

PATENT SPECIFICATION

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(54) METHOD OF MANUFACTURING A HOUSING OF A MAGNETIC-TAPE CASSETTE

(71) We, N.V. PHILIPS' GLOEI-
LAMPENFABRIEKEN, a limited liability
Company, organised and established under
the laws of the Kingdom of the Netherlands,
of Emmasingel 29, Eindhoven, the Nether-
lands do hereby declare the invention, for
which we pray that a patent may be granted
to us, and the method by which it is to be
performed, to be particularly described in and
by the following statement:—

The invention relates to a method of manu-
facturing a housing of a magnetic-tape cassette
for use on a tape recording and/or playback
apparatus, hereinafter referred to as a
"magnetic-tape apparatus". The invention re-
lates particularly to a method of manufactur-
ing a cassette housing made of a plastics ma-
terial and comprising a main part which com-
prises a substantially flat bottom wall formed
with openings for the passage of winding
spindles, cassette-positioning means and a
capstan or capstans of a magnetic-tape
apparatus, and a plurality of side walls pro-
jecting upwardly from the bottom wall at
the periphery thereof, this main housing part
being completely open along one side, or
having a wall at that side in which an open-
ing or openings is or are formed, for the
passage of magnetic-head means of the mag-
netic-tape apparatus or magnetic-head means
and a pressure roller of the apparatus, and
the housing further comprising a lid which
fits on the main housing part and which is
formed with openings for the passage of the
winding spindles, cassette-positioning means
and capstan or capstans of the magnetic-tape
apparatus, the housing also comprising a tape
guide unit which is located within the housing
near said one side of the main housing part
and comprises a plurality of tape guides
which are spaced from one another in a
direction extending along this side of the
main housing part and each of which extends
in a direction perpendicular to the bottom
wall of the main housing part. A cassette
housing of this construction is hereinafter
referred to as "a cassette housing as herein
defined".

The invention is very suitable for manufac-
turing housings of standardized cassettes
(International Electrical Committee publica-
tion 94A) which are commercially available
under the designation "standard cassette",
"Philips cassette" or "Compact Cassette".

Magnetic-tape cassettes are used on a large
scale in magnetic-tape apparatus, both in the
so-called consumer-equipment sector and for
more professional purposes. In the cassette
housing two winding hubs are mounted co-
axially with the openings which are formed
in the cassette housing for the passage of the
winding spindles of a magnetic-tape appara-
tus. On the winding hubs a length of magnetic
tape is wound. As the magnetic tape is un-
wound from one hub and wound onto the
other when the cassette is in use, it passes
along the tape guide unit, so that through
the side of the cassette housing which is open,
or in which openings are formed, magnetic
heads and a pressure roller can be brought
into contact with the magnetic tape.

The quality of a magnetic-tape cassette is
partly determined by the type of magnetic
tape used and furthermore by the accuracy
with which the tape is guided over the mag-
netic head. It is obvious, particularly in the
case of magnetic-tape cassettes employing
high-quality magnetic tape, that care must
be taken that a satisfactory guidance of the
magnetic tape in the cassette is obtained. For
recording signals of high frequencies, for ex-
ample between 15 and 20 kHz, it is necessary
that the magnetic tape runs exactly perpen-
dicularly to the gap in the magnetic head.
A deviation from this ideal orientation of the
tape is professionally referred to as "azimuth
error". An error in the azimuth angle of
between -3 and +3 minutes of arc is in-
evitable with the conventional plastics two-
part cassette housing for cassettes destined
for use in consumer equipment. This compara-
tively large tolerance for the azimuth angle
is associated with and greatly depends on the
method of manufacturing the conventional
plastics cassette housing. When manufacturing
a plastics component with a mould comprising

mould sections, it is necessary that those parts of the component which extend substantially in the direction in which the mould is opened have a certain taper so as to enable the component to be extracted from the mould. This so-called "draft" has an adverse effect on the accuracy of the tape guidance in a magnetic-tape cassette. The azimuth angle tolerance could be reduced substantially if the tape guides were exactly perpendicular to the bottom wall of the main part of the cassette housing and also to the lid of the housing.

