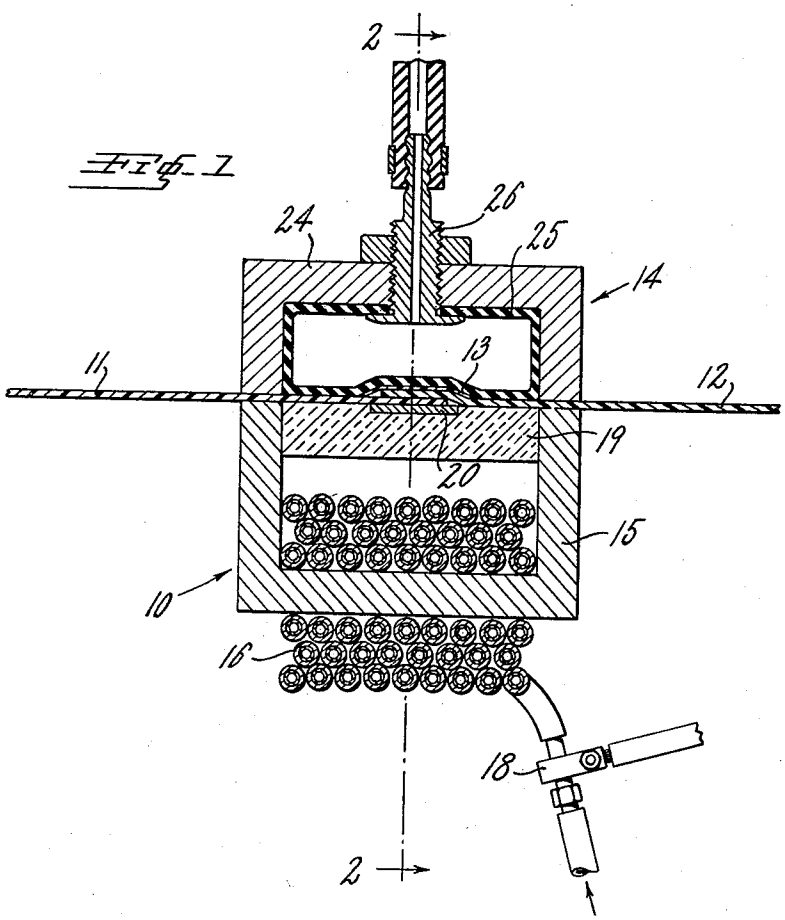
Nov. 15, 1960 W. FERRELL 2,960,147

HEAT SEALING DEVICE

Filed April 15, 1958

2 Sheets-Sheet 1

Fig. 1



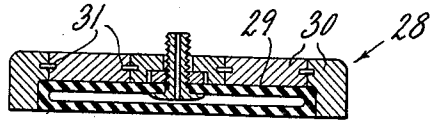


Fig. 3

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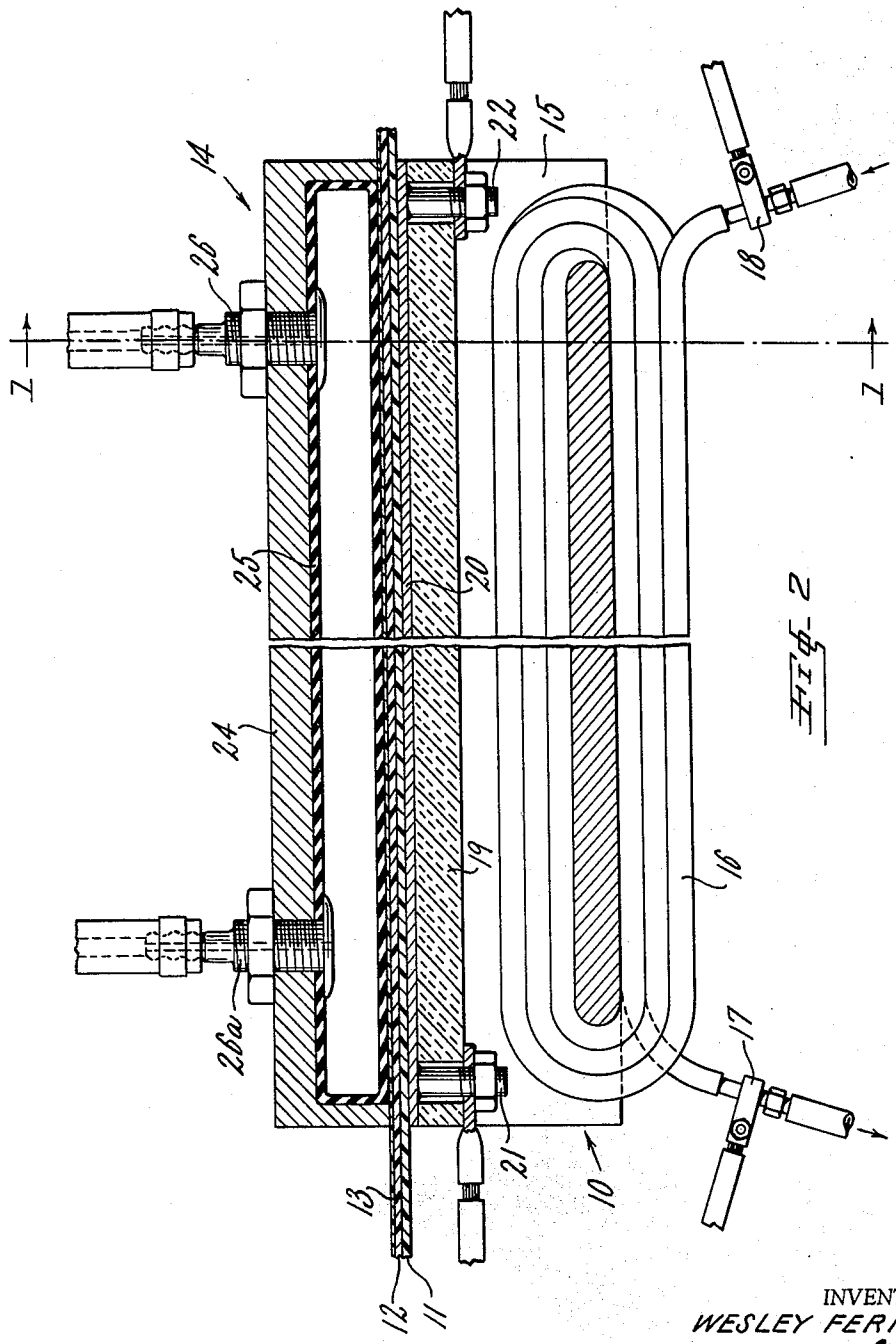

