March 21, 1961 H. J. SEEL ET AL 2,976,037

SHEET HANDLING SUCKER

Filed July 23, 1958 2 Sheets-Sheet 1

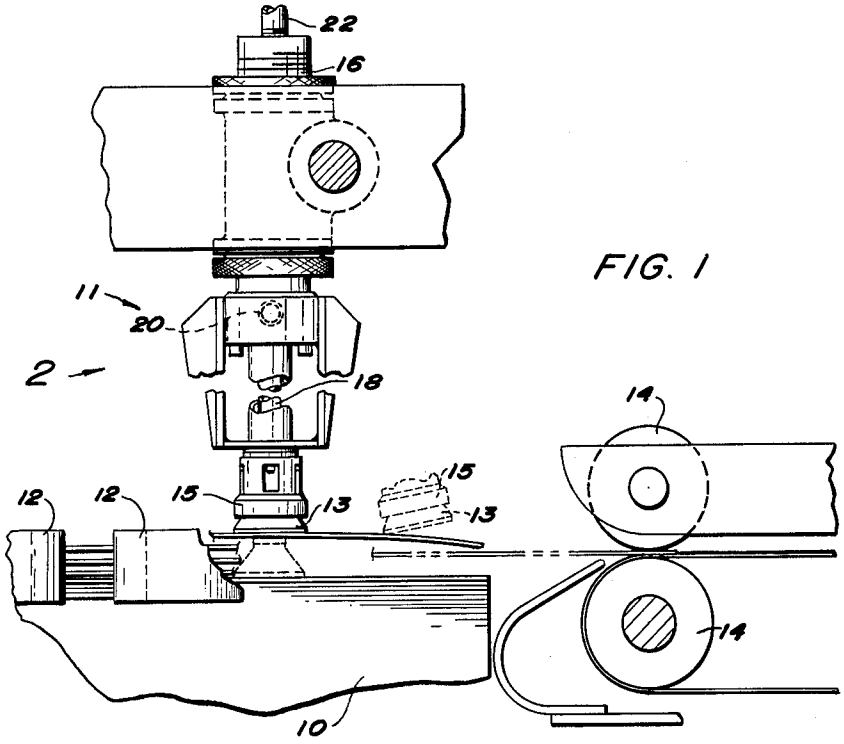



FIG. 1

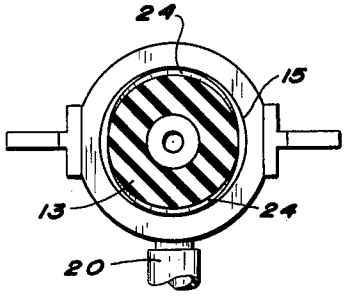



FIG. 4

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SHEET HANDLING SUCKER

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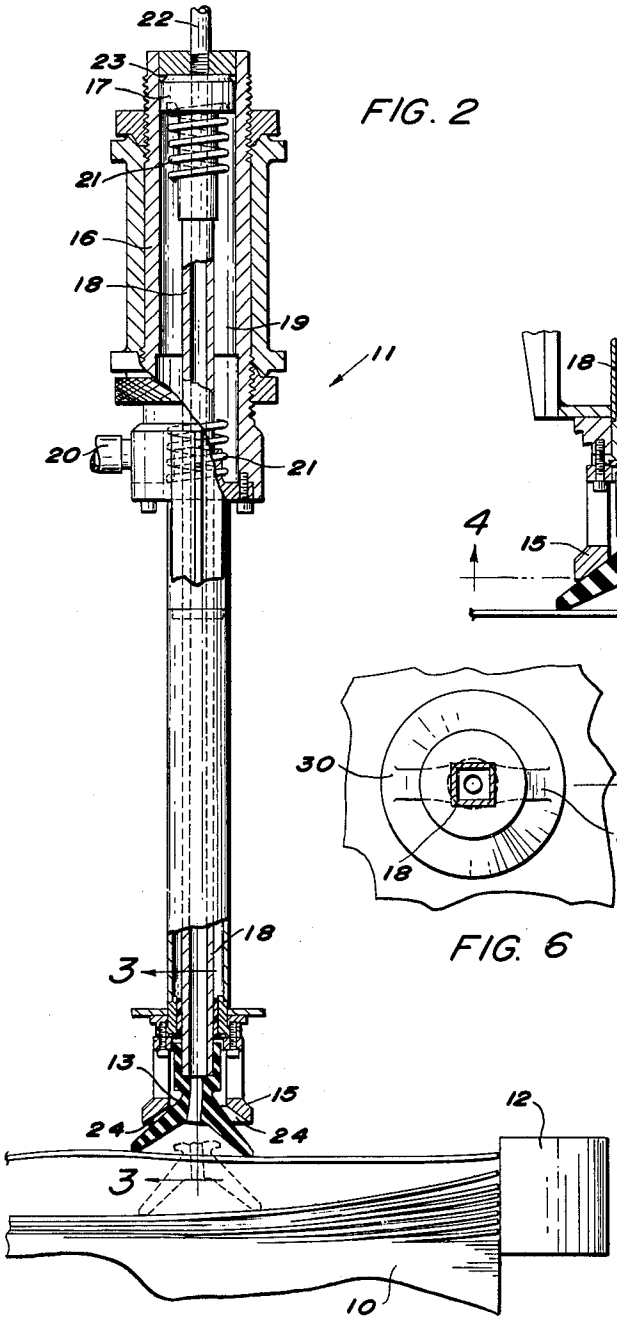



