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Bays

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[54] **APPARATUS FOR REMOVING SHEETS FROM STACKS**

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[51] **Int. Cl.** **B65h 5/10**, B65h 5/14
[58] **Field of Search** ..... 271/11–14, DIG. 3, 63 A, 26 R

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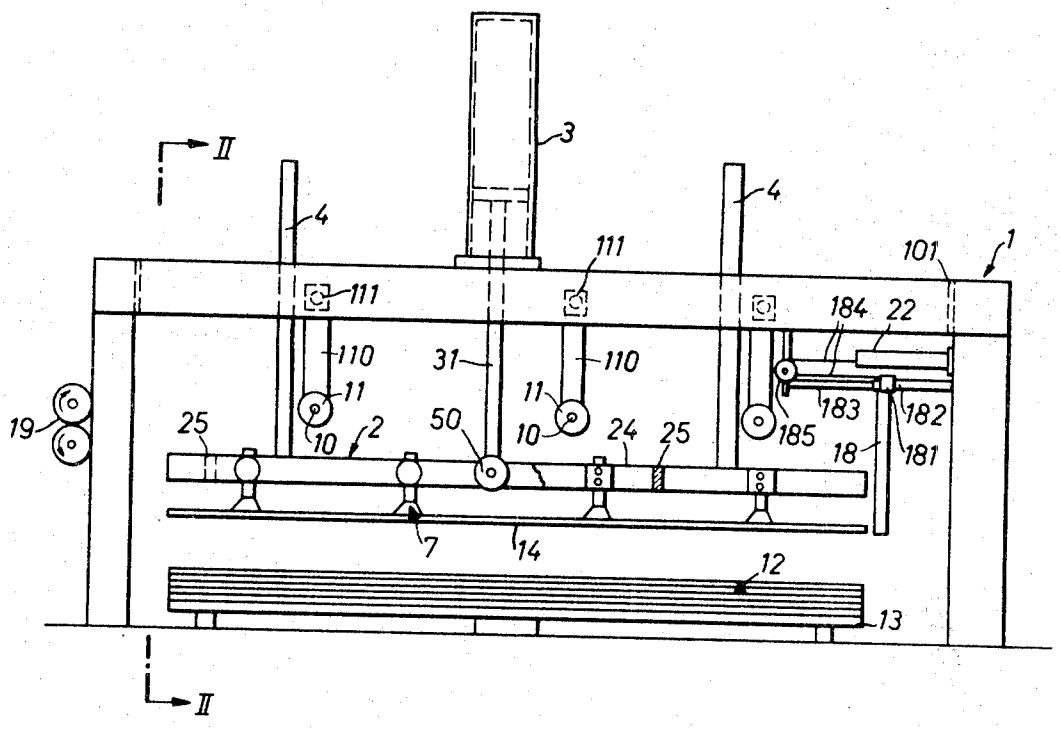
[57] **ABSTRACT**

Apparatus for removing sheets from a stack of sheets includes a fixed frame and a movable frame mounted to the fixed frame, the movable frame being at least vertically movable relative to the fixed frame from a lower position adjacent a stack of sheets to an upper position. Further included is a plurality of suction grippers mounted to the movable frame for engagement with the top sheet of the stack, and a plurality of rotatable magnetic rollers mounted to the fixed frame for engaging and supporting a sheet which is raised up by the suction grippers and movable frame. A movable carrier member is provided for removing the sheet supported by the magnetic rollers, and means is provided for displacing the suction grippers relative to the movable frame to clear the sheet supported by the magnetic rollers during movement of the carrier member, so that the movable frame can be lowered past the supported sheet to engage a further sheet from the stack during removal of the supported sheet without interfering with the removal operations.

