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[54] **APPARATUS FOR ASSEMBLING ELECTRICAL CIRCUITS FOR EXPERIMENTATION**

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[52] **U.S. Cl.** ..... **35/19 A,** 339/12 R

[51] **Int. Cl.** **G09b 23/18**

[58] **Field of Search** ..... 35/7 A, 19 A; 339/12 R, 339/12 G, 12 V, 12 L

[56] **References Cited**

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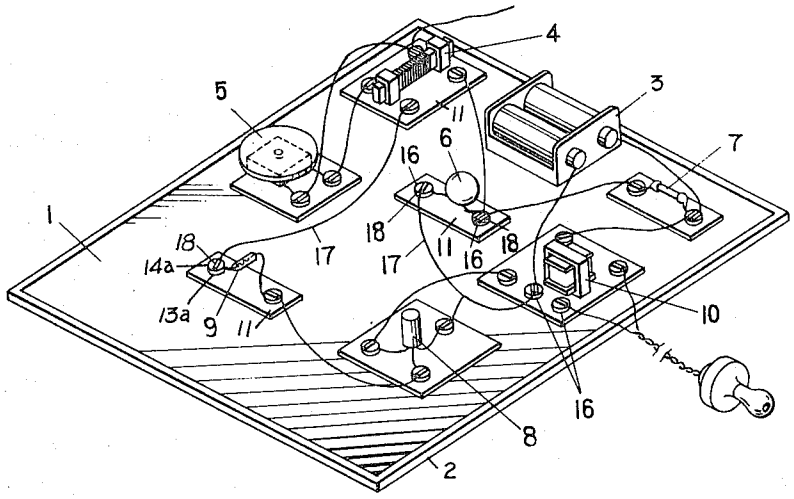
[57] **ABSTRACT**

Electrical circuit assembling apparatus for experimentation, allowing various electronic parts to be located on an insulating base plate, on which terminals are interconnected by means of leads, by making use of magnetic attraction, for which either a metal plate is used underneath the base plate, or block-shaped metal pieces, which latter can be above or below said base plate. In one exemplary embodiment, a metal plate is attached to the reverse surface of the base plate, and one or more optional unit plates are disposed above the base plate, by the force of the magnetic member, acting through the unit plates, or from below. Metal pieces are connected to each lead and/or terminal of the electronic parts, and these metal pieces are attracted by the magnets; thus an electrical circuit is completed without screw terminals or posts, without soldering, or the like conventional expedients.

