United States Patent

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[54] **HYDRODYNAMIC TURNOVER MECHANISMS**
8 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **226/97,** 226/197
[51] **Int. Cl.** **B65h 17/32**
[50] **Field of Search** 226/97, 7, 197

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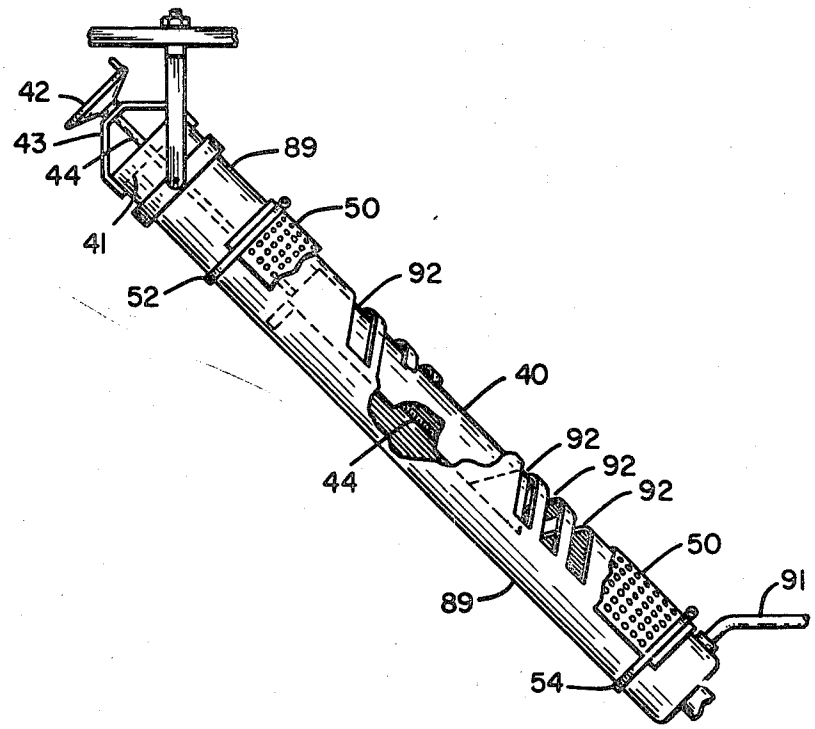
ABSTRACT: A member for hydrodynamically supporting and changing the orientation of a continuously moving flexible sheet of material. The material floats on a cushion of air forced out of slots in the member which member is covered with a plastic coated diffusing screen. Inside the member a movable sleeve controls how many slots are open to the passage of air.



