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INSULATION PANEL AND FASTENER ASSEMBLY

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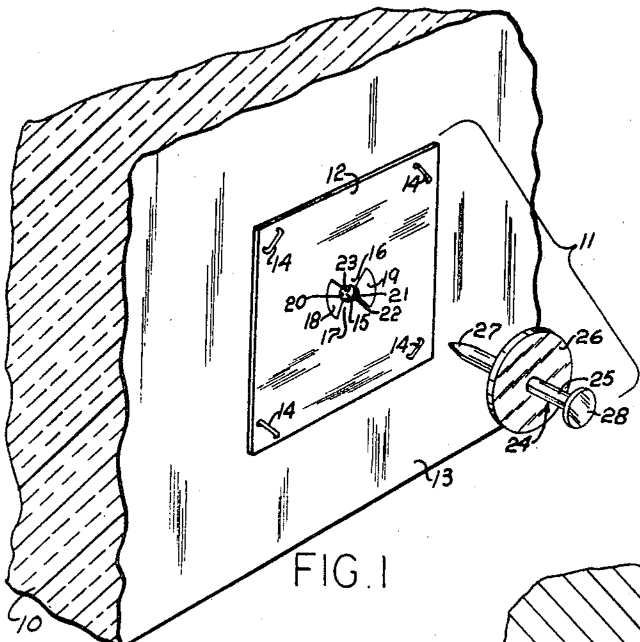

FIG. 1

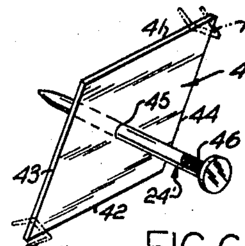

FIG. 6

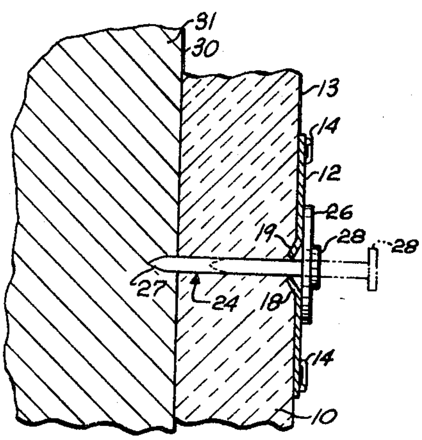

FIG. 3

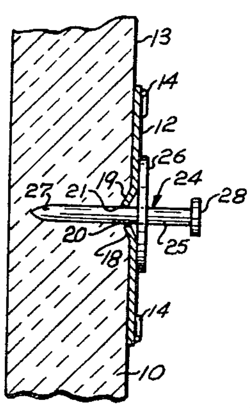

FIG. 2

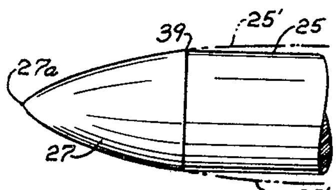

FIG. 5

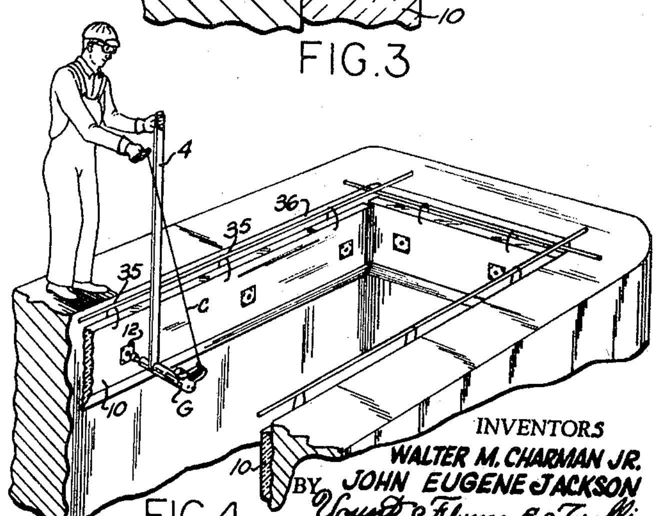

FIG. 4

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INSULATION PANEL AND FASTENER ASSEMBLY

