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(54) **Title**: DEVICE FOR ROUNDING OFF THE LONGITUDINAL EDGES OF HEAVY CLAY PRODUCTS DURING THE PRODUCTION PHASE PARTICULARLY, BUT NOT EXCLUSIVELY, FOR EXTRUDED BENT TILES

(57) **Abstract**: Device for rounding off the longitudinal edges of heavy clay products during the production phase, particularly, but not exclusively, for extruded bent tiles. It includes profiling tools having a curved contact surface, which is a replica of the rounded edge surface that has to be obtained on the final product and also a flat or curved cutting surface that intersects the first one creating a curved cutting edge. Such tools also have a grove, almost parallel to the cutting wire, by which the cutting wire passes inside. To keep the correct working position, the tools lean against the processed element, with a certain adjustable pressure, by means of a force-controlled driving system. The driving system can either be a fluid powered or mechanic or electronic system.

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Title: DEVICE FOR ROUNDING OFF THE LONGITUDINAL EDGES OF HEAVY CLAY PRODUCTS DURING THE PRODUCTION PHASE PARTICULARLY, BUT NOT EXCLUSIVELY, FOR EXTRUDED BENT TILES.

Description.

The present invention relates to a mechanical device for rounding off the longitudinal edges of heavy clay products during the production phase particularly, but not exclusively, for extruded bent tiles and that differs from the known device reported on the document GB 03456 A A.D. 1912 (HEATON JAMES) 3 October 1912, page 5 lines 1-5 and figure 7, lines 6-8 e figure 6.

Table 1 shows figures 1, 2, 3, 4 and 5.

Figure 1 is a perspective view of a bent tile while figure 2 is a front view of the same element. Both are used here to explain the problem that is to be solved by the present invention.

Figure 3 is a partial perspective view of a bent tile that has been chamfered along its longitudinal edges while figure 4 is a front view of the same element.

Figure 5 is a front view of a bent tile that has been chamfered along its longitudinal edges in a slightly different way.

Figures 3, 4 and 5 are used here to describe the state of the art of the existing solutions.

Table 2 includes figures 6 and 7.

Figure 6 illustrates a front view and a perspective view of the invented device as it may appear when fitted on a cutting machine.

Figure 7 illustrates two more perspective views of the invented device.

Figures 6 and 7 are used here to describe the device itself and its working principle.

Table 3 includes figure 8, which illustrates 4 orthogonal views and 3 perspective views of the cutting tool of the invented device.

The production process of extruded clay elements for roofing, which are commonly called bent tiles, includes the phases of extrusion, cutting of the pasty clay, drying, firing and then packaging of the final product. In the first phase the raw clay is prepared and mixed with water to form a pasty material, with the desired moisture level, that is forced through a die by an extruder. As this process runs continuously a clay slug, coming out the die and being carried forward by a conveyor belt, is produced. Depending upon of the configuration of the die, the cutting machine and the handling plant, a production process with 1, 2, 3, 4 or more exits can be set up, where each exit provides a cross section of tile to be cut.

The description that follows refers to each one of those exits, independently of their actual number.

The shaped slug is carried forward to the cutting machine where the tiles elements, of the desired dimension and shape, are generated by means of flying cut operations. After exiting the cutting machine, tiles are picked up by handling devices and transferred to the drying section, while the waste part of the slug is conveyed back to the extruder and recycled

When cutting is performed by wires, sharp edges are created in correspondence of the bottom resting surface of the tile (1). While the inner longitudinal edges (2) show, referring to the cross-section, obtuse angles, the outer edges (3) show acute angles that give rise to problems. Because of their brittleness, chipping of the outer edge may occur, either after the drying phase when the product is handled for loading on to kiln cars or after the firing phase when the product is handled for packaging. These chipped edges result both in lower aesthetic quality of the product and in health and safety issues. Outer chipped edges may indeed be sharp and cause skin abrasions or tiny cuts during manual handling operations.

The innovative device described here has been designed to be fitted on cutting machines, which use wires as cutting tools, to remove the outer sharp edges and replace them with rounded borders.