German Offenlegungsschrift DT-OS 2 348 994 discloses a cassette housing as herein defined which, in contrast to the conventional cassette housings, consists of three separate parts, namely the main part, the lid and a separately manufactured tape guide unit which is mounted between the bottom wall of the main housing part and the lid. This tape guide unit is manufactured in a mould with a mould section which is movable at right angles to the tape guides. The object of this method is to provide more freedom in respect of the choice of the material from which the tape guide unit can be manufactured. A further object is to improve the tape guidance in comparison with the tape guidance in conventional cassettes by a greater perpendicularity of the tape guides. However, whether a real improvement can be attained in respect of this last point is very doubtful. The separate tape guide unit is mounted in the main housing part with an accuracy which depends on the dimensional tolerances of this housing part and the tape guide unit, and furthermore on assembly tolerances. Moreover, the drafts at the top and bottom of the tape guide unit again result in obliquity of the tape guides relative to the bottom wall of the main housing part and the rigidity of the cassette housing is reduced because it is assembled from three separate parts. With such cassette housings the tolerances in the azimuth angle are therefore likely to increase rather than decrease in comparison with conventional two-part cassettes.

According to the invention there is provided a method of manufacturing a cassette housing as herein defined, wherein the main part of the housing and the tape guide unit are moulded integrally with one another in a mould comprising first and second mould sections of which one is movable relative to the other in a direction perpendicular to the bottom wall of the main housing part between a closed position and an open position, and a third mould section for forming the tape guides of the tape guide unit, the third mould section being slidably mounted on one of the first and second mould sections so as to be movable relative to both of these sections between an operative position and a release position in a direction perpendicular to the direction of relative movement between the

first and second mould sections.

With the method according to the invention it is possible to manufacture cassette housings with azimuth angle tolerances having values of approximately 1 minute of arc, so that the cassette housing in combination with a high-quality magnetic tape is suitable for the faithful recording and playing-back of signals with frequencies ranging between 15 and 20 kHz.

A cassette housing manufactured by the method according to the invention, just like conventional cassette housings, comprises only two separate parts. Nevertheless, the tape guides can be made exactly perpendicular to the bottom wall of the main part of the housing. In order to maintain this desired correct position of the tape guides it is important that the main housing part can be given a high rigidity. This is achieved by forming the tape guide unit integrally with the main housing part. The rigidity of the cassette housing can obviously be improved further by a suitable choice of the plastics material used for the housing. This material can be, for example, a thermo-setting plastic or another stable plastic, for example, an acrylonitrile reinforced with glass fibres or glass pellets, instead of the usual polystyrol.

The use of a third mould section in a mould which is used for manufacturing a part of a cassette housing is known *per se* from the manufacture of so-called professional cassettes or digital cassettes. Such cassettes have already been marketed since 1971 (for example, by Philips under the designation LGH 6003 or LGH 6005) and mainly consist of a metal frame which contains the tape guide unit and forms the side walls of the cassette housing, and two thin plastics covers which are mounted on opposite sides of the metal frame. Like the main housing part of a cassette housing manufactured in accordance with the invention the metal frame is manufactured with the aid of a composite mould with a movable third mould section. As a result of this the so-called professional cassettes also provide correct tape guidance owing to a small tolerance in respect of the azimuth angle. Moreover, they have a high rigidity. This rigidity almost entirely depends on the high rigidity of the metal frame and to a much smaller extent on the comparatively thin and readily deformable plastics covers. However, the professional cassettes are less suitable for use in consumer equipment. In a cassette for use in consumer equipment it is necessary that in the rear wall of the cassette housing, which is the side wall situated opposite the side of the cassette housing which is open, or in which openings are formed, local openings can be formed which function as code openings. With the aid of sensors mounted in the consumer equipment, important information about the cassette can be

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detected by the equipment itself. Thus, it is possible, for example, to indicate by means of code openings whether the cassette is or is not provided with a programme which should not be erased inadvertently by the user, and furthermore what type of magnetic tape is used in the cassette. This last-mentioned indication is of importance in view of the differences in magnetic properties of the various types of magnetic tape which are used, which demand an adaptation of the electrical parameters in the magnetic-tape apparatus. In the case of professional magnetic-tape cassettes, such openings cannot readily be formed in the rear wall of the cassette housing. This is because such openings would lead to an impermissible local reduction in strength of the metal frame and might even impair its structure.

