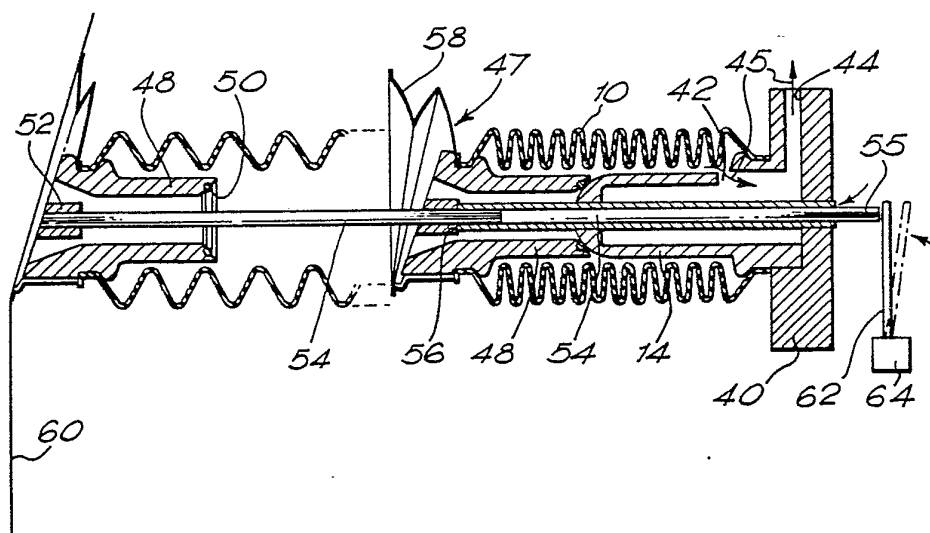




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁴ : B65H 3/08, B66C 1/02 B65G 47/91	A1	(11) International Publication Number: WO 86/ 01493 (43) International Publication Date: 13 March 1986 (13.03.86)
<p>(21) International Application Number: PCT/GB85/00394</p> <p>(22) International Filing Date: 4 September 1985 (04.09.85)</p> <p>(31) Priority Application Number: 8422338</p> <p>(32) Priority Date: 4 September 1984 (04.09.84)</p> <p>(33) Priority Country: GB</p> <p>(71) Applicant (for all designated States except US): WATKISS AUTOMATION LIMITED [GB/GB]; Holme Court, Biggleswade, Bedfordshire SG18 9ST (GB).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only) : WATKISS, Christopher, Robin [GB/GB]; Holme Court, Biggleswade, Bedfordshire SG18 9ST (GB).</p> <p>(74) Agents: THOMSON, Roger, Bruce et al.; G. Rathbone & Co., High Holborn House, 52-54 High Holborn, London WC1V 6RY (GB).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p> <p>Published With international search report.</p>

(54) Title: VALVE MECHANISM



(57) Abstract

A pneumatic valve mechanism, especially for controlling the movement of paper, comprises a mouthpiece (47) which defines an air intake (58), a bellows (10) coupled to the mouthpiece, a passage (42, 44) connecting the interior of the bellows to a pump so that when the bellows is not fully retracted suction is created at the air intake (58), and a seal (50) between the mouthpiece and a valve body (14) which is effective when the bellows is fully retracted, following closure of the air intake by a sheet of paper (60), to seal the air intake from the suction pump. Venting air can enter the mouthpiece in the retracted position of the bellows, to permit the sheet to drop off the intake, but without breaking the seal (50), whereby the bellows is maintained in its retracted position. The bellows (10) will only extend again to seek the next sheet when the effect created by the suction pump is interrupted, as by breaking the seal (50) by energising a solenoid (64) and displacing a mechanical linkage (62, 54).

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-1-

1 VALVE MECHANISMSPECIFICATION

5 This invention relates to valve mechanisms, and is particularly concerned with a pneumatic valve mechanism which incorporates a bellows or like mechanism and which can be used especially for the controlled movement of sheets of paper, card or like material.

10 Various types of suction mechanism are known for use in moving sheets of paper or like material. More particularly, valved suction mechanisms are known, but these generally tend to be complex either in their construction, their manner of operation or their
15 control.

 It is an object of the present invention to provide a pneumatic valve mechanism which is extremely simple in its construction and manner of operation, yet by means of which one can achieve various desirable results in
20 terms of the way in which sheets of material such as paper are controllably moved.