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Original application Oct. 31, 1966, Ser. No. 590,808, now Patent No. 3,372,524, dated Mar. 12, 1968. Divided and this application Feb. 27, 1968, Ser. No. 708,564

Int. Cl. E04f *13/08;* E04b *1/74;* E04c *1/40*

U.S. Cl. 52—127 10 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a preassembled insulation panel and fastener assembly for installation in an ingot mold.

This application is a divisional application of our copending application Ser. No. 590,808, filed Oct. 31, 1966, now Patent No. 3,372,524.

It has been the practice for some time to attach heat insulation panels at the inside of the upper end of an iron ingot mold to provide a heat insulating liner or "hot top" for the purpose of maintaining a reservoir of hot metal on top of the ingot during solidification, as is well known in the art. Such insulation panels must be so firmly attached to the ingot mold that they are maintained in proper position during movement of the mold, usually by rail, from the location where the heat insulation panels are installed to the pouring pit. During the pouring operation, the heat insulation panels must not loosen and float out of their position against the mold wall, which they tend to do because of the great difference in specific gravity between the panels and the molten steel. Such "floating out" of a panel destroys its function as a hot top and usually results in a piped ingot and loss of yield. It is also important to prevent any appreciable amount of steel from rising up and solidifying between the heat insulation panels and the mold walls during the pouring operation. Such steel "fins" between the panels and mold walls may tend to prevent the escape of any gases generated by the burning of any organic materials or binders in the panels, causing "boiling" and displacement of the panels during pouring. Such "fins" also cause difficulties during the later rolling of the ingot, by folding back and rolling into and marking the surface of the good product in the ingot.

Prior to the present invention, the heat insulation panels have been attached to ingot mold walls by using a fastening tool to drive steel fastening pins through the panel and into the iron mold wall. In accordance with this practice, the fastening tool is a gun-like, explosive powder-actuated, impact tool having a recess in its muzzle end into which the user may insert by hand a fastener pin with a washer thereon. The barrel of the tool contains a slidable piston for driving the fastener pin through the heat insulation panel and into the mold wall. A powder charge cap in the tool is exploded, by means of a spring-actuated firing pin, and such explosion drives the piston forward in the barrel to force the fastener pin through the heat insulation panel and into the mold wall. With one type of tool commonly used, a mechanical blow on a plunger, which in turn strikes and explodes the powder charge, is provided by a hammer which is swung by the operator. This requires that there be enough clearance across the inside of the ingot mold for the operator to do this conveniently. Also, it requires a firm backup for the heat insulation panel so that, when the impact blow

is struck with the hammer, the energy of the blow is not cushioned by movement of the panel toward the mold wall. If this occurs, the explosive charge cap may not fire. Also, sometimes the hammer blow may break the heat insulation panel, or if the panel is not held firmly against the mold wall the fastener pin and its washer may be driven too far into the panel and may produce a hole in the panel the diameter of the washer, with consequent loss of holding force of the panel against the mold wall.

Safety is another problem with this prior practice. Since the fastener pin must be inserted manually into the impact gun before the latter is positioned down inside the mold for use, there is a possibility that the impact gun can be fired accidentally before it is so positioned. As a safety precaution, in the prior practice the impact gun is provided with a safety nose on its muzzle end which prevents the gun from being fired until the nose is retracted by forcing it against the panel in place at the inside of the ingot mold. Since considerable force must be exerted to retract this safety nose, this is usually an awkward operation because the workman must perform it while leaning down from the top of the ingot mold. Powder-actuated impact guns require a licensed operator in some states for safety reasons, and this limits their use for the purpose intended.