22 Claims, 5 Drawing Figures



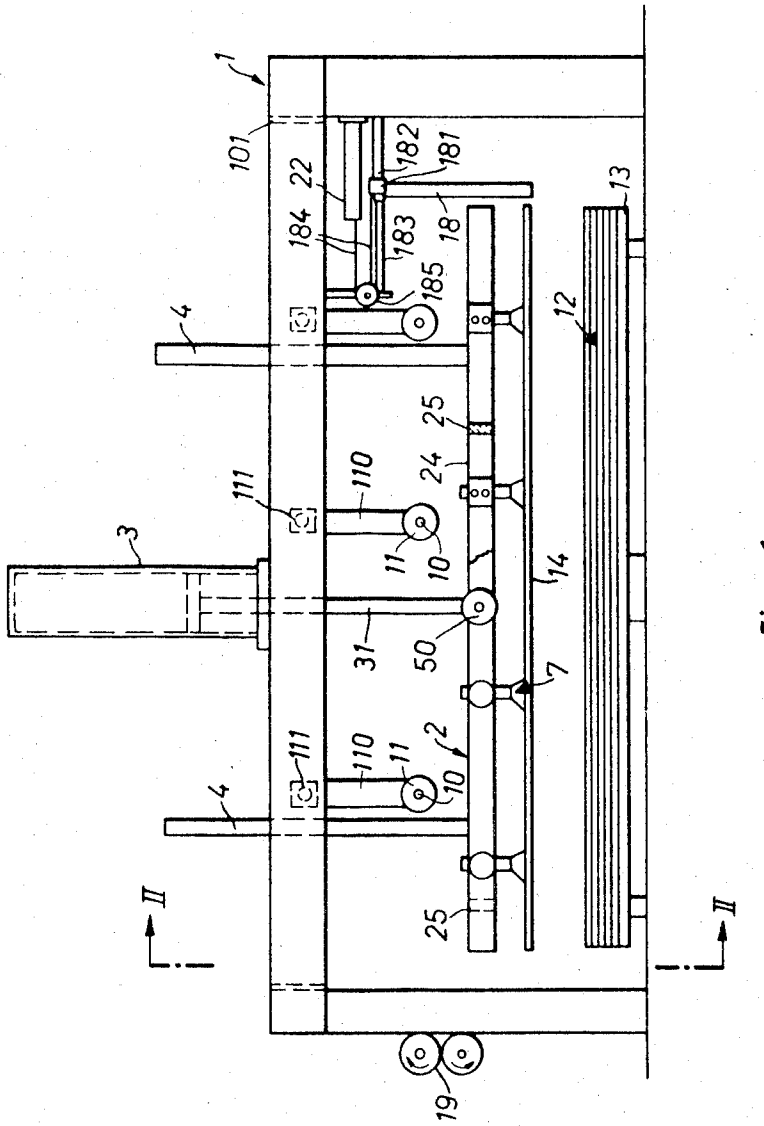

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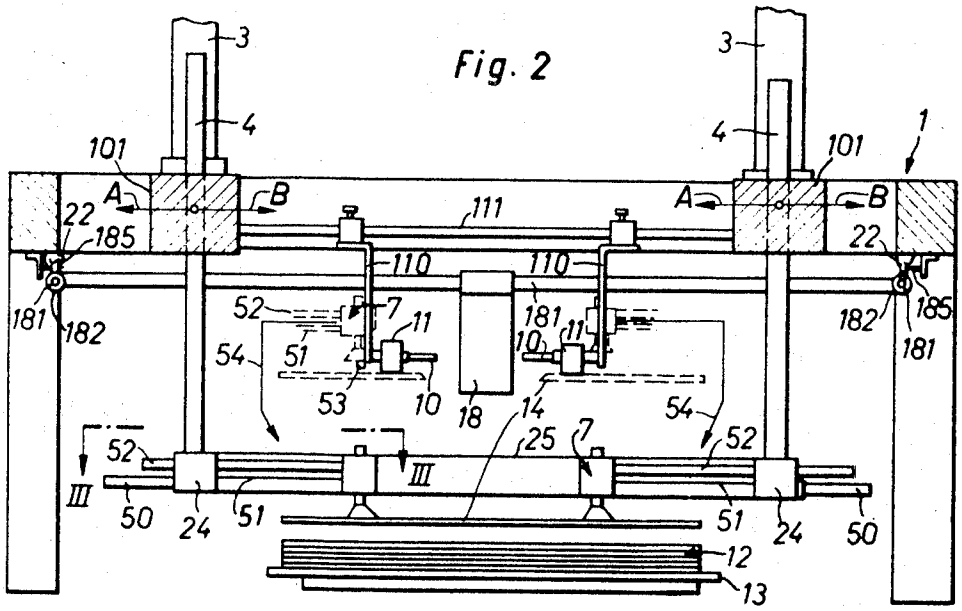
Fig. 1

