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PERMANENT MAGNET CONTAINING
COPPER

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1932, Serial No. 587,822. Divided and this ap-
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4 Claims. (Cl. 175—21)

This constitutes a division from the co-pending
application Serial No. 587,822 filed January 20,
1932.

This invention relates to a strong permanent
magnet comprising 5 to 40% nickel, 7 to 20%
aluminium, copper from a trace to 20% and the
remainder substantially iron. It has for its ob-
ject to economically obtain a permanent magnet
which possesses an extremely high coercive force
and a strong residual magnetism without being
quenched after casting and preserves these quali-
ties without being influenced by thermal changes
and mechanical shocks and having small specific
gravity and non-corrosive property.

Nickel is a ferromagnetic substance while alu-
minium is a paramagnetic one, and it has long
been known that these metals give no beneficial
effects upon the coercive force and residual mag-
netism of steels when they are added to the lat-
ter individually.

Now nickel steels containing 5 to 30% nickel
are called "irreversible steel" by which is meant
that they become transformed at appreciably
higher temperatures on heating than on cooling.
That is the A_{c2} point (the temperature at which
magnetism is lost on heating) is considerably
higher than the A_{r2} point (the temperature at
which magnetism begins to obtain on cooling),
and the difference amounts to over 400° C. For
this reason, when cooling high-nickel steels from
high temperature above the A_{c2} point, the A_{r2}
transformation points are suppressed and the
steels become non-magnetic at room temperature
due to the retention of γ -iron. This is the reason
why scientists insist upon, and metallurgists give
assent, to the fact that the nickel steels can not
be used for magnet steels.

According to the invention it is possible to
economically obtain magnet steels which possess
an extremely high coercive force and a strong
residual magnetism without being quenched, and
preserve these qualities permanently without be-
ing influenced by thermal changes and mechan-
ical shocks. For this purpose the invention pro-
vides for a permanent magnet containing iron
as its chief component, with the addition of 5
to 40% nickel, 7 to 20% aluminium and copper
from trace to 20%.

As described above, according to the invention
the nickel steel, formerly entirely disregarded as
a magnet steel, can now be easily changed into a
strong magnet steel by an addition of a proper
amount of aluminium, which is a cheap material.

The steel will be furnished with an extremely
high coercive force and a strong residual mag-
netism without being quenched. By this means,
therefore, the defect that the known magnetic
steel must necessarily be subjected to deforma-
tion and quenching-crack when quenched, is
completely eliminated. The alloy according to
the invention will be applied for general uses, and
in particular for permanent magnets of precise
measuring apparatus and generators, and other
various kinds of measuring devices.

According to the invention it has further been
found that one portion of the nickel contained in
the new permanent magnet above mentioned, will
be substituted by copper, which is a very cheap
material. The proportion for substitution is 20%
and downwards to trace of the alloy. By this
means the above mentioned magnetic properties
of the alloy will be preserved and its forging
property is never spoiled. The cost of manu-
facture for this alloy is very low.

Actual examples for this case are shown below:

Chemical composition (percent)				Magnetic properties	
Iron	Nickel	Alumin- ium	Copper	Coercive force (Hc) (gauss)	Residual magnetism (Br) (gauss)
65.2	19.8	10.0	5.0	210	9,900
58.2	24.0	12.0	5.5	440	9,500
53.0	25.0	12.0	10.0	540	9,000

In this case also it is noted that the presence
of carbon of below 1.5% and/or a small amount
of impurities does not materially affect the mag-
netic properties of the alloy.

I claim:

1. A permanent magnet comprising 5 to 40%
nickel, 7 to 20% aluminium, from trace to 20%
copper and the remainder iron.

2. A permanent magnet comprising 5 to 40%
nickel, 7 to 20% aluminium, from trace to 20%
copper and the remainder substantially iron.

3. A permanent magnet comprising 5 to 40%
nickel, 7 to 20% aluminium, from trace to 20%
copper, from trace to 1.5% carbon and the re-
mainder iron.

4. A permanent magnet comprising 5 to 40%
nickel, 7 to 20% aluminium, from trace to 20%
copper, from trace to 1.5% carbon and the re-
mainder substantially iron.

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