

1

The present invention relates to machines for fabricating cardboard cartons or boxes, corrugated cardboard cartons or cartons made of similar sheet material, starting from prefabricated panels or blanks of such material as well as a process for the fabrication of a carton using such a machine.

From the patents US-A-4 349 345 and EP-A-0334 707, for example, machines are known with which it is possible to fabricate a cardboard or similar type of carton by wrapping a prefabricated panel round a mandrel.

The machine described in the patent US-A-A 349 345 comprises clamping jaws which fold the panels, which are not provided with prefolding lines, round such a mandrel.

In the patent EP-A-0334 707 a machine is described for the fabrication of a carton starting from a panel of sheet material consisting of a series of rectangular or square sections connected to each other by a first set of folding lines parallel to each other and a first set of lateral flaps arranged on one side of the said series of panels, connected to the latter by a second set of folding lines perpendicular to the said first set of folding lines and destined to form, at least partially, the bottom of the said carton, the said machine comprising :

- a mandrel , the external cross-section of which corresponds to the internal cross-section of the said carton to be produced;
- means to support freely an intermediate section of the said series of sections at least approximately opposite to the matching face of the said mandrel but at some distance from the latter, then to apply the said intermediate section to the said matching face of the mandrel, then press the said intermediate section against the said matching face, after folding of the adjacent sections to the said intermediate section until the said adjacent sections rest against the said mandrel;
- means for wrapping the said series of sections round the said mandrel;
- means for fixing together the end sections of the said series of sections thus wrapped round the said mandrel;
- means for folding the flaps of the said first set against a matching face of the said mandrel; and
- means for fixing the said flaps thus folded to each other.

In these machines, the said mandrel possesses an essentially square or rectangular cross-section (even if the corners of the mandrel of the machine described in patent US-A-4 349 345 are rounded), such that the cartons obtained have four sides defining a volume, the cross-section of which is also square or rectangular and parallel to the bottom of the said cartons. Naturally, two adjacent sides then form a right angle between them and form an edge perpendicular to the bottom of the carton.

Such cartons are used to package objects or groups of objects which are introduced from the top, the lid remaining open, the said lid being closed only after said objects have been introduced.

It rarely happens, though it might, that the cross-section of the load constituted by the said objects or groups of objects is square or rectangular and fits exactly into that of the carton into which the said load is introduced, such that the said load is not firmly held in the said carton by the sides of the latter and that the corners of the said carton project and are empty. It follows from this that the said load may move within the carton, leading to an instability which causes difficulties in handling and loading on board a means of transport. Furthermore, the projecting corners of the carton (except in the case of US-A-4 349 345) are exposed to rough handling and can be easily torn, a circumstance harmful to the presentation and protection of the packaged products. Finally, the empty corners of the carton constitute a waste of sheet matter because they are useless.

The subject of the present invention is the improvement of the machine of EP-A-0334 707 in order to make possible the fabrication of cartons in which :

- it is possible to adapt the form of the cross-section of the carton as closely as possible to the cross-section of the load which it is required to contain, such that the latter can be held laterally in an optimal manner;
- it is possible to eliminate the empty and useless projecting corners of the carton, which enables the risks of deterioration of the said projecting corners to be reduced and economies to be made in the sheet material. These projecting corners (dihedral angle 90°) are then transformed into more open dihedral angles (angle greater than 90°), less vulnerable to rough handling;

- it is possible to increase the number of lateral edges and hence the resistance of the carton to compression.

For this purpose, according to the invention, the machine of the type described in the patent EP-A-0334 707 and pointed out above is characterized in that the said mandrel comprises at least five faces and in that the said means of support, application and pressing of the said intermediate section comprise a pressure plate possessing two faces rigidly connected to each other, the first of the said faces matched against the said intermediate section and the second matched against a first section adjacent to the said intermediate section, the said first and second faces of the pressure plate defining a first dihedral angle such that, when the said first face is applied against the said face of the mandrel matching the said intermediate section, the said second face is applied to the face of the said mandrel matched against the adjacent first section, the edge of the said first dihedral angle being then coincident with the edge of the said mandrel defined by the said corresponding faces of the said mandrel.

Thus, two sections of the said prefabricated panels are perfectly positioned with respect to the mandrel and held in relation to the corresponding faces of the latter during the wrapping of the said panel such that the carton obtained has a particularly precise form.

In order to increase this precision still further, it is advantageous that the said pressure plate comprises a third face rigidly connected to the first and second section adjacent to the intermediate section, the said first and third faces of the pressure plate defining a second dihedral angle such that, when the said first and second faces are applied against the said faces of the mandrel corresponding to them, the said third face is applied against the face of the mandrel corresponding to the second adjacent section, the edge of the second dihedral angle then being coincident with the edge of the said mandrel defined by the said corresponding faces of the said mandrel. Thus, during the final phase of wrapping of the sections three of them are arranged precisely and firmly maintained against the corresponding faces of the mandrel.