Fig. 2



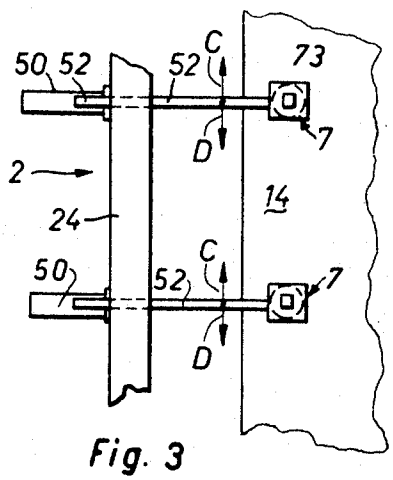


Fig. 3

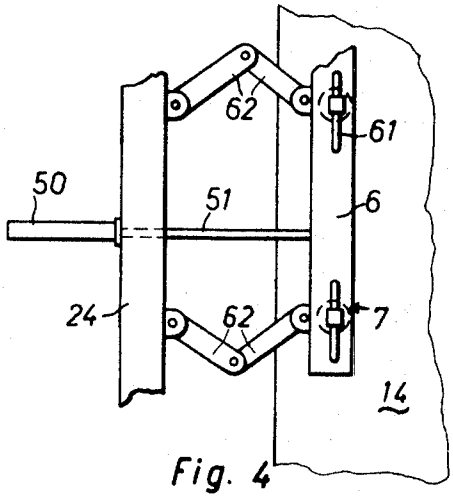


Fig. 4

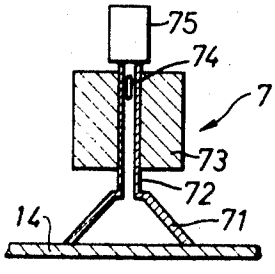


Fig. 5

APPARATUS FOR REMOVING SHEETS FROM STACKS

The present invention relates to apparatus for removing sheets from stacks, and more particularly for removing metal and metal foil sheets from stacks.

A known device of this type is designed to lift sheets individually from a stack and lay them onto two counter-rotating transport rollers which grip the lifted sheets and transmit or feed them, for example to a coiling machine. The lifting of the top sheet from the stack is effected in these devices by means of suction grippers which are most often fastened to a frame, the frame being lowered so that the suction grippers engage the topmost sheet. At the same time a vacuum is created in the suction grippers, while simultaneously the frame moves upwards and then in the direction of the transport rollers, so that the sheet thus lifted by the suction grippers is then inserted between said rollers.

A disadvantage inherent in the known type of devices is that the suction grippers must release the sheets at the exact moment that the transport rollers engage the sheets. Consequently the free end of any given sheet, that is, the end which is opposite to that engaged between the rollers, drops down again, so that in the instant following engagement by the transport rollers, the greater part of the sheet is hanging from the transport rollers. In the case of small sheets this circumstance is of no great importance; with larger, heavier sheets, however, this means a significant overload on the drive mechanism for the transport rollers because the transport rollers not only have to push the sheets forward, but also pull them up. Such a two-phase lifting of the sheets, first by means of the suction grippers and then by means of the transport rollers, is uneconomical. Further, undesirable noise is caused by the falling of each successive sheet as it is released by the suction grippers.

