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(54) Title: WORKPIECE POSITIONING APPARATUS (57) Abstract Two workpiece portions (30, 32) that are to be stitched together along a stitching path (28) each have a stitching region (24, 26) which corresponds to the stitching path (28), but which is so shaped that the regions do not overlap when the workpieces (30, 32) are in a substantially flat condition. Thus some three-dimensional shaping is imparted to the portions during stitching. Each of the workpiece portions (30, 32) is clamped between two rollers (10, 12, 24) one of which is driven and the other freely rotatable, the driven rollers (10, 12) serving to distort the stitching regions into a desired overlapping position progressively in preparation for each successive stitching operation. The rollers are also bodily movable to advance the workpiece portions (30, 32) step-by-step through the operating locality (4) of the sewing machine. For sensing when the stitching regions are in the desired overlapping relationship suitable edge sensing means (40, 42, 44) is provided.		

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TITLE:WORKPIECE POSITIONING APPARATUS

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DESCRIPTION:Technical Field

The invention relates to workpiece positioning apparatus whereby two workpiece portions can be positioned with selected regions thereof in a desired relationship, e.g. an overlapping relationship, and be progressively advanced, in said relationship, through an operating locality of a machine by which said selected regions are progressively treated, e.g. a sewing machine at the operating locality of which a reciprocable needle is located for effecting a progressive sewing operation along said regions, the apparatus comprising workpiece support means for supporting the workpiece portions, workpiece clamping means co-operable with the workpiece support means for clamping the workpiece portions in the desired overlapping relationship, and advancing means for advancing the workpiece portions, clamped as aforesaid in said relationship, along a desired path through said operating locality.

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Background Art

It is advantageous in the manufacture of certain three-dimensional articles, e.g. shoe uppers, to sew the constituent workpiece portions of the article together in a manner that results in the formation of a three-dimensional construction. This manner of stitching, commonly known as "sprung stitching", is adopted because it imparts a preliminary shape to the sewn article which facilitates the ultimate shaping by stretching the article around a former, which in the case of shoe uppers would be a last.

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Whereas in general the feeding of workpiece portions through the operating locality of a treatment machine, e.g. a sewing machine, is relatively straightforward when the portions are "in the flat", difficulties arise in the case of sprung stitching, essentially because the selected regions to be sewn together will each have a stitching region which, while corresponding to the desired stitching path along which the portions are to be sewn, is shaped such that it does not overlap the region of the other portion along the whole of its length when the workpiece portions are in a substantially flat condition.

The two stitching regions must of course overlap at the time they are presented to the needle in order to ensure that the workpiece portions are sewn accurately together along the desired stitching path. One known method of ensuring that the stitching regions are accurately aligned is to deform and temporarily secure the workpiece portions together as a pre-assembly prior to presentation to the needle. When thus secured in this deformed condition the workpiece portions can be sewn together along the desired stitching path without any further need for positional adjustment of either of them. This method is, however, time-consuming because the deforming and temporarily securing operation is essentially a manual one.

Alternatively, the workpiece portions may be advanced to the operating locality of the machine and the operator must ensure that they are progressively deformed to bring the regions into overlapping relationship as they are fed. In such a case, reliance is thus placed solely on the skill of the operator and the task is time-consuming and requires considerable and sustained concentration.

The Invention

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It is thus an object of the present invention to overcome

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1 the problems associated with the known methods of preparing
two workpiece portions of the type referred to above for
presentation to the operating locality of the treatment
machine. This object is resolved in accordance with the
5 present invention, in an apparatus as set out in the first
paragraph above, in that, for enabling workpiece portions to
be treated having selected regions which do not match one
another along the whole of their length when the portions are
in a substantially flat condition, the workpiece clamping
10 means comprises two elements, one engageable with each of the
workpiece portions, by each of which elements movement of the
workpiece portion engaged thereby can be effected transversely
of said path, while the portion remains clamped as aforesaid,
thus to bring the regions progressively into the desired
15 relationship at said operating locality, and in that drive
means is provided for effecting such movement of the elements.

It will thus be appreciated that in using the apparatus
in accordance with the invention, as the workpiece portions
are progressively advanced through the operating locality the
20 relationship between the selected regions of the portions is
varied, also progressively, to bring the regions into the
desired relationship at the operating locality with the result
that they can then be treated at said locality while held in
that relationship. In this way despite the fact that, when
25 the portions are overlaid "in the flat" the selected regions
do not lie in the desired relationship along the whole of
their length, they can nevertheless be brought into the
desired relationship progressively and be treated while in
this relationship.

30 Preferably in the apparatus in accordance with the
invention each element of the workpiece clamping means is
constituted by a conical roller rotatable about an axis. (The
term "conical" where used herein in relation to rollers is to
understood as including frusto-conical rollers.) Moreover in
35 such a case the two axes intersect with each other at said

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1 operating locality. By using conical rollers each workpiece
portion can be reliably clamped against the workpiece support
means along a line contact while at the same time it can be
rotated, effectively about an axis located at the operating
5 locality, and thus effectively at the last treatment point
along the length of the selected regions, such rotation
bringing the selected regions into the desired relationship
for them to be treated at the next-following treatment point.

Although in some instances it may be advantageous or
10 desirable for the workpiece support means to be constituted by
a flat support member having a low-friction surface, it has
been found generally convenient to provide that the workpiece
support means also comprises two conical rollers, one
associated with each of the rollers of the workpiece clamping
15 means, each roller being rotatable about an axis. Again in
such case the two axes intersect with each other and with the
axes of the rollers of the workpiece clamping means at said
operating locality. In this way the line contact between the
support and clamping surfaces (rollers) is maintained, while
20 allowing for enhanced accessibility to both sides of the
workpiece portions.

Preferably, furthermore, the rollers of the workpiece
support means are freely rotatable, so that the risk of
distortion of the workpiece portion by both sets of rollers
25 being driven can be avoided, while also avoiding the need to
synchronise the drive to the two sets.

