Oct. 31, 1967 J. E. GREER ET AL 3,349,578

SEALING DEVICE

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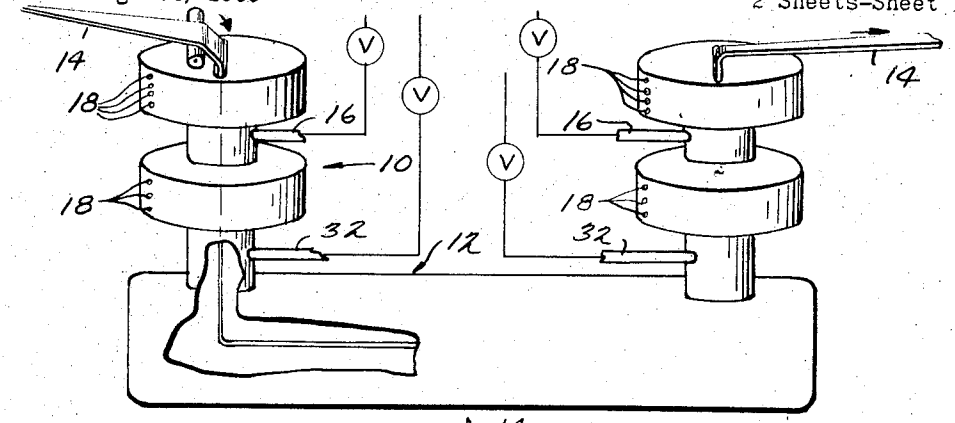


Fig. 1.