In order that the invention may be readily carried into effect, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a perspective view of a cassette housing manufactured by the method according to the invention,

Fig. 2 is a view similar to Fig. 1 but with the lid removed and turned upside down, and

Fig. 3 is a schematic perspective view of parts of a mould used in the injection-moulding of the main part of the cassette housing shown in Figs. 1 and 2.

The cassette housing 1 shown in Figure 1 is of rectangular form and comprises a main part 2 and a lid 3 which fits on the part 2 and is secured thereto by screws 4. The part 2, as can be seen in Fig. 2, comprises a substantially flat bottom wall 5 in which openings 6 are formed for the passage of the winding spindles of a magnetic-tape apparatus. The bottom wall 5 is also formed with openings 7 for the passage of means on the apparatus for positioning the cassette, and openings 8 for the passage of a capstan. Projecting upwardly from the bottom wall 5 at the periphery thereof and formed integrally therewith are a right-hand side wall 9, a left-hand side wall 10 and a side wall 11 which is referred to as "the rear wall". Opposite the rear wall 11 is a side wall 12 which is referred to as "the front wall" and in which is formed an opening which extends over practically the entire length of the wall 12 so that the part 2 of the housing is almost completely open at the front side for the passage of magnetic heads and a pressure roller on the magnetic-tape apparatus. In the lid 3 are formed openings 13 which correspond to the openings 6 in the housing part 2, openings 14 which correspond to the openings 8, and openings 15 which correspond in position to the openings 7 but which, for a reason to be explained later herein, have a form which differs from that of the openings 7.

Near the front wall 12 of the housing part 2 a tape guide unit 16 is situated. This unit extends generally in a direction parallel to the front wall 12 and has a height which corresponds to the local distance between the bottom wall 5 and the lid 3 in the assembled condition (Fig. 1). The tape guide unit has a comparatively complex structure and performs several functions. For guiding a magnetic tape the unit 16 comprises a plurality of tape guides which extend upwardly from the bottom wall 5 at right angles thereto and are formed integrally with this wall and which include two tape guides 17 located at the ends of the unit 16, and further tape guides 18, 19 and 26. The tape guides 19 have a rounded shape and are disposed on opposite sides of a recess 20 which, when the cassette is fitted on a magnetic-tape apparatus, receives the magnetic recording and/or playback head of the apparatus. In this space the usual means can be provided for co-operation with the magnetic head, namely, a resilient bracket with a pressure pad and a mu-metal screening bracket. These components are not shown in the drawings since they do not form part of the cassette housing and they are also employed in conventional cassettes.

Two pins 21 which are disposed perpendicularly to the bottom wall 5 and are formed integrally therewith serve as bearing spindles for two conventional tape guide rollers (not shown). In the rear wall 11 two thin portions 22 are provided which can be readily broken off by the user to leave two code openings through which a sensor of a magnetic-tape apparatus can pass to detect whether the cassette contains a prerecorded tape which should not be erased inadvertently.

At the front edge of the lid 3 are formed a number of lugs 23, 24 and 25 which, when the lid is mounted on the housing part 2, partly close the almost completely open front side of the housing so as to give some protection to a magnetic tape in the housing. When the cassette is assembled the magnetic tape is wound on two winding hubs (not shown) of conventional form which are mounted rotatably in the cassette housing coaxially with the openings 6 and 13 respectively. As the magnetic tape runs from one hub to the other, it passes in front of the tape guide unit 16. Both the part 2 of the cassette housing and the lid 3 have a rectangular opening 27, 28 respectively in which is secured with adhesive a transparent window through which can be seen parts of the tape wound on the two hubs.

The general construction of the cassette housing is almost completely conventional, so that it is assumed that the brief description given so far will suffice. The main housing part 2, the lid 3 and the tape guide unit 16, for example, are very similar to those known from the previously mentioned German Offen-

