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(54) **PICTURE FRAME COMPRISING A VIEWING WINDOW SIDE AND A FRAME SIDE, PICTURE FRAME SYSTEM, CONNECTING ELEMENT**

(57) A picture frame comprises a viewing window side (1) and a frame side (2) with the viewing window side comprising a transparent window (3). There is an interstice between the viewing window and the frame side. A photo or picture can be placed here. The viewing window and frame sides comprise assembly components (5) in order to assemble the viewing window and frame sides together. An assembly component on the frame side comprises a flexible protruding clamping part (51)

provided with a clamping section (52) on a side facing the viewing window (3) and the viewing window (3) is provided with a complementary clamping section (31) at an edge of the viewing window (3) with the complementary clamping sections (52, 31) fitting into each other and with, when assembled, the protruding clamping parts (51) on the frame side exert a clamping force (F2) on the viewing window (3) with the direction of the clamping force (F2) being mainly in the flat plane of the viewing window.

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Description

[0001] The invention concerns a picture frame comprising a viewing window side and a frame side, with the viewing window side comprising a transparent window and with there being an interstice between the transparent window and the frame side for placing a flat object, i.e. a photo or picture, which can be visibly positioned to either side, and with the viewing window and frame sides comprising assembly components for mounting the viewing window and frame sides onto each other and thereby enclosing the flat object.

[0002] The invention also concerns a picture frame system comprising at least two picture frames forming an arrangement of picture frames which can be connected together by means of connecting elements.

[0003] The invention also concerns a connecting element for connecting picture frames together.

[0004] Frames comprising a viewing window side and a frame side which can be mounted onto each other, with a picture being visible through the transparent window, are known from the prior art.

[0005] There can be further parts between the viewing window side and the frame side or between the viewing window section and the frame section. The parts together, including the viewing window section and the frame section, form a picture frame for presenting a photo or picture. Such photo frames comprise an interstice between the viewing window side and the frame side for placing a flat object, i.e. a photo or picture. Examples are known from the US patent specification US4608770, the US patent specification US5544436, the US patent specification US5544438, the US patent application 2007051063, the US patent application US201116758, the US patent application US2002066218, the Japanese patent application JP2002066218, the Chinese patent application CN105832068 and other documents.

[0006] Known picture frames require a relatively large portion of the viewing surface to be used to enable assembly and this assembly is often achieved using separate components. The assembly components in known picture frames are positioned in or on the frame sections such that the assembly space required for the assembly components forms an edge around the photo or picture to be presented or the picture needs to be perforated. Due to this edge which is present outside the surface of the picture to be presented, most picture frames thus formed are intended for presenting stand-alone pictures. Some of these picture frames can be connected together to enable multiple pictures to be presented in a collage structure, but in all these cases they are intended for independent pictures. Cutting one picture into several parts and placing them in different frames in order to display the overall picture would cause excessive interruptions in the overall picture because of the space required for the assembly components.

[0007] If a total picture or photo is to be displayed divided over two or more picture frames in order for them to jointly display one complete picture or photo, the interstice necessary for the assembly components will distort the appearance of the composite total picture or photo since the assembly edge is in the visible surface. The partial pictures are placed apart, separated by assembly edges, as a result of which a composition of several parts of a picture spread over several adjacent frames cannot be shown without any disturbance. There will be an interruption in the appearance of the picture to be displayed at or near the transition from a picture frame to an adjacent picture frame due to the distance from one part of the photo to the next part of the photo being too great.

[0008] An objective of the present invention is to provide a picture frame and a picture frame system such that, on a visible side of the picture frame, partial pictures which are part of a total picture are connected properly from one outer edge to the outer edge on the opposite side so that one image can be displayed, spread over multiple adjacent picture frames with minimal interruptions in the transition of the picture from one frame to the next.

[0009] For this purpose, the photo frame according to the invention is characterised in that the assembly component on the frame side comprises a flexible protruding clamping part, provided with a clamping part on a side facing the viewing window and the viewing window provided with a complementary clamping part at an edge of the viewing window with the complementary clamping parts fitting into each other and with, when assembled, the protruding clamping part on the frame side exerting a clamping force on the viewing window with the direction of the clamping force being mainly in the plane of the viewing window. The clamping force may comprise a slight (up to 25% of the total force) downward, i.e. transversally to the window, component. There are protruding clamping parts on at least two opposite edges of the picture frame.

[0010] The invention enables the width of the edge to be reduced, allowing pictures to optically match together better.

[0011] The clamping parts preferably do not, or not substantially protrude beyond the outer surface of the window. This minimises the optical effect of the clamping parts.

[0012] The clamping parts of the window are preferably provided with notches at the edge which constitute less than 20% of the length of the edge if the material used for the frame side is rigid or they are all around if the frame side material is particularly flexible.

[0013] As a result, the optical effect of the clamping parts is relatively small.

[0014] The viewing window and frame sides are also referred to here as "viewing window section" or "frame section". For the purpose of the invention, "picture frame" is also considered to mean a frame for presenting a flat object which has a picture on it, such as an etching, drawing, water colour, screen printed image, lithograph, embroidery, page from a book, etcetera.

[0015] The present invention provides a design on the viewing window side in which the picture to be presented can extend almost to the edge and in which the assembly components extend in this edge from the frame section to the viewing window section such that, for example and preferably, an edge of only 1 to 2 millimetres wide is required. The viewing window section can extend above this edge and defines the outermost dimensions of both sections with a photo enclosed. Outside this edge where the viewing window section extends above the frame section and the window and frame sections connect together, the edge of the viewing window preferably has a rounding or chamfer to the outer edge shaped such that, when looked at from the viewing side, a lens or optical enlarging effect is created on the window, with the outer edge with the enclosed photo or picture's image information being optically stretched and thus partially or entirely projecting over the edge between the two sides of two viewing window sections. The rounding which enables this optical effect preferably has a beam whose focal point is below the outer edge of the photo and thus has the superimposed image information within the projection beam. If two adjacent frames have both been laid against each other with their viewing window sides facing the viewing plane and each contains a connecting partial photo or partial picture, this part of the invention will cause the pictures to optically connect more closely to each other and the actual edges of material where the frame parts between the viewing window and frame sides join will be less visible.

[0016] If, according to embodiments of the present invention, the photos or pictures were to present one total picture together, optical reduction of the interstice between adjacent viewing windows will improve the perception of the picture and will contribute to the perception of the two parts of a total image as a single entity again. The optical effect intended by the rounding or chamfering towards the edge of the viewing window section is interrupted where the connection causes the clamping parts of the frame section to engage in the side of the viewing window section, which is a preferred embodiment of the present invention comprising a solid non-transparent element equal to the material of the entire frame side. This optical interruption is slight since the clamping parts do not protrude above the viewing window.

[0017] Because the eye sees an interrupted total image that consists of several parts combined together as a single entity if the image information itself is not optically interrupted, the intermediate edges of the frames used according to the invention are minimised to ensure that only a limited part of the image information is lost at these edges which are connected together as a result of the assembly. Using the lens effect in the edge is not required since an outer edge of 1 to 3 mm for each individual picture frame is a very limited interruption. However, the lens effect creates further optical improvement.

[0018] Even without the lens effect resulting from a convexity or slope near the edge, it is a part of an embodiment of the present invention that the surfaces in the edges where the viewing window section connects to the frame part are sloping resulting in reflective surfaces and, as a result of this slope and the reflection, image reflections occur in the inner side of the viewing window section which colour the interrupted edge with image information from the picture or photo.

[0019] This means that the use of a slope or, preferably the convexity, according to the invention has the optical effect that the picture to be displayed is optically stretched at the edges and this also applies to the reflection effect of sloping surfaces in the transparent window under the edge. The clamping parts, hereinafter called 'hook parts', and the notches and the fact that the clamping parts preferably do not protrude above the viewing window surface, together with the optical effect or reflection effect and the slope or convexity cause the image to be displayed to extend to the edge, or almost to the edge, and the assembly components to be hardly, if at all, visible in the total picture. This improves the possibility of achieving an optically smooth transition between picture frames.

[0020] The picture frame system according to the present invention thus provides the option of displaying pictures with a viewing side in the frames by simply displaying the frame sides of the viewing window and frame sections assembled together, possibly in a setup where these frames are connected together or are mounted to the wall without being connected together.

[0021] Furthermore, it is an objective of the present invention in preferred embodiments to present the picture on the viewing window side whereby a contiguous whole can be displayed and whereby the picture frames can be connected together by means of connecting elements which are also enclosed by the assembly component which is used to assemble the viewing window and frame sides together and where the connections with adjacent frames can be achieved by means of these assembly components.

[0022] In the prior art there are picture frames provided with suspension elements in order to mount the frames to the wall. In many cases, these suspension elements prevent the picture frames from being able to be used on the front and the rear sides and thus make them suitable for mounting on one side only. It is a further objective of the present invention to keep the weights of the frame parts low by using narrow materials and by the absence of any loose assembly components so that they can be easily attached to a wall using tape, possibly double-sided tape.

[0023] Known picture frames often provide an eyelet or other mechanism for wall-mounting on the rear of the picture frame. As a result, the picture frame can only be used on one side. An eyelet which enables the picture frame to be moved freely to adjust its horizontal position is often used. This free movement is also the reason why many of these frames with a wall-mounting mechanism hang crooked after some time.

[0024] The use of tapes prevents these frames from changing orientation after having been installed. Besides the frames' front and the back being able to be freely determined, the frames according to the present invention do not have

a specific bottom, top or side either.

[0025] According to the present invention, if several photo frames connected to each other are to be attached to a wall which is not perfectly flat, e.g. a brick wall, the connections should be flexible in order to enable and compensate for the out-of-flat position of the frames.

[0026] Many of the picture frame systems known from the prior art which can be connected together have a connecting element to connect several picture frames together in a frame, but this is by means of a connection using rigid connecting elements of non-flexible material and the movement between them is controlled by a mechanical hinging effect of picture frames connected together. This prior art includes, without limitation, US5544438, US5544436, US6230428, WO2015/089320, FR2963222 and JP201141778.

[0027] The present invention provides for a picture frame system comprising at least two picture frames and a flat connecting element for interconnecting the - at least - two picture frames, with the connecting element comprising one or more central openings for receiving a clamping part of the picture frames which are to be connected, and, when assembled, the parts of the connecting element located on either side of the one or more central openings are clamped into the -at least - two picture frames. This is an easy way to achieve a connection which offers many opportunities.

[0028] The connecting element is preferably made of a thin ductile flexible material which enables an assembly of picture frames in a frame to be easily placed against, and attached to, a wall which is not flat. The thin, preferably, plastic material is flexible due to its limited thickness and enables frames which can be connected together to bend away from the flat plane in order to compensate for any unevenness of the wall.

[0029] Due to the use of a ductile material for the connecting element, the orientation of this ductility in the connecting elements is not limited to bending along one axis or in one direction. The connecting elements for connecting picture frame parts of different frames together are preferably punched from a stiff yet ductile material of slight thickness. The connecting elements according to the present invention are enclosed as well if a viewing window section is complementarily secured between the bulges of a frame section and thus they can preferably move freely between the two assembly components. This enables an assembly of several frames to easily be stuck to walls that are not flat.

[0030] If one wants to provide for interconnectable frames for using standard photo sizes with variable placement position orientations and, as is the case in the present invention, they should be able to be presented up to their edges behind a complete viewing window, the standard photo sizes also determine the dimensions of the frames. If each of them comprises a minimum edge of only 1 to 3 mm and frames of different sizes are to be connected together, the present invention provides for the use of a connecting element whereby the interstice between adjacent frames can be varied.

