My present invention relates to apparatus for electroplating surfaces by a local application of electrolyte, anode and electrolytic current as, for example, in apparatus that may be positioned and manipulated by hand on the surface to be plated, to replace worn spots or for other purposes.

Hitherto in apparatus of the above type the source of electrolytic current has either been placed in the anode itself or has comprised a system containing rotating parts. When the source of current is located in the anode itself which is relatively small in dimension, only weak currents can be used, as high capacity batteries are heavy and cumbersome. Storage batteries are disadvantageous as a source of current inasmuch as they have a very great weight for the current output, must be serviced carefully and charged frequently and are, therefore, not at all times available for use. They are particularly unsuitable for apparatus that must be transported or carried. Therefore, batteries of this type have the disadvantage also inherent in systems that have rotating parts that their servicing charges are high and they are not suitable for use by unskilled persons.

My invention provides a current supply means for anodes of the above type which may be connected to the usual lighting circuits and which transforms energy from such circuits to a suitable electrolytic current by means of a system without rotating parts. This energy and current transforming system may, therefore, be enclosed or sealed in a cabinet or compartment of an electroplating kit containing materials and tools for the galvanizing operation so that it will not be touched or disturbed. The kit or apparatus is, therefore, always ready for operation.

The apparatus may be plugged in or connected to an alternating current or to a direct current. When connected to an alternating current or lighting circuit, the system comprises an alternating current transformer and a static rectifier, that is one of the electrolytic or similar type and without rotating parts. For connection to a direct current source or lighting circuit an alternator is provided which transforms the direct current into alternating current of low voltage and which is supplied to the static rectifier where it is again transformed into direct current of low voltage. Preferably, in accordance with my invention, the system is arranged so that it may be used with both alternating and direct current.

The various features of the invention are illustrated in the accompanying drawings, in which—

Fig. 1 is a diagrammatic sketch of an electroplating kit showing the position of the electric system therein and its connection to the anode and cathode.

Fig. 2 is a plan of the kit shown in Fig. 1.

Fig. 3 is a diagram of the circuit for alternating current.

Fig. 4 is a similar diagram of a circuit for direct current.

Fig. 5 is a diagram of a circuit that may be connected to either alternating or direct current.

Fig. 6 is a diagrammatic sketch of an automatic circuit for connection either to an alternating or direct current.

Fig. 7 is a diagrammatic sketch of connections to anodes of different surface areas or dimensions, and

Fig. 8 is a part sectional view of an anode.

Referring to Figs. 1 and 2, these figures show the arrangement of the electric system in its relation to other articles in the kit 1. The system for supplying the low voltage electroplating current from higher tension lighting circuit energy is located in a compartment 2 from which extend the leads 3 for plugging into the light circuit, and the low tension leads 4 and 4', one of which connects with the hand operated anode 5, and the other of which is connected to a clip 5' for connecting the article to be plated, as a cathode. These various lead wires and plating elements may be enclosed in the kit when not in use. This kit may also contain the other articles used in plating as, for example, a cleaning brush 6, a shelf 7 for holding the anodes, and bottles 8 for electrolyte liquid in compartments 9, and a bath container 10.

In Fig. 3 is illustrated diagrammatically a system for use with alternating current circuits. In this system the wires 3 are connected to a step down transformer 11, the low tension circuit 12 which leads through a rectifier 13 and a resistance 14 to the wires 4 for connection to the anode 5 and the clips 5' for the article to be plated. The rectifier 13 may be of any suitable static type whereby the alternating low tension currents may be rectified to direct current. This rectifier may, therefore, be of any suitable electrolytic, vapor or other type.

The system shown diagrammatically in Fig. 4 is for connection to a direct current lighting circuit. In this system the wires 3 from the lighting circuit lead to an alternator 15 in which they are changed to a low tension alternating current. This low tension alternating current then passes through wires 6 to the static rectifier 17 where it is changed to direct current. From the
rectifier 17 the low tension direct current is taken off through the wires 4, a suitable resistance being included.