Advantageously, the said means for wrapping the said series of sections around the mandrel comprise a mobile gear comprising tilting arms.

Thus, by means of the machine of the present invention, it is possible to produce a carton presenting, parallel to its bottom, a quadrilateral with cutaway corners and capable of presenting eight sides and possessing a rectangular cross-section with four cutaway corners. Such a carton may also present only six sides, the four corners also being cutaway. As an alternative, the carton produced by the machine in conformity with the invention may possess six sides, with only two consecutive cutaway corners. According to another variant, the carton obtained presents eight sides and it possesses a square cross-section with four cutaway corners. In this last case, the eight side faces may be identical.

According to another embodiment, the carton produced by the machine according to the invention exhibits a triangular cross-section with cutaway corners parallel to its bottom. It may present five side faces and possess a triangular cross-section with two cutaway corners. It may also present six side face and possess a triangular cross-section with three cutaway corners.

Thus, a panel of sheet material such as cardboard or corrugated cardboard designed for the fabrication of a carton by means of the machine conforming to the present invention and comprising a series of rectangular or square sections connected to each other by a first set of folding lines parallel to each other and a first set of lateral flaps arranged on one side of the said series of sections, connected to the latter by second folding lines perpendicular to the first folding lines and designed to form at least partially the bottom of the said carton, is such that the said series contains at least five sections.

This panel may contain in addition a second set of lateral flaps arranged on the other side of the said series of sections, connected to the latter by a third set of folding lines perpendicular to the first folding lines and designed to form, at least partially, the lid of the said carton.

Some sections may not comprise lateral flaps of the said first set and/or of the second set.

At least one flap of the first set and/or second set may possess, at least in the neighbourhood of the said second or third corresponding folding line, the form of the cross-section of the carton produced from the said panel.

Two panels of the first and second set of panels, respectively, connected to the same section, may be identical or different in form.

A section not comprising either a flap of the said first set or a flap of the second set may, on the other hand, contain a stub on its edge on the side of the said first set of flaps and a slot on its edge on the side of the second set of flaps, such that when two carton produced from the two such identical panels are superposed, the stub of the lower carton fits into the slot of the upper carton. The cartons thus obtained are then easy to stack.

For the same purpose, as a variant, it is possible to make provisions such that the flaps of the said first and second sets which are on the outside when the carton is formed, exhibit complementary forms such that when two such cartons are superposed, the flaps of the said first set of the lower carton fit into the second set of the upper carton.

In order to further reinforce the solidity of the cartons produced by the machine conforming to the invention, it is advantageous that at least one flap of the said first set and/or of the said second set comprises at least one foldable tab capable of being fixed to a section when the carton is formed from the said panel.

The figures of the appended design will make it easy to understand how the invention can be achieved. In these figures, identical references are used to designate the same elements.

Figure 1 shows a two-dimensional panel of sheet material for the fabrication of a first embodiment of a carton with the aid of the machine conforming to the present invention.

Figures 2 and 3 show in perspective the carton produced from the panel shown in Figure 1, the lid of the said carton being shown open (Figure 2) and closed (Figure 3), respectively.

Figure 4 illustrates, in transverse section parallel to its bottom, the use of the carton of the Figures 2 and 3.

Figures 5, 6 and 7 illustrate schematically the process by which the carton shown in Figure 2 is formed from the panel shown in Figure 1.

Figures 8, 10 and 12 are schematic views in elevation of a machine designed for the fabrication of the carton shown in Figure 2, from the panel shown in Figure 1, at different stages of this fabrication.

Figures 9, 11 and 13 are schematic view from the top corresponding to Figures 8, 10 and 12, respectively.

Figures 14, 15 and 16 illustrate schematically in partial side views, perpendicular to the Figures 8, 10 and 12, the closing of the bottom of the carton shown in Figures 2 and 3.

Figures 17, 20, 23, 26, 29, 32, 35, 38, 41, 44, 47, 50, 53 and 56 show respectively, in two dimensions, variants of panels designed for the machine conforming to the present invention.

Figures 18, 21, 24, 27, 30, 33, 36, 39, 45, 48, 51, 54 and 57 show, in perspective, the cartons produced from the panels shown in Figures 17, 20, 23, 26, 29, 32, 35, 38, 44, 47, 50, 53 and 56, respectively, the said cartons having their lid open.

The Figures 19, 22, 25, 28, 31, 34, 37, 40, 42, 46, 49, 52, 55 and 58 show, in perspective, the cartons produced from the panels shown in Figures 17, 20, 23, 26, 29, 32, 35, 38, 41, 44, 47, 50, 53 and 56, respectively, the said cartons having their lid closed.

