Nov. 24, 1964 P. ALEXANDER 3,158,507

FLOATING ROLLER SEAL

Filed Jan. 11, 1960

FIG. 1

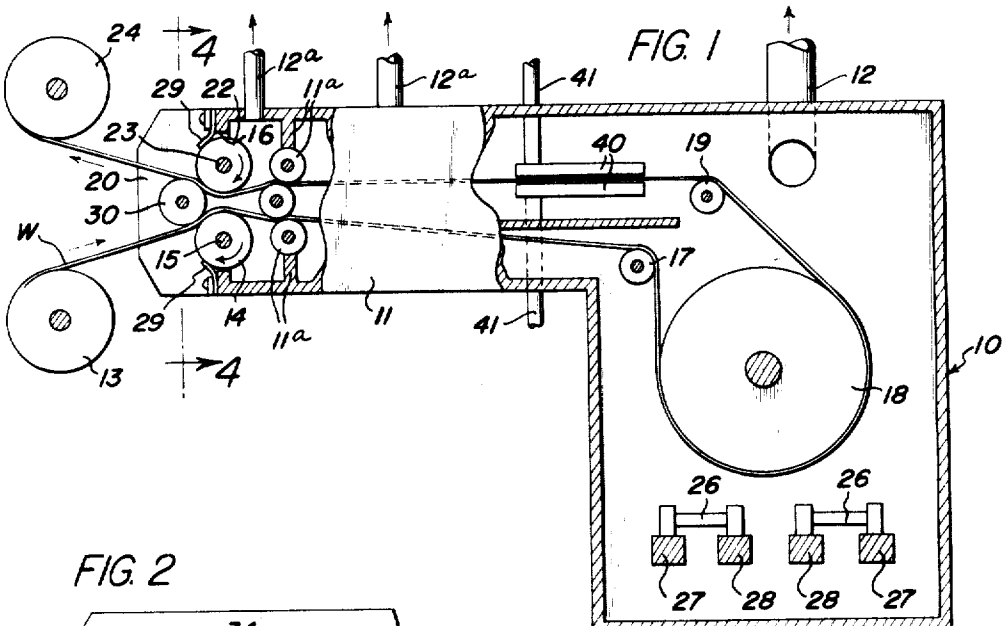


FIG. 2

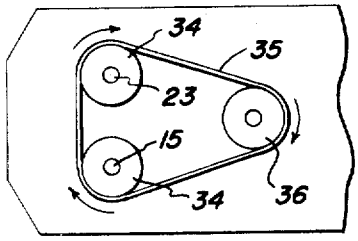
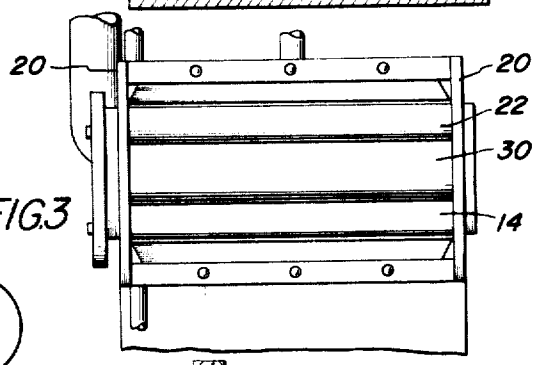


FIG3



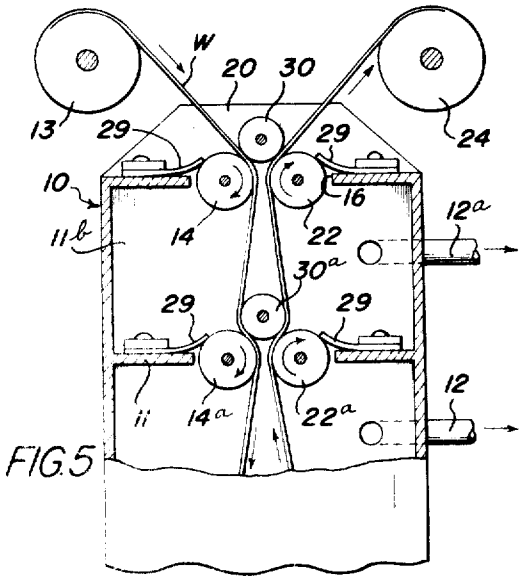


FIG.5

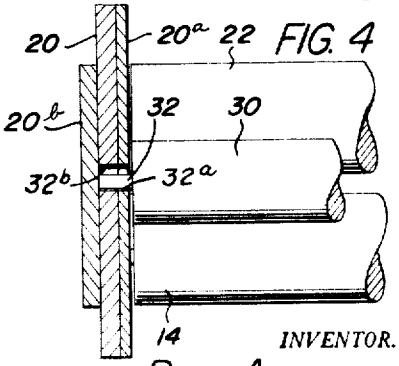


FIG. 4

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3,158,507
FLOATING ROLLER SEAL

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6 Claims. (Cl. 118—49)

This invention relates to sealing devices by which sheets of material may be admitted to and withdrawn from treating chambers within which non-atmospheric conditions must be maintained.