FIG. 2

FIG. 3

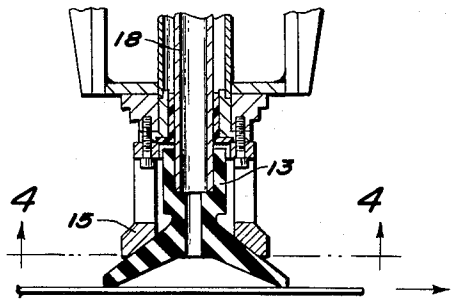






FIG. 6

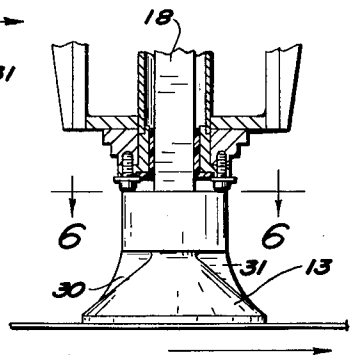



FIG. 5

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# SHEET HANDLING SUCKER

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15 Claims. (Cl. 271—26)

This invention relates generally to suckers for feeding sheets to a sheet handling machine. Specifically it relates to novel suckers designed to handle relatively heavy sheet material such as is used in the manufacture of "tin" containers of various types.

It has been common practice in the sheet metal feeding art to utilize flexibile rubber suction mouths to firmly grip the top sheet of a pile, lift it, and forward it to the sheet handling machine. Such suction mouths, because of their flexibilty, readily conform to the top sheet of a pile even though the sheet may be uneven or be inclined relative to the horizontal. The inclination may be due to the use of magnetic and pneumatic sheet separating mechanism which tends to fan sheets at their sides near the top, or may be due to uneven sheet thicknesses in different areas resulting from dipcoating of the sheets. While the use of flexible rubber suction mouths nicely adapts the suckers for this purpose, their flexibility is disadvantageous during the forwarding action of the suckers in transferring the sheet to the sheet handling machine. This is especially true in high speed feeders which feed sheets in excess of 100 per minute, for example. Due to the weight of the sheets, which may be several pounds depending on the size and thickness of each, the inertia of a sheet tends to cause severe strain on the flexible rubber mouths. This is not only harmful to the suction mouths themselves, but also can cause the sheets to be fed out of time to the machine or to be dropped during forwarding. Loss of a sheet by the mouths during forwarding will often cause it to fall back onto the pile in the wrong position. The next time the suckers attempt to lift a sheet, they will grasp the fallen sheet in the wrong location and the sheet will in all probability be fed to the sheet handling machine incorrectly, causing a jam-up down the line.

It is therefore the primary object of this invention to overcome the aforementioned disadvantages of the prior art sheet feeding mechanism, while retaining the advantages thereof.

Another object of the invention is to provide sheet forwarding mechanism having flexible rubber suction mouths capable of flexibility in a direction transverse to the direction of sheet forwarding, but being relatively unyielding in the direction of forwarding during sheet feeding.

A further object of the invention is to enable rapid lifting of relatively heavy sheets from a pile by means of flexible suction mouths and forwarding them to a sheet handling machine with said suction mouths without loss of sheets during the forward action.

