

J. H. BUNNELL.
Electro-Magnet.

No. 226,485.

Patented April 13, 1880.

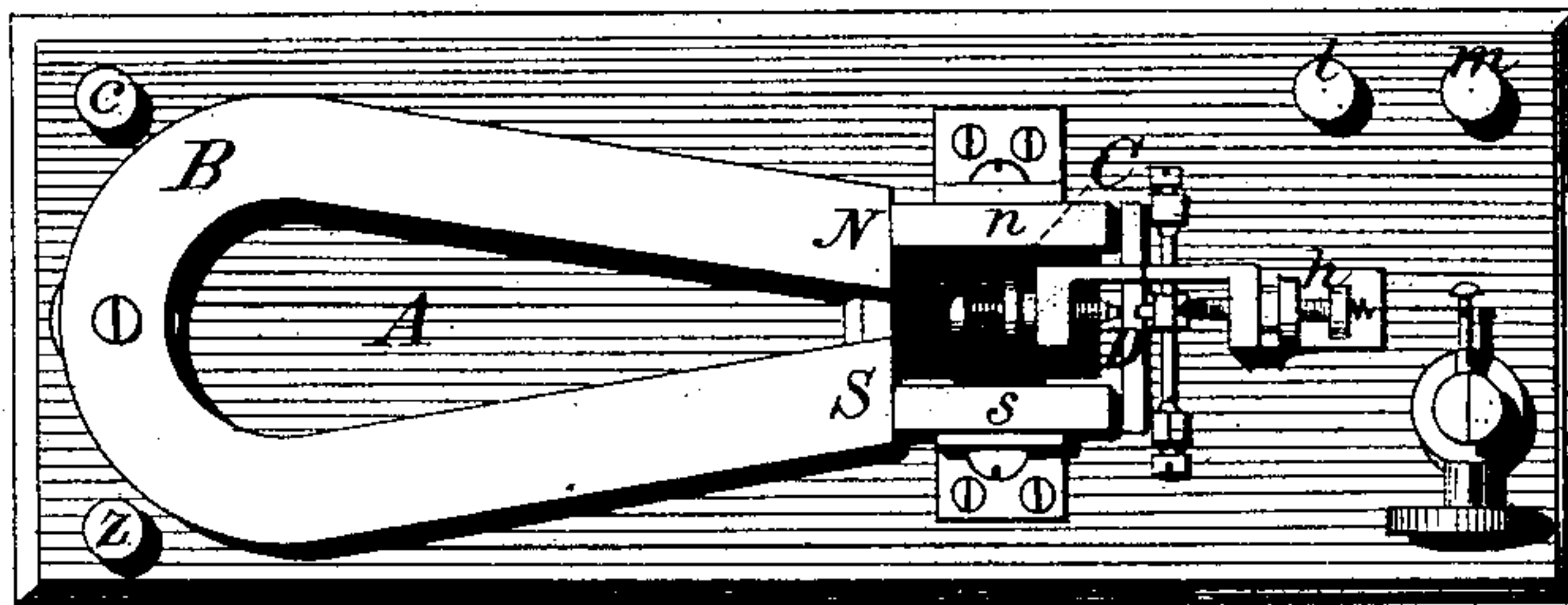


Fig: 1.

