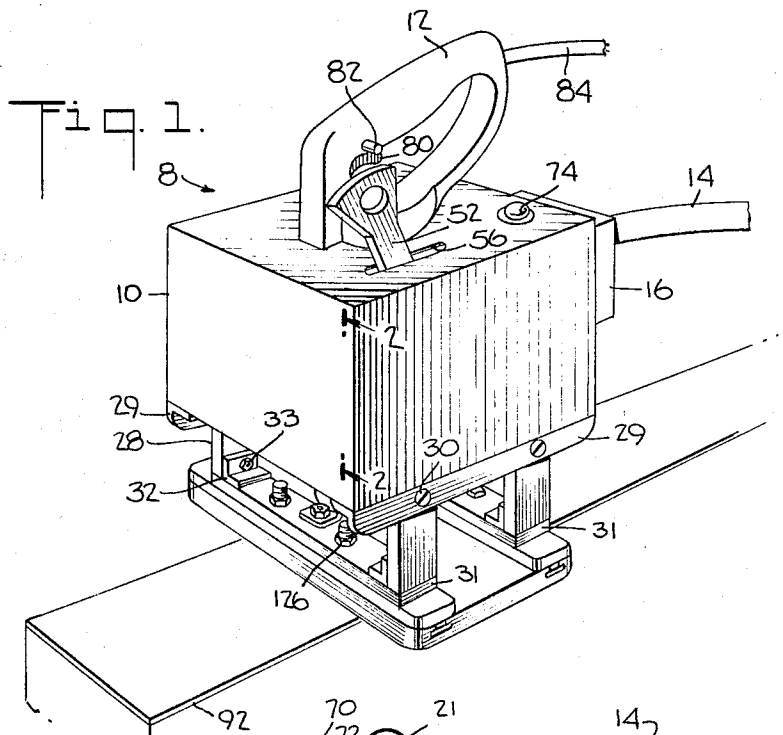
Oct. 25, 1966 S. ZELNICK 3,281,566

ELECTRONIC WOOD GLUING AND PLASTIC BONDING APPARATUS

Filed Nov. 27, 1963 2 Sheets-Sheet 1

Fig. 1.



