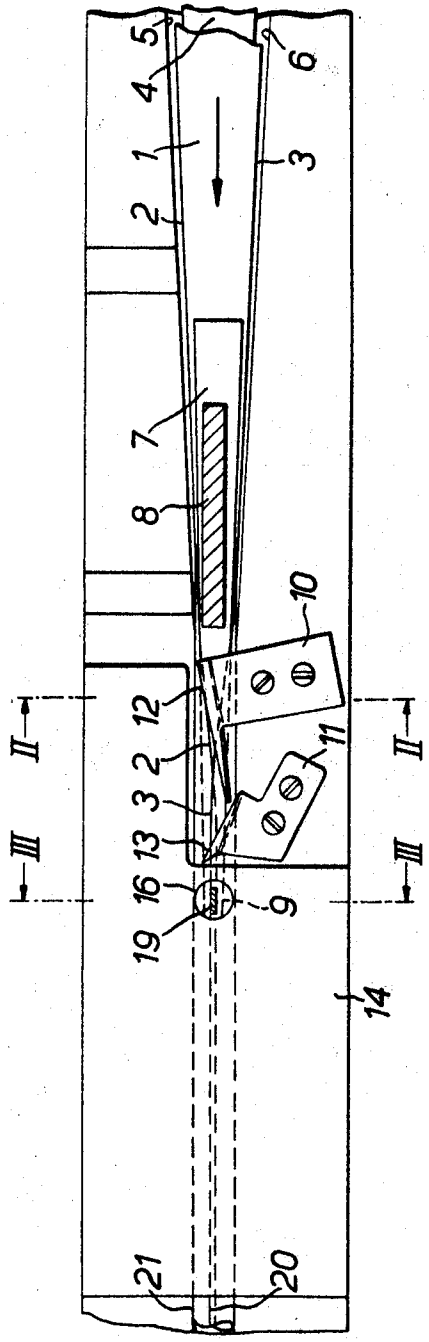
April 8, 1969 D. T. N. WILLIAMSON ET AL 3,437,093

MANUFACTURE OF CIGARETTES

Filed April 26, 1966 Sheet 1 of 2

FIG.1.



INVENTORS
David T. N. Williamson
Douglas Wm. B. Muir

By Watson, Cole, Grindle & Watson
ATTORNEYS

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FIG. 2.

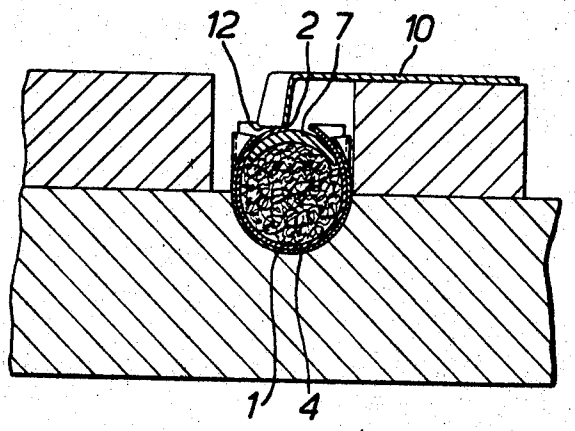
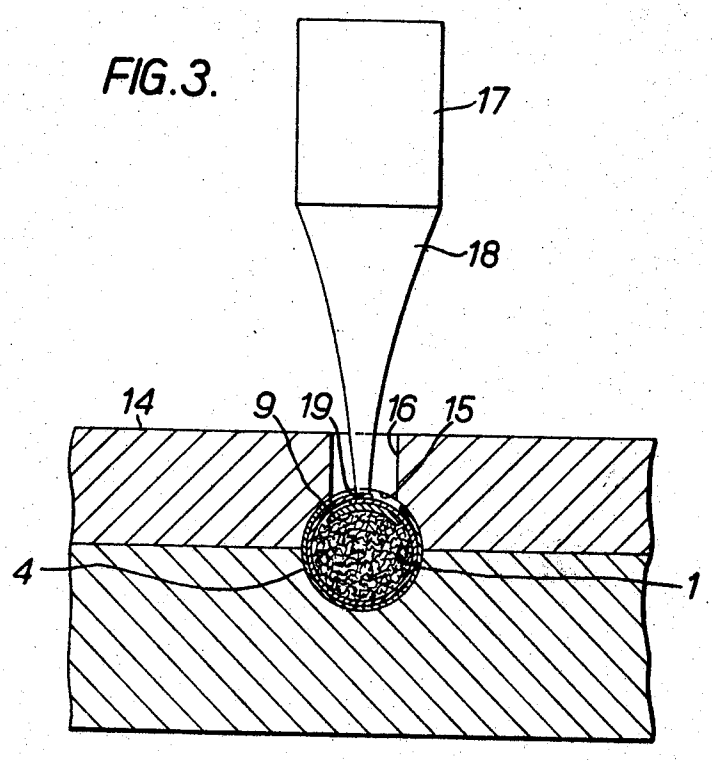