For determining when, as the workpiece portions are
progressively advanced, the selected regions are in their
desired relationship, the apparatus in accordance with the
30 invention preferably further comprises sensing means for
detecting edges of the workpiece portions, said means
controlling operation of the drive means whereby under the
control of the sensing means the selected regions of the
workpiece portions are brought progressively into the desired
35 relationship. The sensing means may be of any suitable form,

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1 e.g. mechanical, but preferably is optical and comprises a
plate member interposed between, but projecting from between,
each of the workpiece portions "upstream" of said operating
locality, which member has a surface reflectivity different
5 from that of the workpiece portions and two emitter/receivers,
one associated with each workpiece portion, co-operable with
projecting portions of the plate member to enable the edges of
the workpiece portions to be detected thereby.

In one particular embodiment of the invention the
10 apparatus is constructed and arranged to position selected
regions of two workpiece portions for a sewing operation to be
performed thereon, in which case a reciprocable needle is
located at the operating locality of the machine. In such case
preferably the drive means is actuated in timed relation with
15 reciprocation of the needle of the sewing machine, whereby
transverse movement of the portions is effected while the
needle is in penetrating engagement therewith, while the
advancing means is also actuated in timed relation with
reciprocation of the needle, whereby the portions are advanced
20 while the needle is out of penetrating engagement therewith.

In this way, it will be appreciated, the needle, located
at the last-formed stitch point, provides a centre about which
the workpiece portions can be rotated to bring the selected
regions into the desired overlapping relationship for the next
25 stitch point and then, with the portions clamped in said
relationship, the needle is withdrawn, the workpiece portions
are advanced and the next stitch is then formed at the said
next stitch point.

Preferably the portions are advanced step-by-step by the
30 advancing means, each step representing one stitch length. To
this end, moreover, conveniently the workpiece support means
and the workpiece clamping means are mounted for movement
towards and away from one another, whereby to cause the
workpiece portions disposed therebetween to be clamped as
35 aforesaid and unclamped, and are also mounted each on a

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1 carriage, for advancing and return movement in a direction
along said path, such advancing movement being effected with
the workpiece portions clamped as aforesaid, thus to cause
them to be advanced, and such return movement being effected
5 with the portions unclamped but with the needle in penetrating
engagement therewith.

In the particular embodiment referred to above the axes
of the conical rollers intersect the axis along which the
needle reciprocates at the time when the latter is in
10 penetrating engagement with the workpiece portions.

In using the apparatus in accordance with the invention,
e.g. the particular embodiment referred to above, once the
workpiece portions have been clamped between the rollers of
the workpiece support means and the workpiece clamping means,
15 no further manual intervention is required; the selected
regions of the workpiece portions are automatically aligned by
the workpiece clamping rollers and advanced, step by step, to
the operating locality at which they are treated, e.g.
stitched together, to produce a finished article. It will be
20 appreciated that the automatic alignment of the selected
regions of the workpiece portions represents a significant
time-saving as compared to the procedures previously
practised, e.g. in the case of the pre-assembling operation or
the like.

25 There now follows a detailed description, to be read with
reference to the accompanying drawings, of one workpiece
positioning apparatus in accordance with the invention. It
will be appreciated that this apparatus has been selected for
description merely by way of non-limiting example.

30

The Accompanying Drawings

Figure 1 is a schematic side view of the workpiece
positioning apparatus in accordance with the invention, shown
35 in its operative position in relation to sewing

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1 instrumentalities of a sewing machine;

Figure 2 is a schematic perspective view from the in-feed side of the sewing machine, showing two workpiece portions clamped between workpiece support means and workpiece clamping
5 means of the apparatus, whilst being fed to the needle of the sewing machine during stitching of the workpiece portions;

Figure 3 is a schematic plan view of two workpiece portions being sewn together whilst clamped as aforesaid;

Figure 4 is a schematic side view of the arrangement
10 shown in Figure 3;

Figure 5 is a series of schematic side views illustrating a sequence of steps in the operation of the apparatus;

Figure 6 is a schematic partial plan view illustrating sensing means of the apparatus, more particularly the
15 positioning of a reflective sensor plate thereof between two workpiece portions to be sewn; and

Figure 7 is a schematic view illustrating the relationship between the sensing means and the workpiece portions in the operation of the apparatus.

20

Best Mode

The workpiece positioning apparatus in accordance with the invention now to be described is constructed and arranged to
25 operate in conjunction with a sewing machine having a sewing head 2 (Fig. 1) supporting a conventional reciprocable sewing needle 4, and a workpiece support table 8 arranged at the out-feed side of the sewing needle 4 (workpieces as they are sewn together being advanced from right to left, viewing Fig. 1).

30 Below the support table 8 is housed a bobbin 6 that co-operates with the needle 4 in a conventinal manner. The needle 4 is mounted for reciprocation along an axis A, which lies in the plane of Fig. 1.

The workpiece positioning apparatus, illustrated in Fig.
35 1 in an operative position in relation to the sewing head, has

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1 a frame (not shown) supporting an upper carriage 18 and a
lower carriage 20. The upper carriage 18 is mounted on a
support 50 for heightwise movement relative to the lower
carriage 20 under the action of a pneumatic motor (not shown),
5 for reasons to be discussed below.

Secured to the upper carriage 18 are two cranked upper
supporting arms 14 (one only shown in Fig. 1). The arms 14
are spaced apart, with one arm to either side of a plane which
is parallel to the plane of Figure 1. Each arm 14 has a
10 horizontal portion 36 and a generally downwardly extending
portion 38 inclined to the vertical. At the lower end of each
arm 14 is supported on a pin 11 a frusto-conical roller,
respectively 10 and 22, forming part of workpiece clamping
means of the apparatus. The apparatus also comprises drive
15 means in the form of, for each roller 10 (22), a stepper motor
52 by which the roller is caused to rotate about its axis 11.

Secured to the lower carriage 20 are two lower supporting
arms 16 (one shown in Fig. 1). The lower supporting arms are
spaced apart, with one arm to either side of the plane
20 parallel to that of Fig. 1. Each arm 16 extends generally
upwards, but inclined to the vertical. At the upper end of
each arm 16 is supported on a pin 13 a frusto-conical roller,
respectively 12 and 24, forming part of workpiece support
means of the apparatus. The support rollers 12, 24 which are
25 arranged to co-operate each with one of the rollers 10, 22,
are freely rotatable.

