(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 190 846**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **86300443.8**

(51) Int. Cl.[4]: **B 41 F 17/00**

(22) Date of filing: **23.01.86**

(30) Priority: **23.01.85 GB 8501686**

(43) Date of publication of application:
13.08.86 Bulletin 86/33

(84) Designated Contracting States:
DE FR IT

(71) Applicant: **Devco Limited**
Statham Street Hanley
Stoke-on-Trent Staffordshire(GB)

(72) Inventor: **Cartlidge, C.D.J.**
c/o Devco Limited Statham Street
Hanley Stoke-on-Trent Staffordshire(GB)

(74) Representative: **MacMaster, Alan Jeffrey et al,**
Swindell & Pearson 44 Friar Gate
Derby DE1 1DA(GB)

(54) **Multi-colour printing.**

(57) A multi-colour printing apparatus comprises a vertically movable non-rotatable printing member, a support for ware to be decorated locatable in a position beneath the printing member and a plurality of transfer members disposed angularly around the central vertical axis of the printing member at a level between the printing member and the ware support. The transfer members are sequentially movable into positions between the printing member and the ware support to permit transfer of printed images from the transfer members to the printing member for subsequent application to ware mounted on the ware support.

EP 0 190 846 A2

Croydon Printing Company Ltd

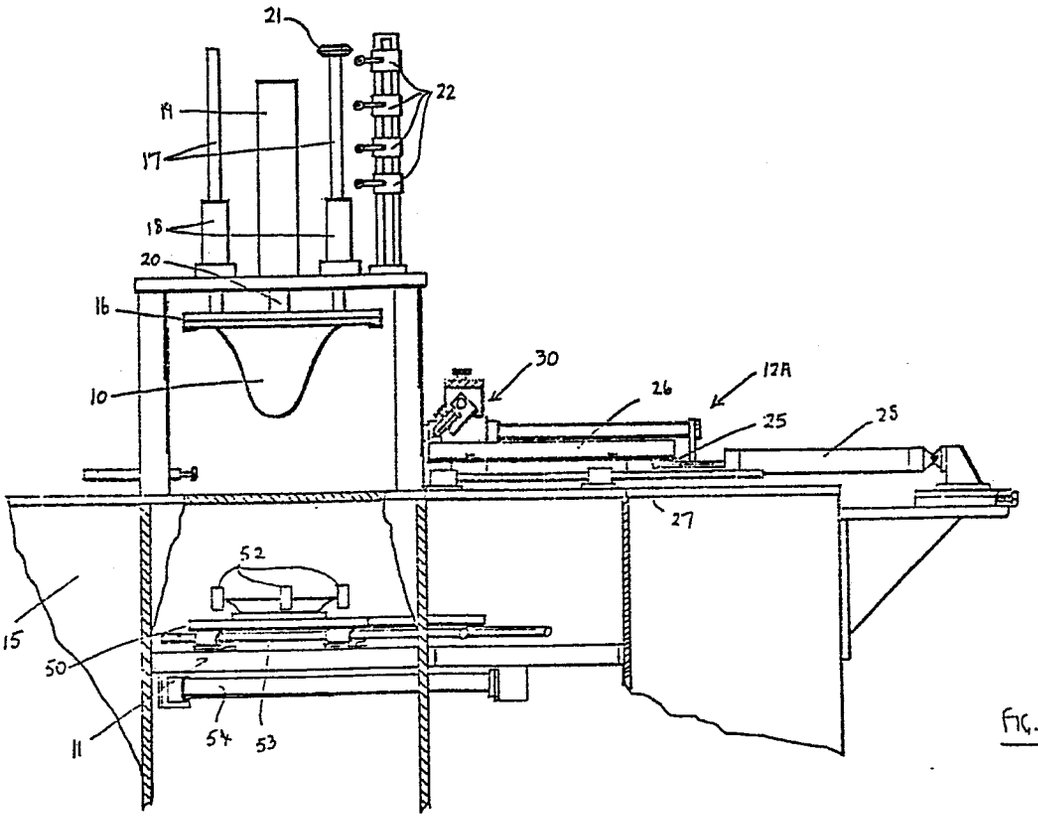


FIG. 2

0190846

Multi-Colour Printing

This invention relates to multi-colour printing. The invention is especially, but not exclusively, applicable to the printing of articles of ceramic ware but may be used for printing other articles. The term "multi-colour" is used herein to refer to the application of two or more colours.

Multi-colour printing of articles is effected by applying individual colours to the article successively. For this to be effective it is essential that precise registration is achieved between the successive printings otherwise the image will become distorted. Most commercially available multi-colour printing apparatus for use in the ceramic industry requires that the article of ware being decorated is moved successively between printing stations at each of which an additional colour printing is applied. This causes substantial registration problems and also involves duplication of printing appartus with consequential increase in cost and complexity.

It is an object of the present invention to obviate or mitigate this disadvantage.

The invention provides multi-colour printing apparatus comprising a vertically movable non-rotatable printing member, a support for ware to be decorated locatable in a position beneath the printing member and a plurality of transfer members disposed angularly

around the central vertical axis of said printing member at a level between same and said ware support, the transfer members being sequentially movable into positions between said printing member and said ware support whereby to permit transfer of printed images therefrom to said printing member for subsequent application to ware mounted on said support.

Preferably said transfer members comprise generally flat plates on which is etched or engraved a portion of the pattern or decoration to be applied to the articles of ware, each transfer member being provided with doctor means and control means being provided to effect doctoring of each plate during transfer to the ware of the image from the preceding plate.

Preferably also said doctor means is operable following transfer of an image from the associated plate to re-ink the plate in readiness for the next operating cycle. For this purpose the doctor means preferably incorporates a doctor blade mounted for pivotal movement between inking and doctoring positions and adapted for bodily movement relative to the associated plate in both operative positions of the latter.

Preferably also each of said transfer members incorporates controllable heating means operable to maintain the transfer member at a temperature which will ensure complete transfer of heat sensitive inks from the transfer member to said printing member during

operation.

