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ULTRASONIC ASSEMBLY [REVIEW]

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Abstract: *The paper exposes the possibility of machine producesers to optimize the costs of clothes assembling. Ultrasonic systems being frequently utilized have many advantages on semi products of synthetic textile and technical textile. First of all, sewing – cutting process can be accomplished under high speeds and rate of losses can be minimized. Cutting seal applications are frequently used for underwear and sportswear. Slicing and unit cutting machines, as well as portable sealing machines are available for labeling sector. Products such as bag, pocket and cover can be sewed in a seamless manner for promotion purposes. All objects in terms of accessories are obtained in same standard. Our quilting machines are preferred in worldwide due to its threadless, high quality sealing. An alternative to the classic sewing assembly, with thread and needles is ultrasonic seaming. In ultrasonic welding, there are no connective bolts, nails, soldering materials, or adhesives necessary to bind the materials together. Ultrasonic is defined as acoustic frequencies above the range audible to the human ear. Ultrasonic frequencies are administered to the fabric from the sonotrode of bonding machine. The high frequency and powerful energy produced, when is release in one special environment, the ultrasound heating this environment. The ability to ultrasonic weld textiles and films depend on their thermoplastic contents and the desired end results. The paper defines the weld ability of more common textiles and films. The welding refers to all types of bonding and sealing, as in point bonding of fabric, or continuous sealing of film.*

Key words: *ultrasonic weld, ultrasonic sealing technology, fabric welding, ultrasonic bonding, ultrasonic.*

1. INTRODUCTION

1.1. Ultrasonic Welding

The classic sewing assembly, meaning thread and needles, has a big concurrent the ultrasonic seaming, without nails, soldering materials or adhesives. Ultrasonic is defined as acoustic frequencies above the range audible to human ear. High-frequency ultrasonic acoustic vibrations are locally applied to work pieces being held together under pressure to create a solid-state weld. The high frequency and energy produced ,when is released on special environment big heating, melting the point contacts between the parts and creates a joint.[1]

2. THE ULTRASONIC SYSTEM

2.1. Components and priciple

Ultrasonic plastic welding is a kind of thermoplastic jointing technology, which makes use of friction between molecules generated by ultrasonic horn. During ultrasonic welding, two plastic part halves are pressed together under pressure, ultrasonic system transform electric energy in 50/60Hz into mechanical energy in 15KHz, 20KHz, 28KHz, 30Khz, 35Khz, 40Khz by convertor, and strengthens it by booster, then transform the energy to the horn and strengthen it again, then the horn transform it to the plastic part and generate the friction between molecules, by which the temperature at the join increases quickly to melt the plastic material at joining surface. When the melting is enough, ultrasonic stops and keep two plastic being pressed together until the jointing area is re-solidified.[2]

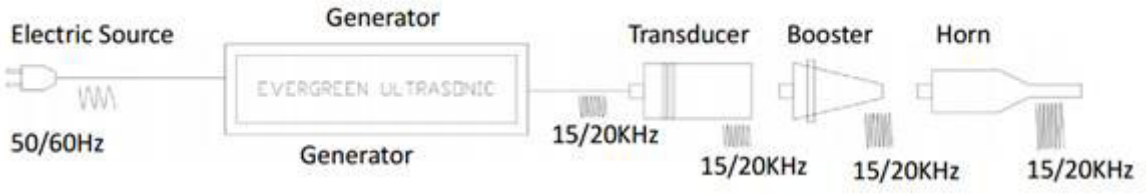

***Fig 1**: Generating System*

The basic principle of ultrasonic assembly is the conversion of standard 50/60 Hz power to 15 kHz, 20 kHz or 40 kHz. This electrical energy travels through a piezoelectric converter. The converter, typically lead zirconate titanate, expands and contracts at the same frequency, converting the electrical energy into high frequency mechanical vibration.[3] This vibration is amplified by a booster and transferred to the workpiece through a shaped tool, or horn, in the form of reciprocating longitudinal motion. Parts being assembled are clamped together under moderate pressure, at which point ultrasonic vibrations force the parts to impact against each other at a preset frequency creating a molecular bond equal to or above the material strength of the parts. Infinite and accurate combinations of weld time, distance and energy, established through a microprocessor, provide repeatable control of the process, and lend to the full automation of the assembly. Statistical process control and reporting are also possible .[3]

2.2. Applications

Ultrasonic sealing machine with rolling sonotrode [4]

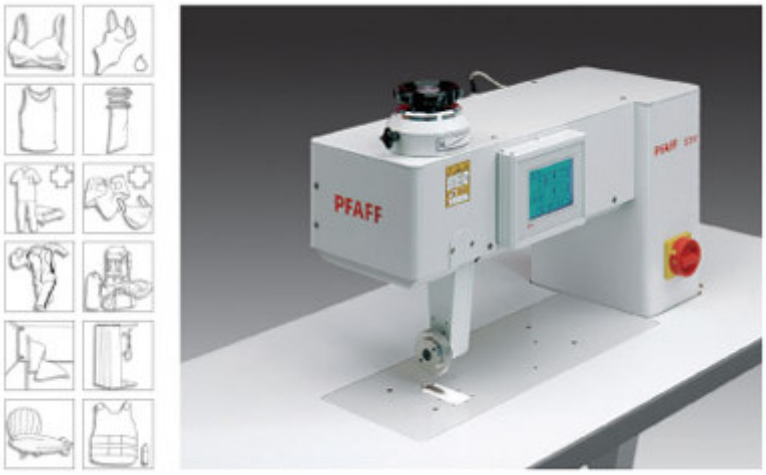

***Fig. 2:** Ultrasonic sealing machine with rolling sonotrode 8310*

Features

- Workpiece fixed between sonotrode and anvil wheel is welded continuously under pressure
- Differential feed: Smooth, non-distorted seams or adding a small fullness is possible by separate drive of sonotrode and anvil wheel
- Touch screen (simple handling with pictograms): programming of operations and complete work cycles
- Process reliability by monitoring of welding parameters
- 8310-041: Top sonotrode, feed-off-the-arm vers./li>
- 8310-042: Bottom sonotrode, flat-bed version, Ø 65.0 mm anvil wheel (standard)

