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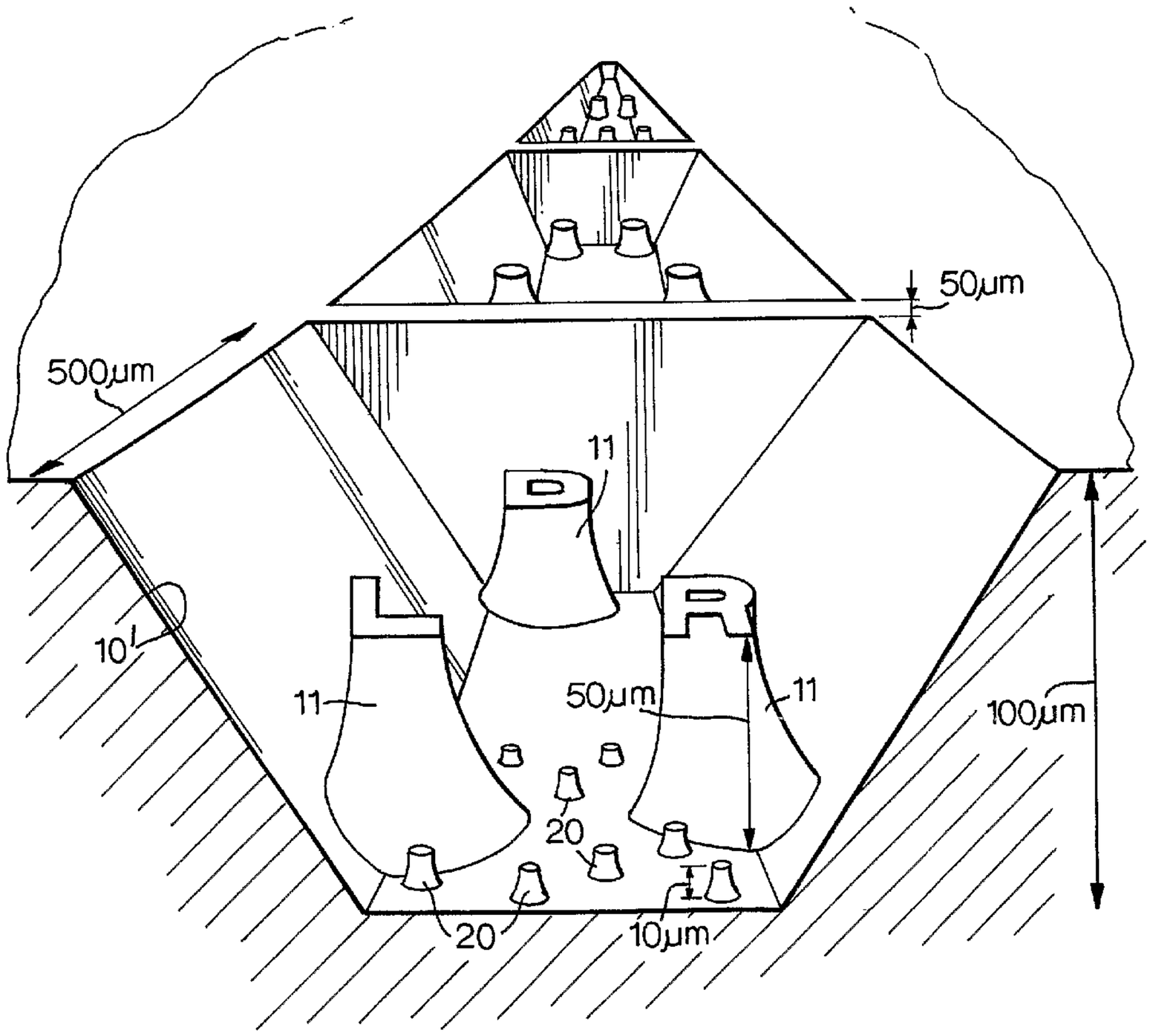
(54) Titre : PLAQUE D'IMPRESSION EN CREUX DOTEE DE STRUCTURES RETENANT L'ENCRE
(54) Title: INTAGLIO PRINTING PLATE WITH INK RETAINING STRUCTURES



