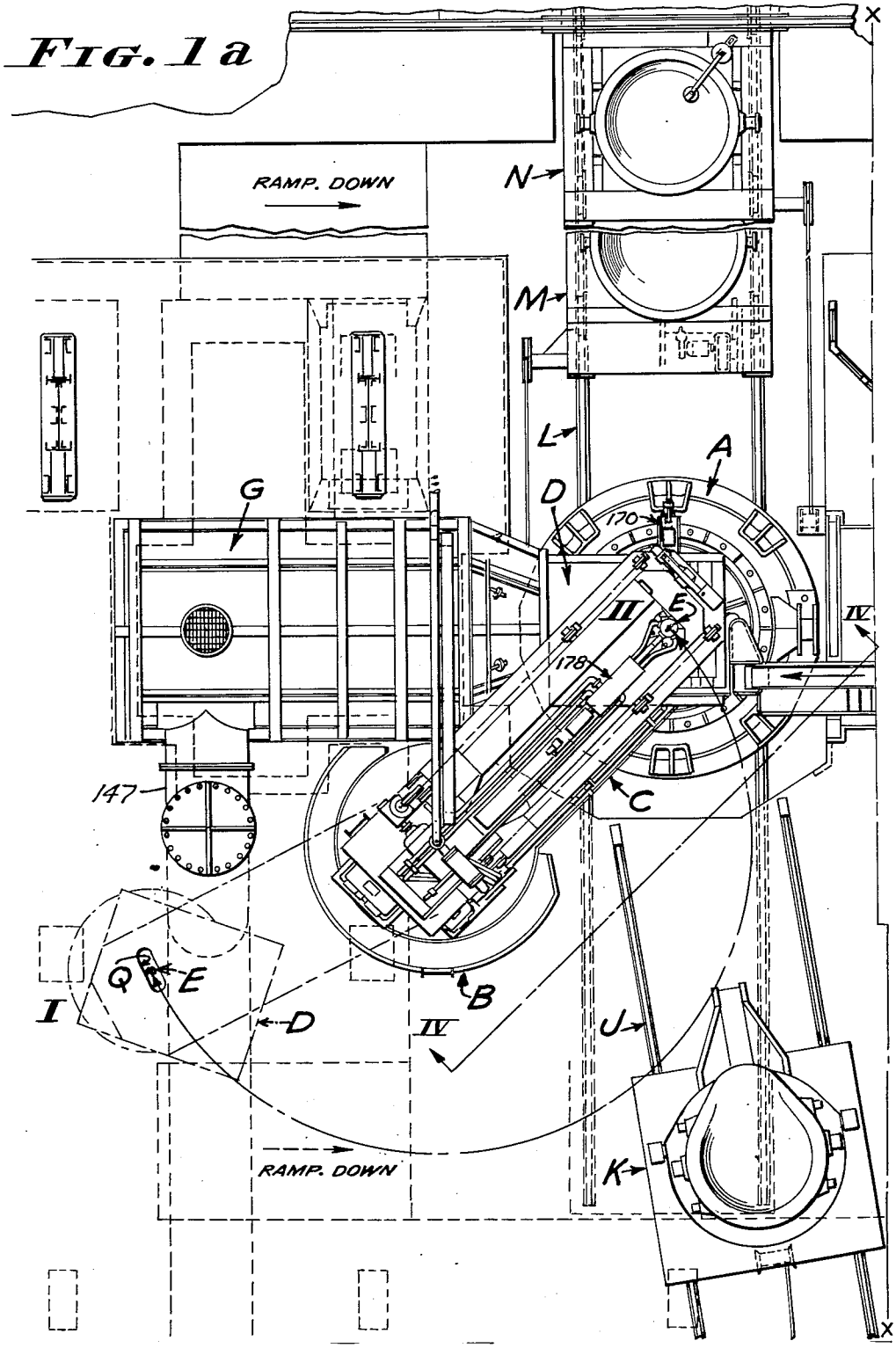
March 20, 1962 H. L. McFEATERS 3,026,102