When sheets of material, e.g., so-called endless webs, of materials such as metal, paper, plastics, are to be subjected to treatments under conditions differing from atmospheric by gas content, pressure, or the like, it is desirable to prevent the entry of atmospheric gases as contaminants of the treating operation, or the escape of gases from the chamber.

Such sheets are not always of uniform thickness, but may have irregularities of thickness, by a wavy conformation of one or both surfaces, by differing thicknesses at the edges, or by local elevations. When fixedly supported rotatable rollers are employed as seals, adjusted to allow passage of the maximum thickness, there is leakage space as the lesser thicknesses are passing: if adjusted to a lesser spacing, there is at least a momentary detention as a greater thickness comes between the rollers, so that the increased tension along the web or sheet may cause tearing or other irregularity in the feeding or treatment. When spring devices are provided to permit one or both rollers to yield, the spring adjustment is usually critical, especially with webs of thin weak material: and at adjustments which cause the rollers to return quickly after separation displacement, the increased tensions when major elevations pass can also cause tearing, while at lower pressure adjustments, the rollers do not follow the surface variations.

An object of this invention is the provision of a sealing device which restricts the flow of gas along the surface of the web, this device being free to accommodate itself to the web.

Another object is the provision of a sealing device including a pair of rollers for guiding the material during admission and exit from a chamber, with the material moving in opposite directions in the space between such guide rollers, and a third sealing roller which is free to move into engagement with such guide rollers and the material guided thereby.

With these and other objects in view, illustrative embodiments of the invention are shown on the accompanying drawings, in which:

FIGURE 1 is a conventionalized upright sectional view of a treating chamber having an inlet-outlet seal according to this invention.

FIGURE 2 is a fragmentary view, showing a roller driving means for the sealing structure of FIGURE 1.

FIGURE 3 is an end view of the sealing structure.

FIGURE 4 is a fragmentary upright section substantially at line 4—4 of FIGURE 1, on a larger scale than FIGURES 1, 2 and 3.

FIGURE 5 is a view, partly in upright section, of a second embodiment.

In FIGURES 1 and 2, a treating chamber structure **10** is shown with closing walls, and an inlet-outlet extension **11** for the substrate, which may contain secondary seals such as the one conventionalized as the partition walls and fixed axis rollers **11***a*: exhaust connections **12***a* can be provided for maintaining successively reduced pressures in the seal compartments. An exhaust connection **12** provides a subatmospheric pressure within the treating

chamber. A supply roll **13** of web material, to be treated, is mounted outside the chamber **10** and its extension and delivers a web W toward a first guide roll **14** having a shaft **15** (FIGURE 2) fixedly journaled on the chamber structure with the roll **14** occupying a lower part of an opening in the end wall of the extension. After passing arcuately over the roll **14**, the web is led in succession through auxiliary seals and to a first turning roll **17**, thence around the cooled deposition roll **18** from which the treated web moves to a turning roll **19**, and thence outward in the sealing extension **11** to a second guide roll **22** mounted on a shaft **23** (FIGURE 2) likewise journaled on the chamber structure and occupying an upper part of the opening **16**. From the roll **22**, the treated web passes to a take-up roll **24** located outside the chamber.

Treatment within the chamber structure **10** is illustrated by the presence of heater-vaporizer elements **26** connected to the electrical bus bars **27**, **28** so that the elements are resistively heated and deliver coating vapor into the chamber for deposit upon the web as a substrate during its passage over the roll **18**.

The sealing guide rolls **14**, **22** have their ends closely fitted (FIGURES 3 and 4) against the check plates **20** forming part of the chamber extension structure and for example having low-friction surfaces provided by sheets **20***a* of fluorocarbon polymer such as that known commercially under the trademark Teflon, to restrict leakage at the ends of the rolls.

The sealing guide rolls **14**, **22** have their peripheries sealed relative to the structure **10** at points remote from the space between the rolls, by close conformation to the structure walls preferably with inclusion of sealing devices shown as flexible imperforate blades **29**, of material like that of the sheets **20***a*, mounted at the outer surface of the chamber wall and each spanning a part of the opening **16** and engaging the periphery of the respective roll.