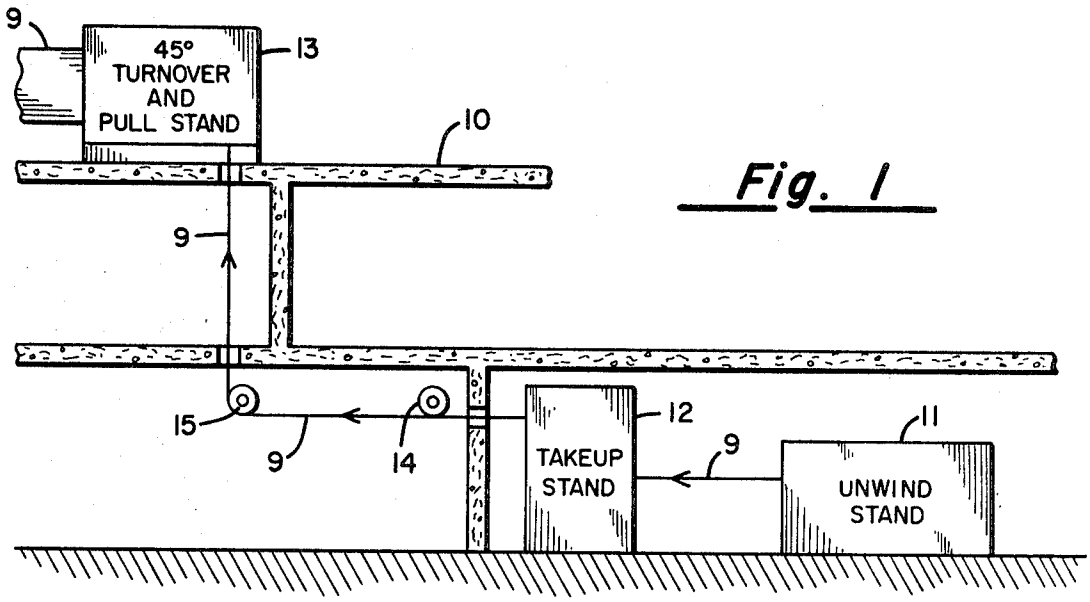


Fig. 1

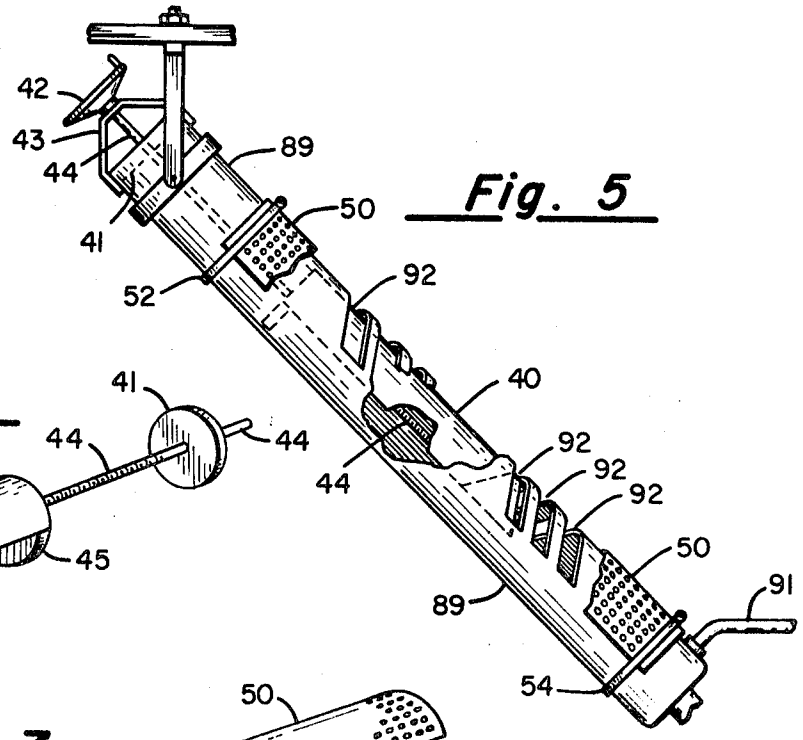


Fig. 5

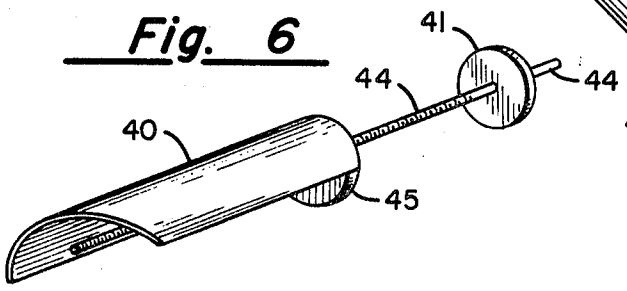


Fig. 6

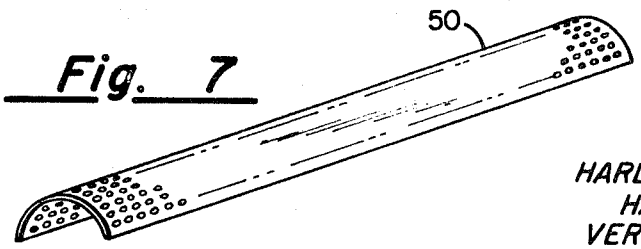


Fig. 7

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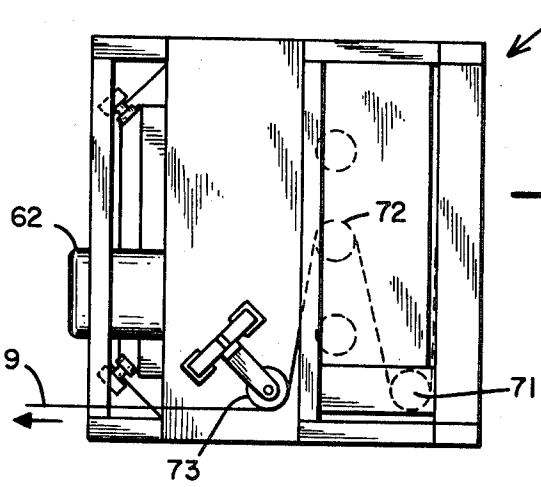


Fig. 3

Fig. 2

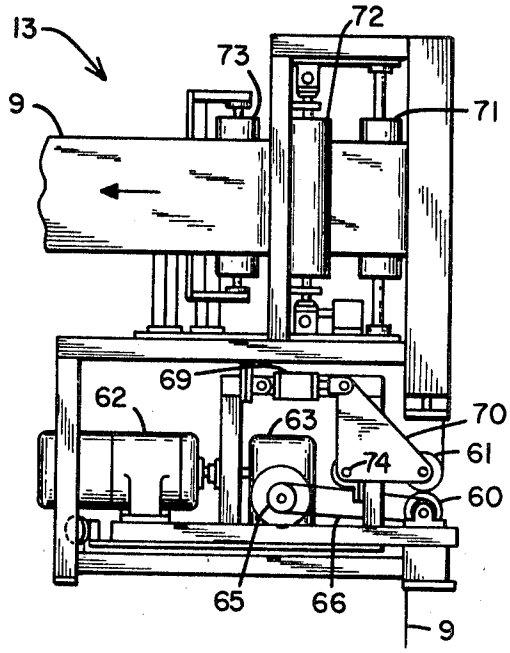
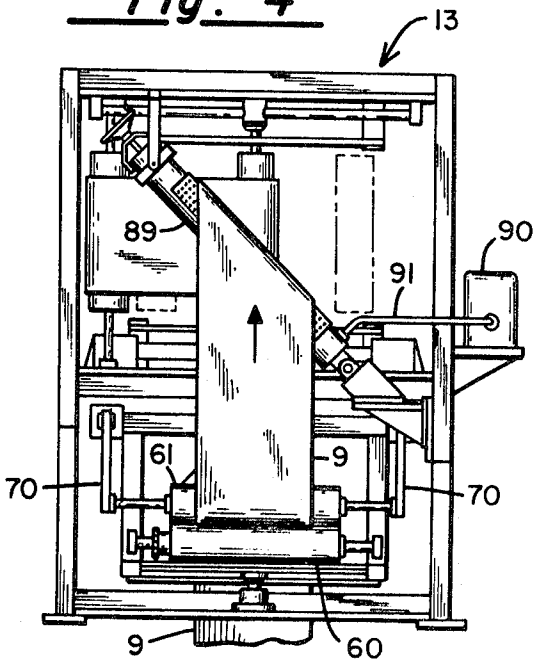


Fig. 4



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HYDRODYNAMIC TURNOVER MECHANISMS

BACKGROUND OF THE INVENTION

This application is a continuation in part of copending application Ser. No. 771,200 filed Oct. 28, 1968 now abandoned. The invention relates generally to sheet material handling equipment and, more specifically, to handling equipment for changing the orientation of a continuously moving flexible metal sheet which is to be etched.

