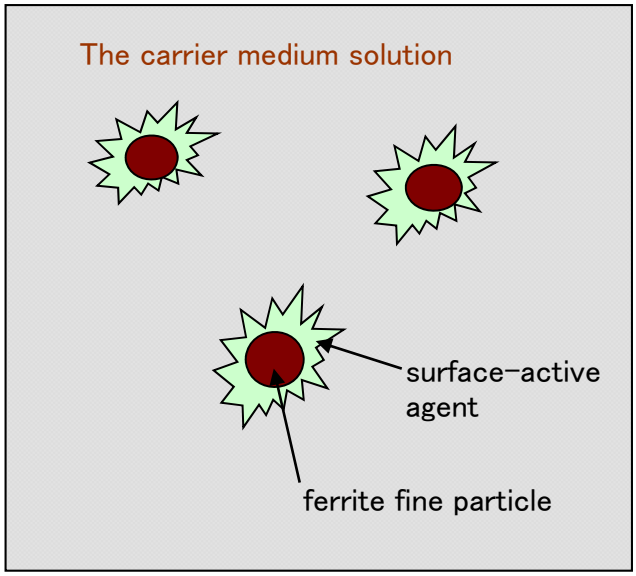
## The outline of the magnetic fluid

The magnetic fluid does the fine particle of the ferromagnetic material at the coat at the surface-active agent, mixes it with carrier medium solution and creates it.
The size of the fine particle of the ferromagnetic material is about 10 nanometers.
Because the surface-active agent which made a fine particle at the coat repels each other, it disperses equally in solution.
Then, as for the magnetic substance body, a strong magnetic field is designed to be equally distributed among them.
Also, the magnetic substance body has the temperature dependency of the saturation-magnetization.

Figure 1




Graph 1

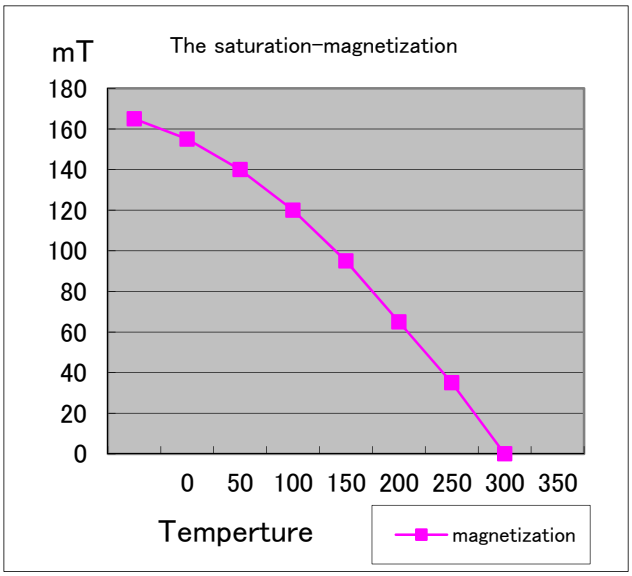
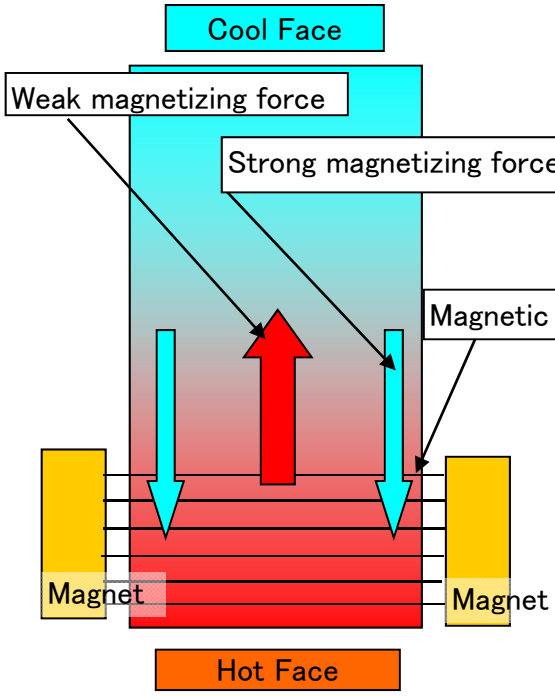



Figure 2




The characteristic of the magnetism convection

When applying heat to the part of the magnetic fluid which was placed in the magnetic field, the magnetic fluid moves to the direction which was shown by the arrow of figure 2.
The strength of this convection depends on

The pressure of this convection is said to that it does about 10 times the heat siphon.