Another disadvantage of the prior practice is that the work is usually done with the operator standing on top of the ingot mold, and he must drive the fastener pins into the heat insulation panel which is below the top of the mold on which he is standing. This practice is slow and laborious, since ten or more fastener pins must be driven on the larger mold sizes, and each shot requires that the breech of the impact gun be opened, a new powder cap installed, a fastener pin and washer installed and held in the barrel of the gun, the gun held against the panel, and the gun be discharged by striking a hammer blow. Before shooting starts, mold clips or clamps usually must be installed to hold the panels against the mold wall.

The present invention is directed to improving the safety and the ease and speed with which such heat insulation panels can be installed in an ingot mold.

In accordance with the present invention, the heat insulation panel and as many fastener pins as are needed for it are pre-assembled as a unitary structure, with the fastener pins preset to a predetermined depth in the panel and having their head ends projecting from one side of the panel. The pre-setting of the fastener pins in the panel eliminates the need for their insertion by the operator manually into the fastening gun. Instead, the operator simply telescopes the muzzle of the gun over the projecting head end of the fastener pin and this positions the latter for an impact blow by the piston when the gun is fired. This greatly improves the ease and speed with which the fastener pins can be driven into the mold wall because all the operator is required to do, once the panels are hung in the ingot mold, is to reload the powder cap after each shot, seek out the end of the fastening pin which projects from the heat insulation panel, telescope the gun muzzle over this pin, and operate the firing mechanism of the gun to drive the pin home into the mold wall. Preferably, in accordance with the present invention the gun is fired by means of a remote firing mechanism which the operator can actuate while standing upright on top of the mold. Also, accidental firing of the impact gun produces no safety hazard because the fastener pin is not present in the gun except when the gun is positioned to drive the pin into the mold wall.

It is an object of this invention to provide a novel pre-assembled, unitary heat insulation panel and fastener assembly for attachment to the inside of an ingot mold.

Another object of this invention is to assure that by presetting the fastener pin in the heat insulation panel perpendicular to the face of the ingot mold the fastener pin point will penetrate the surface of the ingot mold at right angles to the face of the ingot mold, thereby eliminating hazardous fishhooking of the fastener pin with subsequent loss of holding power.

Further objects and advantages of the present invention will be apparent from the following detailed description with reference to the accompanying drawing, in which:

FIG. 1 is a fragmentary exploded perspective view showing the heat insulation panel and one of the fastener pin assemblies therefor in accordance with a first embodiment of the present invention;

FIG. 2 is a horizontal section through the heat insulation panel with the FIG. 1 fastener pin preset therein;

FIG. 3 is a view similar to FIG. 2 and showing the heat insulation panel fastened to the inside of an ingot mold by driving the fastener pin from the preset phantom line position to the final full-line position;

FIG. 4 is a perspective view showing a workman installing heat insulation panels in an ingot mold in accordancewith the present invention;

FIG. 5 is an enlarged elevational view of the pointed end of the fastener pin in the present invention; and

FIG. 6 is a perspective view of a second embodiment of a fastener pin assembly in accordance with the present invention.

Referring to FIGS. 1 and 2, in accordance with a first embodiment of the present invention, before being installed in an ingot mold the usual heat insulation panel **10** is provided with preferably as many preassembled fastener pin assemblies **11** as are necessary for fastening it securely to the inside of the mold.

In one practical embodiment, the insulation panel **10** is predominantly silica sand with approximately equal parts of fibrous material, such as asbestos, and a suitable binder, such as a phenolic resin.

The fastener pin assembly **11** in this particular embodiment comprises a relatively broad area, flat, rectangular impact plate **12**, which is held flush against the inside face **13** of the insulation panel **10** by staples **14** driven through the plate. Alternatively, the impact plate **12** may be attached to the insulation panel **10** by integral tangs on the plate which are driven into the panel, or by any other suitable attachment members which will be effective to hold the plate securely against the panel, as shown, or it may be held by the fastener pin itself, the pin being described hereinafter. Alternatively, the impact plate **12** may be molded into the panel as the panel is formed, or the impact plate may be glued to the panel.

