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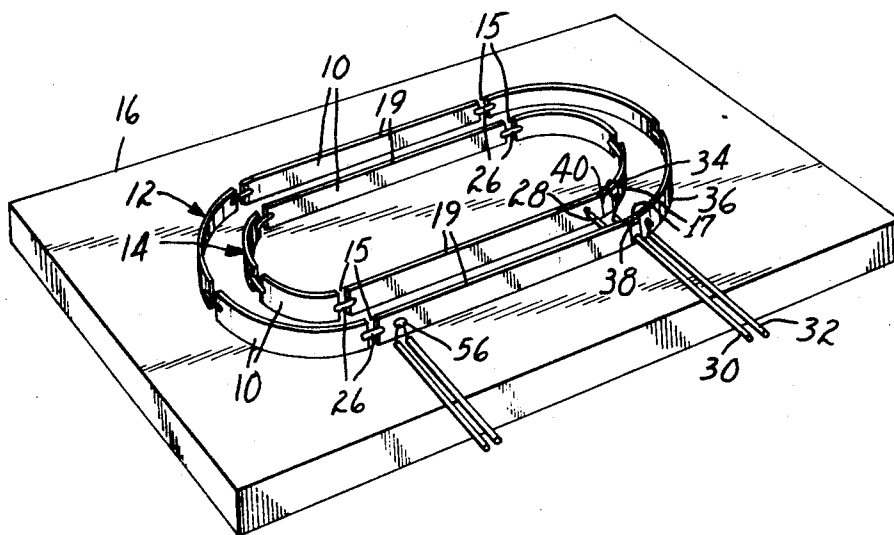
[54] **ELECTRICALLY HEATED DIE-CUTTING APPARATUS**
 2 Claims, 13 Drawing Figs.

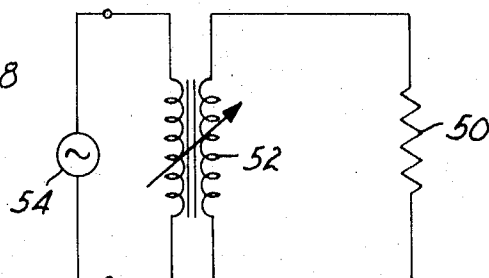
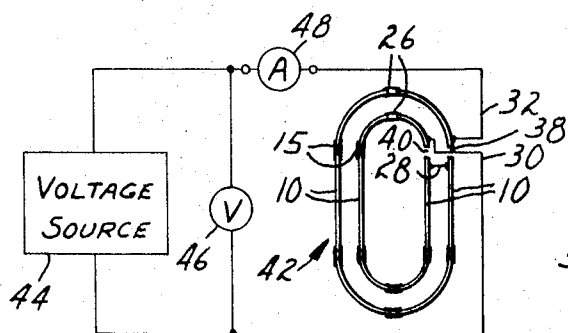
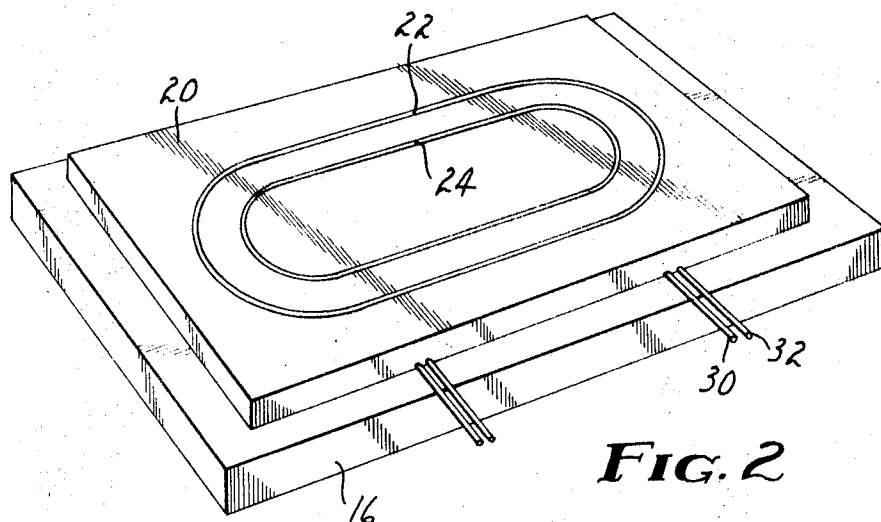
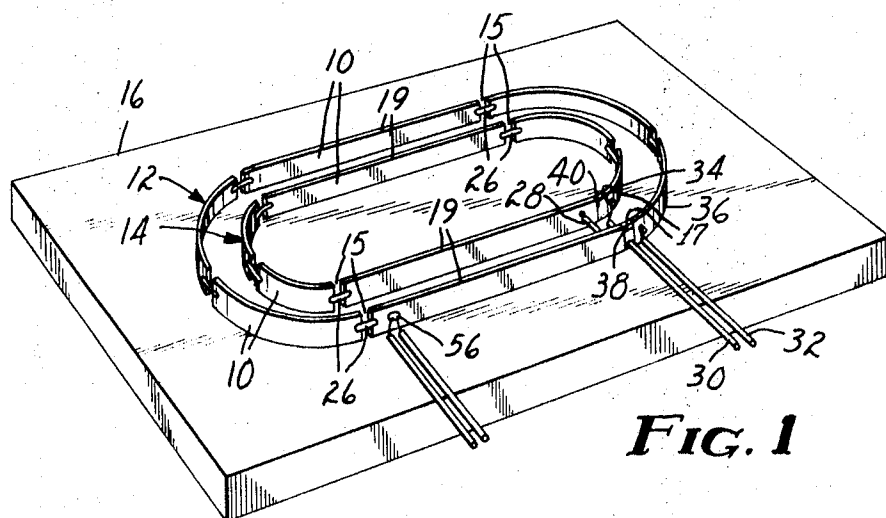
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 10.49; 76/107 (G)