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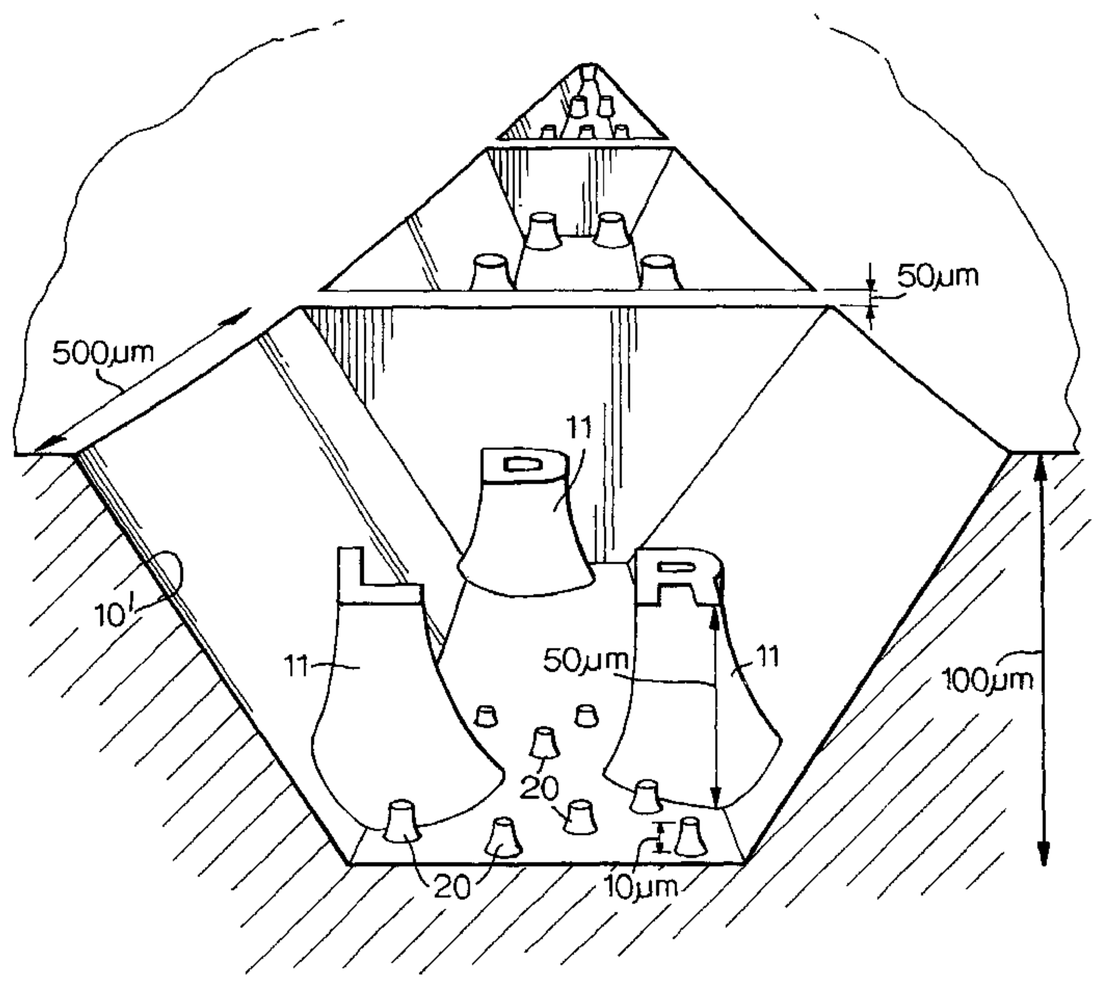
(54) Title: INTAGLIO PRINTING PLATE WITH INK RETAINING STRUCTURES



(57) Abstract: An intaglio printing plate (2) has an array of imaging ink recesses (10); and, in each recess, an ink retaining structure comprising one or more regular arrays of raised elements (11) extending from the base of the recess to no more than 60 % of the height of the recess, ink retaining trenches extending between the raised elements, and wherein no more than 30 % of the area of the recess base is provided with raised elements.

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INTAGLIO PRINTING PLATE WITH INK RETAINING STRUCTURES

The invention relates to an intaglio printing plate.

The intaglio printing process has existed for centuries and its unique characteristics are created by virtue of the physical difference between the non-image area, which is the surface of the plate and the image area, which are the recesses cut or etched into the plate.

Intaglio should be distinguished from gravure. Gravure and intaglio are common processes in that in both instances the image is sunk beneath the surface of the printing plate. The processes differ because a gravure image is composed of a set of cells that hold the ink, which are normally of the same dimension but not depth and serve to provide contrast. An intaglio image content is composed of completely random cuts/etchings into the plate that, within reason, can be of any length, width or depth.

The cell structure of gravure processes is designed to hold very fluid inks that are part and parcel of the gravure printing process. By contrast intaglio ink is tacky and is only removed from the varying engravings of the intaglio plate onto the paper by forcing the paper into these engravings under immense pressure.

The key steps of the intaglio printing process are:

1. Loading ink into the recessed areas of a printing plate.
2. Wiping the plate surface clean.
3. Removing the ink from those recesses in the plate onto the paper by pressure exerted onto the surfaces of those two elements.

The loading of the ink into the recesses of the printing plate causes excess ink to be deposited onto the non-image area of the printing plate. To remove this excess, it is necessary to wipe the surface clean prior to applying the paper to the plate. The process now almost universally applied to achieve this on rotary intaglio printing presses is by the use of a wiping cylinder that is

composed of a PVC type plastic whose surface has some flex. When this type of wiping cylinder, which rotates in the opposite direction to the printing plate at the wiping nip, is applied under pressure to that plate not only does it remove the unwanted ink from the surface, it also removes ink from some of the printed image recesses where the ink is required. The ink is removed from the recesses in the direction the wiping cylinder rotates, i.e. in a contra rotary direction with respect to the plate at the wiping nip.

Removing ink from the required image areas is unacceptable, as it would cause areas of the printing image to become voids. Therefore, to prevent removal, ink retaining structures are cut or etched into the bottoms of those recesses whose form would knowingly not hold the ink. Where these ink retaining structures are required is dependent upon the width and the length of the specific recess. It can also be dependent upon the slope of the side wall of the recess, normally the steeper the side wall angle is the smaller the square area requiring an ink retaining structure. In general, if the side wall angle is 65° or steeper, a recess wider than 300 microns and longer than 500 microns requires an ink retaining structure. Whilst a side wall angle less than 65° can negate the need for an ink retaining structure in smaller recesses, in most instances a recess wider or longer than 1000 microns requires an ink retaining structure.

