June 27, 1961 W. A. MARSHALL 2,989,966

SHAFT SEAL

Filed Feb. 21, 1957

FIG. 1.

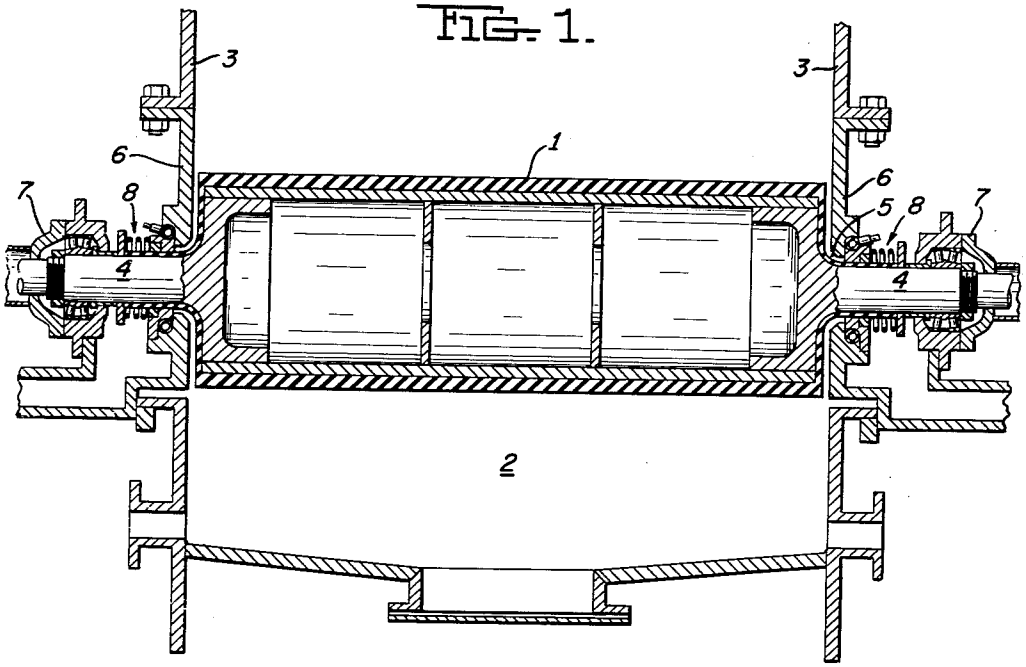
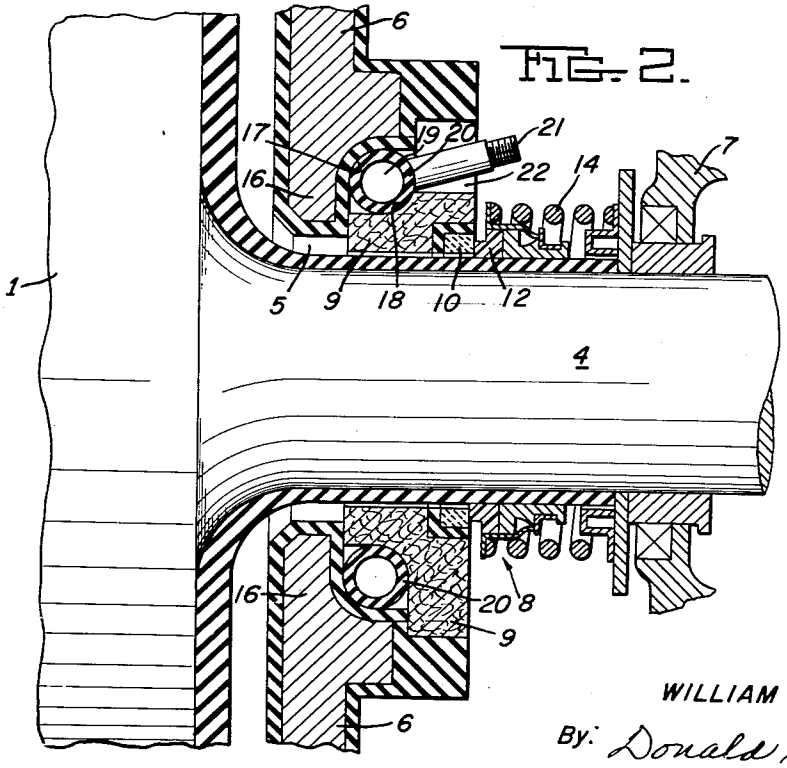


FIG. 2.



INVENTOR
WILLIAM A. MARSHALL,
By: Donald G. Dalton
his Attorney.