[0031] In an embodiment of the present invention, the variation in the interstice can be achieved by using differently shaped connecting elements, each of which is appropriate for achieving a certain distance between the frames.

[0032] In another embodiment according to the present invention, the connecting element itself preferably has two or more orientations in which it can be used and which enables the interstice to be determined. In a preferred embodiment of the invention, the connecting element has holes which complementarily match coupling elements. The position of the coupling element in the attachment to the frame section can be adjusted so that the attachment distances of frame sections can be varied for different frame sizes and orientations.

[0033] For example, the attachment of the coupling element on a short side of a rectangular frame can be located further inward, reducing the distance between two frames coupled together along this short side. In a frame made up of, for example, two frames for photos of 15x15 cm and three frames for photos of 10x15 cm, the present invention provides that the necessary edges around the photos which enlarge the frame dimensions and thus create an uneven distance between the two frames and the three frames are compensated and are evened out by changing the interstice for the different dimensions as well as the edge thickness of the frame parts. The two rows of frames are thus given equal total dimensions so that the coupling elements in two frames which are to be coupled are at corresponding distances. The picture frame connection system according to the invention therefore provides for system elements which enable several different sizes to be connected together into a collage.

[0034] In the prior art it is often prescribed that the parts are made of plastic but a definition is lacking as to why plastic is necessary and there is no description of the properties which the plastic to be used should satisfy in order to make the invention feasible. Thus, in most cases, the properties of the plastic are not part of the invention except for the fact that they determine the choice of material. There are plastics with very rigid properties as well as plastics with very flexible properties and they can be produced in different ways, for example by injection moulding, extrusion or calendering. The present invention preferably provides for injection moulding using a very rigid yet clear plastic for the viewing window sections and a plastic that is somewhat more flexible for the frame sections so that the ductility of connecting elements can be achieved, and the specific limitation of this choice of plastic can be overcome. The shapes of the frame parts in the present invention are so specific that they must be manufactured by injection moulding and, in addition, according to the present invention, the viewing window section is made from a very transparent, yet consequently rigid and hard plastic. Transparency as a property of the plastic causes this plastic to be very rigid and inflexible. The hardness and rigidity are direct consequences of clear injection moulded plastic which cures into a hard material. A soft-curing injection

moulded plastic with the envisaged surrounding wall thickness of 1 to 3 mm cannot or can hardly be produced as a completely clear plastic because the soft properties are achieved by plasticizers which will cloud the material. Therefore, the clear transparent window section is hard and has little flexibility in the present invention, but its clarity enables an undisturbed view of the picture presented. To assemble a viewing window section with a frame section, the frame section is preferably made of a softer plastic that is not clear and is therefore more flexible. The viewing window section can be enclosed or assembled within the bulges on the frame section because the perimeter dimensions stretch flexibly within the bulges of assembly elements on the frame section, thus offering just enough space to provide for the introduction and assembly of the viewing window section between the bulges in the frame section.

[0035] In many instances of the prior art, parts are provided which are intended to assemble the two sides of a frame together. Not only do these assembly options take up space in the viewing plane of the picture, but they also come with separate elements which complicate assembly. Nuts and bolts are provided in many cases. The present invention does not require any separate elements to mount the two frame sides onto each other, but the clamping of the viewing window section between the upright fixed hook elements on the frame section provides for assembly without additional separate parts.

[0036] An important detail in a preferred embodiment of the present invention is that the viewing window section is clamped to the frame section on a contact surface in the side of the viewing window section instead of in the viewing plane on the viewing window section and therefore requires minimal space in the viewing plane on the viewing window side and thus does not disturb, interrupt or perforate the picture to be enclosed. The present invention provides for assembling rectangular and square frames but the system can also be applied to hexagonal, octagonal or round frames.

[0037] Many coupling systems or connecting elements which enable frames to be coupled or connected together are known which are characterised in that they have clearly visible adjustments to their shape which enable coupling. In many cases where these frames are hung individually, the openings and mounting elements are clearly visible and the frames are not actually intended to be hung individually. Part of the present invention is to provide a connection method for adjacent frames whereby the connections between frames are made using transparent materials comprising flat parts preferably of a thickness of less than 0.5 mm, preferably located at the centres of the frames where the separation between the viewing window section and the frame section is located and the connecting element is enclosed. This attachment is provided in the centre, enabling frames to be connected together on two sides, with alternating viewing window or frame sides, without there being any differences in height in the flat frame created by several connected frames in a collage. If a frame according to the invention is individually mounted to a wall in a free space, the opening between the parts where the connecting elements would engage in the case of connected assembly is so minor and is incorporated in the joint between the frame and viewing window sections such that it does not show in such a way that it might give the impression that the frame was not intended to be hanging on its own.

[0038] The connecting elements according to the invention are preferably made of a dense, non-porous material and preferably transparent so that the visibility of any connections between frames which are visible from the viewing side is reduced because people can see through the connecting elements to the wall behind the frame.

[0039] If the interstice between the attachment of a connecting element on one frame and the attachment in the adjacent frame to be connected were increased, it is a part according to the invention that the ductility of the material of the connecting element would enable the frames to adjoin at an angle. According to the invention, this enables three or more adjoining frames to be turned into a three-dimensional assembly of frames.

[0040] Many standard sizes exist for photographic prints. It is a part of the invention to provide a frame system for those standard sizes enabling different standard sizes of photos to be connected together in different assemblies in complementary frame sizes. Commonly used photo sizes are 10 x 15 cm, with actual sizes of 101.6 mm by 152.4 mm, and 15 x 15 cm with actual sizes of 152.4 mm by 152.4 mm which is due to the fact that these sizes originated from American inch sizes such as 4 inch x 6 inch and 6 inch x 6 inch. It is a part of the invention that the dimensions of the frames are provided such that, when connected, for instance three photos of a height of for instance 10 cm in their respective frame housings and assembled together come to the same total height as two photos of for instance a height of 15 cm in corresponding frames and such that the coupling elements when in position in each frame are all equidistant from the corner of the frame and, in a collage of several contiguous frames, opposite coupling elements are adjacent to each other. In view of the exact sizes of the photographs which already have an identical overall height independently of the three (10 x 15 cm) and two (15 x 15 cm) frames in this assembly, the present invention provides for minimal frame edges around those photos which are narrower on the longitudinal sides of the frames intended for 10 x 15 cm than the edges in the frames intended for 15 x 15 cm photos so that the interconnected frames in the assembly also achieve the same overall size. The connection system of the present invention causes the interstice between the two 15 x 15 cm frames to be greater than the interstice between two longitudinally adjacent 10 x 15 cm frames and causes the combined distances of different wall thicknesses and interstices where the rows of the two configurations can be connected together to be such that the positions of these connecting elements are accurately adjacent. This enables different sizes of frames to be combined together in a collage.

[0041] In an embodiment of the present invention, the frame connecting elements are punched from transparent and

dimensionally stable hard yet ductile sheet material. Simple punching devices can only punch a hard material of minor thickness because too much force is required to cut through thicker material. Cutting lines in the punch enable holes in the part which have to be placed over the joint to go past the bulge which needs to be passed since the connection surfaces around the hole can bend along with the notch made and thus a temporary enlargement of the hole can let the bulge pass through. The notches also enable edges of the connector to be secured behind bulges in the glass or the frame part at the location of the enclosed connector.

[0042] Existing systems require much space in the viewing plane outside the dimensions of the picture to assemble the front and back together. In the prior art, in many cases, the assembly elements and the connection mechanism technology are located centrally between the frame parts and therefore require a lot of space in the visible surface. An objective of the invention is to assemble the viewing window and frame sides such that the space required along the outside of the picture to be placed on the viewing window side is minimised. A one to three-millimetre edge is sufficient to assemble both sections using the method according to the invention. Altogether, this minimum space is insufficient to use assembly techniques such as nuts and bolts or similar techniques according to the method in the prior art. The assembly according to the invention is possible within this small space by clamping the viewing window section between assembly elements of the frame part extending directly next to the picture with minimal use of material. The assembly is achieved by flexibility in the material of the frame section enclosing the viewing window section which is to be placed within overlying protrusions.

[0043] In an embodiment according to the invention, the connecting elements have been punched simultaneously as a grid of several connecting elements or they have been injection-moulded but not detached yet. The connecting elements thus remain attached to each other and maintained in the same flat plane and users can detach the desired parts themselves.

[0044] In an embodiment according to the invention, the frame section and the viewing window section are provided with different complementary connection surfaces which align with complementary notches at the correct positions in the outer wall when assembling the frame parts so that the viewing window section is enclosed in the correct location in the frame section. A self-locating action of the two frame parts is created by placing connection surfaces at a complementary angle along which the frame parts slide towards one another in order to achieve the correct assembly position and are positioned opposite each other thus that the upper edge of assembly elements with a bulge rests against the lower edge of the notch in the viewing window and slight manual force creates sufficient movement in the assembly element so that both edges pass one another and the bulge reaches its complementary closed position corresponding to the notch.

[0045] In an embodiment according to the invention, the complementary corners of connection surfaces are also intended to guide the photo to be enclosed into the desired correct position within the frame section before it is assembled together with the viewing window section.

[0046] When enclosing a photo and/or a passepartout between the two frame sections after assembly, these sections should preferably be provided with edges on both the frame section and the viewing window section with self-locating complementary edge parts at an angle so that these oblique planes help to correctly position the two frame parts and so that the point of engagement of the bulge on the assembly element is correctly positioned on the edge of the receiving notch in the viewing window section when, by the temporary bending of the mounting elements, these are placed in complementary position next to each other and the viewing window section with the complementary notch is enclosed between these assembly elements on the frame section. It is more specifically the ductility of the frame section material and the rigidity of the viewing window material that create a kind of click connection between notches in the viewing window section and assembly elements at complementary locations in the frame section.

[0047] The connection surface of walls in the edge of the viewing window section is preferably at an angle so that the colour of the material of the frame section is reflected in it and outwards when looking at the viewing window section.

[0048] In an embodiment according to the invention, a passepartout is printed on hard yet ductile film so that this film also functions as a viewing window and can optionally be included as part of the appearance of the picture to be placed in it; this passepartout is printed on both sides in the colour or with a motif of the desired passepartout. The dimensions of the passepartout material correspond to the interstice between the frame and viewing window sections, so that it will be enclosed such that it fits the picture when these frame parts are assembled.

[0049] In an embodiment according to the invention, the passepartout is a flexible transparent layer with a colour or motif print on two sides and the passepartout can optionally be placed, with one side visible, over the illustration on both the viewing window and frame sides. The gap between the frame parts offers just enough room to mount both the picture and the passepartout in between, thus providing the picture with a colour or motif border or another design.

[0050] These and further aspects of the invention are described below and illustrated by means of the drawing: The figures contained in the drawing show the following:

Figures 1A to 1L show cross-sections of picture frames known from prior art and commercial traffic;
Figures 2 and 3 show cross-sections of a part of a picture frame according to the invention;

Figure 4 shows a perspective view of an embodiment of a picture frame according to the invention;
 Figure 5 shows a detail of a perspective view of a picture frame according to figure 4 provided with a connecting element;
 Figure 6 shows a perspective view of an assembly of two picture frames according to the invention connected by a connecting element;
 Figures 7 and 8 show cross-sections of examples of embodiments of a picture frame according to the invention in an enclosed state and provided with a connecting element;
 Figure 9 shows a view of parts of two picture frames with a connecting element and wall thickness and interstice;
 Figure 10 shows a perspective view of a corner detail of a picture frame according to the invention;
 Figures 11 to 14 show illustrations of connections between picture frames according to the invention and the position of the connecting element used;
 Figures 15 to 17 show examples of connecting elements;
 Figure 18 shows a disassembled picture frame according to the invention;
 Figures 19 to 26 show examples of possible assemblies of picture frames according to the invention;
 Figure 27 shows a cross-section and perspective view of a further example of a picture frame according to the invention;
 Figure 28 shows a connecting element between two picture frames;
 Figure 29 shows a collage assembly of picture frames according to the invention.