In order to avoid this, it has already been proposed that the suction grippers should lift the sheets far enough to bring them into contact with a series of magnetic devices. The suction grippers can then immediately disengage, because the sheets will remain attached to these magnetic devices. However, in such a prior system, the magnetic devices themselves must be driven, in order to insert the lifted sheets between the transport rollers. The driving of several rows of magnetic elements is fairly expensive. In addition, the system must be adjusted to the thickness of the sheets being processed, either to their maximum thickness or to an average thickness determined by most common use.

Furthermore, an upper limit is imposed on the operating speed of a device of the magnetic type, since the suction grippers can return to the stack only after the sheets lifted by them to the magnetic devices and hanging there have been displaced by the transport rollers. This results in a significant delay and consequently a loss of operational time.

Therefore, an object of the present invention is to avoid the expensive drive necessary to displace the magnetic devices, and to provide a simpler mechanism for removing sheets from a stack of sheets.

A further object of the present invention is to improve the utilization of the time in which the sheet is displaced for a downwards and also partially upwards motion of the suction grippers, so that immediately after displacement of the sheets it is possible to bring another sheet to the magnetic devices, thereby increasing operating efficiency.

SUMMARY OF THE INVENTION

In accordance with the present invention, apparatus for removing sheets from a stack of sheets includes a fixed frame, a movable frame mounted to the fixed frame and being at least vertically movable relative to the fixed frame from a lower position which is adjacent to a stack of sheets, to an upper position, and a plurality of suction grippers mounted to the movable frame for engaging the top sheet of the stack when the movable frame is in a lower position. Further included is a plurality of rotatable magnetic rollers mounted to the fixed frame for engaging and supporting a sheet when the movable frame is in its upper position with a sheet carried by the suction grippers. A movable carrier member is further provided for removing the sheet supported by the magnetic rollers for engagement with the magnetic rollers. During movement of the movable carrier member, the suction grippers are moved relative to the movable frame to clear the sheet supported by the magnetic rollers so that the movable frame can be lowered passed the supported sheet without interfering therewith to engage a further sheet from the stack during removal of the supported sheet. By virtue of this arrangement, it is possible to begin engagement of the suction grippers with another sheet from the top of the stack while the previously picked up sheet is being transported to a work station, without interfering with the previously transported sheet. This increases the efficiency of the operation.

Preferably, the magnetic rollers are adjustably mounted to accommodate various sizes of sheets. Further, the suction grippers are preferably suspended from movable longitudinal members which are movably supported in the fixed frame. This enables the position of the suction grippers to be adjusted relative to the sheets to enable the apparatus to be favorably used with various sizes of sheets.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a first embodiment of the apparatus of the present invention in side view;

FIG. 2 illustrates a section along line II—II of FIG. 1;

FIG. 3 illustrates a partial section through the apparatus along line III—III in FIG. 2;

FIG. 4 illustrates a section at the same place as in FIG. 3, but for a different embodiment of the present invention; and

FIG. 5 illustrates a cross-section of a suction gripper.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to FIGS. 1–3, the rigid frame of the apparatus is generally indicated by 1. Two laterally displaceable longitudinal members 101 are mounted to the frame 1 in a known and therefore not further described fashion. Members 101 are displaceable as indicated by the arrows A and B in FIG. 2. A vertically movable frame 2 is mounted to the two longitudinal displaceable members 101. Frame 2 includes two longitudinal beams 24, which are connected together by at least one cross member 25. Two such cross members 25 are shown in FIG. 1. Longitudinal beams 24 are located directly beneath longitudinal members 101 of frame 1. A main piston-cylinder assembly 3 is coupled

to each longitudinal member **101**, the piston rod **31** of which slideably passes through each respective longitudinal member **101**. The end of each piston rod **31** is connected to about the midpoint of a respective longitudinal beam **24**. Each longitudinal beam **24** of movable frame **2** further has two guide rods **4** extending vertically near the ends of beams **24**, the guide rods slideably passing through the respective longitudinal member **101**.

