heat sealable material over the heating zone causes the formation of a heat seal. Travel over the cooling zone allows the seal to cool in a supported state.

When a rotatable cylindrical roller is used to form a transverse web to seal fluent material within a package, there is a risk that the contents of the package will be displaced and/or pressurised within the package by the roller. This has the potential to distribute the contents unevenly within the packages and/or cause poor quality seals.

Embodiments of the present invention seek to address some of the aforementioned disadvantages. Additional or alternative embodiments seek to at least provide the public with a useful choice.

**SUMMARY OF THE INVENTION**

In accordance with a first aspect of the invention, there is provided a rotary impulse sealer for forming a series of discrete bonds in a bondable material, the rotary impulse sealer comprising: a roller rotatable about an axis, the roller having a roller body and a plurality of seal bars extending radially outwardly from the roller and spaced apart around the roller body, at least one of the seal bars having a body and a selectively heatable heating element extending along at least a part of a length of the seal bar body; a tensioned belt for introducing the bondable material to the roller; wherein the roller is rotatable through a pre-heating pressure application region of the rotary impulse sealer in which the at least one seal bar is adapted to apply pressure to a bond area of the bondable material, followed by a heating region of the rotary impulse sealer in which the at least one seal bar is adapted to heat the bond area, the regions being stationary with respect to the rotation of the roller; wherein the speed of rotation of the roller is adjustable relative to the bondable material such that the at least one seal bar moves at substantially the same speed as the bondable material while the seal bar applies pressure to the bond area.

The term ‘comprising’ as used in this specification means ‘consisting at least in part of’. When interpreting each statement in this specification that includes the term ‘comprising’, features other than that or those prefaced by the term may also be present. Related terms such as ‘comprise’ and ‘comprises’ are to be interpreted in the same manner.

In an embodiment, the roller is rotatable through a post-heating pressure application region of the rotary impulse sealer in which the at least one seal bar is adapted to apply pressure to the bondable material.

In an embodiment, the pre-heating pressure application region is directly adjacent the heating region.

In an embodiment, the post-heating pressure application region is directly adjacent the heating region.

In an embodiment, the heating region is a heating and pressure application region.

In an embodiment, the body of the seal bar is or comprises an insulating material.

In an embodiment, the heating element extends substantially along the entire length of the seal bar body.

In an embodiment, the heating element is or comprises a conductive material.

In an embodiment, the roller body has a plurality of slots, each slot retaining one of the seal bars.

In an embodiment, at least one seal bar has a longitudinal axis that is substantially parallel to the roller axis.

In an embodiment, at least one seal bar has a longitudinal axis that is non-parallel with the roller axis.

In an embodiment, each seal bar has a body and a selectively heatable heating element extending along at least a part of a length of the seal bar body.

In an embodiment, the roller axis is a stationary axis.

In accordance with a second aspect of the invention, there is provided a vertical form fill machine, comprising: a drive system for driving at least two sheets of bondable material that are sealed together continuously along their opposite edges through the machine; a fill product supply device for introducing fill product between the two sheets of bondable material; and a rotary impulse sealer according to any one of the preceding claims, the rotary impulse sealer adapted to make transverse seals in the at least two sheets of bondable material to form sealed reservoirs of fill product.

In an embodiment, the vertical form fill machine further comprises two cylindrical rollers for receiving sheets of bondable material and forming two continuous, spaced apart longitudinal seals along opposite edges of the sheets of bondable material.

In an embodiment, the cylindrical rollers are arranged to introduce the sheets of bondable material to the rotary impulse sealer at an angle of about 90° to a horizontal plane.

In an embodiment, the rotary impulse sealer is driven so that the seal bar making the seal moves at substantially the same speed as the bondable material that is being sealed.