[0051] Not all figures are drawn to scale; as a rule, like numerals denote like elements.

[0052] The parts of the picture frame and the picture frame assembly shown in the figures have been provided with the following numerals:

Figures 1A to 1L illustrate known picture frames. The locations where the figures can be found are always indicated next to them. The designation "Nielsen Bainbridge" refers to a commercially available existing model.

[0053] The picture frames comprise a viewing window side 1 provided with a viewing window 3, a frame side 2 and assembly components 5 in order to assemble the viewing window and frame sides together. A photo or picture 4, visible through the viewing window 3, is provided for between the viewing window side 1 and the frame side 2. Note that the fact that one of the sides is referred to as the "viewing window side" does not exclude that the opposite side, the 'frame side' is also transparent. In that case, both sides are both the viewing window side and the frame side.

[0054] In figure 1A, showing a picture frame known from US4609770, the assembly components comprise five complementary parts which engage together. The assembly components form a visible assembly edge around the photo or picture. The width of the assembly components is indicated by Ra. Arrow Fa indicates the point where the force with which the parts engage is exerted and the direction of that force.

[0055] In figure 1B, which shows a picture frame known from US5544438, the frame parts are connected together by means of a screw connection. The assembly components 5 are placed on the edges of the picture frame. The width of the assembly components is indicated by Rb. Arrow Fb indicates the point where the force with which the parts engage is exerted and the direction of that force.

[0056] The further figures 1C to 1L have references to the prior art from which this is known. The width of the assembly components is indicated by Rc, Rd etc. Arrows Fc, Fd, etc. indicate the point where the force with which the parts engage is exerted and the direction of that force.

[0057] Figure 2 shows a cross-section of a frame section and a viewing window section of a picture frame side according to the invention. The assembly component 5 comprises a flexible protruding clamping part 51. The protruding clamping part 51 is provided with a clamping section or bulge 52 on a side facing the viewing window. The viewing window 3 is provided with a complementary clamping section 31 in an edge of the viewing window. When assembled, the clamping section 52 of the protruding clamping part 51 and the complementary clamping section 31 of viewing window 3 engage with the protruding clamping section 52 exerting a clamping force F2 on the viewing window with the direction of clamping force F2 being mainly in the flat plane of the viewing window and the direction of this force causing the shape of the complementary clamping parts to be enclosed and kept in their assembled position. The clamping force F2 may comprise a slight (up to 25% of the total force) downward component, i.e. oriented inwards transversally to the viewing window. There are protruding clamping parts 51 on at least two opposite sides of the picture frame. Preferably, the clamping parts 51 do not, or hardly, protrude beyond the outer surface of the viewing window 3. R2 shows the visible edge and F2 shows the direction of the force.

[0058] Compared with the known prior art as shown in figures 1a to 1h where a force is exerted mainly perpendicular to the viewing window surface, figure 2 shows that the clamping force F2 exerted on the picture frame according to the invention is mainly exerted parallel to the viewing window surface, engaging with the side of said viewing window surface. According to an embodiment of the present invention this enables the width R2 of the necessary edges to be reduced which enables partial images of an image to be displayed to match better, i.e. with fewer visible edges when this image is displayed using several frames.

[0059] The complementary clamping sections 52 and 31 of respectively clamping part 51 and viewing window 3 fit together. The viewing window preferably comprises three notches in its edge into which the clamping parts 31 fit. These notches extend along only a part of the edge according to an embodiment according to the invention, preferably less than 10% of the length of the edge although it is also possible to provide the entire edge of the viewing window with complementary clamping section 31 and to close the viewing window section all around as a consequence of flexibility with the complementary clamping section.

[0060] Figure 3 shows further details of an embodiment of a picture frame according to the present invention whereby the shape of the frame is not limited to rectangular but could also be hexagonal, octagonal or round. A notch or gap 511 is provided around or on both sides of the flexible protruding clamping part 51. This gap 511 increases the flexibility of clamping part 51 to complete an outward movement of the clamping part with less force if part of the frame section temporarily needs space for the viewing window section 3 to pass for clamping. The gap 511 thereby increases the length of the clamping part 51 to the point where the clamping part engages with the frame section, thereby becoming more flexible. Dotted lines in figure 3 show the position of a flexible clamping part 51 bent outwards. Furthermore, this figure schematically shows parts 55 and 56, the function of which will be further described in figures 4 to 6. Figure 3 shows further details of an embodiment of a picture frame according to the present invention in which notches are restricted to the side of the frame parts and do not extend to the picture view side of these frame parts.

[0061] Figures 4 to 6 show preferred embodiments of a picture frame according to the invention. In these preferred embodiments, picture frames are coupled together by a flexible connecting element 6. Figure 4 shows a single picture frame, figure 5 shows a picture frame provided with an assembled connecting element 6 and figure 6 shows an assembly of two picture frames, connected by means of a connecting element 6 mounted in the sides of both frame sections.

[0062] Figure 4 illustrates a preferred embodiment of the invention. The clamping part 51 has a notch 53 on both sides of the clamping part. These notches 53 interrupt outer edge 54 and place clamping part 51 such that it can be manoeuvred more freely and enable an outward movement of the clamping part 51 to be completed with less force as an interrupted part of the outer edge 54. The notches 53 can feature a part that has been lowered even further directly next to the clamping part 51, which lowered part is visible in figure 4 as deep grooves next to clamping part 51. This gives even more flexibility.

[0063] Notch 53 forms an entrance between the frame parts on both sides of the protruding clamping part 51 which is moulded inwardly around protruding clamping part 51 and provides a flat insertion space 56 which extends on both sides around clamping part 51 through edge section 54, preferably with a raised part 55, as indicated in this example. Figure 3 also shows a schematic indication of the flat insertion space 56 and raised part 55.

[0064] Figure 5 illustrates how a connecting element 6 is introduced in a picture frame, with the central opening 62 enclosing clamping part 51; the connecting element 6 engages with the flat insertion space 56. In this example, raised part 55 fits into connecting element opening 61. Viewing window 3 is applied after installing connecting element 6. Clamping part 51 uses the clamping sections 52 of clamping part 51 and clamping section 31 of viewing window 3 to clamp, whereby clamping section 31 is installed in a notch in the side edge of viewing window 3, the viewing window in the picture frame, and thus also the connecting element 6 in the picture frame. Figure 5 illustrates a further preferred embodiment: When assembled, the central opening 62 contains two bulges 63 transverse to the edge of the picture frame around the flexible part 64 of the connecting element 6 on both sides of extended opening 62. These bulges 63 increase the flexibility of the connecting element 6 temporarily giving it sufficient space tolerance in the opening when enclosing two opposite clamping parts so that both parts can enter into central opening 62. The positions of these openings 61 relative to the central opening 62 roughly correspond to the inner positions of the clamping part 51 and raised part 55. The examples show a single central opening 62. This is a preferred embodiment. In principle, it is possible to provide two central openings separated by a strip in connecting element 6, one central for each clamping part, the size of this opening is virtually identical to the width of two adjacent outer edges 54. Furthermore, a gap 65 is provided in preferred embodiments. This gap 65 enables some tolerance to compensate for minor differences. This gap is also visible in figure 28.

[0065] Figure 6 illustrates how a second picture frame can be coupled to the picture frame using connecting element 6 as shown in figure 5, with the situation shown in figure 6 being the situation where viewing window of the second picture frame has not been put in. In this example, the picture frame has also been provided with an edge 59 on which the viewing window can rest. A viewing window is clamped into the second picture frame. The picture to be enclosed rests on edge 58 of the frame part which defines the inside of the frame.

[0066] Figures 7 and 8 show cross-sections of a picture frame according to the invention provided with a connecting element. A passepartout is indicated by 7, and 4 indicates a picture whereby, in each figure, the position of picture 4 behind passepartout 7 is determined by the side from which the picture will be visible. Thus, the picture 4 is visible behind the passepartout on the frame side in figure 7 and, in figure 8, it is visible behind the passepartout on the viewing window side. The use of a passepartout is optional here.

[0067] Figures 7 and 8 show two different ways for complementary profiled sections. Figure 7 shows a cross-section through the clamping part with the viewing window comprising a protruding or convex profile which matches a hollow

profile of a clamping part; in figure 8, the clamping part comprises a protruding or convex profile which matches a hollow profile in the viewing window. Both shapes and combinations of these shapes are possible.

[0068] Figure 8 shows a cross-section corresponding to an embodiment as shown in figure 5, i.e. with a raised part 55 in a preferred embodiment. A slightly simpler embodiment is shown in figure 7. The raised part 55 is missing here since central opening 62 encloses clamping parts 51 and connects the two frame parts when assembled. The clamping force on its own should be sufficient, particularly for small-size picture frames, to be able to connect the picture frames. However, providing a raised part 55 is preferred.

[0069] This provides an extra safeguard that a picture frame will not come loose if, as shown in figure 7 with connecting element 6 the forces of connected frames rest on the clamping parts which assemble the frame parts together through central opening 62. Note that a single raised part is shown in figure 5. This should not be considered to be a limitation; several raised parts can be used and, correspondingly, several openings 61 in the connecting element. In the example, the raised part 55 is detached from the edges of the flat insertion space 56. This is not a limitation, raised parts can connect to an edge of insertion space 56 in embodiments. The semi-circular shape shown for connecting element 6 is a preferred embodiment and is not a limitation; other shapes, for example, rectangular, triangular, polygonal or tubular are also possible.

[0070] Figure 9 shows a view of parts of two connected picture frames with a connecting element that connects them. The figure illustrates the operation and effect of sizing according to the present invention and the size relationships of the various parts when combining picture frames with various standard photo sizes. Figure 9 shows an outer wall and a clamping part of thickness V and with interstice W which determines the distance between two frames and the positions of raised parts 55 as distance U to the clamping parts 51 with two adjacent picture frames. The width of the gap between two picture frames is 2W, i.e. the sum of Ws of each frame. When assembling different sizes of frames together in a collage, the distance from the corner of the frame to the centre of the clamping part, indicated by X in figure 9, is identical in all sizes of picture frame. As a result, the positions of the clamping parts in the frames are fixed and when a series of frames assembled together is intended to connect with a series of frames of other sizes to be assembled alongside, the clamping parts should match in the correct opposite positions and this should be compensated for through the dimensions of Us, Vs and Ws with smaller frames also having smaller W and V sizes and a larger U size. Clamping parts in rows of different sizes of frame connect according to the present invention if the V-W-W-V combination between the two largest frames equals two V-W-W-V combinations between three smaller frames or equals three V-W-W-V combinations of four even smaller frames. This figure shows that distance W is the consequence of the position of raised part 55 shown as distance U and that distance U establishes a relationship between the attachment of a connecting element -which is identical for all picture frames - and 2W as the width of the gap between two adjacent picture frames. The size W varies depending on the size of the picture frame. Since the size W varies and V+W+U should preferably be approximately equal for all picture frames if a universal standard connecting element is used, and the thickness V can be thicker in larger frames and the U smaller leading to a greater distance between one interstice which is equal to a V which is thinner in a smaller frame and a larger U so that two transitions with three frames have an identical total distance which is equal very approximately, for combinations of all sizes, the distance U varies, with the distance U being greater for smaller sizes since the distance W is smaller for smaller sizes.