HOOD POST CRANE

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FIG. 1a

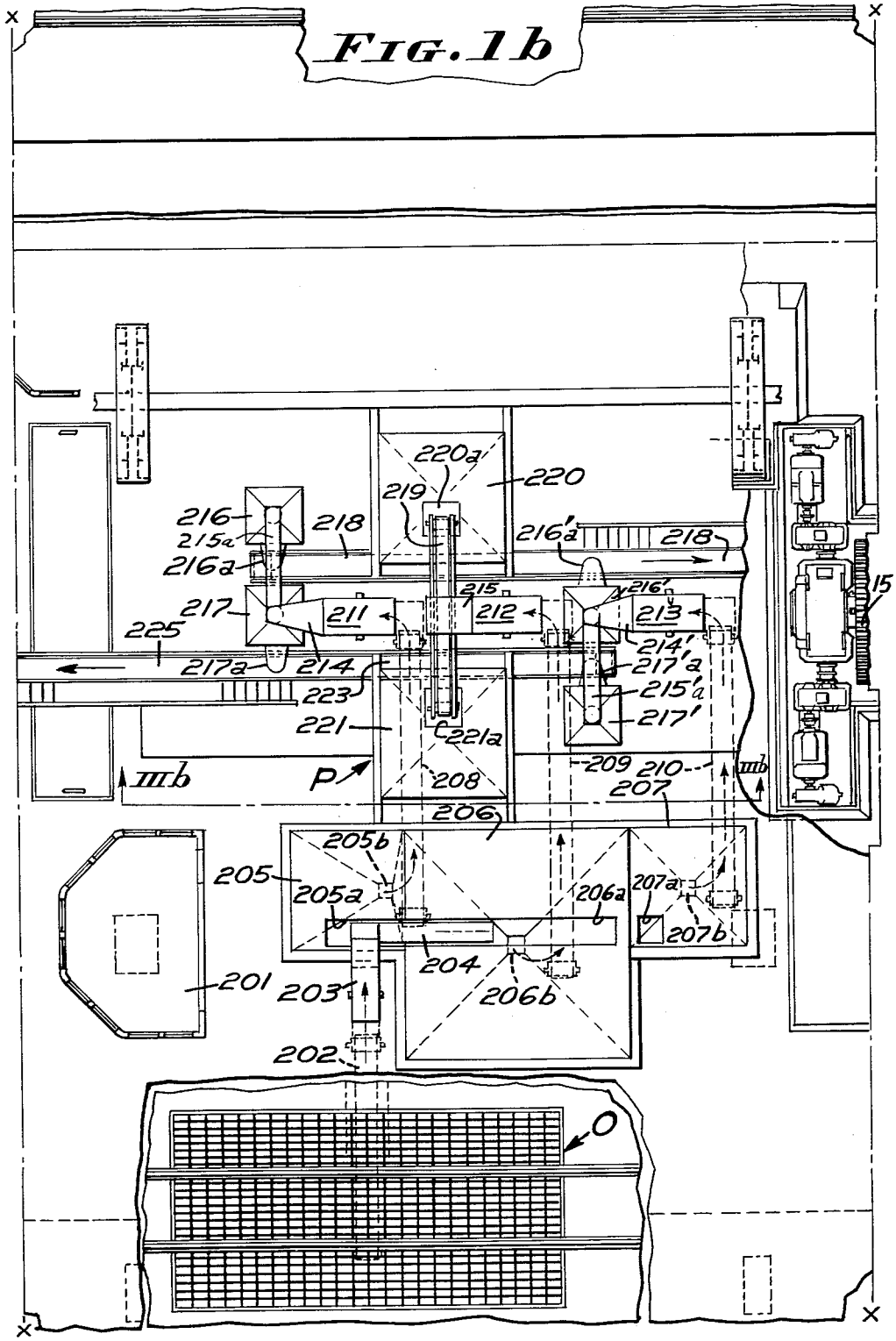


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HOOD POST CRANE

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FIG. 1b

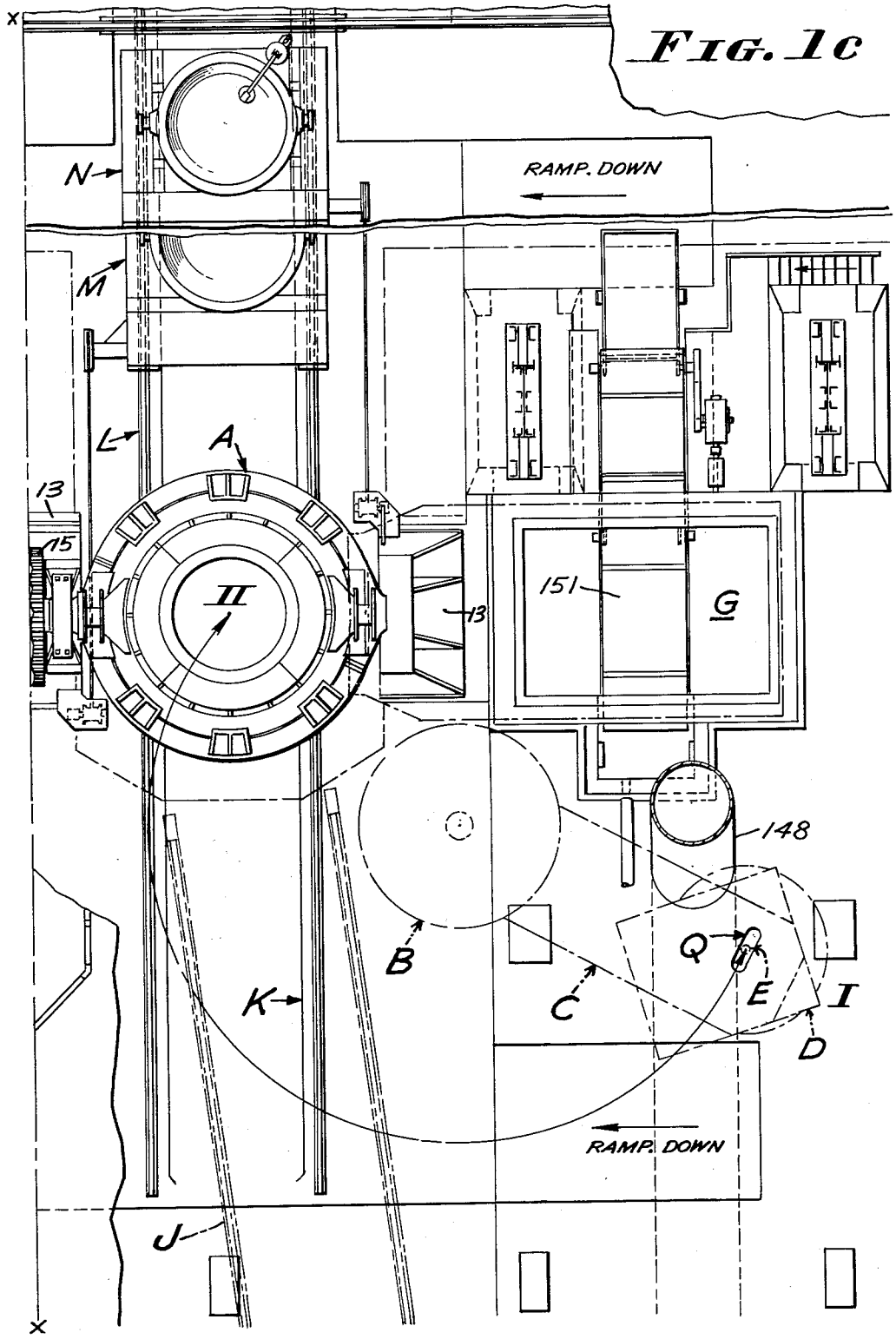