Figure 43 is an end view of the carton shown in Figure 42 produced from the panel shown in Figure 41.

Panel F1 made of sheet material, for example cardboard or corrugated cardboard, shown in Figure 1 comprises a series of eight rectangular sections aligned 1 to 8, connected two by two by preformed folding lines parallel to 9 to 15. Along the length of the free edge of the end section 1 of the said series of sections provision is made for a tongue 16 connected to the said end section 1 by a folding line 17, parallel to the folding lines 9 to 15.

Moreover, each side of each section 1, 3, 5 and 7 are provided with the flaps 18.1, 18.3, 18.5, 18.7 and 19.1, 19.3, 19.5 and 19.7, respectively. Each lateral flap 18.1, 18.3, 18.5, 18.7 is linked to the corresponding section 1, 3, 5 or 7 by a preformed folding line 20.1, 20.3, 20.5 or 20.7. These folding lines 20.1, 20.3, 20.5 or 20.7 are aligned and perpendicular to the folding lines 9 to 15 and 17. Similarly, each lateral flap 19.1, 19.3, 19.5 and 19.7 is linked with the corresponding section 1, 3, 5, 7 by a preformed folding line 21.1, 21.3, 21.5 or 21.7. The folding lines 21.1, 21.3, 21.5 or 21.7 are aligned and perpendicular to the folding lines 9 to 15 and 17. The sections 2, 4, 6 and 8 do not have a lateral flap.

The rectangular sections 1 to 8 all are the same height h . The two sections 1 and 5 are identical and have width l . The two sections 3 and 7 are identical and have a width L , larger than l . The four sections 2, 4, 6 and 8 are identical and have a width e smaller than l . The height h is greater than L .

The panel F1 is designed to form the carton C1 shown in Figure 3 by wrapping and joining of the sections 1 to 8 and assembly of the flaps 18.1, 18.3, 18.5, 18.7, 19.1, 19.3, 19.5 and 19.7 - in the manner described in more detail below in conjunction with the Figures 5 to 16. The carton C1 has a height h , a length $L1$ and a width $l1$. It has the general appearance of a carton of rectangular cross-section with four cutaway corners. In the carton C1, the large sides are formed by the sections 3 and 7, whereas the small sides are formed by the sections 1 and 5, the sections 2, 4, 6 and 8 forming the cutaway corners of the said carton C1. Furthermore, the bottom of the carton C1 is constituted by the flaps 18.1, 18.3, 18.5, 18.7, whereas the lid of the said carton C1 is constituted by the flaps 19.1, 19.3, 19.5 and 19.7.

The four flaps 18.1, 18.5, 19.1 and 19.5 are identical and rectangular. They have a length equal to the width l of the sections 1 and 5.

The flaps 18.3, 18.7, 19.3 and 19.7 are identical. They have a length equal to the length $L1$ of the carton C1 and a width $l1/2$ equal to one half of the width $l1$ of this latter. The flaps 18.3, 18.7, 19.3 and 19.7, whose length $L1$ is greater than the width L of the corresponding sections 3 and 7, are

connected to the said sections by a convergent part whose inclined edges 22 have a length a equal to the width g of the sections 2, 4, 6 and 8. Thus, each of the said flaps 18.3, 18.7, 19.3 and 19.7 corresponds in form to half of the cross-section of the carton C1.

Figure 4, illustrates, in transverse section, an application of the carton C1 with the packaging of six bottles B separated by a separation cross-piece S. It can be seen that, owing to the cutaway corners corresponding to the sections 2, 4, 6 and 8, the bottles B at the corners are firmly held, since the cutaway corners form tangents with the latter. These scarcely projecting corners are much less vulnerable to rough handling. Furthermore, at each corner, as compared with a rectangular carton of the prior art, it is seen that only a proportion $a/2b$ of sheet material is used. If the faces 2, 4, 6 and 8 are inclined at 45° to the faces 1, 3, 5 and 7, this proportion is equal to $1/2$, i.e. equal to 70%. From this there results a saving of material of 30% for each corner.

Finally, the carton C1 possesses eight lateral edges, corresponding to the folding lines 9 to 17, respectively which confer on it a greater resistance to compression than that of a carton with a rectangular cross-section.

Figures 8 to 16 illustrate schematically a machine for the fabrication of the carton C1, with open lid, such as that shown in Figure 2. For the purposes of clarity, these figures are intentionally partial and simplified and each of them shows only the elements necessary for understanding the manufacturing steps which they illustrate.