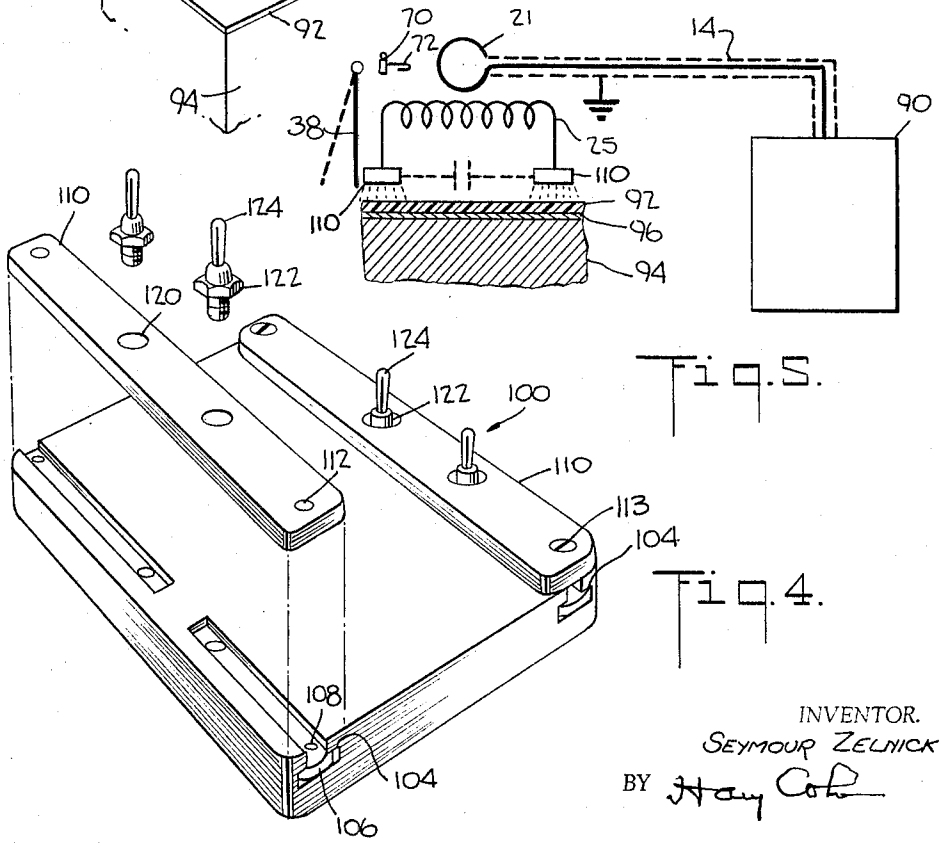


Fig. 5.

Fig. 4.

INVENTOR.
SEYMOUR ZELNICK
BY Hay Cobb
ATTORNEY

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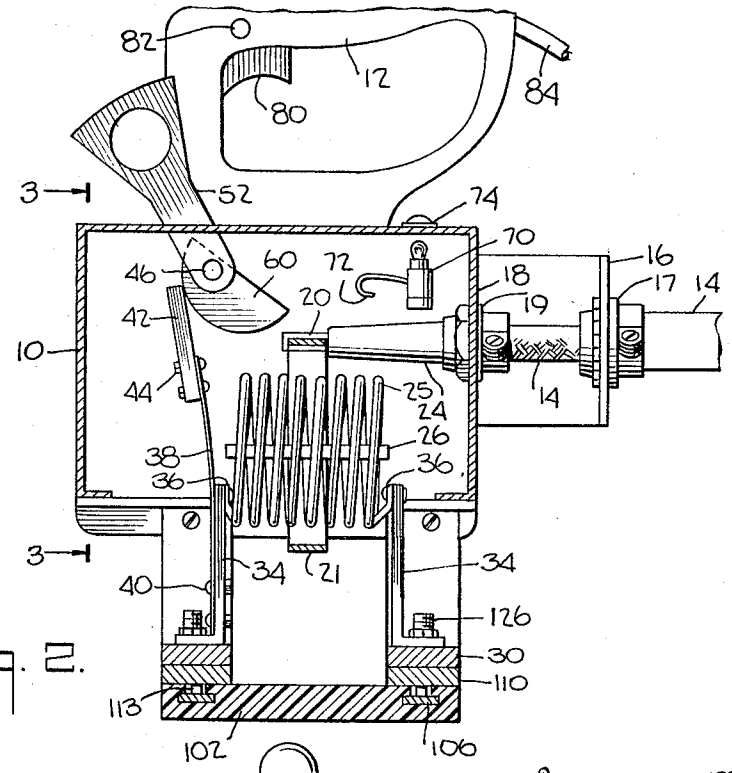

Fig. 2.

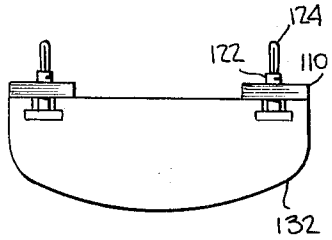

Fig. 6.