In accordance with a third aspect of the invention, there is provided a method of forming packages containing fluid or fluent material comprising:

a) continuously providing at least two sheets of bondable material having a fluid or fluent material therebetween;

b) applying pressure to a transverse bond area of the bondable material to force the fluid or fluent material away from the transverse bond area; and

c) heating the transverse bond area to form a seal

wherein steps b and c are performed by a rotary impulse sealer;

wherein the bondable material is introducible to the rotary impulse sealer by a tensioned belt; and

wherein the speed of rotation of the rotary impulse sealer is adjustable relative to the bondable material such that the rotary impulse sealer moves at substantially the same speed as the bondable material while the rotary impulse sealer applies pressure to the bond area.

In an embodiment, the method further comprises:

d) applying pressure to the transverse bond area after step c.

In an embodiment, step d comprises allowing heat to dissipate from the transverse bond area.

In an embodiment, step c comprises simultaneously applying pressure and heat to the transverse bond area.

In an embodiment, step c is carried out immediately after step b.

In an embodiment, step d is carried out immediately after step c.

In an embodiment, the transverse bond area extends in a transverse direction across the width of the at least two sheets of bondable material.

In an embodiment, the method further comprises the step of providing a rotary impulse sealer, the rotary impulse sealer comprising a roller rotatable about an axis, the roller having a roller body and a plurality of seal bars extending radially outwardly from the roller and spaced apart around the roller body, at least one of the seal bars having a body and a selectively heatable heating element extending along at least a part of a length of the seal bar body, wherein the roller is rotatable through a pre-heating

pressure application region of the rotary impulse sealer in which the at least one seal bar is adapted to apply pressure to a bond area of the bondable material, followed by a heating region of the rotary impulse sealer in which the at least one seal bar is adapted to heat the bond area, the regions being stationary with respect to the rotation of the roller.

In an embodiment, the rotary impulse sealer performs step d.

In an embodiment, step c comprises selectively applying a current to the heating element of the seal bar.

Disclosed herein is a package containing fluid or fluent material produced by the method of the third aspect.

In accordance with an embodiment of the disclosure, there is provided a rotary impulse paddle sealer for forming a discontinuous bond in a bondable material, comprises a roller rotatable about an axis; a plurality of seal bars extending radially outwardly from the roller and spaced apart around the roller, at least one of the seal bars adapted to be selectively excited by a current during a portion of the rotation of the roller to temporarily heat the at least one seal bar, the at least one seal bar adapted to apply pressure to an area of material to be bonded during a portion of the rotation immediately preceding the portion of the rotation in which the at least one seal bar is heated.

In an embodiment each seal bar is adapted to apply pressure during a portion of the rotation immediately following the portion of the rotation in which the seal bar is heated.

In an embodiment the at least one seal bar comprises a seal bar body and a heating element extending along at least a part of a length of the seal bar body.

In an embodiment the heating element extends substantially along the entire length of the seal bar body.

In an embodiment the roller is provided with a plurality of slots adapted to retain respective seal bars, the slots shaped such that the seal bars extend radially from the roller.

In an embodiment at least one of the slots is substantially parallel to the axis about which the roller is rotatable.

In an embodiment at least one of the slots is positioned such that it is not parallel to the axis about which the roller is rotatable.

In an embodiment at least one of the slots is shaped such that it is not parallel to the axis about which the roller is rotatable.

In accordance with a further embodiment of the invention, a vertical form fill machine comprises a drive system for driving at least two sheets of bondable material that are sealed together continuously along their opposite edges through the machine; a fill product supply device for introducing fill product between the two sheets of bondable material; a rotary impulse paddle sealer for forming sealed reservoirs of fill product, the rotary impulse paddle sealer adapted to apply pressure to an area to be bonded during a portion of the rotation immediately preceding a portion of the rotation in which the rotary impulse paddle sealer applies heat to form a bond.

In an embodiment the rotary impulse paddle sealer is adapted to apply pressure during a portion of the rotation immediately following the portion of the rotation in which the rotary impulse paddle sealer applies heat to form a bond.

In an embodiment the rotary impulse paddle sealer is adapted to receive sheets of bondable material containing fill material at an angle greater than 0° to a horizontal plane.

In an embodiment the rotary impulse paddle sealer is driven at substantially the same speed as the bondable material that is being sealed.