The machine shown in Figures 8 to 16 comprises a mandrel (shown on a larger scale in the Figures 5 to 7), the external form of which corresponds to the internal form of the carton C1 to be produced from the panel F1. For this purpose, the cross-section of the mandrel 23 is rectangular with bevelled edges. As shown in Figures 8 to 16, the length of the mandrel 23 may be different from the height h of the carton C1. The mandrel 23 may be full or constituted only of a reinforcement board defining its edges, as shown in the said Figures 5 to 7. In these figures, it is supposed that the said mandrel 23 is constituted of parallel raised sections 24 (seen end-on in Figures 5 to 7), rectangular in cross-section with one corner cut away, defining lateral supporting faces 25 to 32 in the case of the sections of F1

panel, folding edges 33 to 40 corresponding to the folding lines between the said sections, and a frontal supporting face 41 for the flaps 18.1, 18.3, 18.5 and 18.7, the outline of the said supporting face 41 forming folding edges corresponding to the folding lines of the said flaps 18.1, 18.3, 18.5, and 18.7.

In Figures 5 to 7 is illustrated schematically the positioning process of the panel F1 in relation to the mandrel 23, when it is desired to apply the intermediate section 3 to the matching lower face 25 of the mandrel 23.

By means from the prior art, for example those shown in the document EP-A-0334 707, a panel F1 is brought close to the mandrel 23 so that its section 3 is placed at least approximately opposite the supporting face 25. Although the lateral positioning of the said section 3 with respect to the said face 25 is made as precisely as possible, it may happen that a lateral gap - δ - appears between the section 3 and the said supporting face 25. In order to prevent excessive foldings of the panel F1 outside the folding lines 10 and 11, when the other sections of the panel F1 are folded, the section 3 is moved a distance d (see Figure 5) from the supporting face 25 before folding the said other sections. Subsequently, during the folding of the said sections 2, 1 and the tongue 16 on the one hand, and of the sections 4 to 8 on the other, the section 3 is joined to the supporting face 25 by the intermediary of a pressure plate 42, the profile of which is concave and which, transversely to the mandrel 23, presents a face 43 superposable on the face 25 of the said mandrel, a face 44 superposable on the face 26 of the mandrel 23 and a face 45 superposable on the face 32 of this latter, the faces 43 and 44 being connected to each other by an edge 46 superposable on the edge 34, whereas the faces 43 and 45 are connected to each other by an edge 47 superposable on the edge 33. Thus, during the application of section 3 to the face 25 (arrow F), the sections 2, 1 and the tongue 16, on the one hand, and the sections 4 to 8, on the other, are supported against the mandrel 23 (see the dotted lines 48 and 49 of figure 5), which creates a lateral guidance effect and positions the section 3 exactly in relation to the supporting face 25 (see Figure 6). When the pressure plate 42 presses the section 3 against the supporting face 25 (see Figure 7), the folding lines 10 and 11 are exactly superposed on the folding edges 33 and 34 and the folding lines 9 and 12 are exactly superposed on the folding edges 40 and 35.

Since then the panel F1 is provisionally pressed to the mandrel 23 by the pressure exerted by the plate 42, the formation of the carton C1 may be continued by wrapping the panel F1 round the said mandrel (see the dotted lines in figure 8).

As a result such wrapping, the sections 1, 5, 6, 7, 8 are applied against the faces 31, 27, 28, 29 and 30, respectively, and the tongue 16 is folded on to the face 30 (before or after the section 8). Hence it is possible to assemble the tongue 16 and the section 8, for example by gluing.

Then, the flaps 18.1 and 18.5 are folded round the edges of the front face 41 of the mandrel 23 corresponding to the folding lines 20.1 and 20.5, respectively, resulting in their being applied against the matching said front face 41 of the mandrel 23.

Finally, the flaps 18.3 and 18.7 are folded around the edges of the front face 41 of the mandrel 23 corresponding to the folding lines 20.3 and 20.7, respectively, and applied against the already folded flaps 18.1 and 18.5 so that the said flaps 18.1, 18.3, 18.5 and 18.7 can be joined to each other, for example by gluing.

The carton shown in Figure 2 joined together on the mandrel 23 and open on the side of the flaps 19.1, 19.3, 19.5 and 19.7 is then obtained.

In order to fill this carton it is removed from the mandrel 23 and it is placed on its bottom constituted of the joined flaps 18.1, 18.3, 18.5 and 18.7. After being filled, the carton C1 can be closed by folding the flaps 19.1 and 19.5 around the folding lines 21.1 and 21.5, respectively, then by folding the flaps 19.3 and 19.7 on to the already folded flaps 19.1 and 19.5, and finally by joining the said flaps 19.1, 19.3, 19.5 and 19.7, for example by gluing. The closed carton C1 shown in Figure 3 is then obtained.