 In accordance with the present invention there is provided a pneumatic valve mechanism comprising a mouthpiece which defines an air intake; an extensible
25 and retractable sleeve coupled to the mouthpiece to cause the mouthpiece to move therewith; passage means to connect the interior of the sleeve to suction means such that when the sleeve is not fully retracted suction is created at the air intake; a seal between the mouthpiece
30 and a valve body within the sleeve which is effective

-2-

1 when the sleeve is fully retracted, following closure of
the air intake, to seal the air intake from the suction
means; venting means permitting air to enter the
mouthpiece in the retracted position of the sleeve but
5 without breaking the seal, whereby the sleeve is
maintained in its retracted position; and actuating
means arranged upon operation to break the seal and
cause the sleeve to extend.

Preferably, the sleeve is a bellows.

10 The mouthpiece preferably comprises a suction cup.
In a preferred embodiment of the invention the mouthpiece
comprises a sucker which collapses eccentrically when it
makes contact with a sheet of paper, thereby to enable
one to lift an edge or corner of the sheet and initiate
15 a peeling action instead of exerting a direct pull on
the sheet.

Although the valve mechanism of the present
invention preferably uses a straight sleeve, e.g.
bellows, which is extensible and retractable along a
20 rectilinear axis, the valve mechanism of the invention
can alternatively use a sleeve mechanism which is
designed to move or is constrained to move in an arcuate
direction.

With the valve mechanism of the present invention,
25 when a sheet of paper comes to overlie the air intake,
the mouthpiece grips the paper and the cutting off of
the air flow through the intake causes the sleeve to be
retracted. Retraction of the sleeve causes the mouthpiece
also to retract towards the valve body, creating the
30 seal, whereupon the venting means is effective to cause
the paper to be released from the intake, although the
suction means continues to hold the sleeve in the
retracted state.

The mode of operation of this mechanism means that
35 a sheet of paper or like material is grasped by the

-3-

1 mouthpiece, movement is imparted to it in a predetermined
direction for a short time, and thereafter the grip on
the paper is released with the valve mechanism remaining
retracted, i.e. out of the way. It is only upon an
5 interruption of the effect created by the suction means
that the sleeve can extend again to seek another sheet
of paper. This interrupting can be achieved for example
by switching the suction means off and on, or, preferably,
by breaking the seal electromechanically, for example by
10 the use of a solenoid and mechanical linkage. The
latter offers greater flexibility and ease of control,
particularly if the valve mechanism is part of a
computer-controlled system.

 Depending upon how the mouthpiece, or indeed
15 mouthpieces, is/are positioned in relation to the
sleeve, one can exert different forms of control on the
movement of the paper which is grasped at the air
intake. For example, one can use the valve mechanism
simply to move a sheet of paper substantially linearly
20 in a flowing manner, moving the paper either from a
stack to another location within a piece of equipment,
or continuing its motion through a piece of apparatus.
In an alternative arrangement, the valve mechanism of
the present invention can be used to open up folded
25 sheets of paper or like material so that the folded
sheet is opened sufficiently for it reliably to be laid
over a collecting element, such as a bar. This has
particular application to the field of collating folded
sheets for subsequent stitching and binding for example.
30 The valve mechanism of the present invention will find
application in many areas of the paper-handling art, as
will be readily apparent to those skilled in that art.

 In order that the invention may be more fully
understood, a number of embodiments of valve mechanism
35 in accordance with the invention will now be described

1 by way of example, and with reference to the accompanying
drawings.

In the drawings:

5 Fig. 1 is a longitudinal sectional view through a
first embodiment of pneumatic valve mechanism, the
drawing showing the positions of the valve elements both
with the bellows extended and with the bellows retracted;

10 Fig. 2 is a similar longitudinal sectional view
through a second embodiment of valve mechanism, again
with the left-hand part of the drawing showing the
elements as positioned with the bellows extended, and
the right-hand half of the drawing showing those
elements as positioned with the bellows retracted; and

15 Fig. 3 is a similar longitudinal sectional view
through a third embodiment of valve mechanism, again
showing the positions of the elements with the bellows
extended and retracted.