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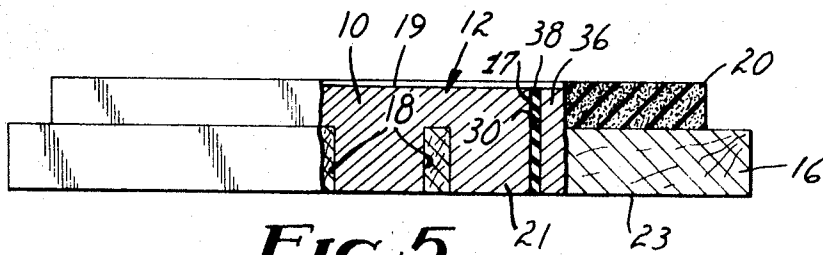
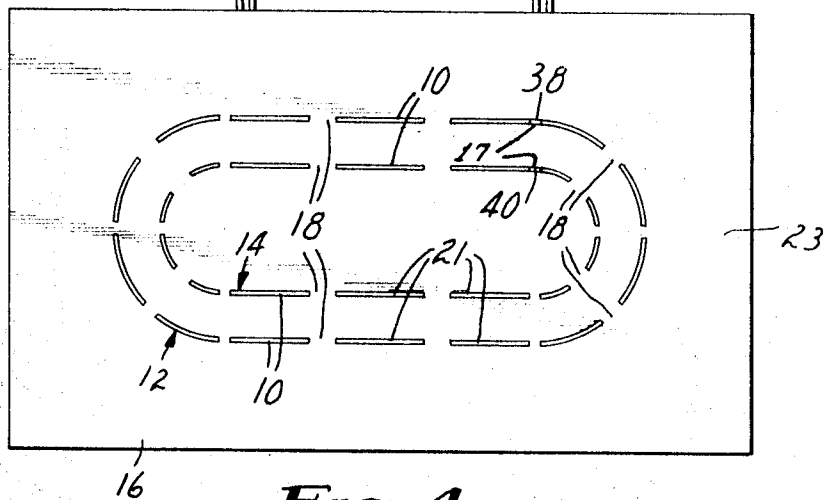
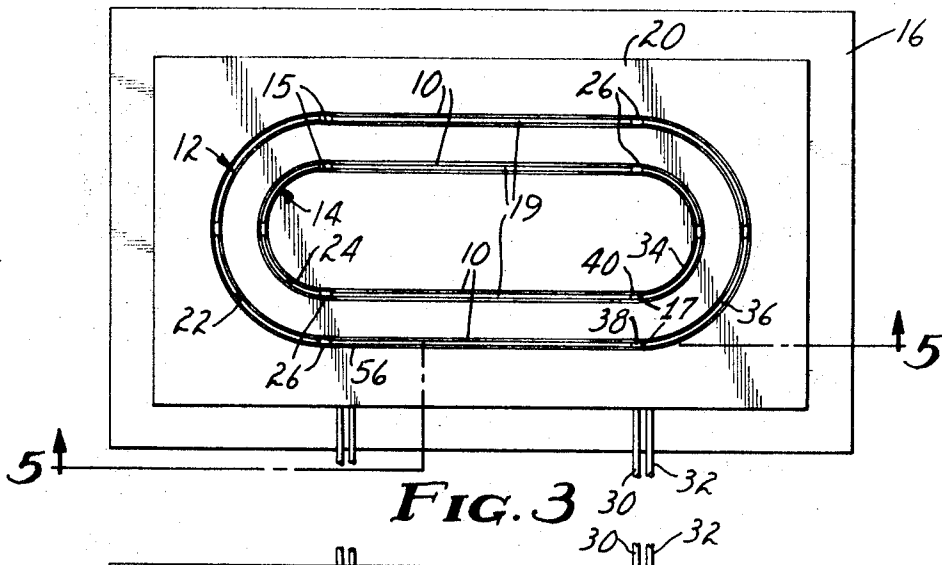
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ABSTRACT: A die-cutting apparatus having a die blade connected into an electrical circuit and adapted to have the die blade electrically resistively heated by the method of passing an alternating current therethrough and a method for using electrically resistively heated die blades for die-cutting a graphic pattern from a thin cuttable material layer is shown. In one embodiment of a die-cutting apparatus, a plurality of die blade segments is formed into a graphic pattern, is electrically connected in an electrically conductive network and is resistively heated by passing an alternating current therethrough. The apparatus is adaptable to both kiss cutting and through cutting. The electrically heated die blade may be substantially enclosed in a heat-insulating foamy layer to retard heat dissipation.