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FIG. 1C



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FIG. 2

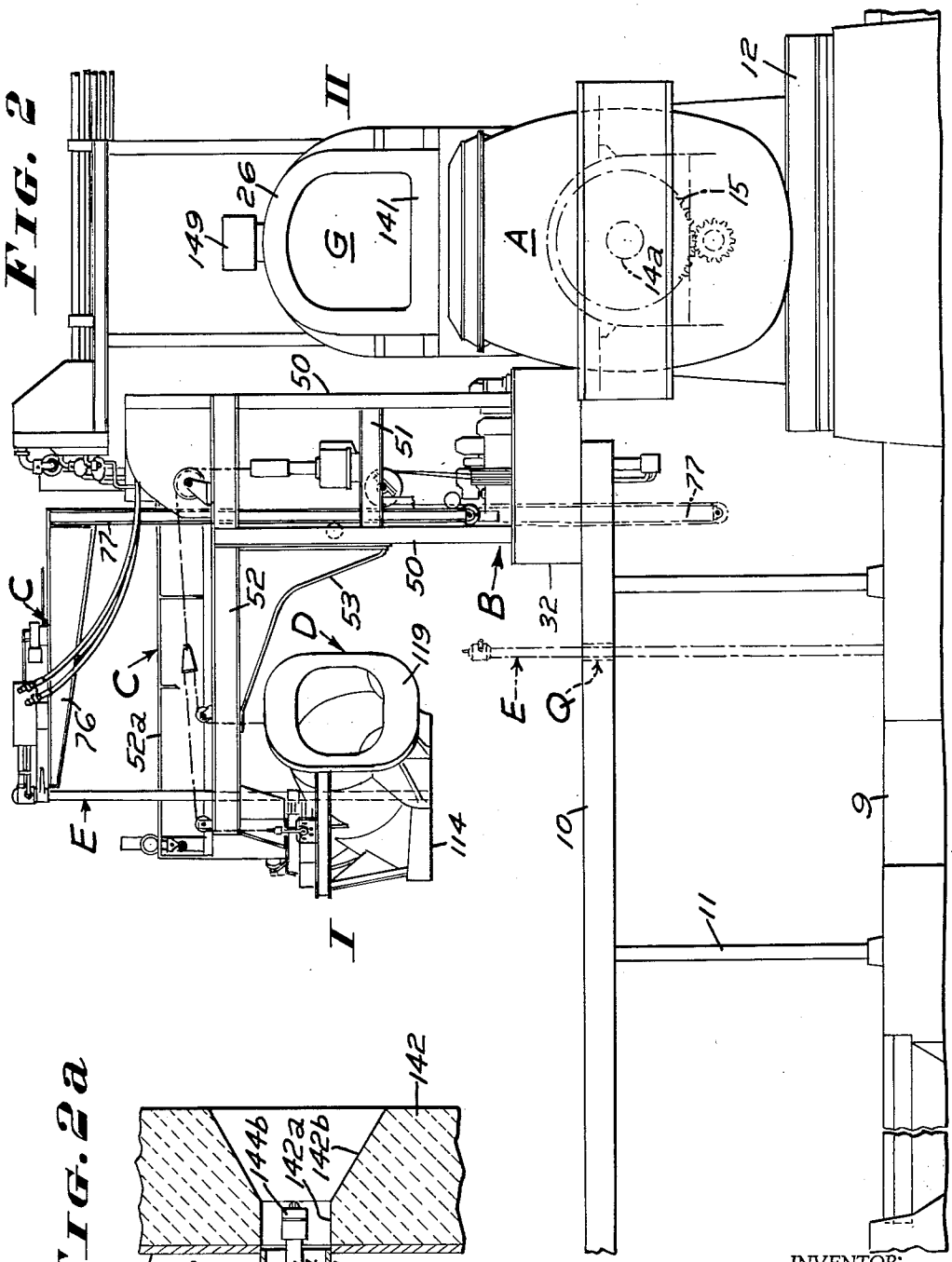


FIG. 2a

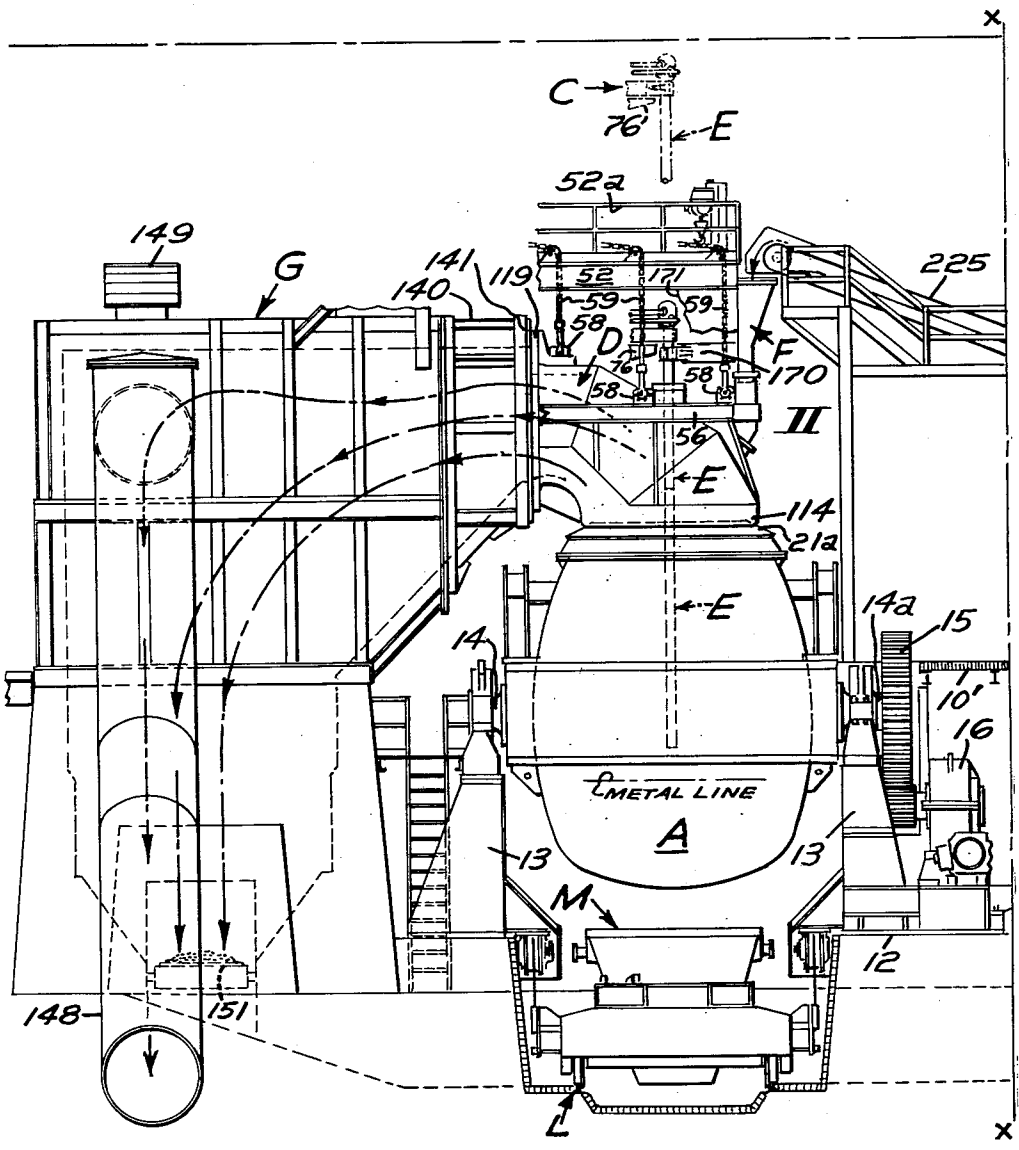
INVENTOR:
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HIS ATTORNEYS.