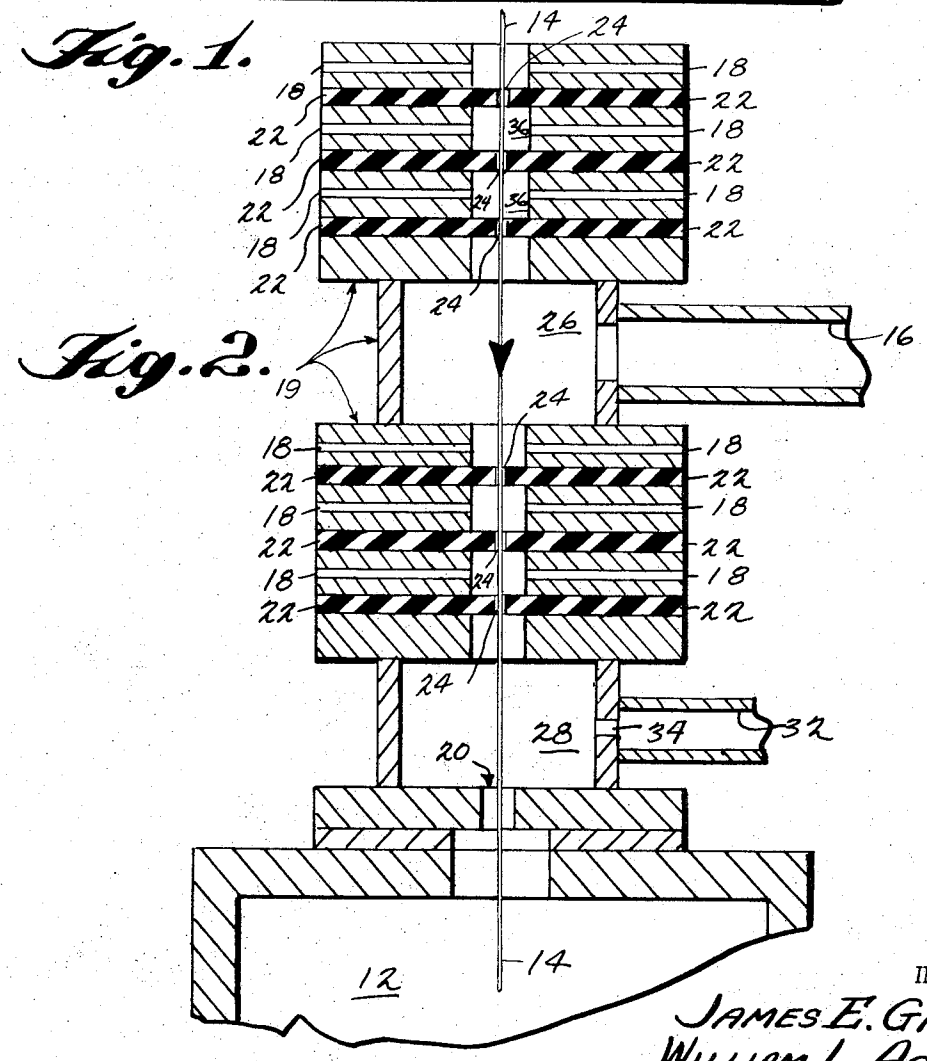


Fig. 2.

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Fig. 3.

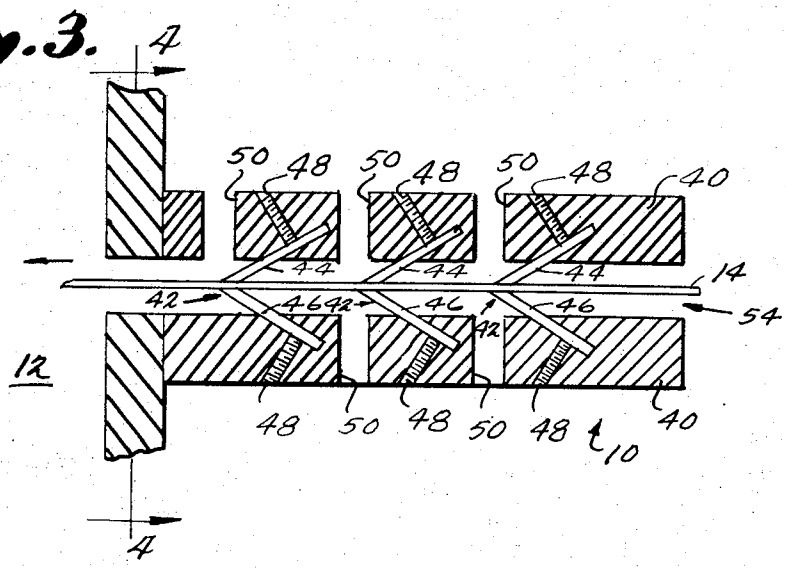
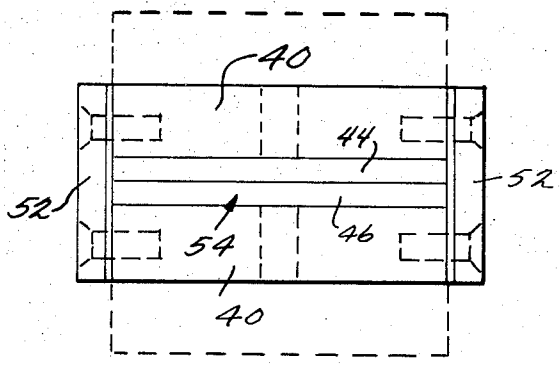


Fig. 4.



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SEALING DEVICE

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ABSTRACT OF THE DISCLOSURE

A sealing device for textile treating apparatus provides for movement of a running length of textile material into and out of a steam or hot water vessel. The sealing device includes a plurality of flexible diaphragm gates through which the material can move without being mechanically abraded or disturbed. Pressure control means are provided for a plurality of chambers associated with the device, and steam is prevented from escaping from the vessel so as to condense on the incoming fabric in a way which would disturb unfixed dye contained in the material.

Brief description of invention

This invention relates to apparatus for treating moving lengths of material, and in particular, the invention is concerned with an improved sealing means used with apparatus for dyeing or processing textile materials. The invention contemplates apparatus used in the treatment of strands, tapes, tows, or other forms of textile fabrics.