7 Claims, 7 Drawing Figures



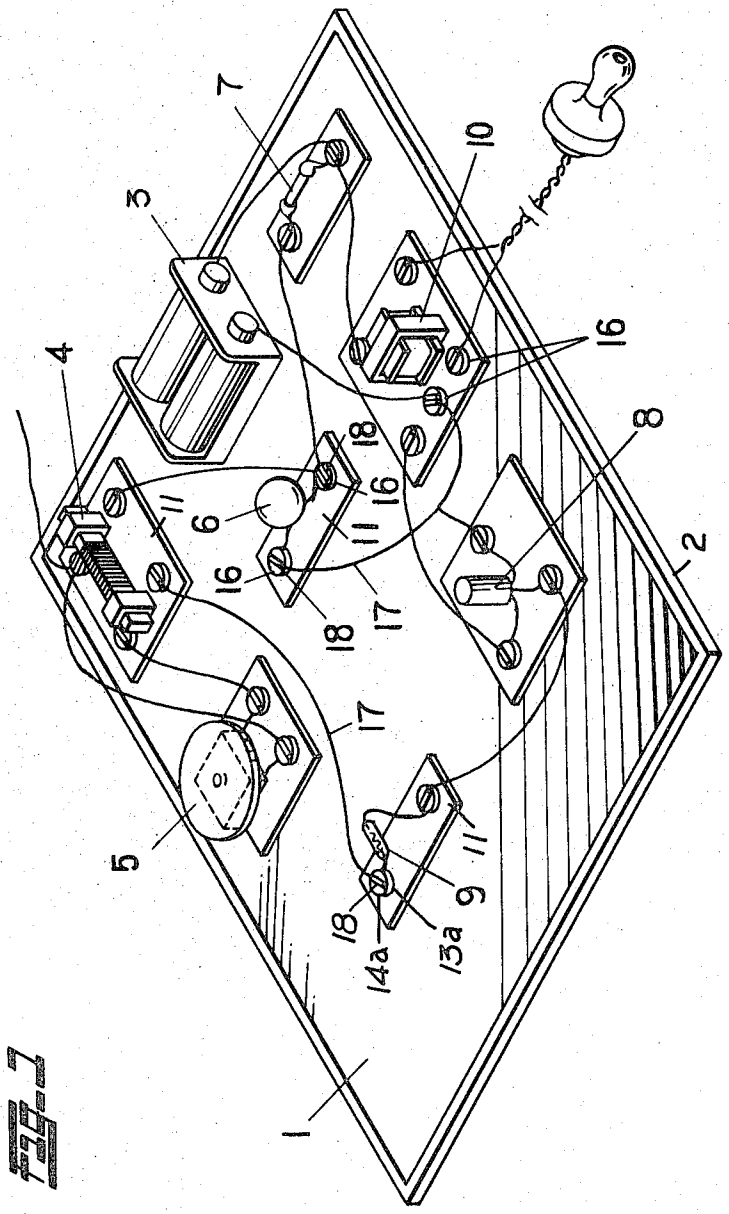


FIG. 1

Fig_2

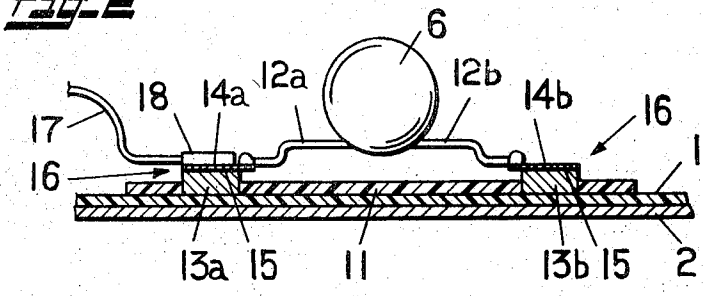


Fig_3

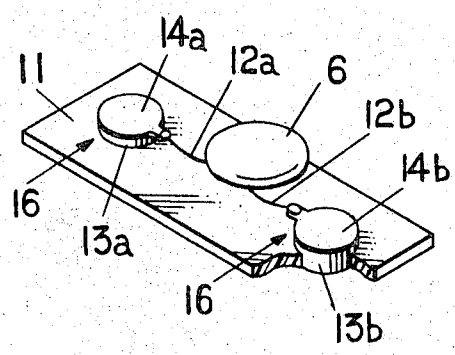


Fig_4

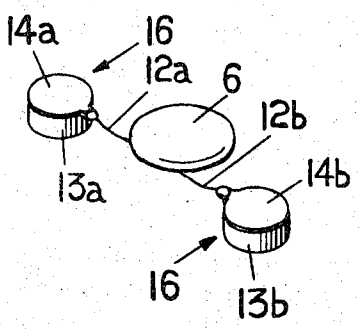


Fig_5

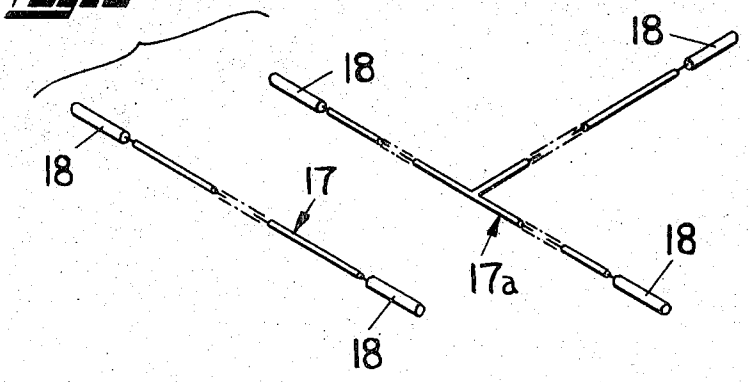
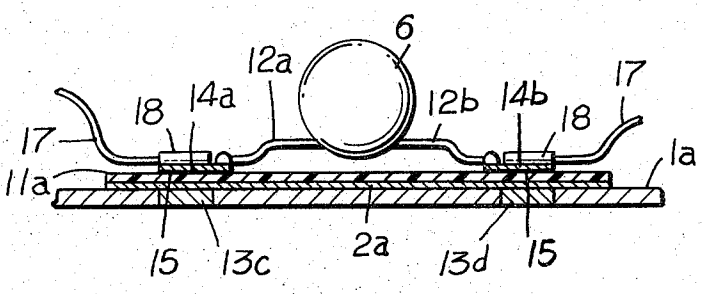


Fig. 6


6
12a
17
18
14a
12b
14b
18
17
17
1a
11a
15
13c
2a
13d
15

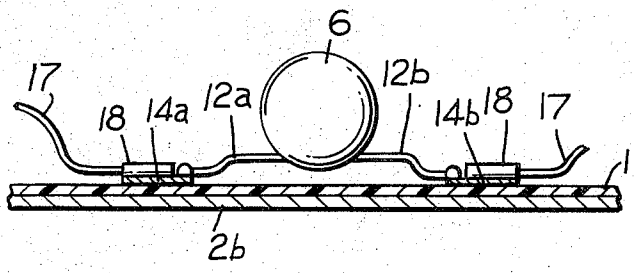

6
17
12b
18
14a
12a
14b
18
17
1
2b

Fig. 7

APPARATUS FOR ASSEMBLING ELECTRICAL CIRCUITS FOR EXPERIMENTATION

This invention relates to an electrical circuit assembling device for experimentation by which electrical theory can be understood in the application and handling of electronic parts, and by which electrical circuits can be assembled and easily disassembled, e.g., for making experimental circuits and the like.

Today numerous electric products and electronic components can be found as a result of the diffusion and widespread dissemination of the knowledge of electricity and electronics. Especially, students of lower classes are interested in experimentation, taught together with basic theories, thereby expediting the acquisition of both theory and practical experience.

Regrettably it is a disadvantage that much time is taken up for such students to solder and assemble the components of an experimental device; often experimentation is unsuccessful due to imperfect soldering. Moreover, as the students are not familiar with the handling of the electrical apparatus, they are in danger of electric shocks and burns. Sometimes the components to be assembled, such as transistors or diodes, are damaged during assembly by conventional methods, e.g. owing to the application of excess heat during soldering.