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HOOD POST CRANE

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FIG. 3a



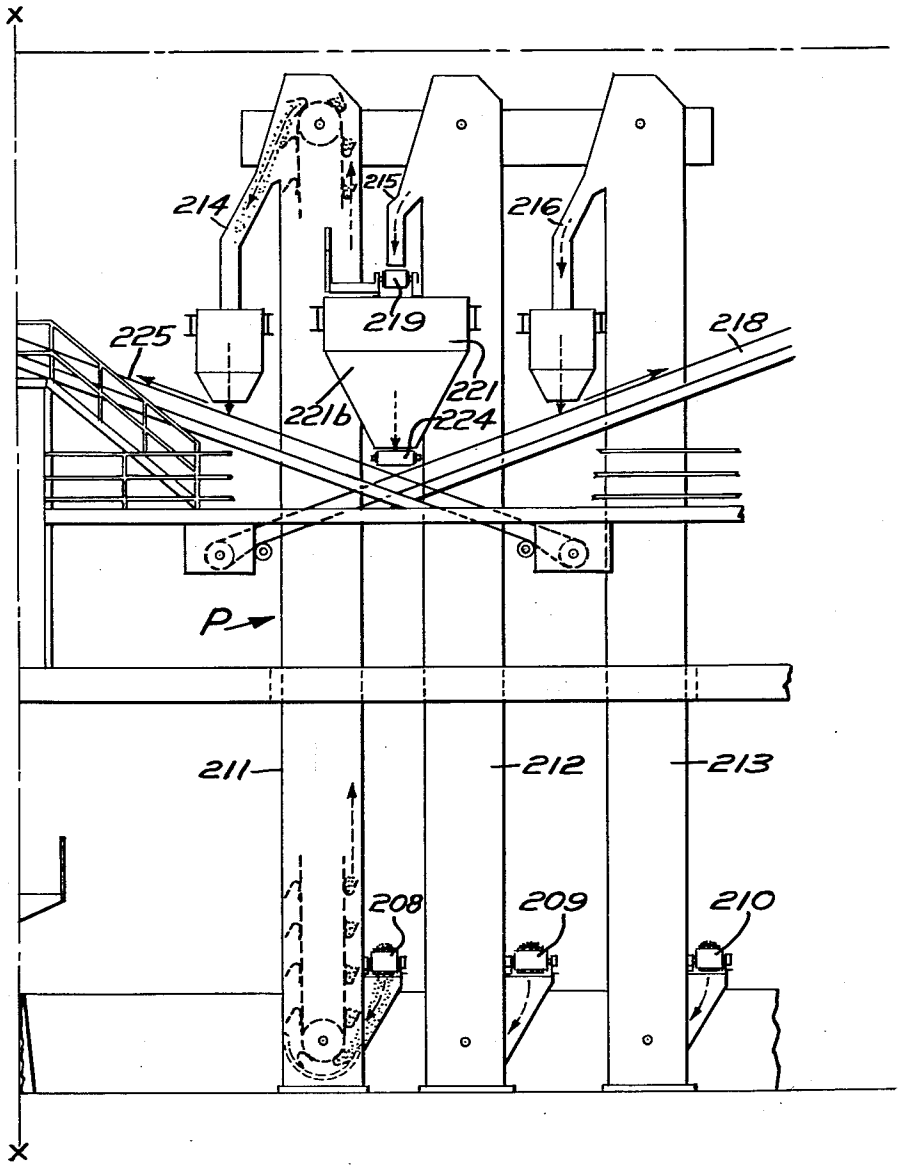
INVENTOR:
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HOOD POST CRANE