FIG. 2

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HEAT SEALING DEVICE

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1 Claim. (Cl. 154—42)

This invention relates to a heat sealing device which has its greatest usefulness in sealing or joining plastic sheets under conditions where both sides of the sheet are not readily accessible to conventional heat sealing equipment. Such conditions are encountered in the construction of plastic bags or containers. It is also useful in bag construction where the opening or port into the bag is very small.

The invention will be described with reference to the accompanying drawing, wherein:

Fig. 1 is a cross sectional view of a device of the invention;

Fig. 2 is a longitudinal sectional view taken along the line 2—2 of Fig. 1 and,

Fig. 3 is a cross sectional view of a modification of a portion of the device.

Referring to the drawings, the particular embodiment of the invention shown includes a support assembly **10** on which are laid plastic sheets **11**, **12** to be sealed with a lap joint having an overlying plastic strip **13**. A pressurizing assembly **14** is disposed over the joint, in alignment with the support assembly.

The support assembly is essentially an electromagnet comprising an iron channel or U-shaped elongated member **15**, the web or cross-piece of which is cut back at each end to accommodate an electrical winding **16** made of copper tubing coiled around the web. The conductive winding is insulated with a non-conductor of electricity capable of withstanding high temperatures, such as glass fiber. During operation this coil is energized by passing direct current through it, by means of electrical terminals **17**, **18** at each end of the coil. The iron channel is thereby magnetized, the two legs of the channel serving as pole pieces. During operation cooling water is passed through the copper coil to keep the coil temperature down. A piece of rigid heat resistant material **19**, such as asbestos-cement board, spans the area between the two legs giving a flush surface between the pole pieces. An electric heater strip **20** imbedded in this surface supplies heat to the area being spliced. Such heater may be energized with alternating current applied at terminals **21**, **22** at each end of the strip.

The pressurizing assembly **14** comprises a shallow channel **24** closed on both ends to form a box or housing for a flexible heat resistant air bag **25**. The housing **24** is open at its lower face and is made of or at least includes iron or similar magnetic material of high permeability, capable of being strongly attracted by the electromagnetic support assembly. The air bag may be inflated with air or other fluid, introduced under pressure through a connecting means **26**, thus applying pressure to the splice. The connecting means **26** is located toward one end of the air bag, and a similar connecting means **26a** is provided toward the opposite end of the air bag, for the purpose of circulating fluid through the bag if desired.

A splice may be made on this apparatus as follows:

The edges to be spliced are lapped over each other and aligned over the heater strip in the electromagnetic member **10**. The pressurizing section **14** containing the air bag is then placed on the sheet so the legs of the upper and lower channels are in alignment. The heating strip is relatively narrow compared to the air bag. The power is then turned on the magnetic coil **16** and the support section, which is made at least in part of magnetic material, becomes magnetized, the flux lines running up the legs of the support channel through the plastic sheet or gap up into the pressurizing section, forming a closed magnetic circuit with the sheet forming the only gap. The support and pressurizing sections therefore rigidly clamp the plastic. The air bag is then inflated to apply sealing pressure to the splice. The box-like casing confines the air bag, except at the face in contact with the splice. The heater is then turned on to complete the splice. The time cycle and the temperature are varied depending on the type of plastic being sealed.