Preferably said ware support is mounted on a carriage arranged to be horizontally movable between a decorating position disposed vertically beneath said printing member and a loading and unloading position convenient to a machine operator. For this purpose the ware support may be slidably movable in a direction radially of said printing member in an angular direction intermediate the angular positions of adjacent ones of said transfer members. The ware support preferably incorporates means for centring ware mounted thereon and for securing the centred ware against movement during operation.

Preferably said printing member comprises a pad of deformable material such as silicone.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying diagramatic drawings, in which:

Fig. 1 is a sketch illustrating the general arrangement of the principal components of a multi-colour printing apparatus according to the invention;

Fig. 2 is a vertical section through the apparatus showing one printing station;

Fig. 3 is an enlarged perspective view of a doctor mechanism incorporated in the appartus;

Figs. 4A to 4D illustrate the sequence of

operation of the doctor mechanism;

Fig. 5 is a vertical cross section through a transfer member incorporated in the appartus;

Fig. 6 is an exploded perspective view showing the components of the transfer member of Fig. 5;

Fig. 7 is a perspective view of a ware support incorporated in the appartus; and

Figs. 8A to 8D illustrate the operation of the printing cycle.

Referring to Fig. 1 the apparatus incorporates a central vertically movable printing member 10 in the form of a deformable silicone pad beneath which a ware support 11 is mounted. Four transfer members 12A to 12D are disposed angularly around the axis of movement of the printing member 10 at a level between the printing member and the ware support and are arranged to be slidably movable in turn into positions between the printing member and the ware support whereby patterns printed on each of the transfer members in different colours may be picked up by the printing member in turn and following withdrawal of the transfer member applied to ware mounted on the support 11 by downward movement of the printing member.

Referring now to Fig. 2 the apparatus is shown in greater detail and comprises a support frame 15 on which the printing member 10, ware support 11 and transfer members 12A to 12D are mounted. Only the transfer

member 12A is shown in Fig. 2. The printing pad 10 is carried by a rigid backing plate 16 having upwardly extending guides 17 slidably mounted in collars 18 fixed to the frame of the machine. A hydraulic cylinder 19 is mounted above the pad 10 and between the guides 17 and has a piston rod 20 extending through the frame and connected to the mounting plate 16. The cylinder 19 may be extended to move the pad 10 vertically downwards and retracted to withdraw it to the position shown in Fig. 2. During such movement the pad is stabilised by the guide members 17 which also serve to prevent rotation of the pad. The pad is therfore constrained so that it may move in a vertical direction only and cannot rotate or move horizontally. An actuating member 21 mounted on one of the guides 17 is adapted to act on control valves 22 mounted vertically adjacent the guide 17 to effect operation of related parts of the equipment in the desired sequence during printing operations.

Each of the transfer members comprises a carrier 25 supporting a generally flat metal plate 26 on which the design or pattern to be applied to the articles to be decorated is etched or engraved. The carrier 25 is slidably mounted on horizontal rails 27 and is adapted to be moved by operation of a hydraulic cylinder 28 between a retracted position shown in Fig. 2 and an extended position in which the transfer member is located between the printing pad 10 and the ware support

11. A doctor mechanism 30 is associated with the plate 26 and is operative to apply ink thereto and to scrape the plate so as to remove ink from the surface except in the areas of the etched or engraved pattern. A similar transfer member and doctor assembly is provided at each of the four locations 12A to 12D, all the plates being engraved with portions of the pattern and each having a different colour of printing ink applied thereto during operation whereby successive colours are applied in sequence to appropriate regions of the pattern during the printing operation.

The doctor assembly is shown in greater detail in Fig. 3 of the drawings and comprises a support or bridge member 31 extending across the path of horizontal movement of the engraved plate 26 and supporting a horizontal shaft 32 rotatably mounted in support blocks 33 and movable between alternative positions of use by a rotary actuator 34. A blade carrier 35 is mounted on the shaft 32 and carries a flexible doctor blade 36 of rubber or similar material which acts on the surface of the engraved plate during operation. Threaded adjustors 37 act between the bridge member 31 and support blocks 33 to provide for adjustment of the blade 36 relative to the surface of the plate on which it acts.

The doctor assembly is arranged both to apply ink to the plate 26 and to scrape or doctor it so as to remove the ink from the high points of the plate but

leave it in the engraved or etched portions. The operation of the mechanism is shown in Figs. 4A to 4D. Fig. 4A shows the rest position of the unit in which the blade 36 is in an inclined position such that its free edge is spaced slightly above the surface of the plate 26. The latter is adapted to be moved horizontally by means of the hydraulic cylinder 28 referred to previously and the doctor mechanism is connected to a similar hydraulic cylinder 38 for movement parallel to the surface of the plate 26. In the position shown in Fig. 4A of the drawings the cylinder 28 is retracted to maintain the plate 26 in its retracted inking position and the cylinder 38 is extended to position the doctor blade 36 in an outer position adjacent the outer end of the plate 26.

When actuated at the appropriate stage in the operating cycle the doctor blade 36 is first rotated into a vertical position in which it is pressed into close contact with the surface of the engraved plate which as been previously coated with printing ink. Cylinder 38 is then retracted to draw the blade 36 across the surface of the plate 26 thereby removing ink from the high points of the surface but leaving ink in the engraved recesses corresponding to selected areas of the pattern to be applied to the articles being

decorated. This position of the apparatus is shown in Fig. 4B. Thereafter the cylinders 28 and 38 are similtaneously extended to move the plate 26 and scraper assembly to their extended positions in which the plate is disposed beneath the printing pad 10. No relative movement takes place at this stage between the plate 26 and the scraper blade 36 and subsequently the printing ink is picked up from the plate 26 by the printing member. Thereafter the blade 36 is moved to its inclined position and cylinder 28 is retracted to draw the plate 26 into its retracted position shown in Fig. 2 of the drawings. Relative movement thus takes place between the surface of the plate 26 and the blade 36 and since the latter is in its tilted position this serves to spread a coating of printing ink introduced behind the blade 36 over the entire surface of the plate 26. The appartus is then in the position of Fig. 4A ready for the next operating cycle.

