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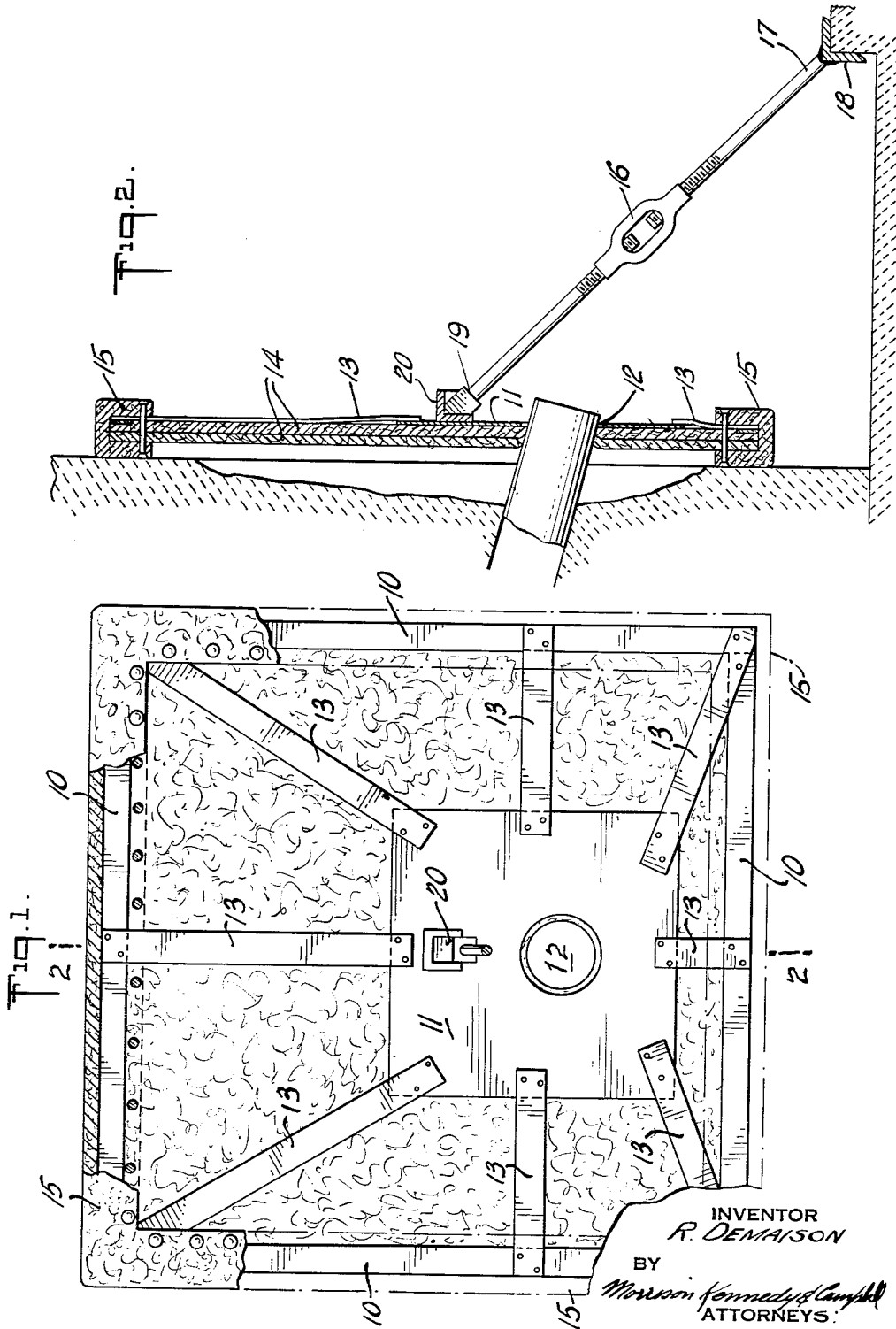
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3,012,299

