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- (72) Inventors JOHN FREDERICK HOLLOWAY  
JOHN RICHARD ISAACS  
JOHN VICTOR PIKE  
JOHN COLLYER REID  
WILLIAM ARTHUR WARWICK



(54) IMPROVEMENTS RELATING TO  
CASH ISSUING APPARATUS

(71) We, INTERNATIONAL BUSINESS MACHINES CORPORATION, a Corporation organized and existing under the laws of the State of New York in the United States of America, of Armonk, New York 10504, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to cash issuing apparatus.

In the banking industry, labour in the past has been readily available and relatively cheap. However in recent years with increasing labour costs, the commercial banks have been attempting to mechanise various tasks in an attempt to stabilize the cost of various operations if not to decrease the cost. Ideally any mechanisation should not only improve efficiency from the bank's point of view but should also provide improved customer service. To this end, cash issuing machines have found increasing use in banks. Although such machines are available in various forms, perhaps the most common nowadays is the type in which the bank customer uses a computer-controlled terminal which, after verification of the customer's identity and account status, dispenses banknotes.

Older machines of this type normally did not give too much choice to the customer as to the amount of cash he could withdraw. Banknotes were normally pre-packaged in envelopes by the bank before loading into the machine.

A more recent innovation is the cash issuing machine in which the customer has a much wider choice of amounts which he can withdraw. Such machines include a hopper which contains a stack of banknotes, for example 2,500 pound notes. When the customer has selected an ap-

propriate amount, this amount is dispensed by the machine from the hopper to a drawer at the front of the machine. Such machines may be located within the bank premises where they can relieve counter staff of the task of paying out banknotes, or in public places such as stores and supermarkets where they can provide a service outside normal banking hours.

Although these cash issuing machines can be used to dispense used banknotes or new banknotes, banks generally prefer to load them with new notes since most customers prefer to receive new notes and also new notes are conveniently supplied to the bank in neat bundles. We have now discovered that certain problems can arise in these machines with some banknotes particularly when they are new.

The problem can best be explained with reference to Figures 2 and 3 of the accompanying drawings. Figure 2 is a fictitious banknote which contains normal writing and a portrait which normally is of the Head of State or of an historical person associated with the state. It is also common for various medallions or roundels to be included on the banknote such as is shown at 1. Frequently, the roundel 1 will be embossed or consist of relief printing in which case the banknote will be thicker at the roundel 1 than it is at blank area 2.

As an example, with a stack of 2,500 pound notes, the difference in thickness of the compressed stack at area 1 can be some 6 cms greater than the thickness at area 2. This variation in thickness will generally decrease as banknotes become used, partly due to surface wear of the high spots on the banknote and partly due to "fluffing up" of the paper with use.

Figure 3 is a view of a hopper having a guide wall 6 and containing a stack 3 of banknotes which are urged in the direction of arrow 4 against a stop plate 14 by a 90

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hopper weight 12. Weight 12 is driven in the direction of arrow 4 under the control of a pressure sensitive switch 20 which may be a microswitch. The switch 20 is positioned to contact the end bank note at its centre. However, because of the variations in bank note thickness mentioned above, the pressure at other areas of the end banknote can be considerably higher. Thus, at area 8 corresponding to roundel 1, Figure 2, the pressure would be very much higher than in the area of contact of switch 20.

The problems which this can cause will be discussed in more detail later but briefly, when the end banknote is withdrawn from the hopper in a direction into the plane of the drawing, it will be subjected to a turning moment about point 8 and consequently will be skewed.

The problem does not occur with every banknote. It does however occur with the current issue of the Bank of England one pound note. Since Governments can and do change the design of banknotes at any time, the problem could crop up in any country and with any value banknote.

Because of the differing sizes of various banknotes etc. and because the position of high spots on the banknotes is normally outside the control of the machine user, it is preferable that any solution to the problem should be readily adaptable to different sized banknotes.

According to the present invention, cash issuing apparatus comprises a hopper for containing a stack of banknotes, means for urging banknotes positioned within the hopper towards one end thereof, a picker mechanism positioned adjacent said end for removing banknotes one by one from the hopper to a transport path for transport through said apparatus, and a stop member positioned adjacent said end for retaining banknotes in said hopper until removal by said picker mechanism, said stop member being so constructed as to apply maximum pressure to the stack of banknotes along two lines positioned substantially equidistantly from but on opposite sides of said picker mechanism.

The invention will now be particularly described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 illustrates part of a cash dispenser,

Figure 2 illustrates a banknote,

Figure 3 is a view along the line III-III of Figure 1,

Figure 4 is a perspective view of a conventional end plate for use in a hopper,

Figure 5 is a perspective view of a preferred embodiment of end stop,

Figure 6 is a front view of the em-

bodiment of Figure 5,

Figures 7 and 8 are side views of the embodiment of Figure 5, and

Figure 9 is a front view of a second embodiment.

Referring now to Figure 1, a hopper 9 comprises a hopper belt 10 which is movable about pulleys 11. Supported on the hopper belt 10 is a hopper weight 12 having an inclined push plate 13 attached thereto. A stop plate 14, shown in detail in Figure 4, is positioned at the unloading end of the hopper and is inclined so as to be substantially parallel to the push plate 13.

A stack 3 of banknotes is located between the plates 13 and 14 and is supported partly by the hopper belt 10 and partly by a hopper guide plate 15. The guide plate 15 slopes downwardly as shown and defines a throat 16 through which banknotes can be removed from the hopper to a transport path. Two flexible blades 17 mounted on a support 18 are used to cause cards in the hopper to follow the downwardly sloping guide plate 15. A belt support plate 19 is located beneath the hopper belt 10 to support the weight of the hopper weight 12 and banknotes positioned over the belt 10.