The rollers 10, 12 shown in Fig. 1 are depicted in an
operative position, in which a workpiece portion 30 is clamped
therebetween for presentation to the needle 4 just above the
30 level of the out-feed table 8. The rollers 22, 24 not shown
in Fig. 1 similarly serve to clamp a second workpiece portion
32. The inclinations of the supporting arms 14, 16 are such
that, in their operative position, the axes of rotation of the
rollers (i.e. the axes of the pins 11, 13) intersect with one
35 another and with the axis of reciprocation A of the needle 4.

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1 The set of rollers 10, 12 shown in Fig. 1 and the set
thereof 22, 24 not shown in said Figure are arranged one at
each side of a stitching path 28 (Fig. 3). This stitching
path intersects the axis A at right angles. For advancing the
5 workpiece portions to the needle 4 of the sewing machine
advancing means in the form of synchronised stepping motors
54, 56 is provided, said motors being associated respectively
with the support 50 for the upper carriage 18 and with the
lower carriage 20. More particularly the motors 54, 56 each
10 carry on their output shaft a pinion, respectively 58, 60,
which meshes with a rack, respectively 62, 64, secured to the
support 50 and lower carriage 20 respectively. By the
synchronised operation of the motors 54, 56 the arms 14, 16
and the rollers 10, 12, 22, 24 supported thereby can be moved
15 forwardly and rearwardly along a workpiece feed direction
indicated by the arrow F (Fig. 3), as will be explained in
greater detail below with reference to Fig. 5.

Fig. 2 illustrates schematically how the two sets of
rollers 10, 12 and 22, 24 engage two workpiece portions 30, 32
20 that are to be sewn together by the needle 4. The two
workpiece portions 30, 32 would typically be shoe upper
components that, when sewn together, are to form a three-
dimensional construction, but may alternatively comprise two
portions of a single shoe component to be closed by stitching.

25 With reference to Fig. 3, the two workpiece portions 30,
32, each having a selected (hereinafter "stitching") region
24, 26 which must be conformed respectively to the stitching
path 28, are shown partially sewn together by the needle 4.
(In Fig. 3 one stitching region is denoted by a row of dots
30 and the other by a row of xs.) The shapes of the workpiece
portions 30, 32 are such that when the portions are in a
substantially flat condition, the stitching regions 24, 26 do
not overlap along the whole of their length; this can be seen
in Fig. 3 from the fact that the stitching regions 24, 26
35 diverge at the in-feed side of the needle 4, adjacent the

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1 rollers 10, 12, 22, 24. The stitching regions 24, 26 are each spaced by a known distance from the edge of the respective workpiece portions 30, 32.

As the stitching regions 24, 26 do not overlap, in order
5 to stitch the workpiece portions together along the desired stitching path 28 they must first be distorted so as to force the stitching regions 24, 26 into an overlapping relationship in advance of the needle 4. To this end, the rollers 10, 12, 22, 24 co-operate to rotate the workpiece portions 30, 32
10 relative to one another, about an axis designated S coincident with the point of intersection of the roller axes, sufficiently to bring the stitching regions 24, 26 into the desired overlapping relationship.

In the apparatus now being described this axis is
15 coincident with the axis of reciprocation A of the needle 4 while the latter remains in penetrating engagement with the workpiece portions at the last-formed stitch point (as shown in Figure 3). When each set of rollers is in engagement with its respective workpiece portion, rotating the rollers thus
20 has the effect of rotating said portion about the axis S, which is also the nearest point to the rollers at which the workpiece portions are secured together. In effect, therefore, the portions 30, 32 are rotated about the last-formed stitch point. Simultaneously rotating the workpiece
25 portions thus results in the unstitched stitching regions 24, 26 being urged into their desired overlapping relationship, progressively for each stitch formation, by transverse movement thereof, i.e. left or right as viewed in Fig. 3, with respect to the workpiece feed direction F. Once transverse
30 movement of the workpiece portions 30, 32 has taken place and the stitching regions 24, 26 have been forced into their desired overlapping relationship rotation of the rollers ceases. The workpiece portions 30, 32 are then held clamped in position during rotation of the needle 4 and the advancing
35 of the workpiece portions 30, 32 to bring the next stitch

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1 joint to coincidence with the axis of reciprocation A of the
needle. The process is then repeated until the two workpiece
portions 30, 32 are sewn together along the whole of the
stitching path 28.

5 Fig. 4 shows the effect that is achieved by sewing the
workpiece portions 30, 32, producing a three-dimensional form
from the initially two-dimensional portions. As can be seen
in Fig. 4, the distortion of the workpiece portions 30, 32
causes them, when sewn, to "curl upwards" beyond the needle 4.

10 Fig. 5 shows a sequence of operating steps designated i
iv, by which one (30) of the workpiece portions is fed to the
needle 4. The same sequence is followed by the other portion
32. As depicted in step i, the workpiece portion is clamped
by the rollers 10, 12. At this time the needle 4 is in
15 penetrating engagement with the workpiece portion 30 (and thus
the axes A and S are coincident). Whilst the workpiece
portion 30 is thus clamped, the roller 10 is rotated so as to
rotate the portion 30 about the axis S and the other portion
32 is similarly rotated until the stitching regions 24 thereof
20 are, so far as concerns the next stitch point, in the desired
overlapping relationship. The support rollers 12, 24 rotate
freely with the workpiece portions 30, 32.

In step ii the needle 4 is withdrawn from the workpiece
portions 30, 32 and thereafter the rollers 10, 12, 22, 24 are
25 advanced by the action of the motors 54, 56 through one stitch
length, while the portions 30, 32 remain clamped in said
relationship.

In step iii the next stitch is formed by the needle again
penetrating the workpiece portions 30, 32 and, following such
30 penetration, the rollers 10, 12, 22, 24 are simultaneously
disengaged from the workpiece portions 30, 32 by the upper
carriage 18 being raised relative to the support 50 and are
returned to the initial position under the action of motors
54, 56.

35 In step iv the rollers 10, 12, 22, 24 are again moved

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1 into engagement with the workpiece portions 30, 32 by lowering
the upper carriage 18 relative to the support 50 and thus are
again in operative position.

The cyclical process until the stitching of the workpiece
5 portions 30, 32 is completed along the whole of stitching path
28.