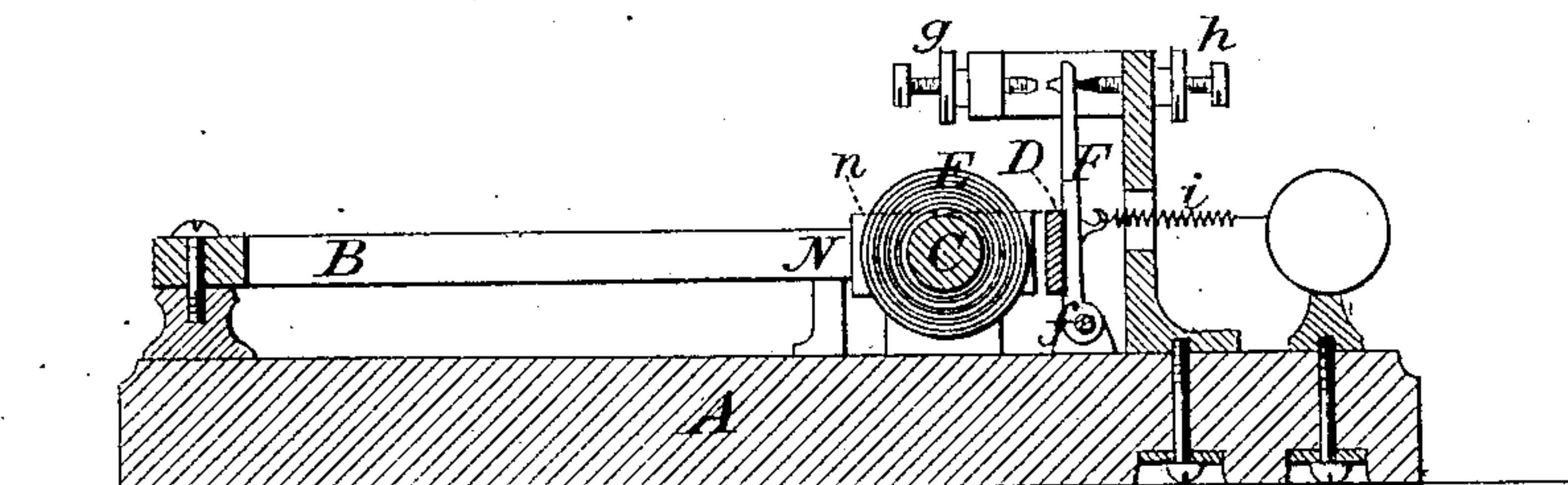


Fig: 2.

Witnesses:

Wm. Arnoux,
Miller & Earl.

Inventor:

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by his Attorney,
Frank L. Pope.

UNITED STATES PATENT OFFICE.

JESSE H. BUNNELL, OF NEW YORK, N. Y.

ELECTRO-MAGNET.

SPECIFICATION forming part of Letters Patent No. 226,485, dated April 13, 1880.

Application filed March 10, 1880. (Model.)

To all whom it may concern:

Be it known that I, JESSE H. BUNNELL, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electro-Magnets for telegraphic and other purposes, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

My invention relates to an improved combination of permanent and electro magnets with a movable armature, intended more particularly for use in connection with telegraphic instruments, but which may be advantageously applied to other electro-magnetic apparatus.

The invention consists in placing permanent and electro magnets with their respective poles in contact in such manner that they will form a closed magnetic circuit, and in so arranging a movable armature in proximity to certain poles or projections situated at or near the points of contact between the permanent and electro magnets that the increment and decrement of the normally existing magnetism at the extremities of said projections produced by the opening and closing of an electric circuit in which the coil or coils of the electro-magnet are included will act upon the armature in the ordinary manner, so as to cause a to-and-fro movement of the said armature, which may be utilized for telegraphic or other purposes.

I have found that by thus arranging the poles or projections which act upon the movable armature in connection with a closed magnetic circuit a given effect upon the armature may be produced by means of an electric current of much less strength than would otherwise be the case. In many instances the effective force acting upon the armature is nearly double that of a similar electro-magnet when not combined with a permanent magnet.

In the accompanying drawings, Figure 1 is a plan view, illustrating the application of my invention to a telegraphic relay-instrument, and Fig. 2 is a longitudinal section of the same.

In the drawings, A represents the base of the instrument, which, in this instance, is a telegraphic relay.

