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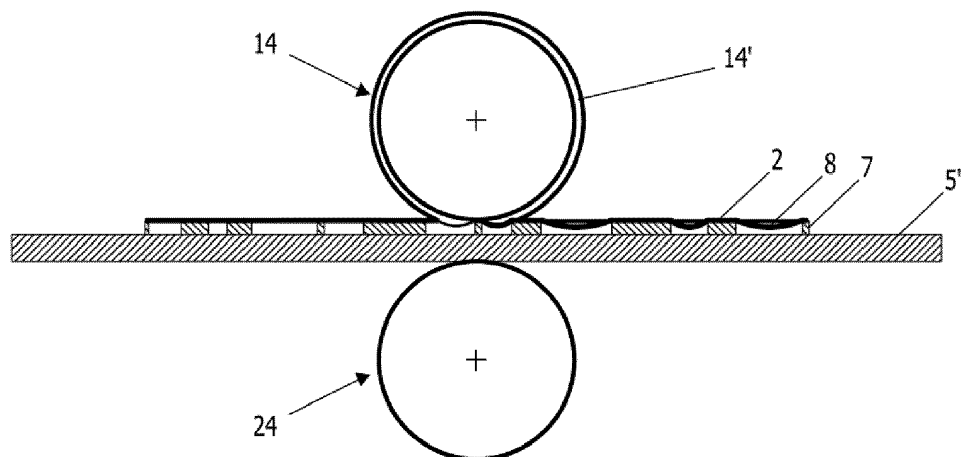
(54) **A MACHINE FOR SHAPING A METAL SHEET AND SHEET SO OBTAINED**

(57) The invention relates to a machine (1) for shaping a metal sheet (2) comprising:
- feed means (3) of a metal sheet (2) to be processed;
- a calender (4) comprising a first roller (14) and a second roller (24);
- motor means (5', 5'') adapted to operate at least one of said rollers;
- recovery means (6) of the processed metal sheet (2);
- a forming mold (7) having a supporting surface (7') for said metal sheet (2), where said supporting surface (7') comprises gaps (8);

Said first roller (14) comprises at least an outer layer (14') made of an elastically yielding material, having a smooth surface; said second roller (24) comprises a surface made of a rigid material.

Said first roller (14) is adapted to exert a pressing force on said metal sheet (2) arranged on said supporting surface (7') of said forming mold (7), so that said elastically yielding material is compressed as a result of the pressure and expands only at said gaps (8) deforming the metal sheet (2) below.

Fig. 3



Description

[0001] The invention relates to the sector of machines for processing metal building and cladding materials.

[0002] More in detail, the invention relates to a machine that implements a method for shaping a metal sheet to be used as finish or cladding for inner and outer walls of buildings or furnishings and design installations, and to a sheet obtained with this machine that implements this method.

[0003] To produce metal sheets with shaped and processed surfaces, there are currently used machines that, starting from a coil of sheet metal, by means of feed means, unroll it and press it inside a calender with double roller.

[0004] Said calender comprises a first and a second roller, both made of metal and motorized, having the respective surfaces processed in a complementary manner.

[0005] In fact, the surfaces of said rollers each comprise a complementary pattern, raised on the first roller and depressed on the second roller, i.e., with coupling of male-female type.

[0006] The passage between the rollers of the strip of sheet metal causes the reproduction, on the two faces of the same plate, of the pattern characterizing the decoration to be obtained.

[0007] Only after pressing of the sheet metal, the strip is cut into single portions, and each sheet thus obtained is sent, by means of appropriate recovery means, to the subsequent processing and packaging steps.

[0008] These conventional rolling machines, and the rolling and shaping technique they implement, have some limits and drawbacks.

[0009] Firstly, they are very costly machines: producing the two rollers processed with the complementary pattern, of male/female type, which is required to impress the desired pattern on the sheet metal, is costly and complex.

[0010] For this reason, once a pair of rollers has been produced, it is often used for a long time, without ever changing it, considerably limiting diversification of production.

[0011] Requests for large amounts of material are necessary to justify the preparation of a pair of rollers with a different pattern or different processing.

[0012] The use of steel sheet wound in coils prevents the surface of the steel from being treated in advance with particular aesthetic finishes, and makes it necessary to use the typical finishes of coiled metal sheet, namely polishing or satin-finish. Consequently, the sheets obtained have a very limited range of surface finishes, not suitable for all possible applications.