Another object of the invention is to enable flexible suction mouths of a pair of sheet lifting and forwarding suckers to conform to uneven top sheets of the pile while at the same time providing a relatively unyielding support for such flexible suction mouths during their sheet forwarding action.

Still another object of the invention is to alternately



make the suction mouths of sheet lifting and forwarding suckers flexible and stiff and thus enable the conformance of the suction mouths to uneven top sheets of the pile when flexible to facilitate the grasping of them, and to provide stiffness to said mouths during the sheet forwarding action to overcome the inertia of relatively heavy sheets without flexing of said mouths.

More specifically, it is an object of this invention to provide unyield-support for each of a plurality of flexible suction mouths of sheet forwarding suckers during their forwarding action and to provide further that said supports be so constructed as to permit transverse flexibility of the mouths.

Other objects and advantages will be appearent from the following description in which reference is made to the accompanying drawings.

In the drawings:

Fig. 1 is a fragmentary side elevational view of a portion of a sheet feeding mechanism constructed according to the invention.

Fig. 2 is an enlarged detailed view, partly in section, of a sucker mechanism looking in the direction of the arrow 2 of Fig. 1.

Fig. 3 is an enlarged fragmentary view taken along lines 3—3 of Fig. 2, a sheet being held in lifted position.

Fig. 4 is an enlarged view taken looking upwardly along lines 4—4 of Fig. 3.

Fig. 5 is a view similar to Fig. 3 showing a modification of the invention.

Fig. 6 is a view taken looking along lines 6—6 of Fig. 5.

Referring now to the one form of the invention illustrated in Figs. 1 through 4, a pile of sheets **10** is supported in a conventional pile feeder and is raised intermittently to maintain the top thereof within reach of a sheet lifting and forwarding sucker **11**. The sucker **11** is one of a pair or more of such suckers, of which only one need be described. The invention may be utilized with various types of sheet material, but is particularly adapted to the rapid feeding of ferrous sheet metal with which magnets **12** and pneumatic means (not shown) are used to separate the edges of the sheets at the top of the pile. The magnetic separation causes the sheets to be uneven as can be seen in Fig. 2. This is largely due to the fact that the weight of the sheets prevents them from being separated in the middle where the strengh of the magnetic field diminishes. The sucker **11** has a flexible rubber suction mouth **13** which moves from a solid-line position in Fig. 1 to its lower dotted-line position to grasp the top sheet of the pile, and then reverses direction to return to its solid-line, lifted position. The sucker is then moved to the right to its second dotted-line position to forward the sheet held thereby to pull-in wheels **14** which subsequently transfer the sheet to a printing press or other sheet handling machine. It will be noted in Fig. 1 from the two dotted-line positions of the suction mouth **13**, that when it takes a sheet at the top of the pile, unrestrained flexibility, particularly transverse of the mouth, is permitted so that the mouth can conform to the uneven top sheet of the pile. Once the suction mouth **13** has been raised to its lifted position, it recedes into a shroud **15**. When the sucker **11** is forwarded to cause the held sheet to be transferred to the pull-in wheels **14**, the shroud moves with the sucker and provides an unyielding support for the suction mouth **13**. As shown, this support is at the front and back of the suction mouth **13** for reasons to be explained later. It is to be understood, however, that back support alone may be sufficient. The support provided by the shroud **15** helps to prevent loss of the sheet during the forward-

ing action, or mistiming of a sheet in transferring it to the pull-in wheels 14.

Referring to Fig. 2, a cylinder 16 has reciprocable therein a piston 17. The piston 17 carries a long hollow stem 18 which in turn carries on its lowermost end the suction mouth 13. To reciprocate the mouth from its solid-line position to its dotted-line position in Fig. 2, vacuum is communicated to a chamber 19 in the cylinder 16 through a line 20. This causes the piston 17 to move downwardly against the resistance of a compression spring 21 in the chamber 19 so that the suction mouth 13 will engage the top sheet of the pile 10. The flexibility of the mouth 13 permits the mouth to conform to the top sheet although it may be very uneven at the time. While the suction mouth is against the pile, vacuum is communicated to a line 22 and through the line to a chamber 23 in the cylinder on the top side of the piston 17. Vacuum is thus also communicated to the suction mouth 13 through the hollow stem so that the mouth will firmly grip the top sheet. After this has been accomplished, vacuum to the line 20 is disconnected and atmospheric pressure is communicated to the chamber 19 through the line. The vacuum in the chamber 23 coupled with the higher relative pressure in the chamber 19 and the force of the spring 21 causes the suction mouth to move upwardly to its solid-line position. In this lifted position, the mouth recedes into the shroud 15 and intimately engages with the front and back of the shroud as viewed in Figs. 3 and 4, but its provided with a clearance 24 at each transverse side as viewed in Figs. 2 and 4.

