May 8, 1962 R. M. BRICK ETAL 3,032,890

SEALING STRUCTURES FOR TREATING CHAMBERS

Filed March 28, 1958 4 Sheets-Sheet 1

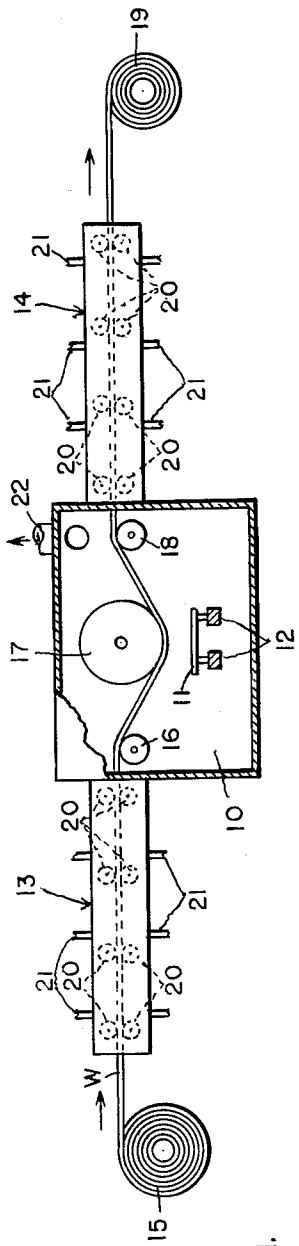


FIG. 1.

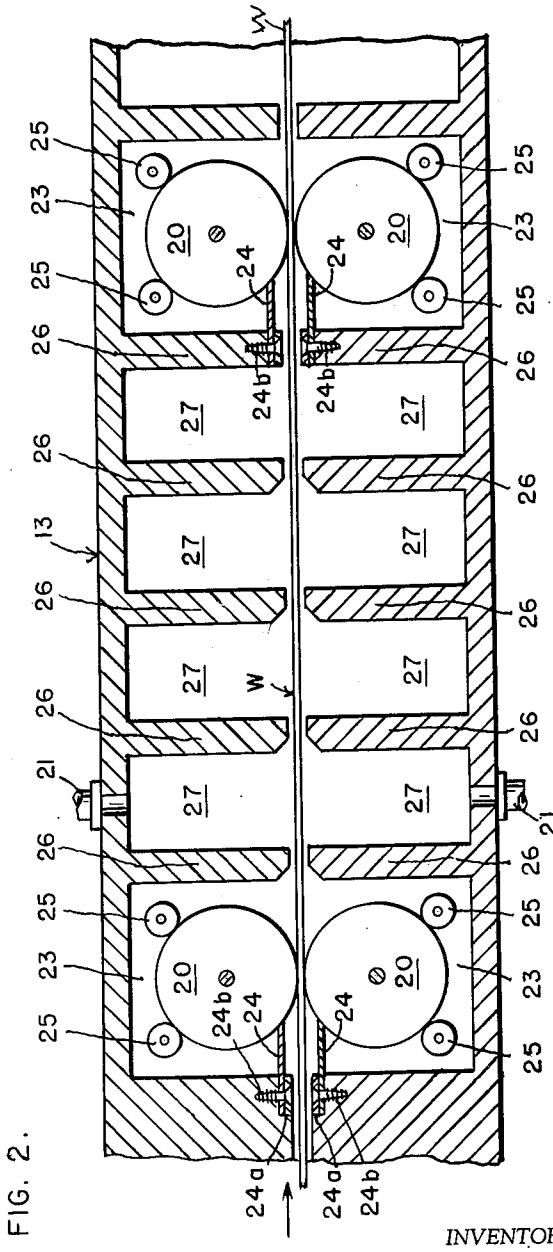


FIG. 2.

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Filed March 28, 1958 4 Sheets-Sheet 2