WO-A-00/20217 and WO-A-00/20216 disclose the roughening of the base of a recess to aid ink retention while WO 96/23201, US-A-2322530, and EP-A-1119457 disclose the use of continuous structures within a recess.

Research has established that the formats of the ink retaining structures are crucial in maximising the benefit of:

- retaining the optimum amount of ink in the recesses and avoiding the ink from being wiped out from them,
- ensuring the optimum ink transfer to the paper,

- ensuring the maximum deformation of the paper into the recesses, which in combination with the ink transfer creates the tactile effect of the intaglio printing process. This element is a vital aspect of intaglio printing.

In accordance with one aspect of the present invention, an intaglio printing plate has an array of imaging ink recesses; and, in each recess, an ink retaining structure comprising one or more regular arrays of raised elements extending from the base of the recess to no more than 60% of the height of the recess, ink retaining trenches extending between the raised elements, and wherein no more than 30% of the area of the recess base is provided with raised elements.

We have found that it is possible to improve significantly the ink retaining properties of the plate by utilizing a much lower density of raised elements with the raised elements extending no more than to 60% of the height of the recess, preferably no more than 50%.

Concerning the height of the ink retaining structures if the bottom of the recess is considered 0% and the plate surface is considered 100%, the ink retaining structure does not want to be higher than 60% as to be higher than this can be to the detriment of the tactile effect but it can be anything below this down to nominally 12%. It can be less than 12% but at this level the ink retained can call into question the value of the durability that intaglio adds to documents that are handled by the public such as banknotes.

Preferably, no more than 20%, such as 15-20%, more preferably 10-15%, and most preferably only 2.5-10% of the area of the recess base is provided with raised elements. In general, the smaller the area of the recess, the smaller the dimensions of the raised elements. Therefore within the parameters set the screen option selected would be appropriate to the size of the recess. This reduces the

effect the raised elements have on the printed ink and is a principle advantage of the invention.

Preferably, the shortest distance between adjacent raised elements is no less than 100 microns since otherwise the paper cannot deform into the ink retaining trenches and the tactile effect is limited to the distance from the surface down to the top of the ink retaining structures.

We have found that preferably the raised elements have maximum lateral dimensions in the range 40-250 microns. In particular, when considering the wiping direction of the plate, the raised elements or ink retaining structures are preferably between 40-100 microns in the wiping direction and between 80-250 microns in the direction orthogonal to the wiping direction.

Another important factor is the orientation of the ink retaining trenches. Thus, preferably, the printing plate defines an ink wiping direction, the raised elements being defined such that no trench wider than the shortest distance between adjacent raised elements extends significantly in the wiping direction. This distance is typically in the range 100-700μm, preferably 550μm. The reason for this is that it reduces the risk of ink being extracted from the trenches during the wiping operation.

In preferred examples, all trenches with a significant length (typically this would be the size of the recess) and with a width no less than the shortest distance between adjacent raised elements extend at an angle in the range 15-75°, most preferably substantially 45°, to the wiping direction.

This can be achieved because of the essentially discontinuous nature of the raised elements.

Although typically a single regular array of raised elements will be provided in one or more of the recesses, in some cases two or even more such arrays could be provided. Typically, these would be arranged side by side although they could be interleaved. Different raised

elements or arrangements of raised elements could be provided in different recesses.

In a particularly preferred arrangement, the ink retaining structure comprises a set of first raised elements defining a regular array, and a set of second, smaller raised elements dispersed between the first raised elements to assist in ink take up.

In some cases, the plate may further comprise a set of further raised elements in each recess, the further raised elements having a height less than the first (and second) raised elements.

The raised elements can have a variety of shapes although typically they have the same shape in plan within a single recess. Thus, the raised elements may define in plan one or more of squares, rectangles, circles, ovals and the like.

Printing plates made according to the invention can be used to print a wide variety of documents, typically paper-based, including documents of value such as banknotes, share certificates, travellers cheques, passports, gift vouchers, stamps, bonds or any other document of monetary value printed by intaglio.

An example of a printing assembly and a printing plate according to the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a schematic, perspective view of the primary cylinders of a printing assembly;

Figure 2 is a cross-section through an intaglio plate recess;

Figure 3 is a cross-section through another intaglio plate recess;

Figure 4 is a plan view of the base of a recess provided with raised elements; and,

Figure 5 is a perspective view of part of another plate.

The printing assembly shown in Figure 1 comprises a plate cylinder 1 on which a set of chrome plated nickel

intaglio plates 2 are mounted, the plate cylinder 1 rotating anti-clockwise in use. (The polymer plates manufactured during origination are converted to nickels which are then protected with a chrome layer.) An ink wiping cylinder 3 is mounted in contact with the plate cylinder 1 and rotates in use in an anti-clockwise direction. Finally, an impression cylinder 4 defines a nip 5 with the plate cylinder 1 through which paper or another receiving medium passes and onto which images defined by the plates 2 are printed.