The snug or intimate engagement as shown in Fig. 3 for the front and back of the suction mouth 13 makes the mouth substantially unyielding during the forwarding action as mentioned previously. The clearance 24 is provided at each side of the suction mouth for the purpose of preventing binding of the mouth against the shroud before it fully recedes into the shroud. It also permits side flexing of the suction mouths during the forwarding action. The binding referred to may result from the sheet being pushed sidewise slightly as it is lifted, and being maintained in such shifted position during the forwarding action. By viewing Fig. 2, it can be seen that the magnet 12 may hold the edge of the sheet, and as the suction mouth moves upwardly and the sheet is straightened from its curved position, the suction mouth will be required to flex. If feeding without magnetic separation, or in those feeders where the mouth is not otherwise urged sidewise, the mouth may be made to mate with the entire inner surface of the shroud. When the sucker is in its lifted position, the conically-shaped outer surface of the suction mouth firmly engages the similarly conical recess in the shroud 15.

A second form is illustrated in Figs. 5 and 6. In this form, each suction mouth 13 is provided with one or more ribs 30 and 31. It will be noted in Fig. 6 that these ribs will permit side flexing of the sucker but will provide the necessary stiffness during forwarding. The ribs 30 and 31 may be of any shape provided they accomplish their aforementioned objectives. They are preferably integral with and of the same material as the suction mouth 13, but may be otherwise. During forwarding of a sheet in the direction of the arrow in Fig. 5, the rib 30 is placed under compression and the rib 31 under tension due to the inertia of the sheet.

To prevent the suction mouth 13 (and thereby the ribs) from rotating about its vertical axis, the stem 18 and its bearing may be made square or any other shape capable of preventing rotation.

It is desired to be understood that while the invention has been shown for use in connection with suckers which perform both the lifting and forwarding action, it is capable of being practiced with suckers which forward sheets which are received from other suckers which do the lifting.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention.

Having described our invention, we claim:

1. In a sheet forwarding device for grasping sheets one at a time and forwarding them to a sheet handling machine, a suction mouth carried by said device, said mouth being flexible at least in a direction transverse to the direction of sheet forwarding to enable the mouth to conform to uneven sheets when they are grasped, means for forwarding said device, and means providing a relatively unyielding support for said suction mouth in the direction of sheet feeding and enabling yielding thereof in a transverse direction during the forwarding action.

2. In a sheet lifting and forwarding device for grasping sheets one at a time from a pile and forwarding them to a sheet handling machine, a suction mouth carried by said device, said mouth being flexible at least in a direction transverse to the direction of sheet forwarding to enable the mouth to conform to uneveness in the top of the pile, means for moving said suction mouth into engagement with the top sheet of the pile to grasp the sheet and lift it from the remainder of the pile, and means providing a relatively unyielding support for said suction mouth in the direction of sheet feeding and enabling yielding thereof in a transverse direction during the forwarding action.

3. In a sheet lifting and forwarding device for grasping sheets one at a time from a pile and forwarding them to a sheet handling machine, a flexible suction mouth carried by said device, said mouth being capable of conforming to unevenness in the top of the pile, means for moving said suction mouth into engagement with the top sheet of the pile to grasp the sheet and lift it from the remainder of the pile, means for forwarding said device and suction mouth to transfer the sheet to the sheet handling machine, and means carried by said device and intimately engaged by a portion of the suction mouth when in its lifted position, said means providing a relatively unyielding support for said mouth in the direction of feeding and enabling yielding thereof in a transverse direction during the forwarding action.

4. The invention as set forth in claim 3 wherein said unyielding support comprises a shroud having a substantially conical recess facing the pile, and wherein the outer surface of said suction mouth is the same general shape as said recess and intimately mates with said shroud recess at least on its back side, said recess being provided with clearance for said mouth on those sides transverse to the direction of sheet feeding.