For controlling the movement of the workpiece portions
30, 32 in order to align the stitching regions 24, 26 in the
desired overlapping relationship the apparatus in accordance
10 with the invention further comprises sensor means (Fig. 6 and
7). The sensor means controls the operation of the stepper
motors 52 that rotate the rollers 10, 22 by sensing the
position of the edge of each workpiece portion 30, 32. (As
already mentioned, each stitching region 24, 26 of each
15 workpiece portion is a known distance away from such edge.)

The sensor means comprises a reflective sensor plate 40, which
is accommodated between the two workpiece portions 30, 32 but
projects from between them, in advance of the needle 4, more
particularly in the region of the next-following stitch
20 points, together with two sensors 42, 44, one associated with
each of the projecting portions of the plate 40. Each of the
sensors 42, 44 is located at the opposite side of the
workpiece portion, whose edge is to be sensed thereby, to the
reflective sensor plate 40. Each sensor 42, 44 contains a
25 light emitter and receiver. Light is emitted from the sensor
42, 44 and reflected by the reflective plate 40 to the
receiver, so long as the path from the sensor 42, 44 to the
reflective plate is not interrupted by the workpiece portion.
In the event of interruption of the light from the sensor 42
30 or 44 to the reflective plate 40, a signal is generated in
response to which the appropriate motor 52 is caused to cease
operation and its associated roller 10, 22 thus ceases
rotation. By way of example, in the case of the portion 30,
the rotation of the roller 10 may produce a movement of the
35 portion from left to right (viewing Figures 6 and 7). The

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1 sensor 40 is so positioned that the path between the emitter
and the reflective plate 40 is interrupted when the portion 30
has moved a sufficient distance to the right, that is, when
the portion 30 has reached a position in which it will be in
5 the desired overlapping relationship with the other portion 32
when the latter has been moved similarly. Once the light from
the emitter to the reflective plate 40 has been interrupted,
lateral movement of the portion 30 under the action of motor
52 ceases. Sometimes, it will be appreciated, the workpiece
10 portion may already be interrupting the light, in which case
movement in the opposite direction will be necessary. In such
case the portion will be moved until the light just ceases to
be so interrupted.

Whereas the invention has been described above with
15 specific reference to a sewing machine, it will be appreciated
that it is also applicable in other cases where workpiece
portions are advanced progressively to an operating locality,
whether step-by-step or continuously, e.g. a machine for
securing workpiece portions together by means of adhesive.

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1 CLAIMS:

1. Workpiece positioning apparatus whereby two workpiece portions (30,32) can be positioned with selected regions (24,26) thereof in a desired relationship and be progressively advanced, in said relationship, through an operating locality (4) of a machine by which said selected regions (24,26) are progressively treated, the apparatus comprising

workpiece support means (12,24) for supporting the workpiece portions (30,32),

workpiece clamping means (10,22) co-operable with the workpiece support means (12,24) for clamping the workpiece portions (30,32) in the desired relationship, and

advancing means (54,56) for advancing the workpiece portions (30,32), clamped as aforesaid in said relationship, along a desired path (28) through said operating locality (4), **characterised in** that, for enabling workpiece portions (30,32) to be treated having selected regions (24,26) which do not match one another along the whole of their length when the portions (30,32) are in a substantially flat condition, the workpiece clamping means (10,22) comprises two elements (10,22), one engageable with each of the workpiece portions (30,32), by each of which elements (10,22) movement of the workpiece portion (30,32) engaged thereby can be effected transversely of said path (28), while the portion (30,32) remains clamped as aforesaid, thus to bring the regions (24,26) progressively into the desired relationship at said operating locality (4),

and in that drive means (52) is provided for effecting such movement of the elements (10,22).

2. Workpiece positioning apparatus whereby two workpiece portions (30,32) can be positioned with selected regions (24,26) thereof in an overlapping relationship and be progressively advanced, in said relationship, through an

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1 operating locality (4) of a sewing machine, at which locality
a reciprocable needle (4) of the machine is located for
effecting a progressive sewing operation along said regions
(24,26), the apparatus comprising

5 workpiece support means (12,24) for supporting the
workpiece portions (30,32),
workpiece clamping means (10,22) co-operable with the
workpiece support means (12,24) for clamping the workpiece
portions (30,32) in the desired overlapping relationship, and

10 advancing means (54,56) for advancing the workpiece
portions (30,32), clamped as aforesaid in said relationship,
along a desired path (28) through said operating locality (4),
characterised in that, for enabling workpiece portions (30,32)
to be treated having selected regions (24,26) which do not

15 overlap along the whole of their length when the portions
(30,32) are in a substantially flat condition, the workpiece
clamping means (10,22) comprises two elements (10,22), one
engageable with each of the workpiece portions (30,32) , by
each of which elements (10,22) movement of the workpiece

20 portion (30;32) engaged thereby can be effected transversely
of said path (28), while the portion (30;32) remains clamped
as aforesaid, thus to bring the regions (24,26) progressively
into the desired relationship at said operating locality (4),
and in that drive means (52) is provided for effecting such

25 movement of the elements (10,22).

3. Apparatus according to Claim 2 characterised in that the
drive means(52) is actuated in timed relation with
reciprocation of the needle (4) of the sewing machine, whereby

30 transverse movement of the portions (30,32) is effected while
the needle (4) is in penetrating engagement therewith,
and in that the advancing means (54,56) is also actuated in
timed relation with reciprocation of the needle (4), whereby
the portions (30,32) are advanced while the needle (4) is out

35 of penetrating engagement therewith.

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1 4. Apparatus according to Claim 3 characterised in that the
workpiece support means (12,24) and the workpiece clamping
means (10,22) are mounted for movement towards and away from
one another, whereby to cause the workpiece portions (30,32)
5 disposed therebetween to be clamped as aforesaid and
unclamped, and are also mounted each on a carriage (18;20),
for advancing and return movement in a direction along said
path (28), such advancing movement being effected with the
workpiece portions (30,32) clamped as aforesaid, thus to cause
10 them to be advanced, and such return movement being effected
with the portions (30,32) unclamped but with the needle (4) in
penetrating engagement therewith.

5. Apparatus according to Claim 1 characterised in that each
15 element (10;22) of the workpiece clamping means (10,22) is
constituted by a conical roller (10;22) rotatable about an
axis (11),
and in that the two axes (11) intersect with each other at
said operating locality (4).