B is a permanent magnet of hardened steel, powerfully magnetized in the usual manner, and supported in a horizontal position upon the base, as shown in the drawings, N being its north and S its south pole. The permanent magnet is preferably of the usual horse-shoe form, and may be composed of a single plate of steel, as in the drawings, or of a number of thin plates laid up together in a well-known manner, so as to form what is termed a "compound magnet." Pole-pieces *n* and *s*, preferably of soft iron, are firmly secured to the respective poles of the permanent magnet B, and virtually form continuations thereof. A cylindrical bar or core of soft iron having about the same area of cross-section as the pole-pieces *n* and *s* is placed transversely between the latter, so as to form a magnetic connection between them at a point considerably within the extreme ends, poles, or projections thereof. Thus it will be understood that the transverse bar C, in connection with the pole-pieces *n* *s* and the permanent magnet B, forms a closed magnetic circuit, by reason of which little or no free magnetism or magnetic attraction is ordinarily manifested at the extreme ends of the pole-pieces *n* *s*, which face the armature D.

The transverse bar or core C is surrounded by a coil of insulated wire, E, in the manner of an electro-magnet, the ends of said coil being carried to binding-screws *z* *c* for the convenient attachment of telegraphic or other conductors.

The movable armature D is constructed and arranged in the ordinary manner, being mounted upon a lever, F, pivoted at *f*. The movement of the armature toward and from the poles of the magnet is limited by the adjustable screw-stops *g* *h*. The armature is also provided with the usual adjustable retracting-spring *i*.

Binding-screws *l* *m* may be provided for the attachment of a local circuit, as in ordinary relay-instruments.

The operation of the apparatus is as follows: When the coil or helix E is placed in an electric circuit, by attaching the conductors of the latter to the binding-screws *z* and *c* the balance of the closed magnetic circuit is disturbed by the inductive action of the coil E upon the core C, which produces magnetic polarity at the outer extremities of the pole-pieces *n* *s*, and

causes the armature D to be attracted. When the circuit through the coil E is broken the magnetic balance is restored and the armature D is drawn away by the spring i.

5 It is preferred to make the pole-pieces *ns* of soft iron, although this is not essential, as the apparatus may be so arranged as to allow the armature to be acted upon directly by the poles of the permanent magnet, these latter
10 being connected with each other by the bar C, so as to complete the magnetic circuit.

It is obvious that the form, arrangement, and proportions of the several parts described may be greatly varied without departing from
15 the spirit of my invention; but I generally prefer to employ substantially the arrangement herein shown and described.

I claim as my invention—

1. An electro-magnet the two poles of which
20 are permanently attached to the respective poles of a permanent magnet in such manner that the intensity of the free magnetism at the extreme ends, poles, or projections of the said permanent magnet may be varied by the trans-
25 mission of an electric current through the coil surrounding the electro-magnet.

2. The combination, substantially as herein described, of a permanent magnet and an electro-magnet, with their respective poles perma-
30 nently in contact in such manner as to form a closed magnetic circuit.

3. The combination, substantially as herein described, of a permanent magnet, provided with soft-iron pole-pieces attached to each of

its poles, a core of soft iron permanently con- 35
necting said pole-pieces with each other, and a coil or helix of wire surrounding said con-
necting-core.

4. The combination, substantially as set forth, of a permanent magnet, a core of soft 40
iron permanently connecting the two poles thereof with each other, a coil or helix of wire surrounding said core, and an armature so situated as to be moved to and fro by the in-
45 crement and decrement of magnetism in said poles when electrical pulsations are caused to traverse the coil.

5. The combination, substantially as set forth, of a permanent magnet provided with soft-iron pole-pieces attached to each of its 50
poles, a bar of soft iron permanently connecting said pole-pieces with each other, and a coil or helix of wire so arranged as to cause an alternate increment and decrement of the mag-
55 netism in the said pole-pieces when electrical pulsations are caused to traverse said coil.

6. The method, substantially as herein set forth, of causing the movement of an armature by altering the normal distribution of magnetic force in the closed and balanced magnetic cir- 60
cuit of a permanent magnet by means of a magnetizing coil or helix acting thereupon.

In witness whereof I have hereunto set my hand this 28th day of January, A. D. 1880.

J. H. BUNNELL.

Witnesses:

WM. ARNOUX,
MILLER C. EARL.