5. In a sheet handling device, a plurality of transversely spaced lifting and forwarding suckers for grasping relatively heavy sheets of flexible sheet metal or the like from the top of a pile and forwarding them one at a time to a sheet handling machine, a flexible suction mouth carried by each sucker, said mouths being capable of conforming to unevenness in the top of the pile, means for moving said suction mouths into engagement with the top sheet of the pile to grasp the top sheet and lift it from the remainder of the pile, means for forwarding said suckers to transfer the sheet to the sheet handling machine, and means carried by each sucker and intimately engaged by a portion of its corresponding suction mouth when in its lifted position, said means providing a relatively unyielding support for said mouths in the direction of sheet feeding and enabling yielding thereof in a transverse direction during the forwarding action.

6. The invention set forth in claim 5 wherein each of said supports comprises a shroud having a substantially conical recess facing the pile, and wherein the outer surface of each suction mouth is of the same general shape as said recesses and intimately mates with its shroud recess at least on its back side, each recess being provided with clearance for its corresponding mouth on those sides transverse to the direction of sheet feeding.

7. A sheet lifting and forwarding sucker for grasping

sheets one at a time from a pile and forwarding them to a sheet handling machine, said sucker comprising a cylinder and a piston reciprocable therein in a direction perpendicular to the top of the pile, a hollow stem carried by said piston for reciprocation therewith, a flexible suction mouth mounted on the lower end of said stem and adapted to have vacuum intermittently communicated thereto from within said cylinder, said mouth being capable of conforming to unevenness in the top of the pile, and a rigid shroud fixed to said cylinder, said shroud being recessed for a reception of the exterior portion of said mouth when a sheet is held in lifted position whereby said mouth is made substantially unyielding only in the direction of sheet feeding and is maintained in such state during the forwarding action of said sucker.

8. The invention set forth in claim 7 wherein said recess is provided with clearance for said mouth on those sides transverse to the direction of sheet feed.

9. Means for feeding ferrous sheets from a pile to a sheet handling machine, magnetic sheet separation means at the sides of the pile along the top thereof, an overhead frame member, a cross shaft supported by said frame member above the pile, a plurality of transversely spaced sheet lifting and forwarding suckers mounted on said cross bar, said suckers each comprising a cylinder and a piston generally vertically reciprocable therein, a hollow stem carried by the piston and a flexible suction mouth mounted on the lower end of said stem and adapted to have vacuum intermittently communicated thereto from within said cylinder, and a rigid shroud fixed to the lower end of each cylinder, each of said shrouds being recessed for reception of a major exterior portion of its corresponding mouth when a sheet is held in lifted position whereby said mouths are made substantially unyielding only in the direction of sheet feeding and are maintained in such state during the forwarding action of said suckers.

10. In a sheet forwarding device for grasping sheets one at a time and forwarding them to a sheet handling machine, a suction mouth carried by said device, said mouth being flexible in a direction transverse to the direction of sheet forwarding to enable the mouth to conform to uneven sheets, means for forwarding said device, and means integral with the suction mouth providing a relatively unyielding support for said suction mouth in the direction of sheet feeding during the forwarding action while enabling transverse flexibility therof.



11. The invention as set forth in claim 10 wherein said integral means comprises a strengthening rib extending in the direction of feeding at least on the back side of said suction mouth.

12. The invention as set forth in claim 10 wherein said suction mouth is restrained against movement about an axis through the mouth.

13. The invention set forth in claim 11 wherein a strengthening rib is provided on each the front and back sides of said suction mouth, said ribs being flexible transversely of the direction of sheet feeding, and said back rib being under compression and said front rib being under tension during sheet forwarding to stiffen the suction mouth in the direction of feeding.

14. A sheet lifting and forwarding device for lifting sheets one at a time from the top of a pile and forwarding them to a sheet handling machine comprising, in combination, a pneumatic cylinder, a piston reciprocable therein in a direction generally perpendicular to the top of the pile, a stem carried by the piston for reciprocation therewith, said stem extending outwardly of the cylinder toward the pile, a suction mouth carried on the outwardly extending end of said stem, means for communicating vacuum to said suction mouth from within said cylinder to grasp the top sheet of the pile, said suction mouth being flexible in a direction transverse to the direction of sheet forwarding to enable the mouth to conform with an uneven top sheet of the pile and being provided with strengthening means in the direction of sheet forwarding to make said mouth relatively unyielding during forwarding, and means restraining said mouth and stem against rotational movement about an axis therethrough.

15. The invention set forth in claim 14 wherein said strengthening means comprises integral rib means at least on the back side of said mouth and extending in the direction of sheet feeding.

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