[0013] The document GB 2 019 288 A discloses a machine for shaping a metal sheet comprising:

- a calender comprising a first upper roller and a second lower roller;

- motor means adapted to operate at least one of said first and second roller;
- a first and a second roller conveyor positioned respective upstream and downstream of said calender,
- a forming mold having a supporting surface for said metal sheet, where said supporting surface comprises gaps;
- a plate made of an elastically yielding material, such as rubber, arranged between said metal sheet and said first upper roller;
- motorized drive means of said forming mold, of said metal sheet and of said plate made of an elastically yielding material above said roller conveyor and between the rollers of said calender.

[0014] Said first roller is adapted to exert a pressing force on said metal sheet arranged on said supporting surface of said forming mold, so that said elastically yielding material is compressed as a result of the pressure and expands only at said gaps deforming the metal sheet below.

[0015] Said motorized drive means comprise a supporting surface onto which said forming mold, said metal sheet and said plate made of an elastically yielding material are loaded, drawn by means of motorized belts along the roller conveyors.

[0016] The machine operates in steps, with the loaded supporting surface that advances under the calender in alternating directions.

[0017] The object of the invention is to eliminate these drawbacks, producing an inexpensive but efficient machine, that is easy to prepare and can be modified to diversify production, capable of processing metal sheets having any type of preliminary surface finish within the scope of known aesthetic treatments of the stainless steel sheets, implementing a method that allows sheets with countless possibilities of surface decorations and treatments to be obtained.

[0018] These objects are achieved with a machine for shaping a metal sheet comprising:

- feed means of a metal sheet to be processed;
- a calender comprising a first roller and a second roller;
- motor means adapted to operate at least one of said first and second roller;
- recovery means of the processed metal sheet,

characterized in that:

- it comprises a forming mold having a supporting surface for said metal sheet, where said supporting surface comprises gaps;
- said first roller comprises at least an outer layer made of an elastically yielding material, having a smooth surface;
- said second roller comprises a surface made of a

rigid material,

where said first roller is adapted to exert a pressing force on said metal sheet arranged on said supporting surface of said forming mold, so that said elastically yielding material is compressed as a result of the pressure and expands only at said gaps deforming the metal sheet below.

[0019] According to a first aspect of the invention, said at least one outer layer of said first roller is made of rubber and said second roller is made of steel.

[0020] According to a further aspect of the invention, said gaps have an irregular shape and are distributed unevenly on the supporting surface of said forming mold.

[0021] In a possible variant, said gaps are isolated from one another.

[0022] According to a further aspect of the invention, said forming mold comprises areas of reduced thickness adapted to define said gaps of said supporting surface and to allow expansion of said elastically yielding material.

[0023] Alternatively, said forming mold comprises shaped holes, adapted to define said gaps.

[0024] According to a preferred variant of the invention, said feed and recovery means each comprise a roller conveyor on which said forming mold is transported.

[0025] In a further preferred variant of embodiment, said machine comprises an abutment panel on which said forming mold rests and said abutment panel is moved by means of said feed and recovery means.

[0026] Advantageously, said machine comprises centring means for said forming mold or for said abutment panel.

[0027] Moreover, said machine comprises adjustment means of the mutual distance between said first and said second roller, adapted to adjust the pressing force exerted by said first roller on said metal sheet.

[0028] The method implemented by the machine according to the invention for shaping a metal sheet comprises the following steps:

- providing a metal sheet to be processed;
- providing a forming mold having a supporting surface for said metal sheet, where said supporting surface comprises gaps;
- resting said metal sheet on said forming mold;
- applying a pressure on said metal sheet so as to cause a deformation of the metal sheet at said gaps.

[0029] The subject matter of the present invention is also a shaped metal sheet obtained by means of said machine that implements said method.

[0030] The invention presents numerous advantages.

[0031] Said first and said second rollers do not require special and costly processing of their surfaces. The task of shaping the metal sheet is entrusted to the forming mold alone, while the rollers have the sole function of exerting a suitable pressing force.

[0032] Providing different forming molds, with diversi-

fied gaps and shaped holes, and distributed in an irregular and fanciful manner, to obtain a wide range of patterns and decorations of the sheet is much easier and less costly compared to having to process the surfaces of the rollers. To produce the forming molds it is advantageous and sufficient to use processing machines with laser or water cut, methods that are well known and widely used.

