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Aleksandar et al.

[11] **3,831,251**

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[54] **MACHINE FOR PRODUCTION OF HIGH VOLTAGE FUSES WITHOUT INSULATING CHAPLET AND WITH MELTING ELEMENTS OF DIFFERENT CROSS SECTION**

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[52] **U.S. Cl.** ..... **29/203 R**

[51] **Int. Cl.** **H05k 13/00**

[58] **Field of Search** ... 29/203 R, 203 P, 622, 203 D

[56] **References Cited**

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[57] **ABSTRACT**

A machine for production of high voltage fuses without holders for the fuse elements comprising a clamping device for supporting a hollow fuse body below a hopper which is adapted for introducing sand into the fuse body. A platform supports the hopper and is adapted for raising and lowering the hopper so as to introduce and retract the same into and from the fuse body. Melting material which is to form the fuse element is coiled into the fuse body and the fuse body is filled with sand which is compacted therein around the coiled melting material. As a consequence, the melting material is supported within the fuse body in the sand without need for a holder for the fuse element.

9 Claims, 2 Drawing Figures

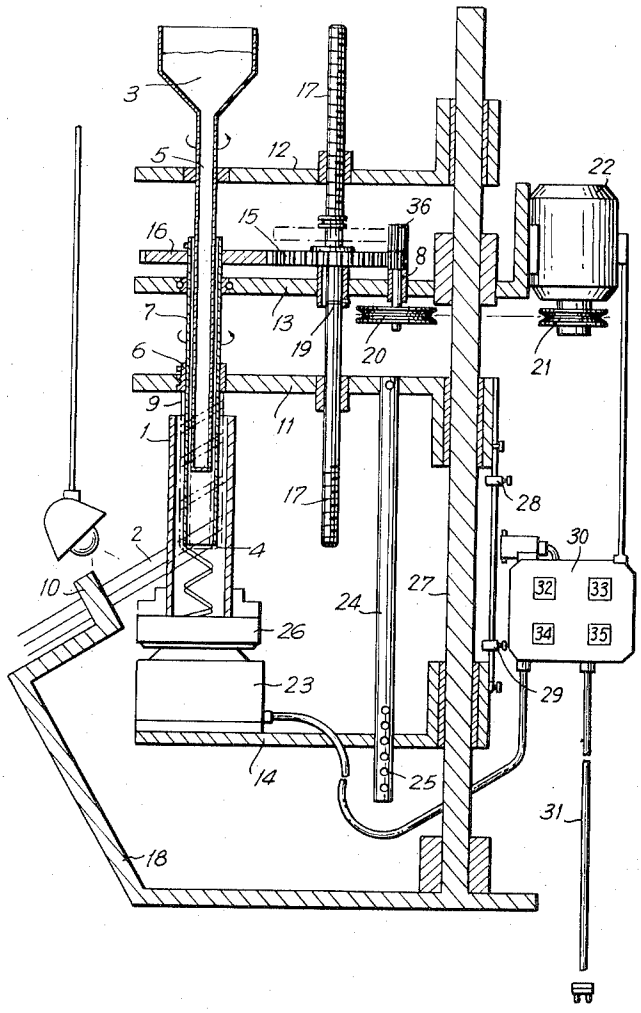

FIG. 1

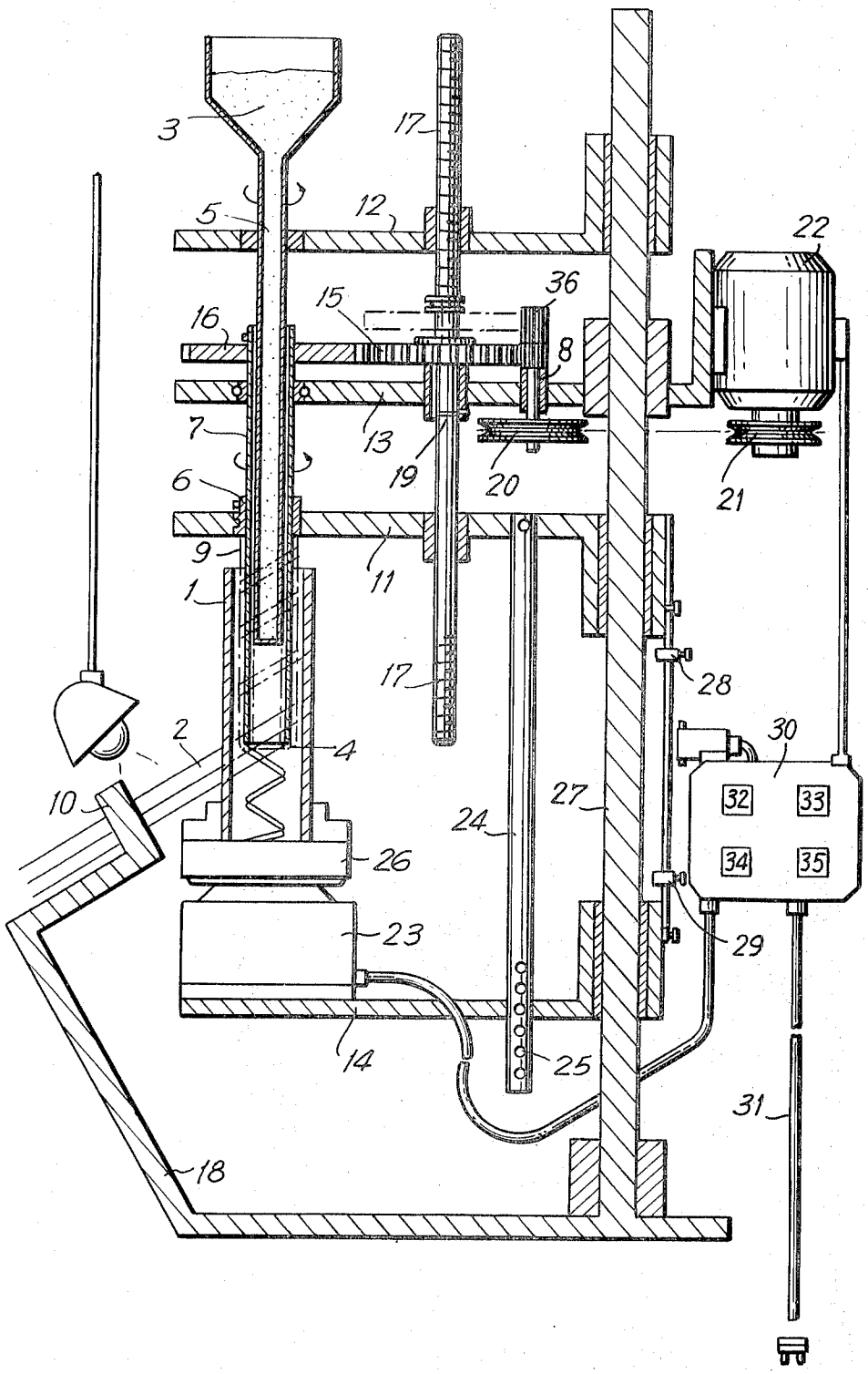
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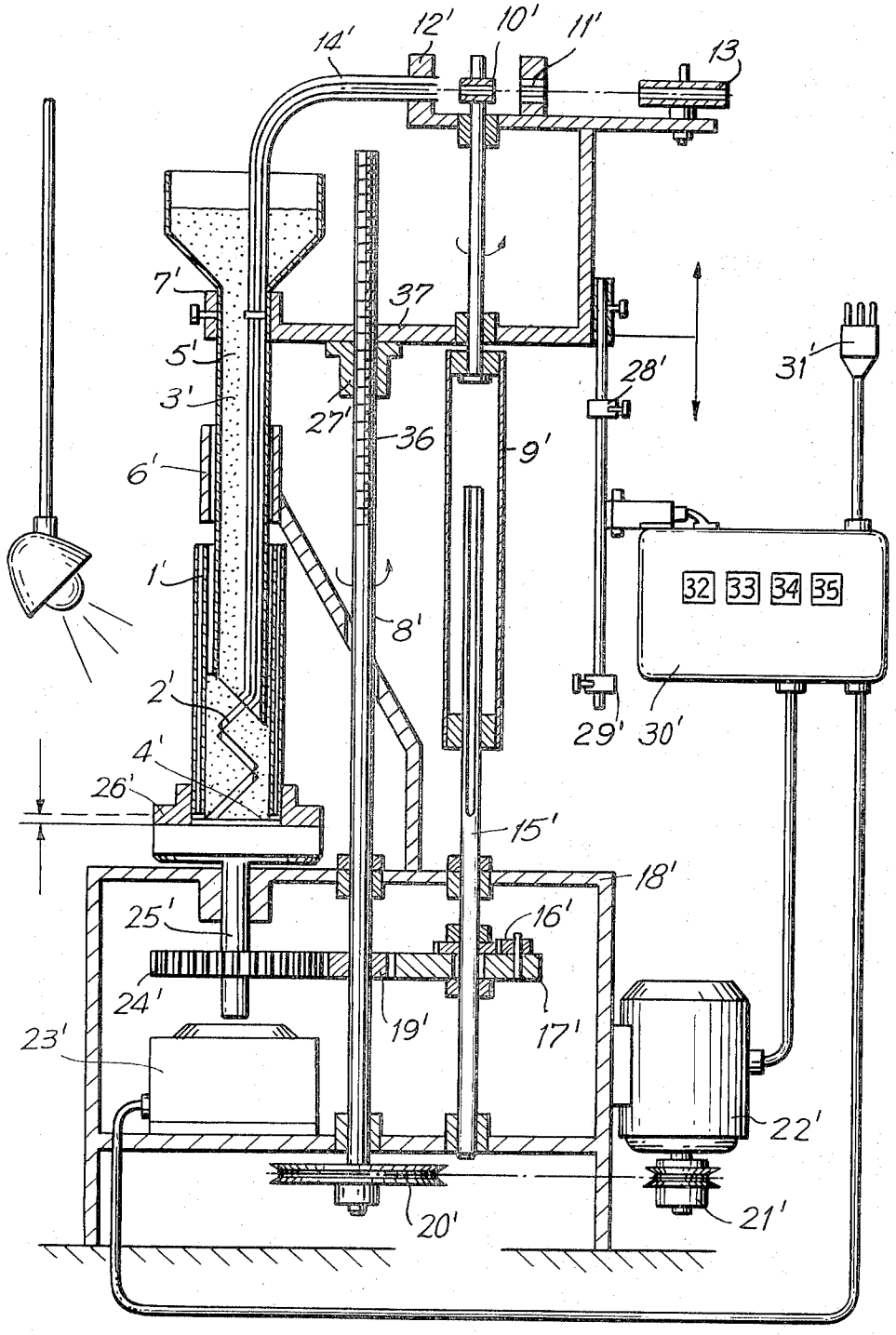
FIG.2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MACHINE FOR PRODUCTION OF HIGH VOLTAGE FUSES WITHOUT INSULATING CHAPLET AND WITH MELTING ELEMENTS OF DIFFERENT CROSS SECTION