[0071] Due to the connection system of the present invention, the width of the gap between two picture frames for 15 x 15 cm photos is greater than the width of the gap of two longitudinally adjacent 10 x 15 cm picture frames. If a collage is assembled with a column of two 15 x 15 cm picture frames on the left or right and a row of three 10 x 15 cm picture frames on the right or left, where the edges of picture frames should be aligned at the top and bottom, the gap width between the 15 x 15 cm picture frames will be virtually equal to twice the width of the gap between the 10 x 15 picture frames, i.e. for example 0.5 mm and 0.25 mm. In this example, this makes the dimension U for the 10 x 15 cm picture frames 0.125 mm greater than the dimension U for the 15 x 15 cm picture frames. The differences in W and thus U cause the combined distances of different wall thickness and interstices to be such that the positions of these connecting elements are accurately adjacent where the rows of the two configurations can be connected together. This enables frames of different sizes to be combined into a collage, assuming fixed existing photo sizes.

[0072] Furthermore, the distance X should preferably be slightly less than 1 inch (2.54 cm).

[0073] As explained above, the actual standard sizes that apply to photos, even if expressed as centimetres, are based on inch sizes, i.e. 15 x 15 cm is 6 x 6 inch. In the collage described above, two 15x15 cm picture frames on the left and three 10 x 15 cm picture frames on the right, the left and right-hand rows under the upper edge and above the lower edge of the collage can be interconnected using connecting elements if X is identical for all picture frames. The left-hand and right-hand rows are then interconnected in two places. A suitable choice of X enables more interconnections of left and right-hand rows to be made.

[0074] There are four possible attachment points for connecting elements on the left, measured from the top edge downwards:

1. X,

2. 15 cm-X,
3. 15 cm + gap width on the left + X
4. 30cm + gap width on the left - X

5 **[0075]** There are six attachment points on the right at positions

1. X
2. 10-X
3. 10 + gap width on the right + X
- 10 4. 20 + gap width on the right - X
5. 20+ 2×gap width on the right + X
6. 30+2×gap width on the right - X.

15 **[0076]** By ensuring that twice the width of the gap on the right equals the width of the gap on the left, attachment points 1 and 4 on the left will be aligned to attachment points 1 and 6 on the right so that the left-hand and right-hand rows of the collage can be interconnected.

[0077] Attachment points 2 and 3 on the left are aligned with, attachment points 3 and 4 on the right respectively, if the following equations are satisfied:

$$20 \quad 15 \text{ cm} \quad - X = 10 + \text{gap width on the right} + X$$

and

$$25 \quad 15 \text{ cm} + \text{gap width on the left} + X = 20 + \text{gap width on the right} - X$$

[0078] That gives two equations and they can be simplified by subtracting the lower equation from the upper equation to form

$$30 \quad \begin{aligned} - \quad & \text{Gap width on the left} - 2X = -10 + 2X \\ & 10 - \text{gap width on the left} = 4X \end{aligned}$$

$$35 \quad X = 2.5 - 0.25 \times \text{gap width on the left}.$$

[0079] As stated above, the actual sizes are inch sizes, i.e.

[0080] $X = 1 \text{ inch} - 0.25 \times \text{gap width on the left}$. With a gap width on the left of e.g. 0.5 mm, the answer is then $1 \text{ inch} - 0.0125 \text{ cm} = 2.53 \text{ cm}$. To compensate for some tolerance in manufacturing accuracy, X is preferably between 2.45 and 2.55 cm.

[0081] The advantage for the embodiment listed is that the left and right-hand rows can be interconnected by connecting elements at four points instead of only two points.

[0082] Figure 10 shows a more detailed view of a picture frame with closed frame and viewing window sections according to the invention. Figure 10 shows how guide wall 57 between raised edge 54 and protruding part 35 influences the joining of two frame parts that should be assembled such that the parts are placed in the correct assembly position and where the interstice 53 is created as a result of the frame parts connecting together. Notch 512 puts the clamping part in a free position in the connection with the viewing window section and enables this clamping part to be placed unhindered in the clamping position when joining the two frame parts. Furthermore, it can be seen how convexity 32 in the viewing window is interrupted by the notch 33 in viewing window 3 for the clamping part 51 and clamping section 31 and that there is a cavity 52 in the notch 33 between the end of part 51 into which a finger or nail can be inserted, thus serving as a leverage point 50 in order to manually move the clamping part 51 outwards. These leverage points 50 are the consequence of the shape of the end of clamping part 51 and the shape of the notch 33 in viewing window 3, creating a small cavity between clamping part 51 and viewing window 3; this cavity in the surface of the viewing window avoids clamping part 31 from having to extend beyond the viewing window and the construction is still provided with a means of easily bending clamping part 31 outwards by hand.

[0083] Figures 11 to 14 show illustrations of connections between picture frames according to the invention with multiple holes 61 being indicated by 61a and 61b and with two more holes 61 indicated as 63a and 63b on the other assembly side of connecting element 6 with central opening 62.

[0084] Figure 12 shows two frames connected with a connecting element according to figure 11 in a flat arrangement where the b holes of the connecting element are not used and raised part 55 engages in the a holes.

[0085] Figure 13 shows the connection of two frames with the connection forming a corner along two window sides and this corner requires more space in the distance between the raised parts in the two frames and the b holes have been used for the assembly in order to provide that increased distance.

[0086] Figure 14 shows a configuration comparable to that of figure 13, but the corner of the frames has been created on the frame side.

[0087] Figures 15 to 17 show examples of connecting elements;

[0088] Figure 18 shows an assembly of the different frame parts which shows how the passepartout 7a or 7b can be used on these two viewing sides and how they can be turned around with a different side facing the viewing side as well as the ability of the picture to turn around and display one of the two frame sides, possibly combined with a side of the passepartout.

[0089] Figure 19 shows an assembly of five picture frames with two square picture frames placed one above the other on the left and three rectangular frames adjacent to each other on the left, with all five frames adjoining to jointly form a rectangle. All the picture frames are visible from the viewing window sides and coupled together. This figure shows a large picture which is displayed over several picture frames as a total picture and where the interrupting effect of the interstices between the frames is visible.

[0090] Figure 20 shows an assembly of five picture frames with two square picture frames placed one above the other on the left and three rectangular frames adjacent to each other on the left, with all five frames adjoining to jointly form a rectangle. All the picture frames are visible from the viewing window sides and coupled together. Each picture frame in this figure displays its own picture and these pictures can be seen in their entirety because the viewing window sides are used such that they are facing the viewing side.

[0091] Figure 21 shows an assembly of five picture frames with two square picture frames placed one above the other on the left, the upper one of which has the viewing window side visible and the lower one has the frame side visible, and three rectangular frames adjacent to each other on the left, with the middle one displaying the frame side and the upper and lower ones displaying the viewing window side. The five picture frames are mounted separately and are not connected. Each picture frame is provided with its own picture and here the frame border is shown over the picture, hiding this part of the picture in the two picture frames with the frame side in view.

[0092] Figure 22 shows a collection of 7 individual picture frames showing the different positions for the X sizes.

[0093] Figures 20 and 22 illustrate a characteristic of or for a preferred embodiment. The distance between a corner point of the picture frame and the centre of a clamping part, and thus the centre of a connecting element is equal for all sizes. This distance is indicated by X in figures 20 and 22. The term "equal" should not be interpreted as a mathematical concept but as equality with the manufacturing tolerances and connection tolerances. It is impossible to make them perfectly mathematically equal to each other.

[0094] Figure 23 shows an assembly of five picture frames with two square picture frames placed one above the other with their frame sides visible on the left and three rectangular picture frames adjacent to each other on the right with their frame sides visible. The five picture frames are mounted separate from each other and are not connected. Each picture frame is provided with its own picture with all the picture frames having the frame side in view and showing the frame border over the picture thus hiding this part of those pictures.

[0095] Figure 24 shows an assembly of five picture frames with two square picture frames placed one above the other on the left and three rectangular picture frames adjacent to each other on the left, with all five picture frames adjoining and jointly forming a rectangle. All the picture frames are visible from the frame sides and are coupled together. In this figure each picture frame shows its own picture placed behind a passepartout as a result of which these parts of the pictures are not visible, and where the frame border covers part of the passepartouts, this part of the passepartout is not visible.

[0096] Figure 25 shows an assembly of five picture frames with two square picture frames placed one above the other on the left and three rectangular picture frames adjacent to each other on the left, with all five picture frames adjoining and jointly forming a rectangle. All the picture frames are visible from the viewing window sides and are coupled together. In this figure each picture frame shows its own picture placed behind a passepartout as a result of which these parts of the pictures are not visible and these passepartouts are individually fully visible behind the viewing window side. In this assembly, two frames are provided with passepartouts whose shaded side is facing the front and three passepartouts whose black side is facing the front.

[0097] Figure 26 shows an assembly of five picture frames with two square picture frames placed one above the other on the left and three rectangular frames adjacent to each other on the left, with all five frames adjoining and jointly forming a rectangle. All the picture frames are visible from the frame sides and are coupled together. In this figure each picture frame shows its own picture placed behind a passepartout as a result of which these parts of the pictures are not visible, and where the frame border covers part of the passepartouts, this part of the passepartout is not visible. In this assembly, all frames are provided with passepartouts whose shaded side is facing the front. This figure and figure 25 illustrate that

the passepartouts can be used on both sides.

[0098] Figure 27 illustrates a further preferred embodiment of a picture frame according to the invention. The viewing window 3 shows a slant, slope or convexity near the edges at the edges in the viewing plane. This convexity or slope 32 has an optically enlarging effect on the picture as a result of which this picture seems to extend to beyond the side of the picture frame.

[0099] Figure 28 illustrates two picture frames connected by a connecting element 6. The two connected picture frames can be two relatively small picture frames, in which case there is a relatively narrow gap with width $2W1$ between the two picture frames, with $W1$ being the W value for a relatively small picture frame. The same universal connecting element 6 can also be used to connect two relatively large picture frames, each with a W value of $W3$. In that case, the gap width between the two relatively large picture frames is $2W3$. In order to compensate for these differences and for any minor variations in size, the openings in the connecting element 6 have been constructed such that some tolerance has been provided. This is indicated by T in figure 28. Some tolerance is also created by providing openings 61 with gaps (see also figure 5).

[0100] Figure 29 illustrates an assembly of picture frames. The figure indicates which W values are applicable. The width of the gap between two picture frames is always $Wx + Wy$ with Wx and Wy being the W values on both sides of the gap.

[0101] It will be clear that the invention enables many variations and that the invention is not limited to the examples described above.

[0102] In summary, the invention can be described as follows:

A picture frame comprises a viewing window side (1) and a frame side (2) with the viewing window side comprising a transparent window (3). There is an interstice between the viewing window and the frame side. A photo or picture can be placed here. The viewing window and frame sides comprise assembly components (5) in order to assemble the viewing window and frame sides together. An assembly component on the frame side comprises a flexible protruding clamping part (51), provided with a clamping section (52) on a side facing the viewing window (3) and the viewing window (3) is provided with a complementary clamping section (31) at an edge of the viewing window (3) with the complementary clamping sections (52, 31) fitting into each other and, when assembled, with the protruding clamping parts (51) exerting a clamping force ($F2$) on the viewing window (3) with the direction of the clamping force ($F2$) being mainly in the flat plane of the viewing window.