[0033] This leads to the possibility of diversifying the production of metal sheets shaped according to demands and needs, even for orders of small quantities, limiting the costs, but reaching maximum production efficiency, with great satisfaction of customers and of the market.

[0034] Advantageously, the machine allows the processing of pre-cut sheets and not strips of sheet metal wound in coils, as used in conventional machines, but always maintaining a flowing movement, which favours productivity.

[0035] Moreover, the feed and subsequent recovery of the metal sheet on motorized roller conveyors also allows the machine to operate in a single direction, unlike the machine described in the cited prior art document GB 2 019 288 A. The single direction allows the machine to be arranged in line with other machines positioned upstream or downstream, further speeding up the whole production process.

[0036] Starting from sheets to be processed already provided with a wide range of colours and finishes allows maximum freedom of planning and design, thereby making the sheets obtained extremely versatile.

[0037] Due to the elastically yielding material with which said first roller is coated and to the adjustment means of the pressing force thereof, it is possible with a single machine and only one calender to process metal sheets with different thicknesses.

[0038] The abutment panel on which the forming mold rests advantageously ensures a uniform resistance force to the pressure of the upper roller.

[0039] Said centring means guide said forming mold, or said abutment panel, and consequently the metal sheet loaded thereon, with precision into the calender, to ensure perfect alignment with the rollers and thus obtain the same processing reproduced identically on all the metal sheets processed in series.

[0040] Said centring means are particularly advantageous when the forming mold has gaps of irregular shape and arrangement. In this case, the pressure of the calender could cause torsion and/or rotation of the forming mold or of the abutment panel and therefore incorrect shaping of the metal sheet. Due to the centring means, this risk is eliminated: in fact, said centring means allow perfect orthogonality to be maintained between the direction of feed of the metal sheet and the pressure line exerted thereon by the calender.

[0041] The adjustment means that adjust the mutual distance between the two rollers allow the machine to be adapted also as a function of the thickness of the metal sheet to be deformed.

[0042] These and other advantages of the invention will be more apparent below from the description of a preferred embodiment, provided by way of non-limiting example, and with the aid of the figures, wherein:

- Fig. 1 illustrates, in a front view, a machine for shaping a metal sheet according to the invention;
- Fig. 2 illustrates, in a side view, a part of the machine of Fig. 1.
- Fig. 3 illustrates, a top plan view, a forming mold for said machine according to a possible variant;
- Fig. 4 illustrates, with proportions altered for clarity of illustration, a partial section of the machine and of the metal sheet being processed;
- Figs. 5 and 6 illustrate, respectively in side view and top plane view, a part of the machine of Fig. 1.

[0043] With reference to the figures, the machine 1 for shaping a metal sheet 2 according to the invention essentially comprises:

- feed means 3 of a metal sheet 2 to be processed;
- a calender 4, comprising a first roller 14 and a second roller 24, through which said metal sheet 2 to be processed passes;
- motor means 5', 5" for said first roller 14 and said second roller 24;
- a forming mold 7 having a supporting surface 7' for said metal sheet 2;
- recovery means 6 of the processed metal sheet 2.

[0044] Said metal sheet 2 to be processed can have various thicknesses and various surface finishes, i.e., it can be satin-finished, polished, mirror polished, electrolytically coloured, coloured by means of PVD, etc.

[0045] With particular reference to Figs. 2 and 4, said calender 4 is illustrated.

[0046] Said first roller 14 is arranged above and comprises at least an outer layer 14' made of an elastically yielding material.

[0047] Said outer layer 14' is, for example, made of rubber or of a suitable elastic polymer and has a smooth surface.

[0048] Said first roller 14 is connected to first motor means 5'.

[0049] Said second roller 24 is arranged below, is made of steel and comprises a rigid and smooth surface adapted to act as abutment surface for said first roller 14.

[0050] Said second roller 24 is connected to second motor means 5".

[0051] In simplified variants of the machine 1, said second roller 24 could be idle and therefore not connected to corresponding motor means.

[0052] Said first roller 14 and said second roller 24 are mounted on a frame 16 resting on the ground.