The impact plate **12** has a central opening **15** which is surounded by four tabs, including a pair of flat, opposed tabs **16**, **17**, which are coplanar with the plate proper, and a pair of opposed, inwardly-bent tabs **18**, **19**. As best seen in FIG. 2, the bent-in tabs **18** and **19** are formed integral with the plate **12** and they extend into the thickness of the insulation panel **10** at opposite acute angles of approximately 20° to the plane of plate. These bent-in tabs terminate in confronting arcuate edge portions **20** and **21** which are offset inwardly from the plane of the impact plate and which partially define the plate opening **15**. The tabs **16** and **17**, which are coplanar with the plate proper, also terminate in confronting arcuate edges **22** and **23** (FIG. 1) which define the remainder of the outline of the plate opening **15**.

The fastener pin assembly **11** also includes a fastening pin **24** having an elongated cylindrical shank **25** which carries a flat metal washer **26**. The washer **26** has a tight interference frictional fit on the fastener pin. The fastener pin has a pointed inner end **27** and an enlarged head **28** on its outer end.

As best seen in FIG. 2, in accordance with the preferred form of the present invention the fastener pin assembly is pre-assembled with the heat insulation panel **10** to provide a unitary structure by first attaching the impact plate **12** to the inside face **13** of the panel by the staples **14** or other methods previously suggested and then driving the pointed end of the fastener pin through the opening **15** in the plate **12** and into the panel **10** until the washer **26** abuts against the impact plate **12**. Preferably this is done without disturbing the original position of the washer **26** on the fastener pin, so that this position of the washer accurately predetermines the depth of penetration of the fastener pin into the panel **10** during this preassembly. As shown in FIG. 2, the fastener pin preferably penetrates most, but not all, of the way through the thickness of the panel **10**. The cylindrical shank **25** of the fastener pin **24** is gripped frictionally by the arcuate edges **20**, **21**, **22** and **23** of the integral tabs **16–19** on the impact plate, so that the fastener pin cannot become dislodged from the panel **10** during its shipment to the ingot mold or while it is being handled.

Referring to FIG. 3, the heat insultion panel **10** is to be positioned against the flat inside face **30** of an upstanding wall **31** of an ingot mold and then fastened to this wall by driving the fastener pin **24** from the preset phantom line position in FIG. 3, in which it projects from the panel, to the final full-line position of FIG. 3, in which it penetrates completely through the panel **10** and into the ingot mold wall **31**. In this final position the fastener pin head **28** may abut against the washer **26**, as shown in FIG. 3, or it may be spaced outwardly from the washer. The fastener pin is driven home by applying an impact blow on the head end of the fastener pin of sufficient force to drive the fastener pin shank through the frictionally-held washer **26** and through the opening **15** in the impact plate until the pointed end **27** of the fastener pin has passed completely through the remaining thickness of the heat insulation panel **10** and into the ingot mold wall **31** to the required depth which will insure secure attachment. The impact plate **12** distributes the shock of the impact blow over a relatively broad area of the insulation panel to avoid breaking the latter or driving the washer through the panel, which otherwise would tend to happen due to the physical characteristics of the panel **10**.

The depth to which the fastener pin **24** is preset into the insulation panel **10** preferably is chosen so that, when the fastener pin is driven into the ingot mold wall, it will penetrate into the latter a sufficient depth to provide a secure fastening, even if there is as much as ¼ inch to ½ inch of steel scrap or slag on the ingot mold wall behind the panel.

Referring to FIG. 4, such attachment of the insulation panel **10** to the ingot mold is done by the remotely-operated firing of an explosive powder-actuated impact fastener tool G. As shown in this figure, the insulation panels **10** may be suspended in position against the inside of the respective walls of the ingot mold be means of wire hangers **35** which are looped over respective rigid bars **36** resting on top of the ingot mold or by other means, not shown. Each insulation panel **10** preferrably has the required number of fastener assemblies **11** preassembled in place, as already described in detail, with the head end of each fastener pin projecting from the panel, as shown in phantom in FIG. 3.