For sealing bags or containers having a very small opening, a modified form of pressurizing assembly **28** (Fig. 3) may be used. In this assembly the box or enclosure for a flexible pressurizing bag **29** is cut lengthwise into narrow strips **30**, which are held in position by a plurality of loose fitting pins **31**. In operation, the magnetic flux is strong enough to hold all the strips tightly together against the opposing pressure of the air bag. After completion of the splicing the air bag is deflated and the magnetism turned off. The box assembly then falls apart into strips which can easily be removed through the small port, and the flexible air bag withdrawn through the same orifice.

Example

An excellent splice was produced using the equipment just described as follows:

Two sheets of polyvinyl chloride polymer containing 40% plasticizer were lapped over each other ⅜ of an inch and placed in position over the support member of the sealer equipment. The pressurizing member containing the air bag was then positioned over the splice in alignment with the support or magnetic section. A D.C. potential of 12 volts was then applied to the water cooled coil causing a current of 130 amperes to flow through the copper coil. The support and pressurizing sections are thereby magnetically attracted to each other clamping the sheet with a pressure in excess of 500 lbs. The air bag was then inflated to 5 lbs. per square inch to apply this pressure to the lapped splice. Two volts A.C. were then applied to the heater strip causing a current of 200 amperes to flow. This current was maintained for a period of 12 minutes heating the lapped splice to 390° F.; at the end of this time the pressure in the air bag was released and air was allowed to blow through the air bag for two minutes to assist cooling. The magnet was then turned off and the sealer removed. Splices formed following the above are essentially molded joints having the strength of the sheet material, and are slightly thicker at the joint, feathering out gradually to the sheet thickness.

From the foregoing, it will be apparent that the invention affords numerous advantages over prior heat sealing devices. The invention affords a unique means for applying clamping pressure to both sides of plastic members being heat sealed, without having any mechanical connection between the clamping members. Electromagnetic force is uniquely utilized in the present invention to permit clamping members, not otherwise physically connected, to be urged toward each other forcibly, thus insuring good contact of the plastic members at the joint.

The advantages of the air bag arrangement as described will be appreciated when it is realized that the

heating strip actually melts the plastic sheets along the seam, and the material coalesces (under pressure) to form the bond. During the time when the plastic is fluid, it is confined by the air bag and cannot flow away from the seam. The ability of the air bag to conform to the exact shape and volume of the plastic insures formation of a proper seam. The bag arrangement shown prevents the melted plastic from being squeezed out, which would cause the seam to be thin and therefore weakened. At the same time the air bag insures that proper pressure is applied to the seam. In practice the amount of plastic material at the seam region will vary, and the air bag (not being a solid or rigid member, but being extensible and conformable) is capable of accommodating such variable amounts of material at the seam region.

Another advantage of the fluid expansible member or air bag is that it tends to feather out the joint gradually to the sheet thickness, thus resulting in a seam of better appearance.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

A heat sealing device for joining plastic sheets comprising in combination a supporting assembly having an elongated generally U-shaped body made of magnetic material, the opposite arms of which include flat end surfaces forming a first plane wherein the plastic sheets to be joined may be supported, an electrical winding wrapped around the cross member of the U-shaped body for operating the U-shaped body as an electromagnet, the said electrical winding comprising an electrically conductive tube through which a cooling fluid can be circulated, a supporting member of insulating material extending across the arms of the U-shaped body for supporting the plastic sheets at the area to be joined, said supporting member having a surface in alignment with the end surfaces of said opposite arms and constituting therewith a planar surface for supporting the plastic

sheets to be joined, a heating element contained in said supporting member for heating the plastic to a molten state at said area, a pressurizing assembly, said pressurizing assembly being disposed in operation above the opposite side of the plastic sheets from said supporting member at the area to be joined, said pressurizing assembly comprising an elongated box-like enclosure made of magnetic material and open at its lower face, said enclosure including sidewall members having flat end surfaces forming a second plane, said sidewall members being spaced apart from each other by an amount equal to the spacing between the arms of said U-shaped body whereby when plastic sheets to be joined are positioned between the U-shaped body and the enclosure, and the electrical winding of the U-shaped body is energized, the arms of the U-shaped body and the sidewalls of the enclosure will be drawn together to clamp the plastic sheets in proper position for sealing, a fluid-expansible bag disposed within said enclosure, the said bag having an opening for introducing an inflating fluid to cause the bag to conform to and confine the plastic at the area to be joined, the said bag having an additional opening whereby a cooling fluid can be passed through the bag at the conclusion of the splice to cool the said area, the said supporting assembly and pressurizing assembly being held together by the electromagnet during the splicing operation against a separating force exerted by the fluid-expansible bag.

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