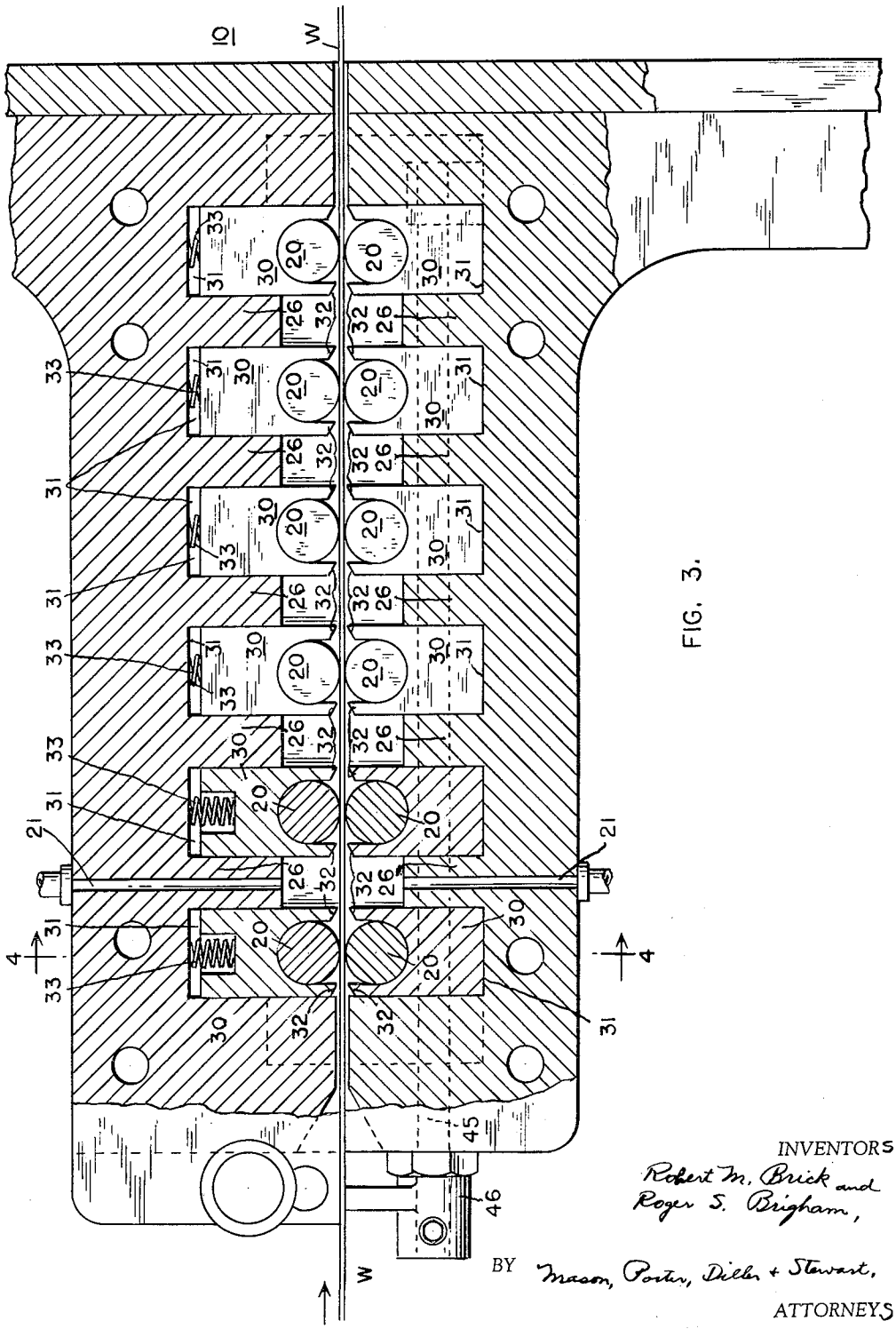


FIG. 3.

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May 8, 1962 R. M. BRICK ETAL 3,032,890