The gun-like impact tool G preferably is of a known type having an explosive powder charge cap for operating a piston which is slidable within the barrel of the gun. The muzzle of the gun barrel has a recess for receiving the head end of the fastener pin, and when the powder charge is fired the piston inside the gun barrel drives the fastener pin completely through the insulation panel and into the mold wall. The tool G is provided with a trigger and, in accordance with the present method, a remote control firing element, including a flexible cable C, is connected to the trigger. This remote control element extends from the gun above the top of the ingot mold. The trigger of the impact tool is operated by an upward pull on the cable C, which may be done by a manually-operated remote control firing element, not shown. As shown in FIG. 4, the tool G is attached to the lower end of a rigid handle H. The workman holds the upper end of this handle H and operates the remote control firing element, including cable C, while standing erect on top of the mold or on an adjacent platform.

In the use of this powder-actuated piston-type impact tool, the operator, holding the handle H, telescopes the gun muzzle over the outwardly-projecting head end of the fastener pin 24 which is preset in the insulation panel, so that the fastener pin is now positioned to be engaged by the piston in the gun barrel. When an upward pull is exerted on the control cable C, such as by means of a remote control firing mechanism, this operates the trigger to fire the tool to drive the fastener pin into the mold wall. This may be done while the operator is standing erect on top of the mold as shown in FIG. 4, or on an adjacent platform, not shown. There is no necessity for the operator to insert the fastener pin manually into the tool before positioning the tool against the heat insulation panel, as in the prior practice, because the fastener pin is already in place in the panel 10, and between successive firings the operator need only replace the explosive charge cap in the tool. Also, the powder-actuated piston-type impact tool need not have the aforementioned retractable safety nose to prevent accidental firing of the tool. Consequently, the time between successive firings of the tool is greatly reduced and there is no safety hazard because the fastener pin is never in place in the tool except when the tool is telescoped over the fastener pin which is preset in the panel **10**.

Referring to FIG. 5, in accordance with the preferred embodiment of the present invention the fastener pin **24** has a novel construction which more effectively prevents it from being dislodged from the mold wall **31** after it is driven in, as shown in the full-line position of FIG. 3. Referring to FIG. 5, the pointed end **27** of the fastener pin has a rounded and tapered configuration, commonly referred to as an ogive shape. This rounded and tapered end of the fastener pin has a curvature such that at its juncture with the shank **25** a distinct corner **39** is formed, as shown somewhat exaggerated in FIG. 5. This is in contrast to the prior practice of providing a smoothly merging or tangential blending of the ogive-shaped end of the fastener pin with the shank of the fastener pin by having the curvature of the ogive, where it is joined to the shank, such that there is no corner or other discontinuity between them, as indicated by the phantom lines **25'** in FIG. 5. In other words, in the present fastener pin the tangent of the curve of the ogive tip at its intersection with the shank of the fastener pin does not extend along the shank as it would if the ogive blended into the shank of the pin, but rather at a diverging angle with respect to the shank, proceeding away from the tip.

It has been found that the provision of this corner or discontinuity **39** between the uniform diameter shank **25** and the progressively decreasing diameter ogive-shaped tip **27** of the fastener pin enables it to have an unexpectedly more secure embedding in the cast iron mold wall when driven into the latter because cast iron has low resiliency, and when displaced by the entrance of the fastener pin point, grips more securely on shank **25**, particularly at the distinct corner **39**, than if the cast iron were displaced still more by a tip which merges or blends smoothly with the shank, as shown at **25'** in FIG. 5.

FIG. 6 shows an alternative embodiment of the present fastener which consists of a fastener pin **24'**, preferably having a pointed end identical to the fastener pin already described, and an impact plate **40**. The shank of this pin is knurled at **46** just ahead of the head **28**. The plate **40** is a nonrectangular parallelogram in outline, having a pair of short opposite side edges **41, 42** and a pair of longer opposite side edges **43, 44** joining them. The edges **41** and **44** extend at substantialy less than 90° to one another and they form a sharp corner which may be straddled by a staple **14'**, shown in phantom in FIG. 6 for attaching the impact plate to the heat insulation panel. The opposite corner of this plate, at the intersection of its remaining side edges **42** and **43**, may be similarly straddled by such a staple.

