Oct. 16, 1956 C. JUHOLA ET AL 2,766,467

APPARATUS FOR DIELECTRIC HEAT SEAM BONDING

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Fig.1

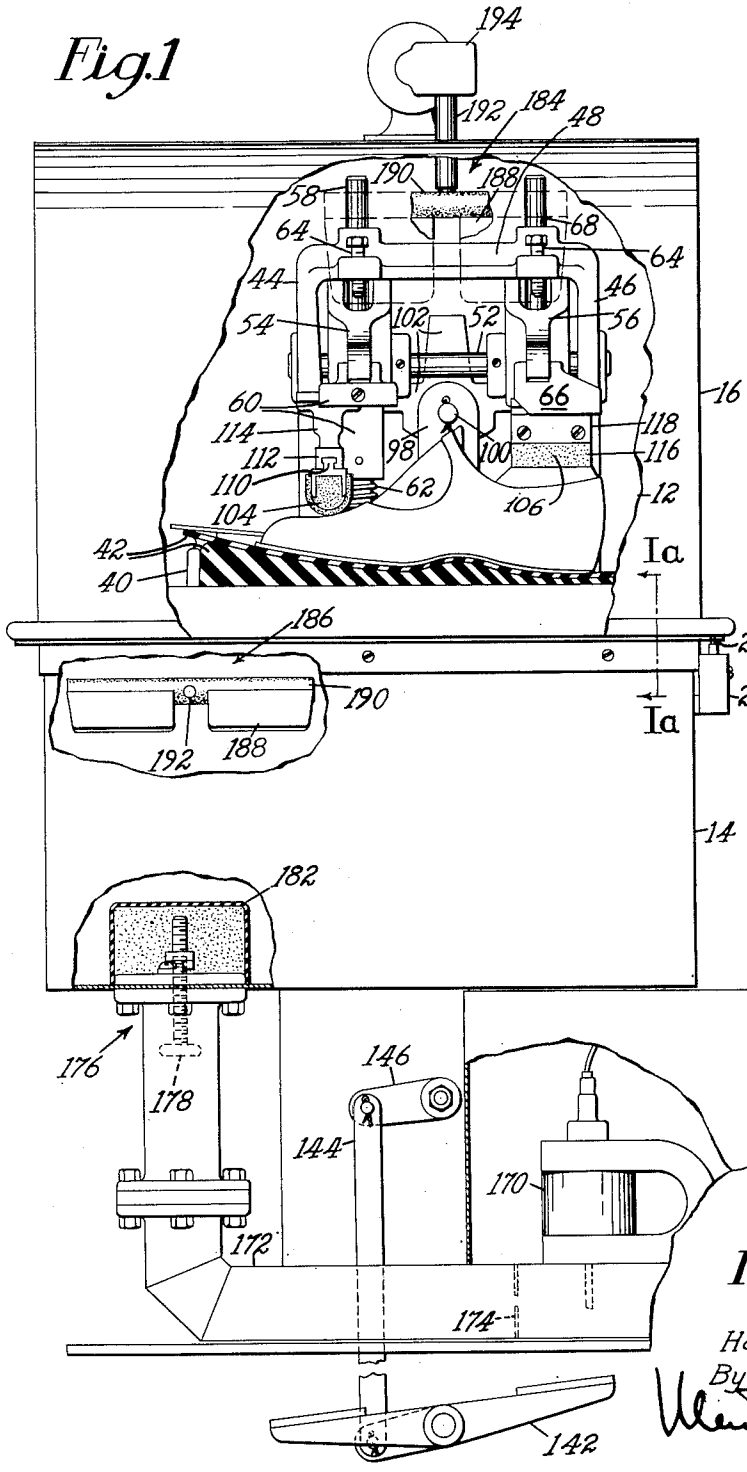
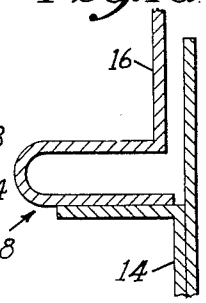