Claims

1. Photo frame comprising a viewing window side (1) and a frame side (2), with the viewing window side comprising a transparent window (3) and with an interstice between the transparent window and the frame side for placing a flat object (4), i.e. a photo or picture which can be visibly placed facing either side and with the viewing window and frame sides comprising assembly components (5) for assembling the viewing window and frame sides together and thereby enclosing the flat object, with the characteristic that an assembly component on the frame side comprises a flexible protruding clamping part (51), provided with a clamping section (52) on a side facing the viewing window (3) and the viewing window (3) is provided with a complementary clamping section (31) at an edge of the viewing window (3) with the complementary clamping sections (52, 31) fitting into each other and with, when assembled, the protruding clamping parts (51) exert a clamping force ($F2$) on the viewing window (3) with the direction of the clamping force ($F2$) being mainly in the flat plane of the viewing window and through which clamping force the viewing window (3) is connected to the frame side when assembled.
2. Picture frame according to claim 1 **characterised in that** clamping parts (5) of both sides are made of one and the same material as the side in which they are incorporated.
3. Picture frame according to claims 1 and 2, **characterised in that** the clamping parts (51) do not, or hardly, protrude beyond the outer surface of the viewing window (3).
4. Picture frame as claimed in one of the above claims, **characterised in that** the edges of the clamping sections of the viewing window have been provided with notches which constitute less than 10% of the length of the edge.
5. Picture frame as claimed in one of the above claims, **characterised in that** the clamping sections of the viewing window are provided with notches on all sides of the viewing window (3).
6. Picture frame as claimed in one of the above claims, **characterised in that** a gap (511) is provided on the inside of the flexible protruding clamping part (51).

7. Picture frame as claimed in one of the above claims, **characterised in that** a notch (53) is provided on both sides of the clamping part (51).
8. Picture frame as claimed in one of the above claims, **characterised in that** the edge of the viewing window (3) displays a rounding or chamfer (32) towards the outer edges of the viewing window (3).
9. Picture frame system comprising at least two picture frames as claimed in one of the above claims and a flat connecting element (6) for interconnecting two picture frames, with the connecting element comprising one or more central openings (62) for receiving adjacent clamping parts (51) of picture frames which are to be connected, and, when assembled, with parts of the connecting element located on either side of one or more central openings (62) being clamped into at least two picture frames.
10. Picture frame system according to claim 9, **characterised in that** the connecting element comprises one central opening (62).
11. Picture frame system according to claim 9 or 10, **characterised in that** one or both picture frames are provided with an insertion interstice (56) for receiving the part of the connecting element (6) which is to be clamped into place.
12. Picture frame system according to claim 11, **characterised in that** the insertion interstice (56) is provided with a raised part (55) and the connecting element (6) is provided with an opening (61) corresponding with the raised part (55).
13. Picture frame system as claimed in one of the claims 9 to 12, **characterised in that** the picture frames which are or have been connected are of different sizes and the distance (X) between a corner point of each of the picture frames and the centre of a clamping part (51) is equal for the different sizes.
14. Connecting element (6), apparently for use in a picture frame system according to one of the claims 9 to 13.
15. Picture frame system according to one of the claims 9 to 13 comprising a collage with multiple rows of picture frames of different sizes connected by connecting elements (6), with the picture frames being separated by separation distances between adjacent pictures and/or pictures placed under or above in the picture frames with the sum of all separation distances along a line in a vertical and/or horizontal direction across the collage is a consequence of the combination of the thickness of clamping parts (51) and interstices W in relation to the positions of raised parts (55) and is completely or to a major extent equal to them.

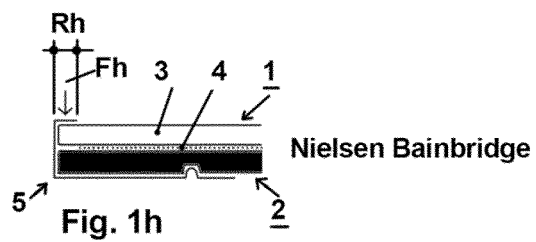
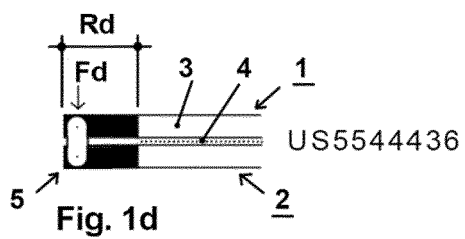
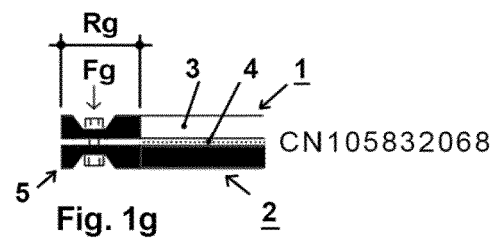
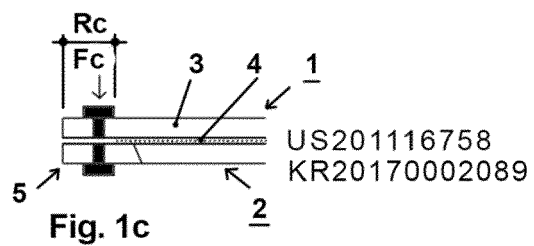
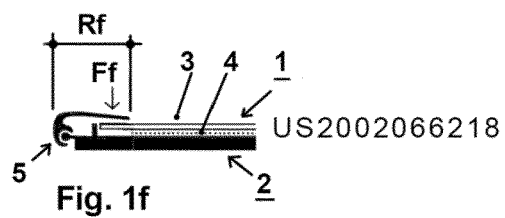
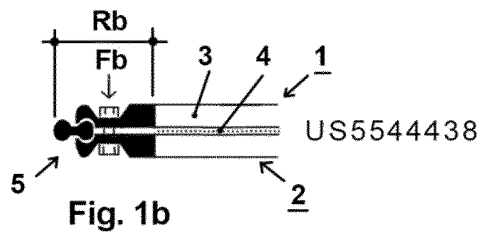
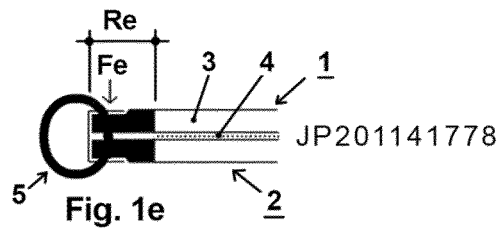
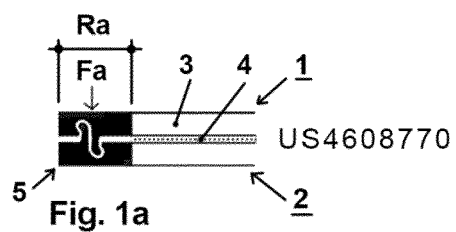