FIG. 3.



INUENTORS
David T.N. Williamson
Douglas Wm B. Muir

By Watson, Cole, Grindle & Watson

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MANUFACTURE OF CIGARETTES

David Theodore Nelson Williamson and Douglas William Ballantyne Muir, Deptford, London, England, assignors to Molins Machine Company Limited, a corporation of Great Britain

Continuation-in-part of application Ser. No. 289,883, June 24, 1963. This application Apr. 26, 1966, Ser. No. 544,613

Claims priority, application Great Britain, June 29, 1962, 25,134/62

Int. Cl. A24c 1/32; A24d 1/02

U.S. Cl. 131—67

5 Claims

ABSTRACT OF THE DISCLOSURE

A continuous-rod cigarette-making machine which produces a seam by joining the two edge portions of the paper by ultrasonic vibratory welding. The downstream end of the compression tongue is used as an anvil, coacting with an ultrasonically vibrated welding tip projecting through an aperture in one of the guide members which fold the paper about the tobacco filler.

This application is a continuation-in-part of our copending application Ser. No. 289,883, filed June 24, 1963, now abondoned.

This invention concerns improvements in or relating to the manufacture of rods in which a web of paper is folded, so that portions of the web overlap, into rod shape (e.g., cylindrical shape), the said overlapping portions being joined together to seal the rod, and in particular to a continuous rod cigarette-making machine in which a tobacco filler is wrapped in a cigarette paper web.

It is to be understood that the term "tobacco filler," when used herein, is intended to denote not only a filler consisting wholly of tobacco, but also any filler suitable for incorporation in a wrapper to form a cigarette rod, and includes, for example, a filler consisting of portions of tobacco between which are spaced mouthpiece portions, as is sometimes used in the manufacture of mouthpiece cigarettes. Further, the word "filler" is to be understood as including a filler of any material, e.g., filtering material, which is enclosed in a paper or the like to form a continuous rod.

In a continuous rod cigarette-making machine a tobacco filler is deposited on a moving web of cigarette paper, which is wrapped about the tobacco filler to form a continuous cigarette rod. Adhesive is usually applied to one edge portion of the paper web, the latter then being folded about the filler so that the said edge portion overlaps the other edge portion of the paper web, and adheres thereto so as to enclose the tobacco filler. The continuous cigarette rod so formed then normally passes beneath a heating device to seal the overlapped, adhering edge portions of the paper web. A similar technique is used in making a continuous rod of mouthpiece material for the production of cigarette mouthpieces such as filter plugs.

It is an object of the present invention to provide an improved apparatus for forming a rod having a paper wrapper with overlapping edge portions secured together to form a seam extending parallel to the longitudinal axis of said rod, in which apparatus no adhesive applicator and heater need be used.

It has been found that this object can be achieved by employing ultrasonic vibratory welding and accordingly apparatus embodying the invention contains an ultrasonic vibratory welding device arranged to act on the aforesaid overlapping edge portions to form the said seam.

It is a further object of the invention to provide an improved continuous-rod cigarette-making machine in which an ultrasonic vibratory welding device is associated with means for folding a cigarette-paper web about a tobacco filler.

In relation to the joining of parts made of materials such as metals or synthetic plastic materials, the term "welding" is employed as meaning uniting by fusing together contacting portions of the parts to be joined. Usually fusion is achieved by the application of heat, although the heat may not be applied as such, but may be generated within the material. For example, radio-frequency electromagnetic energy may be directed on to metal articles so as to induce so-called "eddy currents" within the metal and hence heat the latter.