Apparatus for use in dyeing fabric materials is well known in the art, and usually means are provided for introducing a running length of material into a vat or chamber where the treatment takes place and then for removing the material from the chamber upon completion of the treatment process. Where continuous length material is being introduced into a chamber which is operating at high temperatures or pressures, it is necessary to include sealing devices at the points of entry and exit of the material into and out of the chamber. Prior art sealing devices have included various types of gate structures such as disclosed in the Yoshiike Patent 3,137,-151, and such devices have included attempts to regulate the pressure of a series of chambers adjoining the high pressure treatment chamber where the dyeing process is taking place. Such prior art devices have a disadvantage in that they disturb unfixed dye which may be on the fabric when it passes through the sealing device for subsequent fixation in a steam or hot water chamber. The real difficulty resides in the fact that condensation forms on the entering dyed material while it is passing through the series of gates or other sealing devices, and this condensation together with the mechanical contact of the sealing gates with the material disturbs the unfixed dye on the material and affects the uniformity of the dye treatment.

The present invention provides for an improved sealing means to be used in conjunction with a pressure chamber for introducing or removing continuous length dyed fabric into and out of the chamber. The sealing means of this invention includes flexible diaphragm means through which the fabric passes for introduction or removal from the high pressure chamber. The flexible diaphragm means are positioned in a series of chambers contained within the sealing device, and which are so regulated in pressure relative to one another that condensation does not form on material which is being introduced into the steam chamber. The flexible diaphragm means may be made from synthetic rubbers or suitable plastics, and such sealing means provide for a better pressure seal with less mechanical damage or disturbance to unfixed dyed textiles which are passing through the sealing device.

The sealing device of this invention further includes chambers into which air may be admitted for the purpose of adjusting the pressure environment around the incoming moving material, and one chamber is positioned immediately adjacent to the entry of the moving material into the steam chamber or other treating device. By admitting controlled amounts of air into the separate chambers of the sealing device, and in particular, by admitting air to the chamber which is immediately adjacent to the steam vat, it is possible to prevent the condensation of steam escaping from the steam vat onto the incoming dyed material. This eliminates the problem of condensation on the surface of the unfixed dye material, and there is less disturbance to the moving material as it enters the steam vat through the sealing device.

Thus, the sealing device includes a plurality of flexible diaphragm means which act to prevent the escape of pressure and contents from the steam treating vat, and also means are included for controlling the amount of air pressure within the sealing device so as to prevent condensation of steam onto incoming material. In order to further control the air pressure environment within the sealing device, venting passages are provided through a casing of the sealing device and into its hollow interior so that excess air pressure may escape from the sealing device. The venting passageways are positioned between the plurality of diaphragm means so that a vent is provided out of each chamber defined by the space between subsequent diaphragm gates.

In fixing the dye on a particular fabric, the dyed textile material is moved through the sealing device and into the steam vat or chamber which is under relatively high pressure and temperature. In its movement through the sealing device, the dyed textile passes through the plurality of diaphragm sealing means which are positioned throughout the length of the sealing device to prevent the escape of steam and pressure from the treating vat. As the dyed material progresses through the sealing device, it reaches an opening into the treating vat. Steam can escape from the vat opening and would ordinarily rise into the sealing device and condense onto the incoming fabric. However, the chamber which is immediately adjacent to the vat opening is purged of excess moisture, and a stream of air is admitted to chambers above the adjacent chamber so as to maintain a curtain of protective air around the incoming textile material. As a result, the dyed material enters the treating vat without any mechanical or chemical disturbance of the unfixed dye, and the steam treatment of the material fixes the dye in a more uniform manner than heretofore possible.

Other advantages of the sealing device will become apparent in the more detailed discussion which follows. In that discussion, reference will be made to the accompanying drawings in which:

FIGURE 1 is a vertical sectional view showing the position of the sealing device as related to a treating vessel;

FIGURE 2 is a detailed sectional elevation showing the various chambers and components of the sealing device;

FIGURE 3 is an alternative embodiment of the flexible sealing means of this invention as used with a sealing device;

FIGURE 4 is an end view of the sealing device of FIGURES 2 or 3 showing side plates which attach to the device for forming the sealing chamber through which textile material passes.