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FIG. 3b



INVENTOR:
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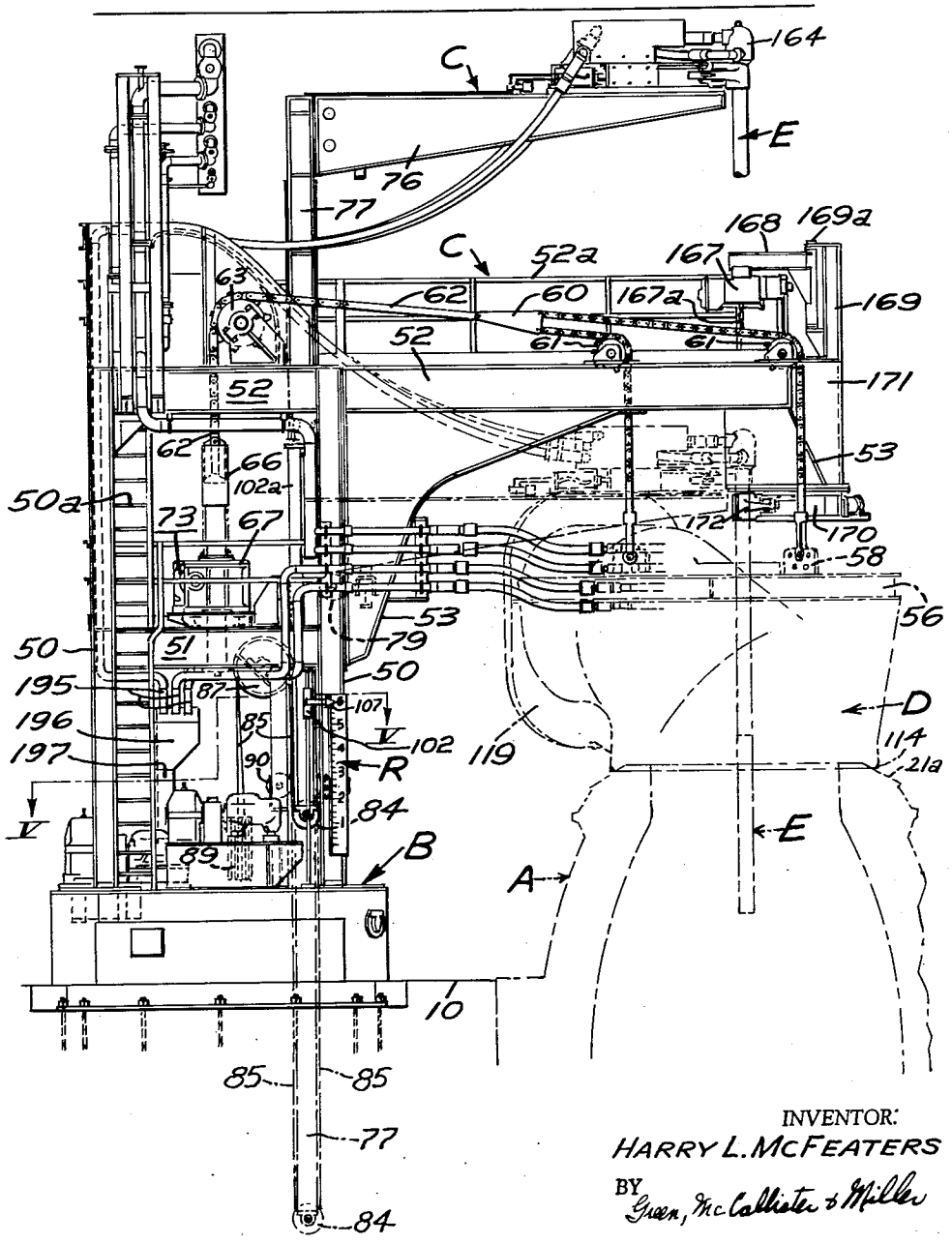
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March 20, 1962 H. L. McFEATERS 3,026,102

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FIG. 4



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FIG. 5

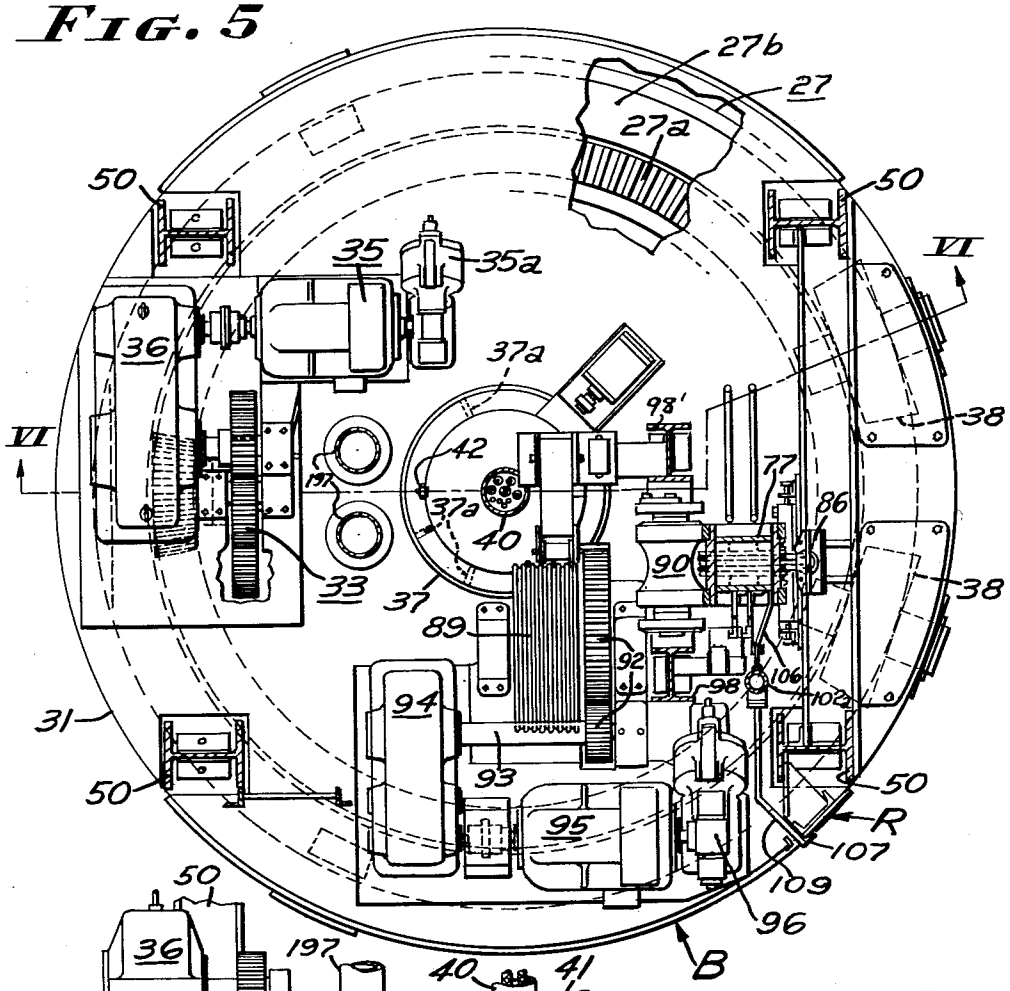
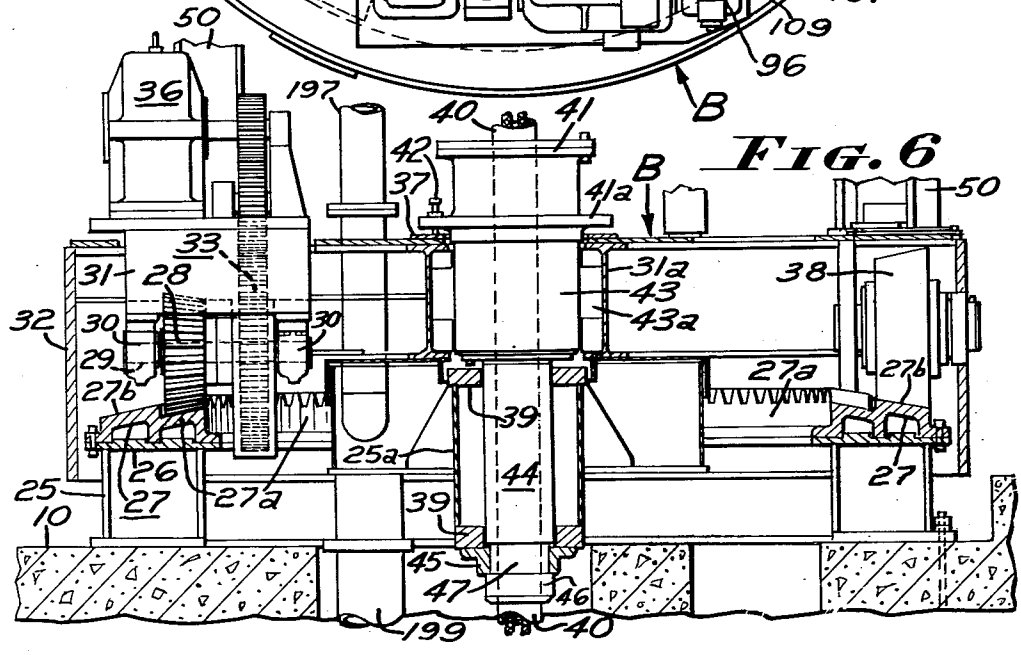