[0053] Said frame 16 comprises lateral shoulders 17' and 17" provided with adjustment means of the mutual distance between said first 14 and said second 24 roller,

consequently adapted to adjust the pressing force of said first roller 14 on said metal sheet 2.

[0054] Said adjustment means comprise two actuators 12', 12", for example of the screw/nut type, each acting on a support of said roller 14, operated by a gear motor 18, by means of a drive system with mechanical rotary joint 19.

[0055] With particular reference to Fig. 3, an example of a forming mold 7 is illustrated.

[0056] The surface 7' of said mold 7 on which, in use, said metal sheet 2 rests comprises gaps 8.

[0057] In the variant illustrated said gaps 8 are produced by means of shaped holes that involve the whole of the thickness of the mold 7.

[0058] In alternative variants, said gaps 8 can be defined by areas of the mold having reduced thickness, so as to create valleys with respect to the supporting surface of said metal sheet 2.

[0059] In particular, said gaps 8 have an irregular shape and are distributed unevenly on the supporting surface 7' of said forming mold 7. Moreover, said gaps design shapes closed and separated from one another, not connected to one another. Therefore, they are discrete shapes.

[0060] In a simplified variant of the machine said forming mold 7 can rest directly on said feed 3 and recovery 6 means, and at said calender 4 be in direct contact with said second lower roller 24.

[0061] Alternatively, and more advantageously, as illustrated in Figs. 3 and 4, said machine 1 comprises an abutment panel 10 on which said forming mold 7 rests and said abutment panel 10 is also moved by means of said feed 3 and recovery 6 means, it too translating horizontally inside said calender 4.

[0062] Figs. 5 and 6 illustrate the feed means 3 of the sheet to be processed, which are similar to the recovery means 6.

[0063] Said feed means 3, and also said recovery means 6, comprise a motorized roller conveyor 13, on which said forming mold 7 is transported.

[0064] Said roller conveyor 13 is moved by a drive chain 23 connected to proper motor means 33.

[0065] Along said roller conveyor 13 there are provided centring means for said forming mold 7 or said abutment panel 10.

[0066] Said centring means comprise centring rollers 11 with vertical axis arranged on two parallel rows along the edges of said roller conveyors 13, longitudinally to the direction of feed of the mold 7.

[0067] The method implemented by the machine according to the invention for shaping a metal sheet 2 essentially comprises the steps of:

- providing a metal sheet 2 to be processed;
- providing a forming mold 7 having a supporting surface 7' for said metal sheet 2, where said supporting surface 7' comprises gaps 8;
- resting said metal sheet 2 on said forming mold 7;

- applying a pressure on said metal sheet 2 so as to cause a deformation of the metal sheet at said gaps 8.

[0068] Using the machine 1 forming the subject matter of the present invention, said step of applying a pressure on said metal sheet 2 resting on said forming mold 7 takes place by means of said calender 4.

[0069] In particular, said first roller 14 is adapted to exert a pressing force on said metal sheet 2 arranged on said supporting surface 7' of said forming mold 7, so that said elastically yielding material 14' is compressed as a result of the pressure and expands only at said gaps 8 deforming the metal sheet 2 below.

[0070] As is evident from the detailed section of Fig. 4, the holes obtained on the forming mold 7 allow expansion of said elastically yielding material 14' that pushes the metal sheet 2 underneath it, deforming it, or shaping it.

[0071] The metal sheet obtained has in substance raised deformed areas that reproduce, in a complementary manner, the holes of the forming mold.

[0072] Replacement of the forming mold 7 based on the desired pattern to impress on the metal sheet 2 allows the simple and rapid diversification of production.

[0073] Adjustment of the distance between the rollers 14 and 24 by means of the adjustment means allows the pressing force exerted on the sheet to be increased or decreased, obtaining, with the same thickness, more or less prominent peaks, or adapting processing based on the thickness of the sheet to be shaped.

Claims

1. A machine (1) for shaping a metal sheet (2) comprising:

- feed means (3) of a metal sheet (2) to be processed;
- a calender (4) comprising a first roller (14) and a second roller (24);
- motor means (5', 5'') adapted to operate at least one of said first (14) and second (24) roller;
- recovery means (6) of the processed metal sheet (2),

characterized in that:

- it comprises a forming mold (7) having a supporting surface (7') for said metal sheet (2), where said supporting surface (7') comprises gaps (8);
- said first roller (14) comprises at least an outer layer (14') made of an elastically yielding material, having a smooth surface;
- said second roller (24) comprises a surface made of a rigid material, where said first roller

(14) is adapted to exert a pressing force on said metal sheet (2) arranged on said supporting surface (7') of said forming mold (7), so that said elastically yielding material is compressed as a result of the pressure and expands only at said gaps (8) deforming the metal sheet (2) below.