At the outward nip of the rolls **14**, **22**, that is, that away from the interior of the chamber structure, is provided a third sealing roller **30** which is free to move toward and from the rolls **14**, **22**. In the illustrated form, this roller **30** has projecting shaft ends **32** (FIGURE 4) which fit loosely and are journalled in holes **32***a*, **32***b* in the respective sheets **20***a* and plates **20** for limited movement in all directions normal to the axis of the third roller **30**. The outer ends (unnumbered) of the holes for the rollers are sealed by the end plates **20***b*. The ends of the roll **30** are likewise sealed against the plates **20** and their sheets **20***a*. During operation of the embodiment in FIGURES 1–4, the roller **30** is drawn toward the chamber when the exhaust connections **12**, **12***a* are energized, so that the roller lightly presses against the arcuate parts of the web which are passing over the rolls **14**, **22**. It will be noted that the inward feeding of the web from the supply roll **13** tends to exert an effort upon the roller **30** to seat it in the nip of the guide rolls **14**, **22** and to cause rotation of this roller **30** at a peripheral or surface speed equal to that of the web. Correspondingly, the outward or exit movement of the web over the surface of the roll **22** and toward the take-up roll **24** imposes a like turning movement upon the roller **30**.

The rolls **14**, **22** are illustratively of the same diameter, and (FIGURE 2) their shafts **15**, **23** are extended in sealed relation through the check plates and have sprockets **34** fixed thereon, and an engaging drive chain **35** passes over the driven sprocket **36** so that the parts are moved in the directions shown by the arrows in FIGURES 1 and 2.

During operation, the loose roller **30** can conform to the material of the web W. Thus, if a local elevation is present on the upper surface of the web as it moves from the supply roll **13**, the contacted part of the roller **30** is

lifted away from the lower sealing guide roll 14, moving at the corresponding part of its periphery upwardly and outwardly along the arc represented by the part of the web which is on the other sealing guide roll 22 and immediately returning as soon as the elevation has passed. When the elevation has passed through the chamber with the web, and comes onto the sealing guide roll 22, it presses the roller 30 downward and outward, with the roller periphery now moving along the arc represented by the part of the web which is then on the sealing guide roll 14. Even if a length of the web, greater than the distance along its path through the chamber, has a wedge-like section with greater thickness at one edge than at the other, the roller 30 likewise compensates and establishes a position of maximum sealing effect. Therewith, although the sealing guide rolls 14, 22 are fixed to turn about parallel axes, the axis of the roller 30 can be parallel thereto when the two parts of the passing web are uniform, or can depart from parallelism as needed to assure optimum sealing.

When the parts are at a standstill for threading a fresh web, the roller 30 can be moved away from the nip, for easy introduction of the web: and immediately assumes sealing position when the system is brought into operation.

When the web undergoes no change of length during the treatment, the driving of the rolls 14, 22 at like peripheral or surface speeds permits drawing-off and drawing through at constant web speed. When the web changes in length, e.g., by thermal expansion due to heating within the chamber, the devices 40 can be employed to restore the linearity of speed relation, e.g., when the web is heated, the devices 40 may be operated with cooling fluid through the connections 41 so that a section of outgoing material has been restored to the same linear dimension present during its inward movement.

In the form shown in FIGURE 5, the chamber structure 10 has the rolls 14, 22 mounted in a top opening, and the loose sealing roller 30 rests in the nip of these rolls, upon the ingoing part of the web W coming from the supply roll 13 and the outgoing part moving to the take-up roll 24. In this form, the sealing blades 29 are mounted on outer wall surfaces of the chamber structure. In FIGURE 5, the roller 30 is moved downward by gravity and by evacuation. FIGURE 5 shows the general chamber as including an antechamber 11*b* bounded by a lower partition 11*c* having a hole therein for a second set of fixed sealing rolls 14*a*, 22*a*, with sealing blades 29, and a loose third roller 30*a*.

It is obvious that the illustrative embodiments are not restrictive, and that the invention can be practiced in many ways within the scope of the appended claims.

What is claimed is:

1. A seal for a system including a chamber structure and means for maintaining a pressure differential between the interior of the chamber and the outer atmosphere, said chamber structure having an opening through which sheet material may be passed to and from the chamber, comprising a pair of sealing guide rolls mounted at said opening and spaced apart on parallel axes with their peripheries at a distance greater than twice the maximum thickness of the material, the material being fed inward and outward between said guide rolls, a third sealing roller of greater diameter than the distance between the peripheries of said pair of rolls loosely positioned between the guide rolls with its axis spaced from the plane through said parallel axes in the direction of the greater differential pressure effect on said third roller, means for independently guiding the ends of said third roller for limited movement in all directions normal to the axis of said third roll whereby the third roller may move in regard to variations of thickness of the material adjacent one edge thereof independently of the thickness at the other edge thereof, the pressure differential between the chamber and the atmosphere being active for returning the third roller toward the said pair of rolls, and sealing means active at the peripheries of the guide rolls and at the ends of the guide rolls and the third roller.