FIG. 6



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FIG. 7

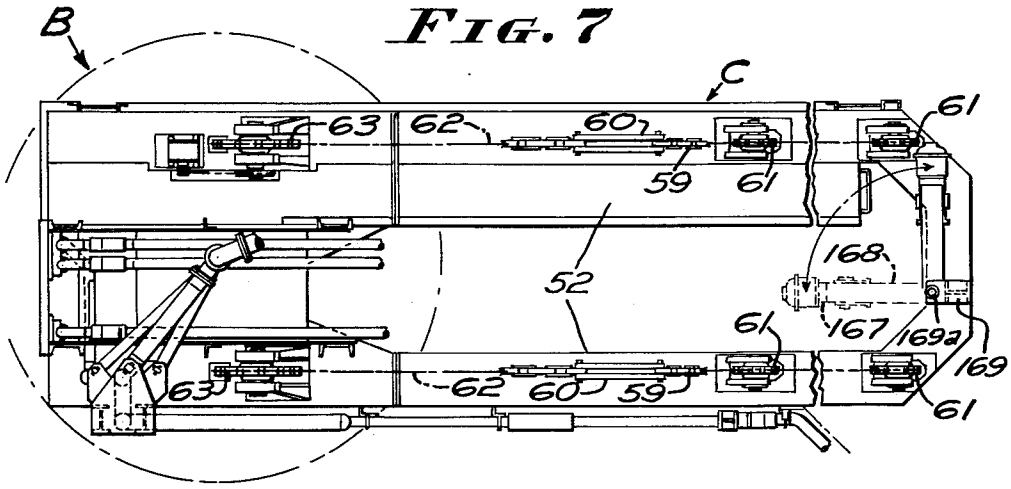


FIG. 8

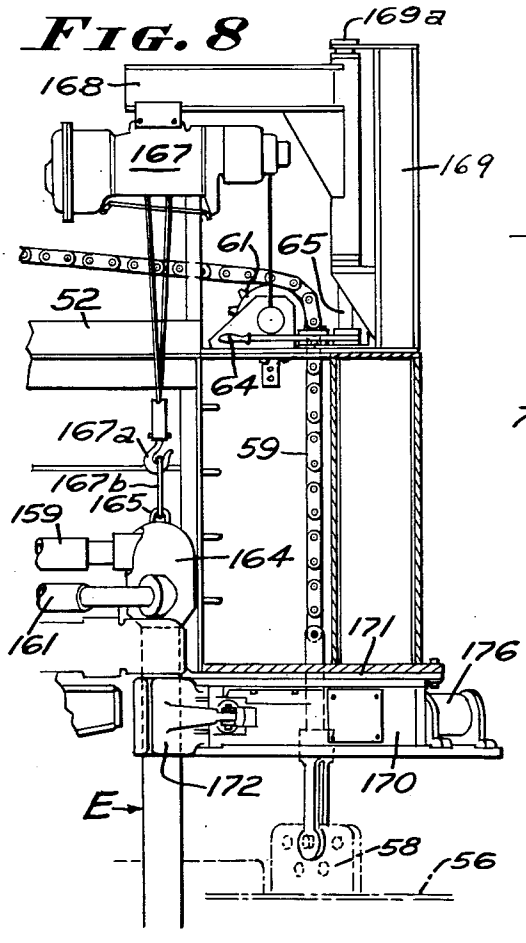
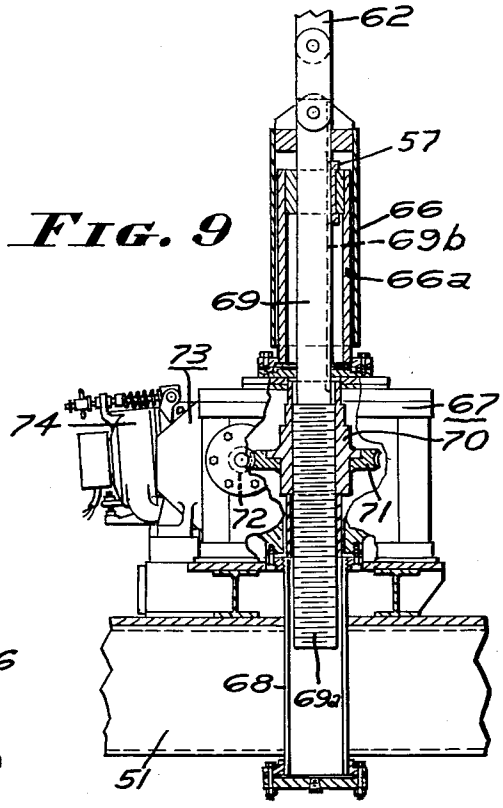