Transfer of printed images from the plate 26 to the printing pad 10 and from the latter to the surface of the ware to be decorated is dependent on the temperatures of the surfaces in contact with the ink images at these different stages. In order to ensure complete release of the printing ink from the engraved plate the latter requires to be maintained at a predetermined temperature. For this purpose the transfer member incorporates heating means.

Referring to Figs. 5 and 6 the engraved plate 26 is mounted in a tray 40 by means of a clamping plate 41 acted on by adjustment screws 42. A heating unit comprising a top plate 43, a heater 44, an insulating plate 45 and a bottom plate 46 is clamped beneath the tray 40 and a temperature sensitive probe 47 is connected to the heater 44 and to control means operable to maintain same at a constant temperature dependent on readings from the probe. The entire assembly is slidably mounted on spaced parallel rods 27 along which it is horizontally movable by operation of the cylinder 28.

The ware support 11 is shown in Fig. 2 and in greater detail in Fig. 7. It comprises a table 50 incorporating a central mount 51 for articles of ware connected to a vacuum source operable to retain ware in position once centred by centring arms 52. The table 50 is mounted on a pair of spaced parallel rods 53 and is directly connected to a hydraulic cylinder 54 for movement along the rods 53 by introduction of hydraulic fluid to one or other end of the cylinder. Hydraulic dampers 55 are provided to arrest movement of the platform 50 at each end of its travel which takes place in a radial direction relative to the vertical axis of the printing member 10 and at an angular location between adjacent ones of the transfer members 12. In its inner or printing position the ware support is

disposed in vertical alignment with the printing member 10. In its outer or loading position the ware support is readily accessible to an operator or to automatic loading and unloading apparatus.

Fig. 8 of the drawings diagramatically illustrates the printing operation. In Fig. 8A the printing member 10 is shown in its raised position and one of the transfer members 12 has been located between the printing member and an article 60 to be decorated supported on the ware support 11. The printing member 10 is then moved vertically downwards as shown in Fig. 8B into contact with the plate 12 from which it picks up the printing ink retained in the engraved portions of the plate. The printing member is then raised clear of the transfer member 12 which is withdrawn to its retracted position leaving the printing member disposed vertically above the article 60 as shown in Fig. 8C. The printing member 10 is then moved vertically downwards into contact with the surface of the article 60 to transfer the printed image thereto. Thereafter the printing member is withdrawn to its uppermost position and the next transfer member 12 is moved into the position shown in Fig. 8A, following which the sequence is repeated. In the embodiment four cycles are carried out to effect complete printing but this could of course vary depending on the number of colours concerned.

Operation of the doctoring mechanism is synchronized with the printing operations in order that when one colour image is being printed onto the article of ware the next engraved plate is being doctored. Thus in operation with all four engraved plates in their retracted positions and the printing member 10 elevated, three of the plates will be in an inked but not doctored condition, the first plate to come into operation will be inked and doctored and the ware support will be in its retracted position accessible to an operator. The operator places an article on the ware support, following which the centring arms 52 act to centre the article and suction is applied to retain it in position. The cylinder 54 is then energised to move the ware support to its extended position in which it is disposed vertically beneath the printing member 10.

The first engraved plate 12A which has been previously doctored is then moved to its extended position beneath the printing member 10 by operation of its cylinder 28. The printing member is then moved downwardly into contact with the engraved plate to pick up the inked image and is raised again to its uppermost position. Plate 12A is then withdrawn to its retracted position and the printing member 10 is moved vertically downwards into contact with the surface of the article to be decorated thereby transferring the first coloured image to the article. Simultaneously the doctor

mechanism on transfer member 12B is actuated to doctor the associated engraved plate leaving the printing ink in the engraved image only. Once the printing member 10 reaches its uppermost position the second engraved plate carried by transfer member 12B is moved to its extended position beneath the printing member and the latter is moved downwardly to pick up the inked image from the plate. Following withdrawal of the engraved plate the printing member is moved vertically downwards to transfer the second image to the surface of the article on the ware suppport. During this operation the third engraved plate is doctored and the sequence continues until all four colour images have been transferred to the article of ware. The ware support 11 is then moved to its retracted position and the operator removes the decorated article and replaces it with a further article following which the operation is repeated.

By virtue of the arrangement described multi-colour decorating of articles may be carried out extremely rapidly and acurately. Because the printing member and the article to be decorated remain horizontally fixed relative to one another throughout the decorating operation registration problems are substantially eliminated. Moreover by arrangement of the transfer members for the different components of the pattern in radial positions around the central printing member and by providing separate doctor assemblies for

each unit, one image can be doctored while the other is printing thereby enabling particularly rapid operation. Moreover only a single printing member is employed regardless of the number of colours to be applied.

Various modifications may be made without departing from the invention. For example the transfer member need not be an engraved or etched plate but could be a substrate to which the design or pattern is applied by screen printing. Means could be incorporated for temperature control of the printing member and/or ware support in addition to the transfer member if required. Alternative forms of doctor assembly may also be employed and while in the embodiment the machine is designed to apply four colours, any desired number of colours may be applied by increasing the number of transfer members arranged radially around the printing member. Moreover while reference has been made primarily to the printing of articles of ceramic ware the invention may be applied to the printing of a wide variety of other articles.

PATENT CLAIMS

1. Multi-colour printing apparatus characterised by a vertically movable non-rotatable printing member (10) a support (11) for ware to be decorated locatable in a position beneath the printing member and a plurality of transfer members (12) disposed angularly around the central vertical axis of said printing member at a level between same and said ware support, the transfer members being sequentially movable into positions between said printing member and said ware support whereby to permit transfer of printed images therefrom to said printing member for subsequent application to ware mounted on said support.