BACKGROUND AND NATURE OF THE INVENTION

The melting or fuse elements in conventional high voltage fuses are maintained in chaplets or holders, each in the shape of a cross or star, so that material filling the fuses may surround the melting elements as extensively as possible. It would be ideal if these elements could be retained without chaplets and could, for example, be axial spirals; but this can generally not be achieved because of the material as well as of the shape of the melting elements, which are not self-supporting.

In theory, fuses without chaplets are ideal as the whole medium is used for arc quenching. During efficiency tests with fuses produced according to the invention, this was confirmed. An overvoltage problem was solved by mixing quartz sand constituents of different granule sizes.

High voltage fuses without star chaplets have heretofore been produced in the laboratory, but all former attempts to industrialize the production of such fuses were unsuccessful, as the assembling was insecure and it was impossible to control the layout of wires inside the cartridge.

The machine according to the invention represents the first instance of industrialized production of high voltage fuses without chaplets.

The new high voltage fuse melting elements can be either of round cross section, in the form of spiral wire, or can be a slab in cross section. Two different types of the new machines for production of high voltage fuses without chaplets are exemplified depending on the chosen form of the melting element. One machine is shown in FIG. **1** where the melting element is a perforated strip; another type is shown in FIG. **2**, where the melting element is a wire.

The construction is principally based on perforated laminas, which are preferred mainly for higher power fuses. Another reason for using perforated laminas is that overvoltage cannot be affected by the variation of the round wire cross section.

In the drawing:

FIG. **1** is a vertical sectional sideview of a first embodiment of this invention; and

FIG. **2** is a similar view of a second embodiment.

Reference will first be made to FIG. **1**.

In order to form spirals of melting lamina strips to provide fuses, the following steps are taken: clamping a strip to a socket, rotating the pipe with reticular socket pipe and transporting laminas. After completing of the spirals, the fuse is mounted, sand is poured into it at the same time the spiral is wound from the socket, and the sand is rammed by vibration without rotation.

A preferred machine for such production of fuses, with slab melting elements, according to the invention, is shown in FIG. **1**. The machine comprises a base **18** with a post **27** having slidably positioned thereon a platform **12** rigidly supporting a hopper **5**. A platform **13** is slidably mounted on post **27** and supports a shaft **8**

adapted for driving a vertical spindle **19** rotatably mounted on platform **13**, the shaft being driven by electromotor **22** through pulley system **20, 21**. Post **27** also slidably supports a platform **11** which supports a socket **6** for a vertical pipe **7** slidably mounted in platform **13**. Secured to platform **11** is a vertical rod **24** with holes **25** for adjusting the height of platform **11** relative to a platform **14**. The platform **14** supports a vibrator **23** below hopper **5** and socket **6** and the platform **14** is provided with a clamp **26** having a fuse **1** positioned thereon.

Vibrator **23** and electromotor **22** are connected via a switch panel **30** for different operating conditions **32, 33, 34, 35**, as is known to those skilled in the art. The switch panel has a power cord **31**.

On the base **18** is also placed a conveyor **10** for transporting melting laminas **2**, made from coils connected to socket **6** joined with network connecting pieces **9**. Driving the winding of a coil, pipe **7** is inserted therein and hopper **5** is inside pipe **7**; for transporting a laminar coil, by the conveyor, pipe **7** is retracted from the coil. For transporting the coil by the conveyor, downward vertical motions of platforms **11, 14** is effected, while platform **12** is raised. In order to obtain these relative motions, one half of the spindle length, in regions **17**, has a right hand thread and the other spindle half has a left hand thread for raising and lowering platforms **12, 11**, respectively, and for uncoupling, by the raising of platform **12**, a gear wheel **15** fixed to platform **12** from a gear wheel **16** on pipe **7** and from a pinion **36** on the shaft **8**. The movement of platform **11** is limited by stops **28** and **29**.

The machine operates in the following manner:

Initially, platform **12** and hopper **5** are maximally raised whereas platform **11** is maximally lowered to the edge **4** of pipe **7**. In that position the network connecting piece **9** is inside the pipe **7**. The end of a melting lamina **2**, transported from the coils by the conveyor **10**, is then connected to the socket **6**. By operating the motor **22**, the hopper **5** on platform **11** moves downwardly and the platform **11** upwardly; the hopper **5**, pipe **7**, socket **6** and network connecting piece **9** being at the same time rotated, thus causing the winding of the spiral on the network connecting piece **9** which is now pulled over the pipe **7**. When a spiral has been wound along the length of the connecting piece **9**, the operation of the motor is stopped, for example by a conventional limit switch (not shown).