SEALING STRUCTURES FOR TREATING CHAMBERS

Filed March 28, 1958 4 Sheets-Sheet 3

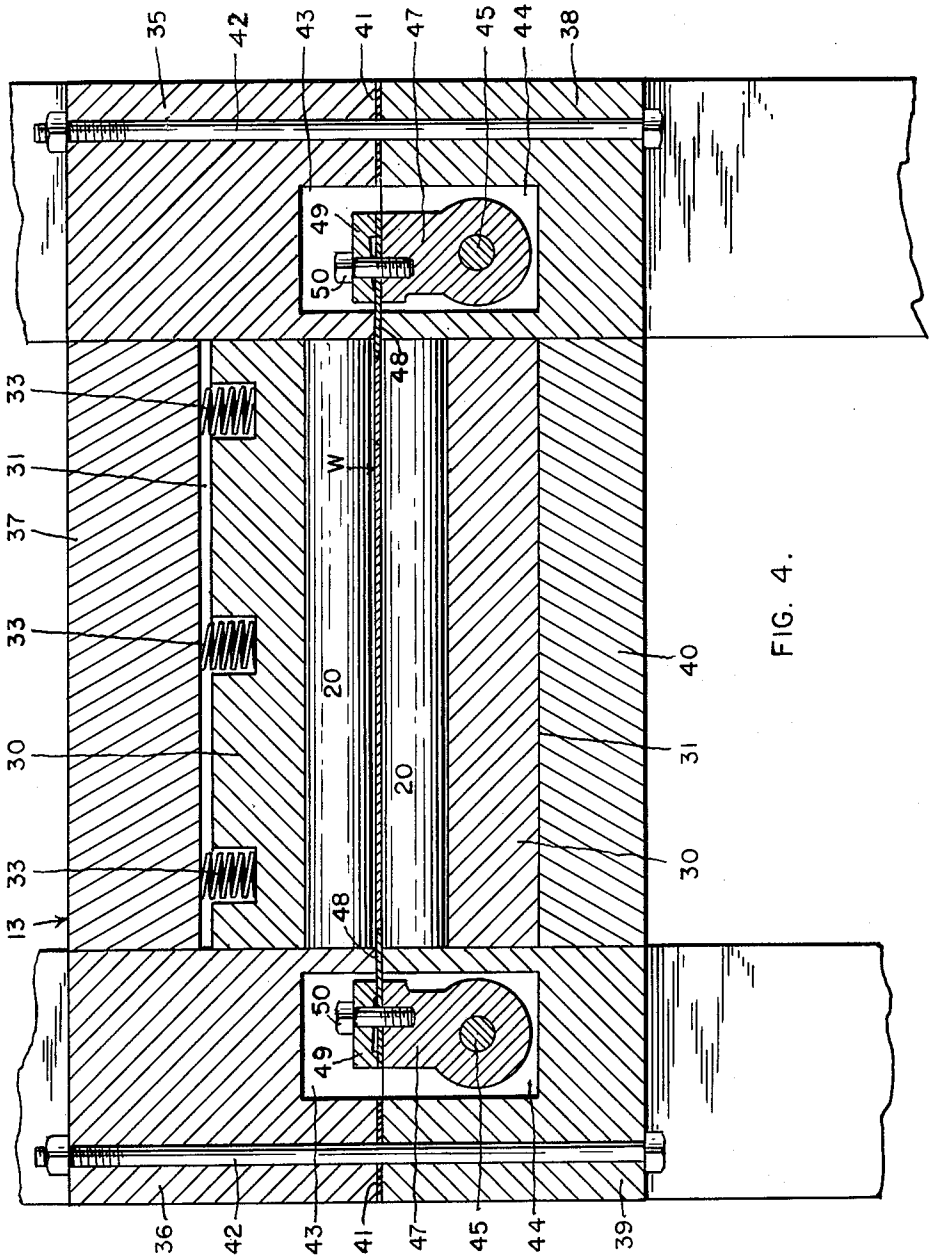


FIG. 4.

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SEALING STRUCTURES FOR TREATING CHAMBERS

Filed March 28, 1958 4 Sheets-Sheet 4

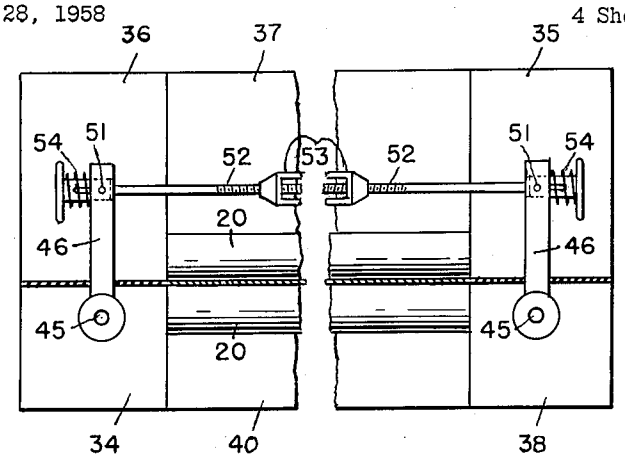


FIG. 5.

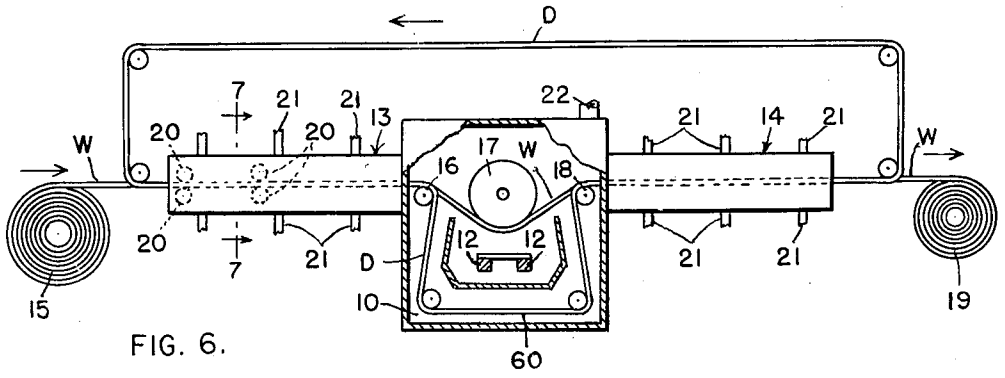


FIG. 6.

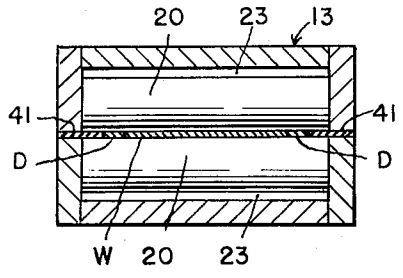


FIG. 7.

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United States Patent Office 3,032,890 Patented May 8, 1962

3,032,890

SEALING STRUCTURES FOR TREATING CHAMBERS

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Filed Mar. 28, 1958, Ser. No. 724,658
8 Claims. (Cl. 34—92)

This invention relates to sealing devices by which materials can be introduced to or removed from a treating chamber, with restriction of movement of atmospheric air toward the chamber or escape of the chamber gases therefrom.

Such devices find employment when strips or webs are to be fed from a work room to an evacuated chamber in which a deposition of aluminum or other vaporizable material is to be effected thereon, or when a vacuum heat treatment is to be performed upon such a sheet or web, or when a strip or web, e.g. of titanium, is to be subjected to a de-gassing treatment, or in other cases where the treating chamber must be closed off from the atmosphere but easy inlet or removal of a material permitted.

An object of the invention is an apparatus and method by which laminar flow through a restricted space adjacent the moving material is converted into a turbulent flow, wherewith the pressure differential along a given length of the material is increased and the leakage rate reduced.

Another object of the invention is the provision of a sealing device which has multiple rolls in contact with the strip or web during its movement, together with means for restricting the flow of gas or vapor from one roll to another.

Another object of the invention is the provision of a sealing device which has multiple pairs of rolls in contact with the strip or web during its movement, together with elements for restricting gas or vapor movement around the rolls whereby a succession of sealing stages are provided between successive pairs of rolls, and means for restricting the flow of gas or vapor from one pair of rolls to the next succeeding pair.

A further object is the provision of a sealing device comprising alternate restriction and expansion points along the direction of movement of the strip or web, with the provision of conduits for evacuating intermediate spaces between the entrance and the outlet ends.