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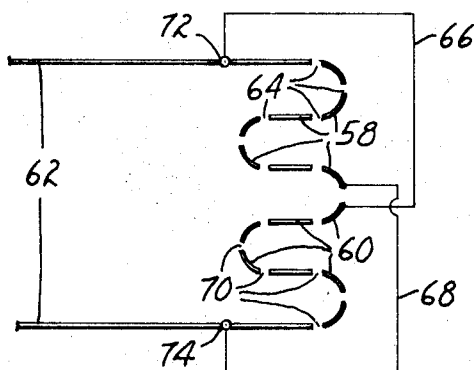


FIG. 7A

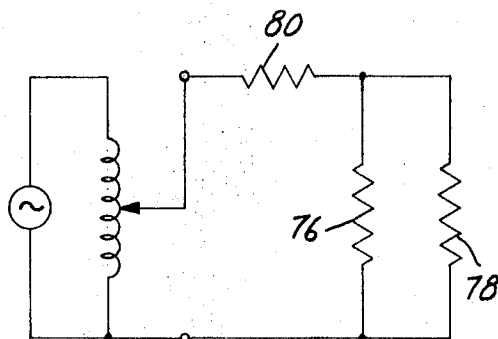


FIG. 7B

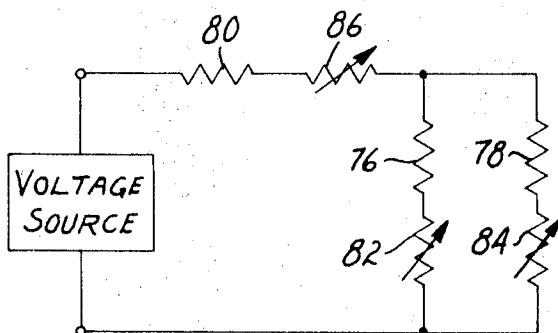


FIG. 7C

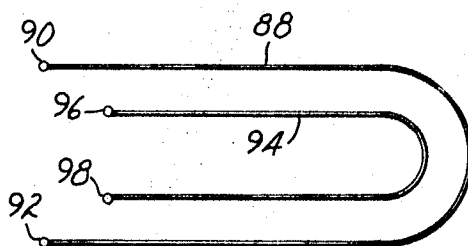


FIG. 8

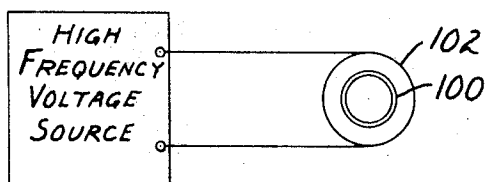


FIG. 9

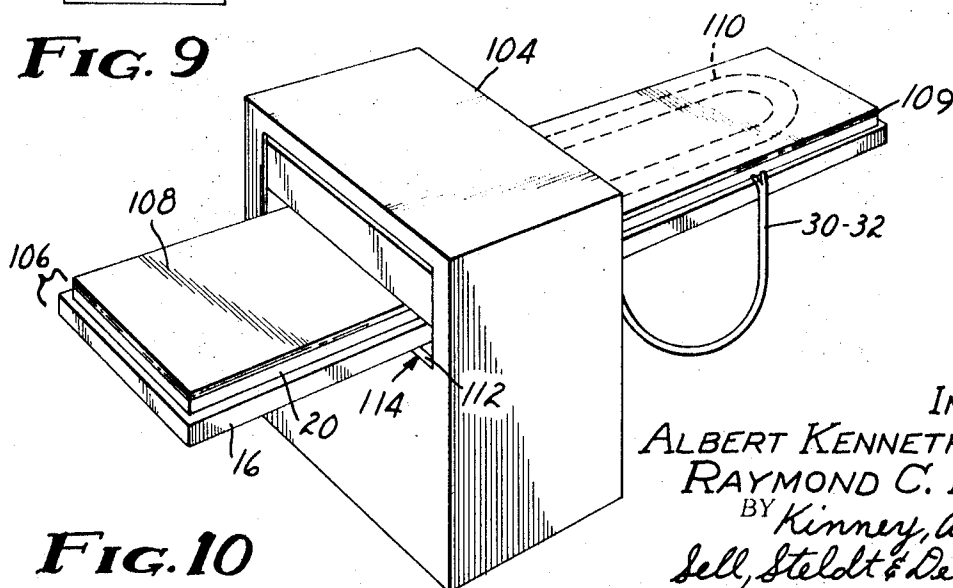


FIG. 10

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ELECTRICALLY HEATED DIE-CUTTING APPARATUS

Hot and cold die-cutting of graphic patterns from sheeting and film is known. For example, graphic patterns may be kiss cut from pressure-sensitive adhesive coated materials such as 3M "Scotchlite" brand reflective sheeting, 3M "Scotchcal" brand vinyl film and the like using known kiss-cutting apparatus having a plurality of die blades.

