APPARATUS FOR STACKING FORM-CUT PIECES OF FABRIC ON TOP OF EACH OTHER

The invention relates to an apparatus for stacking form-cut pieces of fabric on top of each other. The downstream end of a continuous conveyor (5) is provided with a transverse identification gap (34) whose bottom and top surfaces (12, 13) are reflective surfaces, whereby IR-radiation is adapted to travel with multiple refractions from an emitter (10) to a receiver (11). A stacking car (6) is in its start position located below conveyor (5), the forward end of car (6) below the downstream end of conveyor (5). Stacking car (6) is adapted to move away from conveyor (5) when the advance movement in identification gap (34) based on the reflections of IR-radiation is blocked. Thus, car (6) is in motion all the time said conveyor (5) advances a piece of fabric (25) through identification gap (34). The shape of pieces (25) being stacked can be arbitrary.
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Apparatus for stacking form-cut pieces of fabric on top of each other

The present invention relates to an apparatus for stacking form-cut pieces of fabric on top of each other, said apparatus comprising
- a continuous conveyor having a top end and a bottom end and whose upper run travels continuously from top end to bottom end at a fixed conveyor speed,
- one or a plurality of parallel stacking cars adapted to reciprocate within the bottom end zone of the conveyor,
- identification means for identifying the forward and trailing ends of pieces of fabric,
- drive mechanisms for setting the stacking car in reciprocating motion and
- control means for the drive mechanisms for controlling movements of the stacking car on the basis of control impulses issued by the identification means.

This type of stacking equipment is used in ready-to-wear industry for receiving and stacking form-cut pieces of fabric, successively advanced through a main machine used e.g. for hot-pressing. From the main machine conveyor belt the pieces of fabric proceed into a stacking apparatus, the stacks or piles built therein being removed from time to time.

The prior known stacking equipment employs pneumatically movable grippers and sideways swingable intermediate carriers. The construction is relatively complicated and susceptible to malfunction. A drawback or problem in the prior known devices is that they cannot be used at all for stacking e.g. C- or S-shaped pieces. This is because the identification area of identification means is more or less spot-shaped. Thus, the trailing
edge identification already occurs in the middle of a piece. Alternatively, identification of the leading and trailing edges occurs at a substantial distance from the leading and trailing edge, respectively. Thus, the prior known equipment can only be used for stacking pieces of certain shape and even that often requires a precise positioning of pieces in the lateral direction of a conveyor line. In some cases, the problem can be alleviated by effecting the identification of leading and trailing edges using separate identification means which, in the lateral direction of a conveyor, can have a displaced position relative to each other. Even in this case, it is not possible to stack C- or S-shaped pieces.

An object of the invention is to provide a stacking apparatus of the above type, capable of avoiding the susceptibility to malfunction found in the prior known equipment and which does not set restrictions to the shape of pieces being stacked.

This object is achieved by means of the invention on the basis of the characterizing features set forth in the annexed claims.

The invention will now be described in more detail with reference made to the accompanying drawings, in which

fig. 1 is a side view of an apparatus of the invention and

fig. 2 is a plan view of the same apparatus.

Fig. 3 is a forward end view of an identification gap in an apparatus of the invention.
A main machine 1, fitted with an apparatus 2 of the invention, comprises e.g. a hot press for pressing together form-cut pieces of fabric and similarly shaped backing fabrics. The pieces of fabric and the backing fabric are manually laid on top of each other on a preparation table 3 for supplying them onto a conveyor belt 4 of main machine 1. From the conveyor belt 4 of said main machine 1 pieces of fabric 25 are received on a conveyor 5 in a stacking apparatus. The speed of conveyor 5 can be 30 - 40 % faster than that of conveyor 4. The speed of conveyor 5 is e.g. 10 m/min.

Stacking cars 6 are adapted to be reciprocated on horizontal guides 7 by means of wheels 23. A drive belt or chain 8 is fastened at the opposite ends thereof to a frame 35 and said belt or chain 8 is passed around a drive wheel 18 mounted on car 6. The same reference numeral 18 indicates also a drive motor, whereby said drive wheel 18 is rotated for running said car 6 up and down on guides 7.

From conveyor belt 5 said pieces of fabric 25 are advanced to a car 6 through an identification gap 34 (fig. 3). The identification gap 34 is formed between strips 9 and 12. The top surface of strip 12 is a mirror-polished metal surface or an anodized aluminium surface. The bottom face of strip 9 is fitted with similar reflective surfaces 13. The upper strip 9 carries two pairs of infrared emitters 10 and receivers 11 angled in a manner that infrared radiation travels between reflective surfaces 12 and 13 with multiple reflections until the radiation has covered the distance from emitter 10 to receiver 11. The spread angle and angle of reflection of a beam of radiation are selected in a manner that even a tiny obstacle between reflective surfaces
12 and 13 is detectable in the intensity arriving at receiver 11. This produces a detection always, even if there is only a narrow strip of fabric in identification gap 34. Detection does not depend on which part of identification gap 34 a strip of fabric is located.