2. A machine (1) according to claim 1, **characterized in that** said at least an outer layer (14') of said first roller (14) is made of rubber.

3. A machine (1) according to claim 1, **characterized in that** said second roller (24) is made of steel.

4. A machine (1) according to claim 1, **characterized in that** said gaps (8) have an irregular shape.

5. A machine (1) according to claim 1, **characterized in that** said gaps (8) are distributed unevenly on the supporting surface (7') of said forming mold (7).

6. A machine (1) according to claim 5, **characterized in that** said gaps (8) are isolated from one another.

7. A machine (1) according to claim 1, **characterized in that** said forming mold (7) comprises areas of reduced thickness adapted to define said gaps (8) of said supporting surface (7') and to allow expansion of said elastically yielding material.

8. A machine (1) according to claim 1, **characterized in that** said forming mold (7) comprises shaped holes adapted to define said gaps (8).

9. A machine (1) according to claim 1, **characterized in that** said feed (3) and recovery (6) means each comprise a roller conveyor (13) on which said forming mold (7) is transported.

10. A machine (1) according to claim 1, **characterized in that** it comprises centring means (11) for said forming mold (7).

11. A machine (1) according to claim 1, **characterized in that** it comprises an abutment panel (10) on which said forming mold (7) rests and said abutment panel (10) is moved by means of said feed (3) and recovery (6) means.

12. A machine (1) according to claim 11, **characterized in that** it comprises centring means (11) for said abutment panel (10).

13. A machine (1) according to claim 1, **characterized in that** it comprises adjustment means (12) of the mutual distance between said first (14) and said second (24) roller, adapted to adjust the pressing force exerted by said first roller (14) on said metal sheet

(2).

- 14.** A shaped metal sheet (2) obtained by means of the machine according to at least one of claims 1 to 13.