The magnetism convection occurs even if it replaces a hot surface and a cool surface.

The strength of the magnetism convection is decided in three elements.
The strength of the magnetic field
The temperature-characteristic with the saturation-magnetization value of the magnetic fluid
The temperature difference
Then, the structural-design according to the moving heat capacity is possible.

## The simulation with magnetism convection pressure

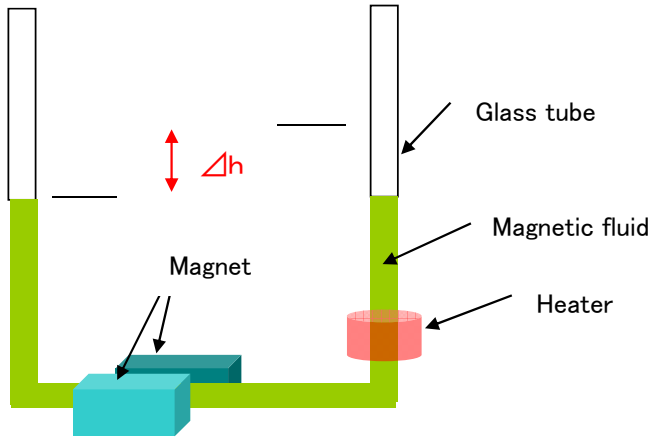
Confidential DOC

It collected the dater which measures a delta-pressure with the equipment of figure 1 and becomes basics.
The details of the equipment

It is filling a magnetic fluid into the glass tube having to do with an U shape.
It arranged two magnets at both sides of the glass tube.
The magnetic field intensity is 80kA/m(10000e).

**Note** Enter a yellow column  Pink column is result

Figure1




| The glass tube caliber(mm) | Difference-elevation |
|---|---|
| 4 | T-334 |
| ⊿h | 32.40 mm |
| M-300/P310 ⊿h | 6.87 mm |
| APG-810 ⊿h | 2.97 mm |
| ⊿temperature | 30 |
| ⊿pressure restraint ⊿h | 32.4 |
| The specific gravity | 1.51 |
| Pa | 480 |

The material

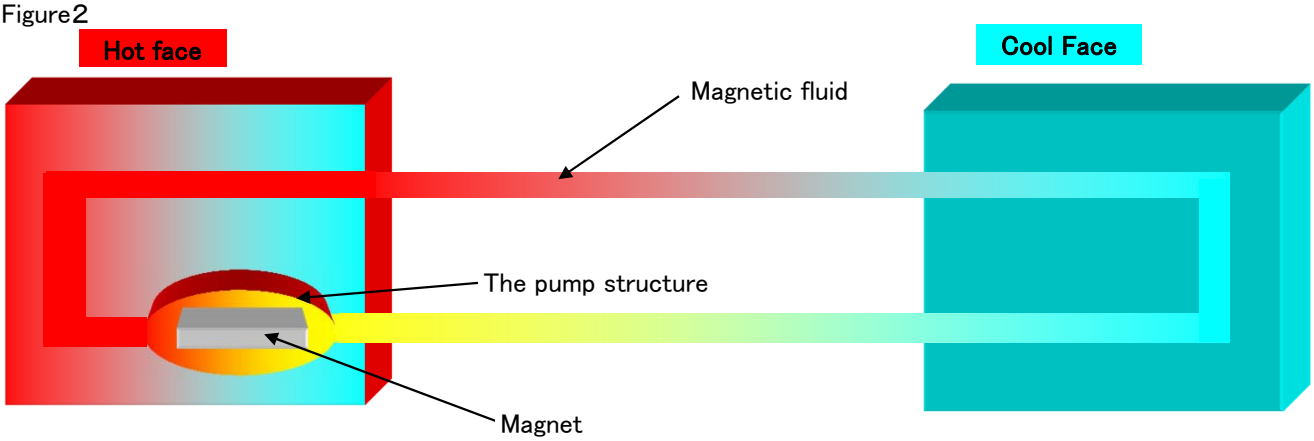
**Note** Converting from ⊿h to Pascal simply!