One point of malfunction in the apparatus has been the transition point between conveyors 4 and 5. One solution in the prior art equipment has been the use of a strip in contact with the surface of conveyor 4. However, the threads at the edge of a piece of fabric may have got between conveyor 4 and the strip to prevent the advance of a fabric. In the invention, this has been avoided by means of a blow strip 14 which is connected to a source of compressed air and whose blow orifice 15 opens into a gap between blow strip 14 and the downstream end of conveyor 4.

The end rollers 16 and 17 of conveyor 5 have been made diametrically as small as possible for eliminating transition problems as completely as possible. The diameter of rollers 16 and 17 is preferably within the range of 18 - 25 mm. A strip which provides a bottom mirror 12 can be designed as a blow strip the same way as strip 14 and, thus, there will be no sticking between strip 12 and conveyor 5. Conveyor 5 can be made e.g. of plastic or nylon mesh or it can also be made of a string whose adjacent loops are sufficiently close to each other. The string conveyor is preferably made of a single continuous string which is continuously tightened with a spring loading in order to maintain the tightness of adjacent loops always the same despite the elongation of a string.

A stacking top 24 in car 6 is supported by a screw
spindle 26. Screw spindle 26 is meshed with the thread of a gear 27. When gear 27 is rotated one way or the other by means of a direct-current motor 29 associated with a pinion 28, said stacking top 24 can be lowered or lifted.

The extreme boundaries for the reciprocating movement of stacking car 6 have been set by means of limit switches 19 and 21 for which the guides 70 are provided with limit blocks 20 and 22.

A power source 30 for the apparatus includes a transformer and a rectifier for producing low-voltage direct current, e.g. a 24 V direct current, for operating motors 29 and 18.

The control impulses received from pairs of light transceivers 10, 11 and 32, 33 are forwarded to an electronic card 31 which in turn controls the relays at the outputs of power source 30, the current being supplied via said relays to motors 18 and 29.

A motor 35 is also a low-voltage direct-current motor and drives continuosly said conveyor 5.

Operation of the apparatus proceeds as follows.

Pieces of fabric are successively advanced through a main machine 1 on a conveyor 4. In the present case, there is one person on either side of a supply table 3 setting up pieces of fabric in two adjacent rows. The leading end (left-hand end in the figure) of a stacking car 6 is in the start position located below the downstream end of a conveyor 5. When the leading edge of a piece of fabric 25 enters an identification gap
24, a detection is obtained from a light receiver 11 to an electronic circuit 31 which controls the relay at the output of a power supply circuit 30 to switch the current on a drive motor 18. By means of this relay, the direction of current has been selected in a manner that said drive motor 18 carries car 6 away from conveyor 5. As car 6 travels at a speed substantially equal to that of conveyor 5, a piece of fabric 25 will be laid upon a stacking top 24 in car 6. When the trailing end of a piece of fabric 25 passes said identification gap 24, the radiation travels with no obstacles from transmitter 10 to receiver 11, said electronic circuit 31 opening the above-mentioned relay switch and closing the other relay switch through which the current is supplied to motor 18 in opposite direction, i.e. said direct-current motor 18 carries car 8 in the return direction.

Simultaneously with the return motion, said stacking top 24 is lowered. For this purpose, the electronic circuit 31 has shut down a third relay switch which supplies direct current to motor 29. Limit switch 19 and limit block 20 halt car 6 in its start position. This stop is followed by opening the third limit switch and closing a fourth limit switch through which direct current is supplied to motor 29 for driving it in the opposite direction, whereby said stacking top 24 rises upwards. When the uppermost piece in a stack finds itself between transceiver pair 32, 33 cutting the visual contact therebetween, said fourth relay switch is opened and motor 29 comes to a halt. Thus, on each work cycle said stacking top 24 remains as much lower as the thickness of a piece of material. Bringing top 24 downwards during the return motion is preferable in that a stack upon car 6 has more space to pass below
strip 12 even if wrinkles were formed in a piece of fabric.

Fig. 1 shows an extension 24a to stacking top 24 in order to prevent the fall of too densely supplied pieces of fabric through the space between the trailing end of car 6 and the downstream end of conveyor 5 upon guides 7 and drive belt 8. The extension 24a also facilitates the receipt of longer pieces of fabric. The limit blocks 22 only have significance if too long a piece of fabric or several successive pieces of fabric are supplied to car 6. Limit block 22 prevents car 6 from colliding with the frame and, if necessary, issues an alarm of malfunction.

When advancing pieces of fabric from table 3 onto conveyor 4, the lateral disposition need not be exactly precise. It is sufficient that a piece of fabric 25 be located within the side edges of car 6 for finding its way on top car 6 after conveyor 5.