In operation, ink is supplied to the printing plates 2 at a position 6 upstream of the wiping cylinder 3 by any conventional means not shown, such as PVC schablones (inking rollers) or rubber blankets that rotate in the same direction as the printing plates at the nip. The ink is received in respective recesses etched into the plates 2 defining the required image. The wiping cylinder 3, which rotates in the same direction as the plate cylinder 1, wipes excess ink from the non-recessed areas of the printing plates 2 and then the remaining ink is transferred from the recesses onto the paper at the nip 5.

As explained above, there is a risk that the wiping cylinder 3 will remove ink from the recesses. This risk depends on the shape of the recesses. Figure 2 illustrates a single recess 10 having a depth of 100 microns and a width of 350 microns. The sides extend at an angle of 45° to the vertical and terminate at a base with a lateral dimension of about 150 microns. With this configuration, ink is not sheared from the bottom by the wiping cylinder.

However, with a steeper side angle as shown in Figure 3 in a recess 10', a much larger base is produced. In this case, the sides extend at an angle of 20° to the vertical (or 70° to an imaginary extension of the plate surface) resulting in a base with a lateral dimension of about 280 microns. With such a large lateral dimension, the recess needs ink retaining structures or raised elements 11 to

prevent the ink from being sheared from the bottom surface by the force of the wiping cylinder 3.

The depth of the image recesses for intaglio printing can vary between 5 microns and 150 microns, the deeper the recess the greater the tactile effect of intaglio printing. However, this becomes complicated by the space ratio and height ratio of the raised elements 11 and it is the relationship and formation of both of these aspects that create the optimum printability and tactile effect.

Figure 4 illustrates an example of an array of raised elements according to the invention within a recess which in this example has dimensions 2.4mm x 4.2mm.

As can be seen, a regular array of raised elements 11 each having a rectangular form in plan, a typical height of 10μm and a separation of 20μm or more are provided over the base 12 and define trenches 13 extending at about 45° to the wiping direction indicated by arrow 14. It will be noted, however, that there are certain narrow trenches defined by the raised elements 11 which run substantially parallel to the wiping direction 14. An example of such a trench 15 is indicated by dashed lines in Figure 4. To prevent this trench extending over a significant distance in the wiping direction, additional raised elements 16 having smaller dimensions than the raised elements 11 are provided. Typically, these smaller elements 16 have a dimension of about 40 microns in the wiping direction and 60 microns in the orthogonal direction.

Even with the elements 16, some very thin, continuous trenches exist. However, we have found that a gap up to 150μm width is acceptable but preferably no more than 100μm and in this example the gap is about 60μm.

The printing plates can be manufactured using any conventional plate making process such as etching or photopolymer wash-out. For example, an original will be first exposed onto a sensitized surface of the printing plate which is then developed (or etched) to the required depths by defining appropriate recesses 10,10'. The next

stage is to expose the ink retaining designs, for example of the type shown in Figure 4, and the plate is again developed or etched to the required depths of the raised elements.

In order to increase the amount of ink transferring from the schablones into the plate, it is preferable to introduce additional structure into the bottom of the recesses. The additional structure will have a lower height (10-20μm) than the ink retaining screen and acts to roughen the base of the engraving and thus assist in ink take up. It is however sufficiently small so as not to interfere with the performance of the ink retaining screen or inhibit ink release.

These additional structures 20 (Figure 5) may be regularly shaped or randomly generated, likewise their position in the engraving may be regular or random. In theory, this additional screen could be produced so as to be unique for every customer and function as an additional forensic security device.

For engraved lines that extend a significant distance in the wiping direction, it has been found advantageous to introduce breaks approximately every 500μm. This prevents ink wiping up the length of the line causing over inking at one end. This approach has been found to increase the sharpness and definition of print workings where it has been employed. The breaks should be 15-100μm wide and extended substantially normal to the wiping direction. It is also preferable that breaks are inserted in a non-regular manner across a design to prevent visualisation, this can be achieved using computer aided design software. If done in this way, the print appears continuous to the human eye.

In some cases, the ink-retaining screen may be made up of raised elements in the form of blocks where the blocks define characters or indicia in the secondary screen or preferably the main screen as shown in Figure 5. In principle, these could be created to be machine

authenticatable but it is preferable if they form a forensic or teller assist feature.

CLAIMS:

1. An intaglio printing plate having an array of imaging ink recesses; and, in each recess, an ink retaining structure comprising one or more regular arrays of discontinuous raised blocks extending from the base of the recess to no more than 60% of the height of the recess, ink retaining trenches extending between the raised blocks, and wherein no more than 30% of the area of the recess base is provided with raised blocks.

2. A plate according to claim 1, wherein no more than 20% of the area of the recess base is provided with raised blocks.

3. A plate according to claim 2, wherein 2.5-10% of the area of the recess base is provided with raised blocks.

4. A plate according to claim 2, wherein 10-15% of the area of the recess base is provided with raised blocks.

5. A plate according to claim 2, wherein 15-20% of the area of the recess base is provided with raised blocks.

6. A plate according to any one of claims 1-5, wherein the shortest distance between adjacent raised blocks is no less than 100 microns.