Fig.1a



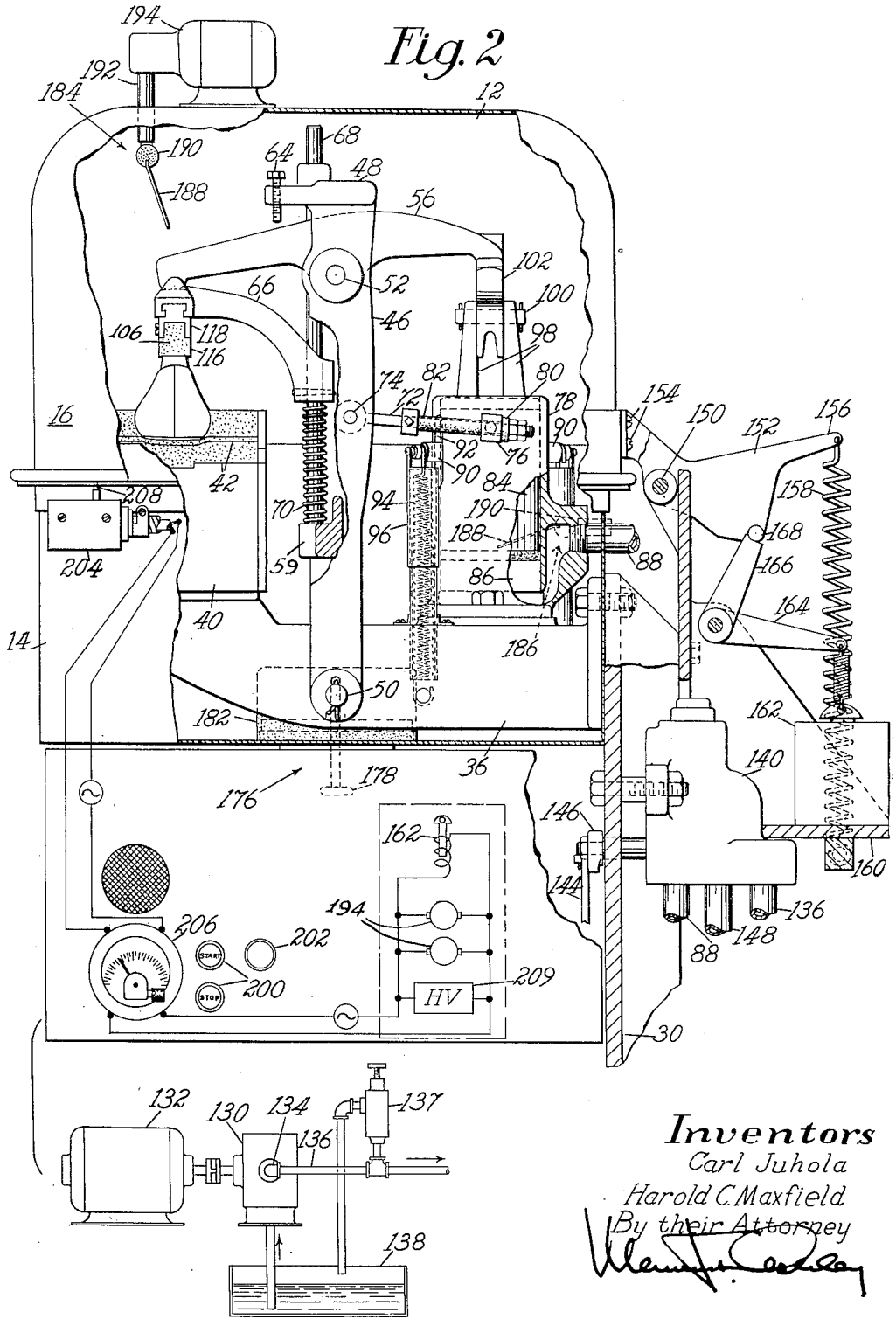
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By their Attorney

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APPARATUS FOR DIELECTRIC HEAT SEAM BONDING

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Fig. 2



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APPARATUS FOR DIELECTRIC HEAT SEAM BONDING

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4 Claims. (Cl. 12—33.2)

This invention relates to apparatus for making shoes. More particularly, it relates to improvements in apparatus for adhesively attaching soles to shoes in which a pre-cemented sole and shoe are pressed together while the adhesive is activated by dielectric heat.

The use of high-frequency electric energy for the activation of sole-attaching adhesive has been explored extensively, and a variety of approaches involving the use of electrodes disposed adjacent to the adhesive layer to establish an alternating electric field therein have been investigated. Such use of electrodes, however, has been attended by several difficulties.

One difficulty is the convenient and proper positioning of an electrode outside of the shoe. It is difficult to position the electrode to provide uniform heating without interfering with the action of the customary sole-pressure pad in applying uniform pressure between the outsole and shoe over the entire area of the bond, particularly where the electrode system must accommodate a wide range of sizes and styles.

Another difficulty is the provision of a desirably large safety margin between activation of the adhesive and burning of the leather. Full advantage cannot be taken of high loss-factor adhesives to secure preferential heating of the adhesive with respect to the leather without causing the electrode disposition to become excessively critical.