Magnetic rollers **11** are loosely journalled on respective axles **10**. Axles **10** are secured to hangers **110**, which for example are displaceably mounted to cross rods **111** between the two longitudinal members **101**. In addition, magnetic rollers **11** can also be displaceable to a limited extent on axle journals **10**. The cross rods **111** are also displaceable relative to their own longitudinal axes. With this arrangement, magnetic rollers **11** may be adjusted to properly engage the sheet surface about to be processed, in both the longitudinal and crosswise directions relative to the sheet lifting apparatus.

At one end of the apparatus is located a movable carrier **18**, which pushes the lifted sheet against a pair of transport rollers **19** (FIG. 1). Carrier **18** is mounted to a cross member **181**, which by means of pushing guides **182** is located movably against guide rods **183** (FIG. 1). Guide rods **183** are arranged underneath longitudinal members **101**. The drive of carrier **18** is effected by means of a piston cylinder assembly **22** and by means of cable **184** which is looped around guide roller **185**.

The above details apply to both illustrated embodiments of the present invention. The specific details of the two illustrated embodiments will be elucidated below.

In the embodiment illustrated in FIG. **3**, several actuation parts **50**, preferably pneumatic cylinder-piston assemblies, are placed against each of the longitudinal beams **24** on the outer surface of frame **2**. Their piston rods **51** pass through the longitudinal beams **24** and on the end of each piston rod **51** is mounted a single suction gripper **7**. Cylinder-piston assemblies **50** are connected, over flexible pipes (not shown in the drawings) to a compressed air source as well as to a control device which governs the direction of movement of piston rods **51** as well as the turning-on of these movements. For smaller devices which need to lift only lighter sheets, every suction gripper **7** can be directly secured to its respective piston rods **51**. In devices which must lift bigger and consequently also heavier sheets, it is however more suitable to let the weight of one of the plates or sheets **14** hanging on suction grippers **7** be assumed by guide rods **52** which are displaceably set in longitudinal beams **24**. Piston rods **51** then serve only to displace suction grippers **7**.

The device operates as follows:

The two main cylinder piston systems **3** together move frame **2** downwards, and at the same time suction grippers **7** are moved toward the middle of the apparatus. The extent of the movement of suction grippers **7** is determined by the width of the sheets **14** to be lifted. Frame **2** moves downward until the suction grippers reach the topmost sheet **14** of a stack of sheets **12**, which stack **12** lies on a table **13** or on a palette in the middle of the apparatus. Suction grippers **7** suck up sheet **14**, and frame **2** then moves back upward until sheet **14** touches against magnetic rollers **11**, as shown by the dashed line representation of sheet **14** in FIG. **2**.

At this moment simultaneously a limit switch **53** is actuated (FIG. **2**) which may be set at any appropriate place and which generates a signal for the cutting off of the suction action of suction grippers **7**. Suction grippers **7** are thereby disengaged from the sheet **14** on which frame **2** stays. Now carrier **18** is caused to grasp the sheet **14** by the front end thereof and pushes it in the direction of a processing machine which is symbolically represented in the drawing by a pair of transport rollers **19** (FIG. **1**). Transport rollers **19** grasp the sheet between them and pull it completely away from magnetic rollers **11**. While sheet **14** is being pushed away by carrier **18**, cylinder-piston assemblies **50** are actuated such that they draw suction grippers **7** (which are now in the position shown in the drawing) against longitudinal beams **24** to "clear" the lifted sheet **14**, immediately after which the return movement of the frame **2** begins. Suction grippers **7** thus move in a path as indicated by arrows **54** (FIG. **2**), thereby enabling suction grippers **7** to approach stack **12** so as to lift up a new sheet while the preceding sheet **14** is still hanging on magnetic rollers **11** or is being displaced from said magnetic rollers **11** by carrier **18**. Suction grippers **7** can also immediately pick up the next sheet and lift it until it is immediately beneath the preceding sheet. As soon as the preceding sheet is completely drawn out of the area of frame **2** by means of transport rollers **19**, suction grippers **7** can continue their upward motion until the new sheet engages and hangs on magnetic rollers **11**. In this way it is possible to pick up one sheet after the other with a minimum delay in feeding into adjacent processing machinery and thereby to achieve a maximum hourly output.