2. Multi-colour printing apparatus according to claim 1 characterised in that said transfer members comprise generally flat plates (26) on which is etched or engraved a portion of the pattern or decoration to be applied to the articles of ware, each transfer member being provided with doctor means (36) and control means being provided to effect doctoring of each plate during transfer to the ware of the image from the preceding plate.

3. Multi-colour printing apparatus according to claim 2 characterised in that said doctor means (36) is operable following transfer of an image from the

associated plate (26) to re-ink
the plate in readiness for the next operating cycle.

4. Multi-colour printing apparatus according to claim 3 characterised in that said doctor means incorporates a doctor blade (36) mounted for pivotal movement between inking and doctoring positions and adapted for bodily movement relative to the associated plate (26) in both operative positions of the latter.

5. Multi-colour printing apparatus according to any preceding claim characterised in that each of said transfer members (26) incorporates controllable heating means (47) operable to maintain the transfer member at a temperature which will ensure complete transfer of heat sensitive inks from the transfer member to said printing member (10) during operation.

6. Multi-colour printing apparatus according to any preceding claim characterised in that said ware support (11) is mounted on a carriage (50) arranged to be horizontally movable between a decorating position disposed vertically beneath said printing member (10) and a loading and unloading position convenient to a machine operator.

7. Multi-colour printing apparatus according to claim 6 characterised in that said ware support (50) is slidably movable in a direction radially of said printing member (10) in an angular direction intermediate the angular positions of adjacent ones of said transfer members (12).

8. Multi-colour printing apparatus according to any preceding claim characterised in that said ware support (50) incorporates means (52) for centring ware mounted thereon and for securing the centred ware against movement during operation.

9. Multi-colour printing apparatus according to any preceding claim characterised in that said printing member comprises a pad (10) of deformable material.

10. A method of multi-colour printing of articles characterised by sequentially applying to the article (60) a plurality of images in different colours to make up the final pattern or decoration while maintaining the article in a fixed stationary position, each successive coloured image being prepared during printing of the preceding image.

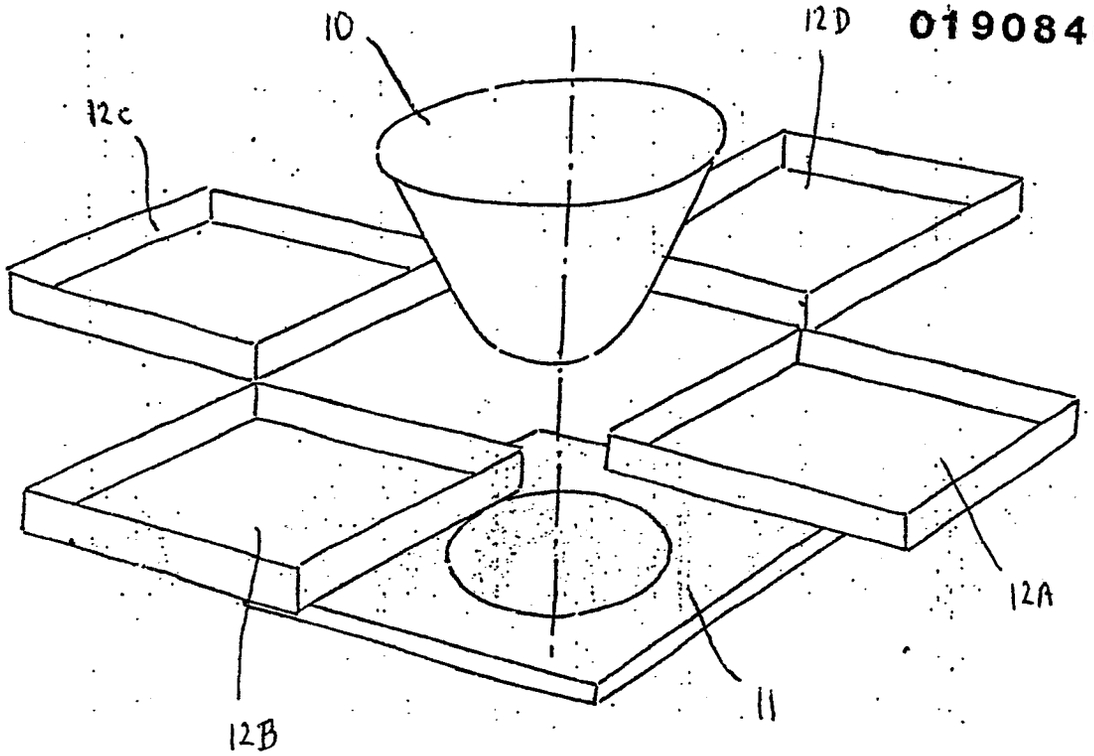
11. A method of multi-colour printing according to claim 10 characterised in that each image for printing

is introduced from a different angular position to a centrally disposed, vertically movable and non-rotatable printing member (10).