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6. Apparatus according to Claim 2 characterised in that each
element (10;22) of the workpiece clamping means (10,22) is
constituted by a conical roller (10;22) rotatable about an
axis (11),
25 and in that the two axes (11) intersect with each other and
with an axis (A) along which the needle (4) reciprocates.

7. Apparatus according to Claim 5 characterised in that the
workpiece support means (12,24) comprises two conical rollers
30 (12,24), one associated with each of the rollers (10,22) of the
workpiece clamping means (10,22), each roller (12;24) being
rotatable about an axis (13),
and in that the two axes (13) intersect with each other and
with the axes (11) of the rollers (10,22) of the workpiece
35 clamping means (10,22) at said operating locality (4).

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1 8. Apparatus according to Claim 6 characterised in that the
workpiece support means (12,24) comprises two conical rollers
12,24), one associated with each of the rollers (10,22) of the
workpiece clamping means (10,22), each roller (12,24) being
5 rotatable about an axis (13),
and in that the two axes (13) intersect with each other and
with the axes (11) of the rollers (10,22) of the workpiece
clamping means (10,22) and with the axis (A) along which the
needle (4) reciprocates.

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9. Apparatus according to Claim 4 characterised in that the
rollers (12,24) of the workpiece support means (12,24) are
freely rotatable.

15 10. Apparatus according to Claim 2 further characterised by
sensing means (40,42,44) for detecting edges of the workpiece
portions (30,32), said means (40,42,44) controlling operation
of the drive means (52) whereby under the control of the
sensing means (40,42,44) the selected regions (24,26) of the
20 workpiece portions (30,32) are brought progressively into the
desired relationship.

11. Apparatus according to Claim 10 characterised in that the
sensing means (40,42,44) comprises a plate member (40)
25 interposed between, but projecting from between, each of the
workpiece portions (30,32) "upstream" of said operating
locality (4), which member (40) has a surface reflectivity
different from that of the workpiece portions (30,32) and two
emitter/receivers (42,44), one associated with each workpiece
30 portion (30,32), co-operable with projecting portions of the
plate member (40) to enable the edges of the workpiece
portions (30,32) to be detected thereby.

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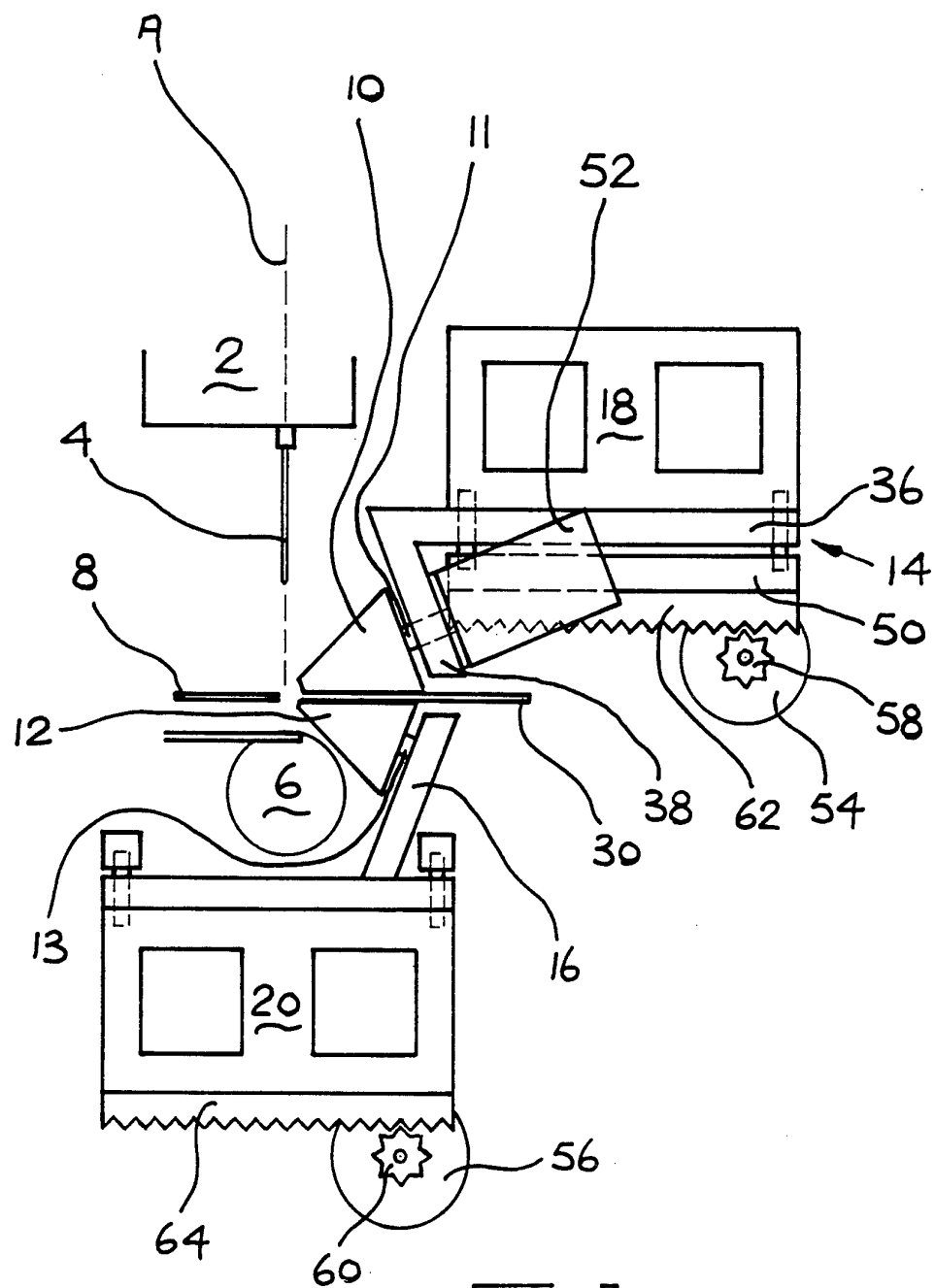