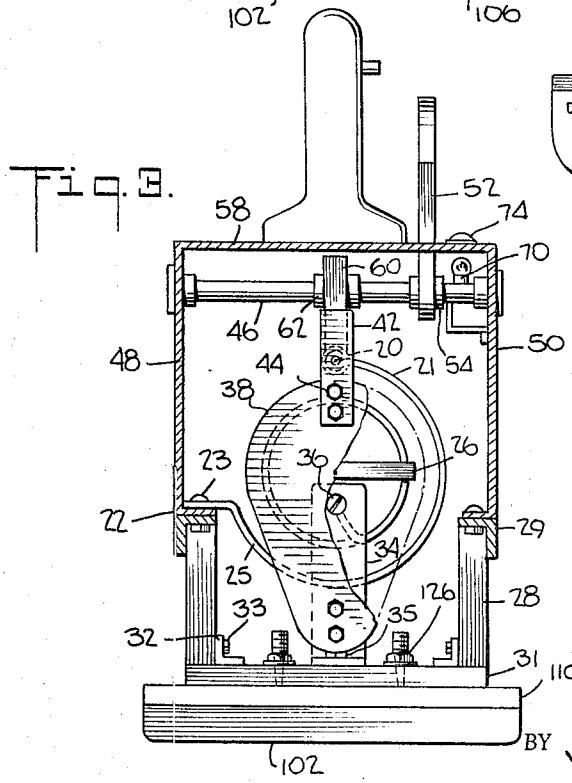

Fig. 8.

INVENTOR.
SEYMOUR ZELNICK
BY Harry Cohn
ATTORNEY

United States Patent Office 3,281,566 Patented Oct. 25, 1966

3,281,566

ELECTRONIC WOOD GLUING AND PLASTIC BONDING APPARATUS

Seymour Zelnick, Toms River, N.J., assignor to Weldotron Corporation, Newark, N.J., a corporation of New Jersey

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4 Claims. (Cl. 219—10.53)

This invention relates to apparatus for the selective and substantially instantaneous application of heat and, more particularly but not exclusively, to automatic glue drying apparatus for the drying and setting of glue bonds.

An object of the invention is the provision of automatic glue drying apparatus providing convenient and extremely rapid glue bond drying and setting.

Another object of the invention is the provision of apparatus as above providing substantially instantaneous heat generation with a glue bond without appreciable heating of surrounding materials.

A further object of the invention is the provision of apparatus as above embodying significant operational versatility whereby the said apparatus is readily adaptable, with only minor modification, to the performance of such diverse operations as outside corner gluing, edge bonding, and inside corner gluing.

Another object of the invention is the provision of apparatus as above of a truly portable nature due to the lightweight and compact design thereof.

A further object of the invention is the provision of apparatus as above of sturdy and dependable construction requiring only the use of readily available and relatively inexpensive components to provide dependable and efficient operational results.

In general, the glue bonding apparatus of my invention comprises a high frequency power oscillator or generator, and a hand gun which includes a tuned circuit and electrode connection means connected therein. The oscillator or generator is inductively coupled to the tuned circuit and electrode connection means of the hand gun. Means are provided in the hand gun to enable the convenient tuning of the said tuned circuit to approximately match the frequency thereof to the frequency of the generator whereby maximum power may be absorbed from the latter. An electrode-containing shoe is provided and is attached to the hand gun by the electrically conductive attachment of the said electrodes to the said electrode connection means. The shoe includes a surface contact member of natural anti-friction, electrically insulative material which functions to more evenly distribute the contact pressure of the glue bonding apparatus on the work to be glued. In use, the said surface contact member is pressed against the joint or surface overlying the glue bond which is to be set and dried (known as the "load") and the said tuned circuit energized to generate a high frequency current, and resultant heat in the "load." Power absorption indicating means are provided on the hand gun, whereby the frequency of the said tuned circuit may be varied until the "load" is tuned in, at which time the latter will absorb maximum power from the generator and hand gun with resultant maximum heat generation therein.

The above and other objects and advantages of the invention are believed made clear by detailed reference hereinbelow to the accompanying drawings wherein:

FIG. 1 is a perspective view of the hand gun of the invention;

FIG. 2 is a vertical sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a perspective view of the electrode and electrode shoe assembly;

FIG. 5 is a schematic illustration of the generator and the coupled inductive circuit of the hand gun electrodes, depicted in conjunction with a plurality of elements to be glue bonded; and

FIG. 6 is a side plan view of a modified form of electrode shoe assembly.