Referring first to Fig. 1, the pneumatic valve
comprises an extensible and retractable sleeve in the
20 form of a bellows 10 having a suction cup 12, which
constitutes a mouthpiece, mounted fixedly at one end
thereof. Within the other end of the bellows 10 there
is fixedly mounted a two-part valve body comprising an
outer valve member 14 and an inner plug 16. The valve
25 member 14 is provided with a circumferential flange 15
to which the end of the bellows 10 is secured. The
forward end of the valve member 14 which extends into
the bellows is rounded and is provided with a central
hole 18 therethrough. The curvature of the rounded end
30 of the valve member 14 is matched to a curved internal
surface 20 of the suction cup 12 so that, as shown in
the right-hand half of Fig. 1, these two surfaces form a
seal when seated one against the other. The valve body
comprising the member 14 and plug 16 defines two
35 independent air-ways. One air-way, as indicated by

1 arrow 21, extends from around the valve member 14,
through a slot 22 in the valve member, and through an
axially extending channel 24 in the plug 16 to a pipe 26
which is connected to a pump 25 or like device to create
5 a reduced air pressure within the bellows 10. This
device 25 is herein referred to as a vacuum source,
although the pump or like device creates a reduced air
pressure or suction air flow, not of course a true
vacuum. The other air-way defined by the valve body is
10 a venting passageway, indicated by arrows 27, defined by
a channel 28 formed axially along the length of the plug
16 which communicates at one end with the hole 18 at the
forward end of the valve member 14 and at the other end
with the ambient air.

15 In operation, with the vacuum source switched on,
when the valve mechanism is to pick up a sheet of paper
or like material, the bellows 10 is triggered to extend
from its retracted position towards the position A-A
of maximum extension indicated at the left-hand side of
20 Fig.1. The vacuum source functions to draw air in
through the air intake defined by the suction cup 12.
As soon as a sheet of paper overlies the cup 12, i.e. as
soon as the suction cup finds a sheet or as soon as a
sheet is presented to the suction cup, whether at the
25 position A-A or before, the flow of air in through the
cup ceases and the vacuum source causes the paper to be
gripped by the cup and the bellows to be fully retracted
to the position corresponding to the cup intake lying in
the plane defined by the line B-B. When the bellows 10
30 is retracted to this position, with the cup still
holding the sheet, the surface 20 of the cup seats
against the forward end of the valve member 14 and forms
a seal which immediately cuts off the vacuum source from
the interior of the cup 12. This, in combination with
35 the venting action through the hole 18, causes the sheet

1 to drop away from the suction cup 12. However, the
release of the sheet from the grip of the cup is not
accompanied by a return of the bellows 10 to its
extended position. It is maintained in its retracted
5 position by the continuing effect of the vacuum source
and by virtue of the seal between the cup 12 and the
valve member 14. The bellows 10 will only return to an
extended position to seek a new sheet when the seal is
broken by interruption of the suction effect created by
10 the vacuum source. That effect can conveniently be
interrupted in this embodiment by switching the vacuum
source off and on again, as indicated schematically in Fig. 1 by a
switch 29 which constitutes an actuating means.

Referring now to Fig. 2, this shows a modified
15 form of pneumatic valve mechanism. In this embodiment
the valve body comprises only the valve member 14, and
the plug is omitted. In this embodiment the whole of
the interior of the valve member 14 is in communication
with the vacuum source 25, although there is no hole in
20 the valve member at its forward end. Instead, an
elongate rod 30 is fixedly secured to the forward end of
the valve member 14 and extends longitudinally of the
valve mechanism. In this embodiment the suction cup 12
is turned through 90° as compared with its orientation
25 in the embodiment shown in Fig. 1. The suction cup 12
is positioned at one end of a mouthpiece 31 which
comprises a moulding of plastics material which incorpor-
ates both the suction cup 12 and also a seat portion 32
which defines the internal curved surface 20 to seat
30 against and seal the curved forward end of the valve
member 14. The mouthpiece 31 also incorporates a plate
34 which is perforated by a hole 36 so that the rod 30
can extend therethrough and slide back and forth in
relation to the hole 36 in the plate 34. The hole 36 in
35 the plate 34 is made sufficiently large for it to act as

1 a venting hole in communication with the interior of the
cup 12.