7. A plate according to any one of claims 1-6, wherein the raised blocks have maximum lateral dimensions in the range 40-250 microns.

8. A plate according to any one of claims 1-7, wherein the printing plate defines an ink wiping direction, the raised blocks being defined such that any trench extending by the size of the recess in the wiping direction has a width which does not exceed the shortest distance between adjacent raised blocks.

9. A plate according to any one of claims 1-8, wherein all trenches with a length substantially equal to the size of the recess and with a width no less than the shortest distance between adjacent raised blocks extend at an angle in the range 15-75° to the wiping direction.

10. A plate according to any one of claims 1-8, wherein all trenches with a length substantially equal to the size of the recess and with a width no less than the shortest distance between adjacent raised blocks extend at an angle of substantially 45° to the wiping direction.

11. A plate according to any one of claims 1-10, wherein the ink retaining structure comprises a set of first raised blocks defining a regular array.

12. A plate according to claim 11, wherein the ink retaining structure comprises a set of second, smaller raised blocks dispersed between the first raised blocks to assist in ink take up.

13. A plate according to claim 11 or claim 12, wherein all the first raised blocks have the same shape in plan.

14. A plate according to any one of claims 1-13, wherein the raised blocks define in plan one or more of squares, rectangles, circles, ovals and the like.

15. A plate according to any one of claims 1-14, wherein at least two of the imaging ink recesses have different ink retaining structures.

16. A plate according to any one of claims 1-15, wherein the ink retaining structure comprises a set of further raised blocks in each recess, the further raised blocks having a height less than the other raised blocks of said ink retaining structure.

17. A plate according to any one of claims 1-16, wherein the first raised blocks define indicia.

18. A plate according to any one of claims 1-17, wherein each recess defines a side wall which defines an angle of 65° or more with an imaginary extension of the surface of the plate.

19. A printing assembly comprising a printing plate according to any one of claims 1-18; an inking system for supplying ink to the imaging ink recesses; a wiping mechanism for removing excess ink by wiping the printing plate in a wiping direction; and a system for transferring ink from the printing plate to a substrate.

20. An assembly according to claim 19, wherein the printing plate is mounted for rotary movement, the wiping mechanism comprising a wiping cylinder which abuts the printing plate and rotates in an opposite direction to the printing plate.

Fig.1.