Referring now to FIGS. 1, 2 and 3, a hand gun is generally indicated at **8** and comprises a box-like casing **10** with handle **12** attached thereto in any convenient manner. A coaxial cable **14** is supported as shown exteriorly of the casing by casing-mounted support bracket **16** and fittings **17**. The said cable extends, through an aperture formed in the adjacent casing wall **18** at fittings **19**, to within the housing, and is electrically connected therewithin at **20** to one extremity of a semi-circular, electrically conductive member **21**, preferably but not necessarily of copper. The said ring is supported as shown within the housing by the said connection at **20**, and by the connection of the other extremity thereof to interior casing flange **22** (FIG. 3) by attachment screw **23** extending therebetween. The portion of the cable **14** which extends within the casing from casing wall **18** to the conductive member connection at **20**, is electrically shielded as by a hollow, frustoconically shaped insulating member **24** placed thereover.

A coil **25**, preferably but not necessarily of copper, which includes a coil winding separator element **26** of any suitable insulating material supported therewithin by frictional contact therebetween, is supported as shown in a manner described in detail hereinbelow, within the semicircular conductive member **21**, whereby it may be understood that the coil is inductively coupled to the said conductive member.

Four electrode support members **28**, of any suitable insulating material, are attached as shown in equally spaced pairs to exterior, flanged casing members **29** by attachment screws **30** (FIG. 1) extending therebetween. Two electrode connection members **31**, of any suitable electrically conductive material, are attached as shown to the respective pairs of support members **28** by L-shaped attachment members **32** and attachment screws **33** extending therebetween.

Two coil support members **34** of any suitable electrically conductive material are attached as shown at first extremities thereof to the respective electrode connection members **31** by attachment screws **35** extending therebetween, and extend upwardly therefrom for supporting attachment of the coil to the opposite extremities of the support members by attachment screws **36** extending therebetween. Thus may be understood whereby the coil is supported as shown within the conductive member **21**, and the said electrode connection members electrically connected to said coil to form the tuned circuit of the hand gun.

A generally elliptically shaped plate **38**, preferably but not necessarily of relatively thin, resilient copper sheet, is attached as shown in cantilever fashion at one extremity thereof to one of the electrode support members **34** by attachment screws **40** extending therebetween. A cam follower **42**, preferably but not necessarily of Teflon or a similar natural anti-friction, insulating material, is attached to the other extremity of the plate **38** by attachment screws **44** extending therebetween. A support shaft **46** extends between, and is rotatably journaled in, opposite casing walls **48** and **50**, as best seen in FIG. 3. A shaft actuator **52** is fixedly attached to the said shaft at **54** and extends upwardly therefrom through slit **56** (FIG. 1) in casing wall **58** to project as shown without the casing **10**. A cam **60**, preferably but not necessarily of Teflon, is fixedly secured to the support shaft **46** at

62 in surface contact with cam follower 42, whereby may be understood that rotation of the support shaft 46 from without the housing through movement of shaft actuator 52 will result in corresponding rotation of the cam 60 and corresponding movement of the plate 38 toward or away from coil 25 due to the cooperation between the said cam and cam follower 42. In practice, such movement of the plate 38 toward the coil 25 functions to decrease the inductance of the latter and increase the frequency of the tuned circuit of the hand gun to match it to the output frequency of the high-frequency generator 90 (FIG. 5) in a manner discussed in greater detail hereinbelow.

A pilot light 70 is supported as shown in any convenient manner within the casing 10 and includes a relatively short length of bent-over copper wire 72 projecting therefrom, whereby the said light is capacitance coupled to the coil 25 for energization therethrough upon energization of the latter. A lens 74 is positioned in the casing directly above the said pilot light whereby the operation of the light may be observed from without the casing.

Handle 12 is hollow and includes a non-illustrated on-off switch of any suitable form contained therewithin. The switch is actuated by switch actuator 80 and includes a locking member 82 projecting therefrom whereby the switch may be maintained in the closed position in a well known manner by depression of the actuator 80 and locking member 82 in that order. Paired conductors 84 are connected across the said switch, and extend as shown from the handle 12 to a non-illustrated junction with coaxial cable 14. In practice, depression of switch actuator 80 to close the said handle-mounted switch functions to complete a circuit through the paired conductors to couple the coaxial cable to the high-frequency generator output and energize the coil 25.

Through the preferable use of die cast aluminum for the handle 12, and reinforced aluminum for the hand gun casing 10, a truly portable hand gun of extremely durable and dependable construction, and light weight (in practice less than three pounds) is provided.

