July 26, 1949. G. H. BROWN ET AL 2,477,040

SEWING MACHINE FOR THERMOPLASTIC MATERIALS

Filed March 13, 1945

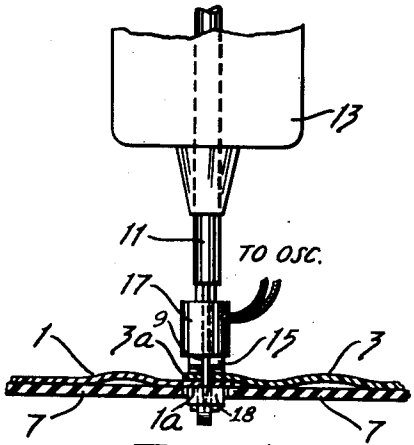


Fig. 1

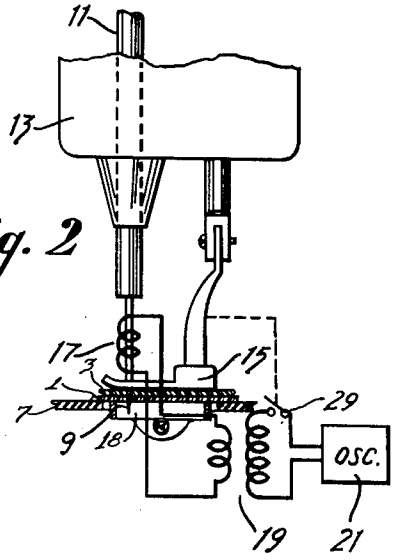


Fig. 2

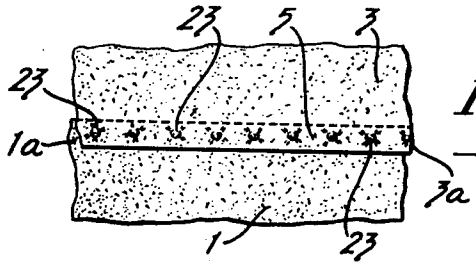


Fig. 3

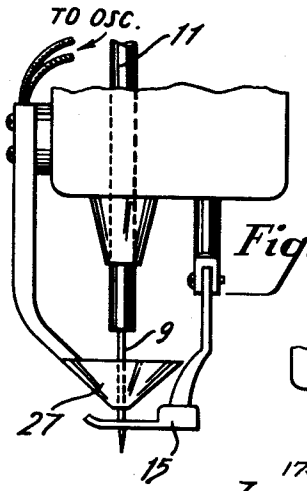


Fig. 4

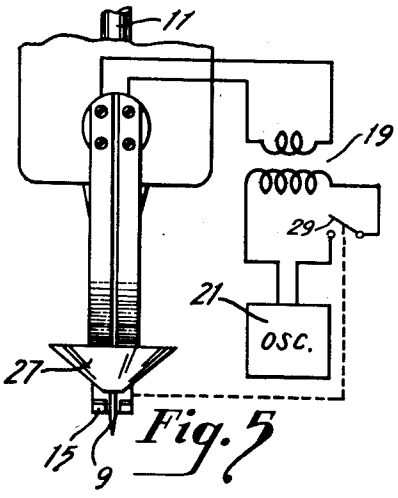


Fig. 5

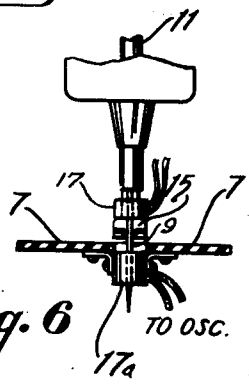


Fig. 6

INVENTORS
George H. Brown &
Rudolph A. Bierwirth

BY

ATTORNEY

Patented July 26, 1949

2,477,040

UNITED STATES PATENT OFFICE

2,477,040

SEWING MACHINE FOR THERMOPLASTIC MATERIALS

George H. Brown and Rudolph A. Bierwirth, Princeton, N. J., assignors to Radio Corporation of America, a corporation of Delaware

Application March 13, 1945, Serial No. 582,564

6 Claims. (Cl. 219—47)

1

This invention relates to sewing machines, and more particularly to sewing machines for bonding together a plurality of superposed or adjacent, contacting layers of thermoplastic material.

There are many instances where several layers of thermoplastic material are "sewn" to each other or to intermediate layers of non-thermoplastic materials by bonding them together with the aid of heat and without the use of thread. One of the forms of apparatus proposed heretofore for this purpose, employs a Nichrome wire which pierces the layers to be bonded together and is brought into contact with a metallic plate which closes an electrical circuit and causes a current to flow through the Nichrome wire, thus heating the wire and the material close to the wire.