To solve the same problem, two different solutions are be found in existing cutting machines. The first solution is found in machines that use wires for cutting the bottom surfaces of the tiles and consists of two steel knives that, working nearby the cutting wire, chamfer the outer edges. In this case each sharp edge is replaced by a chamfer, (4) and (5), that is almost perpendicular to the bottom surfaces. The second solution is to cut out the bottom surfaces by the use of a pair of symmetric steel tools instead of a wire. Each tool consists of a piece of extruded, circular or rectangular, thick wire that has been curved in a hook-shaped way. The use of such tools allows the obtaining of bottom surfaces that are round-shaped along the whole width or just along the external part, according to the geometry of the tools. An example is given in figure 5. In this case risks of chipping are reduced because the outer edges are no longer acute and also out above the resting plane.

In both existing solutions the chamfering tools are driven during the cutting operation to follow the outer surface of the bent tile and obtain the desired result. Anyway, In both solutions the existing automation system always performs a position-controlled movement of the tools, regardless of the actual relative position of the slug. What frequently happens is that, either because of tools wear or due to transversal shifts of the slug, the final result is not as expected. In particular, if a transversal shift of the slug takes place, an asymmetric chamfering of the tile is likely to result, forcing the machine operator to tune up the device once more.

The innovative device here described (6) has been designed to be fitted on the travelling unit (7) of machines that cuts the bottom surfaces of the bent tile by means of wires.

The device includes, for each exit of the extrusion process, a pair of moving tools whose geometrical shape has been purpose designed (8). The tools are symmetrical to each other with respect to the symmetry plane of the tile. Each tool is fixed at its toll-holder bar (9) that is, in turn, fitted on to a linear slider (10). Given that, each tool has just one degree of freedom that is translation along horizontal axis and thus perpendicular to the feed direction of the slug and parallel to the cutting wire. The tool is driven by a linear actuator (11) acting in force-controlled mode. The actuator can

either be a fluid-powered cylinder, liquid or gas, or an electro-mechanic or electronic device.

The innovation of the present device consists in its working principle, made possible by both the purpose-designed geometry, see figure 8, and the driving mode of the tool. In its working configuration the device is fitted on the cutting machine and tuned up in such a way that:

- the frame of the device is fixed to the supporting frame of the wire, so then it follows the rigid body motion of the cutting wire;
- the tools can move parallel to the cutting wire;
- the cutting wire passes inside the purpose-made grove of the tools (12);
- the working surfaces (13) and the cutting edges of the tool (14) are placed upstream the wire with regard to the slug feeding direction.

In their rest position actuators keep tools opened, that is they stay off the slug and do not interact with it. When the cutting machine starts cutting the bottom surfaces of the tile, actuators are powered to drive tools towards the slug. Each tool penetrates the slug, which has a defined range of plasticity, until it stops when its wide purpose-made contact surface (15) leans against the outer surface of the slug. By means of both the wide contact surface and the controlled force applied by the actuator, each tool is pushed against the outer surface of the slug with the desired pressure.

As the phase of cutting the bottom surfaces of the tile proceeds ahead, each tool slides along the outer surface of the slug while remaining upstream the wire. At the same time the cutting edge of the tool (14) engraves the slug right where the wire is to cut the bottom surface of the tile. In this way the desired rounded border is created.

Due to the purpose-made shape of the lower working surface (13) of the tool, clay is cut off only from the upper part of the slug, where the tile is to be created, and is pushed downwards to the waste part of the slug. In other words the tool operates as a "plough".

As soon as the phase of cutting the bottom surfaces of the tiles terminates, actuators are powered to reverse and tools are driven off the slug.

Because the cutting wire is always downstream and, in particular, bound behind the profiling tool in correspondence of the outer edge of the tile, the clay being cut off by

the tool from the upper part of the slug always remains stuck to the lower portion of the slug, which is the waste.

The innovative advantages of the device are as follows:

- The device is self adjusting, that is it is intrinsically able to drive tools to follow the surface that has to be worked, regardless of the wear of tools and/or small transversal shifts of the slug. Therefore the device allows to obtain consistent profiling operations all along the tile length and among all the produced tiles;
- It makes it possible to create, thanks to its working principle and the purpose-made geometry of the tool, rounded longitudinal edges of the bent tile that are also connected smoothly to the outer surface. This brings both a nice aesthetic effect and a much safer condition for manual handling of tiles.
- It operates the profiling of the outer edges of the tile in such a way that the chip of clay, which is being cut off, always remains stuck to the lower part of the slug, therefore avoiding the formation of free clay chips which may negatively impact the quality of the product.