By using a heated die blade, a cleaner more uniform cut is obtained than with an unheated blade since the heat operates on these materials in combination with the blade to part the material more evenly. Also, when hot die-cutting reflective sheeting, such as 3M "Scotchlite" brand, the heat provided operates upon the cut edges of the sheeting to seal these cut edges from corrosion.

Prior-art methods of heating die blades of die-cutting apparatus have included conduction heating techniques. In one well-known prior-art method, the die blades were formed into graphic patterns and were heated by direct contact from a source of heat by placing the noncutting edge of the die blade into physical contact with a heated platen. After the cutting edge of the die blades was conductively heated to a desired temperature, the die-cutting apparatus was used for kiss cutting a graphic pattern from a thin cuttable material layer.

There are several attendant disadvantages to the known prior-art method of conductively heating die blades. For example, limitations are imposed as to both the type of die press which can be used with such die-cutting apparatus and the maximum practical size of the graphic pattern or design which can be formed by the die-cutting apparatus die blades and be die-cut from the thin cuttable material layer using such a die press.

This known prior-art conduction heating method also has inherent operational shortcomings. In some instances, up to approximately 1½ hours may be required to heat the plurality of die blades to the desired temperature. In the prior-art conduction heating method, the heating time depends on the size and material of the die blades and on the heating energy supplied by the platen heat source.

Another important shortcoming of the prior-art conduction heating method includes that the noncutting edge of the die blade, which edge contacts the heated platen, must be heated to a higher temperature than that required at the cutting edge in order to compensate for heat loss or heat drop through the blade so as to obtain the predetermined temperature at the cutting edge of the die blades. Also, heat from the heating platen must be supplied, at the higher temperature, at a heating rate substantially equal to the heat loss from both the heat drop across the die blade and the heat loss from the apparatus during the die-cutting operation.

The prior-art method of conductively heating die blades is limited to use with platen die presses and cannot practically be used with a reciprocating die press of the type wherein the die and cuttable material layer being die-cut are simultaneously fed through the press.

Another disadvantage of the prior-art method and apparatus is that they are not adaptable for use with existing die-cutting equipment for die-cutting large intricate patterns and designs used by the automotive industry for decorative striping on automobiles.

It is therefore one object of this invention to provide a novel die-cutting apparatus having a die blade which is capable of being electrically resistively heated.

It is another object of this invention to provide a die-cutting apparatus having a die blade which is capable of being electrically resistively heated and which is capable of being unrestricted in its graphic pattern configuration in at least one dimension compared to the dimensions of the die press with which it is to be used.

It is another object of the present invention to provide apparatus for die-cutting graphic patterns from thin cuttable material layers wherein the die blade has a relatively short heating time which results in more productive time than the prior-art methods and apparatus.

Briefly, the invention comprises a die-cutting apparatus having a die blade which is electrically connected into an electrically conductive path and which is electrically resistively heated by passing an electrical current through the electrically connected die blade.

In the preferred embodiment, the die blade is formed of material capable of being electrically resistively heated to a predetermined temperature by passing an electric current therethrough and is capable when so heated of cutting a graphic pattern from a thin cuttable material layer. The blade is shaped into the graphic pattern and also is formed into an electrically conductive path for the current flow. Circuit means adapted to be electrically connected to a variable voltage source are electrically connected directly to the die blade to enable current flow through the die blade to heat the same when the circuit means are connected to the voltage source. When cutting a cuttable material layer, the power supply is at first varied to observe the cutting effect of the heated die blade at different levels of supplied current in order to determine what range of supplied current the power supply for the circuit should be operated to provide quality cutting. A thermocouple placed near the cutting edge of the die blade allows determination of the temperature range in which quality kiss cutting of a selected thin cuttable material layer can be achieved.

The above-noted advantages of the invention will become readily apparent when considered in light of the following description of a preferred embodiment, which refers to the accompanying drawing wherein:

FIG. 1 is an isometric view illustrating a die-cutting apparatus having a die blade made of a plurality of die blade segments constructed in accordance with the teachings of the present invention;

FIG. 2 is an isometric view illustrating the die-cutting apparatus of FIG. 1 with the die blade cutting edges enclosed in a heat insulating foamy material to retard heat dissipation;

FIG. 3 is a top view of FIG. 2 illustrating the die blade edges enclosed in the heat-insulating foamy material layer;

FIG. 4 is a bottom view of FIG. 1 illustrating the noncutting edges of the die blade, which die blade is rigidly supported in a rigid support;

FIG. 5 is a front sectional side view partially in cross section taken along section line 5-5 of FIG. 3;

FIG. 6A is a schematic diagram partially in block and pictorial form illustrating one embodiment of the present invention wherein the plurality of die blade segments is connected into a series electrical network energized from a voltage source;

FIG. 6B is a schematic diagram illustrating an equivalent electrical circuit and energizing voltage source for the embodiment of FIG. 6A;