FIG. 9



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FIG. 10

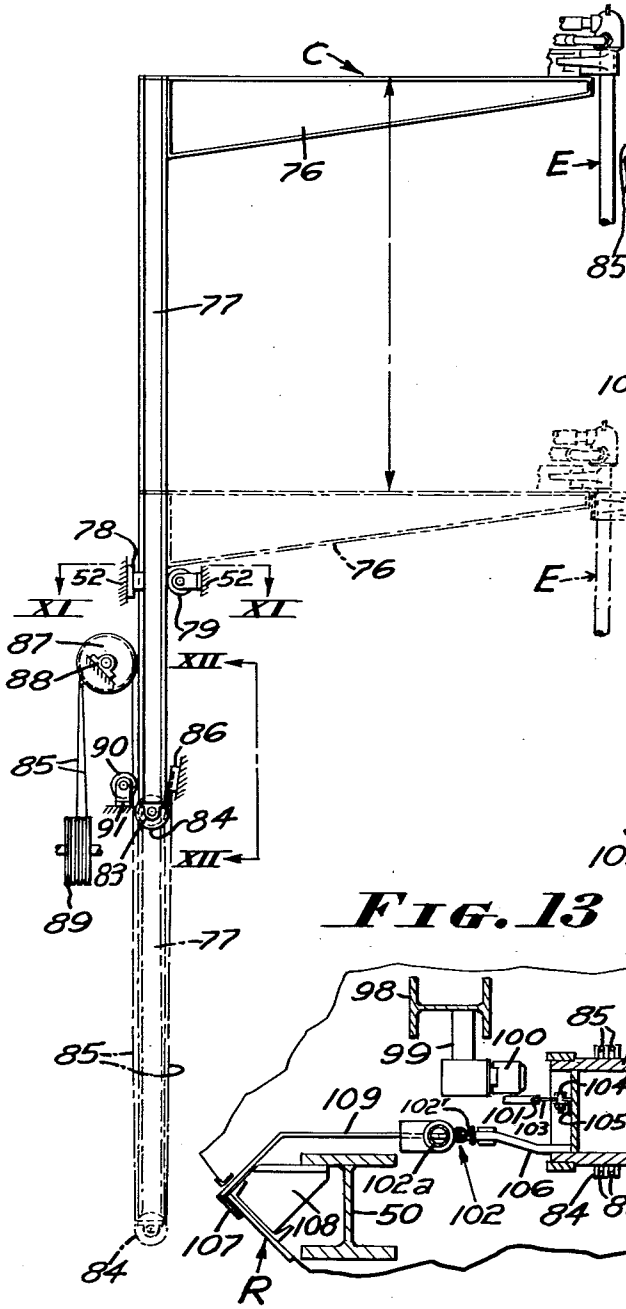


FIG. 11

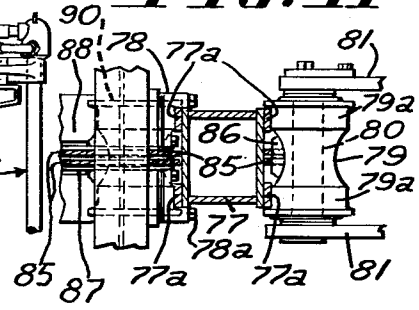


FIG. 12

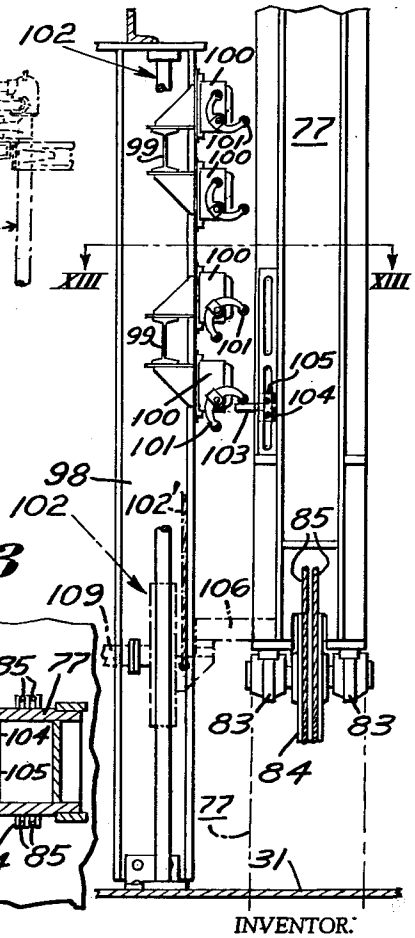


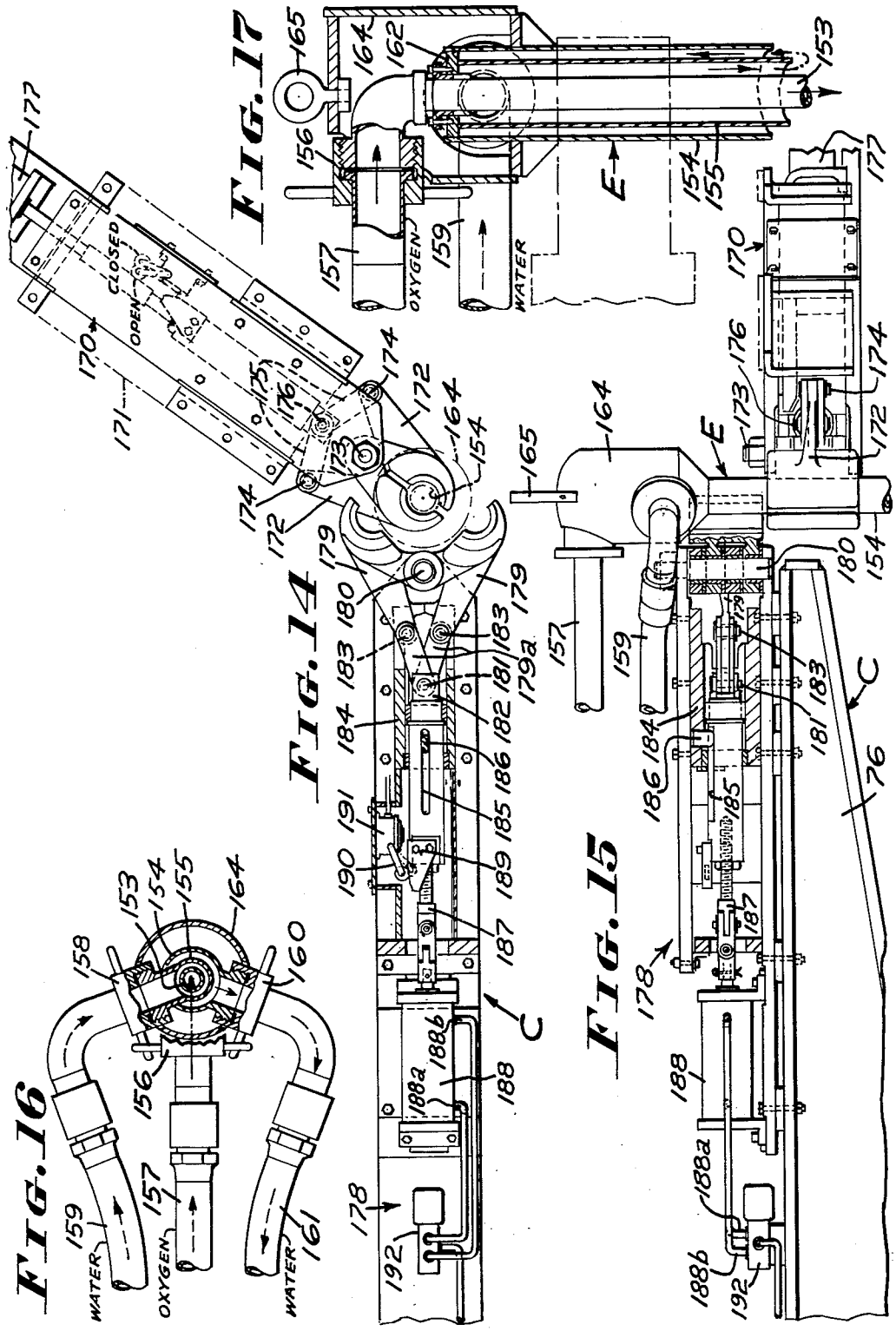
FIG. 13

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HOOD POST CRANE

