-
tion of heat to the surroundings may be im-
proved by the provision of ribs. Finally, more
remote parts that can be reached more readily
by a flow of coolant than moving and distribut-
ing apparatus, e. g., shaft or wheel, may be pro-
vided with an artificial cooling system. Today
it is possible to apply a heat-insulating layer
to the vital parts of the machine, as heat-resist-
ing protective substances are available for their
protection, substances which can stand the tem-
perature of the hot working medium and can
sustain themselves. It is expedient to trans-
form the tensile stresses of said protective cov-
erings as much as possible into compressive
stresses. Thus the moving blades are designed
for example with head bands which take up the
tensile stress of the heat-insulating and the heat-
resisting protective substance and transform it
into compressive stresses.

The decrease of the temperature of metal parts
by means of insulation may be effected in the
rotating and the stationary parts of the turbine.
At certain points, especially on the stator, the
insulating protection by means of heat-resisting
metal covers may be omitted. The heat-insulat-
ing substance may be sprayed on the supporting
or the protective metal, or inserted between the
two or forced in. The protective material may
also be applied by means of a spraying process.

The annexed drawing shows diagrammatical
examples of embodiment of the subject matter
of the invention. Fig. 1 shows a rotor with
blade in section, Fig. 2 a section of a moving
blade with view on the head band, Fig. 3 two
moving blades in section with view on the inter-
mediate covering piece on the wheel rim, Fig. 4
the longitudinal section of a moving blade, Fig.
5 a section of a distributor, and Fig. 6 a section
of a guide blade.

In Fig. 1, 1 is the shaft, 2 is the rotating wheel,
3 a moving blade. The blade 3 may be made of
either hot-strong metal capable of resisting tem-
peratures of about 600 degrees centigrade or of
ordinary metal. The foot 5 of the blade 3 is
inserted in the rim 10 of the rotating wheel 2.
Blade and wheel may also be integral. The head
band 6 is made in one piece with the blade
3. Wheel and blade are covered with a heat-in-
sulating layer 7. This layer may be made of solid
material placed over the supporting blade and
wheel or may be sprayed on the latter. If the
insulating layer 7 can be durably applied, it
will be sufficient without any additional protec-

tion. However, in Fig. 1 water cooling of the wheel is provided for in the hub 4 to promote the removal of the heat.

In order to protect the insulating layer against the effects of stresses, a protective covering of metal capable of resisting temperatures of about 1000 degrees centigrade and over is placed over the layer 7, consisting of the parts 13, 14, 9, 12 and 11, which consist of said heat-resisting metal. As indicated in Fig. 1, the edges of the individual parts of the protective covering may be welded together. It is advisable to leave a clearance between the protective covering 9 and the wheel rim 10, to allow the former to expand freely; it is put under compressive stress by the centrifugal force. The centrifugal forces of the protective coverings 9 and 11 are taken up by the head band 6 of the cold supporting blade 3. The two protective coverings 13 can expand freely in a downward direction; it is best to construct them as discs of the same strength.

Protection of the heat insulation on the outer wheel rim is effected by the covering parts 14' (Fig. 3) placed between the blades 3, which on both sides are welded to the covering discs 13.

In this manner the supporting wheel 2 and the supporting blade 3 are protected by means of heat insulation 7 and the latter by means of said heat resistant metal, against the impulsive and centrifugal forces, while on the contrary the centrifugal forces of the insulation and protective material are largely taken up again by the cold supporting material 2 and 3. Such a structure may therefore be subjected to substantially higher working substance temperatures than an ordinary hot-strong blade, without paying the price of a complicated cooling water supply or great heat losses.

The protective covering 11 may also be omitted. As the small unprotected face 12 of the blade does not receive any impacts from the working substance, the insulation is less stressed at this point.

Finally, not only the protective covering, but also the insulation may be omitted at the faces, as the small face of the supporting blade can take up only little heat, which in the presence of sufficient removal maintains the temperature at the face at admissible values.

Figs. 5 and 6 show a distributor and a guide blade respectively, which are protected on the same principles. 15 is the blade made of hot strong or ordinary material, 16 is the insulation and 17 the protective covering. 18 and 19 are the protective plates of the guide disc consisting of heat resistant material; they enclose the insulation 20, which protects the disc 21.

The structural embodiments may be of any convenient kind; the protective coverings may be retained for example at the foot between the blade and the wheel.

Having thus described my invention, I claim:

1. A rotating heat engine having a turbine wheel comprising a metallic disk provided with metallic vanes, said disk and vanes being coated with a layer of heat insulating material, and said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is

higher than that of the metal of said disk and vanes.

2. A rotating heat engine having a turbine wheel comprising a metallic disk provided with metallic vanes, said vanes being coated with a layer of heat insulating material, and said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of said metal of said vanes.

3. A rotating heat engine having a turbine wheel comprising a metallic disk provided with metallic vanes, said disk being coated with a layer of heat insulating material, and said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of said metal of said disk.

4. A rotating heat engine having a turbine wheel comprising a metallic frame provided with metallic vanes, said frame and vanes being coated with a layer of heat insulating material, said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of the metal of said frame and vanes, and said metal of said higher heat resistance being held to said layer of insulating material by adhesion.

5. A rotating heat engine having a turbine wheel comprising a metallic frame provided with metallic vanes, said vanes being coated with a layer of heat insulating material, said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of said metal of said vanes, and said metal of said higher heat resistance being held to said layer of insulating material by adhesion.

6. A rotating heat engine having a turbine wheel comprising a metallic drum provided with metallic vanes, said drum being coated with a layer of heat insulating material, said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of said metal of said drum, and said metal of said higher heat resistance being held to said layer of insulating material by adhesion.

7. A rotating heat engine comprising a turbine wheel including a metallic drum with metallic vanes, said vanes being coated with a layer of heat insulating material, said layer of insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of said metal of said vanes, and the terminal of each of said vanes having a rim projecting over the terminals of both of said layers.

8. A rotating heat engine including a series of metallic vanes, said vanes being coated with a layer of heat insulating material, and said layer of heat insulating material being coated with a layer of metal having a resistance to disintegration resulting from heat, which resistance is higher than that of the metal comprising said vanes.

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