OPEN HEARTH TAP HOLE REPAIRING FORM

Filed Aug. 20, 1959

3 Sheets-Sheet 1



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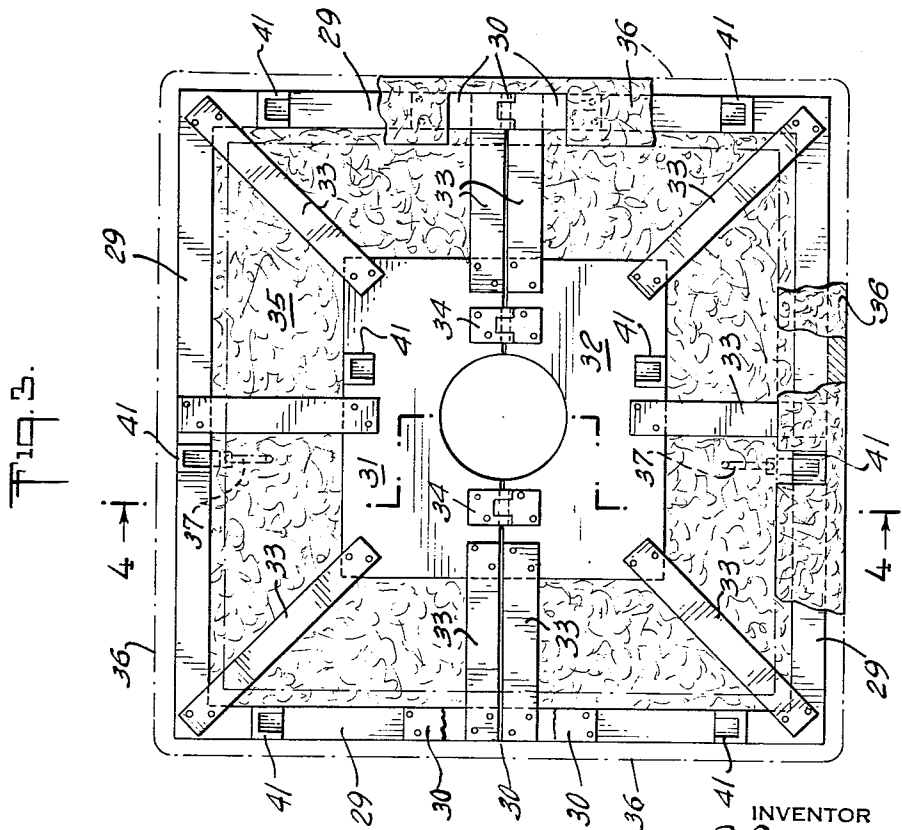
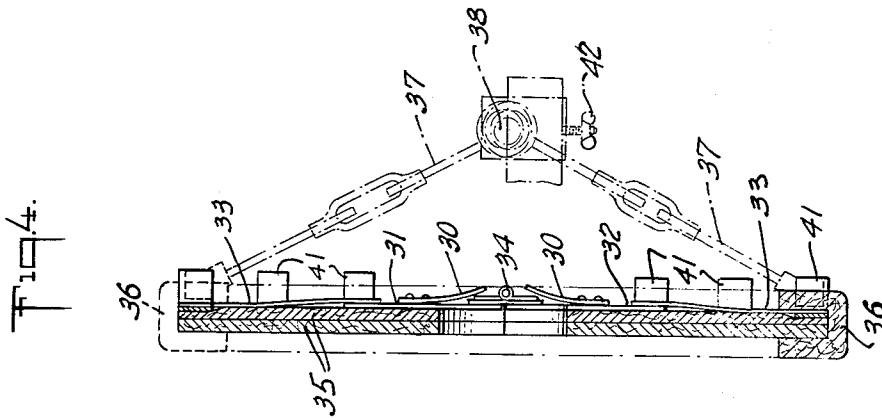
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OPEN HEARTH TAP HOLE REPAIRING FORM