Fig. 1

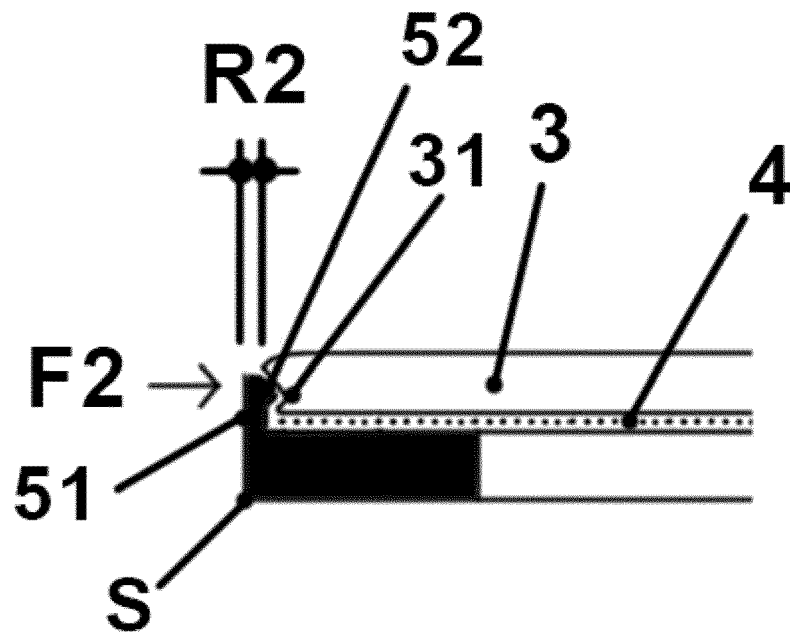


Fig. 2

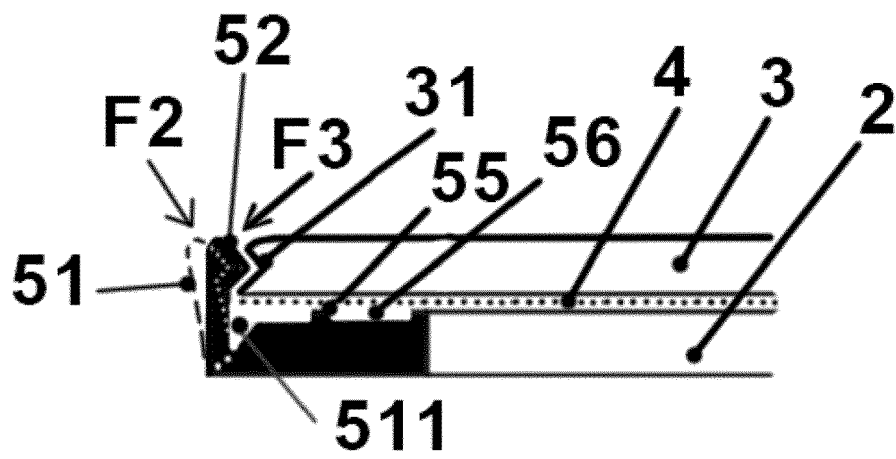


Fig. 3

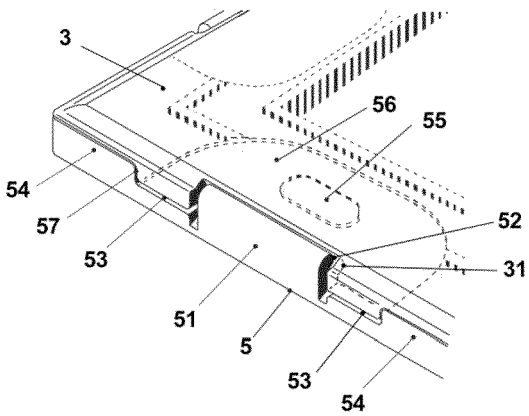


Fig. 4

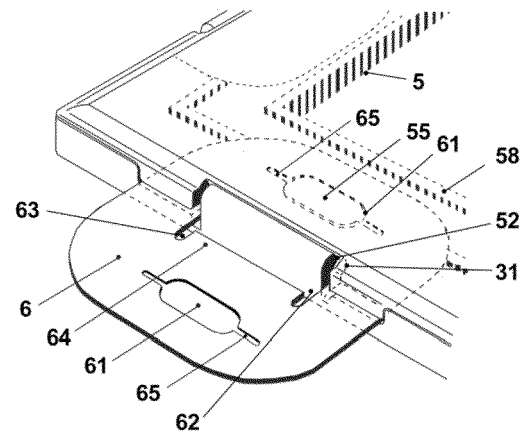


Fig. 5

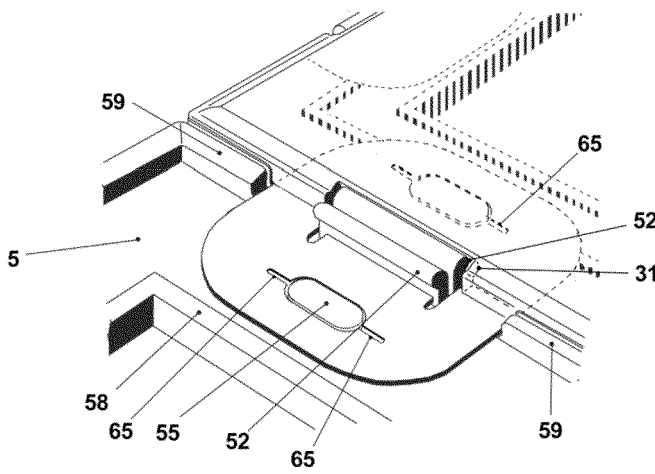


Fig. 6

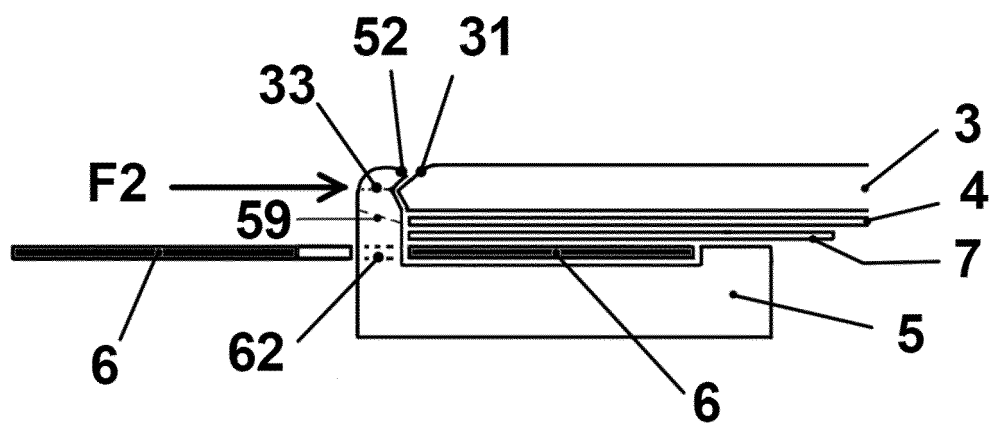


Fig. 7

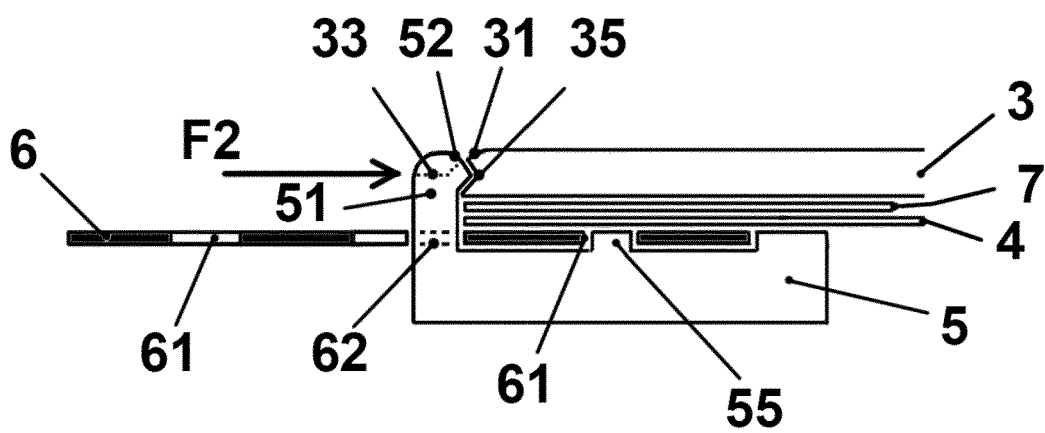


Fig. 8

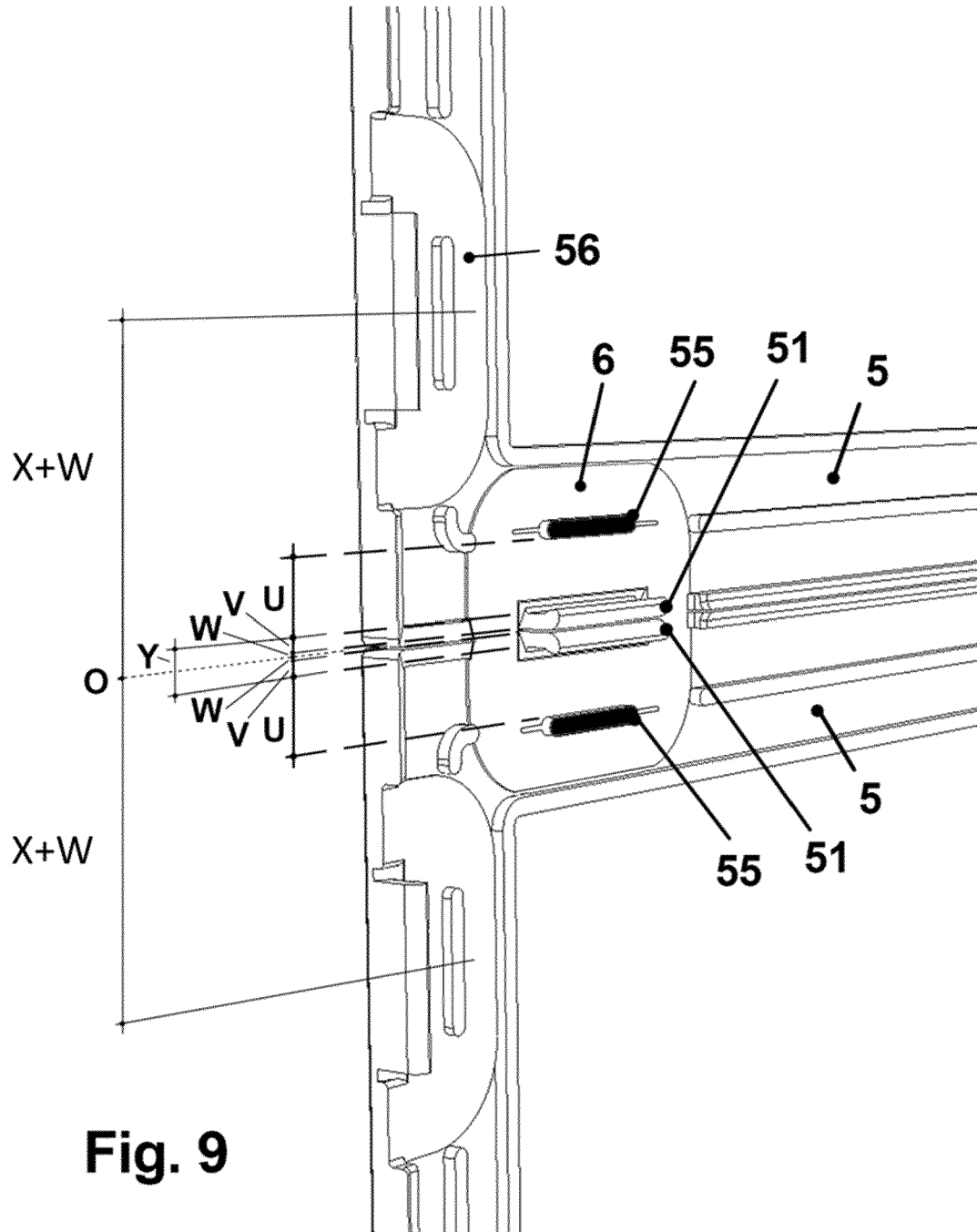


Fig. 9

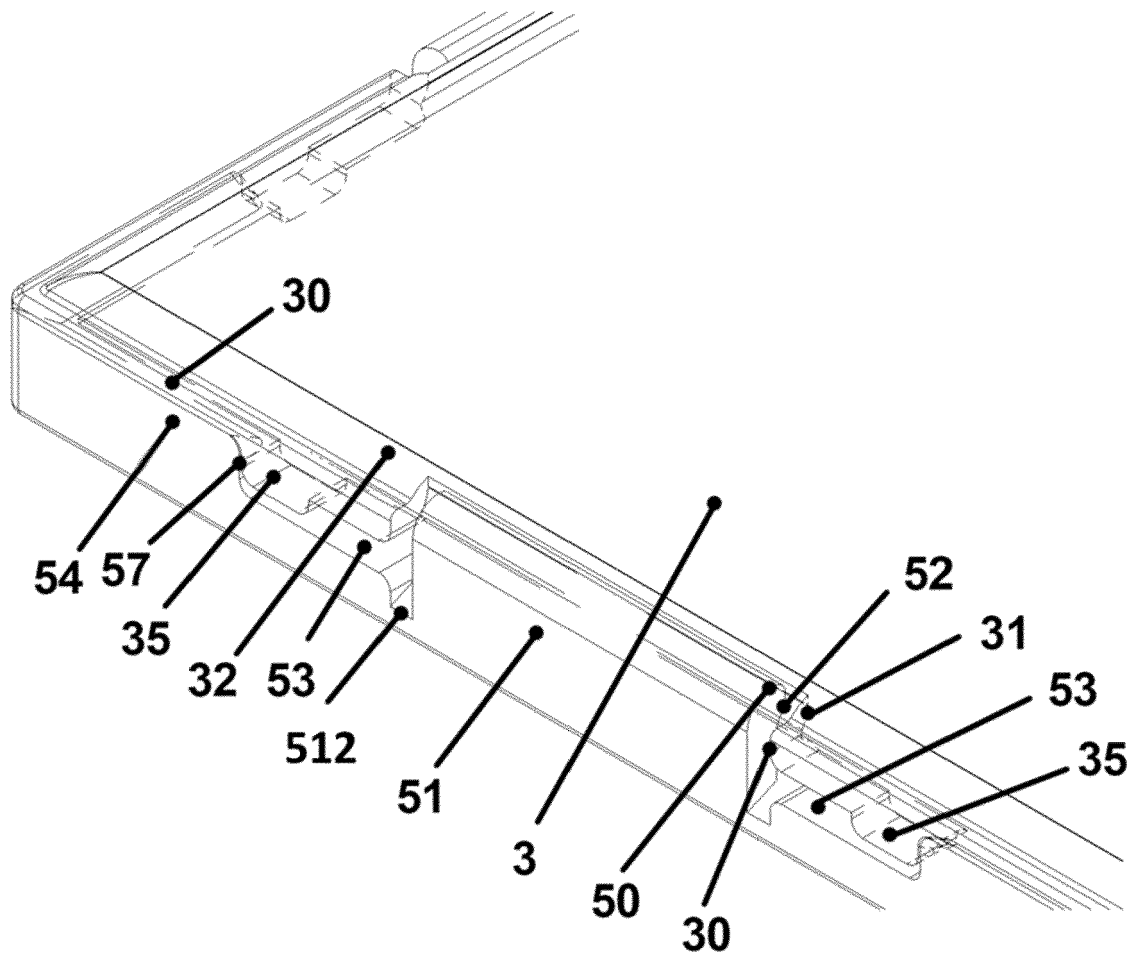


Fig. 10

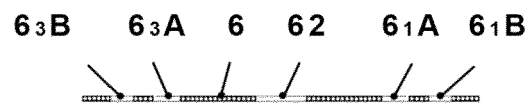