12. Articles decorated by the method or apparatus of any preceding claim.

FIG. 1

0190846



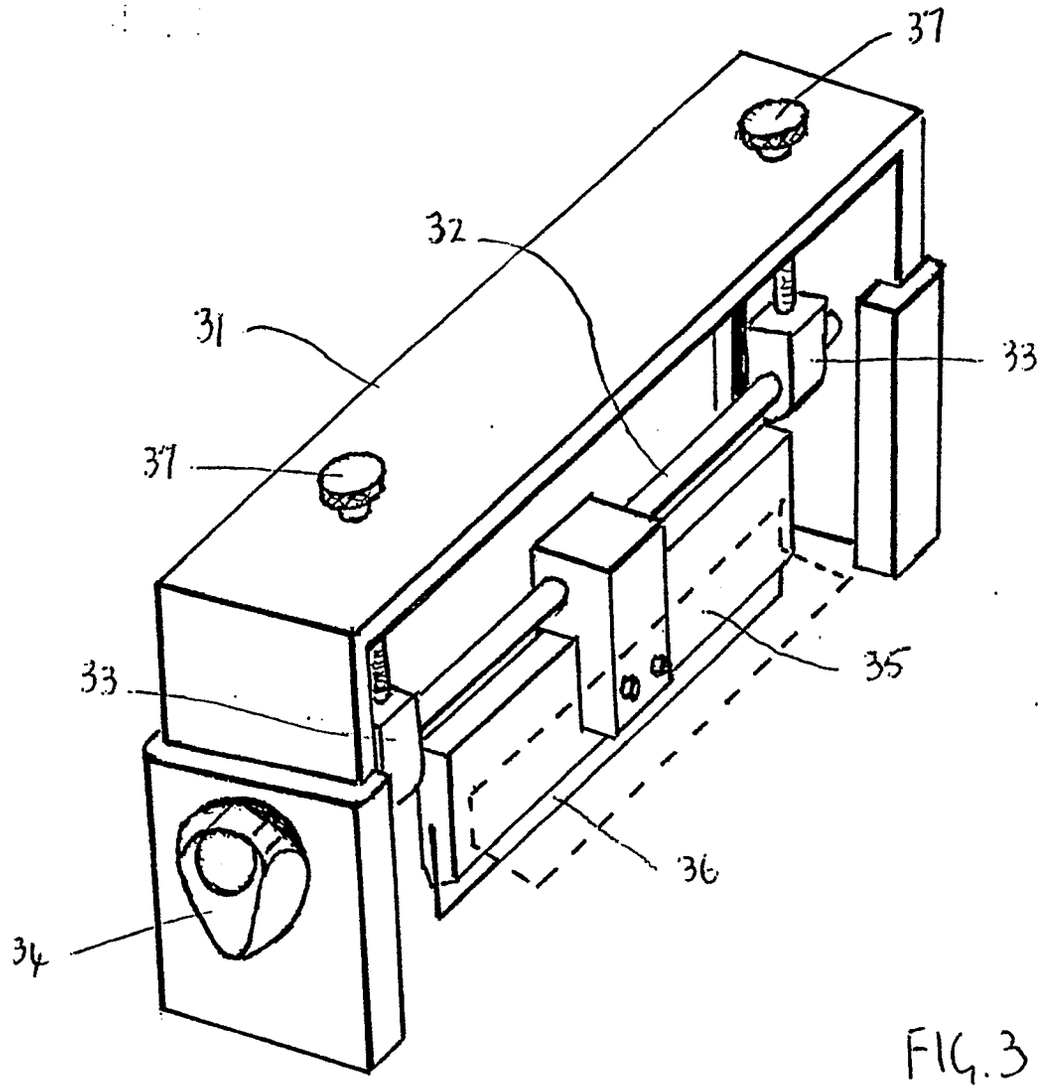
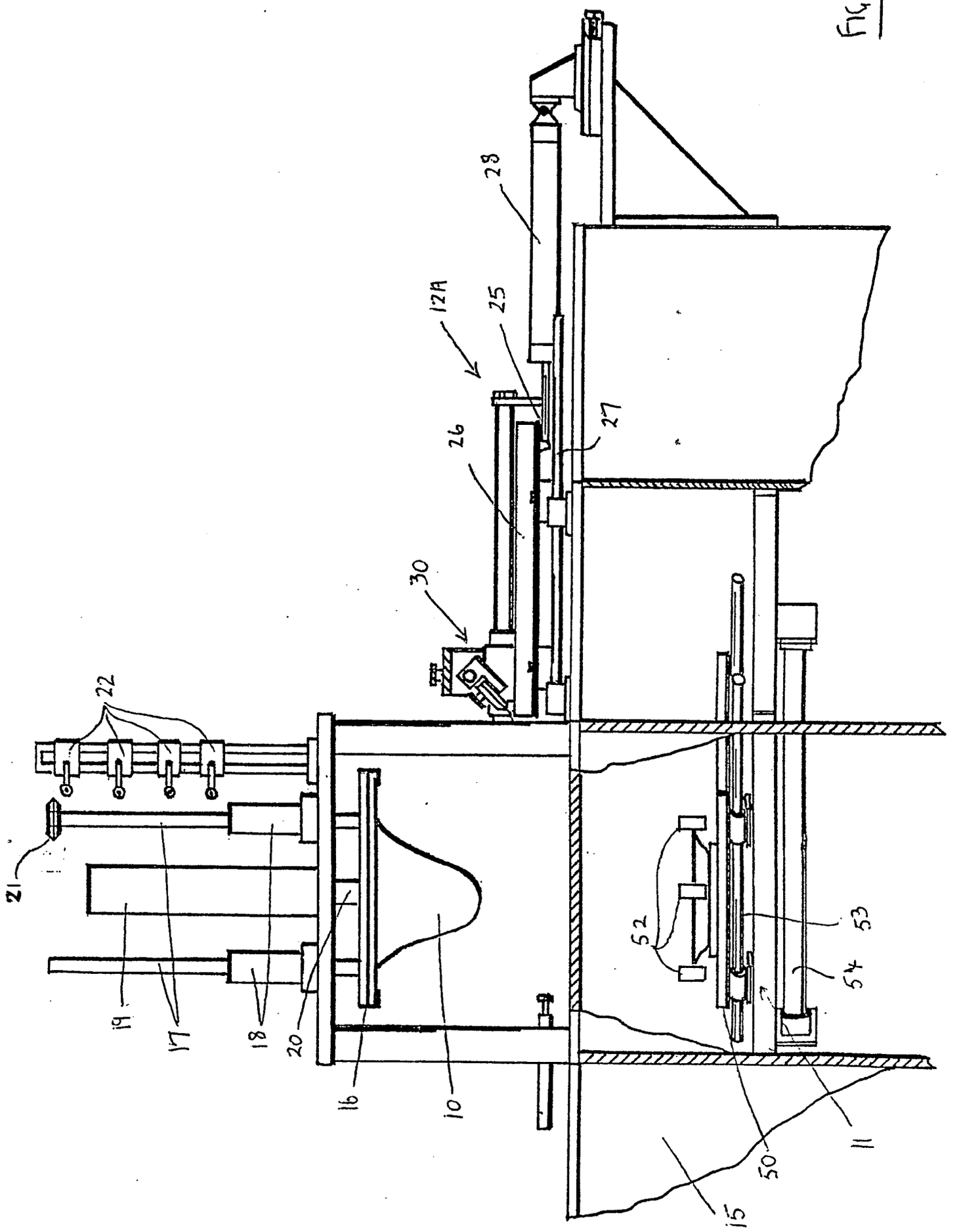