In accordance with a further embodiment of the invention, a method of forming packages of fluid or fluent material comprises providing a drive system adapted to drive at least two sheets of bondable material; sealing a first edge and a second edge of the sheets of bondable material together continuously; introducing a fluent material between the two sheets of bondable material; providing a rotary impulse paddle sealer adapted to apply pressure to an area to be bonded during a portion of the rotation immediately preceding a portion of the rotation in which the rotary impulse paddle sealer applies heat to form a bond.

The invention in one embodiment comprises several steps. The relation of one or more of such steps with respect to each of the others, the apparatus embodying features of construction, and combinations of elements and arrangement of parts that are adapted to affect such steps, are all exemplified in the following detailed disclosure.

It is intended that reference to a range of numbers disclosed herein (for example, 1 to 10) also incorporates reference to all rational numbers within that range (for example, 1, 1.1, 2, 3, 3.9, 4, 5, 6, 6.5, 7, 8, 9 and 10) and also any range of rational numbers within that range (for example, 2 to 8, 1.5 to 5.5 and 3.1 to 4.7) and, therefore, all sub-ranges

of all ranges expressly disclosed herein are hereby expressly disclosed. These are only examples of what is specifically intended and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application in a similar manner.

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting. Where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

As used herein the term '(s)' following a noun means the plural and/or singular form of that noun.

As used herein the term 'and/or' means 'and' or 'or', or where the context allows both.

Embodiments of the invention consist in the foregoing and also envisage constructions of which the following gives examples only.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Preferred forms of the rotary impulse paddle sealer will now be described by way of example only with reference to the accompanying figures in which:

Figure 1 shows a schematic of a vertical form fill machine including a rotary impulse paddle sealer;

Figure 2 shows an exemplary rotary impulse paddle sealer roller;

Figure 3 shows an exemplary rotary impulse paddle sealer seal bar; and

Figure 4 shows an alternative arrangement of a drive system for a vertical form fill machine.

**DETAILED DESCRIPTION**

Figure 1 shows a schematic of a continuous vertical form fill machine 100 for manufacturing packages 105 of fluid or fluent fill product 110. The vertical form fill machine 100 includes a drive system 115 for driving at least two sheets of bondable material 120, 121 that are sealed together continuously along their opposite edges though the machine 100. The drive system operates continuously. The vertical form fill machine 100 also has a fill product supply device 125 for introducing fill product 110

**CLAIMS**

1. A rotary impulse sealer for forming a series of discrete bonds in a bondable material, the rotary impulse sealer comprising:

a roller rotatable about an axis, the roller having a roller body and a plurality of seal bars extending radially outwardly from the roller and spaced apart around the roller body, at least one of the seal bars having a body and a selectively heatable heating element extending along at least a part of a length of the seal bar body;

a tensioned belt for introducing the bondable material to the roller;

wherein the roller is rotatable through a pre-heating pressure application region of the rotary impulse sealer in which the at least one seal bar is adapted to apply pressure to a bond area of the bondable material, followed by a heating region of the rotary impulse sealer in which the at least one seal bar is adapted to heat the bond area, the regions being stationary with respect to the rotation of the roller;

wherein the speed of rotation of the roller is adjustable relative to the bondable material such that the at least one seal bar moves at substantially the same speed as the bondable material while the seal bar applies pressure to the bond area.

2. The rotary impulse sealer according to claim 1, wherein the roller is rotatable through a post-heating pressure application region of the rotary impulse sealer in which the at least one seal bar is adapted to apply pressure to the bondable material.

3. The rotary impulse sealer according to claim 1 or claim 2, wherein the pre-heating pressure application region is directly adjacent the heating region.

4. The rotary impulse sealer according to claim 2 or claim 3, wherein the post-heating pressure application region is directly adjacent the heating region.

5. The rotary impulse sealer according to any one of the preceding claims, wherein the heating region is a heating and pressure application region.

6. The rotary impulse sealer according to any one of the preceding claims, wherein the body of the seal bar is or comprises an insulating material.

7. The rotary impulse sealer according to any one of the preceding claims, wherein the heating element extends substantially along the entire length of the seal bar body.