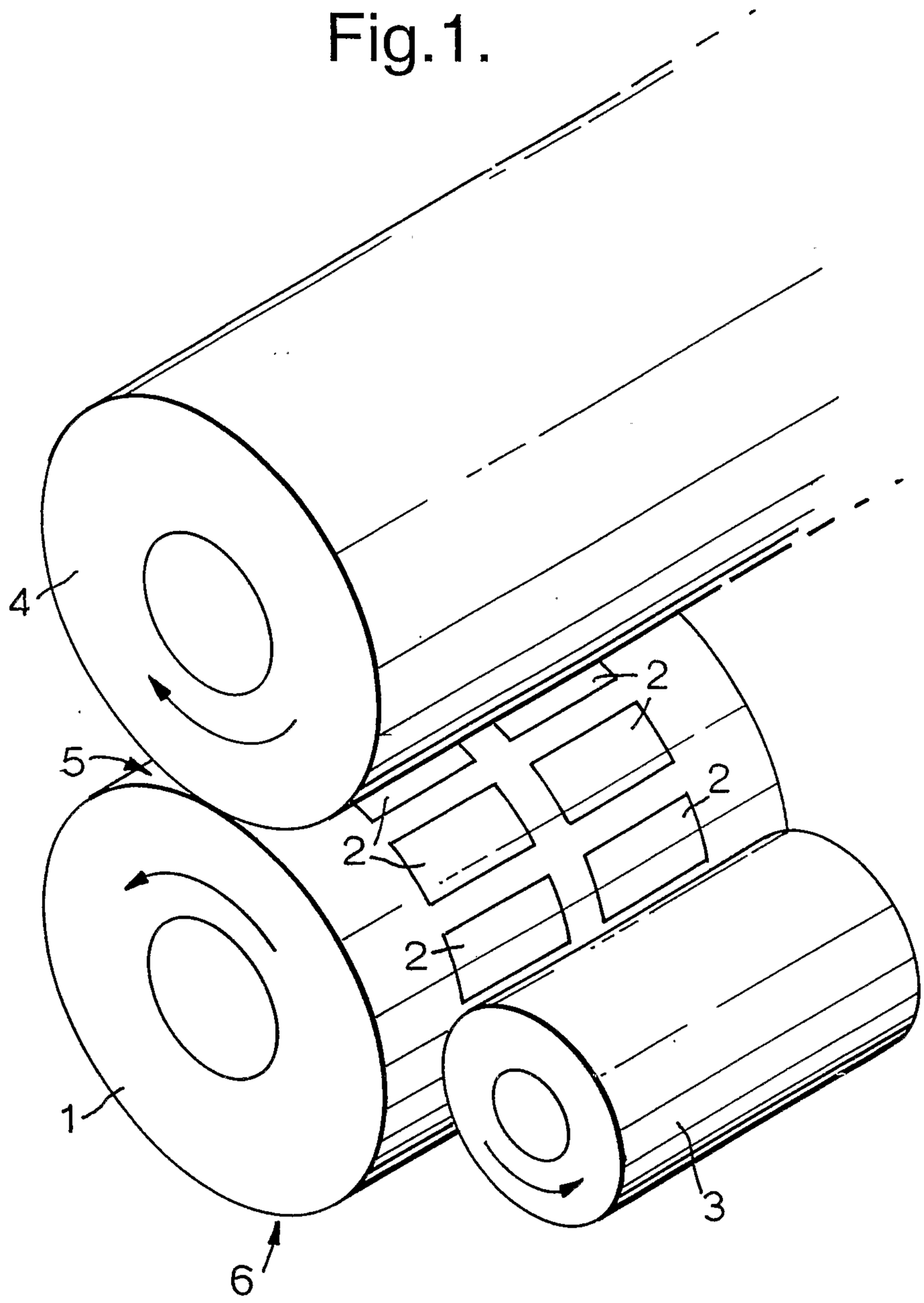


Fig.2.

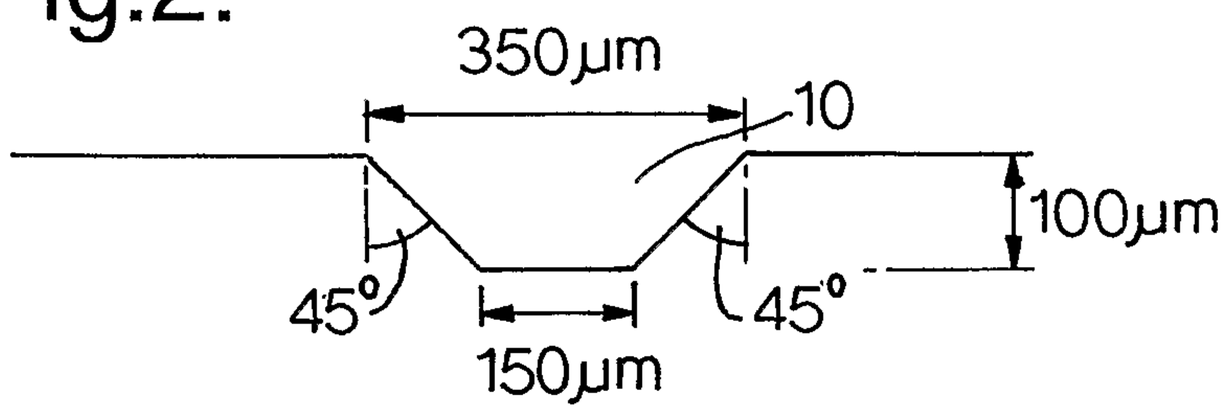


Fig.3.

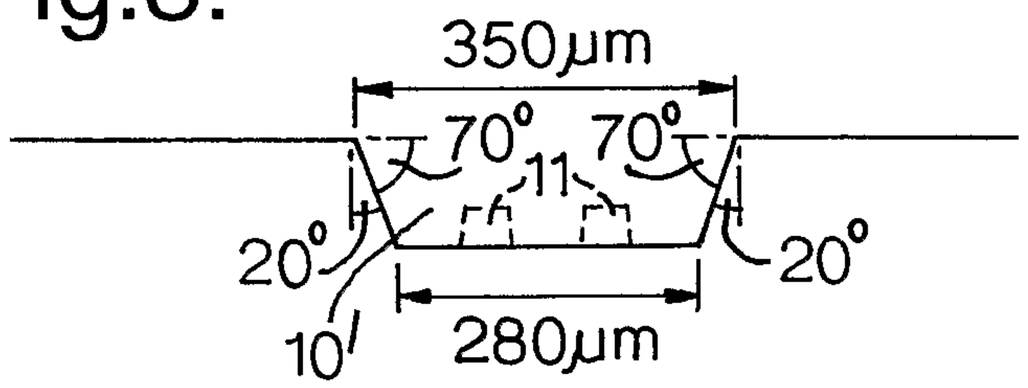


Fig.4.