| Model | Medium | Magnetism metal | Value (mT) | Viscosity (η)mPA | The specific gravity | ⊿pressure(Pa) at⊿T30℃ |
|---|---|---|---|---|---|---|
| M-300 | Water | Magnetite | 32 | 30 | 1.41 | 95 |
| P-310 | Poly α Olefin | Mn/Zn-Ferrite | 34 | 180 | 1.2 | 95 |
| T-334 | Iso-paraffin | Mn/Zn-Ferrite | 33 | 190 | 1.51 | 480 |
| | | (Low Curie Point) | | | | |
| APG-810 | Hydrocarbon Oil | Magnetite | 11 | 180 | 1.2 | 35 |

**The equipment of figure 2 shows the outline of the magnetism pump structure and the heat carrier system.**

In the example of figure 1, it used two magnets but the about quadruple convection pressure can be won in the composition of figure 2 by using one magnet.
As for the magnetism pump structure, the performance depends on the composition roughly.
It applies for the patent.

Figure2



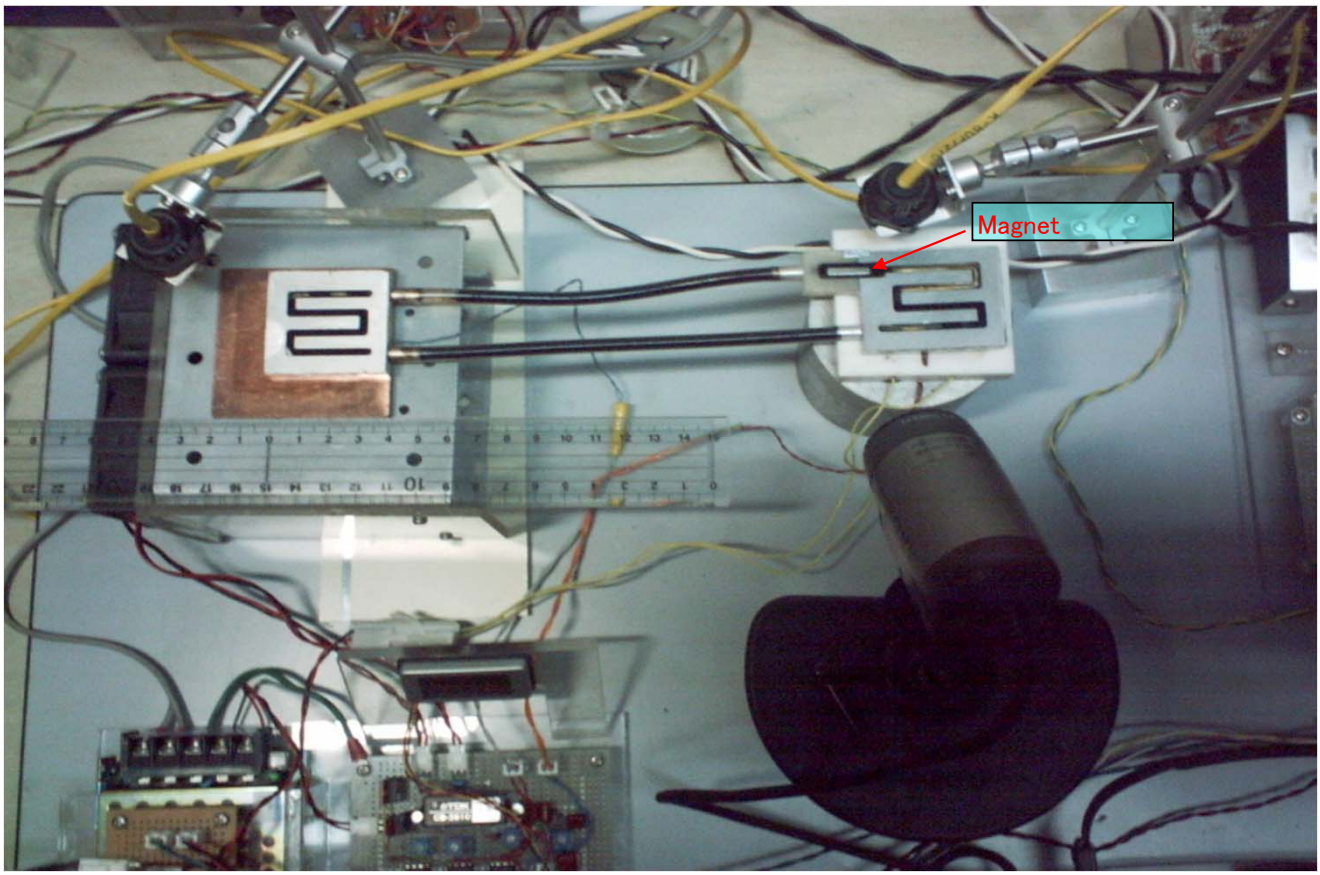

### The restraint when the convection pressure circulates levelly

$V=\pi * P * a^{4} * t/(8 * L * \eta)$

| Pressure(P)Pa | Pulumbing radius | Time | Plumbing length | The viscosity | Specific heat | J/cm2 |
|---|---|---|---|---|---|---|
| | | | | | | 2 |
| 1920 | 0.002 | 1 | 0.5 | 0.019 | | 1.27 |
| Pa(P) | m(a) | Sec(t) | m(L) | Pa(η) | | cc(V) |
| | | | | ⊿T | Heat Transfer | W |
| | | | | 30 | | 76.19 |

**Image 3 is the example of the principle model.**

Image 3