An electrode-containing shoe assembly is attached to the hand gun electrode connection members and utilized to distribute the electrode application pressure over a much wider area. The use of such shoe assembly would be particularly desirable for applications in which the hand gun is to be used in the glue bonding of thin plastic or veneer strips to the edges of wooden panels, and buckling or bending of such strips is to be prevented. The said shoe assembly is generally indicated at 100 and, as best seen in FIG. 4, comprises a flat, generally rectangular plate 102 of any suitable insulating, and natural antifriction material, as for example Teflon. T-shaped slots 104 are machined in the top surface of the plate adjacent opposite side edges thereof, and holding members 106, including threaded bores 108 formed therein, are positioned as shown within the said slots. Electrodes 110, of any suitably conductive metal, include threaded bores 112 formed therein and are attached to the plate 102 by attachment screws 113 extending through the said threaded bores 112 and the threaded bores 108 of the holding members 106. By attaching the electrodes to the plate in this manner no electrode metal passes directly through the plate 102 thereby precluding arcing between each of said electrodes and the upper, finished surface of the element 92 of the workpiece which might damage said finished surface.

Four threaded bores 120 are also formed as shown in the electrodes 110, whereby threaded attachment members 122, including resiliently compressible projecting portions 124 in the nature of well known telephone terminal plugs, may be securely affixed as shown to the said electrodes. Hand gun electrode connection members 31 include four sleeve-like attachment members 126 positioned therein as best seen in FIGS. 1 and 3. The said attachment members 126 each include a bore formed therein of a shape which is complementary to the compressed shape of the resiliently compressible portions 122 of shoe electrode attachment members 122. Thus, forced insertion of the said projecting portions within the said complementary shaped bores will result in secure, but readily removable, attachment of the shoe assembly 12 to the handgun electrode connection members 31, and electrically conductive contact between the latter and the electrodes 110.

Referring now to FIGS. 1 and 5, the operation of the hand gun 8, with the electrode-containing shoe assembly 100 attached thereto, will be described in conjunction with the glue bonding of element 92 to element 94 by the glue bond 96 positioned therebetween. In practice, one or both of these elements might be of wood, Masonite, Formica, Celotex, Textolite, Micarta, or any one of a wide variety of other and similarly electrically non-conductive materials, and element 92 up to two inches in thickness. The glue used in forming the bond 96 is preferably, but not necessarily, a thermosetting plastic glue of general urea formaldehyde composition, which presents a much higher loss factor, i.e., resistance to the passage of an electric current therethrough, than do the surrounding elements to be bonded of the nature referred to hereinabove.

In operation, the relatively large undersurface area of plate 102 is placed in surface contact with the adjacent surface of material 92, and actuator 80 of the non-illustrated handle-mounted switch referred to hereinabove, depressed to energize the coaxial cable 14, i.e. couple it to the high-frequency output of the generator 90. Energization of the said cable results in energization of the semi-circular conductive member 21 which is electrically connected thereto, and of the coil 25 and electrodes 110 which are inductively coupled to the said conductive member. For purposes of description, it may be assumed the normal generator output frequency is 27 megacycles and that the coil and electrode circuit of the hand gun is also tuned to a frequency of 27 megacycles with no load, i.e. glue bond, placed across the electrodes 110. Thus, when the said electrodes are placed in surface contact with element 92 and the glue bond load 96 placed thereacross to increase the effective capacitance therebetween, the frequency of the tuned hand gun circuit will be decreased from 27 megacycles whereby the said circuit will be unable to absorb maximum power from the coaxial cable. At this point, copper plate 38 is moved, by movement of actuator 52 from without the casing 10 in the manner described in detail hereinabove, closer to the coil 25 whereby the inductance of the coil is decreased and the frequency of the tuned hand gun circuit increased to again assume a value of substantially 27 megacycles and again match the generator frequency and enable maximum power absorption by the said circuit. This point of maximum power absorption may be very closely approximated by observation, through lens 74, of capacitance coupled pilot light 70 in that maximum brightness of the said light should coincide with maximum power absorption by the said tuned hand gun circuit.