FIG. 3

0190846

Fig.2



0190846

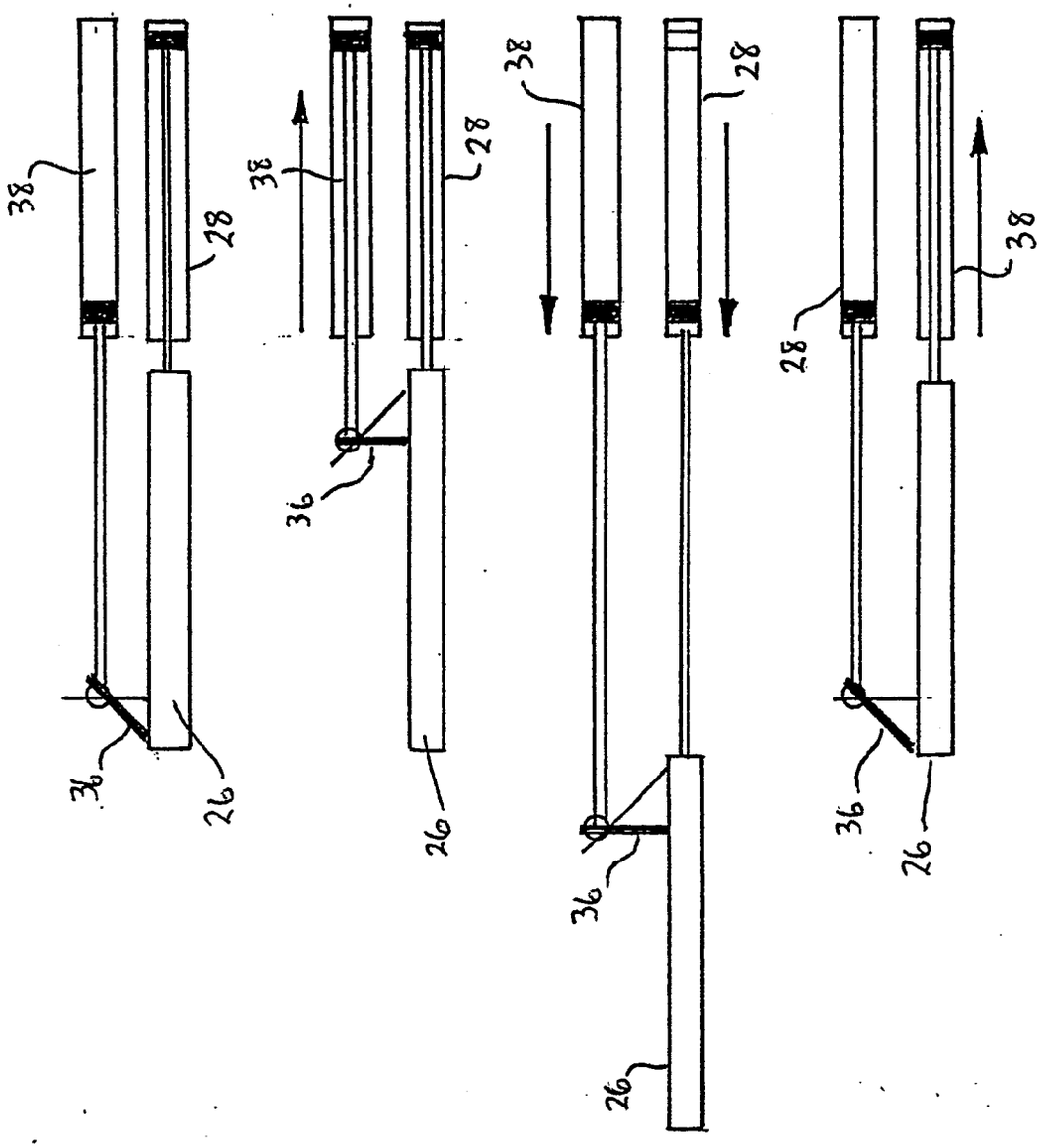


FIG. 4A

FIG. 4B

FIG. 4C