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legungsschrift DT—OS 2 348 994. However, there is an essential difference in that the tape guide unit 16 is integral with the housing part 2. The exactness of the perpendicularity of the tape guides 17, 18, 19 and 26 relative to the bottom wall 5 of the housing part 2 therefore depends entirely on the moulds used for the manufacture of the housing part 2 and cannot be adversely affected by subsequent mounting and assembly operations. Furthermore, as the tape guide unit 16 is integral with the housing part 2, it stiffens this part, which consequently has a high rigidity despite the existence of the very large openings in its front wall 12. The rigidity of the housing part 2 is further increased by internal stiffening webs 29 and stiffening member 30. It is possible to form local openings in the rear wall 11 of the housing part 2 at locations 31 for signalling the presence of, for example, chromium-dioxide magnetic tape in the cassette housing. Neither these openings nor openings formed at other locations in the rear wall 11 significantly affect the rigidity and strength of the housing part 2, because the rear wall 11 is integral with the bottom wall 5. The high rigidity of the housing part 2 relative to the lid 3, which rigidity can be further increased by a suitable choice of the material of the housing, makes it beneficial to provide the tape guide unit 16 with cassette-positioning members 32 which face away from the bottom wall 5. These members have openings 33, corresponding to the openings 7, for the passage of the cassette-positioning means on the magnetic-tape apparatus. When the cassette housing is assembled, the cassette-positioning members 32 pass through the openings 15 in the lid 3, as shown in Fig. 1. When the cassette is placed on a magnetic-tape apparatus with the lid 3 facing the apparatus, the cassette-positioning means of the apparatus will co-operate with the cassette-positioning members 32 and thus with the main part 2 of the cassette housing. The position of the cassette housing relative to the cassette-positioning means is therefore always determined by the more rigid part of the housing. (In Fig. 1 the amount by which the cassette-positioning members 32 project beyond the lid 3 has been slightly exaggerated). This step is known *per se* and is also used in, for example, the previously discussed digital and professional cassette with a metal framework.

Fig. 3 illustrates the manufacture of the housing part 2 in a mould. This figure is schematic and the parts of the mould shown do not represent the actual appearance of a mould as used in practice, because this is not considered necessary in the scope of the pre-

sent description. Figure 3 shows a first, lower mould section 34. A second, upper mould section (not shown) is movable relative to the lower mould section in a direction indicated by an arrow A. A third, sliding mould section 35 is mounted on the lower mould section 34 so as to be slidable between an operative, moulding position, shown in Fig. 3 and a retracted release position. The direction of movement of the sliding mould section 35 is indicated by a double-headed arrow B. Fig. 3 shows a situation in which the mould is open, the upper mould section having been moved away from the lower mould section 34 in the direction A, whilst the sliding mould section 35, which forms the tape guides 17, 18, 19 and 26, is still in its operative position. A cassette housing part 2 which has just been formed in the mould is shown still lying in the lower mould section 34. By accurate guidance of the sliding mould section 35 on the lower mould section 34, and by appropriate design of the profiled moulding face of the sliding mould section, an exact perpendicularity of the tape guides of the tape guide unit 16 relative to the bottom wall 5 of the housing part 2 can be obtained.

WHAT WE CLAIM IS:—

1. A method of manufacturing a cassette housing as herein defined, wherein the main part of the housing and the tape guide unit are moulded integrally with one another in a composite mould comprising first and second mould sections of which one is movable relative to the other in a direction perpendicular to the bottom wall of the main housing part between a closed position and an open position, and a third mould section for forming the tape guides of the tape guide unit, the third mould section being slidably mounted on one of the first and second mould sections so as to be movable relative to both of these sections between an operative position and a release position in a direction perpendicular to the direction of relative movement between the first and second mould sections.
2. A method of manufacturing a cassette housing, substantially as herein described with reference to the accompanying drawings.
3. A cassette housing manufactured in accordance with the method claimed in Claim 1 or 2.

R. J. BOXALL,
Chartered Patent Agent,
Berkshire House,
168—173 High Holborn,
London, WC1V 7AQ,
Agent for the Applicants.



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1. A method of manufacturing a cassette housing as herein defined, wherein the main part of the housing and the tape guide unit are moulded integrally with one another in a composite mould comprising first and second mould sections of which one is movable relative to the other in a direction perpendicular to the bottom wall of the main housing part between a closed position and an open position, and a third mould section for forming the tape guides of the tape guide unit, the third mould section being slidably mounted on one of the first and second mould sections so as to be movable relative to both of these sections between an operative position and a release position in a direction perpendicular to the direction of relative movement between the first and second mould sections.
2. A method of manufacturing a cassette housing, substantially as herein described with reference to the accompanying drawings.
3. A cassette housing manufactured in accordance with the method claimed in Claim 1 or 2.

R. J. BOXALL,
Chartered Patent Agent,
Berkshire House,
168—173 High Holborn,
London, WC1V 7AQ,
Agent for the Applicants.