Detailed description of invention

With reference to FIGURE 1, a sealing device **10** is shown as being mounted on a pressure vessel **12** at a point

where continuous length fabric or other textile material is entering the pressure vessel for treatment. A second sealing device **10** is shown at the exit of the material from the pressure chamber, and the second device may be of a similar construction to that used for the inlet sealing device. Continuous length material **14** is moving in the direction indicated by the arrows, and it is contemplated that such material may be in any form, such as strand, tow, or woven fabric. The sealing devices **10** may be made of such dimensions to accommodate any dimension of textile material which is to be introduced into the treating vessel **12**. For example, the device may be constructed to receive a normal width of fabric coming from a loom, and the same device could receive and seal smaller widths of fabric or even single strands of textile material. The sealing device **10** is adaptable for use as a sealing means for any treating chamber **12**; however, it will be described with particular reference to protecting dyed fabrics from disturbances while at the same time effectively sealing the pressure within a steam vessel **12** which is used for fixing dye on such fabrics. The FIGURE 1 view also shows connections **16** for air hoses which communicate with certain portions of the sealing device **10** to regulate the gaseous environment within the sealing device and to prevent the formation of steam condensate on the incoming textile material **14**. Also, the FIGURE 1 shows venting passages **18** which communicate with the interior of the sealing device to permit the escape of excess air pressure from within the device.

Referring to the detailed view of FIGURE 2, the various elements which make up the sealing device are shown as related to the position of the mounted device on the pressure vessel **12**. In its basic form, the sealing device includes a casing or housing **19** defined by the various components which make up the outside walls of the device, and a longitudinally extending central passage is provided through the housing for introducing moving textile material into the pressure vessel **12**. The pressure vessel **12** includes a slit or opening **20** for receiving the entering material from the sealing device. The split or opening **20** is of such a size to accommodate the particular textile material which is to be received within the treating vessel, but the opening is restricted so as to prevent an abnormal escape of steam or pressure from within the vessel **12**. The sealing device **10** includes a plurality of flexible diaphragm means **22** positioned along the length of the device so as to prevent the escape of pressure or steam from the vessel **12**. The diaphragm elements **22** are preferably made from rubber or any synthetic material which provides a degree of flexibility and is resistant to the action of steam or other chemical action which would be encountered in such a unit. The diaphragm elements **22** may be in the form of sheets of synthetic rubber having slots **24** positioned through the central portions of the sheet so that when the plurality of diaphragm elements are aligned along the sealing device, the running length of textile material may pass through the aligned centrally located slots **24**. The slots may be simple, straight line cuts through the diaphragm element, or they may be dimensioned to accommodate larger thicknesses of textile material. In either case, the slots are of such a size that the moving material contacts opposed faces of the diaphragm material on each side of the slot so that an effective seal is attained while permitting the passage of textile material through the diaphragm element with little or no mechanical abrasion of the textile material.

The diaphragm elements **22** are spaced from one another throughout the length of the sealing device casing so as to define separate compartments between adjoining diaphragm elements, as shown. In the illustrated form of the invention, three diaphragm elements are arranged in spaced relationship to one another in an upper portion of the sealing device **10**, and a second set of three diaphragm elements are spaced from one another in a lower portion of the sealing device. A relatively large chamber **26** is interposed between the two sets of diaphragm elements at the upper and lower portions of the sealing devices, and a similar chamber **28** is included at the lowermost portion of the sealing device at its point of attachment to the pressure vessel **12**. The two large chambers **26** and **28** are positioned to permit a control of pressure in the sealing device and to provide a curtain of air around the running length of material which is passing through the device and into the pressure vessel. The purpose in introducing a curtain of air around the material is to prevent condensation of steam or other moisture which is rising up from the pressure vessel **12**, and by preventing such condensation, there is no mechanical or chemical disturbance of unfixed dye that may be carried on the entering material. The upper chamber **26** is connected to an air pressure line **16** which leads to a suitable source of air or gas under pressure and known control devices can be included in the line for controlling the rate of admission of air pressure into the upper chamber. The lower chamber **28** is connected to a purge line **32** through the port **34**, and the purge line **32** may be controlled with valving devices to relieve excess pressure or moisture from the lower chamber **28**. In the preferred embodiment of this invention, air or gas is admitted to the lower chamber **28**, through the line **32**, for providing a curtain of condensation-preventing air in that chamber, as is provided in the upper chamber **26**. Suitable valving means may be included in the air line **32** to control the admission of air to chamber **28**.