While some of these earlier approaches were capable of producing a satisfactory job of sole attaching under favorable circumstances, the aforesaid difficulties have impeded the employment on a commercial scale of dielectric heat for such activation.

Accordingly, an object of the present invention is to provide dielectric heat sole attaching apparatus which will overcome the foregoing difficulties.

To this end, and in accordance with a feature of the present invention, there is provided apparatus comprising an enclosure adapted to provide a substantially closed cavity having conductive interior surfaces, the enclosure containing a sole-pressure pad and pressure applying means cooperative with said pad for pressing together a sole and a shoe, the apparatus also includes means for supplying to the space within said enclosure high-frequency electromagnetic energy while the shoe and sole are under pressure, thereby to establish an electromagnetic field in the adhesive layer without the use of electrodes. To enhance the uniformity of heating, the enclosure is relatively large with respect to the wave length of the energy supplied thereto and is therefore capable of sustaining a large number of modes which may be favored in turn by mode-stirring, thereby changing the field pattern periodically to provide a time integrated heating effect which may be substantially uniform throughout the layer of adhesive.

In accordance with another feature of the invention, the enclosure comprises a body portion open at its top and a cover portion, the shoe press being so disposed

that the top of the pad is above the top edge of the body portion, thus providing free access to the pad.

These and other features and advantages of the invention to be defined in the claims are described in detail in the following specification in connection with the accompanying drawings, in which:

Fig. 1 is a front elevation, partly broken away and partly in section of a preferred embodiment of the present invention;

Fig. 1*a* is a section taken on line I*a*—I*a* of Fig. 1; and

Fig. 2 is a side elevation, partly broken away and partly in section, of the apparatus shown in Fig. 1.

Referring to the figures, the apparatus comprises a copper-lined steel enclosure **12** having a body portion **14** formed with a rimmed opening at the top and a cover portion **16**, the enclosure **12** being supported on a member **30** (Fig. 2). The portions **14** and **16** have their mutually engaging edges formed with flanges shaped to provide a choke joint **18** (Fig. 1*a*) to reduce radiation losses, although other means for preventing escape of energy, for example, a R. F. gasket, could be employed. The enclosure **12** is constructed to contain a shoe press comprising pressure-applying means substantially similar to those of a single station of a shoe press of the type shown in United States Letters Patent No. 2,047,185, issued July 14, 1936, on an application of Milton H. Ballard et al.

Accordingly, secured to the member **30** and extending within the enclosure **12** is a bracket **36** (Fig. 2) on which is mounted a pad box **40** and shoe-engaging and pressure-applying devices to be described. The box **40** supports a pad **42** having pad members advantageously consisting of low-loss rubber, these members being shown in section in Fig. 1. It will be observed that the pad **40** extends above the top edge of the body portion **14**, thus giving the operator free access to the pad and other pressure-applying members. On the side of the box **40** remote from the operator are two uprights **44**, **46** connected at the top by a crosshead **48**. The uprights **44**, **46** are pivoted to the side walls of the bracket **36** below the bottom of the pad box by a shaft **50** which extends transversely of the bracket **36**. Between the uprights **44**, **46** near their upper ends are pivoted on a shaft **52** two levers **54**, **56** which extend transversely of the pad box **40**. Passing through an opening formed in the lever **54** is a rod **58** which is guided in the crosshead **48** and in a web **59** connecting the uprights **44** and **46** for right line movement parallel to the upright **44**. To the rod **58** is pinned a member **60** which extends outwardly and beneath the outer end of the lever **54** and is formed on its outer end with two ears which embrace the end of the lever **54** and are slotted to receive a pin passing loosely through them and the lever. The underside of the outer end of the lever **54** is formed with a convex surface adapted to bear on a flat surface formed on the upper side of the member **60**. The member **60** is held up against the lever **54** by a compression spring **62** (Fig. 1) arranged on the rod **58** between the web **59** and the member **60**. Upward movement of the front arms of each of the levers **54**, **56** is limited by an adjustable stop screw **64** threaded in a lug projecting from the crosshead **48**. Beneath the lever **56**, a member **66** similar to the member **60** is similarly mounted on a rod **68** and is upheld by a compression spring **70** (Fig. 2). The shoe-engaging mechanism described is capable of swinging rearwardly about the shaft **50** from the position shown in the figures, in which the outer ends of the levers **54**, **56** are disposed over the pad box, into an inclined position in which the forward ends of the levers **54**, **56** are withdrawn over the pad box, thus giving the operator free access thereto. To limit this swinging movement of the uprights **44**, **46**, a rod **72** (Fig. 2) is pivoted to

the upright 46 by a pin 74 and passes through a swivel block 76 pivoted to the side of a fixed cylinder 78. The inner end of the rod is provided with a polystyrene washer 80 and nuts to limit the forward swinging movement of the uprights while the portion of the rod which passes through the swivel block 76 is provided with a polystyrene sleeve 82, such insulation preventing arcs between the rod 72 and the block 76 during operation. In general, metallic joints in the enclosure should be tight, while ferromagnetic parts may advantageously be copper-plated to reduce energy losses.