Fig. 11

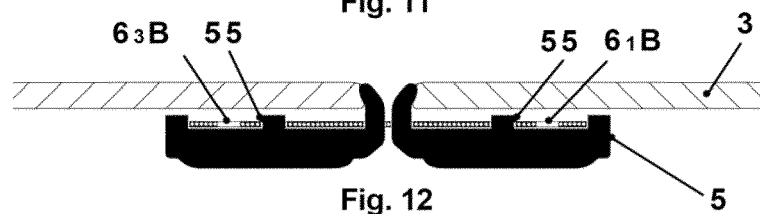


Fig. 12

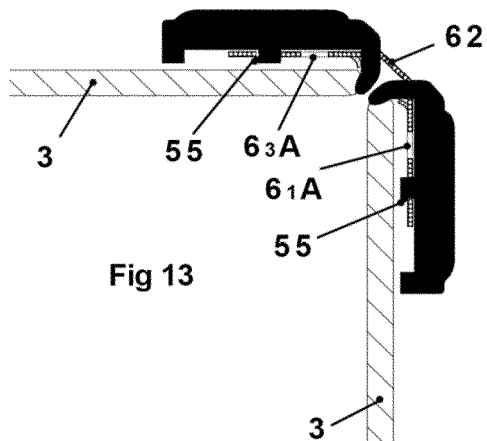


Fig. 13

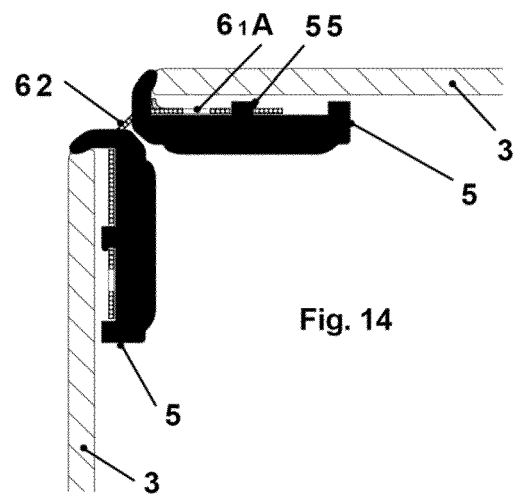


Fig. 14

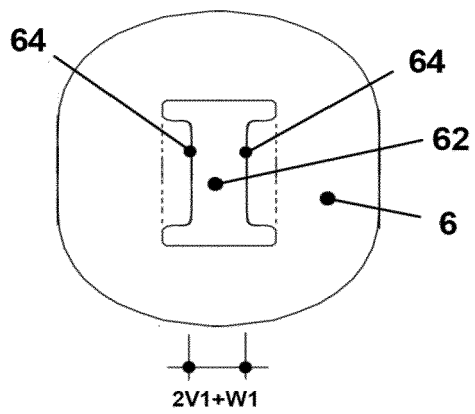


Fig. 15

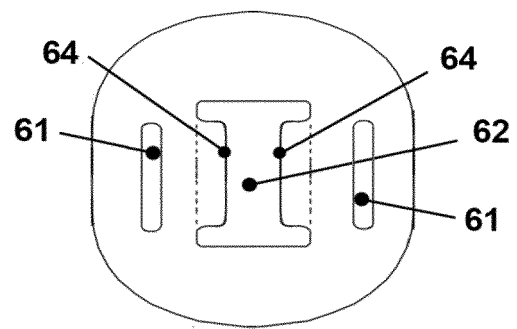


Fig. 16

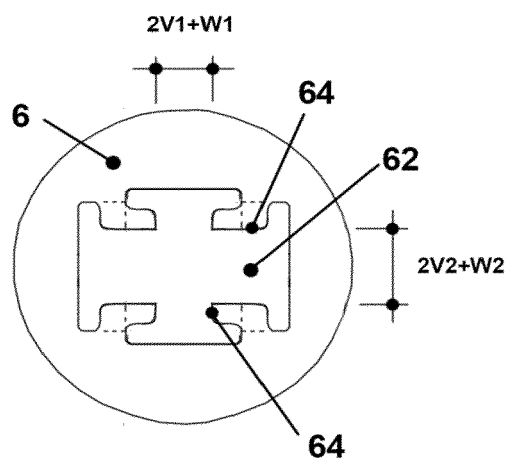


Fig. 17

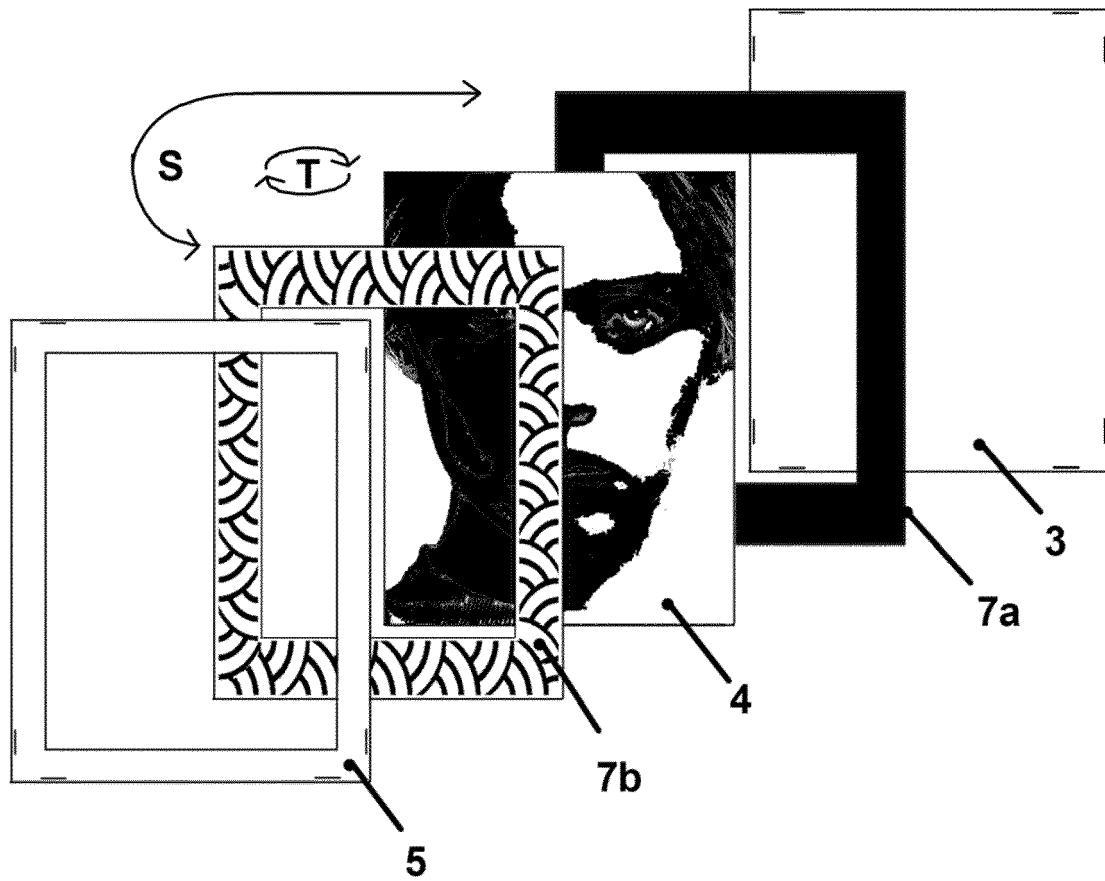


Fig. 18

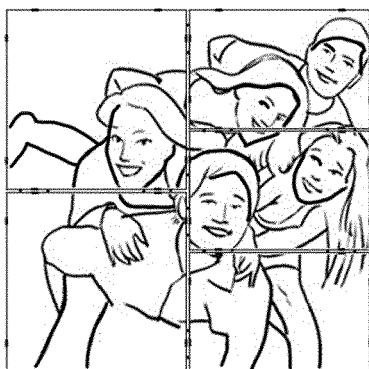


Fig. 19

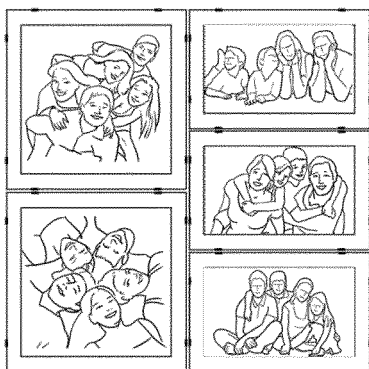


Fig. 21