A pressure sensitive switch 20 in the form of a microswitch protrudes through an aperture 36, Figure 4, in the stop plate 14. When the pressure on the switch 20 falls below a predetermined value, a control circuit, not shown, causes the pulleys 11 to rotate in the direction of the arrows, thus moving the stack 3 to the right.

Located adjacent throat 16 is a picker mechanism 21 which comprises pulleys 22 and a frictional separator belt 23 which protrudes through a slot 37, Figure 4, in the stop plate 14 to contact the end banknote in the stack. Also located adjacent the hopper throat 16 is a restraint mechanism 24 comprising pulleys 26 supporting a restraint belt 25 which protrudes through the hopper guide plate 15.

It will be apparent that by rotating the pulleys 22 in the direction of the arrows, the end banknote in the stack 3 will be withdrawn from the hopper 9 and passed through the hopper throat 16. Simultaneous rotation of the pulleys 26 in the direction of the arrows will cause the restraint belt 25 to restrain any other banknotes from moving out of the hopper throat 16.

When a banknote leaves the throat 16, it is passed along a transport path constituted by an upper transport belt 27 supported on pulleys 28 and a lower transport belt 29 supported on pulleys 30. By rotating the pulleys 28 and 30 in the directions of the arrows the banknote will be moved

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to a reject area 31. Located on an inclined plate 32 are a number of photocells, not shown, which cooperate with lamps, not shown, to detect whether an oversize banknote or whether two or more superimposed banknotes are travelling along the transport path. Details of this fault detection feature is not given since they do not form part of the present invention. However further details of this feature and other parts of the apparatus will be found in the various published manuals of the IBM (Registered Trade Mark) 2984 Cash Issuing Terminal.

If a fault condition is detected, when the "faulty" banknote arrives at the reject area, a deflector blade 33 is raised and the banknote is deflected into a reject tray 34. If no fault has been detected, the banknote will be passed into a cash tray 35. When the amount selected by the customer has been delivered to the cash tray 35, the tray 35 is lowered to allow the customer to withdraw the banknotes.

As indicated above, high spots on the banknotes can cause the stop plate 14 to apply a considerably higher pressure on the end banknote at area 8, Figure 3, than is detected by the pressure sensitive switch 20. In these circumstances, the end banknote can be skewed as it leaves the hopper throat 16. At worst, the skewed banknote can cause a jam in the transport path or indeed a banknote may be torn as it leaves the hopper. At best, it may be detected as an oversize banknote and consequently be deflected into the reject tray 34. The machine may eventually stop functioning if too many "faulty" banknotes are deflected into the reject tray 34, the machine normally being provided with logic circuits, not shown, designed to recognize a repetitive fault situation.

Figure 4 shows the conventional hopper end plate 14 in more detail. Plate 14 has an aperture 36 through which the switch 20 (Figures 1 and 3) can protrude and a slot 37 through which the separator belt 23 (Figure 1) can protrude. Mounting holes 38 allow the stop plate 14 to be secured to the framework of the machine.

Figure 5 is a perspective view of a preferred embodiment of end stop which is designed and constructed to minimize the problem of skewing and which is intended to replace the plate 14 to avoid the skewing problems mentioned above. Referring now to Figures 5 to 8, the end stop comprises a bracket 39 which can be secured to the framework of the machine by means of mounting holes 38. Secured to the bracket 39 is a first pair of guide wires 40 and 41 which, as will be seen more clearly in Figures 7 and 8 are bent forwardly so as to extend along an imaginary plane which is co-planar with the front surface

42 of the bracket 39.

Also secured to the bracket 39 is a second pair of guide wires 43 and 44. As will be seen with particular reference to Figures 7 and 8, guide wires 43 and 44 are bent backwardly so as to be able to support the stack of banknotes but allowing relaxation of any increase in pressure due to high spots. As will be seen from the drawing, the lower ends of the guide wires may be bent forwardly so that as the banknote leaves the stack it is guided into the transport path in a substantially flat condition.

Secured to the guide wires 40, 41, 43 and 44 are lateral wires 45 to 48 which serve to increase the rigidity of the structure. In addition, wires 47 and 48 may be optionally bent forward as shown to form a retainer for an edge of a banknote to prevent banknotes from moving sideways out of the hopper.

Superimposed on Figure 6 is a view of a banknote. It will be seen that the guide wires 40 and 41 are positioned so that they apply two lines of pressure equidistantly from the separator belt 23 along lines of substantially constant thickness. High spots such as 1 are not supported by the wires 40 and 41. In addition, it will be noted that the leading edge of the banknote is beneath the lateral wires 45 to 48. This will avoid any problems due to buckling of the banknote as it moves downwardly along the "face" of the end stop through the throat of the hopper.

It will be apparent that the exact dimensions and shape of the guide wires will be dependent upon the particular banknote to be used therewith, i.e. their size and position of embossed markings or relief printing.

The embodiment shown in Figures 5 to 8 is particularly attractive because of its simplicity, ease of manufacture and ease of installation. The latter quality is important in view of the possible need to modify machines which are already in use should the banknotes being handled be altered in design. If banknotes are redesigned after a machine has been installed, all that is necessary is to replace the end stop with an appropriately designed end stop to adapt the machine to the new banknotes.