The system shown in Fig. 5 may be connected to either a direct or alternating current lighting circuit. As in Fig. 3, it includes the step down transformer 11 to the high potential terminals 19 of which the lead wires 3 may be connected directly through a double throw switch 20. The low tension alternating current from the stepped down side of the transformer then passes through conductors 12 and rectifier 13 to the wires 4 as in the system of Fig. 3.

When the apparatus is to be used for direct current the switch 20 is moved out of contact with the high tension terminals 19 of the transformer 11 into contact with terminals 21 that lead to an alternator 22 similar to that of Fig. 4 but delivering current at the potential of the lighting circuit. The alternating current from the alternator 22 is then conducted through conductor wires 23 to other blades 24 of the double throw switch which connect these wires to the high tension terminals 19 of the transformer 11.

Thereafter, the current passes to the transformer 11 as in the case of an alternating current circuit.

When the switch 20 is thrown to connect the wires 4 directly to the transformer 11, the switch 24 is swung to open position, being movable with the switch 20.

The system shown in Fig. 6 is usable with either alternating or direct current and contains mechanisms that automatically adjust the apparatus for either alternating or direct current. When the apparatus is connected to a direct current lighting circuit, current from the latter passes through the inductive or choke coils 25 to an alternator 26 where they are transformed into alternating current. This alternating current then passes through lead wires 27 and switches 28 to the high tension terminals 29 of a step down transformer 30. The low tension alternating current is taken from the low potential side of the transformer 30 through lead wires 31 to the rectifier 32 and thence to the wires 4 which include the usual resistance 14.

In passing through the choke coils 25 the direct current energizes the latter and thereby opens the switches 33 which have armatures attracted by the energizing of the coils 25. This breaks an alternating or by-pass circuit leading through the wires 34 and 35 to the condensers 36 and thereby prevents any striking back of the alternating current from the high potential terminals 29 of the transformer 30 through the conductor wires 37 and solenoids 38 which are connected to the condensers 36.

When the system is connected to an alternating current lighting circuit the choke coils 25 become de-energized or de-magnetized sufficiently to permit the switches 33 to close. Then current flows from the lead wires 3 through the by-pass wires 34 and switches 33 to the wires 35 and condensers 36. From the latter the alternating current is transmitted through the solenoids 38, which are non-choking coils, and thence through the connecting wires 37 to the high tension terminals 29 of the transformer 30. From the latter, the stepped down low tension alternating currents pass through the rectifier 32 and to the wires 4 and 5. The passage of the alternating current through the solenoids 38 energizes the latter and thus opens the switches 28 which are controlled electromagnetically by the solenoids 38 and prevent a back surging of the alternating current through the connector wires 27 to the alternator 26. Accordingly, this system may be plugged into an alternating or direct current lighting circuit without any adjustment or action on the part of the operator.

To assure a correct reaction of the switches or relays 29, 28, even when no current is drawn from the low voltage side, a ballast resistance 39 is provided across the low potential terminals of 10 the transformer 30.

The particular advantage of the system of Fig. 6 is that when connecting to a direct current circuit it is not necessary to check up on the poles. Whatever connection is used in any particular case, the current strength in the case of a short circuit in the off-take low voltage direct current may always be limited to a degree that is harmless for the current source by the resistance 14 which is permanently built into the low voltage side.

Inasmuch as corrosion resisting deposits of good appearance can only be obtained if the current density is kept within a permissible limit for each electrolyte, the surface area of the 25 anodes is kept the same, although their shapes, curves and appearance may be as one from the other. In this case the leads 34 40 may be permanently connected to the current source and the differently shaped anodes may be fastened to the free ends of the leads as, for example, by plugging therein. In certain cases, however, where articles of different dimensions are to be plated, anodes of various surface areas may be required. The current density to be used is thus different in the various cases, and when the apparatus is to be used by unskilled workers it is so arranged that the maximum permissible current is automatically switched in.