In a dye-fixing process, the material **14** which is entering the pressure vessel **12** carries unfixed dye on its surface and the pressure vessel contains steam for fixing the dye onto the material. The pressure vessel **12** may be under a typical pressure of 15 p.s.i.g., and with such a pressure there would be a tendency for the pressurized steam to escape from the pressure vessel **12** upwardly into the sealing device **10**, thus accounting for the usual condensation which takes place on incoming fabrics which are introduced into such treating vessels. However, the use of spaced chambers between flexible sealing elements together with the introduction of air under pressure into the sealing device assists in balancing the pressure differences between the sealing device **10** and the pressure vessel **12**. It has been found that if the pressure in the upper chamber **26** is maintained at approximately 2–3 p.s.i.g., the pressure in the lower chamber **28** will be approximately 7 p.s.i.g., and condensation will be prevented on incoming fabric material. In addition to the advantage in preventing condensation on the surface of the entering material, the use of flexible sealing elements in the form of the flexible diaphragms **22** prevents any mechanical disturbance of the unfixed dye or of the surface of the incoming material **14**. Thus, there is provided an improved sealing device for introducing a continuous length of material into a treating vessel while at the same time preventing the escape of pressure from the vessel or any disturbance to the incoming material which is being treated.

As mentioned above, the individual diaphragm elements **22** are spaced so as to define smaller chambers between adjoining diaphragm elements, and these chambers are indicated generally at **36**. In order to better control the curtain of air and the air pressure within the sealing device, venting passages **18** are included through the walls of the casing of the sealing device at spaced intervals corresponding to the locations of the smaller chambers **36**. The venting passageways **18** may be formed by boring small holes through the casing wall **19**, as shown, and a sufficient number are provided to permit a slow escape of excess air from the chamber at all times. This prevents the build-up of too much pressure within the sealing device, and also a continuous flow of air is maintained through the sealing device so as to carry off moisture and to prevent condensation. Also, it can be seen that a flow of air is maintained in all parts of the sealing device above

the lowermost chamber **28**, and thus steam is prevented from rising above the chamber **28**. Any moisture which does escape past the lowermost diaphragm element is carried away through the vents **18** by the flow of air in the upper parts of the sealing device **10**.

In the preferred form of the invention, the sealing device **10** may be made up of a plurality of plate-like elements which define the casing and the longitudinal opening through the casing for the passage of entering material. The plate-like elements may be stacked so as to define the upper and lower sections of the sealing device, as shown in FIGURE 2. Separate tubular casing members may be interposed between the stacks of plate-like members to define the upper and lower chambers **26** and **28** respectively, and all of the elements are secured in such a manner as to provide a seal between adjoining elements. The diaphragm elements **22** may be of a similar size and shape in their outside configuration to the plate-like elements **28**, and preferably the diaphragm elements are staggered in the stacking arrangement of the plate-like elements so as to provide the spaced arrangement shown.

In an alternative form of the invention, as shown in FIGURE 3, the sealing device **10** may be made up of opposed elongate plates **40** which make up walls of a rectangular shaped sealing device. In such a construction, the elongate plates are provided with slots for containing separate opposed portions of diaphragm elements **42**. Conceivably the slots can be arranged in direct alignment with one another so that a single diaphragm element having a slot in its central portion may be used, as in the preferred form of this invention, but the construction of FIGURE 3 illustrates the use of diaphragm elements **42** which are made up of separate opposed portions which converge toward one another so as to provide a passage at their point of juncture for the entering material **14**. The opposed portions of the diaphragm elements **42** may be placed into the slots contained within the elongate plates in a spaced relationship so as to define separate chambers between adjoining diaphragm elements **42**. The separate portions **44** and **46** which make up a single diaphragm element **42** are held in position by the holding screws **48** which are threaded into the elongate plate members **40** so as to be adjustable from the outside of the sealing device **10**. Air connections **50** are provided through the walls of the elongate plates **40** between the separate chambers defined by the spaced diaphragms **42**, and air is introduced into these chambers in the same manner as described above for the purpose of preventing condensation and to equalize pressures between the sealing device **10** and the pressure vessel **12**.