The embodiment illustrated in FIG. **4** operates in the same manner as the above-described embodiment. The chief difference relative to the previously described embodiment is that the individual suction grippers of one side are set on carriers **6**. Each carrier **6** is connected with the adjacent longitudinal beam **24** of movable frame **2** by means of several pivotally connected levers **62**.

For the displacement of each carrier **6** relative to its respective longitudinal beam **24**, a single cylinder-piston assembly **50** generally suffices. The advantage of this embodiment lies in that it is easier to effect displacement of the suction grippers **7** along carrier **6** so as to adjust to the sheet width to be processed. This is accomplished, for example, by displaceably mounting each suction gripper **7** in an elongated slot **61** in carrier **6**. In theory this is also possible with the embodiment of FIG. **3**, but in FIG. **3** each individual cylinder-piston assembly **50** including piston rod **51** and guide rod **52** must be mounted as a laterally displaceable unit in longitudinal beam **24**, the direction of desired lateral displacement being indicated by arrows C and D in FIG. **3**. This type of adjustable arrangement in FIG. **3** would be mechanically undesirable.

The vacuum for the suction grippers is generated by the grippers themselves. Referring to FIG. **5**, at the moment of application of each suction gripper **7** to a sheet **14** the suction cup **71** is pressed flat, so that the air is forced out of its interior. When lifted it assumes its original shape again, thus also exhibiting its original volume. But since in the meantime the air was pressed out, a partial vacuum is created interior of suction cup **71** which is sufficient even for relatively heavy sheets (given a sufficient number of suction grippers). Suction

cup 71 is attached to a hollow piston 72. The hollow piston 72 is laterally displaceably mounted in member 73 of the suction gripper, piston 72 having an opening 74 therein which is closed when the sheet is lifted. Piston 72 is actuated by means of an electromagnet 75, which at the moment limit switch 53 is actuated by the contact of magnetic rollers 11 with sheet 14, is excited and draws up piston 72 so that opening 74 is at least partially drawn out of housing 73. When opening 74 is drawn out of housing 73 air can enter the inside of suction cup 71, which leads to the immediate release of the sheet 14 by suction gripper 7.

While the invention has been described with respect to specific embodiments, it should be clear that various modifications and alterations can be made to the structural arrangement without departing from the inventive concept set forth in the accompanying claims.

I claim:

1. Apparatus for removing sheets from a stack of sheets, comprising:

a fixed frame (1);

a movable frame (2) mounted to said fixed frame (1) and being at least vertically movable relative to said fixed frame (1) from a lower position adjacent a stack of sheets (12) to an upper position;

a plurality of suction grippers (7) mounted to said movable frame (2) for engagement with the top sheet (14) of said stack (12);

a plurality of rotatable magnetic rollers (11) mounted to said fixed frame (1) for engaging and supporting a sheet (14) when said movable frame (2) is in its upper position with a sheet (14) carried by said suction grippers (7);

a movable carrier member (18) for removing said sheet (14) supported by said magnetic rollers (11); and

means (50–52) for displacing said suction grippers (7) relative to said movable frame (2) to clear the sheet (14) supported by said magnetic rollers (11), so that said movable frame (2) can be lowered past said supported sheet (14) to engage a further sheet from said stack (12).