Fig. 1

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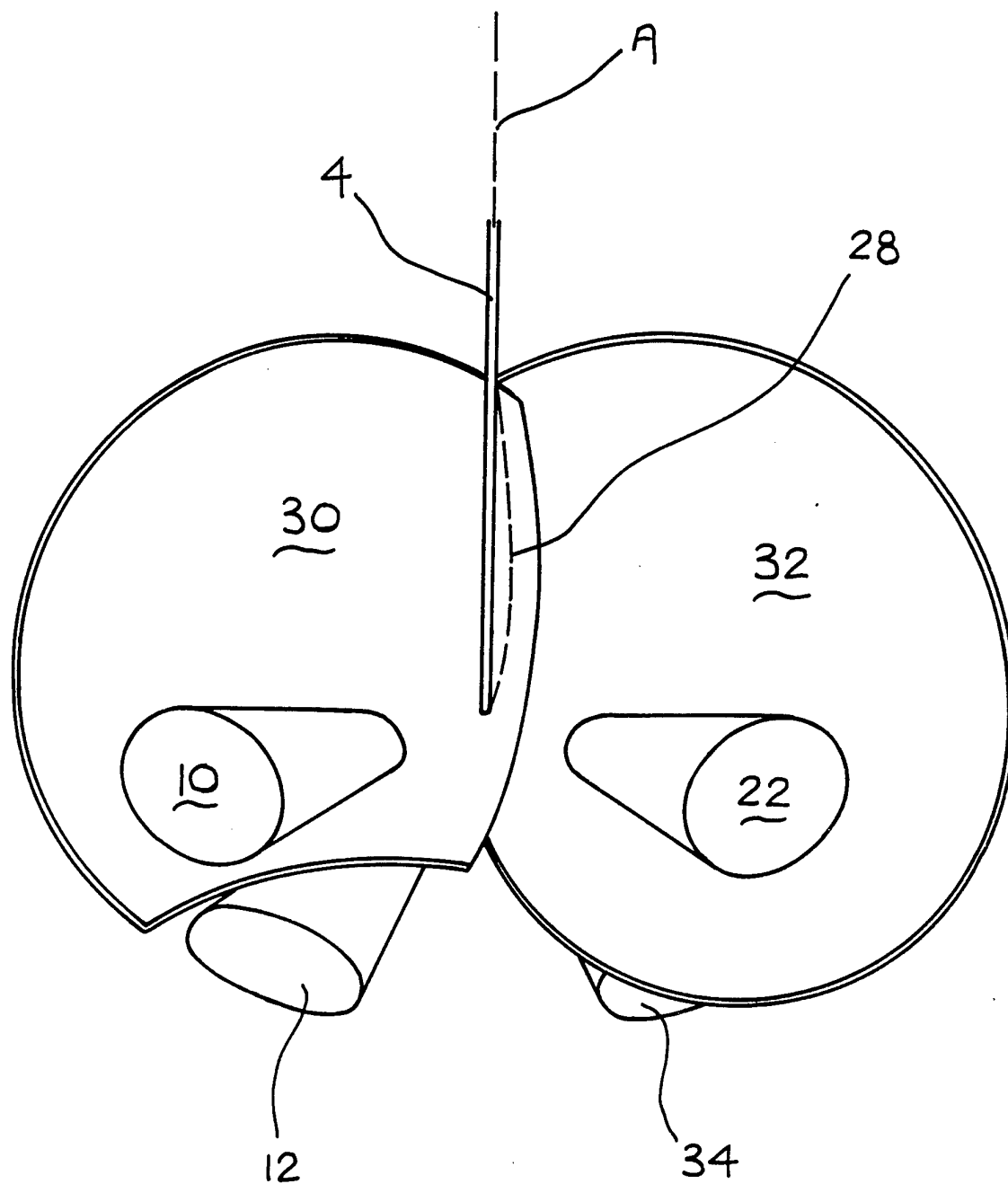