The operations indicated above may be performed automatically by means of the machine illustrated schematically and partially in Figures 8 to 16. This machine consists of a frame 50 in relation to which are mounted the mandrel 23 and the pressure plate 42. In addition, it consists of a device

(not shown) of any known type, which takes the panels one at a time from a magazine and transports them under the mandrel 23. Glue appliances 51, 52 and 53, mounted on the frame 50, make it possible to deposit lines of adhesive 54, 55, 56 on the tongue 16 and the flaps 18.1 and 18.5, respectively, during the transport of a panel F1 under the mandrel 23.

Thus, by means of the glue appliances 51 to 53, the panel F1 is placed already glued under the mandrel 23 in the position shown in Figure 5, above the pressure plate 42, moved by a jack, borne by the frame 50.

In order to wrap the sections 1 to 8 and the tongue 16 round the mandrel 23, the machine includes a mechanism including a mobile gear 58 which can be raised or lowered by the intermediary of a jack 59, which rests on the frame 50.

The mobile gear 58 comprises two articulated arms 60 and 61, for example moved by a gear assembly 62 connected to the frame 50 and by a cam 63 mounted on the said frame, respectively.

The actuating gears 64 to 67 such as jacks for example, are mounted on the frame 50 and can fold the flaps 18.1, 18.5, 18.7 and 18.3, respectively. Presses 68 and 69, also mounted on the frame 50, are designed to apply the tongue 16 and the section 8 to the face 30 of the mandrel 23.

Once a panel F1 has been transported under the mandrel 23 so as to be in the position shown in Figure 5 (see Figures 8 and 9), the jacks 57 and 59 are actuated in order that, on the one hand, the pressure plate 42 is brought close to the mandrel 23 and, on the other hand, the articulated arms 60 and 61, in response to the raising of the mobile gear 58, fold the sections of the panel F1, arranged on either side of the section 3, respectively. The panel F1 then successively takes up the relative positions illustrated by figures 6 and 7, with respect to the mandrel 23. Then, the raising of the mobile gear is continued, the arms 60 and 61 stick the sections 5, 6 and 1 against the matching faces 27, 28 and 31, respectively, of the mandrel 23 (see Figures 10 and 11).

The presser 68 then applies the tongue 16 against the face 30 of the mandrel, after this the other presser 69 applies the section 8 against the

tongue 16 and the face 30. By means of the adhesive line 54, the section 8 is then joined to the tongue 16 (see Figures 12 and 13).

Then, the actuating gears 64 and 65 fold down the flaps 18.1 and 18.5 against the front face 41 of the mandrel 23 (Figure 11), after that the actuating gears 66 and 67 respectively apply the flap 18.7 (Figure 15) then the flap 18.3 (Figure 16) against the folded flaps 18.1 and 18.5. By means of the adhesive lines 55 and 56, the flaps 18.1, 18.3, 18.5 and 18.7 are joined to each other to form the bottom of the carton C1.

Figures 17, 20, 23, 26, 29, 32, 35, 38 and 41 show respectively panels of sheet material F2 to F10 capable of forming cartons of rectangular cross-section with cutaway corners, like carton C1. In the panels F2, F3, F5 to F9 of the Figures 17, 20, 23, 26, 29, 32, 35 and 38 are presented the series of eight aligned rectangular sections 1 to 8, connected two by two by the preformed folding lines parallel to 9 to 15 and bordered by the folding lines 20.1, 20.3, 20.5, 20.7, 21.1, 21.3, 21.5 and 21.7 as described above in regard to Figure 1. However, in these different embodiments, the flaps 18.1, 18.3, 18.5, 18.7 and 19.1, 19.3, 19.5 and 19.7 exhibit different forms so that the cartons produced C2, C3 and C5 to C9 are different from the carton C1, although exhibiting the same rectangular cross-section with cutaway corners.

As regards the panels F4 and F10 of Figures 23 and 41, the series of aligned rectangular sections 1 to 8 is also different so that the corresponding cartons C4 and C10 are different from C1, even though their cross-section is the same.

From the foregoing it will be readily understood that the cartons C2 to C10 may be produced by the use of the machine described in respect to the Figures 5 to 16, possibly by adjusting the position and/or the number of gluing applicances 51 to 53, actuating gears 64 to 67 and pressers 68, 69.

In the panel F2 of Figure 17, the flaps 18.3, 18.7, 19.3 and 19.7 are identical and rectangular. They have a length equal to the width of the sections 3 and 7 and a width equal to a half of 11. Furthermore, the flaps 18.1, 18.5, 19.1 and 19.5 are identical and each of them has a length equal to 11. It is the flaps 18.1, 18.5, 19.1 and 19.5 which thus comprise, close to

their folding line with the corresponding sections, the enlargement provided by the inclined edges, the latter having the length a .