8. The rotary impulse sealer according to any one of the preceding claims, wherein the heating element is or comprises a conductive material.

9. The rotary impulse sealer according to any one of the preceding claims, wherein the roller body has a plurality of slots, each slot retaining one of the seal bars.

10. The rotary impulse sealer according to any one of the preceding claims, wherein at least one seal bar has a longitudinal axis that is substantially parallel to the roller axis.

11. The rotary impulse sealer according to any one of the preceding claims, wherein at least one seal bar has a longitudinal axis that is non-parallel with the roller axis.

12. The rotary impulse sealer according to any one of the preceding claims, wherein each seal bar has a body and a selectively heatable heating element extending along at least a part of a length of the seal bar body.

13. The rotary impulse sealer according to any one of the preceding claims, wherein the roller axis is a stationary axis.

14. A vertical form fill machine, comprising:

a drive system for driving at least two sheets of bondable material that are sealed together continuously along their opposite edges through the machine;

a fill product supply device for introducing fill product between the two sheets of bondable material; and

a rotary impulse sealer according to any one of the preceding claims, the rotary impulse sealer adapted to make transverse seals in the at least two sheets of bondable material to form sealed reservoirs of fill product.

15. The vertical form fill machine according to claim 14, further comprising two cylindrical rollers for receiving sheets of bondable material and forming two continuous, spaced apart longitudinal seals along opposite edges of the sheets of bondable material.

16. The vertical form fill machine according to claim 15, wherein the cylindrical rollers are arranged to introduce the sheets of bondable material to the rotary impulse sealer at an angle of about 90° to a horizontal plane.

17. The vertical form fill machine according to any one of claims 14 to 16, wherein the rotary impulse sealer is driven so that the seal bar making the seal moves at substantially the same speed as the bondable material that is being sealed.

18. A method of forming packages containing fluid or fluent material comprising:

a) continuously providing at least two sheets of bondable material having a fluid or fluent material therebetween;

b) applying pressure to a transverse bond area of the bondable material to force the fluid or fluent material away from the transverse bond area; and

c) heating the transverse bond area to form a seal

wherein steps b and c are performed by a rotary impulse sealer;

wherein the bondable material is introducible to the rotary impulse sealer by a tensioned belt; and

wherein the speed of rotation of the rotary impulse sealer is adjustable relative to the bondable material such that the rotary impulse sealer moves at substantially the same speed as the bondable material while the rotary impulse sealer applies pressure to the bond area.

19. The method according to claim 18, further comprising:

d) applying pressure to the transverse bond area after step c.

20. The method according to claim 19, wherein step d comprises allowing heat to dissipate from the transverse bond area.

21. The method according to any one of claims 18 to 20, wherein step c comprises simultaneously applying pressure and heat to the transverse bond area.

22. The method according to any one of claims 18 to 21, wherein step c is carried out immediately after step b.

23. The method according to any one of claims 19 to 22, wherein step d is carried out immediately after step c.

24. The method according to any one of claims 18 to 23, wherein the transverse bond area extends in a transverse direction across the width of the at least two sheets of bondable material.

25. The method according to any one of claims 18 to 24, further comprising the step of:

providing a rotary impulse sealer, the rotary impulse sealer comprising a roller rotatable about an axis, the roller having a roller body and a plurality of seal bars extending radially outwardly from the roller and spaced apart around the roller body, at least one of the seal bars having a body and a selectively heatable heating element extending along at least a part of a length of the seal bar body,

wherein the roller is rotatable through a pre-heating pressure application region of the rotary impulse sealer in which the at least one seal bar is adapted to apply pressure to a bond area of the bondable material, followed by a heating region of the rotary impulse sealer in which the at least one seal bar is adapted to heat the bond area, the regions being stationary with respect to the rotation of the roller.

26. The method according to claim 25 when dependent on claim 19, wherein the rotary impulse sealer performs step d.

27. The method according to any one of claims 25 to 26, wherein step c comprises selectively applying a current to the heating element of the seal bar.