Fig-2

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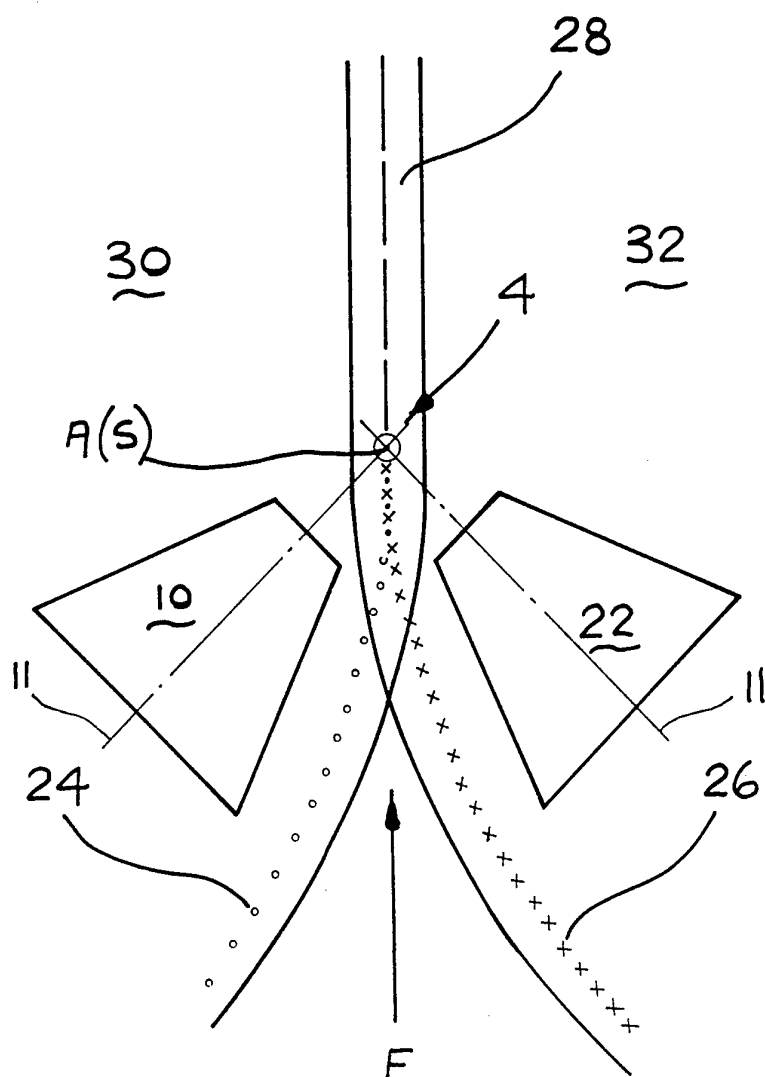
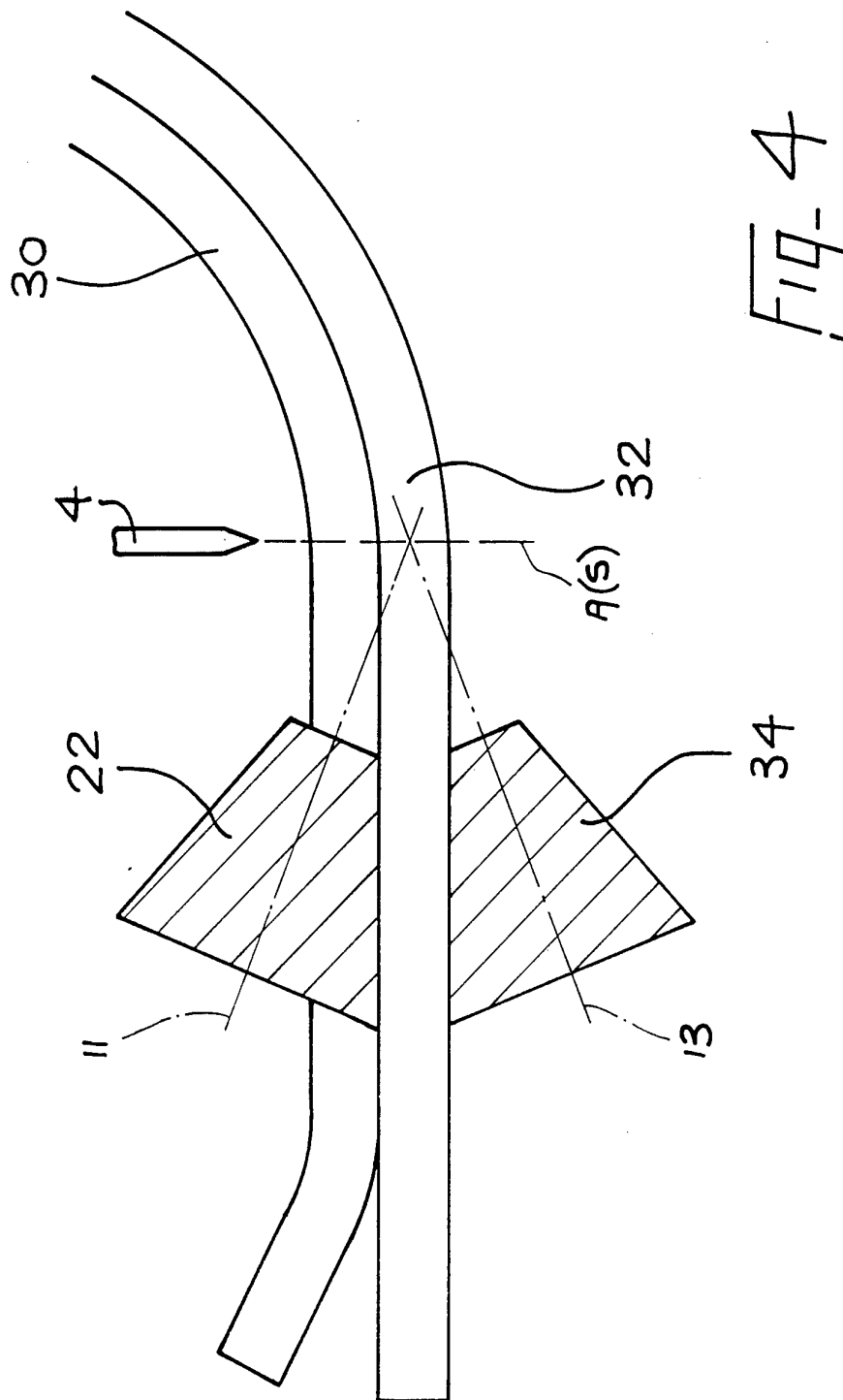


Fig-3



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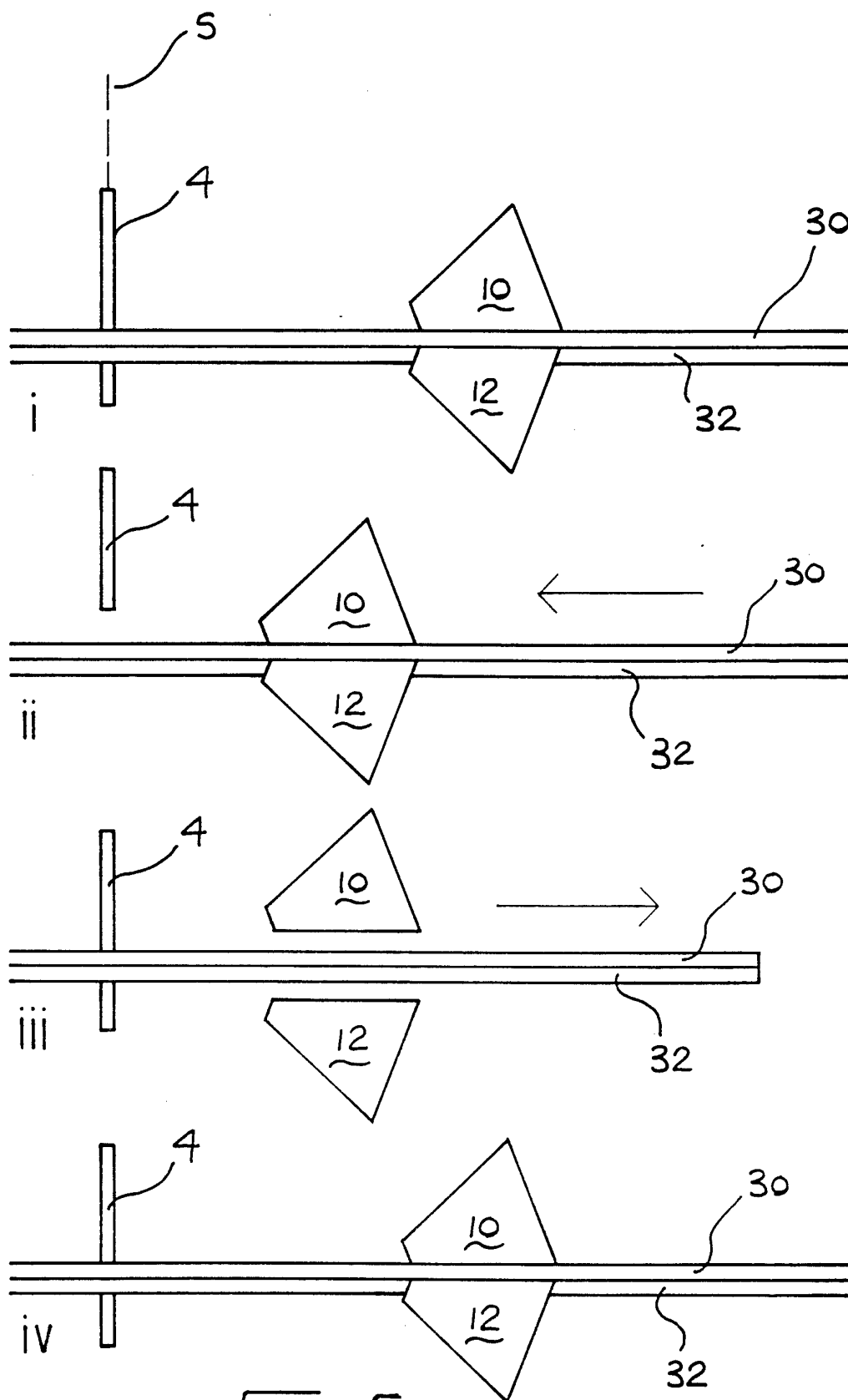