FIG. 4D

0190846

FIG. 5

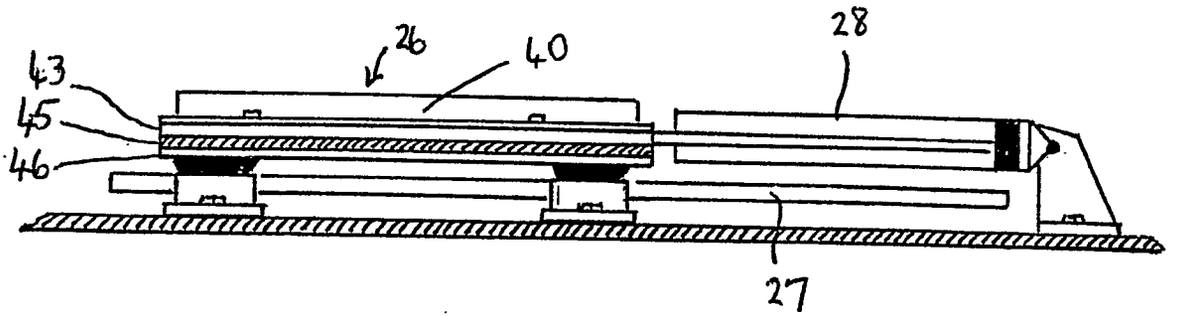
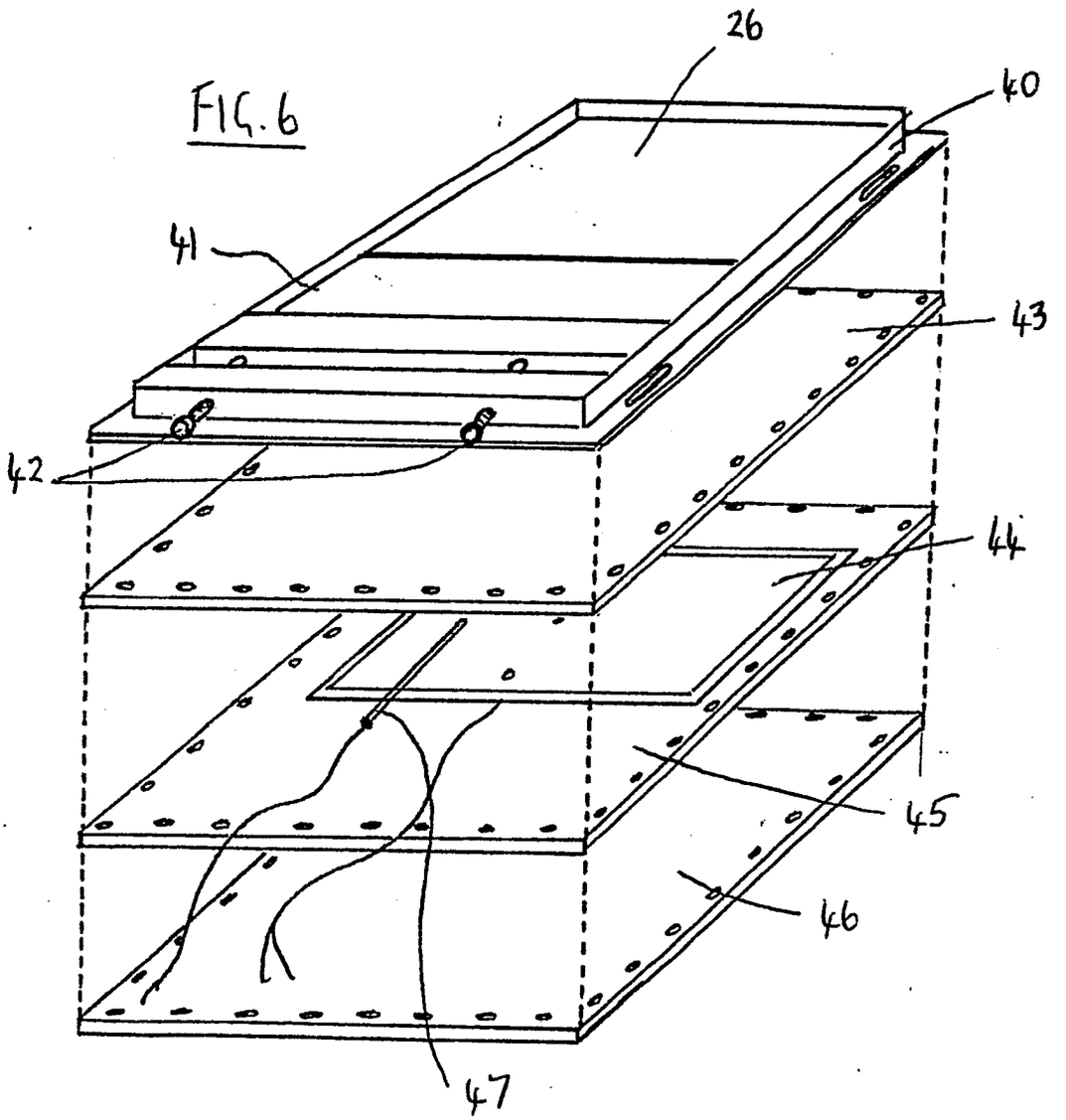