A further object of the invention is the provision of a sealing device which has a passageway from the atmosphere to the treating chamber, with multiple pairs of rolls disposed across the passageway for contact with the strip or web as the latter moves toward or from the chamber, together with elements for restricting gas or vapor movement along the sheet or web from one pair of rolls to the next.

With these and other objects in view, as will appear in the course of the following description and claims, illustrative forms of practice of the invention are shown on the accompanying drawings, in which:

FIG. 1 is an elevation, with parts broken away, of a treating chamber having sealing devices according to this invention.

FIG. 2 is an upright longitudinal section of a part of a sealing device.

FIG. 3 is an upright longitudinal section of another form of sealing device.

FIG. 4 is an upright transverse section, substantially on line 4—4 of FIG. 3.

FIG. 5 is an end view of the structure of FIGS. 3 and 4, on a smaller scale.

FIG. 6 is a view corresponding to FIG. 1, and showing the employment of an endless filler or dummy strip.

FIG. 7 is a cross-sectional view substantially on line 7—7 of FIG. 6, on a larger scale.

In FIG. 1, a treating chamber 10 is illustratively shown as having vaporizer elements 11 which are heated through electrical resistance by current flowing in the bus bars 12 and serve to vaporize a deposition material, such as aluminum, so that the chamber is filled with the vapor. An inlet conduit 13 leads from the atmosphere to the chamber; and an outlet conduit 14 leads back to the atmosphere. A supply roll 15 delivers the web W, e.g. of metal, to the inlet conduit 13 through which the web moves to the treating chamber 10, where it is guided by roll 16, to the cooled coating roll 17, and thence the coated web is guided by roll 18 into the outlet conduit 14 and thus returns to the atmosphere and is collected on a take-up roll 19. The supply, treating and take-up structures have been conventionalized to show employment of the sealing conduits; these conduits can be alike in structure as each terminates respectively at the atmosphere and at the treating chamber, and can have multiple pairs of rollers 20 spaced therealong with four such pairs shown in each conduit. These pairs of rollers provide multiple stages or chambers between the atmosphere and the treating chamber 10; and in the illustrative employment in vacuum deposition these chambers are maintained at differing pressures, decreasing from the atmospheric end to the treating chamber end, by intermediate evacuation means illustrated as the suction conduits 21. In practice, the chambers in the sealing means are each divided into upper and lower group compartments by the web W, and hence individual conduits 21 are shown connected to these groups of compartments; noting, however, that it is preferred to have a spacing between the edge-sealing strips 40 described below, and the respective adjacent edges of the web W of the order of about one-eighth inch total for the two sides, to compensate for irregular tracking and prevent excessive edge contact and rubbing, wherewith these spacings permit balancing of the pressures above and below the web and thereby prevent distortions of the web material, and they also permit employment of a single evacuating connection to each group of chambers when the actual pressure differential is low. It has been found preferable to have the evacuation conduit 21 communicate with the expansion space, with a structure as in FIG. 2, at the first chamber adjacent a region of major pressure differential, since this is near the major source of air or gas leakage, e.g. with a seal for inlet to a vacuum chamber, the conduit 21 opens adjacent the entry rolls through which the web W moves from a region of higher pressure on the left to one of lower pressure on the right side. It is particularly preferable with vacuum chamber seals to have the conduit connection at the end of the sealing unit which is adjacent the higher pressure, as a greater effect in converting the air leakage from laminar to the slower turbulent flow occurs; noting also that the effectiveness of each successive expansion chamber is greater, in such conversion, at low pressures than at high pressures, wherewith the first expansion chamber is the best for intermediate evacuation. The chamber 10 has a like connection 22 by which it is held at the desired reduced pressure.

Two pairs of such rollers 20 are shown in FIG. 2. The conduit passageway is enlarged above and below the web W to provide transverse cavities 23 for receiving the rollers 20. The rollers 20 have smooth surfaces for contact with the web W, and are sealed at their peripheries by plates 24 of low friction material such as polymerized fluorocarbons, e.g. the commercially available Teflon material; these plates 24 being held in place by steel strips 24a with screws 24b passing through the respective strip and plate and into the seal structure housing, and extend-

ing chordally relative to the rollers and engaging the same along their lengths.