United States Patent Office 2,989,966 Patented June 27, 1961

2,989,966

SHAFT SEAL

William A. Marshall, Walnut Creek, Calif., assignor to United States Steel Corporation, a corporation of New Jersey

Filed Feb. 21, 1957, Ser. No. 641,589
6 Claims. (Cl. 134—122)

This invention relates to shaft seals and more particularly to fluid seals for stub shafts at the ends of conveyor sink rolls.

In metal strip conveyors which include sink rolls for moving strip continuously through a liquid bath, the problem of obtaining an effective liquid seal about the roll necks or stub shafts at the ends of the sink rolls has proved particularly troublesome in practice. The liquid bath in pickling, washing, and electrolytic coating operations, for example, is contained in tanks which have spaced and parallel side walls extending along the edges of the path of strip movement. The conveyors have upper and lower sets of conveyor rolls extending transversely of the tank side walls and over which the strip is trained in vertically extending loops, the rolls in the lower set being designated "sink rolls" and being immersed in the liquid. Annular end bells mounted in the sides of the tank provide for removal and replacement of the sink rolls and define openings through which the stub shafts at opposite ends of the sink rolls project for engagement in bearing supports and with driving connections therefor. To prevent leakage of liquid through the openings centrally of the end bells, fluid seals must be provided about the sink roll stub shafts.

The bearing supports and driving connections for the sink rolls are located on opposite sides of the tank in which such rolls are positioned and have engagement with the stub shafts projecting through the central openings in the tank end bells. By reason of this arrangement, the sink roll stub shafts seldom occupy positions exactly concentric with respect to the end bell or tank openings through which they extend. In addition, it provides for independent movement of the sink rolls and tank sidewalls relative to each other. This relative movement and eccentric location of the sink rolls with respect to the end bell openings renders it difficult to obtain satisfactory seals about the internal surface of the end bell openings. Irregularities in and surface pitting of the end bells about the central openings causes further difficulty in obtaining a satisfactory seal.

One of the principal objects of this invention is to provide a liquid seal for the stub shafts of strip conveyor sink rolls in tank sidewalls which will compensate for relative movement and eccentric location of the stub shafts with respect to the tank wall openings through which they project. Another object of the invention is to provide a liquid seal which will not be affected by pitting or other irregularities in the tank wall surface defining the openings through which the stub shafts project. To the accomplishment of these and related ends, this invention further contemplates a pneumatic seal for a sink roll stub shaft in a tank opening. More specifically, there is provided in accordance with the principles of this invention a fluid seal which comprises a rubber tube arranged between facing annular surfaces respectively about an end bell opening in a tank wall and about a sealing ring on a sink roll stub shaft which is pneumatically inflated to a condition in which it is compressed between and has sealing engagement with such annular surfaces.

Other objects and advantages of the invention will become apparent from the following description.

In the drawings, there is shown a preferred embodiment of the invention. In this showing:

FIGURE 1 is a vertical sectional view taken longitudinally of a strip conveyor sink roll and transversely of a liquid tank in which it is mounted; and

FIGURE 2 is an enlarged view of a portion of the structure shown in FIGURE 1 which illustrates in detail the seal of this invention.

FIGURE 1 of the drawings shows a conventional arrangement of a single sink roll **1** forming part of a conveyor for moving metal strip through liquid contained in a tank **2**. The sink roll **1** is one of several similar rolls in the lower set of a strip conveyor over which the strip is trained in vertically extending loops for movement through the tank **2** in a direction parallel to its sides **3**. Stub shafts **4** at opposite ends of the roll **1** project axially through openings **5** defined by flanges at the inner edges of annular end bells **6**. The end bells **6** are removably secured in the tank sides **3** and provide for removal and replacement of the roll **1** in an endwise direction. The shafts **4** are supported for rotation in bearings **7** arranged outwardly of the tank sides **3**.

The tank **2** may, for example, be either a plating tank containing an electrolytic plating fluid or a pickling tank containing acid pickle liquor. To provide protection against the corrosive action of liquid in the tank **2**, the roll **1** is provided with a protective covering of rubber as shown in the drawings and all internal surfaces in the tank **2** are provided with a similar protective rubber covering (not shown). Liquid seals, designated as a whole by the numeral **8**, are provided for preventing leakage of liquid through the openings **5** about the external surfaces of the shafts **4**.

