March 3, 1953 G. E. GARD 2,630,519

METHOD AND APPARATUS FOR HEATING MATERIAL IN PREDETERMINED AREAS ONLY PREPARATORY TO FURTHER PROCESSING, E.G. SHEARING

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Fig. 1.

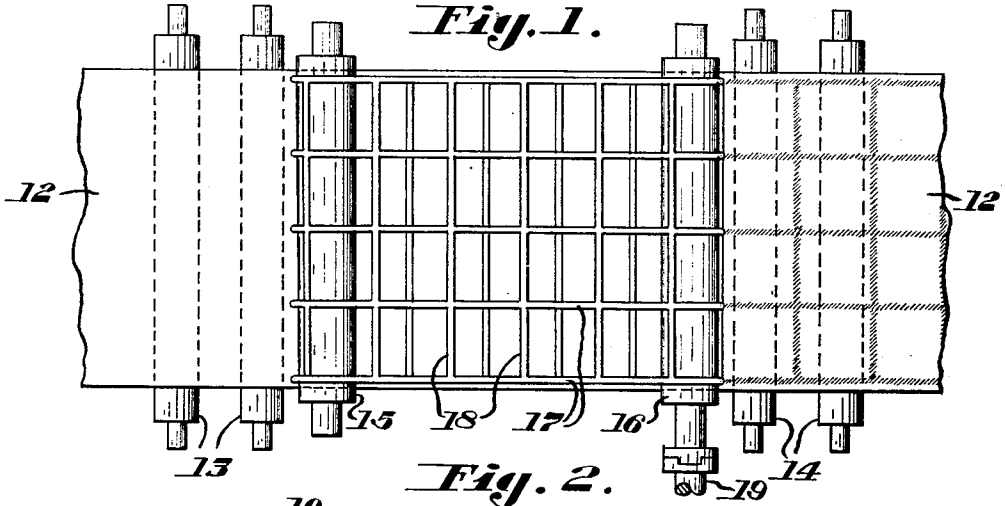


Fig. 2.

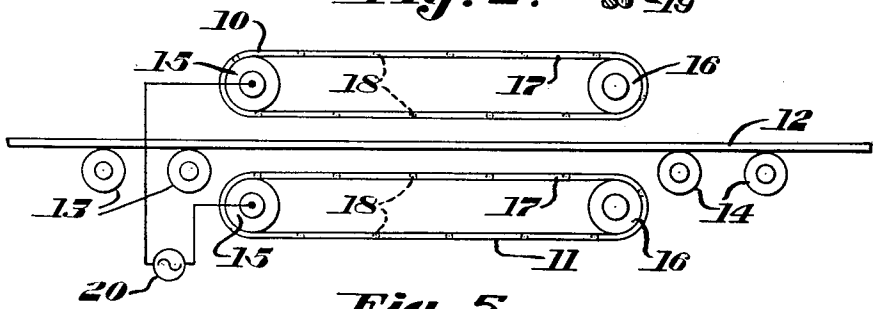


Fig. 5

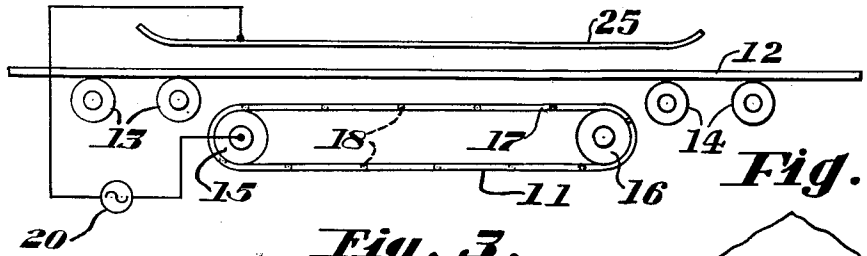
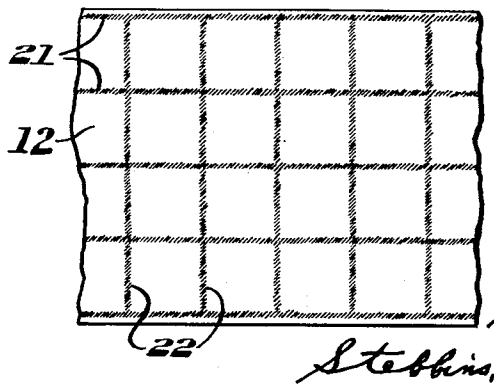
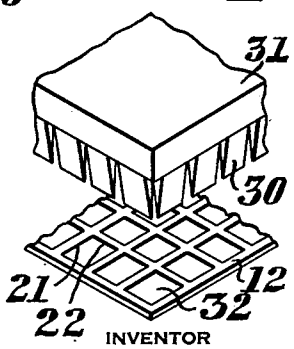


Fig. 4.