Laminas are removed from the coils and their ends are connected to the end of the network connecting piece **9**, as by gluing, cementing or soldering; then the vibrator **23** with clamp **26** is moved aside and the fuse **1** is pulled over pipe **7** and the network connecting piece **9**. Vibrator **23** is then returned to the starting point and the fuse is fixed thereto, to the bottom of which having been previously connected the ends of the laminas, which have been connected to the network connecting piece. The hopper is then filled with a defined amount of sand **3**, which is sufficient for one charge of the fuse. Gear wheel **15** is moved into an upper position, so that it is disengaged from the gear wheel **16**, and thus the rotation is stopped.

The vibrator is then switched on; vibrator **23** and platforms **11** and **14** begin to move downwardly, and platform **12** with hopper **5** upwardly. The hopper retracts the network connecting piece **9** and the spirals of melting elements **2** slip down into the sand so as to be

dug therein and rammed in place. When the hopper reaches its upper position, the filling of the fuse is completed and the latter is removed and sent for further mounting.

For forming fuses with melting wire spirals, the following steps are required: fixing the wires to an indicator, rotating the fuse, transporting the wires for the fuse, and charging and ramming the sand into the fuse. For the first step it is necessary to have free space for stretching the spiral wire by hand for fixing the spiral to an indicator. Accordingly, sufficient working space and visibility are needed to enable workers to work in normal positions using the required tools.

The indicator wire should set the indicator spring free, during a short-circuit; in view of which the wire has to be stretched. This construction is based on the fact that the indicator wire will be used by the arc along its length.

In order to obtain melting element spirals in the fuses with proper geometric form and sufficiently stretched in the rammed sand, the rotating of the fuse, the transporting of the wire, charging and ramming of the sand are critically dependent upon the operations and working sequences, described hereinafter.

The fuse turns once for each screw pitch. For this ratio, wire of properly defined length, which forms an axial spiral of given diameter, is charged by the conveyor.

Driving of the wire pinch rolls is adjusted so that, during idle operation (back pull), when the platform moves downwardly, these rolls do not transport the wire, which means that it is necessary to enable the driving of the wire transport to be automatically divided at this moment, by cogged gears, Technically the most critical question resides in the problem of wire charging and discharging, as silver wire of 0.08 to 0.3 mm diameter is to be forced or guided through a pipe of predetermined clearance, length and curvatures. The problem of charging and discharging the wire is solved by suitably chosen pinch rolls and guides. Sand charging is provided by the hopper unit, which is charged with the amount of sand sufficient for filling one fuse. Changes in the size of the sand granules do not affect the discharging and charging characteristics of the sand to any appreciable extent.

The machine according to FIG. 2 is provided so as to satisfy all the above mentioned requirements. The unit below the lower fuse top transmits the vibrations from the vibrator to the fuse; at the same time it rotates together with the fuse during the filling. The elements of the fuse coming from the indicator side are previously positioned on this unit. Pivotable linkage between the fuse and this unit is obtained by admission of the fuse screw top into this unit. The construction of this embodiment of the machine is such that these basic requirements are realized, regarding the filling of the high voltage fuses, according to the previously given melting wire spiral layout in the fuse, as: stretching the fuse device in auxiliary processes in connection with mounting the indicator; connecting the melting wires on one side and the other; vibration of the fuse during rotation without transmitting the vibrations to the device frame and the rest of the mechanism; rotation of the fuse in the corresponding direction and by the corresponding speed; subsequent filling of the fuse with the sand during vibration; rotating and transporting of the melting wire from the coil over the roll and guides to the fuse at a corresponding speed; maximum capacity of the device being made dependent on charging of the fuse with sand; limiting of the path; electric blocking of individual and collective movements and actuations; removing of the filled fuse; and back pull without shifting melting wire or transmitting vibrations.