In apparatus of this type the wire will tend to bend when it butts against the aforementioned metallic plate and sparking at the point of contact burns the needle tip, rendering the needle tip blunt after a comparatively short period of use.

The primary object of our present invention is to provide an improved sewing machine of the type set forth above which will be free from the aforementioned difficulties.

More particularly, it is an object of our present invention to provide an improved apparatus for and method of bonding together layers of thermoplastic material in a quick and simple manner.

It is also an object of our present invention to provide an improved apparatus as above set forth which can be applied readily to existing, conventional sewing machines which normally employ thread for sewing.

A further object of our present invention is to provide an improved method and apparatus as aforesaid which will be highly efficient in use.

In accordance with our present invention, we place around the needle of a more or less conventional sewing machine an inductor coupling coil connected to a source of radio frequency energy and induce in the metallic needle a high frequency current which rapidly heats the needle to a temperature sufficient to render plastic, in the region around the needle, the layers of thermoplastic material to be sewn or bonded together. The heated, softened regions flow together and when the needle is withdrawn, these regions cool and the layers thus become bonded together. The inductor coupling coil is placed along the

2

axis of the needle either above or below the cloth or fabric to be sewn. Since the needle is heated by induction, no electrical contact need be made thereto. This eliminates the sparking at the tip of the needle and greatly increases its life. Moreover, since no electrical contact need be made to the needle, the needle can be made quite flexible. An additional advantage afforded by our invention is that the needle may be heated at all times, even though it is reciprocating back and forth at a great speed, wherefore it becomes a relatively simple matter to control the temperature thereof.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages, thereof will best be understood from the following description of several embodiments thereof, when read in connection with the accompanying drawing in which

Figure 1 is a front view of a portion of a sewing or bonding machine constructed in accordance with our present invention,

Figure 2 is a side elevation thereof shown partly in schematic form,

Figure 3 is a fragmentary, top plan view of a fabric having portions sewn or bonded together in accordance with our present invention,

Figure 4 is a view similar to Figure 2 but showing a modified form of our invention,

Figure 5 is a front elevation of the apparatus shown in Figure 4, and

Figure 6 is a fragmentary, front elevation of still another form of our invention.

Referring more particularly to the drawing, wherein similar reference characters designate corresponding parts thoughout, there is shown, in Figures 1 and 2, two layers of fabric 1 and 3 of thermoplastic material having overlapping portion 1*a* and 3*a* which are to be bonded or sewn together along a "seam" 5. This may be accomplished by placing the layers 1 and 3 on the work plate 7 of a suitable sewing machine with the overlapping portions 1*a* and 3*a* of the thermoplastic layers in the path of a reciprocatory, steel needle 9. The needle is reciprocated by a suitable reciprocating bar 11 carried by a head 13 and is arranged to pass through a presser foot 15 in known manner.

Surrounding the needle 9 is a coil or winding 17 having an axial bore disposed in the path of reciprocatory movement of the needle 9. The coil 17 may be connected through a suitable transformer 19 to a source of radio frequency energy, such as a vacuum tube oscillation generator 21. High frequency current supplied to the coil 17 induces a high frequency current in the needle 9 and rapidly heats the reciprocating needle to a temperature sufficient to render the material 1, 3 plastic. When the needle 9 passes through or penetrates the overlapped layers 1a and 3a, it heats the overlapped layers 1a and 3a and softens them in the region immediately therearound. These softened regions flow together into a unified region, and when the needle is withdrawn from the work, the unified region cools and the parts remain bonded together. A feed dog or any other suitable device 18 may be employed for advancing the sheets 1 and 3 in known manner past the needle 9 with an intermittent motion, the needle 9 piercing successive portions of the work during intervals of stoppage thereof to provide a series of successive, bonded regions 23 which form the "seam" 5.

The form of our invention shown in Figures 4 and 5 is quite similar to that described above. However, instead of employing a multi-turn coupling coil 17, we may place around the needle 9 a single turn, conical coupling coil 27 of the type disclosed in Bierwirth Patent No. 2,314,865. This type of coupling coil has the advantage of concentrating the magnetic field established thereby in a small area along the axis of the coil and will therefore heat the needle very rapidly.

