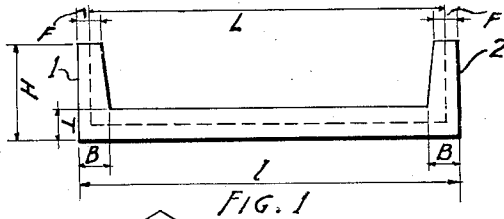
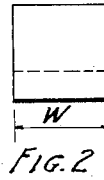
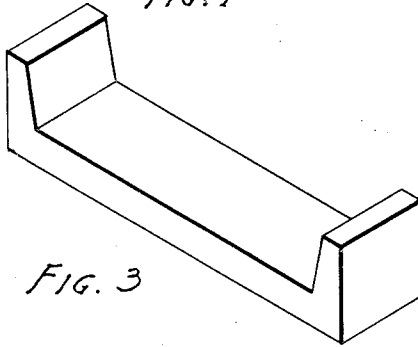
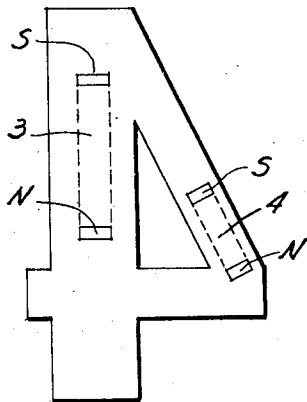
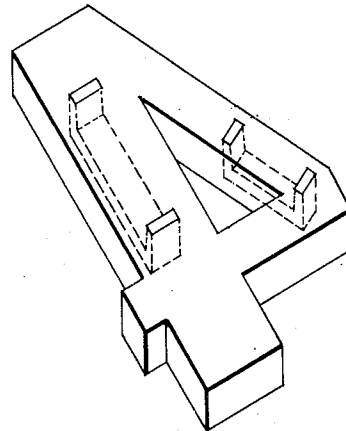


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G. HALE ET AL  
MAGNET CONSTRUCTION

2,144,184

Filed Nov. 30, 1934



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## UNITED STATES PATENT OFFICE

2,144,184

## MAGNET CONSTRUCTION

Gerald Hale, Chicago, and Kenneth L. Scott,  
Western Springs, Ill., assignors, by mesne as-  
signments, to Magnet-O-Signs Corporation, a  
corporation of Illinois

Application November 30, 1934, Serial No. 755,306

## 1 Claim. (Cl. 175-21)

Our invention relates to a method of construct-  
ing magnets of a small size to act as a supporting  
means for display letters or devices or toys formed  
of a plastic or other moulded material, or for the  
construction of magnets for any other use where  
high magnetic power in relation to the mass or  
volume of the magnet is a requisite.

Our invention further relates to a combination  
of such magnets with plastic letters, devices or  
toys and a magnetic metallic plate for support-  
ing and displaying such letters.

Other objects of our invention will appear and  
be described in the specification.

The novelty of our invention will be hereinafter  
more fully set forth and specifically pointed out  
in the claim.

In the accompanying drawing:

Fig. 1 is a side elevation of a  $\frac{3}{4}$ " magnet drawn  
four times natural size.

Fig. 2 is an end elevation of such a magnet.

Fig. 3 is a perspective view of the magnet shown  
in Figs. 1 and 2.

Fig. 4 is a reverse view of a figure 4 containing  
a magnet 3 and a magnet 4.

Fig. 5 is a perspective view of the figure 4 shown  
in Fig. 4.

In Fig. 1, the dimension "l" refers to the actual  
length of the magnet; the dimension L, shown  
by the dotted line, refers to the length of the  
magnet as discussed in this application, length  
referring to the distance from the center of one  
face to the center of the other along the dotted  
line; the dimension H refers to the height includ-  
ing the feet; dimension F refers to the width of  
the foot at the face of the magnet pole and the  
dimension B refers to width of the foot at its  
base; dimension T refers to the height of the  
magnet not taking into account the feet; in Fig.  
2 the dimension W refers to the width of the  
magnet. D, which we term the "diameter" of the  
magnet and which appears in the formula below,  
is the diameter of a circle having an area equal  
to the cross sectional area of the magnet, deter-  
mined from the equation

$$\frac{\pi D^2}{4} = WT$$

to have the value

$$D = 2\sqrt{\frac{WT}{\pi}}$$

These symbols will be hereinafter used in refer-  
ring to the various dimensions.