In the manufacture of precision etched parts a continuous sheet of material is unwound from a roll and passed through a number of processing stations either on edge or flat. A number of vertical or horizontal orientated rollers pressure engage the metal web and maintain it in either a vertical orientation (on edge) or a horizontal orientation (flat) as the metal web passes through these processing stations. Obviously, a metal web moving a horizontal plane can be made to move in a vertical plane by passing the web under a horizontal roller and then guiding the web upward in a vertical direction. Movement of the web upwards in a vertical direction is not desirable as the processing stations would have to be arranged in a vertical manner. Instead, the preferred vertical orientation of the metal web is when the metal web travels laterally or in a line parallel to the horizontal. However, a metal web moving in a horizontal plane cannot be readily turned to move in a line parallel to the horizontal without twisting the metal web. To distinguish between these two vertical orientations of the metal web, hereinafter the orientation in which the web travels in a vertical plane upward will be referred to as vertical end orientation and the orientation in which the metal web moves in a vertical plane along a line parallel to the horizontal will be referred to as a vertical edge orientation. Normally, the metal web is maintained in either a horizontal or vertical edge orientation because of the difficulty involved in changing the orientation of continuously moving metal web. However, this is not the ideal situation because during certain process steps it is desirable to maintain the metal web in vertical edge orientation and in other process steps it is desirable to maintain the metal web in a horizontal orientation.

Generally, this metal web comes in huge rolls that are unwound as the web is fed into the processing stations. It is preferable to maintain the roll of metal web in a horizontal orientation during unwinding of the roll as it tends to become loosely wound if maintained in a vertical edge orientation. Also it is preferable to convey the metal web horizontally because it is difficult to maintain the metal in a vertical edge orientation without a number of supporting and compensating rollers to prevent the metal from sagging and slipping on the rollers under its own weight. If the metal sags in a vertical edge orientation, it causes the metal web to unwind unevenly. Also the downward slippage of the metal web along the vertical orientated roller must be compensated for. If the metal web is maintained in a horizontal orientation the sagging of the metal web does not have an effect on the unwinding of the roll as the weight of the metal web pulls evenly on the roll as it unwinds. Also, the downward slippage of the metal web is eliminated if the rollers are in a horizontal orientation. Thus, it is preferable to unwind and transport the metal web in a horizontal orientation to the processing stations.

As the continuous metal web passes through certain processing stations it is preferable to maintain the metal web in a vertical edge orientation. For example, it is easier to apply a uniform coat of enamel to the metal web if the metal web is in a vertical edge orientation.

In order to achieve the objective of transporting a metal web in one orientation and processing it in another orientation, it is necessary to have some type of a turning mechanism for changing the orientation of the metal web.

A prior art method of changing a continuously moving sheet of material from a horizontal orientation to a vertical edge orientation or vice versa involved placing an elongated roller

having its central axis at 45° angle to the horizontal. The continuously moving material passed through a pair of horizontally orientated rollers over the elongated roller located at a 45° angle to the horizontal and then through a pair of vertically orientated rollers or vice versa. The purpose of the elongated roller is to change the orientation of the metal web from a vertical end orientation to a vertical edge orientation or vice versa. This type of changeover or turnover roller works particularly well for a wide variety of applications. However, in the process that is used for precision etched sheets, this type of turnover roller is unsuitable for the reason that while the surface of the turnover roller rotates about the axis of the roller, the metal web moves at a 45° angle to the axis of the roller as it moves from vertical end orientation to a vertical edge orientation. Thus, there is slippage between the surface of the turnover roller and the metal web. In many applications, surface scratches cannot be tolerated, especially in the production of precision etched parts. In order to eliminate this scratching of the surface of the metal web it is necessary to either process the metal web continuously horizontally or continuously vertically.

BRIEF SUMMARY OF THE INVENTION

The present invention overcomes the problem of slippage between the surface of the turnover roller and the metal web, which produces these undesirable scratches, by hydrodynamically supporting the metal web as it passes over a nonrotative guide member. More specifically, there is provided a nonrotating cylindrical guide member having a plurality of slots for supplying air under pressure to the area under the metal web thereby forming a layer of air for hydrodynamically suspending the metal web as it passes over the cylindrical member. Besides being nearly frictionless, the turning guide prevents the metal web from contacting it and therefore protects the surface of the metal web from being marred by rubbing or scratching.