CLAIMS

1. Device for rounding off the longitudinal edges of heavy clay products during the production phase particularly, but not exclusively, of extruded bent tiles characterized by profiling tools (8) that:
   I. have a curved contact surface (15) which is a replica of the rounded surface that is to be obtained on the final product, and have a cutting surface (13), which may be flat or curved, that intersects the first one creating a curved cutting edge (14), and also have a grove (12) almost parallel to the cutting wire and by which the cutting wire passes inside;
   II. to keep the correct working position the tools lean against the processed slug with a certain adjustable pressure by means of their curved contact surface (15) and of a force-controlled driving system, while they engrave the target surface cutting off a clay chip.
2. Device for rounding off the longitudinal edges of heavy clay products, according to claim N. 1, characterized by the fact that the force-controlled actuator driving the tool can be either a liquid fluid powered device or a gas fluid powered device or a mechanical or electronic system.
3. Device for rounding off the longitudinal edges of heavy clay products, according to claim N. 1, characterized by the fact that the profiling tools (8) can either be made up of plain carbon steel, stainless steel, high speed steel, metallic carbides, ceramic materials or any other wear resistant material.
4. Device for rounding off the longitudinal edges of heavy clay products, according to claim N. 1, characterized by the fact that it includes profiling tools (8) with the geometrical shape to obtain longitudinal rounded surfaces that are connected smoothly to the outer surface of the processed element.
5. Device for the rounding out of the longitudinal edges of bent tiles, according to all the previous claims, characterized by the fact that the profiling tool (8) has the geometrical configuration in which the cutting edge(14) and the cutting surface (13) are shaped and positioned in the way that the clay that is being cut off from the tile during profiling always remains stuck to the lower part of the slug.