Specifications

- Max. speed: 0.5 to 10 m/min.
- Optional up to: 20 m/min.
- Seam width: 1.0 to 10.0 mm
- Ultrasonic frequency: 35 KHZ

Mobile heat-sealing machine with hot-wedge[4]

Fig.3: *Mobile heat-sealing machine with hot-wedge 8362*

Features

- Noiseless and accurate sealing without any fumes
- All welding parameters can be adjusted separately
- Digital readout of set and actual temperature
- Easy handling as weight only 10 kg
- Low energy consumption (<0,8 KW)
- High seam quality: No marks outside the seam
- Solid, long lasting construction

Specifications

- Welding temperature: 0 - 450°C
- Max. Speed: 7 m/min.

2.3. Theory of Operation

Ultrasonic bonding is accomplished by channeling high-frequency vibrations to the fabric. As synthetic or nonwoven material passes between an ultrasonic unit's horn and anvil, the vibrations are directed into the fabric where they create a rapid heat buildup. This heat causes the material's synthetic fibers to melt and fuse, creating bonded seams that will not fray or unravel.

2.4. Categories of Welding Fabric

There are basically two types of fabric welding- Dielectric Welding and Rotary Welding.Ultrasonic welding is generally categorized as rotary welding. In this type, the fabric moves continuously through the machine while it is being welded.

Dielectric Welding is the older of the two types of welding. In this method, a die is lowered onto the two fabric pieces that are supported by an underlying base plate. A timed pulse of radiofrequency energy is sent between the die and the base plate. The fabric between the die and base plate gets heated enough so as to melt the thermoplastic coating on a temporary basis. With the melting oft his coating, both pieces of fabric are fused together. The die is then lifted and new pieces of fabric move into position, and the whole process is repeated again.

Rotary welding is a continuous process where the fabric pieces move continuously through the welding area, usually pulled along by a pair of drive wheels. Heat is sent through any of the sources like a heated metal wedge or hot air, just before the fabric passes between the drive wheels. On the drive wheels, the welding pressure is applied which seals the fabric permanently.

Rotary welding is faster than dielectric welding. The speed increases with the length of the products and seams. Welding speeds of up to 6 meters/ per minute and even higher can be achieved through it. However, rotary heat sealing requires a skilled and well trained operator to achieve full speed and flexibility[6]. It is also capable of producing three dimensional finished products (products that do not lie flat) like garments, inflatable boats, bags, and luggage. As dielectric welding uses flat

base plate, it restricts its application to the products whose seams must lie flat during the sealing process.[7]

However, nowadays, certain specialized dielectric welders have three dimensional dies, base plates and vacuum systems for holding the fabric pieces in position while the dies are applied but they are very costly.

3. CONCLUSIONS

The applications of ultrasonic welding are extensive and are found in many industries including electrical and IT, automotive and aerospace, medical, business, consumer, medical, toys and packaging. Whether two items can be ultrasonically welded is determined by their thickness.
Ultrasonic welding is a very popular technique for bonding thermoplastics. It is fast and easily automated with weld times often below one second and there is no ventilation system required tore move heat or exhaust. This welding technology may be an alternative method of manufacturing cloth and is gentle with the environment because less waste is produced. The method presents the advantage that no yarn, needles, adhesives are need and holes in fabric are not necessary and in consequence less waste is produced.

REFERENCES

[1].Wikipedia Free Encyclopedi., [Online]. Avaible: www.wikipedia.org/wiki/UltrasonicWelding

[2]. Hornwell tW,Custom-made Equipment, ultrasonics, [Online]. Avaible: http://hornwelltech.com.Accesed 20/04/2015

[3].Ultrasonic Seal, Ultrasonic Assembly Overwiew. [Online]. Avaible: http://www.ultrasonicseal.com

[4]. Kortz, A.& Olaru, N. (2006), *Cusaturi de asamblare prin sudare*, Simpozion Annual, ED.PERFORMANTICA, Iasi, ISBN 973-730-271-0,ISBN 978-973-730-271-7, Pp. 249-258

[5]. Branson, *Ultrasonic Welding Characteristics of Textile and Films* , [Online]. Avaible: www Branson-PlasticsJoin.com

[6]. Mitu, S.,Mitu, M. (2005), *Bazele tehnologiei confecţiilor textile,* Vol. II, Editura Gh. Asachi, Iasi, ISBN 973-730-025-4; 973-730-027-0,pp109 - 117

[7]. Dodu, A & colaboratorii (2003) *Manualul inginerului textilist,* Vol. II . Partea B, Secţiunea VII, Confecţii textile, ISBN 973-8466-10-5, 973-8466-96-2, Editura AGIR, Bucureşti, pp 1419 – 1423,