The manner of operation of this second embodiment is similar to that described above in connection with Fig. 5 1, except that in this case the suction cup 12, being turned through 90°, can exert a different pulling movement on a sheet of paper. The embodiment shown in Fig. 2 is more appropriate for generating a movement of a sheet whereby the sheet is moved in its own plane. The 10 rod 30 can be omitted if desired, leaving just a venting hole 36 in the mouthpiece 31. The rod 30 does exert a guiding action on the movement of the mouthpiece and bellows and can also be used to exert a guiding function on an associated stack of sheets of material which are to 15 be moved under the control of the valve mechanism. When the bellows 10 of the valve mechanism is in its retracted position, the rod 30 extends substantially beyond the forward end of the valve mechanism and can thus be used to guide and control either a stack of sheets or a 20 mechanism associated therewith.

Fig. 3 shows a third, and preferred, embodiment of valve mechanism in accordance with the invention. Here again the valve member 14 is secured to one end of the bellows 10. The valve member 14 is fixedly mounted in a 25 base 40. The valve member is provided with a hole 42 which communicates both with the interior of the bellows and also with a passageway 44 which is connected to a vacuum source (not shown) such as a pump. Arrows 45 indicate the suction air flow out of the compartment or 30 chamber defined by these components. A hollow guide tube 46 extends axially through the valve member 14 and is secured at its one end in the base 40.

Secured to the forward end of the bellows 10 and displaceable with the bellows, is a mouthpiece, indicated 35 generally at 47. The mouthpiece comprises a generally

1 cylindrical tube 48 which is curved or tapered or
otherwise shaped at its rearward end and there carries a
sealing member 50. As can be seen from the right-hand
half of Fig. 3, the sealing member 50 forms a seal with
5 the rounded forward end of the valve member 14 when the
bellows 10 is fully retracted. Mounted centrally within
the axial bore through the tube 48 is a socket 52 which
holds one end of a guide rod 54 which is received at its
other end in the guide tube 46. When the mouthpiece is
10 at its fully extended position the rear end of the guide
rod 54 is still within the end of the guide tube 46, and
when the bellows is fully retracted the rear end of the
guide rod 54, as shown, projects out of the rear end of
the guide tube 46. The guide rod 54 is provided with a
15 surface groove or grooves 55 or is dimensioned in
relation to the internal diameter of the guide tube 46 so
that there is a venting passageway between guide rod and
guide tube from where the guide rod exits from the rear
of the guide tube forwards to where the socket 52 abuts
20 against the forward end of the guide tube 46. Radial
holes or slots 56 are provided at the forward end of the
guide tube 46 to complete the venting passage to the
mouthpiece.

In this embodiment the forward end of the mouthpiece
25 tube 48 is set at an inclined angle and the air intake
proper is defined by a removable boot 58 which fits over
the end of the tube. This boot 58 is made of a relatively
soft material and is shaped and folded so that it will
collapse eccentrically when it comes into contact with a
30 sheet of paper, as shown at the left-hand side of Fig. 3
where the sheet of paper is indicated at 60. This
initiates a peeling action which means that one can lift
a corner or edge of a sheet instead of exerting a direct
tractive force at right-angles to the plane of the paper
35 sheet.

1 With this valve mechanism the suction effect
exerted by the pump on the interior of the bellows is
continuous and is not interrupted in order thereby to
enable the mouthpiece to seek out another sheet.
5 Instead, the seal at 50 is broken by electromechanical
means. A movable arm 62 controlled by a solenoid 64 is
positioned so that when the solenoid is energised the arm
will strike the end of the guide rod 54, pushing the
whole mouthpiece forward and breaking the seal. The
10 bellows 10 then immediately extends, until the air intake
is shut off by the boot 58 contacting the next sheet.

 It should be appreciated that with the valve
mechanism of the present invention the mouthpiece will
pick up a sheet of paper regardless of where the sheet is
15 positioned between the limits A-A and B-B (Fig.1). The
air intake is effective throughout the extension phase of
the bellows movement. Maintaining the bellows retracted
until the actuating means is triggered is also advantageous,
in that access to the zone in front of the mouthpiece is
20 unimpeded.

 The seal between the mouthpiece and valve body may
comprise an actual sealing element or may be achieved
just by the engagement of the two parts if the materials,
shapes and dimensions are appropriate.

25 Although the pneumatic valve mechanism of the
present invention has wide application to all aspects of
the handling of sheet material, it is particularly useful
in conjunction with collating machines. For example, a
plurality of such valve mechanisms can be used in
30 conjunction with a rank of linearly arranged stations at
each of which a stack of sheets of material, such as
paper, is positioned. The top sheet of each stack can be
readied for onward movement, and when detector means
indicate that a sheet is ready in each station then the
35 valve mechanisms can be actuated to move the sheets

-10-

1 simultaneously or sequentially from the respective
stations with the valve mechanisms remaining retracted
out of the way after advance of the sheets.