In order to assemble repeatedly an electronic device, or to assemble various circuits on the same base plate with the same or different components, it is necessary in such experiments for the terminals of the electronic parts to be mounted and dismounted freely and placed at any given position, both physically and in terms of the electric circuit involved.

Therefore, the primary object of this invention is to provide an experimental electrical circuit assembling apparatus which allows connections to be made between the terminals of the electronic parts, located on the base plate, without utilizing other electrical apparatus (e.g. soldering tools).

Another object of the invention is to provide an apparatus for assembling electrical circuits having terminals of the electronic parts that can be freely assembled or disassembled on the base plate.

A further object of the invention is to provide a circuit assembling apparatus for experimentation which may have the electronic parts located at any given position on the base plate.

Other objects and many of the attendant advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description, when considered with the accompanying drawings, wherein

FIG. 1 is a perspective view of an assembling apparatus according to the invention, for making any desired electrical circuit from its components or parts, in a preferred, exemplary embodiment thereof;

FIG. 2 is an enlarged partial cross-sectional view of some of the parts shown in FIG. 1;

FIG. 3 is a perspective view of the electronic parts of FIG. 2, with the base plate omitted;

FIG. 4 is a view similar to that of FIG. 3 but also omitting the unit plate for the parts in question;

FIG. 5 is a perspective view of two exemplary lead lines or jumpers used for connecting the components of the circuit shown in FIG. 1;

FIG. 6 is a view, similar to that of FIG. 2, of a modified or second embodiment according to the invention; and

FIG. 7 is another modification in accordance with this invention.