The ends of the rolls and the spaces between the rolls at the edges of the web may be sealed as shown in FIG. 4, or, as shown in FIGS. 6 and 7, the apparatus can be employed with strips of varying length by employing an endless filler or dummy strip D of slightly less thickness than the web W itself and of a width complementing the web so that together they substantially occupy the space between the side walls **38, 39**. This dummy strip can be led through the inlet seal and then across the treating chamber, preferably through a passage **60** where change of its character, e.g. by deposition thereon, is avoided, and then through the outlet seal where it performs a like function, and then returning externally to re-enter the inlet seal with another part of the web. In general, the spacing of the web from the side walls, or the total of the spacings of the web W and dummy strip D from the side walls and the spacing between the web and dummy strip can be between 0.010 to 0.050 inch without permitting leakage that cannot be compensated by pumps capable of commercially evacuating the chambers volume in reasonable times, without such leakage points. The rollers **20** in FIG. 2 are illustratively shown as supported against movement away from the web by the support rolls or wheels **25** which are journalled in the conduit structure. Between the cavities **23**, the conduit structure has pairs of walls **26** with their edges adjacent the path of the web and has a plurality of expansion pocket chambers **27** opposite the web and intervening between the wall positions **26**. In practice, the opposed edges of the pairs of walls **26** may be spaced about one inch, so that each edge acts in conjunction with the web where present, or in conjunction with the opposed wall where the web is not present, as a type of venturi, with the successive pairs of walls spaced by intermediate chambers into which the leakage gas, moving rapidly through the venturi points, can expand and hence lose its characteristic of laminar flow and assume one of turbulent flow. In operation, as the web moves in the direction of the arrow in FIG. 2, it is contacted by the first pair of rolls **20** which thus form a seal to prevent movement of gas or vapor from the spaces at the inlet side of the roller nip to the outlet side, and then passes along the conduit successively between the walls **26** and the pocket chambers **27** until it passes between the second pair of rolls where a similar contact seal is effected as at the first pair. Much of the gas or vapor leaking around the first pair of rolls is drawn off by the exhaust connection **21** at the first pocket chamber **27**. The gas flows rapidly through the restricted orifices between the first walls **26** and the web, and then enters the first pocket chamber where it expands and loses velocity; and then repeats this action for the other restricted orifices and pocket chambers in turn. This reduces the rate of flow and impedes the gas or vapor movement so that a pressure differential is established between the first cavities **23** and the exit cavities **23**; and assures attaining a much less entry of air, in the illustrated form, from atmosphere into the treating chamber and by employment of a limited number of exhaust connections.

The illustrative showing in FIG. 2 is of a stage in the inlet conduit, and similar arrangements may be employed for the outlet conduit, with the sealing plates **24** preferably positioned in each case so that the greater pressure effects are exerted on the sides thereof for pressing the plates toward the rollers **20**. The rollers **20** may be rotated by the engagement of the web W therewith when the web is advanced by driving the take-up roll **19**.

In the structure of FIG. 3, the web W passes between pairs of rollers **20** which contact therewith, and through spaces of restricted dimension bounded by the wall surfaces **26** of the passageway. The rollers **20** are received in closely fitting pockets in the blocks **30** which are movable, independently of one another, in the cavities **31** provided in the passageway enclosure. These blocks **30** can have the guide surfaces **32** which taper to narrow orifices at the approach to and departure from the rollers **20**. The blocks **30** are pressed by springs **33** in the direction toward the web W to assure maintenance of the seal thereaft.

The forms of FIGS. 2 and 3 can be constructed with the upper and lower rolls mounted in separable upper and lower parts of the passageway structure. Thus in FIG. 4, the upper structure can have the lateral longitudinal members **35, 36** and a central member **37**, the latter having the cavities **31** therein. The lower structure is likewise formed of the lateral members **38, 39** and the central member **40**, the latter having cavities **31**. The rollers **20** are shown as non-driven and as accurately fitting, at their ends, against the lateral members. When the upper structure and its rollers **20** are raised, threading of the web is simply the operation of bringing it into place over the lower rollers **20**, and threading through the treating chamber. When the rollers **20** and the upper structure is brought down upon the gaskets **41** and secured by the bolts **42**, the seal is ready to operate.

In the structure of FIG. 4, provision is shown for employment with webs or strips of different widths. The members **35, 36, 38, 39** have longitudinal chambers **43, 44** at each end of the rolls. Rock shafts **45** extend along these chambers and project to the exterior, and have crank arms **46** (FIG. 3). Within the device, the rock shafts **45** have projections **47**, which are at the height of the web W and support the flexible filler strips **48** having a thickness slightly less than the thickness of the web W. Plates **49** and screws **50** clamp the strips **48** so that they are moved as the rock shafts are turned and thus are adjusted so that the space between them is correlated to the width of the web W which is undergoing treatment. This adjustment can be accomplished from the exterior by moving the arms **46**, and is effective to reduce the leakage area which otherwise would be present at the edges of a web that is of lesser width than the spacing of the lateral members and the length of the rollers **20**. Thus in FIG. 5, the arms **46** are shown connected at pivots **51** by a link **52** having a turnbuckle **53** therein for adjustment of the normal spacing, and including springs **54** which permit the edge sealing strips **48** to conform to lateral travel of the web, e.g. due to camber therein, so that one strip moves with the edge of the web which is moving toward the adjacent end wall **38** or **39** and the other strip conversely moves from its adjacent end wall, so that the leakage factor remains substantially constant.

The blocks **30** can be made of polyfluoro carbon material, such as the commercially available Teflon plastic, or of other low friction material such as graphite. The strips **48** can be of hardened steel.

Performance of such seals, during employment, may be exemplified as follows:

EXAMPLE 1

A structure as in FIGS. 3 and 4 was employed with varying numbers of pairs of rolls. The spacing of the side walls **38, 39** and the lengths of the rollers **20** was six and one-eighth inches: the length from inlet to outlet was eight inches. A steel strip six inches wide and 0.009 inch thick was placed between the rolls, extending from end to end. The structure was connected at its outlet end to a chamber 36 inches in diameter by 24 inches long and providing a steadying tank, being evacuated by a single stage, duplex design, rotary piston, oil-sealed vacuum pump having a rated free air displacement of 218 cubic feet per minute and driven at a pumping speed of about 180 cubic feet per minute at pressures from atmospheric to about one millimeter, and an ultimate cut-off at 10 microns (a commercial pump known as Kinney KD–220 was used). The inlet end was open to the atmosphere. The edge guide seals **48** were 0.006 inch thick. The roll bearing

blocks **30** were of low-frictional material (commercial copper-impregnated Teflon was used). The number of pairs of rolls **20** was varied for tests 1–*a* to 1–*e* by successively removing the pairs of rolls at the right in FIG. 3, that is, adjacent the outlet: for test 1–*f*, the pairs of rolls at the entrance and outlet ends were present: for test 1–*g*, only a pair of rolls at the entrance end was present. The conduits **21** were closed, and not evacuated: that is, the system was operated as a simple seal between the atmosphere and the evacuated chamber. The results were:

Table I

Test No.	Number of rolls in seal	Chamber pressure, mm.
1-a	6	1.5
1-b	5 (in succession)	1.8
1-c	4 (in succession)	2.0
1-d	3 (in succession)	2.5
1-e	2 (in succession)	3.5
1-f	2 (at inlet and outlet)	2.5
1-g	1 (at inlet)	5.5

These data shows that multiple pairs of rolls are more effective than a single pair (Test 1–*g*); and that two pairs of rolls, at entrance and exit with a large expansion chamber between them (Test 1–*f*) is more effective than two pairs with a small chamber between them.

EXAMPLE 2

A structure as in FIGS. 3 and 4 was employed to determine the effects of edge sealing guides **48**. Six pairs of rolls were used as in Test 1–*a* above. The blocks **30** were of graphite-impregnated Teflon. Conditions otherwise were as in Example 1, except that the thickness of the hardened steel edge guides **48** and their spacing from the stock strip were varied. The results were:

Table II

Test No.	Edge seal guide	Chamber pressure, mm.
2-a	0.009 inch thick, against strip edges	0.5
2-b	0.006 inch thick, against strip edges	1.5
2-c	0.006 inch thick, 1/16 inch from strip edge	2.5
2-d	Edge guides removed	15.0

These data show that an edge seal guide of the same thickness as the strip stock gives the best sealing efficiency; and that thinner guides give satisfactory sealing effects without the mechanical difficulty of applying a braking effort against the rotation of rolls **20**. Test 2–*d* was performed without edge seals and without packing the space between the housing members **35, 38** and **36, 39**: and hence is high due to leakage via the rock shaft spaces **43, 44**.

EXAMPLE 3

A structure as in FIGS. 3 and 4 was employed to determine the effects of spacings between the stock strip and the edge seal guides **48**. Edge guides 0.008 inch thick were used, with conditions otherwise as in Example 2; but with variation of the width of the stock strip and therewith of the spacing of this strip from the edge guides, the strip being centered to provide two spacings of like width. The results were:

Table III

Test No.	Width of stock strip, in.	Width, each spacing, in.	Chamber pressure, mm.
3-a	6	None	1.8
3-b	5¾	1/8	2.6
3-c	5½	¼	3.4
3-d	5	½	6.1
3-e	4	1	9.2
3-f	3	1½	12.4
3-g	2	2	16.0

These data show that two leak paths, each 0.009 by 1/8 by 8 inches only slightly affect the vacuum; but when the width of each is increased to ½ inch, the loss in vacuum is too high for a system which must seal a chamber at about 4 millimeters pressure, against an atmospheric inlet. It may be commented that quasi linearity of the ratio of pressure to leak length is probably valid only over a limited range.

EXAMPLE 4

Two structures as in FIGS. 3 and 4 were employed in tandem; the first structure communicating with the atmosphere at its entrance end and with a first chamber 36 inches in diameter by 24 inches in length at its exit end; the second structure was connected at its entrance end to the first chamber and at its outlet end to a like second chamber. The first chamber was evacuated by a Kinney KD–220 pump as in Examples 1, 2 and 3: the second chamber was evacuated by a rotary lobe, positive displacement pump having a rated displacement of 1230 cubic feet per minute acting as a high vacuum booster with no sealant, driven for pumping 1000 cubic feet per minute at 500 to 10 microns pressure, and with an ultimate pressure cut-off at 0.1 micron (a commercial pump known as Kinney KMB–1200 was used). Mechanical conditions as in Test 1–*a*, with six pairs of rolls, were maintained for each structure except as noted below, and the chamber pressures were individually observed.

Table IV

Test No.	Condition	Pressure in first chamber, mm.	Pressure in second chamber, mm.
4-a	First chamber open to atmosphere, with only second sealing structure operative, no stock strip present.	760	0.450
4-b	Both pumps and structures operative, stock strip 6 inches wide by 0.009 inch thick extending through both sealing structures.	3.9	0.032
4-c	As in 4-b, but no stock strip in second structure.	4.3	0.034

These data show that multiple sealing structures, in tandem or cascade, are effective with the pumping equipment to produce vacua to the low pressures required for work such as metal vapor production and deposition. Comparison of Tests 4–*a* and 4–*b* shows that the leakage space through a seal of the present type is less important at the low pressures of 4 millimeters than at atmospheric pressure of about 760 millimeters: that is, the second and successive seals are more efficient than the one communicating with the atmosphere. This is further emphasized by comparison of Tests 4–*b* and 4–*c*, where the added presence of a leak equivalent to the strip stock, that is, 6 inches by 0.009 inch, caused increase of the pressure in the second chamber of only 0.002 millimeter or about 6 percent.