Instead of forming the end stop from rods or wires as described above, a stop plate can be formed as shown in Figure 9. In Figure 9, a stop plate 49 consists of a metal sheet 50 in which two guide rails 51 and 52 have been coined. Aperture 53 allows a pressure sensitive switch to contact the end banknote through the plate and slot 54 allows a separator belt to contact the end banknote. Optional apertures 55 and 56 allow more relief of "high spot



pressure" than would simple coining. As before, if the banknotes are redesigned, a new stop plate can be readily fitted to the cash issuing machine to adapt it to the new banknote.

**WHAT WE CLAIM IS:—**

1. Cash issuing apparatus comprising a hopper for containing a stack of banknotes, means for urging banknotes positioned within the hopper towards one end thereof, a picker mechanism positioned adjacent said end for removing banknotes one by one from the hopper to a transport path for transport through said apparatus, and a stop member positioned adjacent said end for retaining banknotes in said hopper until removal by said picker mechanism, said stop member being so constructed as to apply maximum pressure to the stack of banknotes along two lines positioned equidistantly from but on opposite sides of said picker mechanism.

2. Apparatus as claimed in claim 1, in which said stop member comprises a first pair of wire guides positioned one on each side of a movable frictional surface forming part of said picker mechanism and extending in the direction of movement of the frictional surface.

3. Apparatus as claimed in claim 2, in which said stop member comprises a second pair of wire guides extending substantially parallel to the first pair when viewed in a direction along the hopper and spaced from an imaginary plane defined by said first pair of guide wires, the second pair of wire guides being separated from one another by said first pair of guide wires.

4. Apparatus as claimed in claim 3, in which one of each pair of guide wires is joined to one of the other pair of guide wires by one or more transverse wires positioned so that the or each transverse wire is not traversed by a leading edge of a banknote as it leaves the hopper.

5. Apparatus as claimed in claim 4, in which two transverse wires are constructed to constitute a retaining surface along one edge of banknotes within the hopper.

6. Cash issuing apparatus, substantially as herein described with reference to Figure 1 as modified by Figures 5 to 8 or Figure 1 and as modified by Figure 9 of the accompanying drawings.

JOHN BLAKE,  
Chartered Patent Agent,  
Agent for the Applicants.