In relation to paper which comprises a mat of interlaced vegetable fibres, there is no question of welding by fusion, as if the temperature of the paper is raised the effect is first to dry out the paper, then to char (i.e., carbonise) it, and ultimately to produce combustion. It has however been found possible to join two superposed pieces of paper by rapidly repeated blows on the superposed pieces, and so far as can be ascertained the joint is produced by the intermingling of surface fibres of the two pieces. Such intermingling of the fibres, without interposition of any adhesive or binder, may be considered as comparable with welding of fusible materials, in that two articles are joining by causing intermingling of the material adjacent to contacting surfaces of the two articles, hence by analogy a joint so produced between pieces of paper is herein termed a weld.

In practice, it is found that the convenient and rapid production of satisfactory welds in paper requires the blows to be so rapidly repeated that they occur at ultrasonic frequency. The pieces of paper to be joined are placed in overlapping relationship between a support element or anvil and a member which is caused to vibrate at ultrasonic frequency and thus strike the paper repeatedly at that frequency. The means employed for producing such vibration is immaterial, but while such means may be purely mechanical, it will be obvious that any mechanical device operating at such high frequency will be severely stressed and liable to fatigue. Hence it is preferred to produce the ultrasonic vibrations by applying electrical oscillations of the desired frequency to an electromechanical transducer such as a piezoelectric or magnetostrictive device. An example of the latter form of device is discolsed in U.S. Patent No. 3,054,309 to Elmore et al., and includes a core which (as stated at column 4, lines 25–27) is "properly dimensioned to insure axial resonance with the frequency of the alternating current applied thereto so as to cause it to alter in length."

It should be noted that in place of the support member or anvil we may provide a second vibrating member; in such a case it is essential that the vibration of the two members should be correctly phased and it is most convenient to use an electromechanical transducer to vibrate each member and to supply both transducers with oscillations from a common source.

As in producing cigarettes only a narrow overlap is provided between the edge portions of the cigarette paper, while the generation of vibrations of adequate power may require a transducer of larger area, it is convenient to provide a so-called mechanical impedance transformer between the transducer and the vibrating member which engages the paper. Such a mechanical impedance transformer serves to convert relatively low-pressure vibrations exerted over a large area to relatively high-pressure vibrations exerted over a small area (using the term "pressure" in its strict sense of force-per-unit area) and comprises an exponentially tapered rod.

In a continuous-rod cigarette-making machine embodying the invention, the tongue which is employed in such machines to compress the tobacco filler during the final stages of folding the paper wrapper around said filler serves as the support member or anvil which coacts with the vibrating member in the ultrasonic vibratory welding operation; it is of course necessary to employ the downstream (considered in the direction of movement of the filler and paper wrapper) end of the tongue for this purpose, as at the upstream end folding of the paper has not been completed so that the edge portions of the paper are not in proper overlapped relation, ready for welding, as they pass said upstream end.

Such a machine incorporates folding means in the form of one or more (usually at least two) guide members shaped to guide the edge portions of the cigarette paper web into overlapping relationship. Any of the known forms of guide members (often termed folding blades) may be so employed; at least one of such members extends at least as far as the downstream end of the tongue mention above, being apertured to permit access of the vibrating member to the paper so that said tongue may be employed as a support member as above mentioned, and to ensure that the overlapped edge portions of the paper are held by at least one of the guide members until welding has been effected.

Various other features may be included in apparatus embodying the invention, as will be seen from the following description of one preferred form of such apparatus, shown in the accompanying drawings in which:

FIGURE 1 is a plan view, partly in section of part of the apparatus on a continuous rod cigarette-making machine.

FIGURE 2 is a partial sectional view on the line II—II of FIGURE 1, the tongue support being omitted for clarity.

FIGURE 3 is a partial sectional view on the line III—III of FIGURE 1.

Referring to FIGURE 1, a continuous cigarette paper web **1**, having side edges **2** and **3**, is moved lengthwise in the direction of the arrow on a moving conveyor tape **4** through a U-shaped channel having converging side walls **5** and **6** which cause the edges **2** and **3** to assume the positions shown in FIGURE 1. A tobacco filler (not shown) is carried on the web **1**, and the side edges **2** and **3** gradually move upwardly to partially enclose the filler as the paper **1** moves through the channel.