The FIGURE 3 embodiment of the sealing device has the advantage of providing flexible sealing gates which make a tighter seal in proportion to the amount of pressure building up in the pressure end of the device which is in communication with the pressure vessel **12**. As pressure increases in the vessel **12**, there is a greater tendency for the opposed flexible sealing elements **44** and **46** to bow upwardly in a manner which places more of their sealing surfaces in contact with the incoming fabric or material **14**. This increase in sealing characteristic of the devce is accomplished without mechanically abrading or frictionally disturbing the incoming fabric.

FIGURE 4 illustrates an end view of the device shown in FIGURE 3. It can be seen that the sealing device is generally rectangular in its cross sectional configuration, and that the elongate plates **40** are held in spaced relationship to one another by the side wall plates **52**. The plates **52** may be bolted or otherwise secured to the walls of the elongate plates **40** so as to form a sealed unit having central passageway **54** running through its central longitudinal axis.

Although this invention has been described with reference to preferred embodiments, variations will become apparent to those skilled in the art, and such variations are intended to be included within the scope of the invention.

What is claimed is:

1. A sealing device for pressure sealing a vessel from an external atmosphere and for passing a continuous length of material into and out of said vessel through said sealing device, comprising:

a hollow casing having an opening at each end, said casing being mounted over an opening into said vessel,

a plurality of flexible diaphragm means included in said casing and spaced from one another along the length of said sealing device so as to define a plurality of chambers in said sealing device, said plurality of flexible diaphragm means each having a central opening therethrough for allowing the passage of continuous length material through the plurality of diaphragm means and

means for introducing a fluid into at least one of said plurality of chambers for increasing the pressure within said sealing device to prevent the escape of pressure from said vessel, and wherein said chambers formed between the plurality of diaphragm means include venting means for exhausting fluid to the atmosphere, whereby a fluid stream is created in said sealing device and condensation of steam onto incoming continuous length material is prevented.

2. The sealing device of claim **1** wherein one of said plurality of chambers adjoins the pressure vessel to which said sealing device is attached and including a conduit in communication with said adjacent chamber for admitting a fluid for preventing the rise of moisture from said vessel into the remaining chambers of said sealing device.

3. The sealing device of claim **1** wherein each of said flexible diaphragm means comprises separate sheets of flexible material placed in opposed relationship within said sealing device so as to contact opposite faces of material passing between said separate flexible sheets.

4. A pressure sealing device for use with a high pressure treating chamber, and through which a continuous length of material can pass for introduction into said high pressure treating chamber, comprising:

a hollow casing having open ends and having a passage throughout its length for introducing continuous length material through said casing and into said treating chamber,

flexible diaphragm means interposed throughout the length of said hollow casing for contacting all surfaces of the continuous length material being moved through said sealing device, said flexible diaphragm means providing a seal for preventing the escape of pressure or contents from said treating chamber and said diaphragm means forming a plurality of chambers through which the continuous length material must pass,

gas inlet means connected to at least one of said plurality of chambers, said gas inlet means providing for an increase of pressure within said chamber, and

venting means interposed along the length of said hollow casing for releasing excess pressure and moisture from said housing so as to prevent the condensation of liquid upon incoming continuous length material.

5. The sealing device of claim **4** wherein each of said flexible diaphragm means comprises a sheet of flexible material having a central opening therethrough for allowing the passage of continuous length material, and wherein openings of said plurality of spaced diaphragms are in axial alignment with each other throughout the length of the sealing device.

6. The sealing device of claim **4** wherein said flexible diaphragm means comprises opposed sheets of flexible material having separate faces approaching one another so as to contact opposite sides of a continuous length material passing between the opposed sheets of material

whereby the flexible sheets of material form a pressure seal through which material can pass with no mechanical disturbance of the surfaces of the material.

7. The sealing device of claim 6 wherein said separate sheets of flexible material are arranged so as to converge toward one another at an angle so as to form a diaphragm means having a V-shaped cross sectional configuration directed toward the pressure side of the sealing device, whereby increased pressures within said vessel causes said separate diaphragm means to bend into a tighter sealing engagement with material passing through the sealing device.

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