At this point, a high frequency current of substantially maximum value will be instantaneously concentrated in the glue bond 96 and generate a very appreciable amount of heat therein to substantially instantaneously dry and set the said glue bond. No appreciable heat will be generated in the surrounding elements 92 and 94 because of the much lower loss factors, i.e. resistance to the passage of a high frequency electric current therethrough, presented thereby. Thus, the now well bonded elements 92 and 94 may be handled immediately after the drying and setting of the glue bond 96 in that no time need be lost in awaiting the cooling of the former.

The surface of the plate 102 which normally contacts the outer surface of one of the elements to be glue bonded may take any of a wide variety of shapes compatible with

the shape of said outer elements. Thus, for example, in the glue bonding of thin strips to concave surfaces, the said plate surface may take the convex shape depicted in FIG. 6. Alternatively, the said plate surface may take inverted or upright V-shape for outside corner and inside corner, respectively, glue bond drying and setting.

While I have shown and described the preferred embodiment of the invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

I claim:

1. An apparatus for the generation of heat in a workpiece, comprising: tuned circuit means, including an output coil having two spaced apart ends; two electrodes, one attached to each respective end of said coil; a presser plate made of a material having a high dielectric constant, having a lower surface adapted to be pressed against the workpiece and an upper surface for receiving said electrodes; two spaced apart voids formed in the interior of said presser plate; two holding means, one disposed in each respective void; two fastening means, one passing through said upper surface of said pressure plate and removably interconnecting each respective holding means with a respective electrode, whereby said presser plate is removably clamped to said electrodes and the lower surface of said presser plate remains imperforate.

2. An apparatus for the generation of heat in a workpiece, comprising: tuned circuit means, including an output coil having two spaced apart ends; two electrodes, one attached to each respective end of said coil; a presser plate made of a material having a high dielectric constant, having a lower surface adapted to be pressed against the workpiece and an upper surface for receiving said electrodes; two spaced apart T slots formed in said presser plate, the cross of said T being formed between upper and lower surfaces and the leg of said T passing through said upper surface, whereby the lower surface of said presser plate remains imperforate; two holding plates, one disposed in the cross of each respective T slot; two fastening means, one passing through the leg of each respective T slot and removably attaching each respective holding plate with a respective electrode, whereby said presser plate is removably clamped to said electrodes.

3. An apparatus for the generation of heat in a workpiece, comprising: a chassis; an air transformer carried by and fixed with respect to said chassis; said transformer including a primary winding for coupling to a high frequency generator, a secondary winding coaxial with said primary winding and having two ends, each of said ends being coupled to a respective one of two electrodes, which electrodes are adapted to be disposed adjacent the workpiece thereby loading said secondary winding; a conductive element carried by said chassis without said secondary winding and movable within the field of the secondary winding for varying the inductance of said secondary winding and thereby adapted to tune said transformer when it is loaded by the workpiece to match the frequency of the generator.

4. An apparatus for the generation of heat in a workpiece, comprising: a chassis; an air transformer carried by and fixed with respect to said chassis; said transformer including a primary winding for coupling to a high frequency generator, a secondary winding coaxial with said primary winding and having two ends, each of said ends being coupled to a respective one of two electrodes; a presser plate made of a material having a high dielectric constant, having an upper surface for receiving said electrodes and an imperforate lower surface adapted to be pressed against the workpiece thereby loading said secondary winding; two spaced apart voids formed in the interior of said presser plate; two holding means, one disposed in each respective void; two fastening means, one passing through said upper surface of said presser plate and interconnecting each respective holding means with a respective electrode, whereby said presser plate is clamped to said electrodes; a conductive element carried by said chassis without said secondary winding and movable within the field of the secondary winding for varying the inductance of said secondary winding and thereby adapted to tune said transformer when it is loaded by the workpiece to match the frequency of the generator.

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RICHARD M. WOOD, *Primary Examiner.*

L. H. BENDER, *Assistant Examiner.*