FIG. 6



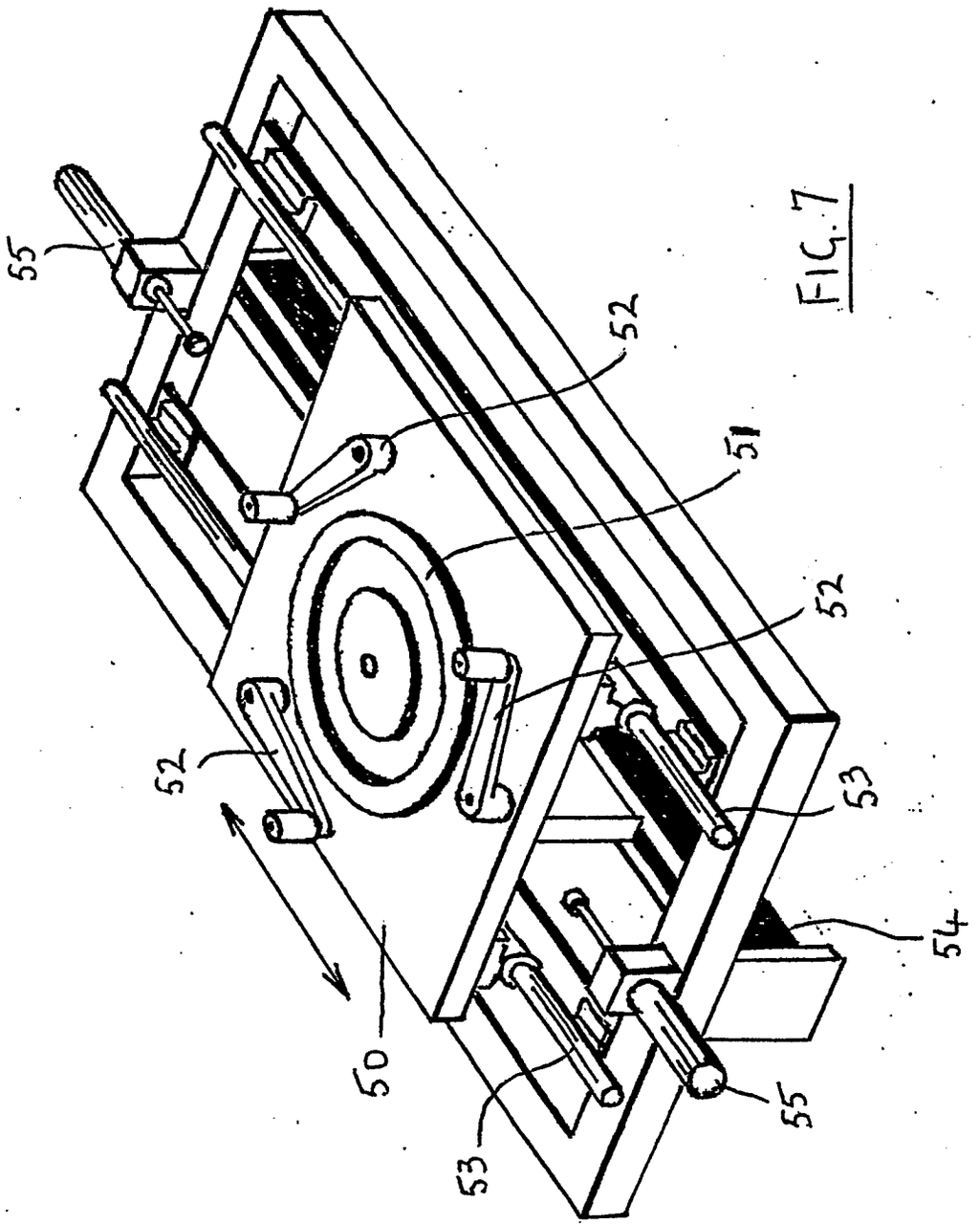


FIG. 7

0190846

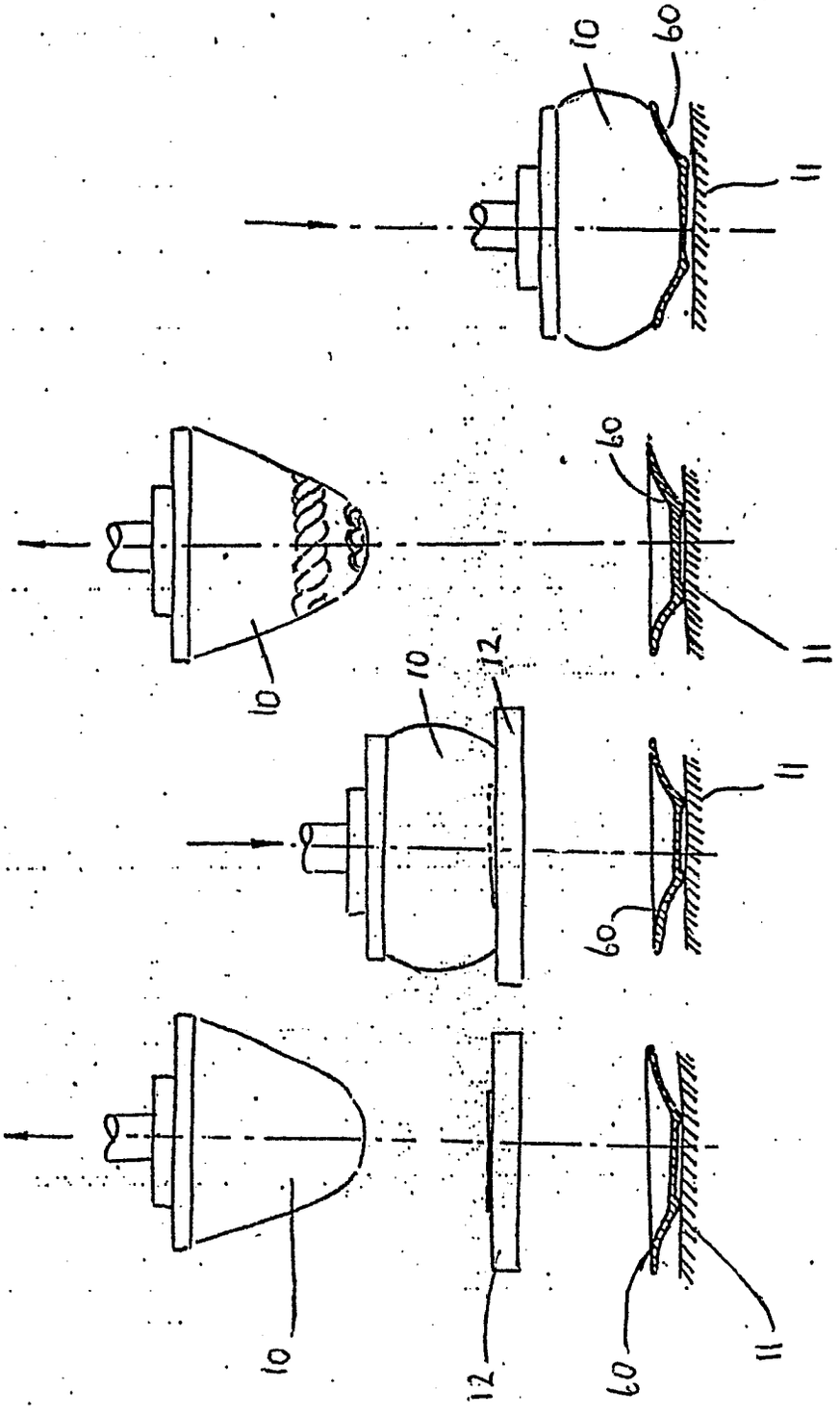


FIG. 8A

FIG. 8B

FIG. 8C

FIG. 8D