FIG. 7A is a partial view illustrating another embodiment of the present invention wherein the plurality of die blade segments is connected into a series-parallel electrical network;

FIG. 7B is a schematic diagram illustrating an equivalent electrical circuit of the embodiment of FIG. 7A and also showing a voltage source used in association therewith;

FIG. 7C is a schematic diagram illustrating an equivalent circuit of a modification of the equivalent circuit of FIG. 7B;

FIG. 8 is a partial pictorial representation illustrating a top view of an alternate embodiment of a die-cutting apparatus wherein the die blades are formed in a continuous strip;

FIG. 9 is a pictorial and block representation illustrating yet another embodiment of a die-cutting apparatus wherein the die blade is formed into a cylinder having a thin wall and which is capable of being electrically resistively heated using induction heating by a high frequency voltage source; and

FIG. 10 is a pictorial representation illustrating a reciprocating die press which is capable of carrying out the kiss-cutting method with a die-cutting apparatus of the present invention.

FIG. 1 illustrates a perspective view of the die-cutting apparatus of the present invention. Typically, known die-cutting

apparatus utilize a plurality of die blade segments 10 wherein each die blade segment is shaped into a predetermined form in relation to the others to form a desired graphic pattern. For example, in FIG. 1, the die blade segments 10 are shaped to form two portions 10 and 12 defining a graphic pattern of two concentric loop patterns 12 and 14. Preferably, the die blade segments 10 are constructed from flexible steel rule. While steel rule is flexible, there are limitations in the graphic patterns into which a piece of steel rule can be shaped. Thus, as illustrated in FIG. 1, it is sometimes necessary to use a plurality of die blade segments 10. Gaps 15 are shown between the die blade segments 10. The illustrated size of the gaps 15 is greatly exaggerated for the purpose of showing their existence. Ideally, the die blade segments 10 would be physically positioned in contiguous relationship to each other thereby providing a substantially continuous cutting edge.

In the preferred embodiment of the present invention, at least one spatial discontinuity or gap is provided in each loop. These discontinuities provide an electrically nonconductive gap in the die blade. An electrically nonconductive thermal conductor 17, such as a ceramic material, can be inserted into this gap in order to provide a continuous cutting edge. If desired, each concentric loop configuration 12 and 14, illustrated in FIG. 1, could be made as one continuous segment having only a single electrically nonconductive gap as described above.

The die blade segments 10 forming loops 12 and 14 are mounted in a mounting means such as rigid support 16 in order to prevent flexing of the die blade segments 10. The rigid support 16 may be formed of a nonconducting insulating material, such as, for example, wood, preferably plywood or hardboard. The mounting means or rigid support 16 has an aperture therethrough for receiving the noncutting edge of the die blade segment which rigidly supports the die blade in a position enabling the die blade to extend from one side of the rigid support 16. The die blade segments 10 have notches 18 (illustrated in FIGS. 4 and 5) to improve the gripping relationship between the die blade segments 10 and the rigid support 16.

It is preferable to enclose the cutting edge 19 of the die blade 10 in a resilient heat insulating foamy material layer 20 (illustrated in FIGS. 2, 3 and 5). A foamy silicone rubber may be used as the heat-insulating foamy material layer 20.

In FIGS. 2 and 5, the heat-insulating foamy material layer 20, in its relaxed state, extends slightly beyond the cutting edge 19 of blade segments 10. When the foamy material layer 20 is compressed, the cutting edges of the die blade segments extend through the foamy material layer 20.

The foamy material layer 20 retards heat dissipation from the die blade segments 10, thereby decreasing the amount of heat which must be supplied to the blades. Being extended beyond the cutting edge 19 of the die blade, the insulating material layer 20 also serves to hold the heated cutting edge 19 of the die blade away from the thin cuttable material layer both before and after a graphic pattern is cut therefrom. The insulating foamy material layer 20 defines passageways 22 and 24 through which the cutting edges of the die blade segments pass when cutting a graphic pattern from a thin cuttable material layer.

FIG. 3 illustrates a top view of the die-cutting apparatus of FIG. 2. In FIG. 3, the inner and outer die blade loops 12 and 14 are shown to be enclosed by the heat-insulating foamy material layer 20 and to be situated in passageways 22 and 24. In this embodiment, the dimension of the insulating foamy material layer 20 in its relaxed state is less than the dimension of the rigid support 16 but greater than the dimensions of the die blade loops 12 and 14.

FIG. 4 illustrates a bottom view of the die-cutting apparatus of FIG. 1. In FIG. 4, the noncutting edges 21 of each die blade segment extend through the apertures in rigid support 16 and are thereby securely mounted to the rigid support 16.

FIG. 5, which is a section taken along lines 5-5 in FIG. 3, illustrates this mounting in detail. The die blade segment 10 has

notches 18 on its noncutting edge 21 which die blade segment 10 is located in the rigid support 16. Also, the relationship between the insulating material 20 in the relaxed position and the die-cutting edges of die blade segment 10 is illustrated. The degree of the extension of the insulating material layer 20 beyond the cutting edge 19 is exaggerated in FIG. 5 for purposes of showing its existence. The noncutting edge 21 of the die blades is preferably constructed flush with the outer surface 23 of rigid support 16.