Heat devices the magnetic convection pressure of the pump.  Both ends of the magnet work continuously due to the temperature difference. As for us, the heat control by the Peltier element and the heat pipe and so on is a best field but to do the inclination of the temperature gradient roughly is very hard. The small magnet in Image 3 generates 2000 pascal in pressure, which can improve the entire operation of the device.

2010/9/24

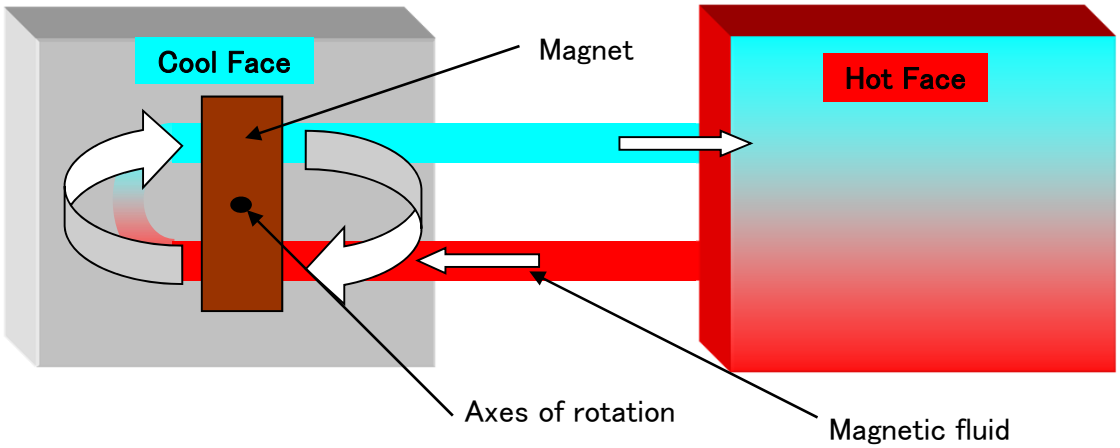
DaVinci Co.Ltd  Kenji Higashi

## Turning permanent magnet makes flow of magnetic fluid

Confidential DOC

Figure 4 shows one example of magnetic fluid pump driven by a permanent magnet. Magnetic fluid has a special property that it changes its magnetic property according to its temperature. In this figure, rotating a ″brick-type″ permanent magnet generates flow of magnetic fluid, which transfer heat between hot and cold surface. The permanent magnet can be rotated in many ways, such as by using motor or power of windmill, etc

Figure 4




The interesting feature of this system is that the magnet fluid can be moved in ″non-contact″ way.

Moreover, the flow rate can be controlled to some extent by changing the rotational speed of the permanent magnet. A fan can also be attached to this rotating magnet, which will contribute to further cooling the cool surface.

We have already investigated the basic phenomenon and constructed a experimental model to analyse the phenomenon. Commercialization will require additional time and cost.

Several patents have already been applied concerning this technology.

2005/6/2

DaVinci Co.Ltd Kenji Higashi