As indicated above, this invention is directed to improvements in the seal **8**. As best shown in FIGURE 2, the seal **8** comprises a stationary ring **9** fabricated of suitable packing material which is arranged concentrically about the stub shaft **4** and has a concentric ceramic ring insert **10** at one end thereof. A carbon ring **12** has sealing engagement with the external surface of the stub shaft **4** for preventing leakage of fluid in an axially outward direction and is provided with a spring assembly **14** for biasing its movement axially to a position in fluid sealing engagement with the ring **10**. The specific arrangement of the parts **9**, **10**, **12** and **14** thus far described and the fluid seal provided by the carbon ring **12** are conventional and form no part per se of this invention.

In accordance with the principles of this invention, the inner portion on flange **16** of the end bell **6** is provided with an annular surface **17** which has a concave contour in a direction axially of the shaft **4** and opening **5**. By reason of its concave contour, the surface **17** faces radially inwardly and axially outwardly with respect to the opening **5**. The inner end of the ring **9** is recessed to provide an annular surface **18** which faces toward the annular surface **17**. The annular surface **18** has a concave contour in a direction axially of the shaft **4** such that it faces radially outwardly and axially inwardly with respect to the opening **5**. The surfaces **17** and **18** are complementary and cooperate to define an annular chamber **19** in which pneumatically inflatable rubber tube **20** is received. By reason of the opposite concave contours of the surfaces **17** and **18**, the chamber **19** has a circular shape in a direction axially of the shaft **4**. After the tube **20** is arranged in the space **19** as shown in FIGURE 2, it is inflated through a valve stem **21** which projects outwardly through a slot **22** in the outer edge of the ring **9** to force it into tight sealing engagement with the surfaces **17** and **18**. The engagement of the rubber tube **20** with the surfaces **17** and **18** provides a seal which prevents leakage of liquid through the opening **5** over the interal edge of the end bell **6** and over the external surface of the sealing ring **9**. Attention is particularly directed to the fact that

pneumatic expansion of the rubber tube **20** upon inflation will compensate for any pitting or other irregularity in the surface **17**. In addition, it compensates for eccentric locations of the shaft **4** with respect to the opening **5** as well as for relative movement between the shaft **4** and end bell **6**.

While one embodiment of my invention has been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. The combination with an annular flange defining an opening and a rotatable shaft extending through said opening, of a fluid seal comprising a stationary ring having means on its internal periphery in bearing and fluid sealing engagement with said shaft, said flange and said ring respectively having facing annular surfaces defining an annular space therebetween, and a pneumatically inflated rubber tube in said space and in fluid sealing engagement with each of said ring and flange annular surfaces.

2. A fluid seal for shafts as defined in claim 1 characterized by said ring and flange annular surfaces being complementary and cooperating to define an annular compartment in which said tube is recevied.

3. A fluid seal for shafts as defined in claim 2 characterized further by said ring and flange annular surfaces respectively having a concave contour in a direction extending axially of said shaft.

4. In continuous strip processing apparatus including a tank for liquid and conveyor means for moving the strip through the liquid in said tank, the combination with a pair of annular end bells mounted in opposite sides of said tank in positions with their inner edges respectively defining axially aligned openings, and a sink roll forming part of said conveyor means and having stub shafts at opposite ends thereof projecting through said openings, of fluid seals for said shafts in said bell openings respectively comprising a stationary ring having means on its internal periphery in fluid sealing engagement with one of said shafts, said ring and the inner

edge of one of said end bells respectively having facing annular concave surfaces defining an annular compartment therebetween, and a pneumatically inflated rubber tube in said compartment with its external surface forced by pneumatic pressure into fluid sealing engagement with each of said annular surfaces.

5. The combination with an annular flange defining an opening and a shaft extending through said opening, of a fluid seal comprising a stationary ring arranged concentrically with respect to said shaft and said opening, means providing a seal against leakage fluid through said opening about the outer periphery of said ring comprising a pneumatically inflated tube between said ring and flange and in fluid sealing engagement therewith, and means cooperating with said ring to provide a fluid seal against leakage of fluid through said opening about the inner periphery of said ring.

6. In a container for liquids having a side-wall with an opening therein and a rotatable shaft extending through said opening, an assembly sealing said opening against leakage of fluid through the space about said shaft comprising a stationary ring arranged concentrically with respect to said shaft and said opening, a sealing ring having liquid sealing engagement with said shaft, said stationary and sealing rings having axially facing end surfaces in liquid sealing engagement with each other to prevent leakage of fluid through said opening about the inner periphery of said stationary ring, and a pneumatic inflated tube in fluid sealing engagement with said stationary ring and the portion of said container sidewall about said opening to prevent leakage of fluid through said opening about the outer periphery of said stationary ring.

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