EXAMPLE 5

A structure as in FIGS. 3 and 4 was employed, for determining the effects of specific inlet flow volumes. A closing plate was clamped across the entrance end of the structure, with a hole provided with a valve and meter for regulating and indicating the flow or rate of admission of air from the atmosphere. Pressure meter readings were taken in front of the first pair of rolls, and at the space behind each pair of rolls, noting that the reading behind the sixth pair was taken at the outlet chamber. Otherwise, the conditions were as in Test 1–*a*. The

values are in liters per minute for flow; and in millimeters for pressures. The results were:

Table V

Test No.	Flow rate	Pressure at entrance	Pressures behind roll pairs					Chamber pressure
			1st	2nd	3rd	4th	5th	
5-a	None	0.125	0.110	0.105	0.100	0.89	0.65	0.017
5-b	0.1	14	13	12	11	9	8	1.021
5-c	0.2	40	30	28	23	19	17	0.034
5-d	0.4	56	51	46	39	32	29	0.06
5-e	0.8	102	92	83	72	57	54	0.10
5-f	1.6	174	158	144	124	99	92	0.21
5-g	2.6	258	236	215	185	148	138	0.35
5-h	3.6	341	311	283	245	193	184	0.5
5-i	(1)	760	664	592	490	393	351	1.8

[1] Plate removed.

These data show that each pair of rolls contributes to the sealing efficiency, but the major pressure drop is after the sixth or last pair.

EXAMPLE 6

A structure as in FIGS. 3 and 4 was employed, set up as in Example 5, except that all rolls were removed except the first and last pair (note Test No. 1–*f*), so that the arrangement resembled that of FIG. 2, with inlet and outlet pairs of rolls, with four expansion chambers between them. The results were:

Table VI

Test No.	Flow rate	Pressure at entrance, mm.	Pressure behind entrance rolls, mm.	Chamber pressure, mm.
6-a	None			0.013
6-b	0.1	10	7	0.022
6-c	0.2	20	14	0.038
6-d	0.4	30	23	0.064
6-e	0.8	60	45	0.11
6-f	1.6	103	77	0.22
6-g	2.6	154	116	0.38
6-h	3.6	201	153	0.51

These data may be compared with those in Table V. The lower pressures in Table VI, for the entrance position and behind the first pair of rolls, show that with the same rate of supply of air to the front of the seal, this air passes the first pair of rolls and is evacuated by the pump much faster than with four intervening pairs of rolls. However, the exit or chamber pressures in Tables V and VI are essentially the same, for a given rate of entrance flow, wherewith the four expansion spaces are as effective as four pairs of rolls at the same points, in limiting over-all flow or leakage through the seal.

EXAMPLE 7

A structure as in FIGS. 3 and 4 was employed, but with all rolls **20** and bearing blocks **30** removed and replaced by blocks at the positions of the first five roll pairs, these replacement blocks being spaced apart to provide slits 6⅛ inches wide by 0.015 inch clearance, with 1½ inch expansion spaces between successive slits. No stock strip was employed. The results were:

Table VII

Test No.	Flow rate	Pressure at entrance	Pressure behind slits				Chamber pressure, mm.
			1st	2nd	3rd	4th	
7-a	None						0.019
7-b	0.1	7	6	5	3	0.12	0.022
7-c	0.2	13	11	10	8	0.25	0.037
7-d	0.4	19	17	14	12	0.40	0.065
7-e	0.8	32	29	24	20	0.64	0.11
7-f	1.6	52	47	41	30	1.0	0.24

These data show that the leakage or flow rate through slits is faster than through pairs of rolls, comparing the lower entrance pressures of Table VII with the entrance pressures of Tables V and VI. The chamber pressures in Table VII are nearly the same as with the roll seals of Examples 5 and 6, indicating that the successions of restricted passageways alternating with expansion spaces are effective in limiting the over-all flow or leak rate. In practice, it may be noted, the pairs of rolls may be found desirable because of the smoother guiding of the stock strip or web and the avoidance of damage by rubbing against the edge of a slit.

EXAMPLE 8

A structure as in FIG. 2 was employed, with the entrance and exit pairs of rolls spaced about eight inches apart, with four intermediate expansion spaces or pocket chambers **27** separated by partition walls **26** providing slits. The rolls were 6⅛ inches long between closed side walls; no edge seal guides were present. A stock strip 6 inches wide by 0.009 inch thick was placed through the structure. A plate with a flow control and flow meter, as in Examples 5, 6 and 7, was placed across the entrance. The exit end was sealed to a chamber evacuated as in Example 1. The conduits **21** were sealed, so there was no intermediate evacuation. The rolls **20** were supported by needle bearings, and the leak paths past the bearings were closed by low-friction sealing plates (commercial Teflon material being used). The results were:

Table VIII

Test No.	Flow rate	Pressure at entrance, mm.	Pressure at second expansion space, mm.	Chamber pressure, mm.
8-a	None		0.068	0.015
8-b	1.8	84	55	0.2
8-c	3.1	108	75	0.3
8-d	5.1	189	153	0.5
8-e	7.4	253	210	0.7
8-f	9.7	324	270	1.0
8-g	13.5	446	378	1.5
8-h	15.7	726	720	1.9
8-i	17.5		725	2.1
8-j	24.1	749	740	2.9

These data show that the pair of rolls for the entrance seal is not very effective, in that the pressure drop is small. However, the intermediate spaces effectively limit over-all flow so that reasonable and satisfactory chamber vacuums are attained. The values indicate that the normal seal leakage, without the entrance closing plate, is about 17 to 24 liters per minute.