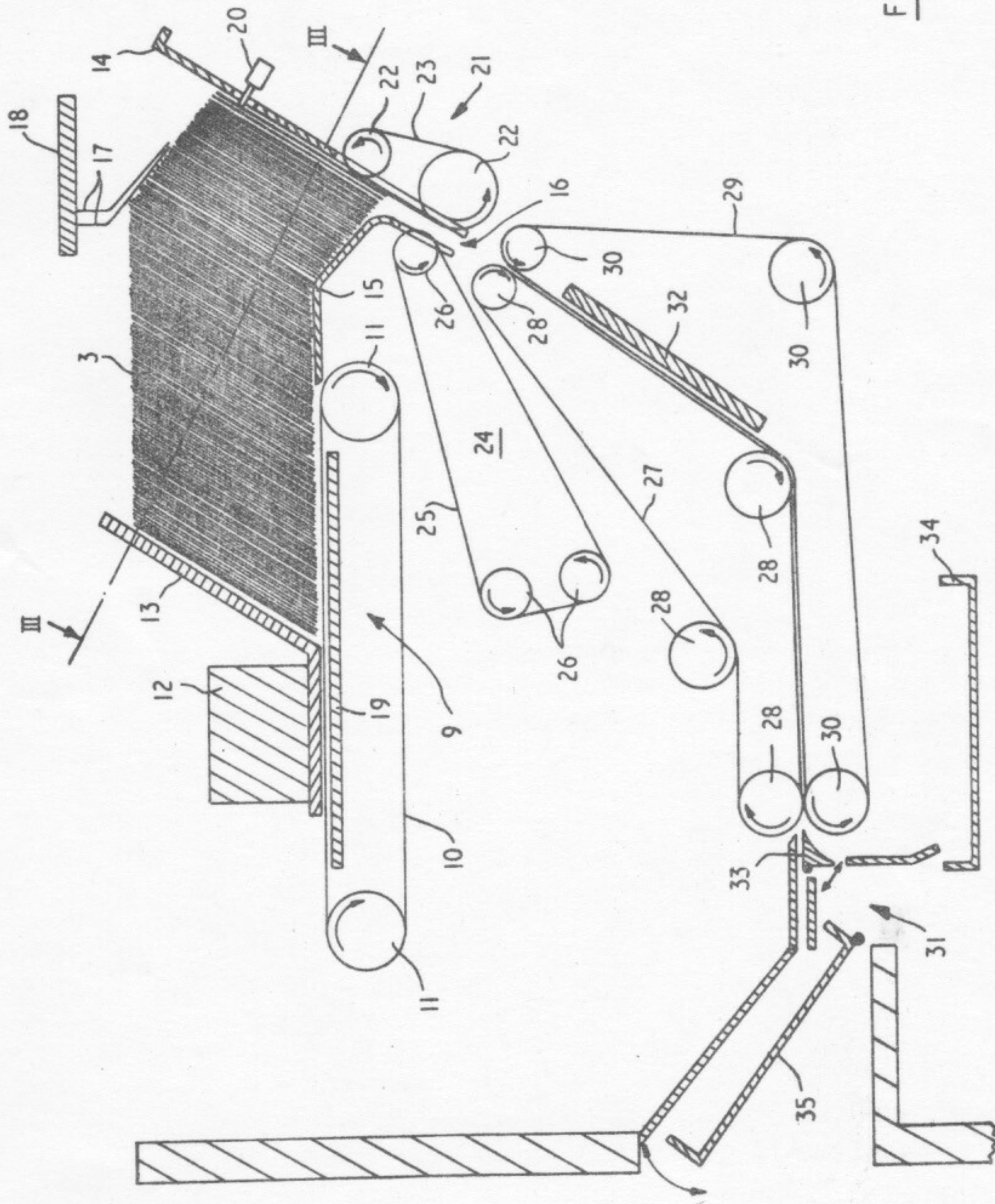


FIG. 1