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Fig. 1

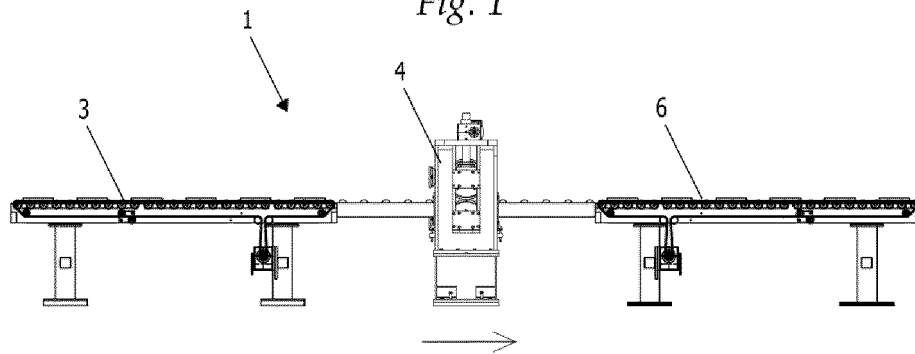


Fig. 2

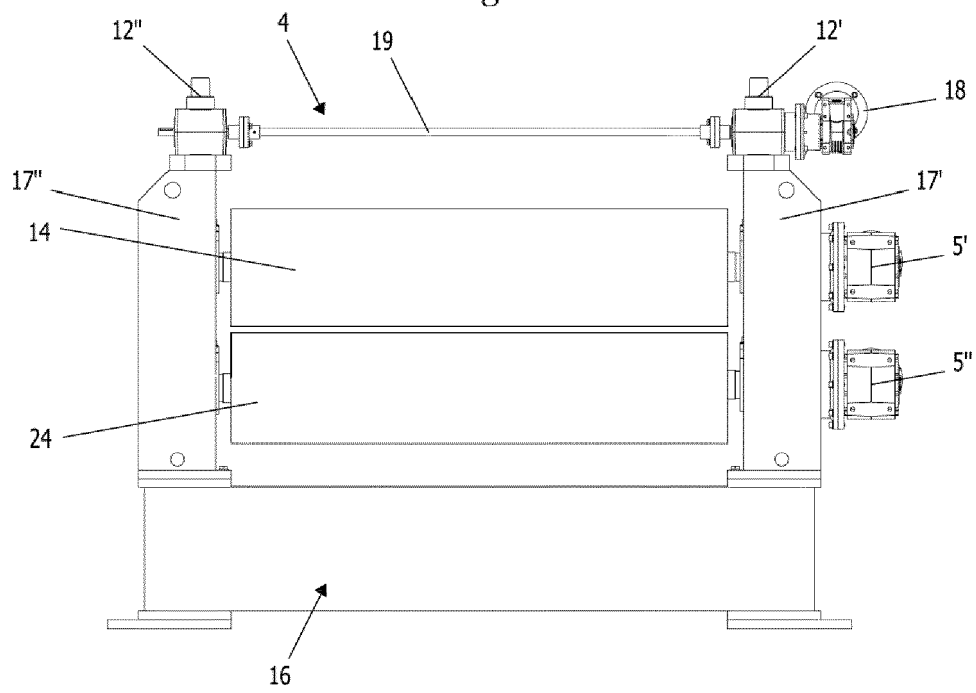


Fig. 3

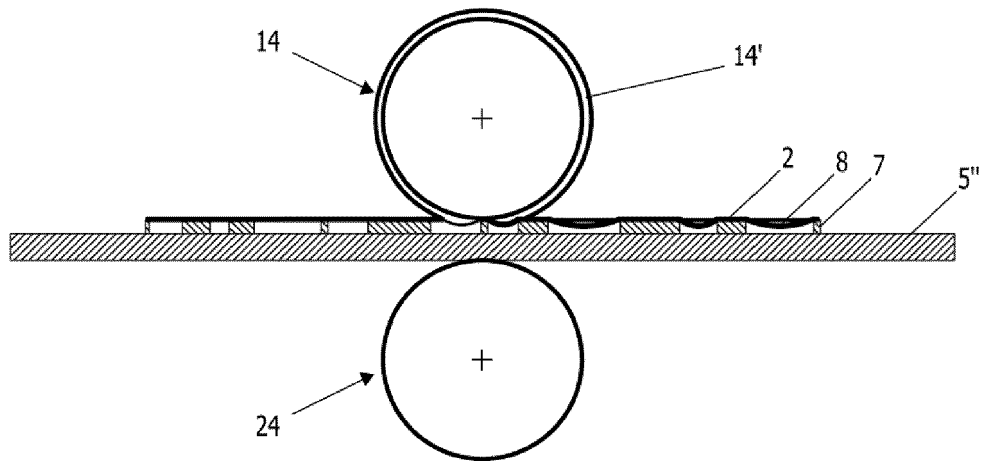


Fig. 4

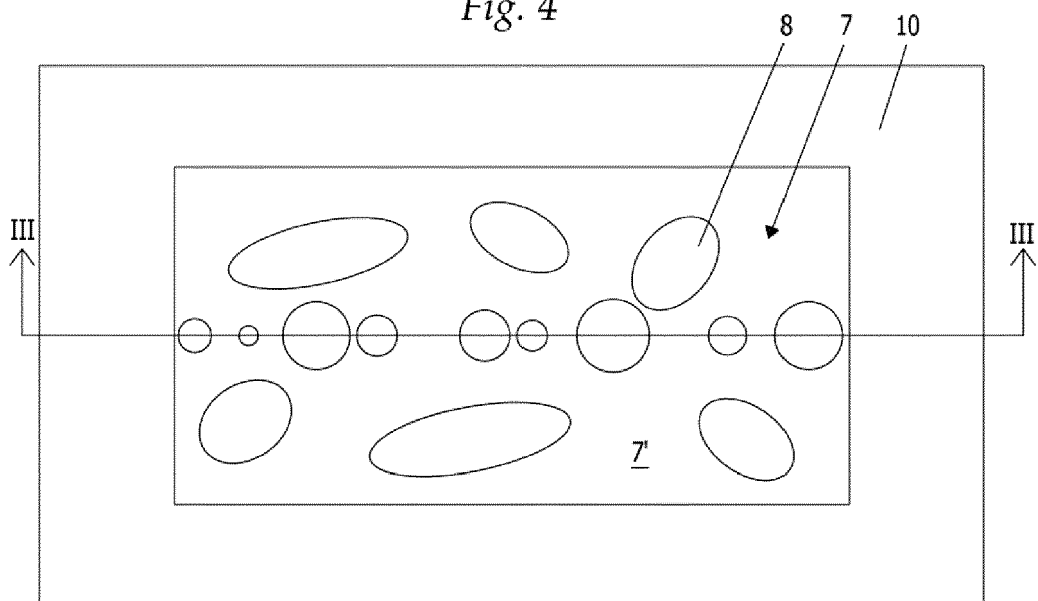


Fig. 5

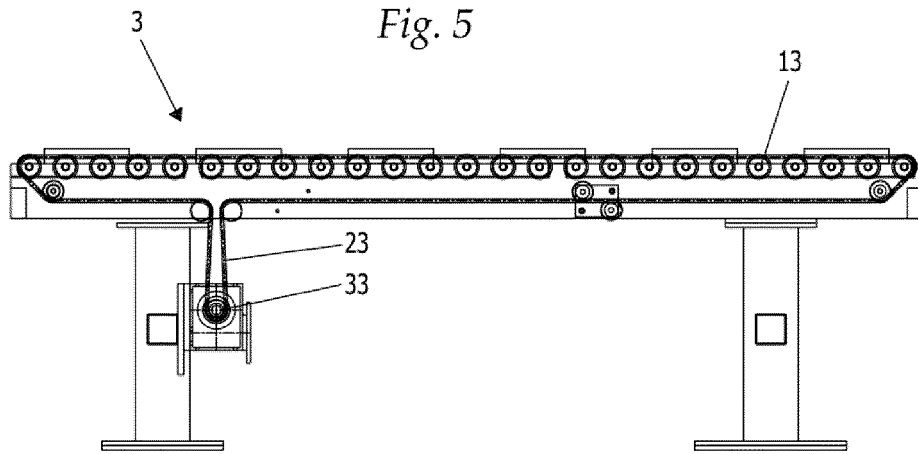