Our invention, while not alone directed to small  
magnets or small plastic tablets containing mag-  
nets, is a solution of the problem which arises in

producing small plastic tablets containing mag-  
nets of sufficient magnetic power to support the  
tablets permanently and firmly upon a plate of  
magnetic material. We have found that by main-  
taining certain dimensional proportions in mag-  
nets, the most efficient magnet in relation to its  
size or mass can be produced. In maintaining  
these proportions the maximum efficiency is at-  
tained, when using a high quality of cobalt mag-  
net steel containing between 25% and 35% of  
cobalt, or precipitation hardening magnet al-  
loys, or other alloys of a magnetic quality equal  
to cobalt magnet steel.

We have found that if a dimensional relation  
is maintained between the length of the magnet,  
or L, and the magnet's diameter, or D, taking  
into account certain properties of the magnet  
material hereafter referred to, the most efficient  
magnet will result.

We have further found that a specific rela-  
tionship exists between the strength of the mag-  
net, the dimensions of the magnet, and the mag-  
netic properties of the magnet material, that is,  
the residual induction in gauss, represented in  
the art by the symbol  $B_r$ , and the coercive force  
in oersteds, represented in the art by the symbol  
 $H_c$ . Both of these properties have been or can  
be specifically determined for any given magnet  
material. In producing a magnet of the desired  
maximum efficiency, we follow the formula

$$\frac{L}{D} \left( \sqrt{\frac{H_c}{B_r}} \right) = 1.25$$

Following this formula will produce the strong-  
est magnet possible from a given amount of ma-  
terial or in a magnet of a given length, or a de-  
sired diameter. Assume that it is necessary to  
design magnets of sufficient power to support a  
plastic figure "four", one and one-half inches  
high. The available material is Honda magnet  
steel containing 35% cobalt having a  $B_r$  of 10,000  
in gauss and an  $H_c$  of 225 in oersteds. If the  
practicable limit for the magnet's over all length,  
or L is  $\frac{3}{4}$ ", using the formula, the other dimen-  
sions of the magnet should be

$$\frac{.75"}{D} \left( \sqrt{\frac{H_c}{B_r}} \right) = 1.25$$

This would give a diameter of .09 inch.

While in the laboratory, the foregoing formula  
produces the best result, in practice, particularly  
in the production of very small magnets, a small  
variation from the dimensions obtained from the  
formula will still very closely approximate the

results obtained from following the formula exactly.

The foregoing formula applies only to a straight bar magnet and does not take into account the feet, 1 and 2, Fig. 1 which are tapered from the width at the base, B, to the width at the face, F, a construction which adds to the strength and force of the magnet. There seems to be no precise formula to follow in constructing the taper of the feet but we have determined that the dimension H, Fig. 1, is substantially constant with the dimension W, Fig. 2, and the dimensions B and F, Fig. 1, maintain the ratio of three to two.

Applying these magnets to our display method for letters, numbers, symbols or devices and the like, or to children's toys formed of disassembled pieces or otherwise, we take a piece of moulded plastic material having from one to three magnets of the requisite strength positioned in the back of the piece, the feet of the magnets being either flush with the back, protruding therefrom

to a desired length to set off the piece of material from a magnetic plate, or recessed in the plastic. If permanent magnets of the necessary strength are used, the tablets can be attached indefinitely to a metallic plate and can be removed therefrom or rearranged as desired.

Having fully described our invention, we claim:

A permanent magnet of cobalt magnet steel containing between 25-35 per cent. cobalt, of a shape adapted to be embedded in tablets for holding them against plates of ferro-magnetic material, having a length or diameter bearing a relationship to the other dimension conforming substantially to the formula, the product of length times the square root of the coercive force of the material used is equal to 1.25 times the diameter times the square root of the residual induction of the material used.

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