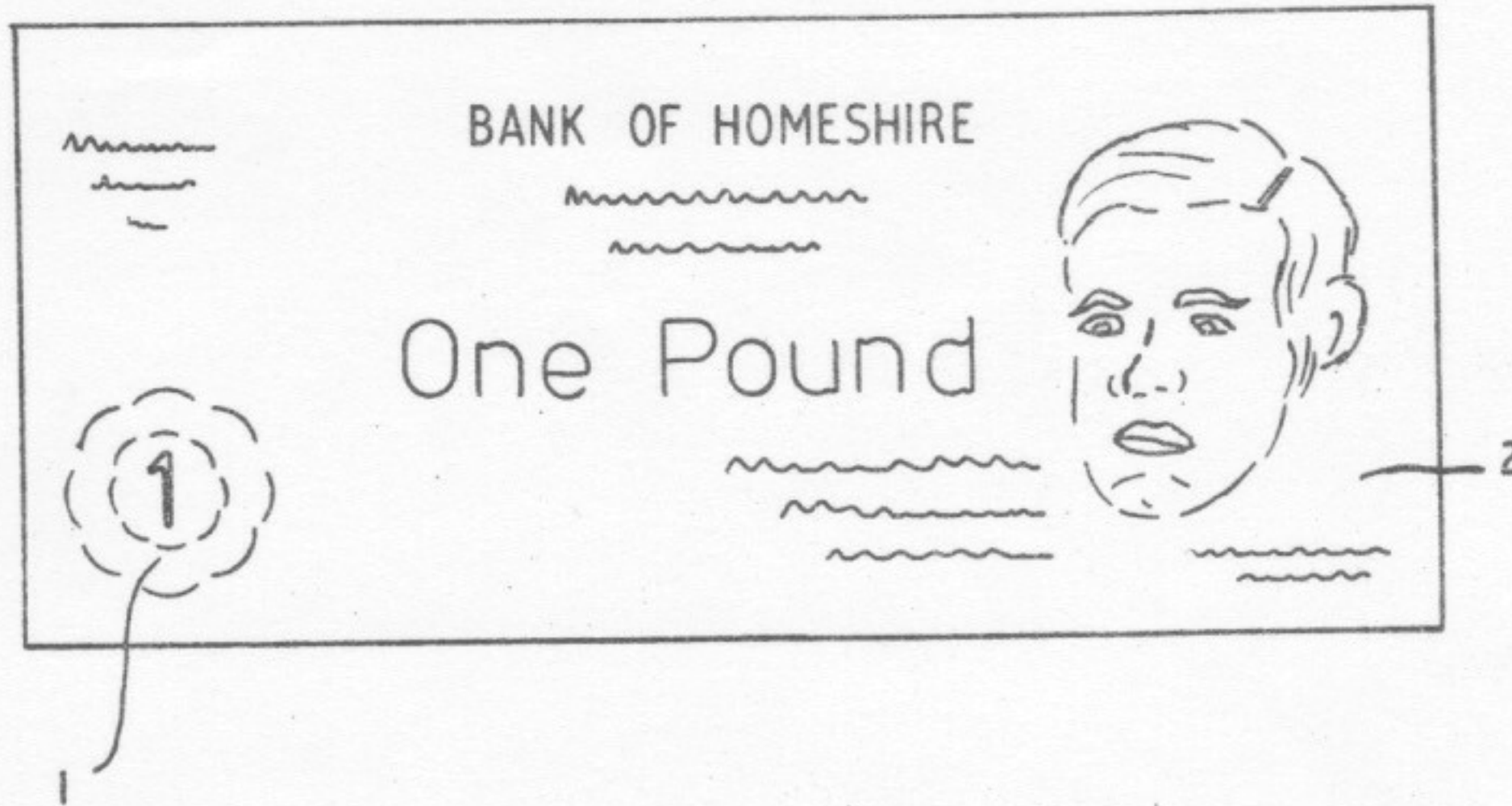


FIG 2

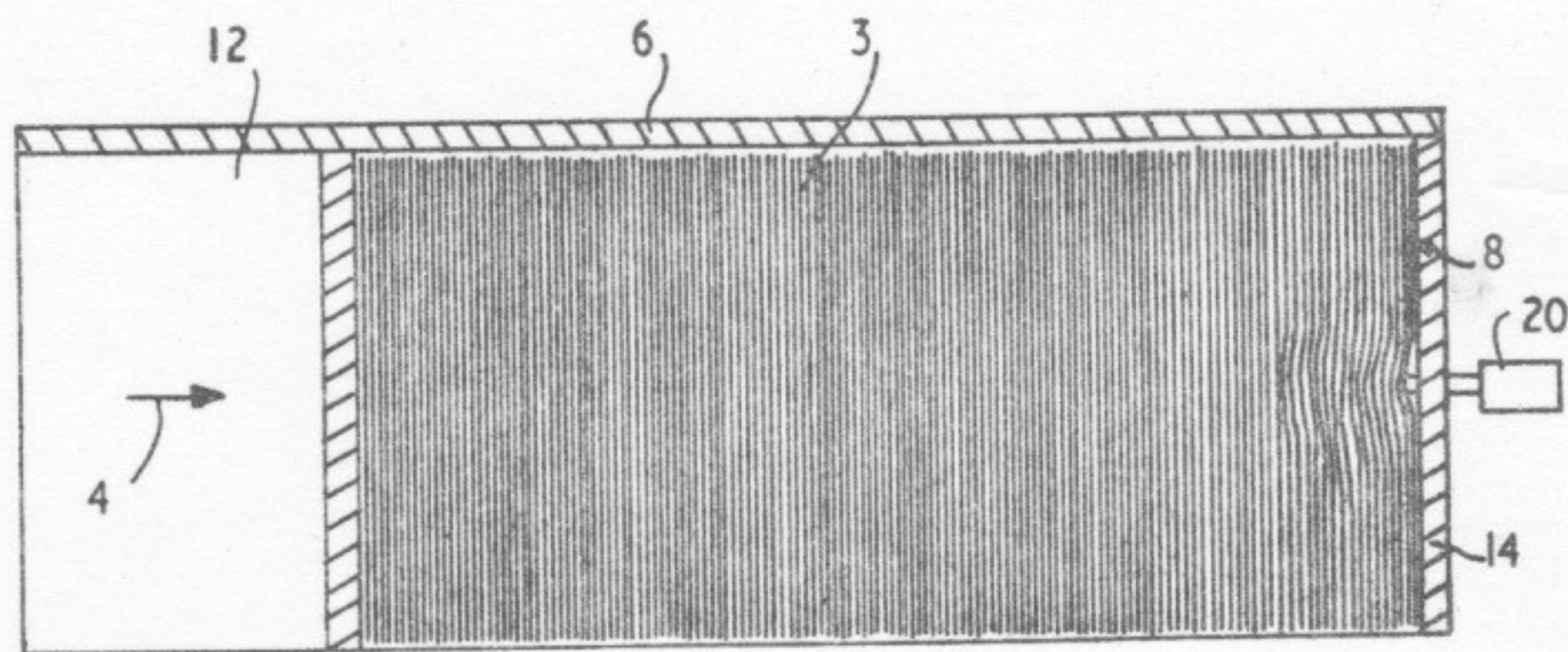