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1 CLAIMS:

5 1. A pneumatic valve mechanism comprising a
mouthpiece which defines an air intake; an extensible and
retractable sleeve coupled to the mouthpiece to cause the
mouthpiece to move therewith; passage means to connect
the interior of the sleeve to suction means such that
when the sleeve is not fully retracted suction is created
at the air intake; a seal between the mouthpiece and a
10 valve body within the sleeve which is effective when the
sleeve is fully retracted, following closure of the air
intake, to seal the air intake from the suction means;
venting means permitting air to enter the mouthpiece in
the retracted position of the sleeve but without breaking
15 the seal, whereby the sleeve is maintained in its
retracted position; and actuating means arranged upon
operation to break the seal and cause the sleeve to
extend.

20 2. A valve mechanism as claimed in claim 1, in
which the extensible and retractable sleeve is a bellows.

3. A valve mechanism as claimed in claim 1 or 2, in
which the mouthpiece comprises a suction cup.

25 4. A valve mechanism as claimed in claim 3, in
which the suction cup itself defines a sealing surface
engageable with the valve body to form the seal.

5. A valve mechanism as claimed in claim 3, in
which the mouthpiece comprises a generally tubular member
having the suction cup at one end thereof and sealing
means at the other end thereof.

30 6. A valve mechanism as claimed in claim 5, in
which a guide rod extends from the valve body through and
out of the mouthpiece, the venting means comprising an
aperture in the mouthpiece around the guide rod.

35 7. A valve mechanism as claimed in claim 5, in
which the mouthpiece includes a guide rod movable with

1 the tubular member and extending longitudinally through
the bore thereof, the guide rod being received at its
other end in a guide tube rigidly connected to the valve
body, the venting means comprising a passageway between
5 the guide rod and the guide tube.

8. A valve mechanism as claimed in any preceding
claim, in which the mouthpiece comprises a boot which
defines the air intake and which is shaped to collapse
eccentrically when it comes into contact with and grips a
10 sheet of material, thereby to initiate a peeling movement
of the sheet.

9. A valve mechanism as claimed in any preceding
claim, in which said actuating means comprises switching
means arranged to interrupt the effect of the suction
15 means.