Referring first to a preferred embodiment of the inventive apparatus as shown in FIGS. 1 to 3, FIG. 1 constitutes an overall view of the apparatus while FIG. 2 is a sectional view, on an enlarged scale, of a portion of the circuit, FIG. 3 showing the same in a perspective view (with parts omitted). As illustrated in FIG. 2, a base plate 1 is made of an electrically insulating material such as synthetic resin, to the reverse or bottom surface of which is attached (e.g., by gluing if necessary) a metal plate 2 made for example of a thin iron sheet. It will be understood that such sheets are readily attracted even by small magnets, as will be described further down.

Various electronic parts such as a battery box 3, a choke coil 4, a variable condenser 5, a fixed capacitor 6, a resistor 7, a transistor 8, a diode 9, a transformer 10, etc., and the like can be arranged on the surface of the base plate 1. The invention is by no means limited to the use, connection and arrangement of the just enumerated elements.

Each electronic part has two or more terminals or posts, generally designated by numeral 16, to which wires 12*a*, 12*b* lead from the parts, as shown. By conventional means, e.g., by soldering or crimping, small flat metal pieces 14*a*, 14*b* are secured to the respective ends of the wires 12*a*, 12*b*. The individual electronic parts can be interconnected at their posts 16 (see FIG. 1) by way of jumpers or leads 17 or 17*a* as shown on a larger scale in FIG. 5, and to be described later, together with small rod-shaped (or optionally flat) metal pieces 18 applied to the jumper ends, as visible in FIGS. 1, 2 and 5 and elsewhere, for the purposes to be explained in more detail.

As to the attachment of the electronic parts to the base plate 1, for example, the capacitor 6 (see FIG. 2) is attached to an optional unit plate 11 of its own, shown in FIG. 3 in perspective, also made of an electrically insulating material such as synthetic resin, plastic and the like. Small, preferably block-shaped magnets 13*a*, 13*b* are secured to the unit plates 11, at least partly passing through respective cut-outs therein, and each unit plate is secured to the base plate 1 by the attractive force of the magnet blocks 13*a*, 13*b* acting on the plate 2 attached to the reverse or bottom surface of the base plate 1.

On the other hand, to dismount the unit plates 11 from the base plate 1, it is only necessary to pull away the plate 11 from the base plate against the force of the magnet blocks 13*a*, 13*b*. Symbols or marks such as +, −, B, C, E, etc., can be indicated on the unit plates 11, if necessary.

The metal pieces 14*a*, 14*b* are connected and fixed respectively to the ends of the wires or leads 12*a*, 12*b*, e.g., of the capacitor 6, and these pieces 14*a*, 14*b* are also attracted by the above-mentioned magnet blocks 13*a*, 13*b*.

In FIG. 5 the jumpers or leads 17, 17*a* are shown on a larger scale, the latter being T-shaped with three instead of two terminal metal pieces 18, namely for making connections between three terminals. FIG. 1 only shows the jumpers 17 but it will be easily understood that for example the battery 3 may be connected to

more than one point, and then one of the jumpers **17***a* may serve as a suitable branching. Two parallel or consecutive jumpers **17***a* may redouble the number of connected points. in FIG. **1** it can be seen on the right-hand side of the unit plate **11** which carries the capacitor **6** how two rod-shaped metal pieces **18** meet on top of a single metal piece (**14***a* or *—b*), namely for jumpers leading respectively to and from the choke coil **4** and the resistor **7.**

It should be noted that the shape of the metal pieces **18** may also be the same as that of the metal pieces **14***a*, **14***b* at the terminals **16** mentioned above.