FIG 3



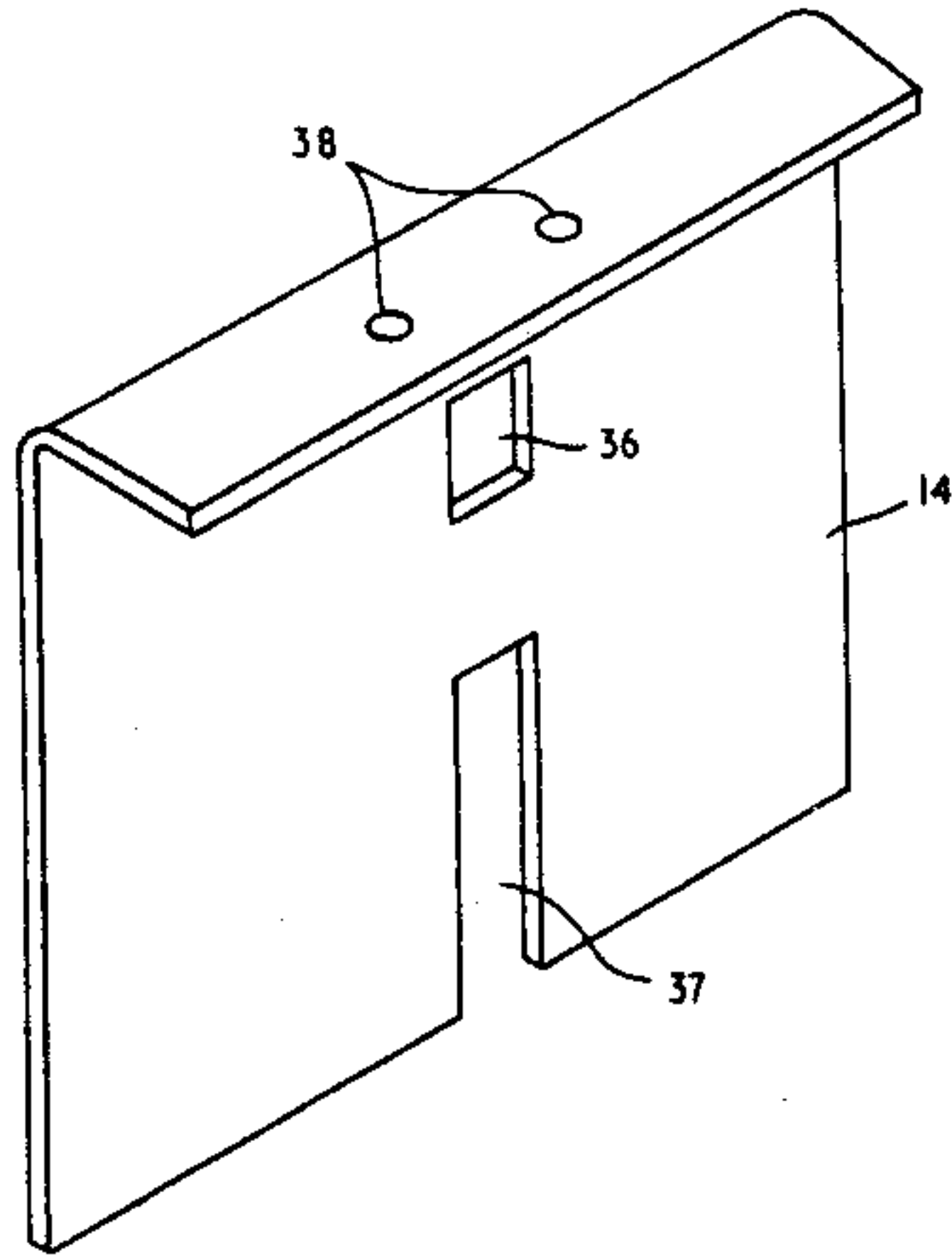