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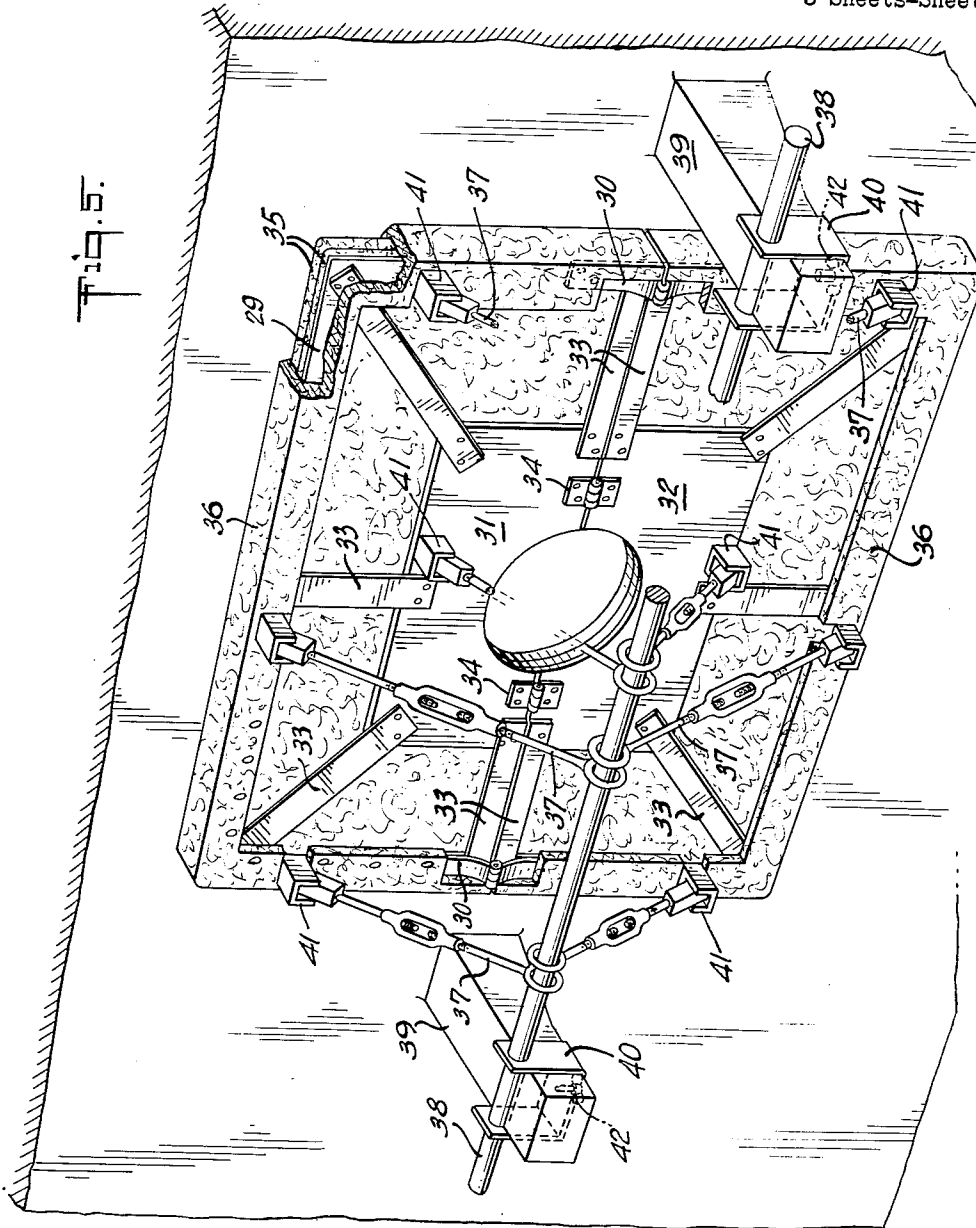
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OPEN HEARTH TAP HOLE REPAIRING FORM

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Fig. 5.



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OPEN HEARTH TAP HOLE REPAIRING FORM
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Company, Inc., a corporation of New York
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7 Claims. (Cl. 25—118)

This invention relates to a new and novel flexible form for use in repairing refractory around the tap hole of an open hearth furnace.

In the normal open hearth furnace, the tap hole is lined with a steel pipe which is embedded in a suitable high temperature refractory rammed or sprayed in place and extends from the open hearth furnace chamber beyond the outside wall and thereby allows molten metal to be drawn off therethrough. In the tapping of the molten metal, the pipe is melted and surrounding refractory is eroded and spalled and needs constant replacement after such heat. The hearth furnace wall is also formed on either side of the tap hole with two outwardly extending supporting brackets which are used to support the refractory lined trough for drawing off the molten metal.

An object of the present invention is to provide a flexible form which may be mounted over the spalled tap hole area and not only serves as a flexible form for confining the refractory as it is rammed or sprayed into place but in addition serves to position and support the new tap hole pipe in the open hearth furnace wall.

A more specific object is to provide a flexible form which will conform to the spalled contour of the outside furnace wall and be held in place by means of a suitable jack or jacks from the platform edge or from a pipe laid across between the two brackets, normally used to support the trough for pouring and tapping the molten metal and thus serve both to position the pipe in the tap hole and to support and confine the refractory material as it is put in place.

A brief description of the invention is hereby given in order to allow a better understanding of just how the flexible form is constructed and what it accomplishes. One of the problems that is encountered in the repair of tap holes in open hearth furnaces is the unevenness of the exterior walls in the vicinity of the tap holes due to the extreme heat to which the refractory in the vicinity thereof is subjected, resulting in spalling. It is therefore impossible to use a flat plate without first plugging up the outer contour of the furnace wall in order to seal the edges of the plate against leakage of the refractory. It was with these difficulties in mind that the present invention was conceived.