The panel F3 shown in figure 20 is identical with the panel F2 shown in Figure 2, except as far as the free edges of the sections 2, 4, 6, 8 and the tongue 16 are concerned. The free edges of the said sections and the said tongue on the side of the flaps 18.1, 18.3, 18.5 and 18.7 have indentations 70, whereas those on the side of the flaps 19.1, 19.3, 19.5 and 19.7 have projections 71. Thus, the carton C3 contains slots 73 in its lower part and stubs 74 in its upper part. When two C3 cartons are superposed, the stubs 74 of the lower carton penetrate into the slots 73 of the upper case so that the said cartons are held together laterally.

The sections 2 to 8 and the flaps 18.3, 18.5, 18.7, 19.3, 19.5 and 19.7 of panel F4 shown in figure 23 are identical with those of panel F1 shown Figure 1. On the other hand, the section 1, the tongue 16 and the flaps 18.1 and 19.1 were removed and replaced by two rectangular sections 1.1 and 1.2, joined respectively to the external edges of the sections 2 and 9 along the folding lines 9 and 75. With each of the sections 1.1 and 1.2 are associated rectangular flaps 18.11, 19.11 and 18.72, 19.72, respectively. The sections 1.1 and 1.2 and the flaps 18.11, 19.11, 18.72 and 19.72 have a width l_2 greater than the half width l of the section 5. Thus, after folding of the panel F4 round the mandrel 23, the sections 1.1 and 1.2 and the flaps 18.11, 19.11, 18.72 and 19.72 are superposed along the overlapping zone 76, along which they can be joined, for example by gluing.

Essentially, in the panel F5 shown in Figure 26, the sections 1 to 8, the tongue 16, the flaps 18.1, 18.3, 18.5, 18.7, 19.1 and 19.5 are identical with those of the panel F1 shown in Figure 1. However, the length of their inclined edges 22, the flaps 18.3 and 18.7 comprise tabs 77. Moreover, the flaps 19.3 and 19.7 have a form which corresponds to the cross-section of the carton C5. In addition, the inclined edges 22 and 78 of the cutaway corners of the flap 19.7 include tabs 79. Thus, when the carton C5 is formed from the panel F5, the tabs 77 and 79 are folded and joined to the faces of the said carton corresponding to the sections 2, 4, 6 and 8. The tabs thus constitute reinforcements connecting the bottom and the lid of the carton C5 to the side wall of the latter. In addition, a handle 80 has been provided on the flap 19.7, the said handle 80 being accessible through a slit

81 provided in the flap 19.3 when the latter is folded back on the flap 19.7 and joined to the latter.

In the panel F6 of Figure 29, the sections 1 to 8, the tongue 16 and the flaps 18.1, 18.3, 18.5 and 18.7 are identical with those of the panel F2 shown in Figure 17. On the other hand, the flaps 19.1, 19.3, 19.5 and 19.7 are narrow and all have inclined edges 22. Thus, the carton C6 contains a lid constituted only of a peripheral border 82, defining a central opening 83.

The panel F7 of Figure 32 contains sections 1 to 8, a tongue 16 and flaps 18.1, 18.3, 18.5 and 18.7 similar to those of panel F1 shown in Figure 1. The flaps 19.1 and 19.5 are rectangular, with a length equal to the width 1 of the sections 1 and 7, but quite narrow. The flaps 19.3 and 19.7 possess inclined extension edges 22, but their width is less than $11/2$. Furthermore, in longitudinal extension, the said flaps 19.3 and 19.7 possess tabs 84. Thus, the carton C7 contains a lid constituted of a peripheral edge 85 defining a central opening 86, tabs 84, after folding and gluing, joining the said lid to the lateral faces of the said carton corresponding to the sections 1 and 5.

In the panel F8 shown in figure 35, the sections 1 to 8 and the tongue 16 are identical with those of the panels F1 and F2 of Figures 1 and 2. The flaps 18.1, 18.5, 19.1 and 19.5 are identical. Similarly, the flaps 18.3, 18.7, 19.3 and 19.7 are identical. Each flap 18.1, 18.5, 19.1 and 19.5 comprises, close to its folding line and connecting line to the adjacent section, a widening with inclined edges 22, followed by a narrowing with the edges 87 inclined in the opposite sense to the edges 22, and finally an area 88 of constant length. Each flap 18.3, 18.7, 19.3 and 19.7 comprises, close to its folding line and connecting line to the corresponding section, an area 89 of constant width, then a wider area with inclined edges 90 and finally an area 91 of constant length.

The total width of the flaps 18.3, 18.7, 19.3 and 19.7 is equal to half of 11 and their length, over the part of constant length 91, is equal to L1. The carton C8 produced from the panel F8 is shown in Figures 36 and 37.