The cylinder 78 is secured to the bracket 36 and is provided with a piston 84 beneath which is a chamber 86 into which fluid under pressure may be introduced through a pipe 88 to move the piston upwardly. To retract the piston, pins 90 at opposite sides of the piston extend through slots 92 in the opposite sides of the cylinder. A tension spring 94 is secured to each of the pins 90 and has its lower end secured to the bracket 36. Each spring 94 is housed in a two-part telescoping cylindrical conductive housing 96 to minimize loss of high frequency energy therein.

On the upper end of the piston 84 are secured two ears 98 between which is mounted on a pin 100 a pressure-distrbuting device, shown as a distributing lever 102, the opposite ends of which engage respectively the rear ends of the levers 54, 56 when the uprights 44, 46 are in their forward position and the piston is raised.

On the outer ends of the members 60, 66 are mounted respectively shoe-engaging devices 104, 106. The device 104 on the member 60 comprises a rubber-padded polystyrene member for engaging the forepart of the shoe. This member is mounted by means of a T-head 110 for adjustment transversely of the shoe in the direction of the tip line in a block 112 on the lower end of a post 114 which, at its upper end, is provided with a T-head mounted for movement longitudinally of the shoe in a T-slot formed in the lower face of the member 60. The device 106, which is adapted to engage the top of the cone of the last, comprises a contact piece 116 of polystyrene secured in a block 118 having on its upper part a T-head which engages a T-slot formed in the lower side of the member 66 and extending longitudinally of the pad box 40.

To provide fluid pressure for operating the piston 84, a gear pump 130 of usual construction (shown diagrammatically in Fig. 2) is provided, the pump being arranged by connection with an electric motor 132 to be driven constantly during the time the machine is in operation. From the delivery side 134 of the pump, the fluid is led by a pipe 136 to a pressure relief valve 137 which leads to a sump 138. The pipe 136 also leads to a control valve 140 which is arranged to be controlled by a treadle 142 (Fig. 1), through a link 144 and arm 146, to connect the pipe 88 to the pipe 136 when the treadle is rocked counterclockwise (Fig. 1) and to connect the pipe 88 to a pipe 148 leading to the sump when the treadle is rocked in the other direction.

As seen in Fig. 2, the cover portion 16 of the enclosure 12 is pivotally supported on a shaft 150 secured to the frame member 30 by means of a bracket member 152 secured to the cover portion by screws 154. The member 152 has a rearwardly extending finger 156 to which one end of a counterbalance tension spring 158 is secured, the other end of the spring 158 being fastened to a bracket 160 extending from the member 30. Secured to the bracket 160 is a solenoid 162 which is arranged when energized to pull one arm 164 of a bell crank pivoted on the bracket 160 so that the stub end of another arm 166 of the bell crank extends underneath a lug 168 extending from the bracket member 152, thereby locking the cover portion 16 in its closed position.

Electromagnetic energy is supplied to the enclosure 12 from a magnetron oscillator 170, indicated diagrammatically in Fig. 1, through a wave guide 172 containing a matching iris 174 and a feeding tuner 176 having an adjustable stub 178. A cover 182 of polystyrene may be inserted over the wave guide at its junction with the enclosure 12 to keep particles of foreign matter out of the wave guide.

A pair of mode-stirrers 184, 186 secured respectively to the cover portion 16 and the body portion 14 are arranged to vary the mode pattern during the time the apparatus is in operation. Each mode-stirrer comprises a pair of vanes 188 mounted on a rod 190, the rod being attached at its center to a shaft 192 projecting through the enclosure to a motor drive 194 attached to the outside of the enclosure. While the use of only one stirrer has been found to produce a reasonably satisfactory job, we have found that by employing two mode-stirrers arranged to rotate at right angles to each other, as illustrated, a somewhat more uniform heating pattern may be obtained at the marginal interfaces between a shoe and sole.

The stub 178 is positioned to minimize the standing wave ratio for all positions of the mode-stirrers. For this purpose, the lower section of the wave guide 172 may be slotted to permit measurements of said ratio.

The electric control circuits include a main start and stop switch 200 which is arranged to control the energy supply from the line to other control circuits, the electric motor 132 and to the magnetron filament and cooling blower, a pilot light 202 indicating that these circuits are energized.