The flexible form of this invention consists of a suitable flat metal frame of suitable shape and size in which is mounted by means of flat metal springs a central flat metal plate containing a hole for holding and positioning the tap hole pipe. The whole of this frame with its spring mounted center plate is then covered on its furnace mounting side with a suitable heat resisting blanket which acts as a form and serves as a seal by fitting into the irregular spalled contours of the face of the furnace wall. The heat resisting blanket, being of heavy weight and being backed by the springs which support the center plate, makes a smooth contour form that can readily be filled by ramming or spraying and then removed. The flexible form must be mounted on the spalled area in such manner as to provide a suitable opening at the top side, or sides near the top, in order to provide a suitable means for the placing of the refractory material. If desired, the frame may be split into two equal halves above and below the tap hole and supported in place by a pipe resting on the two wall brackets.

In the accompanying drawings there is shown the two disclosures mentioned above.

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FIG. 1 is a front elevational view of a one piece flexible form;

FIG. 2 is a side elevation taken along the lines 2—2 of FIG. 1 and discloses the single placing and retaining means;

FIG. 3 is a front elevational view of a split or two piece adjustable form;

FIG. 4 is a side elevation taken along the lines 4—4 and discloses the multiple placing and retaining means; and

FIG. 5 is a front view of the furnace with the two piece form of FIG. 3 mounted in place.

As disclosed in FIGS. 1 and 2, the flexible form includes an outside flat metal frame 10 of suitable shape and size. In this instance, it has been made square but it is possible to change this shape to meet existing conditions. A metal plate 11, with a suitable hole 12 therein, is mounted on the flat metal frame 10 by means of flat blade springs 13 which keep the plate 11 spaced in constant relation to the outside metal frame but allow facewise displacement if necessary in order to follow the spalled outside furnace wall contour. The furnace mounting side of the metal frame 10 is covered with a high temperature resistant blanket 14 composed of one or more layers of heavy woven asbestos cloth or other suitable material. The outside edge of the entire frame is then covered with an additional narrow strip 15 of the same high temperature resistant material to furnish a further edge sealing means in order to preclude any leakage of the refractory material. The entire prefabricated adjustable form is then placed in position by means of a jack 16 with angle clip 17 on its lower end which engages the outer edge 18 of the furnace platform, and a mounting clip 20 on the plate 11 is engaged by an extension 19 of said jack 16 to thereby position and support the flexible form in proper position with the tap hole pipe properly placed in the hole 12 therein as the jack is extended. The jack in this instance is in the form of a suitable turnbuckle. In the mounting of the flexible form on the spalled furnace wall, it must be remembered to select a position that will allow an opening at the top or sides into the space behind the flexible form for the insertion of the refractory material. There is always sufficient leeway in placing the tap hole pipes or by slightly tilting the flexible form to provide a suitable filling opening. In FIG. 2 the flexible form is shown placed against the furnace wall ready for jacking into place thereon and thus seal and provide a suitable form for retaining and confining the refractory material in place. The inner face of the blanket 14 will contact the spalled face of the furnace wall at the edges where the spalling has started as the flexible form is jacked in and will thus seal off said space from edge to edge.

As disclosed in FIGS. 3 and 4, the adjustable form comprises a flat metal frame 29 which is split into halves and hinged in the middle at 30. A metal plate, split in the middle to provide an upper half 31 and a lower half 32, is then mounted on the flat metal frame 29 by means of flat blade springs 33 which keep the plates 31 and 32 spaced in constant relation to the outside flat metal frame but allow facewise displacement where necessary in order to follow the spalled outside wall contour. In certain instances, if the flexible forms are made too big to use a single blade spring as shown, the use of multiple-layer leaf springs may be resorted to or in lieu thereof a series of flat springs, fabricated and placed and formed as to cover the entire face of the form, may be resorted to. It will be noted that the plates 31 and 32 are also provided with hinges 34 in line with the frame hinges 30 to permit the form to be folded upon itself for the use of one half at a time. The furnace mounting side of the outer metal frame 29 is covered with a suitable high tem-

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perature resistant blanket 35 similar to the blanket 14. The outside edge of the entire frame is also covered with an additional narrow strip 36 of the same high temperature resistant blanket material to furnish a further edge sealing means in order to preclude leakage of the refractory. The entire prefabricated flexible form is placed in position by means of suitable jacks 37 supported on a rod or pipe 38 placed in supporting brackets 39 and locked therein by means of clips 40 which prevent said rod or pipe from being displaced in said brackets. The jacks 37 in the form of adjustable turn buckles are extended to prop the flexible form against the furnace face by use of jacking clips 41, one on each section of the central metal plate. It will be noted that the ends of the turn buckles are held from turning by the clips 41 and the rod or pipe 38.