Several outlets from the transformer may be provided from the rectifier to one contact box for each such outlet or tap into which may be plugged the leads from different anodes; or, for each anode, a resistance 39 corresponding to the area of the anode may be built in in advance of the contact sockets 40 for the respective anodes, as in Fig. 7, with a common connection from these sockets to the transformer. To prevent confusing the different anode connections, the lead wires to the anode may be permanently connected to the latter and the free end of the lead wires may be given distinctive shapes, for instance, different diameters. The leads to the anodes, which have smaller areas and are therefore to be operated at lower current densities will have plugs of larger diameter than those of larger area which operate at higher current densities. This prevents an overload through plugging of a thin plug into a larger socket; or, to ensure against confusion, the free end of each lead that is permanently connected to an anode may bear a different arrangement of the two contact plugs as, for example, the different distances between these plugs and that of other anodes.

If it is desired to work with anodes of different surface areas and to have the leads to these anodes permanently connected to the current source, and to use only one lead to each anode, an automatic setting of the proper current density may be provided by building into each anode permanently a rheostat switch or cut-out switch as shown at 42 in Fig. 8, which automatically limits the current in accordance with the surface area of the anode.
Through the above invention I have therefore provided a system in which energy from the ordinary house lighting circuits may be used without the inter-position of rotating parts to supply low tension direct current for electroplating. I have also provided systems whereby an apparatus may be used that will alter automatically with direct or alternating circuits, and in which the proper current density is maintained under various plating conditions.

What I claim is:

1. Apparatus adapted to deliver to a load circuit a direct current voltage from an alternating or a direct current source, said apparatus including an alternating current transformer having primary and secondary windings in correct ratio to produce an induced alternating current at a desired voltage for said load circuit, two electrical circuits for energizing said primary winding, one of said circuits having a relatively high alternating current resistance and a relatively low direct current resistance and including means to convert direct current into pulsating current and means to energize the said primary winding with said pulsating current, the other of said circuits having a relatively high direct current resistance and a relatively low alternating current resistance and being adapted to pass the current from said source directly through said primary winding, electro-magnetic switch means adapted to be energized by the current from said source to open the second said circuit when the current from said source is direct current and to permit the current from the source to pass only into the first said circuit, a solenoid switch means adapted to be energized by the current from said source to open the first said circuit when the current from said source is alternating current and to permit the current to pass only into the second said circuit, a rectifier device, means to pass the induced current in said secondary winding through the rectifier device, and means to feed the output of said rectifier device into said load circuit.

2. Apparatus adapted to deliver to a load circuit a direct current voltage from an alternating or a direct current source, said apparatus including an alternating current transformer provided with primary and secondary windings having a ratio adapted to produce in said secondary winding an induced alternating current of desired voltage for said load circuit, a pair of terminals for connection with said source, an electrical circuit including a direct current alternator device electrically connected across said terminals, a second electrical circuit for impressing the output of said alternator device across the primary winding of said transformer, an electromagnetic switch having a magnetic coil of relatively high alternating current resistance and a switch arm adapted to be moved to circuit opening position upon energization of said coil by direct current and to be returned to circuit closing position upon deenergization of said coil, means to electrically connect the said magnetic coil in series with said alternator device in said first circuit, means to electrically connect said switch arm electrically in series in said second circuit, a solenoid actuated switch having a solenoid coil and a switch arm adapted to be moved to open position upon energization of said coil by alternating current and to be returned to closed position upon de-energization of said coil, means to electrically connect the said solenoid coil electrically in series in said third circuit and means to electrically connect said switch arm electrically in series in said second circuit, a rectifier device, circuit means to pass the induced current in said secondary winding through the rectifier device, and circuit means to feed the output current of said rectifier device into said load circuit.

MAX SCHLÖTTER.