A compression tongue **7**, mounted on a support **8**, acts to compress tobacco in the tobacco filler as the latter passes beneath the tongue **7**. The tongue **7** slopes and is tapered towards its downstream end (the left hand end in FIGURE 1), but a small part **9** adjacent its extreme downstream end as viewed in plan is devoid of taper, i.e., has parallel sides.

Positioned above the tongue **7**, towards its downstream end, are two guide parts **10** and **11**, having downwardly depending guide edges **12** and **13** respectively (see also FIGURE 2). The guide part **10** is located upstream of the part **11**, and as the web **1** moves past the tongue **7** with the edges **2** and **3** positioned one on each side of and slightly above the tongue, the edge **2** engages the guide edge **12** and is guided inwardly as viewed in plan, and downwardly towards the tongue **7** (FIGURE 2). Further downstream the edge **3** also engages the guide edge **12** and is guided inwardly and downwardly to move over the edge **2**.

The slightly overlapping edges **2** and **3** are further guided into overlapping relationship by the guide edge **13**, and are held in overlapping relationship by a stationary guide member **14**, which is shaped with a longitudinal groove **15** of semicircular cross section (FIGURE 3) to aid in guiding the paper edges **2** and **3** into overlapping relationship. Part of the member **14** is positioned above the tongue **7**, to hold the paper edge portions in overlapping relationship against the part **9** of the tongue **7**. The paper edges **2** and **3**, being held in overlapping relationship

by the member **14**, tend to move together and downwardly upstream of the member **14** on account of the stiffness of the paper. The edge **3** is therefore already folded over slightly before it engages the guide edge **12**, the latter acting to further guide the edge **3** downwardly and over the edge **2**. As the edges **2** and **3** of the cigarette paper web **1** are thus guided into the desired overlapping relationship, the tape **4** remains in contact with the web to support the latter, said tape eventually enclosing the web and filler almost completely (FIGURE 3), only the overlapped edge portions **2**, **3** and closely adjacent areas of the web being left uncovered.

Thus the guide parts **10**, **11** and the member **14** constitute, in combination, folding means to fold the portions of the paper web **1** adjacent the edges **2** and **3** into overlapping relationship about the part **9** of the tongue **7**, so that the latter lies between the tobacco filler and the overlapping paper edge portions.

Referring also to FIGURE 3, an aperture in the form of a hole **16** is provided in the member **14** directly above the part **9** of the tongue **7**, so that the overlapping paper edge portions are exposed as they move beneath the hole **16**. An ultrasonic vibratory welding device, comprising a transducer **17** connected to a coupler **18** serving as a mechanical impedance transformer and having a welding tip **19**, is positioned above the hole **16** so that the tip **19** can act through the latter. Thus, the welding tip **19** acts on the overlapping paper edge portions as they move beneath the hole **16**, and welds them together, while they are supported by the part **9** of the tongue **7**, to form a seam **20** running lengthwise of the wrapped continuous cigarette rod **21**.

The rod **21** then passes to cut-off mechanism (not shown) of the cigarette-making machine to be cut into individual cigarette lengths. Each cigarette so formed thus has a seam comprising overlapped ultrasonically welded edge portions of the cigarette-paper wrapper, the seam running lengthwise of the cigarette.

The tip **19** is substantially rectangular in section (FIGURE 1), having dimensions of 1 mm. by 5 mm., and its surface is concaved slightly to correspond to the upper surface of the part **9** of the tongue **7** (see FIGURE 3). With a tip of this shape and size a single line seam, approximately 1 mm. in width, is formed, but it will be understood that other forms of tip may be employed to give seams of different characteristics. In the construction shown the tip **19** may be made of any suitable material; a metal tip is preferred but a nonmetallic tip, such as diamond or sapphire with a roughened surface, may be employed to provide a rougher appearance to the welded seam which more closely resembles the appearance of the remainder of the cigarette-paper. If desired, the paper web may be dampened before welding. An additive, such as china clay, to the paper web may be used to assist in the welding operation.