The split repair form of FIGS. 3 and 4 may be used in its spread or unfolded condition just as the one-piece form of FIGS. 2 and 3. However, on occasions it may be desirable to make the tap hole repairs in two stages, first in the region below the hole and then the region above the hole. In the tap first stage the form will be separated or folded to bring the top half down to lay on the pipe support 38 and thus present the center plate in position to receive and support the tap hole pipe. After the repair in the bottom area has been made, the top half of the form may be swung up into its extended position (in the plane of the lower half) and the repair in the upper area then made. The point is that the damage to the tap hole and furnace wall is never too great for the one-piece form with its flexibility and resilience, will always adapt itself to cover the whole area of repair. Here again it must be remembered to place the flexible form in such a position as to provide an entrance into the void space in back for the insertion of refractory material.

In FIG. 5 is shown a front view of the complete form of FIGS. 3 and 4 on the furnace wall with all the jacks 37 in use and mounted on the pipe or rod 38 laid in the brackets 39 and held therein by clips 40. It will be noted that the clips 40 may be tightened to hold the pipe or rod 38 securely in place by use of wing bolts 42.

From the foregoing disclosure it can readily be seen that the invention is one which has taken cognizance of the problems encountered in the repair of tap holes in open hearth furnace walls and furnishes a quick and easy method of forming said walls in order to provide a means of retaining the refractory material in said wall in the vicinity of the tap hole and also hold and locate the pipe in said tap hole. The instant invention is now being used in some of the steel mills for the repair and replacement of tap holes and has presented no problems in its use or application.

It will be understood that there can be various departures in the design of the improved adjustable form without departing from the spirit of the invention.

What is claimed is:

1. A flexible resilient form for use in repairing the refractory material around open hearth furnace tap holes, said form comprising an outer metal frame and an inner apertured plate, flat blade springs connecting said apertured metal plate to said outer metal frame, and a flexible heat resisting blanket attached to the outer metal frame and the inner apertured plate and backed-up by the flat blade springs.

2. A flexible resilient split form for use in repairing the refractory material around open hearth furnace tap holes, said form comprising an outer metal frame made in two hinged sections, and an inner apertured plate also made in two hinged sections, flat blade springs for connecting the two sections of the apertured plate to the cor-

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responding sections of the outer metal frame, and a flexible heat resisting blanket attached to the outer metal frame and the inner apertured plate for conforming to the furnace wall.

3. A flexible resilient split form for use in repairing the refractory material around open hearth furnace tap holes according to claim 2 wherein the bottom half may be used to repair the lower portion and then the upper half brought into use to complete the repairs.

4. A flexible resilient form for use in repairing the refractory material around open hearth furnace tap holes, according to claim 2 wherein the inner apertured split plate and the outer split metal frame contain suitable brackets adapted for engagement with jacks for jacking said flexible resilient form in place around said furnace wall.

5. A flexible resilient form for use in repairing the refractory material around open hearth furnace tap holes, said form comprising an open outer metal frame adapted to surround the damaged area of the tap hole, a flexible heat resisting blanket attached at its outer edges to said frame and covering the opening therein, an inner metal plate arranged at the front side of the blanket in the immediate area of the tap hole pipe, and resilient means for connecting said inner plate to said outer metal frame to permit a facewise displacement of the plate with reference to the frame and to transmit to the frame a portion of the force applied to the plate in effecting its facewise displacement, said inner plate and said resilient means restraining the flexible blanket against forward displacement but permitting the blanket to conform to the damaged area of the tap hole, and said inner plate and flexible blanket being formed with a hole therethrough to accommodate and support the tap hole pipe and permit the form as a whole to be pressed into place around the tap hole by pressure against the inner plate.

6. A flexible resilient form for use in repairing the refractory material around open hearth furnace tap holes, said form comprising an outer metal frame and an inner apertured metal plate adapted to be slipped over the tap hole pipe, resilient means for connecting said apertured plate to said frame, and a flexible heat resisting blanket attached to the outer metal frame and the inner apertured plate for conforming to the furnace wall, said inner apertured plate containing a suitable bracket adapted for engagement with a jack for jacking said flexible resilient form in place against the furnace wall.

7. A flexible resilient form for use in repairing the refractory material around open hearth furnace tap holes, said form comprising an outer metal frame and an inner apertured metal plate adapted to be slipped over the tap hole pipe, resilient means for connecting said apertured plate to said frame, and a flexible heat resisting blanket attached to the outer metal frame and the inner apertured plate for conforming to the furnace wall, said outer metal frame being covered at its outside periphery with an additional thickness of heat resisting material to seal the outer side edge of said form.

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