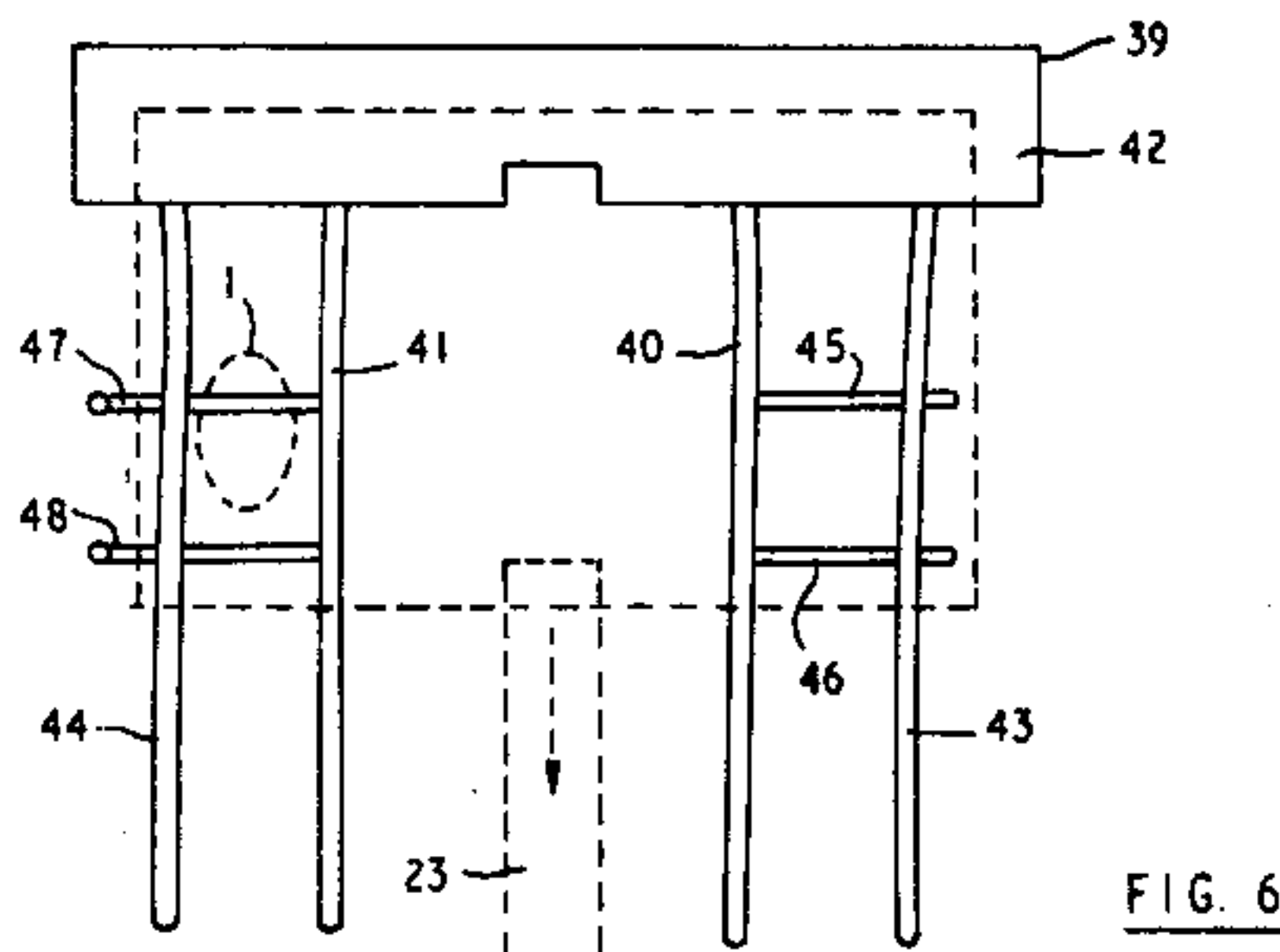
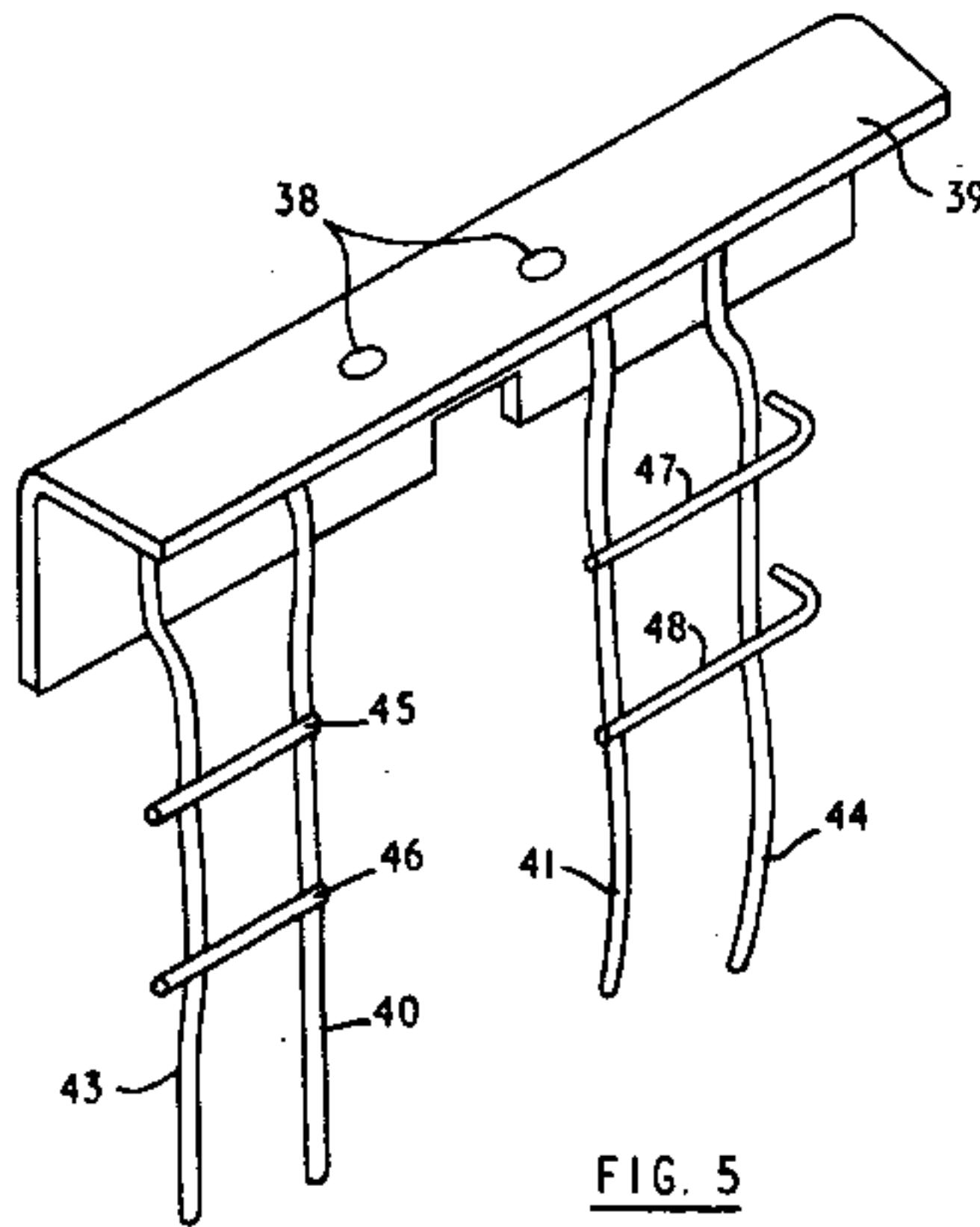