Gear wheels **16'** are placed inside a box **18'** for transmission of the drive of electromotor **22'** through pulley systems **20'**, **21'** to a shaft **8'** the rotation of which is transmitted through gear wheels **19'** and **17'** to a shaft **15'** with a guiding connecting piece **9'**, to roll wire conveyor **10'** and through the gear wheels **19'**, **24'** to shaft **25'** with clamp **26'** and fuse **1'**. Vibrator **23'** is placed within the box **18'** and is connected, together with electromotor **22'**, to the switch panel **30'** with the controls **32, 33, 34, 35** for different operations. The switch panel has a power cord **31.**

Shaft **8'** with fixed gear wheel **19'** has a threaded end **36** engaged with a thread in socket **27'** secured to platform **37** for moving the platform upwardly and downwardly, the path of which is limited by stops **28'**, **29'**. The hopper **5'** with transport pipes **14'** is fixed by a clamp **7'** on platform **37.**

The machine as shown in FIG. **2,** for making melting wire fuses operates in the following manner: the fuse **1'** is first fixed to clamp **26'**, and inside the fuse, the hopper **5'** is located with transport pipes **14'**, and the melting wires are fixed to the fuse bottom. The hopper is charged with the correct amount of quartz sand **3'**. When switching on the electromotor **22'**, the vibrator **23'** starts the filling of the fuse. While rotating the fuse **1'** from motor **22'**, the hopper **5'** with transport pipes **14'** moves upwardly, the conveyor **10'** forces the wires from coil **13'** through the guides **11'** and **12'** to the pipes **14'**, causing spiral windings of the wires in the sand which is at the same time being rammed by vibrator **23'**. Upon completion of the filling thereof, the fuse is removed. During back pulling, the conveyor does not transport the wires, due to the provision of a pawl and ratchet gear **16'.**

The machines for making high voltage fuses without chaplets have been tested as to the parameters essential for the quality of the product. All tests gave satisfactory results.

What we claim is:

1. A machine for production of fuses without holders for the fuse elements, said machine comprising a clamping means for supporting a hollow fuse body, a hopper supported above said clamping means, said hopper serving for introduction of sand into the fuse body, a platform supporting said hopper, means for raising and lowering said platform and introducing and retracting said hopper into and from said fuse body, a supply of melting material to form a fuse element, means for coiling said melting material into said fuse body and vibrator means for compacting the sand in the fuse body around the coiled melting material.

2. A machine as claimed in claim **1** wherein said means for raising and lowering said platform comprises a drive motor, and a rotatable shaft coupled to said drive motor and threadably engaged with said platform.

3. A machine as claimed in claim **1** comprising a base with a support beam on which said platform is slidably mounted, a second platform slidably mounted on said support beam and supporting said vibrator means, said means for raising and lowering the first said platform

comprising a drive motor, and means coupled to said drive motor moving said platforms, in concert, on said support beam respectively towards and away from one another.

4. A machine as claimed in claim 3 wherein said means for moving said platform comprises a shaft having opposite ends with opposite direction threads on said ends, said ends of the shaft being respectively threaded in said platforms.

5. A machine as claimed in claim 3 wherein said means for coiling the melting material into the fuse body comprises a socket rotatably mounted on the second platform adapted for receiving the end of melting material to be coiled in the fuse body, a rotatable drive pipe drivingly engaged with said socket, said drive pipe being drivingly coupled said drive motor, a network connecting piece connected to said hopper and adapted for being disposed around said pipe, said socket causing winding of the melting material around said connecting piece, said hopper causing said connecting piece to be withdrawn from the wound melting material while the fuse body is lowered when said platforms are moved away from one another.

6. A machine as claimed in claim 2 comprising a box containing said vibrator means, said shaft extending into said box and including a fixed gear thereon, and a plurality of further gears in said box in mesh with said fixed gear and respectively coupled to said vibrator means and to said means for coiling the melting material.

7. A machine as claimed in claim 6 wherein said hopper is fixed to said platform.

8. A machine as claimed in claim 6 wherein said means for coiling the melting material comprises a transport pipe passing through said hopper into the fuse body, and means driven in rotation by one of said further gears and engaging the melting material to pass the same through said transport pipe.

9. A machine as claimed in claim 8 wherein the melting material coming from the transport pipe is secured to said fuse body, means being driven by another of said further gears to effect rotation of the fuse body and formation of coils of the melting material delivered from the transport pipe.

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