An optional method is to fasten in advance the metal pieces **14***a*, **14***b* to the magnet blocks **13***a*, **13***b* e.g. by an electrically conductive binding or glueing agent as shown in FIG. **2** at **15.** This adds mechanical stability between these parts and avoids transient surface resistance effects between the contacting areas.

It will be understood that in the case where an electronic part has several terminals **16,** such as the transistor **8,** or the transformer **10,** the same number of magnet blocks **13***a*, **13***b* as these terminals is arranged on the respective unit plate **11,** the magnets at least partly passing through it, as explained before. The object in providing the magnets on the unit plates is to fix the latter to the base plate, without electrical interconnection, as well as to constitute the individual electrical terminals or posts by simply sticking the terminals **14***a*, **14***b* of the electronic parts (**3** . . . **10**) to the magnet blocks **13***a*, **13***b*.

By way of recapitulation it should be added that the first preferred embodiment of the inventive apparatus was so far described in respect to FIGS. **1** through **3,** where the small block-shaped magnets **13***a*, **13***b* are at the level of the partly embedded in the unit plates **11,** separated from the basic metal plate **2** by the insulating overall base plate **1.** In the following, modifications will be described.

A first modification is constituted by omitting one or all unit plates **11,** and using the electronic components with their posts **16,** as shown in FIG. **4,** particularly if the weight of the parts does not require particular support. This figure is the counterpart of FIG. **3,** but the overall assembly is not shown (which would be similar to FIG. **2** but omitting therefrom the unit plate **11**). In this case, the magnets **13***a*, **13***b* rest directly on the insulating base plate **1.**

As an alternative embodiment of the invention, FIG. **6** shows (in a view similar to that of FIG. **2**) again preferably block-shaped magnets **13***c*, **13***d*, embedded or pushed into cut-outs or appropriate holes of a base plate **1***a*, and a thin metal plate **2***a* attached to the bottom surface of a unit plate **11***a*, the surface which faces the top of the base plate **1***a*. It will be understood that the just mentioned elements are similar to and act in a manner like those described before (namely, magnets **13***a*, *—b*, insulating base plate **1,** metal plate **2,** and insulating unit plate **11,** respectively).

In this case, the magnet blocks **13***c*, **13***d* in plate **1***a* attract the iron plate **2***a*, the unit plate or plates **11***a* being thus fixed onto the base plate **1***a*, and the magnets also attracting the metal pieces **14***a*, *—b*, as described before, connected and fixed to the terminals of the electronic parts, by way of the respective wires **12***a*, *—b*, thereby constituting the electrical terminals. For the sake of completeness, the glueing layer **15** is also shown in this figure although it is of course optional.

As to yet another modified embodiment of the inventive apparatus, FIG. **7** (similar to FIGS. **2** and **6**) shows an arrangement that can be used when the electronic parts are comparatively light, such as the capacitor **6** or the resistor **7,** and there are no heavy components (e.g., transformers or the like). The terminals are sufficiently strong to support the units, even when dispensing with the earlier described unit plates (**11, 11***a*).

In this figure, the same numerals are used as in FIG. **2** (except for plate **2***b*), base plate **1** being again of an insulating material, a plate **2***b* therebelow being this time of a magnetic material, to substitute the omitted small magnets (**13***a*, . . . *—d*), the metal pieces **14***a*, *—b* being directly supported by the plate **1** on account of the magnetic attraction emanating from the plate **2.** In this embodiment, if desirable, counterparts of the block-shaped magnets could still be included for added support of the electronic parts.

It will be understood by those skilled in the art that the disclosed embodiments use at least one magnet in each arrangement, such as blocks **13***a*, **13***b* in FIGS. **1** to **3** (between plate **1** and the metal pieces **14***a*, **14***b*), similar blocks **13***c*, **13***d* in FIG. **6** (this time below base plate **1***a*), and a plate-shaped magnet **2***b* in FIG. **7** (again below the plate **1**). All other metallic parts are made of a material which is readily attracted and held by the magnets in question.