FIG. 4





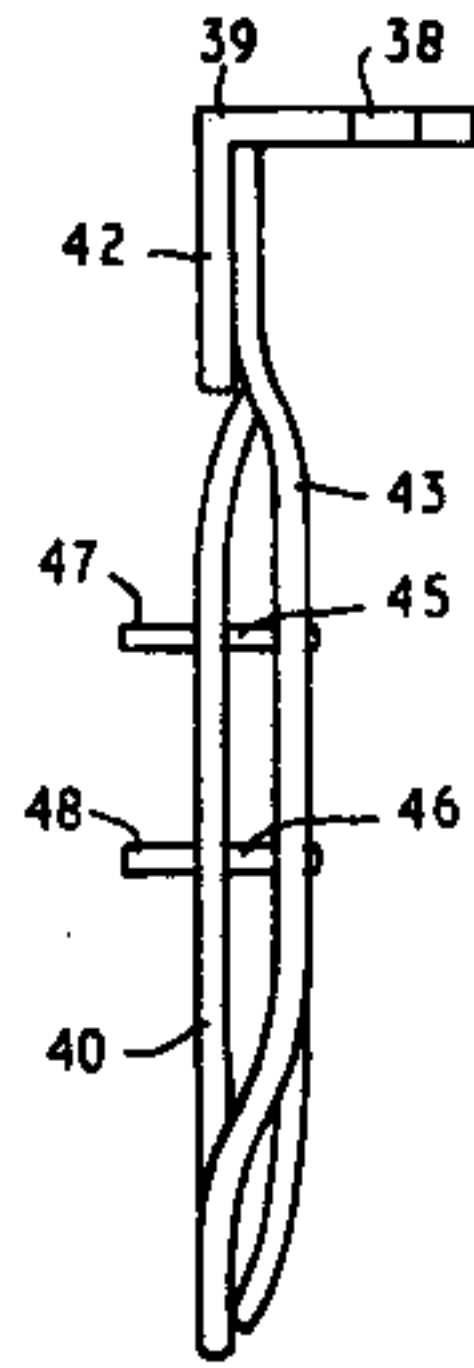


FIG. 7

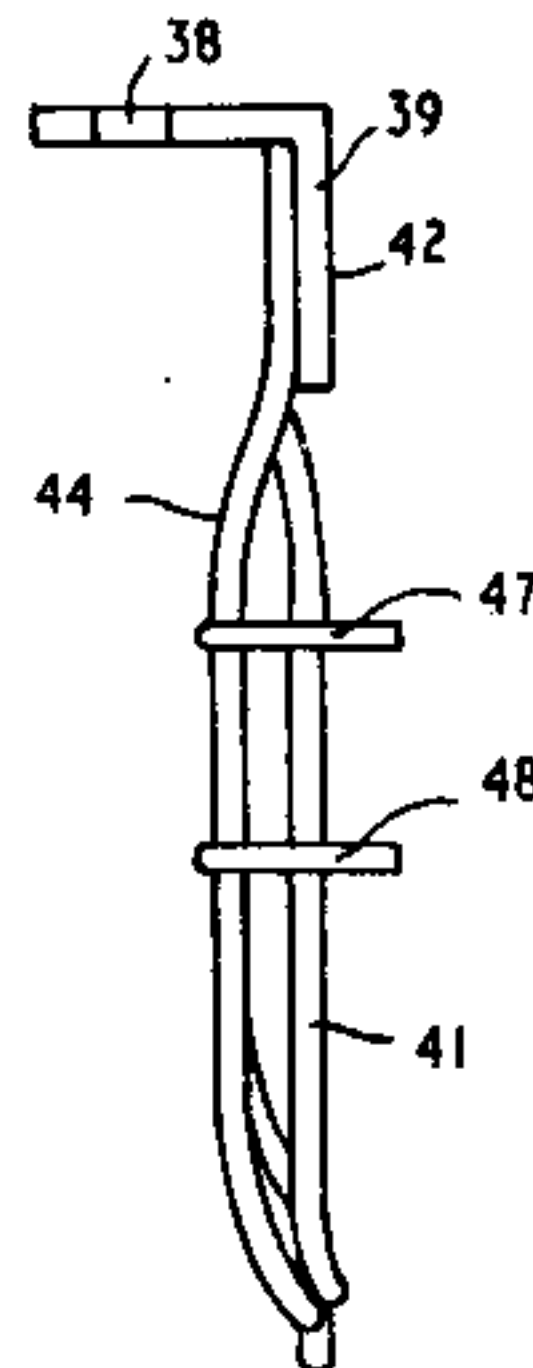


FIG. 8

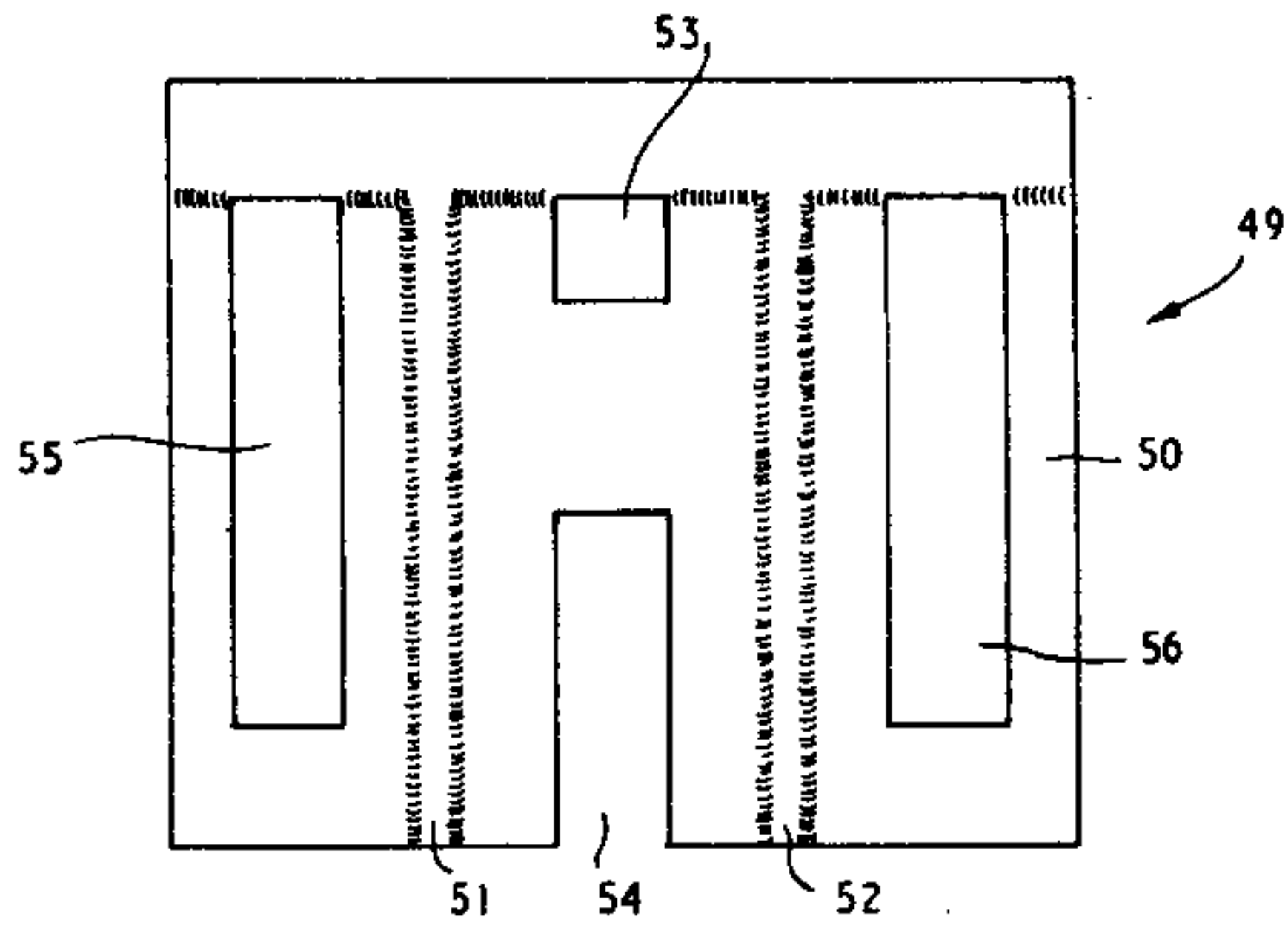


FIG. 9