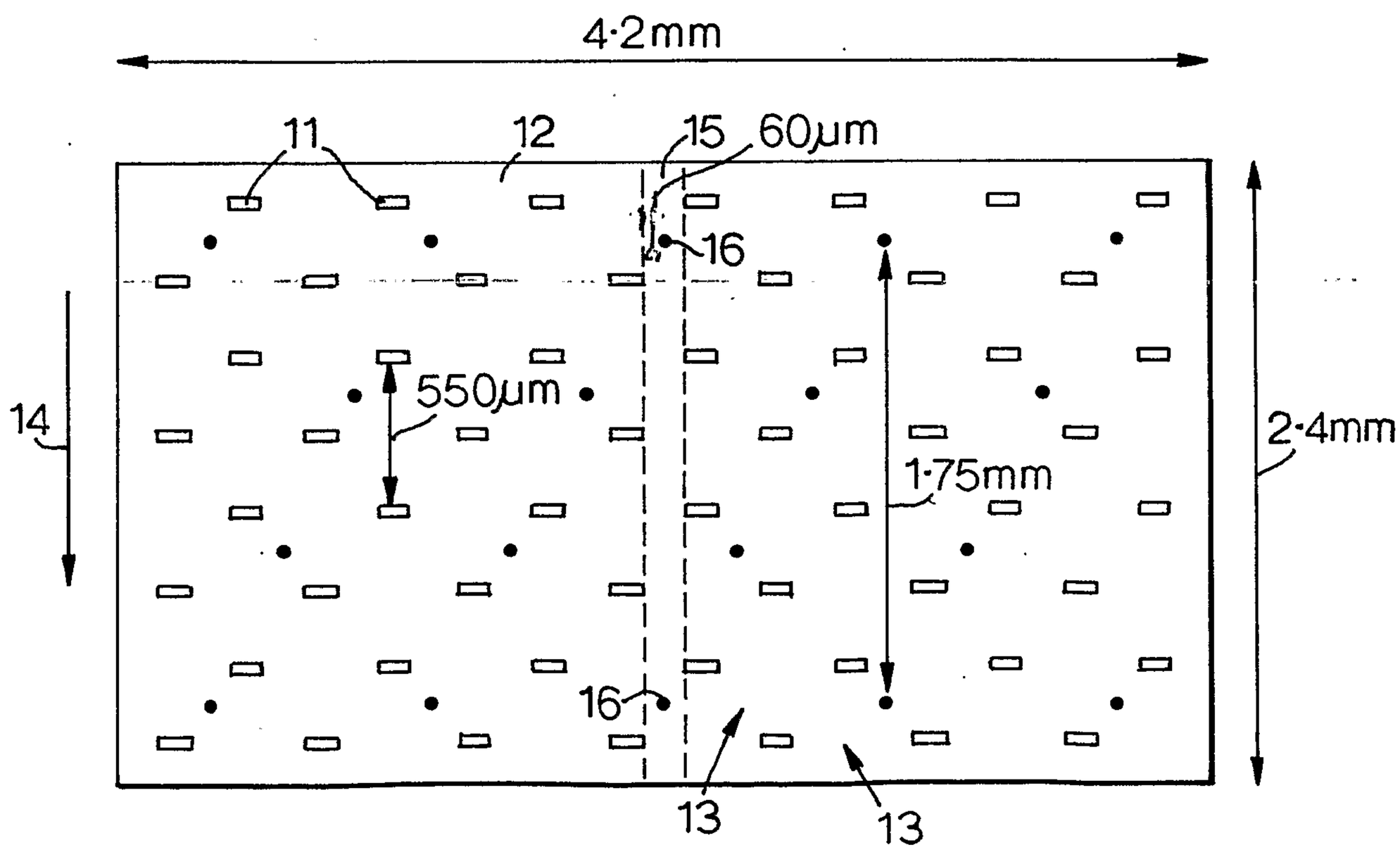
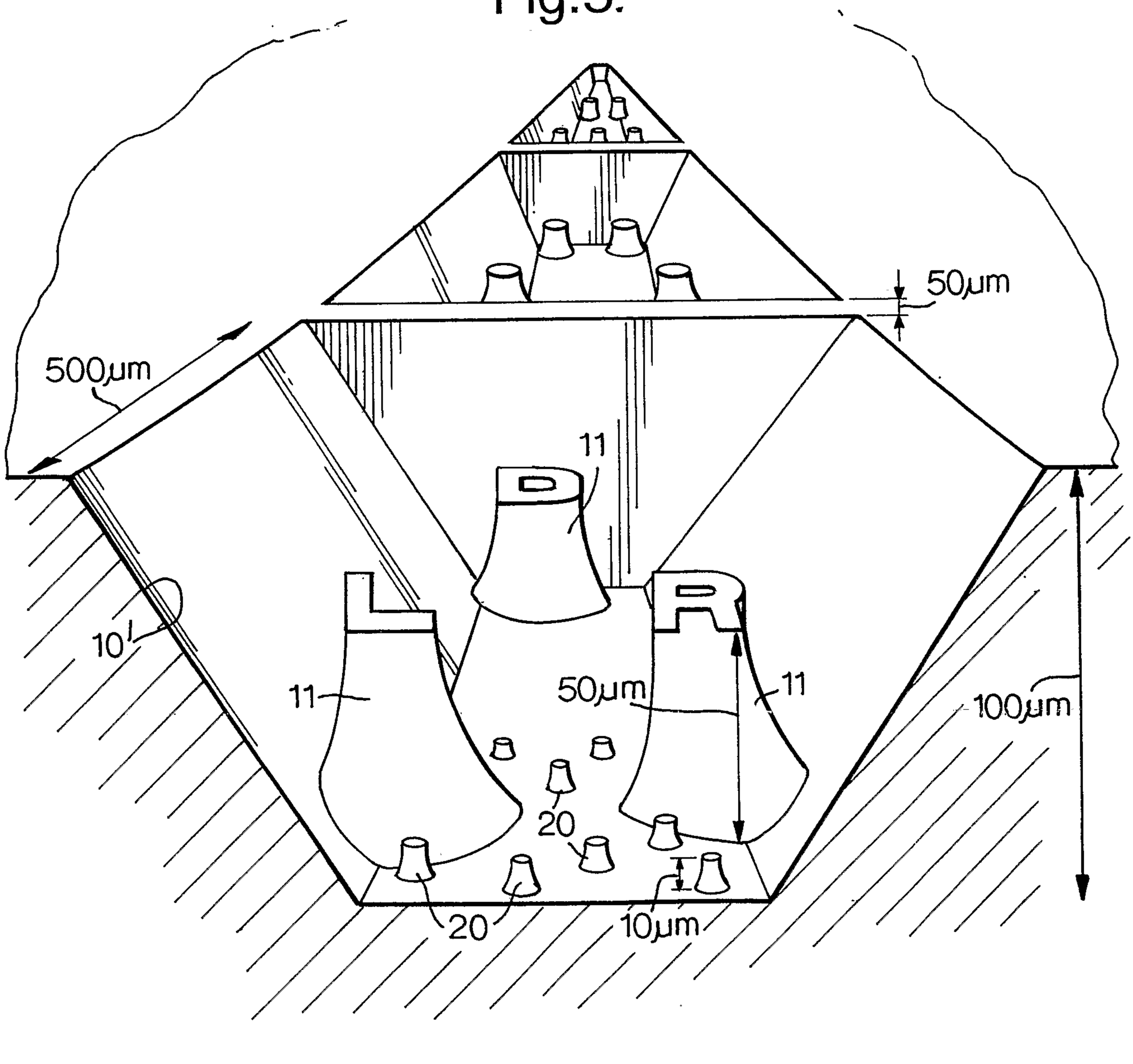