Based on the teachings of this invention, the die blade segments 10 can be directly heated by electrically connecting them as a resistance load in predetermined electrical circuit configurations and applying a voltage across the electrical circuit to cause an electrical current to pass through the die blade segments 10. Referring again to FIG. 1, the die blade segments 10 are soldered together, such as shown by junctions 26 at certain of the gaps 15, to give electrically conductive integrity to the cutting blade. For example, silver solder can be used for electrically connecting the die blade segments 10 because silver solder has a higher melting temperature than the temperature to which the die blade segments 10 are heated. Alternatively, the die blade segments 10 can be mechanically joined together, such as by nuts and bolts, to form the desired electrical circuit.

In the embodiment of FIG. 1, the die blade segments 10 are electrically connected in series such that a uniform current can pass through each die blade segment. Connections between the inner die blade loop 14 and the outer die blade loop 12 are made by silver soldering a suitable sized copper wire connection 28 between the ends of an inner loop die blade segment and an outer loop die blade segment. The wire is large enough so as not to appreciably heat up when current flows through the die blade segments 10. Circuit means operatively connected to the die blade segments 10, such as power leads 30 and 32, are adapted to have a voltage applied thereacross to pass a current through the electrical circuit formed of the die blade segments 10 for resistively heating the die blades to a predetermined temperature.

In the embodiment of FIG. 1, an electrically conductive path is formed through lead 30 to die blade segment 34, then through the remaining die blade segments which form the inner die blade loop 14 to wire 28 and then through the die blade segments which form outer die blade loop 12 to die blade segment 36 which is connected to power lead 32. In this embodiment, electrically nonconductive gaps 38 and 40 are maintained in the outer and inner loops 12 and 14 respectively so that all die blade segments 10 are connected in series. The series connection results in the same current flowing in all segments and is generally preferred.

After the electrical connections are completed, the blades are covered with an insulating foamy material layer 20 as illustrated in FIGS. 2, 3 and 5. The passageways 22 and 24 are formed in insulating foamy material layer 20 by placing the uncut insulating foamy material layer on top of the cutting edges 19 and then making an initial pass through the press, thereby cutting the insulating material layer 20 with the blade loops 12 and 14.

FIG. 6A is a schematic diagram illustrating the die blade segments 10 as part of an electrical circuit. In FIG. 6A, an electrical circuit is formed by connecting the die blade segments together into a network 42 and applying a voltage from a voltage source 44 across the network 42. In the preferred embodiment, the voltage source 44 is a variable alternating current voltage source. A voltmeter 46 and an ammeter 48 may be utilized with the circuit to measure the electrical power being supplied to the die blade network 42. In this manner, the magnitude of the current can be regulated to maintain a relatively constant predetermined temperature in the die blade network 42.

FIG. 6B is a schematic diagram illustrating the equivalent circuit of FIG. 6A wherein the die blade network 42 is represented as a resistor 50 placed across a variable trans-

former 52 connected to an AC voltage source 54. A thermocouple 56 can also be physically mounted onto the die blade near the cutting edge 19 to measure the temperature for purposes of maintaining the cutting edges 19 at a predetermined temperature using current regulation as discussed with respect to FIG. 6A.

In the embodiment described in relation to FIGS. 1—6B, the series-connected die blade segments 10 are formed into a graphic pattern comprising two concentric loops 12 and 14. For purpose of example, a cutting apparatus so constructed can be used for kiss-cutting graphic patterns from a thin cuttable material such as a pressure-sensitive adhesive coated vinyl film having a thickness of about 0.003 inch to about 0.005 inch (about 76.2μ to about 127μ) and having a pressure-sensitive adhesive coated thereon. Such a thin cuttable layer is described in U.S. Pat. No. 2,647,848. The pressure-sensitive adhesive coated vinyl film is mounted in releasable engagement with a paper backing having a thickness of about 0.004 inch to about 0.006 inch (about 101.6μ to about 152.4μ) which backing has been impregnated with a polyethylene and silicone impregnator.

The die blade segments 10 are electrically resistively heated by a connection to an alternating current voltage source to a predetermined temperature of about 200°F . (about 93°C). In the kiss-cutting method, the dwell time of the cutting edge on the pressure-sensitive adhesive coated film mounted on an impregnated paper backing in order to kiss cut a graphic pattern from the vinyl film and adhesive is in the order of one-tenth of a second.

It is contemplated that a person skilled in the art could determine the proper predetermined temperature, dwell time and the like for the type of cuttable material layer in order to obtain clean, smooth cuts. It is also contemplated that a person skilled in the art could determine the voltage and current ratings for the voltage source upon knowing the size and resistance of the die blade. If desired, multiple layers of cuttable material could be through cut by the die-cutting apparatus and method disclosed herein. Generally, it has been determined that for kiss-cutting materials such as 3M "Scotchcal" brand vinyl film type 3650, it was required to heat the cutting edges of the die blades to about 200°F . to about 220°F . (about 93°C . to 105°C .).