2. Apparatus according to claim 1 wherein said rotatable magnetic rollers (11) are mounted to said fixed frame by means of respective horizontally extending shafts (10), said rollers being rotatably mounted to said respective shafts.

3. Apparatus according to claim 1 wherein said magnetic rollers (11) are adjustably mounted to said fixed frame (1) to enable adjustment for varying sizes of sheets.

4. Apparatus according to claim 1 wherein said means (50–52) for displacing said suction grippers (7) includes means for horizontally displacing said suction grippers relative to said movable frame (2).

5. Apparatus according to claim 1 wherein said fixed frame includes at least one longitudinal member (101) horizontally displaceable relative to said fixed frame (1), and wherein said movable frame (2) is movably coupled to said at least one horizontally displaceable longitudinal member (101).

6. Apparatus according to claim 5 including a piston-cylinder assembly (3) movably coupling said movable frame (2) to said at least one horizontally displaceable longitudinal member (101), said movable frame being vertically movable relative to said horizontally displaceable longitudinal member.

7. Apparatus according to claim 5 including vertically extending guide rods (4) slideably coupling said movable frame to said horizontally displaceable longitudinal member (101).

8. Apparatus according to claim 7 wherein said guide rods are fixedly coupled to said movable frame and are slideably mounted to said horizontally displaceable longitudinal member (101).

9. Apparatus according to claim 1 wherein said means (50–52) for displacing said suction grippers includes at least one cylinder-piston assembly coupling said suction grippers to said movable frame.

10. Apparatus according to claim 1 wherein each suction gripper is mounted to said movable frame by means of respective displaceable members (52).

11. Apparatus according to claim 10 wherein said separate displaceable members for mounting said suction grippers to said movable frame each include a slideably mounted guide rod (52) connected at one end to a suction gripper and being slideably mounted to said movable frame, and means for displacing said guide rod relative to said movable frame to thereby displace said suction gripper.

12. Apparatus according to claim 1 including a holding member (6) carrying a plurality of suction grippers, and being displaceably mounted relative to said movable frame (2), said means for displacing including means for displacing said holding member (6) relative to said movable frame.

13. Apparatus according to claim 12 wherein each holding member is coupled to said movable frame by a plurality of pivotally connected lever members (22).

14. Apparatus according to claim 1 wherein said means for displacing said suction grippers is mounted on the outer side of said movable frame.

15. Apparatus according to claim 12 wherein each suction gripper is displaceably mounted on its respective holding member in a longitudinal slot in the holding member.

16. Apparatus according to claim 1 wherein said carrier member is moved by at least one cylinder-piston assembly mounted to said fixed frame.

17. Apparatus according to claim 1 wherein said magnetic rollers are mounted to said longitudinal members (101) by means of hangers (110) displaceably mounted to said longitudinal members.

18. Apparatus according to claim 17 including two longitudinal members (101) and wherein said hangers (110) are displaceably mounted on cross-rods (111) which are mounted between said two longitudinal members.

19. Apparatus according to claim 1 wherein each of said suction grippers (7) includes a suction cup (71); a piston (72) in air communication with said suction cup (71), said piston (72) having an air relief opening (74) therein; a slideable member (73) slideably mounted over said piston (72) and adapted to selectively open and close said air relief opening (74); and means (75) for selectively sliding said slideable member (73) over said piston (72) for selectively opening and closing said air relief opening (74).

20. Apparatus according to claim 19 wherein said means for moving said movable member includes an electrical solenoid (75).

21. Apparatus according to claim 1 wherein said means (50–52) for displacing said suction grippers (7) displaces said suction grippers to clear said sheet (14) during movement of said carrier member (18).

22. Apparatus according to claim 2 wherein said magnetic rollers (11) are displaceably mounted on said respective shafts (10).

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