In the panel F9 shown in figure 38, the sections 1 to 8, the tongue 16 and the flaps 18.1, 18.5, 19.1 and 19.5 are similar to those of the panel F2

shown in Figure 17. However, the width of the said flaps is less than half of l_1 . The flaps 18.3, 18.7, 19.3 and 19.7 are identical. They comprise, close to its folding line and connecting line to the corresponding section, a rectangular part 92, then a narrower part 93, with inclined edges 94. The width of these last flaps is equal to half of l_1 . As is illustrated in figure 38, the fabrication of the panels F9 is economical in sheet material since two panels F9 can be fitted into each other, with a longitudinal gap.

In Figure 41, a panel F10 is shown in which the series of the sections 1 to 8 is such that the height h of these latter is less than the width L of the sections 3 and 7, unlike what was shown for the panels F1 to F9 previously described. The flaps 18.1 and 18.5 are approximately similar to those of the panel F2 shown in figure 17, whereas the flaps 18.3 and 18.7 are approximately similar to the panel F1 shown in figure 1. Furthermore, the flaps 19.1, 19.3, 19.5 and 19.7 are approximately similar to those of the panel F2 shown in figure 17. The lateral edges of the flaps 19.3 and 19.7 possess indentations 95.

The bottom of the carton C10 is formed by folding and fixing the flaps 18.1 and 18.5 on to the previously folded flaps 18.3 and 18.7, so that the said flaps 18.1 and 18.5 project with respect to these latter. The lid of the carton C10 is formed by folding and fixing the flaps 19.3 and 19.7 on to the previously folded flaps 19.1 and 19.5 so that the said flaps 19.3 and 19.7, which project with respect to the flaps 19.1 and 19.5, form cavities 96 at the ends of the said carton. The form of the said cavities 96 corresponds to that of the flaps 18.1 and 18.5. Thus, when two cartons C10 are superposed, the projections formed by the flaps 18.1 and 18.5 of the bottom of the upper carton are accommodated in the cavities 96 of the lid of the lower carton such that the interplay of the projections 18.1 and 18.5 and the cavities 96 ensures the vertical stability of the said cartons. This stability is further reinforced by the fact that the sections 2, 4, 6, 8 possess the projections 71 and the indentations 70 of the panel F3 shown in Figure 20 such that the carton C10 possesses stubs 74 and the slots 73 similar to those of the carton C3 promoting the stacking of the said cartons C10.

In the panel F11 shown in figure 44, the sections 1 and 5 of the panels F1 to F10 described below were eliminated. In addition, the section 8 is linked to section 2 and it bears the tongue 16. As a result the carton C11 has a

hexagonal, not an octagonal, cross-section. Triangular flaps 18.2, 18.4, 18.6, 18.8, 19.2, 19.4, 19.6 and 19.8 are arranged at the ends of the sections 2, 4, 6 and 8. The flaps 18.3, 18.7, 19.3 and 19.7 are trapezoidal.

Thus, in the carton C11, the corners are widely cut, leading to the total removal, as compared with the cartons C1 to C10, of the sides corresponding to the sections 1 and 5.

The carton C12 shown in Figures 48 and 49 has only two consecutive cutaway corners. For this purpose the corresponding panel F12 contains the same series of sections 8, 2, 3, 4, 6, 7 as the panel F11 but, after formation of the carton C12, the sections 6 and 8 are orthogonal to the section 7. These sections 6 and 8 do not possess any flaps. The sections 2, 3, 4 and 7 possess flaps 18.2, 18.3, 18.4, 18.7, 19.2, 19.3, 19.4 and 19.7 capable of forming the bottom and the lid of the carton C12.

The panel F13 shown in Figure 50 contains a series of eight identical sections 1 to 8, with which are associated identical trapezoidal flaps 18.1 to 18.8 and 19.1 to 19.8. The carton C13 produced from the panel F13 thus has an octagonal cross-section corresponding to a square cross-section with the four corners cut away. Provision is made for octagonal plates for the carton C13 in order to form the bottom and the lid, respectively, in cooperation with the flaps 18.1 to 18.8 and 19.1 to 19.8.

The panel F14 shown Figure 53 contains a set of five sections 3 to 7, the tongue 16 being linked to the first section 3. The carton C14 thus has a triangular cross-section with two corners cut away. The section 5 bears flaps 18.5 and 19.5 in a corresponding approximately triangular form comprising at their base inclined sides 22 in order to adapt to the sides corresponding to the sections 4 and 6. In addition, the sections 3 and 7 comprise flaps 18.3, 18.7 and 19.3, 19.7 designed to serve as supports of the flaps 18.5 and 19.5 and to form the bottom and the lid of the carton C14.

The panel F15 shown in Figure 56 is similar to the panel F14 shown in Figure 53 but contains an additional section 8 and the tips of the sections 18.5 and 19.5 are cut away. The carton C15 thus has a triangular cross-

section with three corners cut away. In addition, a handle 80 is attached to the section 8.