As indicated diagrammatically in Fig. 2, line voltage is supplied from the main switch 200 through a normally-open switch 204 to the motor terminals of a conventional timer 206. The switch 204 is secured to the body portion 14 of the enclosure and has a plunger 208 which is engaged by the cover portion 16 when closed to close the contacts of the switch 204 to energize the timer 206. Leads from the switch contacts of the timer 206 are connected to the solenoid 162, to the motors of the two mode stirrers 184, 186 and to a high voltage power supply 209 which provides about 5,000 volts D. C. to the magnetron 170.

In operation, the operator will normally find the apparatus with the cover portion 16 held open by the spring 158. Upon pressing the start button 200 the pump motor 132 is started and the magnetron filament and blower motor are also energized. The operator may now place a shoe and sole upon the pad 42 and by depressing the left side of the treadle 142 the pressure applying devices 104 and 106 are brought to bear upon the shoe. Previously the shoe and sole will have been cemented with a suitable adhesive. While many adhesives may be used, we have found particularly suitable those adhesives which have a high loss-factor. Such an adhesive may comprise, for example, a solvent solution of a vinyl resin and a butadiene-acrylonitrile copolymer rubber with carbon added to improve its dielectric loss. The cover portion 16 is now closed, actuating the switch 204 to energize the timer 206 which in turn causes the solenoid 162 to lock the cover closed, starts the mode stirrers, and causes high voltage to be supplied to the magnetron which thereupon supplies electromagnetic energy to the enclosure 12. When the timer has run its course, the solenoid 162 is deenergized, allowing the cover portion 16 to rise. This opens the switch 204, preventing reenergization of the solenoid or magnetron until the cover is again closed. The operator may then depress the right-hand side of the treadle 142 to relieve the pressure upon the shoe so that he may remove the shoe and replace it with another.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In apparatus of the class described, an enclosure adapted to provide a substantially closed cavity having conductive interior surfaces and adapted to be excited

with electromagnetic energy in a large number of modes, a shoe press disposed within said enclosure, said press comprising a support of adjustable contour including a dielectric pad member adapted to support an outsole and a dielectric pressure-applying member adapted to engage a shoe disposed in registering relation with a sole on said pad, means for providing relative movement between the pad and the pressure-applying member to press together said shoe and sole, means for supplying to the space within said enclosure electromagnetic wave energy having a wavelength small with respect to the dimensions of the enclosure for effecting radiant energy heating in a large number of modes, and means for effecting sequential changes in the mode pattern within the cavity during excitation thereof.

2. In apparatus for adhesively attaching soles to shoes, an enclosure adapted to provide a substantially closed cavity having conductive interior surfaces, said enclosure comprising a body portion having an opening at the top and a cover portion supported for movement into and out of closing relation with the body portion, a pad mounted in said body portion with its upper surface above the top edge of said body portion, power-operated pressure-applying means cooperative with said pad to clamp a shoe and sole together under pressure, manually operated means arranged to control said power-operated means, and means for supplying to said enclosure electromagnetic energy having a wavelength small with respect to the dimensions of the enclosure.

3. In apparatus for adhesively attaching soles to shoes, an enclosure adapted to provide a substantially closed cavity having conductive interior surfaces, said enclosure comprising a body portion having an opening at the top and a movable cover portion, pressure-applying members disposed in said enclosure, said members including a shoe pad mounted with its surface above the top edge of the body portion and a cooperative pressure-applying member movable to clamp together a shoe and a sole, a fluid-pressure-operated motor operable to move said movable member to apply pressure between such shoe parts, a pump, an electric motor connected to said

pump to drive it to supply fluid pressure, fluid connections between said pump and said fluid-pressure-operated motor including a valve operable either to admit fluid to said motor from said pump or to discharge fluid from said fluid-pressure-operated motor, control means connected to said valve to operate it, and means for supplying to said enclosure electromagnetic energy having a wavelength small with respect to the dimensions of the enclosure.

4. In apparatus for soling shoes, an enclosure adapted to provide a substantially closed cavity having conductive interior surfaces and adapted to be excited with electromagnetic energy in a large number of modes, a first support for a lasted shoe, a second support for soling material for said shoe, said second support having a surface generally conforming under pressure to a shoe bottom, means for effecting relative movement between said supports for pressing soling material against the bottom of a shoe, means for feeding to the entire space within said enclosure electromagnetic wave energy having a wavelength small with respect to the dimensions of the enclosure for effecting radiant energy heating in a large number of modes, and means for effecting sequential changes in the mode pattern within the cavity during excitation thereof.

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