Fig. 3.





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METHOD AND APPARATUS FOR HEATING MATERIAL IN PREDETERMINED AREAS ONLY PREPARATORY TO FURTHER PROCESSING, e. g., SHEARING

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3 Claims. (Cl. 219—47)

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This invention relates generally to the heating of material by the dielectric effect and, in particular, to the progressive localized heating of a traveling strip of material in certain areas only thereof, as an aid to further processing.

In heating sheet material, for example, by the dielectric effect, it has usually been the practice to subject it to a high-frequency alternating voltage of substantially uniform intensity over the entire area of the sheet. This causes substantially uniform heating of the area subject to the voltage. In some industrial processes, however, it is beneficial to heat sheet material only in certain areas, for special purposes. One example is the heating of linoleum preparatory to shearing it into "blocks" or pieces of various shapes, usually rectangular. Here, the heating serves the purpose of softening the material, thereby facilitating severance and reducing wear on the knives. Any heating of the material in areas other than along the lines of shearing is useless and represents a waste of energy.

I have invented a novel method and apparatus for continuously heating a traveling strip of dielectric material in certain localized areas only, thereby avoiding the loss of energy incident to heating the entire area needlessly when the heat has a beneficial effect only in predetermined portions of the material. In a preferred embodiment and practice, I provide a traveling electrode, such as an endless, flexible belt composed of conductors forming a pattern like that of the heating effect desired in the material being processed. In the example mentioned, i. e., shearing linoleum into pieces, I employ an electrode in the form of a traveling grid. I advance the material along a path between spaced electrodes and maintain the speeds of the electrodes and material substantially equal. I apply a voltage of suitable magnitude and frequency across the electrodes so as to heat the material along the projections of the electrodes on the sheet to the desired temperature by the time a point on the sheet has passed beyond the electrodes. By this arrangement, the portions of the sheet which are not adjacent the projections of the electrode remain practically unheated. The energy consumed is proportional to the amount of heat actually generated in the material so that loss of energy resulting from the unnecessary heating of portions of the sheet where such is not beneficial, is avoided.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the preferred embodiment and practice. In the drawings,

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Figure 1 is a plan view, largely diagrammatic, showing an arrangement of apparatus according to the invention;

Figure 2 is a side elevation thereof;

Figure 3 is a plan view of a strip of material after processing in the apparatus of Figures 1 and 2, showing the heated areas shaded;

Figure 4 is a diagrammatic perspective view of the shearing knife assembly for severing the blocks of material within the heated areas shown in Figure 3; and

Figure 5 is a view similar to Figure 2 showing a modification.

Referring in detail to the drawings and, for the present, to Figures 1 and 2, I provide spaced traveling electrodes 10 and 11 for processing a continuous strip 12 of dielectric material traveling between the electrodes and being supported in proper position relative thereto by conveyor rollers 13 and 14. The electrodes 10 and 11 are substantially identical. Each includes spaced guide rollers 15 and 16 journaled in suitable supports (not shown). Endless, flexible, conducting members 17 are trained about the rollers and are spaced apart along the length thereof. Cross wires 18 extend to the members 17 at intervals therealong forming a grid-like belt. One of the rollers 15 and 16 is driven from any convenient source of power through a connecting shaft 19.

As shown in Figure 2, the electrodes 10 and 11 are disposed relative to each other so that the members 17 and the cross wires 18 of the two electrodes are exactly superposed. The members 17 may conveniently be braided wire or metallic tape and the cross wires 18 may be soldered or welded thereto. The cross wires 18 are located in the same plane as the members 17 so that both are equidistant from the strip 12.

The conveyor rollers 13 and 14 are driven by any suitable means. The speed of the electrodes is accurately equalized with the speed of the strip 12 so that the area of the strip subjected to the stress of the voltage between opposed cross wires of the electrodes remains the same. A source of high-frequency voltage indicated at 20 is connected across the electrodes 10 and 11 by any convenient means such as sliding contacts engaging the shafts of the rollers 15. The bearings for the shafts of the rollers of one of the electrodes 10, 11 should, in that case, be insulated from ground. Alternatively, the rollers 15 may be of insulating material and contact made with the grid-like belts by flexible fingers slidingly engaging them. The source 20 preferably comprises a vacuum-tube oscillator and a suitable tuning in-

ductance in parallel therewith whereby the circuit may be tuned to resonance.