EXAMPLE 9

The structure of Example 8 was employed, and for some of the tests a small rotary, oil-sealed vacuum pump driven at a rating of only two cubic feet of atmospheric air per minute, with a pressure cut-off of 0.1 micron (a commercial Welch pump was used) was connected by conduit means **21** to the second intermediate expansion space **27**. The results were:

Table IX

Test No.	Flow rate	Pressure at 2nd expansion space, mm.		Chamber pressure, mm.	
		Welch pump working	No intermediate pumping	Welch pump working	No intermediate pumping
9-a	0.1	1.6	6.5	0.017	0.024
9-b	0.2	2.9	10.5	0.018	0.038
9-c	0.4	4.1	14	0.020	0.063
9-d	0.8	6.1	20	0.025	0.11
9-e	1.6	9.1		0.037	0.22
9-f	2.0	11		0.044	0.29
9-g	2.5	13		0.054	0.33
9-h	3.0	14		0.066	0.40
9-i	3.5	15		0.078	0.49

The data indicates that even the slight intermediate evacuation causes a six-fold reduction of the chamber pressure; and indicates the value of reinforcing conditions for producing turbulent in lieu of laminar flow, and that the intermediate spaces between restrictions become more effective in reducing leakage rates as the pressures are reduced.

The illustrative practices are not restrictive and the invention can be practiced in many ways within the scope of the appended claims.

What is claimed is:

1. A sealing structure for employment with a strip moving between the atmosphere and regions of different sub-atmospheric pressures, comprising a housing of two sections, each section having outer closing walls and transverse partitions spaced from one another in the direction of strip movement through the housing and forming a plurality of gas-expansion pockets, means for connecting the sections in externally sealed relation with each said partition of one section being alined in a pair with a said partition of the other section and presenting a slit therebetween whereby the strip passes through the successive slits during its movement between the connected sections of the housing, each section having a roll-supporting device at one end thereof adjacent the region of higher pressure, a roll mounted on the roll-supporting device thereof and located therein to engage and sealingly guide the strip in alinement with the slits during the movement of the strip, and an evacuation connection to the pocket adjacent the said roll and spaced by several said transverse partitions from the slit adjacent the housing and connected to the region of lower pressure.

2. A sealing structure for employment with a strip moving between regions of different pressures, comprising a housing having outer closing walls and a plurality of internal transverse partitions spaced in the direction of strip movement through the housing, each partition having a slit through which the strip can move, said partitions providing a series of gas-expansion pockets along the path of strip movement through the housing with portions of each pocket above and below the path, a pair of rolls mounted within the housing respectively above and below the path of the strip for guiding and sealing contact therewith, said rolls being located adjacent the high pressure region, means for evacuating the pocket adjacent the rolls, said housing also having an internal longitudinal wall located adjacent one end of the rollers and sealed thereto and having a longitudinal slit alined with the path of the strip, a strip-edge sealing plate in said longitudinal slit, and means for holding said sealing plate in position in the longitudinal slit and extending between the rollers for occupying space therebetween not occupied by the strip.

3. A sealing structure as in claim 2, in which an outer housing wall and the longitudinal wall provide a chamber extending along the housing, and in which the plate holding means includes a longitudinal shaft having a portion in said chamber, means for connecting the shaft and the plate whereby the plate is shifted parallel to the roller axes when the shaft is rocked, and means for rocking said shaft.

4. A sealing structure as in claim 2, in which the said holding means includes a resilient device for urging the edge of the sealing plate toward the edge of the strip.

5. A sealing structure for employment with a strip moving between the atmosphere and regions of different sub-atmospheric pressures, comprising a housing having outer closing walls and a plurality of internal transverse partitions spaced in the direction of strip movement through the housing and each partition having a slit through which the strip can move, said partitions providing a series of gas-expansion pockets along the path of strip movement through the housing, pairs of rollers at inlet and outlet of a web-wall series of pockets for guiding control at both ends and mounted within the housing respectively above and below the path of the strip and in sealing contact therewith, means for evacuating the pocket adjacent the rolls located at the higher pressure end of said housing, and longitudinal internal walls in the housing in sealing engagement with the ends of the rolls.

6. A sealing structure for employment with any of a plurality of strips of different widths moving between regions at different pressures, comprising a housing having outer closing walls, and a plurality of internal transverse partitions spaced in the direction of strip movement through the housing, each partition having a slit through which the strip can move, said partitions providing a series of gas-expansion pockets along the path of strip movement from the inlet to the outlet of the housing, a pair of rolls mounted within the housing respectively above and below the path of the strip for guiding and sealing contact therewith, said rolls being located adjacent the region of higher pressure, an evacuation conduit connected to the pocket adjacent the rolls, and sealing means of substantially the thickness of the strip and having portions located between the rolls and in the partition slits for complementing the width of the passing strip and occupying space between the rolls and in the slits not occupied by the strip.

7. A sealing structure as in claim 6 in which the region at low pressure is a chamber and sealing means includes an endless packing band mounted to move through the housing parallel to and alongside the strip for complementing the width of the strip relative to the length of the rollers and devices external to the chamber and housing for guiding the band from the outlet to the inlet housing.

8. A sealing structure as in claim 7, including devices within the chamber for guiding the band away from the strip while the strip is being treated in the chamber, and effective for guiding the band and strip from the chamber into the housing.

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