2. A seal as in claim 1, in which the opening is at the top of the chamber structure, and in which the third roller rests by gravity in the nip of the two guide rollers.

3. A seal for a system including a chamber structure and means for maintaining a pressure differential between the interior of the chamber and the outer atmosphere, said chamber structure having an opening through which sheet material may be passed to and from the chamber, comprising a pair of sealing guide rolls mounted at said opening and spaced apart on parallel axes with their peripheries at a distance greater than twice the maximum thickness of the material, the material being fed inward and outward between said guide rolls, a third sealing roller of greater diameter than the distance between the peripheries of said pair of rolls loosely positioned between the guide rolls with its axis spaced from the plane through said parallel axes in the direction of the greater differential pressure effect on said third roller, means for independently guiding the ends of said third roller in movements relative to the said pair of rolls whereby the third roller may move in regard to variations of thickness of the material adjacent one edge thereof independently of the thickness at the other edge thereof, the pressure differential between the chamber and the atmosphere being active for returning the third roller toward the said pair of rolls, and sealing means active at the peripheries of the guide rolls and at the ends of the guide rolls and the third roller, said guide rolls having shaft extensions journalled in the chamber structure adjacent said opening, and means external to the chamber structure are present for separately rotating the rolls in the same angular direction.

4. A seal for a system including a chamber structure and means for maintaining a pressure differential between the interior of the chamber and the outer atmosphere, said chamber structure having an opening through which sheet material may be passed to and from the chamber, comprising a pair of sealing guide rolls mounted at said opening and spaced apart on parallel axes with their peripheries at a distance greater than twice the maximum thickness of the material, the material being fed inward and outward between said guide rolls, a third sealing roller of greater diameter than the distance between the peripheries of said pair of rolls loosely positioned between the guide rolls with its axis spaced from the plane through said parallel axes in the direction of the greater differential pressure effect on said third roller, means for independently guiding the ends of said third roller in movements relative to the said pair of rolls whereby the third roller may move in regard to variations of thickness of the material adjacent one edge thereof independently of the thicknes at the other edge thereof, the pressure differential between the chamber and the atmosphere being active for returning the third roller toward the said pair of rolls, and sealing means active at the peripheries of the guide rolls and at the ends of the guide rolls and the third roller, said chamber structure including an extension providing the said opening and having upright check plates for journalling and forming a part of the said sealing means for the said pair of rolls, said third roller having shaft extensions into holes of the check plates, the holes being longer than the shaft extensions so their walls form part of said independently guiding means whereby the ends of the third roller may move independently of one another in response to differing thicknesses of material across the width thereof.

5. In combination with a chamber structure having an opening for receiving sheet material in elongated strip form and including sheet material guide means for reversing the direction of movemenet of the sheet material and returning the sheet material out of the chamber structure through the same opening, means for reducing the pressure within the chamber below atmospheric pressure, a device within the chamber for treating the material, a

seal comprising first and second sealing guide rolls mounted in the opening and spaced apart on parallel axes with the peripheries thereof spaced at a distance greater than twice the maximum thickness of the sheet material, a third sealing roller loosely positioned adjacent said first and second sealing rolls and having a diameter greater than the distance between the peripheries of said first and second rolls, said third roller having its axis located outside the plane through the said first and second rolls whereby the pressure differential urges the third roller toward the nip of said first and second rolls with said first sealing roll to define a first sheet material passage, said third roller also defining with said second sealing roll a second sheet material passage for outgoing sheet material, means connected to said first sealing roll for rotating said first sealing roll to feed sheet material into said chamber toward said material guide means, means connected to said second sealing roll for separately rotating said second sealing roll in the same angular direction as the rotation of said first sealing roll and at the same peripheral speed to feed sheet material from said material guide means and out of said chamber, independent means on the chamber structure for loosely positioning the ends of the third

roller adjacent the respective ends of the first and second sealing rolls and effective for controlling the return of the respective end of the third roller after it has been moved away from a respective first or second roll by a greater thickness of material passing therebetween.

6. The combination of claim 5, in which a treating within the chamber is effective to cause change in the length of the material passing the same, and in which a second and conditioning device is present within the chamber and adjacent said opening for restoring the outgoing material to the same length per unit as the length dimension of said material during its movement into the chamber.

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