Regardless of the exact details of construction, it will be apparent that by the apparatus illustrated diagrammatically in Figures 1 and 2, I am able to subject certain portions of a traveling strip progressively to a high-frequency voltage and thereby heat them without effecting any substantial heating of the remaining portions of the strip. With the apparatus disclosed, the pattern of the heating effect produced by the grid-like electrode belts will correspond to the appearance of the electrodes. This is shown in Figure 3 in which longitudinal zones of heating designated by shaded areas 21 correspond to the members 17 of the electrodes while the transverse lines of heating designated by shaded areas 22 correspond to the cross wires 18. Since the wires 18 and members 17 are equally spaced from the strip, the longitudinal and transverse zones of the latter are heated to substantially the same temperature. It will be evident that when the strip has been heated as illustrated in Figure 3, the shearing of the strip in the areas 21 and 22 will be materially easier than the shearing of unheated material would be. Preferably, appropriate shearing apparatus of known construction is located adjacent the outlet end of the heating apparatus shown in Figures 1 and 2 so that the material may be sheared immediately succeeding the heating. Thus, as illustrated in Figure 4, shearing knives 30 set in a holder 31 are positioned above the strip of material 12 heated in the longitudinal and transverse zones 21 and 22. When the holder 31 descends, the knives 30 sever the blocks 32 from the material by passing through the heated areas of the strip 12 bordering and outlining those blocks.

Figure 5 illustrates a modified form of apparatus which is somewhat simpler than that of Figures 1 and 2. The modification consists in the replacement of the upper electrode 10 with a fixed plate 23. The lower electrode 11 is the same in construction as that illustrated in Figures 1 and 2 and described in detail above. This arrangement has substantially the same effect in heating the material as the apparatus previously described, since the voltage stress between the electrodes exists only in the regions adjacent the members 17 and cross wires 18, despite the fact that the electrode 23 is continuous and uninterrupted.

It will be apparent from the foregoing that the invention is characterized by numerous advantages over prior practice in progressively heating a traveling strip by the dielectric effect. In the first place, the heating is confined to the regions where the effect thereof is beneficial. This is important in cases where heating of the remainder of material might be objectionable for some reason. Secondly, the efficiency of heating is increased since energy is absorbed only in the areas where heat is generated. A further advantage is that the capacity of the load, i. e., between the electrodes, is reduced so that a larger inductance may be used to tune the circuit. A greater area of strip material may be heated in a given time with a given amount of power than if the material were heated uniformly throughout all portions. As applied to the specific problem of shearing the linoleum, the invention has a further advantage of reducing the wear on the cutting knives.

Although I have illustrated and described but a preferred embodiment and practice of the invention, it will be recognized that changes in the details of the apparatus and procedure may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A machine for dielectrically heating dielectric strip material along predetermined intersecting longitudinal and transverse zones only, comprising, in combination, means for moving said material along a predetermined path at a predetermined speed, means for supporting said strip in a flat condition during movement, dielectric electrodes positioned on opposite sides of said material and extending for a substantial distance along and parallel to said path, means for moving at least one of said electrodes at substantially the same speed as the speed of said material along said path, said electrode so moved having the conductive electrode material thereof formed in the pattern outlined by said intersecting longitudinal and transverse zones, and means for applying a high-frequency voltage across said electrodes, whereby said material is dielectrically heated in said longitudinal and transverse zones only to facilitate severance of said material within said zones while so heated.

2. A machine for dielectrically heating dielectric strip material along intersecting longitudinal and transverse bordering areas only, comprising, in combination, conveying means for moving said strip along a predetermined path at a predetermined speed, means for supporting said strip in a flat condition during movement, dielectric electrodes positioned on opposite sides of said material and extending for a substantial distance along and substantially parallel to said path, said electrodes being in the form of endless belts and having the conductive electrode material thereof conforming exactly to the pattern outlined by said intersecting longitudinal and transverse bordering areas, said electrodes further having the pattern of one electrode in registry with the pattern of the second electrode on the opposite side of said material, means for moving said electrodes at substantially the same speed as the speed of said material, and means for applying a high-frequency voltage across said electrodes to effect such dielectric heating of said material, whereby said material may be readily sheared within said longitudinal and transverse bordering areas while so heated.

3. In a method of heating dielectric strip material in predetermined areas only thereof and severing the same wholly within said heated areas, said areas being spaced transversely and longitudinally of said strip and intersecting one another, the steps comprising moving a strip of dielectric material along a predetermined path at a predetermined speed, establishing a high-frequency field directly within said moving strip in predetermined areas only thereof, which areas are spaced longitudinally of said strip and also transversely of said strip and intersect one another, moving said field for a substantial distance along and parallel to said path at substantially the same speed as the speed of said strip along said path to heat said strip material dielectrically in said predetermined areas only thereof during the course of coincidental movement of said strip material and said field along said predetermined path, and while said strip is in heated condition severing the same along lines extending both longitudinally and transversely of said strip wholly within said heated areas thereof.

GEORGE E. GARD.

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