The transducer diagrammatically shown at **17** in FIGURE 3 is preferably of a known magnetostrictive type, having a polarising coil and an excitation coil, and the frequency of vibration used is 22 kc./sec. However, it will be appreciated that other types of transducers, for example piezoelectric transducers employing barium titanate etc. can also be used, and that other frequencies of vibration (e.g., within the range 20 to 150 kc./sec.) may be employed.

What we claim as our invention and desire to secure by Letters Patent is:

1. In a continuous rod cigarette-making machine, in which a tobacco filler is formed and deposited on a moving continuous cigarette-paper web, apparatus for wrapping the tobacco filler in the paper web, comprising folding means to fold the paper web about the filler so that one edge portion overlaps the other edge portion of the paper web, a compression tongue positioned to lie between the filler and said overlapping edge portions to compress the filler, a member provided with a vibrating welding tip, said folding means including a stationary

guide member past which the paper web moves, said guide member being shaped to guide the edge portions of the paper web into said overlapping relationship about a downstream end part of the tongue, considered in the direction of movement of the tobacco filler, so that said part of the tongue lies between the filler and the overlapping paper edge portions and being positioned to hold the paper edge portions in said overlapping relationship against said part of the tongue while the paper is welded, said guide member being so shaped as to define an aperture through which said welding tip extends, and means to cause ultrasonic vibratory motion of said welding tip so as to produce cyclic variations of the spacing between said welding tip and said tongue at an ultrasonic frequency whereby said edge portions are welded together by ultrasonic vibratory welding to form a seam extending parallel to the longitudinal axis of the wrapped cigarette rod.

2. Apparatus as claimed in claim 1 wherein said welding tip is rectangular in section.

3. Apparatus as claimed in claim 1 wherein said tongue is of arcuate section and said welding tip has a concave surface facing the convex side of said tongue.

4. In a continuous rod cigarette-making machine in which a tobacco filler is formed and deposited on a moving continuous paper web, apparatus for wrapping the tobacco filler in the web comprising an arcuate, relatively thin, elongated tongue, means for supporting said elongated tongue parallel to the direction of movement of and adjacent to said filler such that the concave side of said tongue compresses said filler, the upstream portion of said tongue, considered in the direction of movement of the tobacco filler, being secured to said support means, a welding tip spaced from the convex side of the downstream portion of said tongue, said welding tip being substantially rectangular in section with its surface adjacent said tongue being concave corresponding to the adjacent arcuate surface of said tongue, means for folding said web about said filler and tongue such that the longitudinal edge portions of said web overlap at a position located between said tongue and said welding tip, and means for producing ultrasonic vibratory motions of said welding tip relative to said tongue causing an ultrasonic cyclic variation of the spacing between said tongue and said welding tip whereby said overlapping edge portions of said web are welded together to form a seam parallel to the longitudinal axis of the cigarette rod.

5. In a continuous rod cigarette-making machine in which a tobacco filler is formed and deposited on a moving continuous paper web, apparatus for wrapping the tobacco filler in a web comprising a tape arranged to support said web, an arcuate relatively thin elongated tongue, means for supporting said elongated tongue parallel to the direction of movement of and adjacent to said filler such that the concave side of said tongue compresses said filler, the upstream portion of said tongue considered in the direction of movement of the tobacco filler being secured to said support means, a welding tip spaced from the convex side of the downstream portion of said tongue, means for folding said web about said filler and tongue such that the longitudinal edge portions of said web overlap at a position located between said tongue and said welding tip, said folding means comprising two guide parts and a stationary guide member, the first guide part being located upstream from said second guide part and being so positioned to guide a first longitudinal edge portion of said web towards said tongue followed by the opposite longitudinal edge portion of said web into overlapping relation with said first longitudinal edge portion, said second guide part being so positioned to subsequently guide further both said longitudinal edge portions into overlapping relationship, said stationary guide member defining an aperture through which said welding tip extends and said guide member extending downstream from said second guide part to retain the longitudinal edge portions of said web in overlapping relationship about said filler and against said downstream portion of said tongue, and means for producing ultrasonic vibratory motion of said welding tip relative to said tongue causing an ultrasonic cyclic variation of the spacing between said tongue and said welding tip whereby said overlapping edge portions of said web are welded together to form a seam parallel to the longitudinal axis of the cigarette rod.

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JOSEPH S. REICH, *Primary Examiner.*

U.S. Cl. X.R.

131—15; 156—73; 228—1