In both forms of the invention thus far described, the coupling coil is placed above the work plate 7 and the fabric layers 1 and 3. If desired, one coil may be placed underneath the work plate 7, or two coupling coils 17, 17a may be provided, one above and the other below the work plate 7, as shown in Fig. 6, it being sufficient merely that the reciprocating needle pass through one or more of such coils during its reciprocatory motion and while it is pierced through the layers to be bonded together.

Although we have shown and described several forms of our invention, it will undoubtedly be apparent to those skilled in the art that many other modifications thereof are possible. Furthermore, it should be apparent that the present invention may be employed for bonding together not only thermoplastic layers, but also textile fabrics impregnated with thermoplastic materials, textile or other fabrics interposed between layers of thermoplastic materials, and the like. In some cases, it may be desirable to make the pressure foot 15 out of dielectric material to avoid inducing currents therein. Also, if desired, a switch 29 in circuit with the transformer 19 may be arranged under control of the presser foot 15, so that current will be supplied to the heating coils only when the presser foot is lowered into engagement with the work. Various other changes are also possible within the spirit of our invention. We therefore desire that our invention shall not be limited except insofar as is made necessary by the prior art and by the spirit of the appended claims.

We claim as our invention:

1. In apparatus for bonding together superposed layers of thermoplastic material to form a seam, the combination of a metallic needle adapted to penetrate superposed layers of said material at points spaced from the edges thereof, means for inducing in said needle a high frequency electric current adapted to rapidly heat said needle to a temperature sufficient to render said material plastic in the region around said needle when said needle penetrates said layers, means for intermittently advancing said material with respect to said needle, and for causing said needle to periodically penetrate said layers at spaced points along the length of said seam.

2. Apparatus according to claim 1 wherein said high frequency current inducing means comprises an inductor coil surrounding said needle.

3. Apparatus according to claim 1 wherein said needle is arranged for reciprocatory movement along a definite path, and wherein said high frequency current inducing means comprises an inductor coil having an axial bore in said path through which said needle passes in the course of its reciprocatory motion.

4. In a sewing machine, the combination with a work plate; a head thereabove; a reciprocatory, work-penetrable, metallic needle carried by said head; and a presser foot carried by said head in association with said needle for movement toward and away from said work plate of a source of high frequency electrical energy, an inductor coupling coil positioned to have said needle pass therethrough during its reciprocatory movement, means coupling said coil to said source, and a switch in circuit with said means, said switch being coupled to said presser foot and being arranged to be closed when said presser foot is lowered toward said work plate and opened when said presser foot is raised from said work plate whereby energy will be supplied from said source to said coil only when said presser foot is lowered.

5. In apparatus for bonding together superposed layers of thermoplastic material, the combination of a work plate having an opening therein for supporting the layers of material to be bonded together, a metallic needle adapted to penetrate said layers and to pass through said opening, means for inducing in said needle a high frequency electric current adapted to rapidly heat said needle to a temperature sufficient to render said layers plastic in the region around said needle when said needle penetrates said layers and passes through said opening, said means comprising a pair of inductor coils one located above and the other beneath said work plate in alignment with said opening, and means for causing said needle to periodically penetrate said layers.

6. In apparatus for bonding together two layers of thermoplastic material having only their edges overlapping so as to form a seam, the combination of a metallic needle, means for reciprocating said needle along a vertical axis, means for intermittently moving the overlapping edges of said material under said needle in a direction normal to the axis of reciprocation, said movement taking place when said needle is in a raised position and said material being stationary when said needle is in its lowered position where it penetrates said material, a coil having a central aperture and surrounding said needle at a point adjacent said material, and a source of radio frequency energy connected to said coil for inducing heating currents in said needle whereby to raise its temperature above the fusing temperature of said material.

GEORGE H. BROWN.
RUDOLPH A. BIERWIRTH.

(References on following page)

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,878,458	Blanchet	Sept. 20, 1932
1,900,842	Northrup	Mar. 7, 1933
1,954,678	Meissner	Apr. 10, 1934
1,987,458	Adams, Jr.	Jan. 8, 1935
2,004,041	Driver	June 4, 1935
2,044,263	Stoyan	June 16, 1936
2,063,345	Scott	Dec. 8, 1936
2,093,425	Dreyfus	Sept. 21, 1937
2,232,640	Schwartzman	Feb. 18, 1941
2,268,510	Kulberg et al.	Dec. 30, 1941
2,322,298	Johnston	June 22, 1943

FOREIGN PATENTS

Number	Country	Date
117,247	Australia	July 7, 1943