In the embodiment of the invention described above, the die blade segments 10 were adapted to be connected as a series resistance element. A series connection is but one embodiment. In certain cutting configurations, such as that shown in FIG. 7A, the proximity of the various die blade segments 58 and 60 to each other may give rise to a higher temperature at their cutting edges than in those die blade segments 62 which are not as close to other die blade segments because of greater heat transference between the closer segments 58 and 60. In such a configuration, it may be desirable to pass a different magnitude current through the die blade segments 58 and 60 than through die blade segments 62 to compensate for the relatively higher heating of the die blade segments 58 and 60 due to their relative proximity, in order to provide a more uniform temperature all along die blade segments 58, 60 and 62.

To achieve compensation, the die blade segments 58 are connected in series at junctions 64 and connected in parallel by wires 66 and 68 with segments 60 which segments 60 are connected in series at junctions 70. This parallel combination is connected in series with the segments 62 at junction terminals 72 and 74. The higher current thus flows through segments 62.

This combination is represented in the schematic diagram of FIG. 7B which is an equivalent circuit of FIG. 7A wherein die blade segments 58, 60 and 62 are represented by resistors 76, 78 and 80 respectively.

Referring to FIG. 7C, variable resistor elements 82, 84 and 86 are connected in series with the die blade segments 58, 60 and 62 of FIG. 7A which are represented by resistors 76, 78 and 80 in FIGS. 7B and 7C and thus provide the capability of

achieving more precise regulation of the current in each branch of die blade segments.

FIG. 8 illustrates another embodiment wherein separate voltage supplies may be used to supply currents to separate continuous die blades in order to provide a more uniform temperature to the die blade cutting edges. Current through die blade 88 may be supplied by a second voltage source at terminals 90 and 92 while current through die blade 94 is supplied by a second voltage source at terminals 96 and 98. The voltage are varied to cause the desired magnitude of current to flow in both die blades 88 and 94.

An alternative method of heating a die blade by establishing an eddy current through an endless continuous die blade is by transformer or electrical induction action. The die blade is disposed in a magnetic field established by an induction coil such that the die blade functions as a shorted secondary winding. An eddy current is established which electrically resistively heats the die blade to the predetermined temperature.

FIG. 9 illustrates a preferred embodiment wherein a cylindrical die blade 100 is mounted coaxially with a cylindrical coil 102. Preferably, the transformer heating method should utilize a choice of frequency which is appropriate for the size of the die blade being heated.

From the foregoing, it should be appreciated that a die blade adapted to be electrically resistively heated by passing a current through the die blade and the novel method of so heating a die blade have been disclosed herein. It is readily apparent to one skilled in the art that the disclosed invention presents several advantages not found in prior-art apparatus and methods. For example, the apparatus of the present invention can be used with more than one type of die press. It can be readily used with the reciprocating die press 104 as illustrated in FIG. 10. One such die press which may be used for practicing this invention is a Hytronic® Series 60 cutting press manufacture by United Shoe Machinery Corporation.

In FIG. 10, a die-cutting apparatus 106 having an elongated piece of multilayer material 108 containing a thin cuttable material layer 109 which is to have a graphic pattern kiss cut therefrom is in contacting engagement with the insulating material layer 20 portion of the die-cutting apparatus 106 with the thin cuttable material layer 109 contacting the insulating material layer 20. The assembled die-cutting apparatus 106 and multilayer material 108 in combination is passed through the die press 104 from left to right. As the assembly is advanced incrementally through the press die, a graphic pattern corresponding to the graphic pattern formed by the die blade cutting edges is kiss cut from the thin cuttable material layer 109 as illustrated by dashed lines 110.

An electrically insulating material member 112 separate from the die-cutting apparatus is situated between the press bed 114 and the mounted die-cutting apparatus 106. This electrically insulating material member 112 may be rigidly affixed to the noncutting side of the mounted die-cutting apparatus 106 or onto the press bed 114. A preferred insulating material is bakelite sheeting.

The present invention allows the die blade to be portable and a heating system need not be contained within the die press. Also, the apparatus of the present invention gives rise to more flexibility in die design change since the dimensions of the design are not wholly restricted to the dimensions of the die press and heat transmission medium, such as the heated platen of the prior-art apparatus. Furthermore, with the apparatus of the present invention, the die blade can be heated in a matter of only a few minutes instead of up to approximately $1\frac{1}{2}$ hours thus resulting in a considerable reduction in both nonproductive heat dissipation and in nonproduction time. Also, the fact that only the die blade is being heated, instead of both the die blade and an auxiliary heat transmission medium, results in further reduction of nonproductive heat dissipation.

Electrically resistively heated cutting die blades have wide utility. In one application, the novel die-cutting apparatus was used in controlled-depth cutting or kiss-cutting letters or designs in vinyl film.