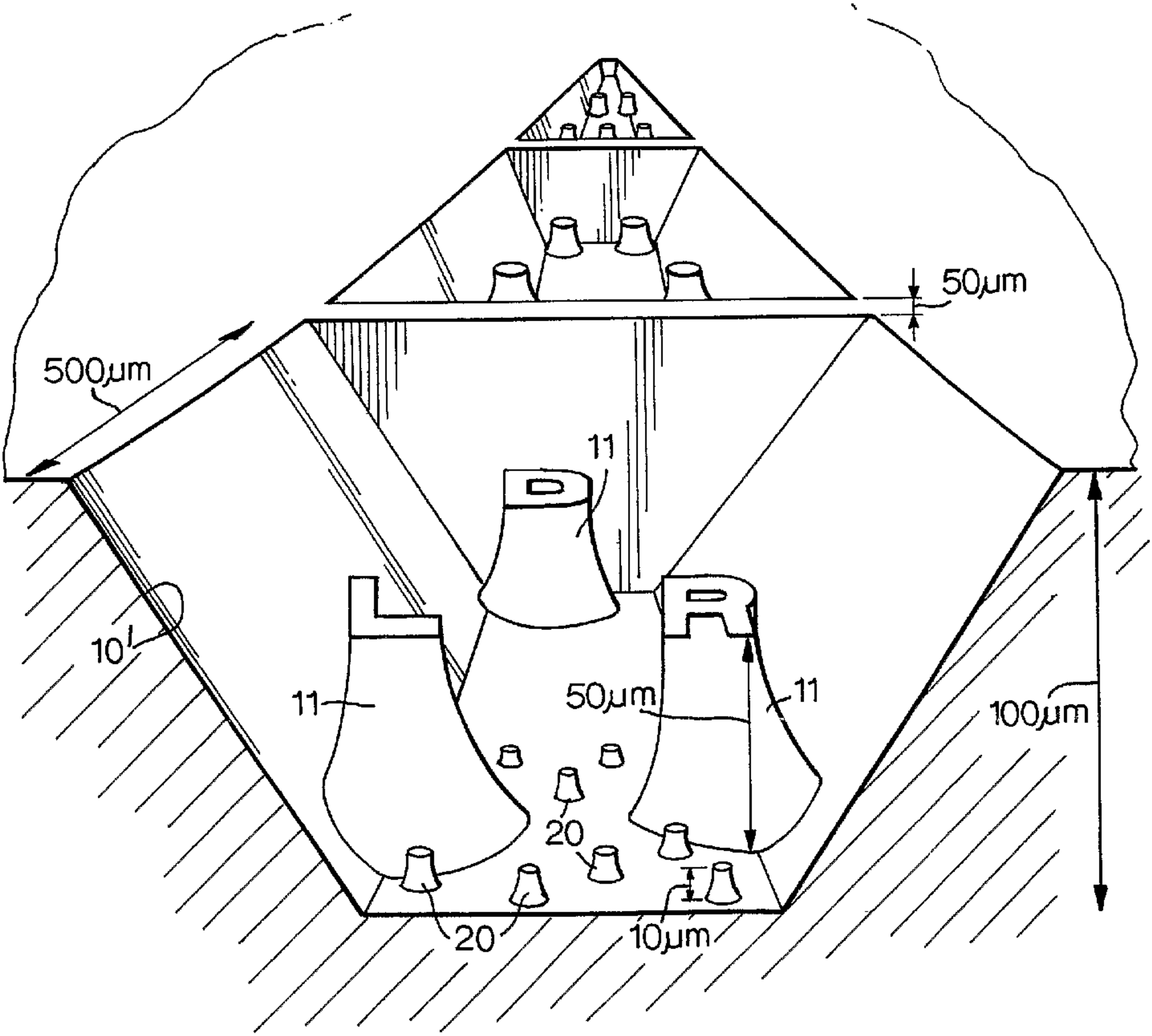


Fig.5.




50μm
500μm
11
10
11
50μm
11
100μm
20
20
10μm