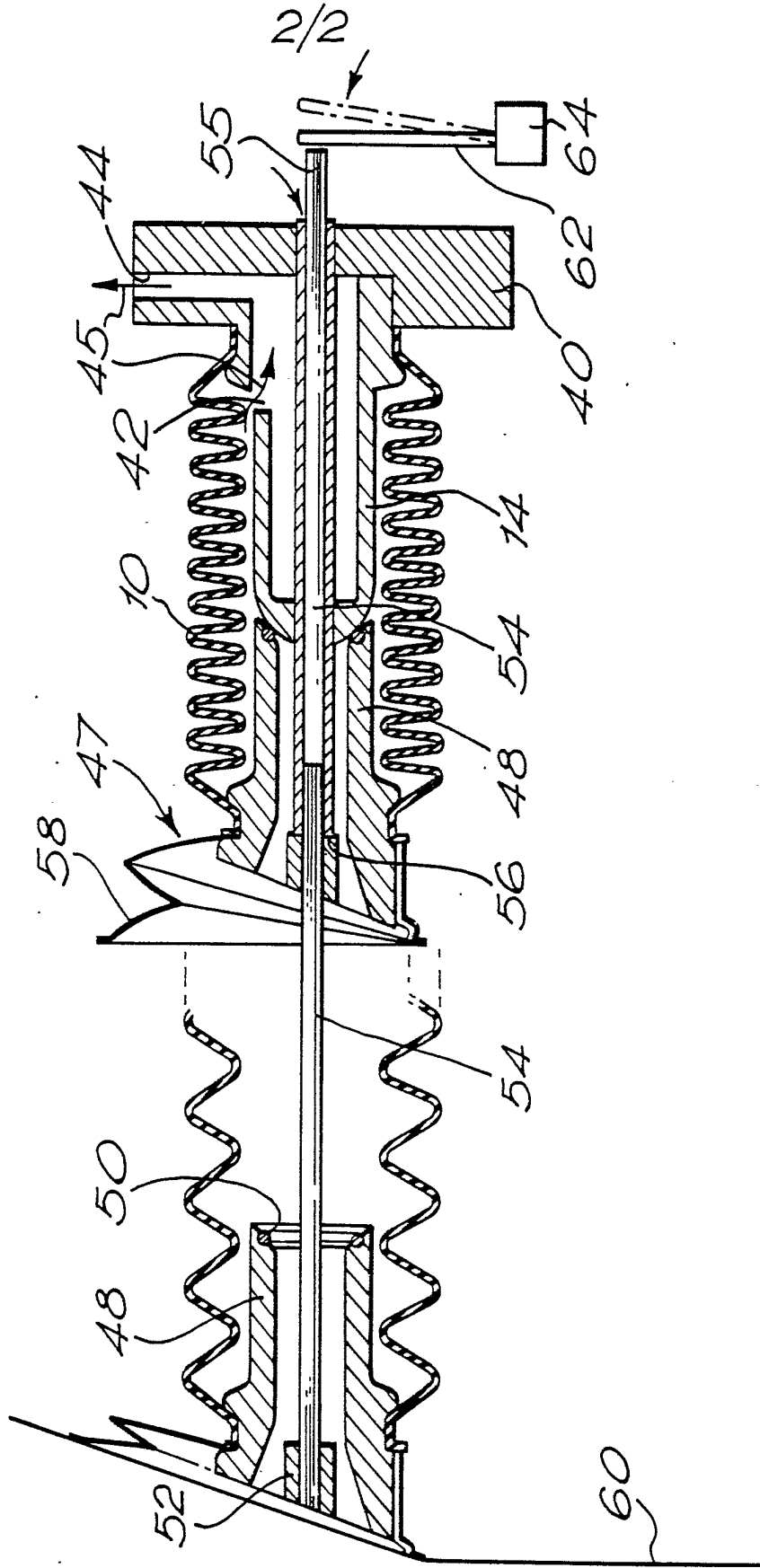
10. A valve mechanism as claimed in any of claims 1
to 8, in which said actuating means comprises electromag-
netic means arranged to control movement of a mechanical
linkage, displacement of which causes the seal to be
20 broken.

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FIG. 3.



SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No **PCT/GB 85/00394**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶

According to International Patent Classification (IPC) or to both National Classification and IPC
IPC⁴: B 65 H 3/08; B 66 C 1/02; B 65 G 47/91

II. FIELDS SEARCHED

Classification System	Minimum Documentation Searched ⁷
IPC ⁴	B 65 H; B 65 G; B 66 C

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are included in the Fields Searched ⁸

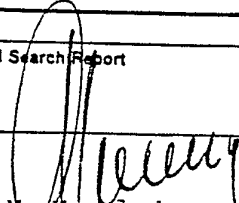
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹

Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	DE, B, 1176816 (BETEILIGUNGS- UND PATENT- VERWALTUNGSGESELLSCHAFT mbH) 27. August 1964, see column 2, line 27 - column 3, line 42; claim 1; figures	1,3,5-7
A	GB, A, 865376 (SPIESS) 19 April 1961, see page 2, lines 5-33; claims 1,4-6; figure	1,3,5
A	DE, B, 2263732 (VITS-MASCHINENBAU GmbH) 14 February 1974, see claims 1,2; figures	1-3,8
A	DE, A, 3016346 (VEB KOMBINAT UMFORMTECHNIK HERBERT WARNKE) 15 January 1981	
A	US, A, 4327906 (FRÖHLICH et al.) 4 May 1982	

¹⁰ Special categories of cited documents:

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>
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IV. CERTIFICATION

Date of the Actual Completion of the International Search 19th November 1985	Date of Mailing of this International Search Report 19 DEC. 1985
International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer  G.L.M. Krüvdenberg

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 85/00394 (SA 10582)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 11/12/85

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-B- 1176816		NL-A- 281176	
GB-A- 865376		None	
DE-B- 2263732	14/02/74	US-A- 3901502 GB-A- 1456399 FR-A- 2330269 JP-A- 49089048	26/08/75 24/11/76 27/05/77 26/08/74
DE-A- 3016346	15/01/81	None	
US-A- 4327906	04/05/82	None	

For more details about this annex :
see Official Journal of the European Patent Office, No. 12/82