Additionally the present invention comprises a movable valve sleeve member inside the turning guide for changing the number of apertures available to pass air so as to adjust to different sizes of moving metal web. The guide member is also covered with a plastic covered screen so as to diffuse the passage of air from the apertures while supporting with a very slippery surface any parts of the web which are not completely supported by the air pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram in schematic form illustrating part of the system for handling a metal webbing utilizing the present invention;

FIG. 2 is a side view of the equipment identified as a turnover and pull stand in FIG. 1;

FIG. 3 is a top view of the equipment identified as a turnover and pull stand in FIG. 1;

FIG. 4 is a front view of the equipment identified as a turnover and pull stand in FIG. 1;

FIG. 5 is a partially fragmentary view of the hydrodynamic turnover and guide member of the present invention;

FIG. 6 is a perspective view of the valve sleeve; and

FIG. 7 is a perspective view of the plastic covered diffuser screen.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, reference numeral **10** generally designates a structure for storing and processing a continuous roll of metal web. Located within structure **10** are an unwind station **11**, a takeup stand **12** and a turnover and pull stand **12**. Normally, a metal web **9** is taken from a roll in unwind station **11** and passed through a takeup stand **12** to turnover and pull stand **12**. Typically, a takeup stand comprises two sets of rollers that can be brought together to speed the metal web as it leaves the stand or can be moved apart to slow or stop the metal web as it leaves the takeup stand. The purpose of the

takeup stand 12 is to take up and store metal web and then slowly release it while an operator welds the end of one metal web to another. In this manner, a continuous metal web passes through the process stations without having to stop the processing stations while two metal webs are welded together. Takeup stands are well known in the art and do not comprise a part of the present invention.

Metal web 9 passes from unwind station 11 through takeup stand 12 over a guide roller 14 and a guide roller 15. Therefrom, metal web 9 passes upward until it enters turnover and pull stand 13. In a typical setup, turnover and pull stand 13 and unwind stand 11 would be remote from each other. The unwind stand can be located in a dock area or some storage place where the huge rolls of metal web can be unloaded from trucks or other transportation vehicles while the turnover and pull stands would be located next to the processing stations.

Referring to FIGS. 2, 3, and 4 our turnover and pull stand 13 is shown in greater detail from a side view, a top view and a front view respectively. Like parts in different views bear identical reference numerals. Typically, metal web 9 passes between a first power-driven rubber roller 60 and a second rubber roller 61. Rubber rollers 60 and 61 are maintained in pressure contact so that the power driven roller 60 pulls metal web 9 between rollers 60 and 61. A motor 62 drives roller 60 through a speed reducing mechanism 63, a suitable gear 65, and a chain drive 66. To ensure that roller 60 and roller 61 are in pressure contact so metal web 9 will not slip between rollers 60 and 61, there is provided a tension mechanism. The tension mechanism comprises a pair of triangular shaped pivot plates 70 that have one corner pivotally mounted to stand 12 on a pivot rod 74, one corner supporting roller 61, and the third corner attached to a hydraulically actuated cylinder 69. With this arrangement an operator can adjust the pressure between roller 60 and roller 61 by applying a signal to hydraulically actuated piston 69. This pivots plate 70 causing roller 61 to exert a downward force against roller 60 and metal web 9.

Web 9 feeds from between rollers 60 and 61 onto a hydrodynamic turnover member 89. From hydrodynamic turnover member 89, metal web 9 passes over a vertical roller 71, a movably mounted vertical takeup roller 72 and a vertical roller 73. From roller 73 metal web 9 is fed into the processing stations.

Referring now to FIG. 5, the hydrodynamic turnover member 89 is shown in greater detail partially cut away for explanatory purposes. Turnover member 89 comprises a cylindrical tube having a plurality of angled slots or apertures 92 located therein. A pressure source 90 supplies air to the inside of tube 89 through a pipe 91. In operation, air is continuously supplied to tube 89 wherefrom it exhausts through slots 92. This allows air to flow between the surface of turnover member 89 and metal web 9. Although slots are provided for supplying air to hydrodynamically supported metal web 9 it is envisioned that these supply ducts could also be formed with sintered metal. As the air exhausts through the slots, it forces metal web 9 away from the turnover member 89 thus providing an air cushion hydrodynamic support for metal web 9. Thus, metal web 9 passes freely over turnover member 89 with hardly any surface to surface contact between turnover member 89 and metal web 9 which would mar the surface of metal web 9. Typical supply pressures range from 5 to 10 p.s.i. Slots 92 are inclined with respect to member 89 so as to run generally parallel to the direction of travel of web 9. The size, shape, and number of slots 92 are such as to supply a large quantity of air to web 9 and any other configuration of apertures that perform this function could be substituted for the arrangement shown without departing from the spirit and scope of the invention.