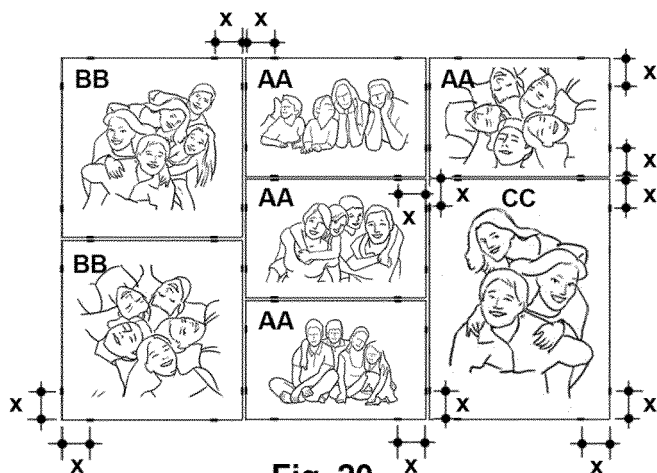


Fig. 20

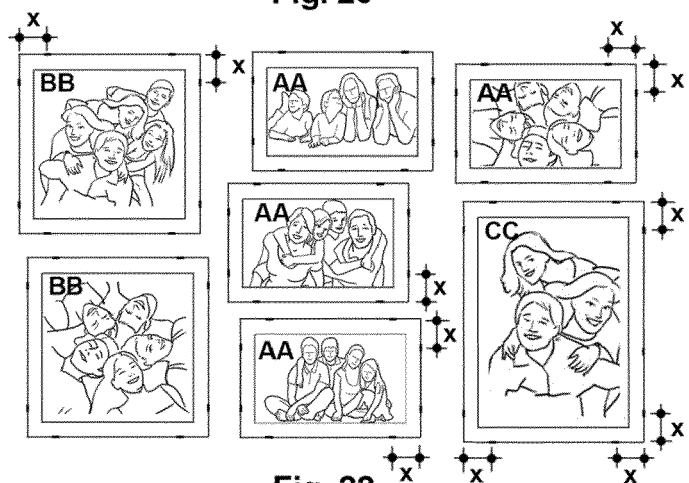


Fig. 22

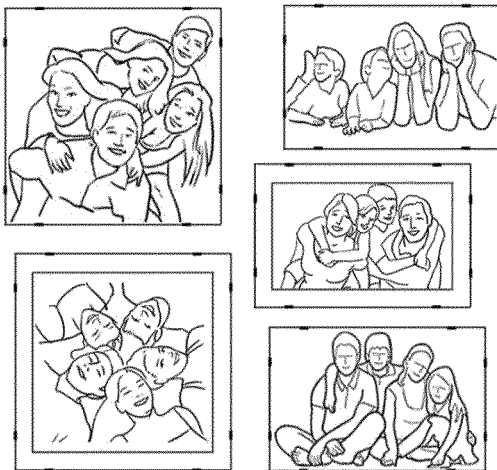


Fig. 23

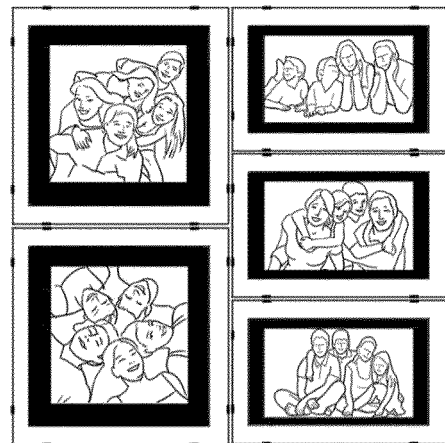


Fig. 24

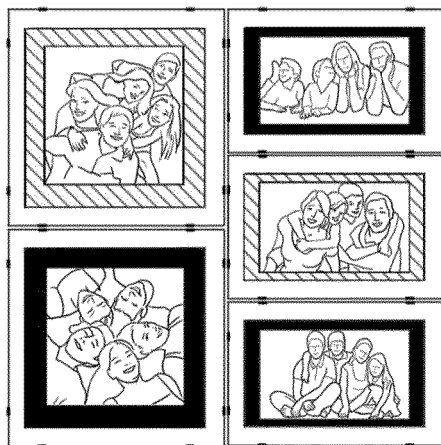


Fig. 25

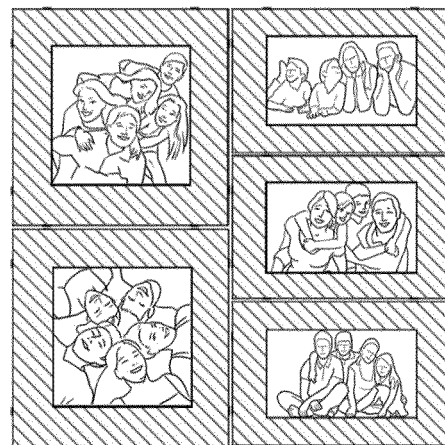


Fig. 26

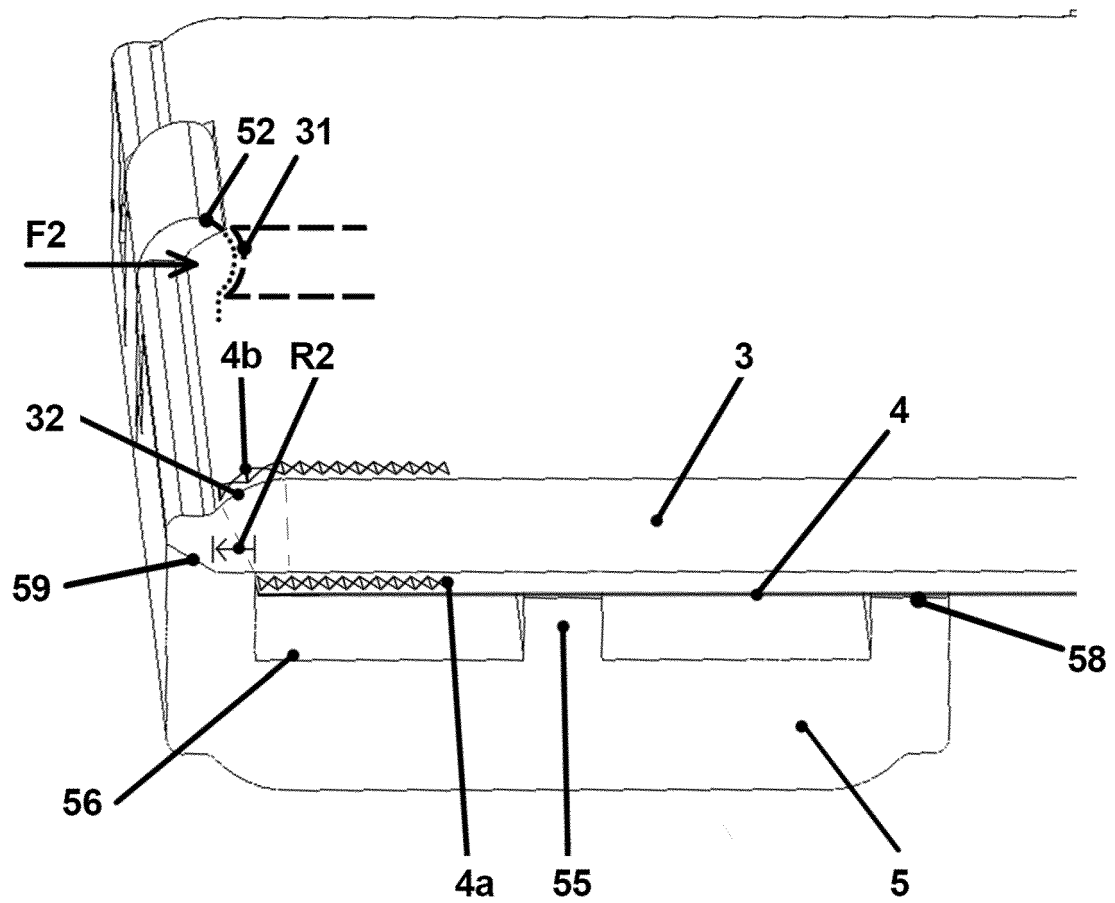


Fig. 27

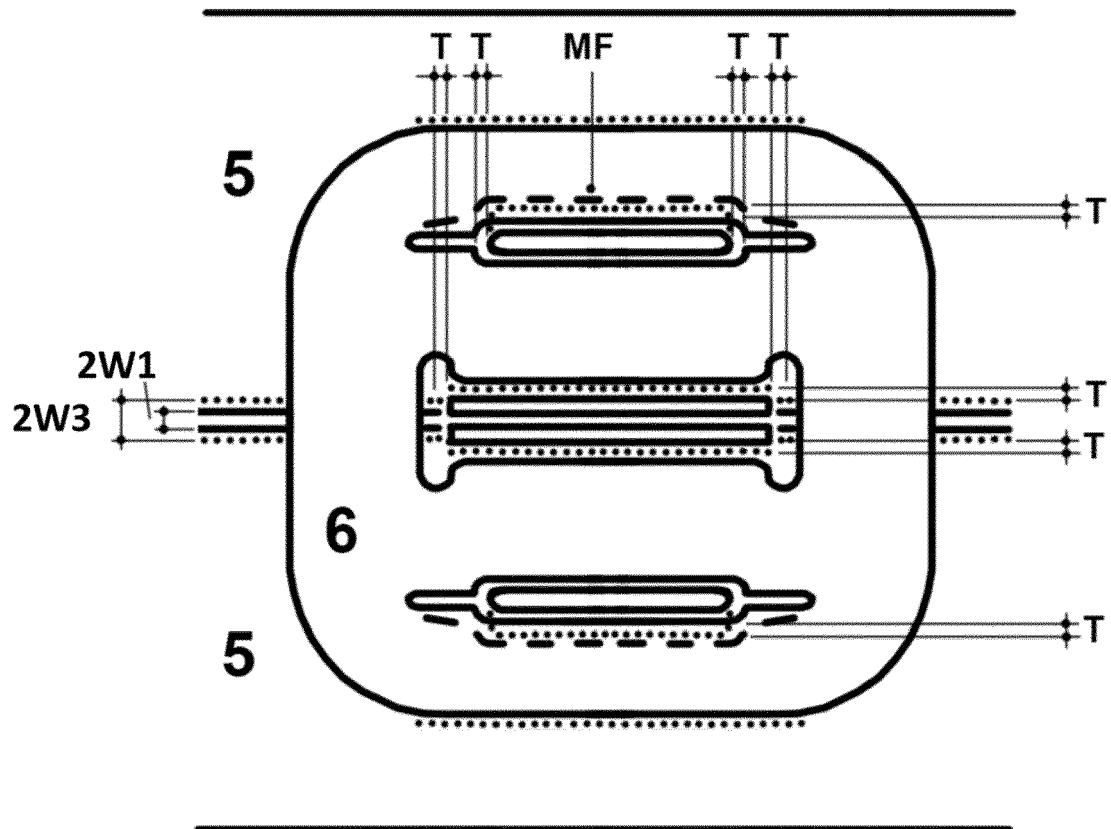


Fig.28

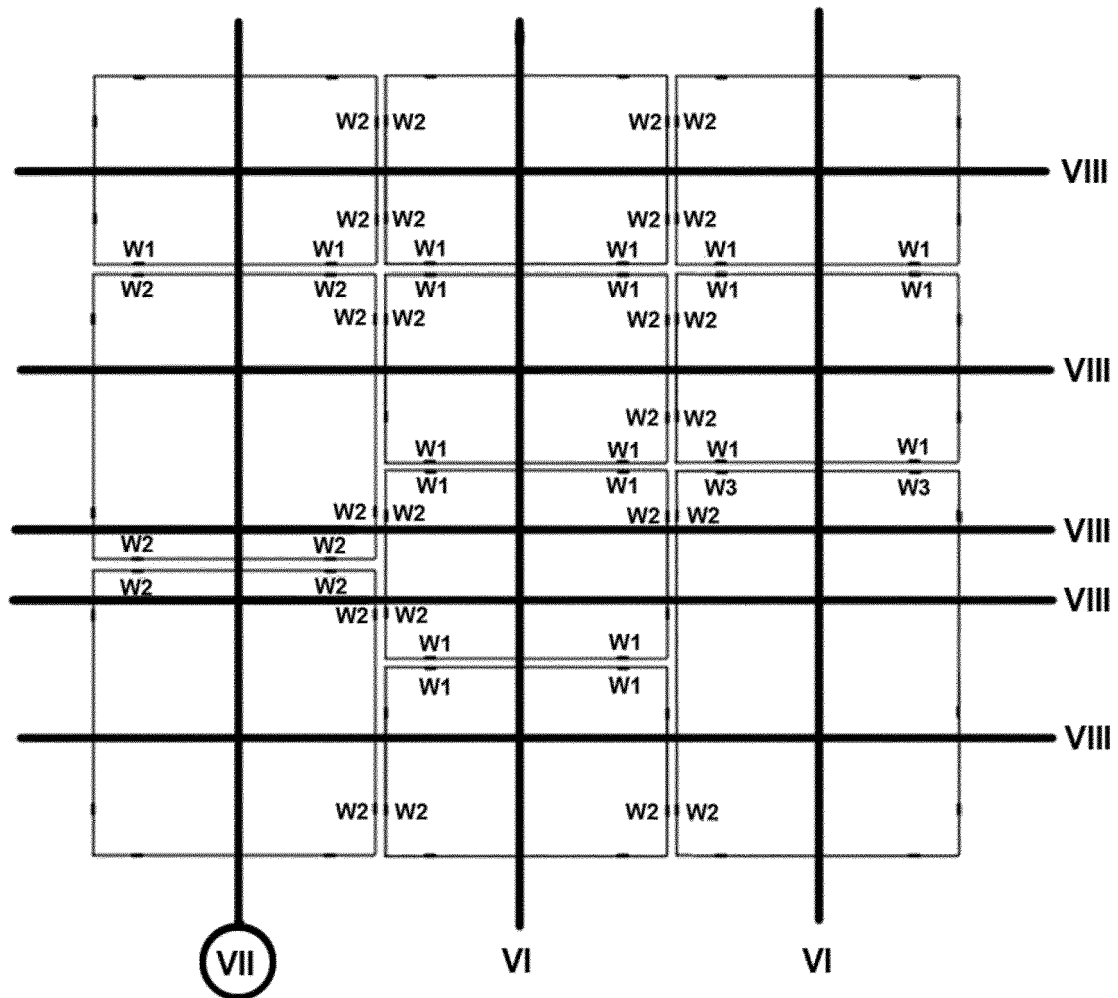


Fig. 29



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