The impact plate **40** has a circular opening **45**. This opening receives the shank of the fastener pin **24'** with a tight frictional fit.

The impact plate **40** and pin **24'** may be assembled together as shown in FIG. 6, with the pointed end of the fastener pin projecting past the plate **40** by an amount corresponding to the desired depth of its partial penetration through the insulation panel. The fastener pin may be driven into the insulation panel until the plate **40** abuts against the face of the panel, and then the plate is stapled to the panel to provide the preassembled unitary structure of the panel and the fastener assembly. The knurled surface **46** on the shank of the fastener pin will be securely gripped by the frictional fit with the impact plate **40** at the latter's opening **45** to insure that the impact plate cannot come loose from the fastener pin after the latter is driven into the side of the mold.

While certain presently-preferred embodiments of the present preassembled panel and fastener pin structure, as well as the preferred method of installing this panel and fastener pin structure in an ingot mold, have been described in detail with reference to the accompanying drawing, it is to be understood that modifications which depart from these particular embodiments may be adopted without departing from the scope of the present invention, as defined in the appended claims.

What is claimed is:

1. A preassembled panel and fastener pin assembly for attachment to the inside of an ingot mold, said assembly comprising a heat insulation panel, an impact plate on said insulation panel at one side thereof and having an opening, and a fastener pin element frictionally received in said opening in the impact plate and having an inner end extending into the panel and an outer end projecting beyond the plate at said one side of the panel.

2. An assembly according to claim **1**, wherein said fastener element is a pin having a pointed end embedded in the panel at a predetermined depth therein.

3. An assembly according to claim **2** wherein said fastener pin has a substantially cylindrical shank portion projecting into the panel and a rounded and tapering pointed end segment extending inward into the panel from said shank portion, said tapering pointed end segment having a nontangential curvature adjacent its juncture with said shank portion such that a distinct corner is provided at said juncture.

4. An assembly according to claim **1**, wherein said plate at said opening has integral bent-in tabs which project into the panel and terminate in edge portions of said opening which are offset inwardly and which grip the fastener pin frictionally to lock the fastener pin against displacement out of the panel.

5. An assembly according to claim **4** and further comprising a flat washer frictionally gripping the fastener pin and abutting against the outside of said impact plate.

6. An assembly according to claim **5**, wherein said fastener pin has a cylindrical shank portion projecting through said plate into the panel and an ogive-shaped inner end segment extending inward, nontangentially, from said shank portion to an end tip and forming a distinct corner with said shank portion at their juncture.

7. A preassembled panel and fastener pin assembly for attachment to the inside of an ingot mold, said assembly comprising a heat insulation panel, an impact plate on said insulation panel at one side thereof and having an opening, and a fastener pin element extending through said opening in the impact plate and having an inner end extending into the panel and an outer end projecting beyond the plate at said one side of the panel, said fastener pin element being releasably held in said opening in the impact plate and being displaceable with respect to the impact plate by an impact blow on the outer end of the fastener pin element in the direction of the panel for driving the fastener pin element into the panel.

8. An assembly according to claim **7**, wherein said fastener element is a pin having a pointed end embedded in the panel at a predetermined depth therein.

9. An assembly according to claim **8**, wherein said fastener pin has a substantially cylindrical shank portion projecting into the panel and a rounded and tapering pointed end segment extending inward into the panel from said shank portion, said tapering pointed end segment having a nontangential curvature adjacent its juncture with said shank portion such that a distinct corner is provided at said juncture.

10. An assembly according to claim **8** or **9**, and further comprising a flat washer holding the fastener pin and abutting against the outside of said impact plate.

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