In order to spread and diffuse the air rushing out of slots 92 a plastic coated diffuser screen 50 is fastened to member 89 over slots 92. A pair of bands 52 and 54 are used to secure diffuser screen 50 to member 89. Screen 50 is formed with a great number of apertures therein so as to spread the air over a larger, more even area. In the preferred embodiment screen 50 has been designed to have about 44 percent of its area as open space. Since screen 50 is shown in fragments in FIG. 5 it is shown again in FIG. 7 in a complete state so as to be more easily understood.

Screen 50 is plastic coated on the outside to provide a nearly friction free surface to any portions of web 9 which may be temporarily unsupported by the air pressure. In the preferred embodiment a number of plastics were found suitable especially those fluorinated plastics known by the trade name Teflon. Screen 50 is additionally advantageous in that it is movable and replaceable thus affording easy access to the inside of tube member 89 through the large slots. Thus, cleaning and maintenance are easier. Furthermore if somehow the bearing surface does become marred or scratched only the small screen 50 need be replaced as opposed to the prior art systems wherein the whole turnover member had to be replaced.

Disposed inside tube 89 is a sleeve valve 40 shown most clearly in FIG. 6. Sleeve valve 40 is movable along the length of tube 89 so as to cover or uncover the correct number of slots or portions of slots so as to supply air to any width of web 9 which is being processed. The prior art schemes were confined to one width of material in this respect. With a fixed number of holes there is not enough air to support a wider web whereas if a smaller web is processed too much air escapes around the edges of the narrow web to maintain support pressure. Sleeve valve 40, however, may be adjusted to open just the right number of holes to support any width web. To move sleeve 40 a handle 42 connected to a rod 44 is turned. Rod 44 passes through a bracket 43 on tube 89 and a seal 41 in the end of tube 89. The lower portion of rod 44 is threaded so as to engage a sleeve guide 45 connected to sleeve 40. As handle 42 is turned sleeve 40 moves along threaded rod 44 to the desired position. The pressure inside tube 89 serves to keep sleeve 40 tightly against the inside of tube 89 so as to seal slots 92.

We claim:

1. Apparatus for changing the direction of motion of a continuously moving web material without marring the surface of the web material comprising:

a support stand;

a fluid pressure containing turnover member mounted on said support stand for receiving and discharging a continuously moving web material, said turnover member having a central axis defining a first line, the direction of motion of the incoming web material defining a second line located substantially at a 45° angle to said first line and the direction of motion of the discharging web material defining a third line located substantially at an angle to said first line, said turnover member having openings therein so as to hydrodynamically support the moving web material on said member so as to prevent marring of the surface of the web material and said member; and

a movable valve member in said turnover member operable to block a variable number of openings to accommodate different widths of web material.

2. The invention as described in claim 1 wherein the angle of said third line is substantially 45° to said first line.

3. The invention as described in claim 1 wherein said stand includes a pair of pressure engaging rollers, at least one of which is power driven for pulling said web material into said stand.

4. The invention as described in claim 3 including a vertically orientated roller for receiving said web material as it discharges over said member.

5. The invention as described in claim 1 wherein said openings comprise slots for discharging air under pressure so as to hydrodynamically support said web material.

6. The invention as described in claim 5 including a diffuser screen mounted between said slots and said web material.

7. The apparatus of claim 5 in which said valve member comprises a sleeve inside said turnover member adapted to slidably block at least some of the slots in said turnover member.

8. The apparatus of claim 7 wherein said diffuser screen has a plastic bearing surface.