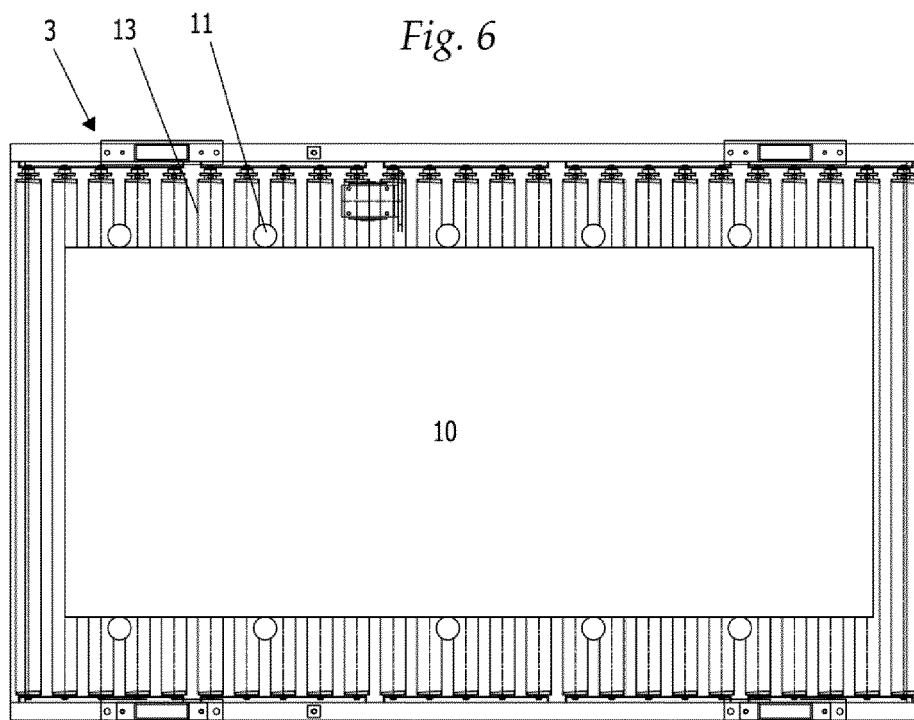


Fig. 6





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Application Number
EP 17 18 2448

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 January 2018	Examiner Ritter, Florian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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