Fig-5

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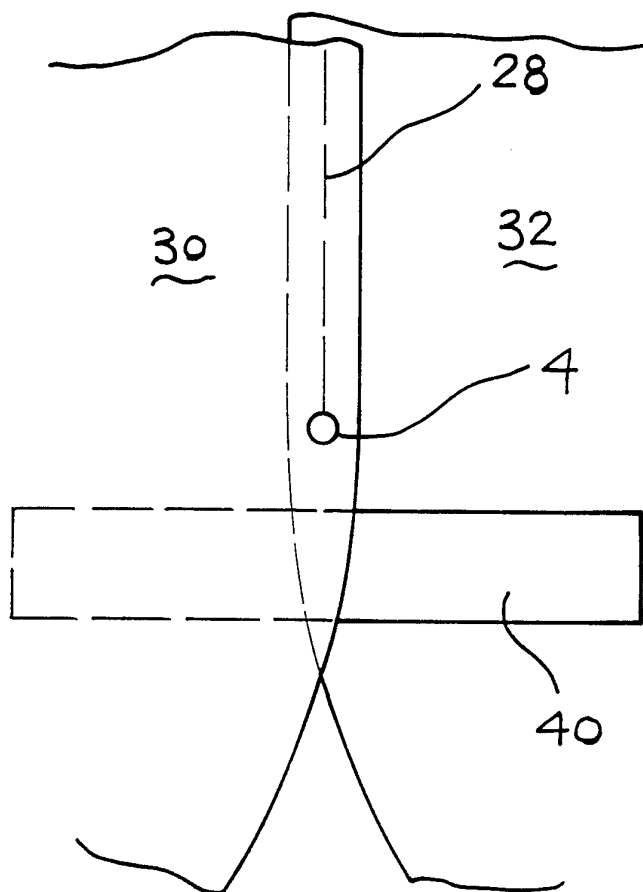


Fig- 6

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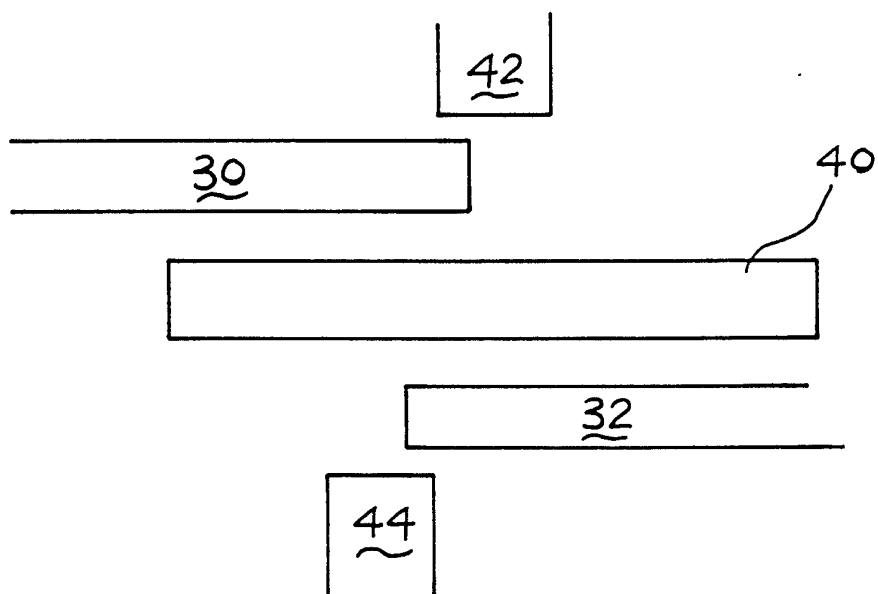


Fig-7

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INTERNATIONAL SEARCH REPORT

Int. onal Application No

PCT/GB 93/01839

A. CLASSIFICATION OF SUBJECT MATTER

IPC 5 D05B35/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 D05B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR,A,2 585 683 (BERTIN & CIE.) 6 February 1987 see the whole document ---	1-3, 10, 11
A	DE,A,28 22 634 (VEB RATIONALISIERUNG KONFEKTION) 26 April 1979 see claims; figures -----	1, 2, 10, 11



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

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- "O" document referring to an oral disclosure, use, exhibition or other means
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"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

25 November 1993

Date of mailing of the international search report

15. 12. 93

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 93/01839

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A-2585683	06-02-87	EP-A, B 0216644 JP-B- 1054072 JP-C- 1568249 JP-A- 62034589 US-A- 4730824	01-04-87 16-11-89 10-07-90 14-02-87 15-03-88
DE-A-2822634	26-04-79	NONE	