It will be easily understood with the aid of what has been described with respect to the Figures 5 to 16 that the cartons C11 to C15 may be produced by wrapping the panels F11 to F15 round mandrels 23 with a form corresponding to the cross-section of the said cartons, this wrapping process being done cooperatively with a pressure plate 42, the profile of which corresponds to that of two, and preferably three, consecutive faces of the said mandrel.



CLAIMS

1. Machine for the fabrication of a carton from a panel (F) of sheet material comprising a series of rectangular or square sections (1-8, 16) connected to each other by a first set of folding lines parallel to each other and a first set of lateral flaps (18.1-18.7) arranged on one side of the said series of sections and connected to the latter by a second set of folding lines perpendicular to the said first set of folding lines and designed to form, at least partially, the bottom of the said carton, the said machine comprising :

- a mandrel (23), the external cross-section of which corresponds to the internal cross-section of the said carton to be produced;
- means (42) to support freely an intermediate section (3) of the said series of sections at least approximately opposite to the matching face (25) of the said mandrel but at some distance from the latter, then to apply the said intermediate section to the said matching face of the mandrel, then to press the said intermediate section against the said matching face, after folding of the adjacent sections to the said intermediate section until the said adjacent sections rest against the said mandrel;
- means for wrapping (60, 61) the said series of sections round the said mandrel;
- means for fixing (51) together the end sections of the said series of sections thus wrapped round the said mandrel;
- means for folding (64-67) the flaps of the said first set against a matching face (41) of the said mandrel; and
- means for fixing (52, 53) the said flaps thus folded to each other,

characterized in that the said mandrel (23) comprises at least five faces and in that the said means of support, application and pressing of the said intermediate section comprise a pressure plate (42) possessing two faces (43, 44) rigidly connected to each other, the first of the said faces matched against the said intermediate section and the second matched against a first section adjacent to the said intermediate section, the said first and second faces of the pressure plate defining a first dihedral angle such that, when the said first face is applied against the said face (25) of the mandrel matching the said intermediate section, the said second face is applied to the face (26) of the said mandrel matched against the adjacent first section, the edge (46) of the said first dihedral angle being then coincident with the



edge (34) of the said mandrel defined by the said corresponding faces of the said mandrel.

2. Machine according to Claim 1, characterized in that the said pressure plate (42) comprises a third face (45) rigidly connected to the first and second section and corresponding to the second section adjacent to the intermediate section, the said first and third faces of the pressure plate defining a second dihedral angle such that, when the said first and second faces are applied against the said faces of the mandrel corresponding to them, the said third face (45) is applied against the face (32) of the mandrel corresponding to the second adjacent section, the edge (47) of the second dihedral angle then being coincident with the edge (33) of the said mandrel defined by the said corresponding faces of the said mandrel.

3. Machine according to any one of the Claims 1 and 2, characterized in that the said means for wrapping the said series of sections round the mandrel include a mobile gear (58) comprising tilting arms (60, 61).

4. Process for the fabrication of carton from a panel of sheet material, comprising a series of rectangular or square sections (1-8, 16) connected to each other by a first set of folding lines parallel to each other and a first set of lateral flaps (18.1-18.7) arranged on one side of the said series of sections and connected to the latter by a second set of folding lines perpendicular to the said first set of folding lines and designed to form, at least partially, the bottom of the said carton, the said process entailing the use of a machine according to any one of the preceding Claims, characterized in that :

- the panel (F1) is brought close to the mandrel (23) so that its section (3) is placed at least approximately opposite the supporting face (25) of the mandrel, the section (3) being separated from the supporting face (25) by a distance d ;
- the sections (2, 1) and the tongue (16), on the one hand, and the sections (4 to 8), on the other are folded, the said section (3) being applied to the supporting face (25) by the intermediary of the pressure plate (42) such that during the application of section, the sections (2,1) and the tongue (16), on the one hand, and the sections (4 to 8), on the other, are supported against the mandrel (23) which creates a lateral guidance effect and positions the section (3) exactly in relation to the supporting face (25)



- the section (3) is pressed between the pressure plate (42) and the mandrel (23) such that the first set of folding lines (10, 11; 9, 12) of the section (3) are respectively superposed exactly on the folding edges (33, 34; 40, 35) of the mandrel;

- when the plate (42) presses the section against the supporting face (25), the panel is wrapped round the mandrel, the sections (1, 5, 6, 7, 8) being applied respectively against the faces of the mandrel (31, 27, 28, 29, 30) and the tongue (16) being folded on to the face (30);

- the flaps (18.1; 18.5) are folded round the edges of the front face (41) of the mandrel (23), then the flaps (18.3, 18.7) are folded round the edges of the front face (41) of the mandrel (23) such that the flaps (18.1, 18.3, 18.5, 18.7) are joined together by gluing.

5. Process according to Claim 4, characterized in that the tongue (16) and the section (8) are joined together by gluing.