TABLE 1

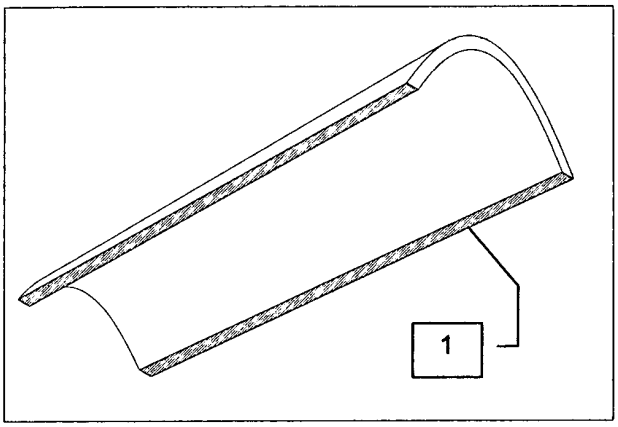

FIGURE 1

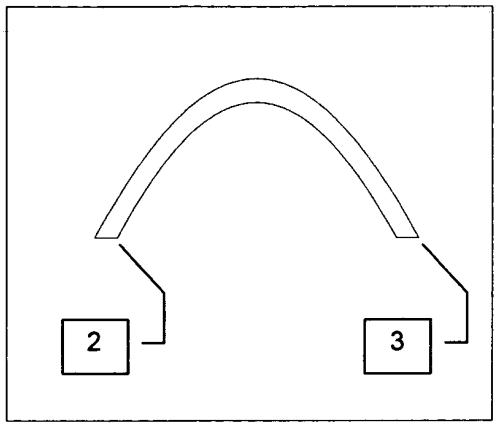

FIGURE 2

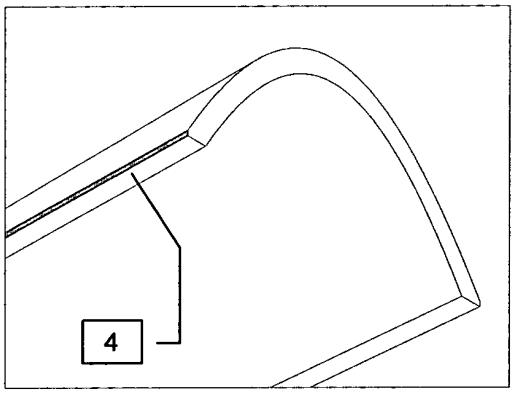

FIGURE 3

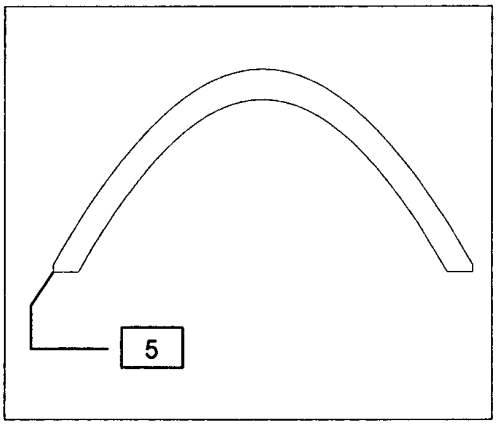

FIGURE 4