Normally, the parallel cars 6 operate individually and independently. However, in order to stack broader pieces of fabric such parallel cars 6 can be combined for simultaneous operation, said cars 6 together providing a single broad stacking top. The linking of cars 6 can be effected just electrically by means of a selector switch. It is also possible to employ a mechanical linking between cars 6. Sometimes it is sufficient to have a single car 6 but in some other cases it is necessary to have four parallel cars 6.

The power consumption of an apparatus of the invention is very low. A sufficient maximum output for drive motor 18 is circa 14 W and a sufficient maximum output
for vertical motor 29 is circa 10 W. The commercially available pairs of transceivers 10, 11 and 32, 33 operate within an infrared range, e.g. on a wavelength of 880 nm.

The above embodiment has by no means been described in a sense to limit the invention but its structural details can be varied in a plurality of ways within the scope of the annexed claims.
Claims

1. An apparatus for stacking form-cut pieces of fabric on top of each other, said apparatus comprising
- a continuous conveyor (5) having an upstream end and a downstream end and whose upper run travels continuously from upstream end to downstream end at a fixed conveyor speed,
- one or a plurality of parallel stacking cars (6) adapted to reciprocate within the downstream end zone of conveyor (5),
- identification means (10-13) for identifying the leading and trailing ends of pieces of fabric (25), drive mechanisms (8, 18, 30) for setting stacking car (6) in reciprocating motion and
- control means (10, 11, 31) for drive mechanisms for controlling movements of stacking car (6) on the basis of control impulses issued by identification means (10-13), characterised in that the identification means include an identification gap (34) which is located at the downstream end of the conveyor and whose surfaces (12, 13) facing each other are smooth reflective surfaces wherebetween electromagnetic radiation is adapted to travel with multiple radiations from an emitter (10) to a receiver (11), that said stacking car (6) is in its start position located below conveyor (5) so that the forward end of stacking car (6) is located below the downstream end of conveyor (5), and that said stacking car (6) is adapted to move away from conveyor (5) whenever the advance movement in identification gap (34) based on the reflections of electromagnetic radiation is at least partially blocked.

2. An apparatus as set forth in claim 1, characterised in that...
the width of identification gap (34) in a direction perpendicular to the conveying direction corresponds substantially to the width of stacking car (6) and at the same time to the distance between emitter (10) and receiver (11).

3. An apparatus as set forth in claim 1 or 2, characterized in that said stacking car (6) is adapted to travel along horizontal carrier guides (7) and a drive belt or chain (8) is fastened at the opposite ends thereof to an apparatus frame (35) and is passed around a drive wheel (18) mounted on stacking car (6).

4. An apparatus as set forth in claim 1, characterized in that the level of a stacking top (24) in stacking car (6) is made adjustable and the stacking car body is fitted with an electric eye (32) for controlling the level of stacking top (24) according to the top surface of a forming stack of pieces.

5. An apparatus as set forth in claim 4, characterized in that said stacking top (24) is adapted to be lowered during the return motion of stacking car (6) and to be lifted in the start position of car (6) until the top surface of a stack of pieces finds itself between the pair of transceivers (32, 33) of electric eye (32).

6. An apparatus as set forth in any of claims 1 - 5, characterized in that the end rollers (16, 17) of conveyor (5), identification means (10-13) and carrier guides (7) for stacking cars are all mounted on a common frame (35).
7. An apparatus as set forth in any of claims 1 - 6, characterized in that a drive motor (18) for producing the reciprocating motions of stacking car (6) and a drive motor (29) for providing the vertical adjustment of stacking top (24) are mounted on said stacking car (6).

8. An apparatus as set forth in claim 7, characterized in that said drive motors (18, 29) are low-voltage direct-current motors.

9. An apparatus as set forth in claim 1, characterized in that between the upstream end of conveyor (5) and the downstream end of a conveyor (4) of said main machine (1) there is a blow strip (14) which is connected to a source of compressed air and whose blow orifice (15) opens into a gap formed between blow strip (14) and the downstream end of main machine conveyor (4).

10. An apparatus as set forth in claim 1, characterized in that the end roller (16, 17) of conveyor (5) has a diameter which is circa 18 - 25 mm.

11. An apparatus as set forth in claim 1, characterized in that parallel stacking cars (6) are controllable to operate simultaneously for providing together a single broad stacking top.
### INTERNATIONAL SEARCH REPORT

**International Application No:** PCT/FI89/00018

#### I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC:

- A41 H 43/02

#### II. FIELDS SEARCHED

**Classification System** | **Classification Symbols**
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IPC 4 | A 41 H 42/00, 43/00, 02; B 65 H 43/00, 02, 06, 08
US Cl | 271: 176, 198, 199, 201, 215

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched:

SE, NO, DK, FI classes as above

#### III. DOCUMENTS CONSIDERED TO BE RELEVANT

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#### IV. CERTIFICATION

- **Date of the Actual Completion of the International Search:** 1989-05-03
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- **International Searching Authority:** Swedish Patent Office
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