In any of the illustrated and described exemplary embodiments of the inventive apparatus, for example, if a transistor radio is to be assembled, the electronic parts **2** . . . **10** required are arranged on the base plate **1** or **1***a;* the unit plate or plates **11, 11***a*, if provided, are fixed to the base plate by the attracting force of the magnets (the small block-shaped pieces **13***a* . . . **13***d* or the single plate **2***b*); then the electrical terminals **16** of the electronic parts are interconnected by means of the jumpers **17, 17***a* in accordance with a wiring diagram. Several rod-shaped terminals **18** fit onto each metal piece **14***a*, **14***b*.

It will be understood by those skilled in the art that in the apparatus of the invention, if the base plate and the parts needed for the assembly are prepared (for example, a phono amplifier, a code practice oscillator, a fluorescent light, or the like, in addition to the already mentioned transistor radio), the asembling experimentation can be done quickly, safely and with certainty. No material (e.g. connecting wires, solder) is wasted, all the jumpers can be re-used for other circuit arrangements, parts can be substituted and tested, and the entire procedure is considerably simplified.

Further, the apparatus of the invention can have units constituting the various electronic parts, and therefore they can be handled more easily; various experimental circuits can be built because each electronic part and the required lead lines or jumpers can be interconnected and detached freely and without difficulty.

In addition, in the inventive apparatus, it is not necessary to maintain the position of the electronic parts but they can be moved around to any given or desired part of the base plate. Therefore, various arrangements of the electronic parts can be considered in the assembling circuit, during the experimentation, especially when a transistor radio or the like is assembled where the effect of one coil, for example, can be considered, balanced or eliminated with respect to other coils, transformers and parts (either by changing the orienta-

tion or by removing and shifting the part in question to a distant area of the base plate).

It should be understood, of course, that the foregoing disclosure relates only to preferred embodiments and modifications of the invention and that it is intended to cover all changes and further modifications of the examples described which do not constitute departures from the spirit and scope of the invention.

What I claim is:

1. An apparatus for assembling electrical circuits for experimentation; comprising, in combination: an electrically insulating base plate for supporting on one of its surfaces discrete electronic parts which constitute the electrical circuits; each of said parts having at least two wires connected thereto and extending therefrom; small metal pieces constituting terminals for said parts at the ends of said wires; a metal plate substantially coextensive with and adjoining said base plate; block-shaped metal pieces corresponding in number to that of said terminals; jumper leads having at least two metal terminals of a small size, adapted to fit unto said metal pieces, for electrically interconnecting at least two of said terminals; and magnet means constituted by at least one of said metal plate and said block-shaped pieces, for holding together by magnetic attraction said metal pieces, said metal plate, said block-shaped pieces and said jumper terminals when said parts are positioned on said base plate, and thereby constituting the electrical circuits; said metal pieces, said jumper terminals, as well as the remaining ones of said metal plate and said block-shaped pieces being of a material responding to magnetic attraction by said magnet means.

2. The assembling apparatus as defined in claim **1**, further comprising an electrically conductive binding agent on the underface of at least some of said metal pieces, for added mechanical stability of said parts with respect to said base plate.

3. The assembling apparatus as defined in claim **1**, further comprising at least one electrically insulating unit plate, each for carrying at least one of said parts, interposed between said base plate and said metal pieces.

4. The assembling apparatus as defined in claim **3**, wherein at least one of said base plate and said at least one unit plate has cut-outs therein for at least partly lodging at least some of said block-shaped pieces.

5. The assembling apparatus as defined in claim **1**, wherein said magnet means is constituted by said block-shaped pieces, disposed between said base plate and said metal pieces, and wherein said metal plate is disposed adjacent the other surface of said bottom plate.

6. The assembling apparatus as defined in claim **1**, wherein said magnet means is constituted by said block-shaped pieces, disposed adjacent the other surface of said base plate, and wherein said metal plate is disposed between said base plate and said metal pieces.

7. The assembling apparatus as defined in claim **1**, wherein said magnet means is constituted by said metal plate, disposed adjacent the other surface of said base plate.

* * * * *