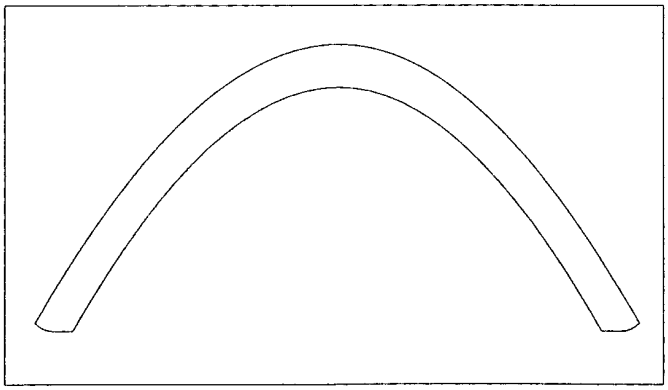

FIGURE 5

TABLE 2

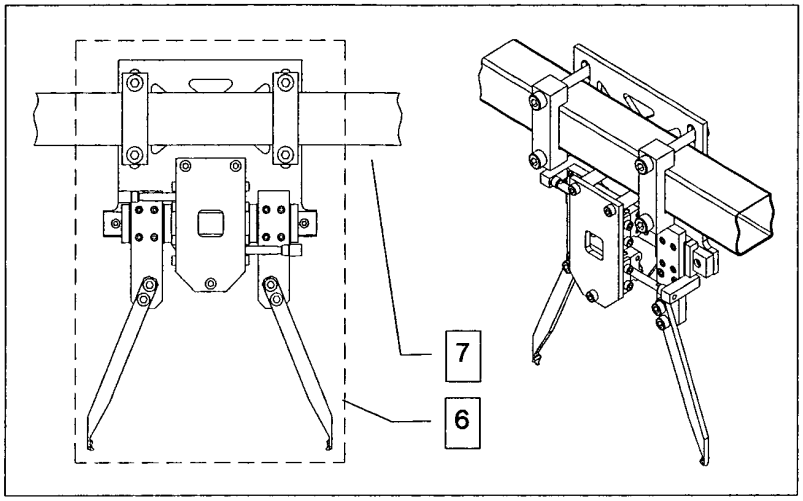

FIGURE 6

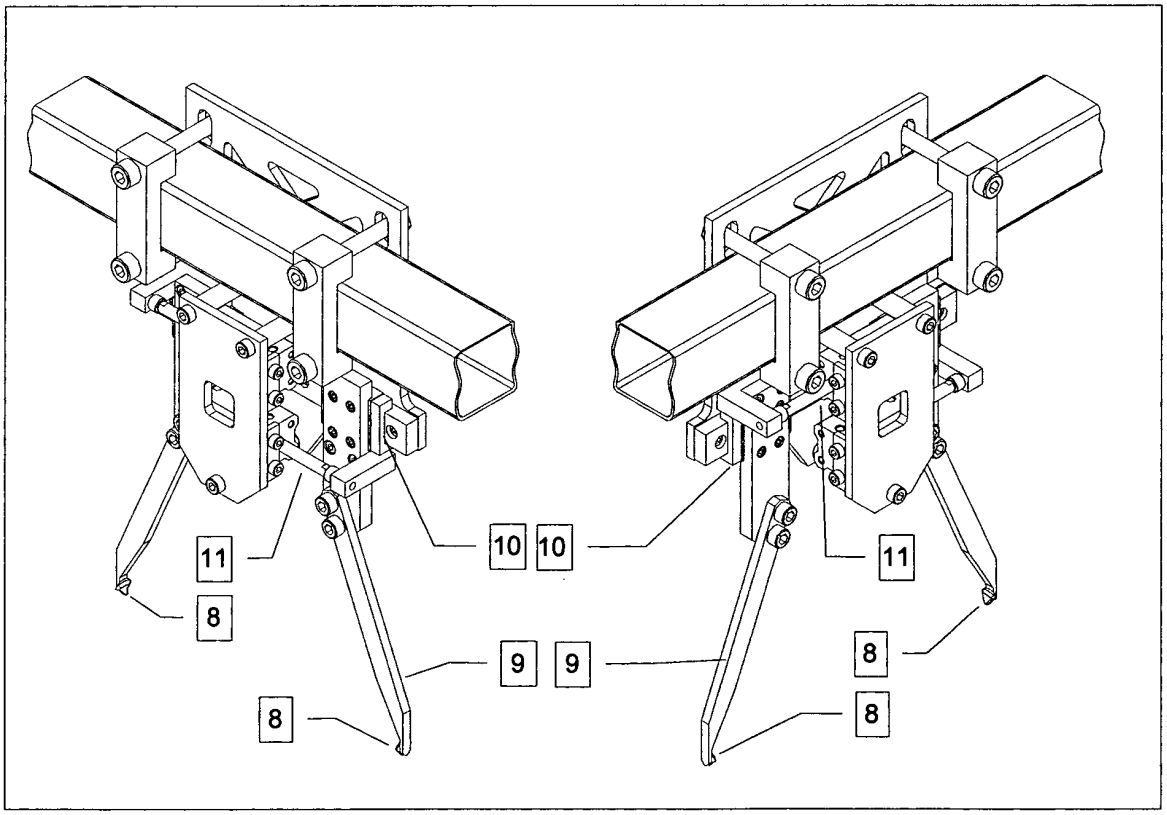

FIGURE 7

TABLE 3

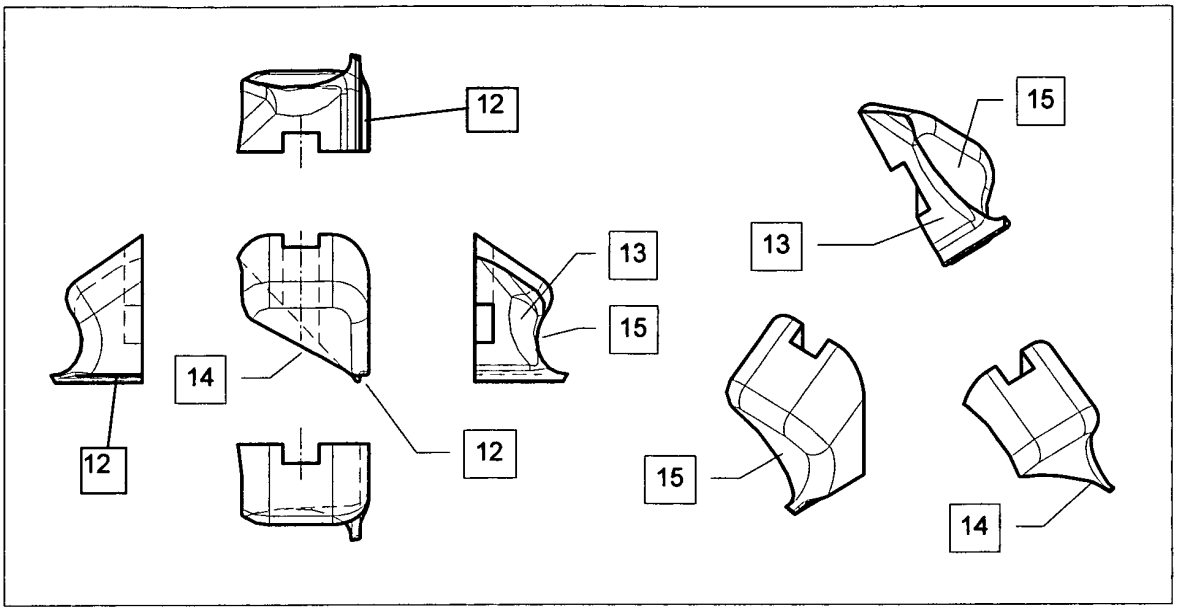

FIGURE 8