An example of this utility is for kiss-cutting pressure sensitive adhesive coated vinyl film, such as that sold under the trade name of "Scotchcal" brand No. 3650, in predesigned configurations. Consider the prespaced design stripes which are applied to automobiles. These stripes are a pressure-sensitive adhesive coated film having a paper backing. Higher quality cuts, that is cleaner cuts, of the pressure-sensitive adhesive coated vinyl film are obtained when the cutting die is heated to a predetermined temperature. The design is cut through the material but not through the paper backing by the kiss-cutting technique using electrically respectively heated die blades. After the cut is made, the material not essential to the design is stripped from the backing and discarded.

A 7-foot (about 2.1 m.) decal adapted for use as a racing stripe was kiss cut from a pressure-sensitive adhesive coated vinyl film generally known as 3M "Scotchcal" brand film type No. 3650. The vinyl film was of approximately 0.004 inch (about 100 μ) in thickness and was releasably supported on a backing member formed of a silicone-impregnated paper backing of approximately 0.006 inch (about 150 μ) thickness. The pressure-sensitive adhesive used to coat the vinyl film is selected to have a peel-back characteristic which permits the vinyl film to be peeled from the paper backing with the pressure-sensitive adhesive retained on the peeled away vinyl film. The decal or design formed of the vinyl film can thus be permanently positioned on the exterior of an automobile.

The above-described decal was kiss cut using a die blade which was approximately 7 feet (about 2.1 m.) in length, approximately 1 inch (about 2.5 cm.) high and approximately 0.030 inch (about 760 μ) thick. The die blade segments of the 7-foot (about 2.1 m.) die-cutting apparatus were silver soldered together in a series electrical network, the equivalent of which is illustrated in FIG. 6B. The die blade was connected to an AC power supply capable of delivering more than 100 amperes at 60 Hz. at approximately 30 volts. An ammeter and voltmeter were used to measure the current and voltage being supplied to the blade. A thermocouple was impressed near the cutting edge of the die blade.

At a current of approximately 30 amperes, and a measured temperature in the order of 200° F. to 220° F. (about 93° C. to 105° C.), the cleanest, most uniformly cut graphic patterns were obtained. Thus, the predetermined temperature for this combination of die blade and cuttable material is in the order of 200° F. to 220° F. (about 93° C. to 105° C.). The die blade temperature could be varied by varying the input voltage which in effect varied the current. The kiss-cutting die blades were heated to this predetermined temperature in approximately 2 to 3 minutes.

Once the current giving rise to the predetermined temperature for a given combination of apparatus and cuttable material is known, the circuit may be preset for a given current magnitude and temperature need not be directly measured. The technique of presetting the current magnitude was effective to maintain the die blade temperature within a few degrees of the desired predetermined temperature.

The temperature at the notches was observed to be approximately 20° F. (about 11° C.) higher. Heat dissipation from the 7-foot (about 2.1 m.) kiss-cutting die apparatus was reduced by enclosing the heated kiss-cutting die blade with a heat-insu-

lating foamy material layer as described herein.

It is contemplated that a temperature sensor could be physically located on a die blade and be used in a feedback temperature control system which varies the input current or voltage as required in order to maintain the desired predetermined temperature. Such feedback temperature control system may be desired in the event the kiss-cutting operation is automated.

We claim:

1. A die-cutting apparatus for forming a graphic pattern from a thin cuttable material layer, comprising a die blade having a cutting edge and being shaped into said graphic pattern, wherein the die blade is formed of material capable of being electrically resistively heated to a predetermined temperature by passing an electric current therethrough, wherein when the die blade is heated to said predetermined temperature the die blade is capable of cutting said graphic pattern from said thin cuttable material layer upon the cutting edge engaging said thin cuttable material layer, and wherein the die blade defining the graphic pattern contains at least one die blade portion defining a closed pattern, which die-cutting apparatus is characterized by the improvement that

the die blade forms an electrically conductive current path; the die-cutting apparatus further comprises power leads electrically connected to the die blade for electrically connecting a voltage source of a predetermined voltage to the die blade to produce current flow through the die blade to uniformly heat the cutting edge of the die blade to the predetermined temperature; and said die blade portion defining a closed pattern includes at least one thermally conductive electrically nonconductive material segment in the blade to define an electrically nonconductive gap in the die blade, at which gap said die blade portion is operatively coupled to the power leads.

2. A die-cutting apparatus for forming a graphic pattern from a thin cuttable material layer, comprising a die blade having a cutting edge and being shaped into said graphic pattern, wherein the die blade is formed of material capable of being electrically resistively heated to a predetermined temperature by passing an electric current therethrough and wherein when the die blade is heated to said predetermined temperature the die blade is capable of cutting said graphic pattern from said thin cuttable material layer upon the cutting edge engaging said thin cuttable material layer, wherein the die blade includes portions positioned in a noncontiguous relationship to one another, which die-cutting apparatus is characterized by the improvement that

the die blade forms an electrically conductive current path; the die-cutting apparatus further comprises power leads electrically connected to the die blade for electrically connecting a voltage source of a predetermined voltage to the die blade to produce current flow through the die blade to uniformly heat the cutting edge of the die blade to the predetermined temperature; and said noncontiguous portions are electrically connected in series circuit relationship to one another, wherein each said noncontiguous portion provides an open loop current path.