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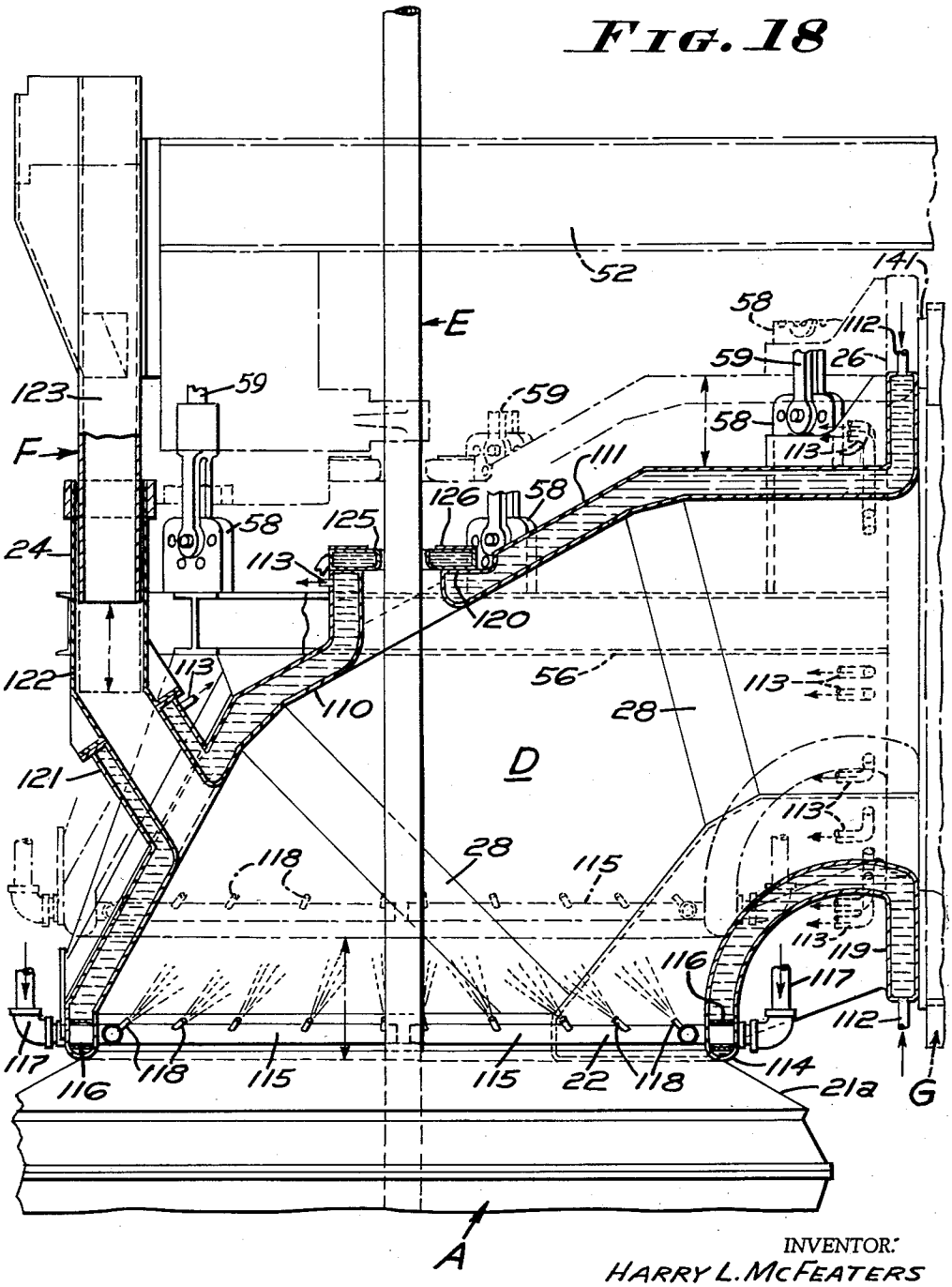


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FIG. 18



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HOOD POST CRANE

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FIG. 19

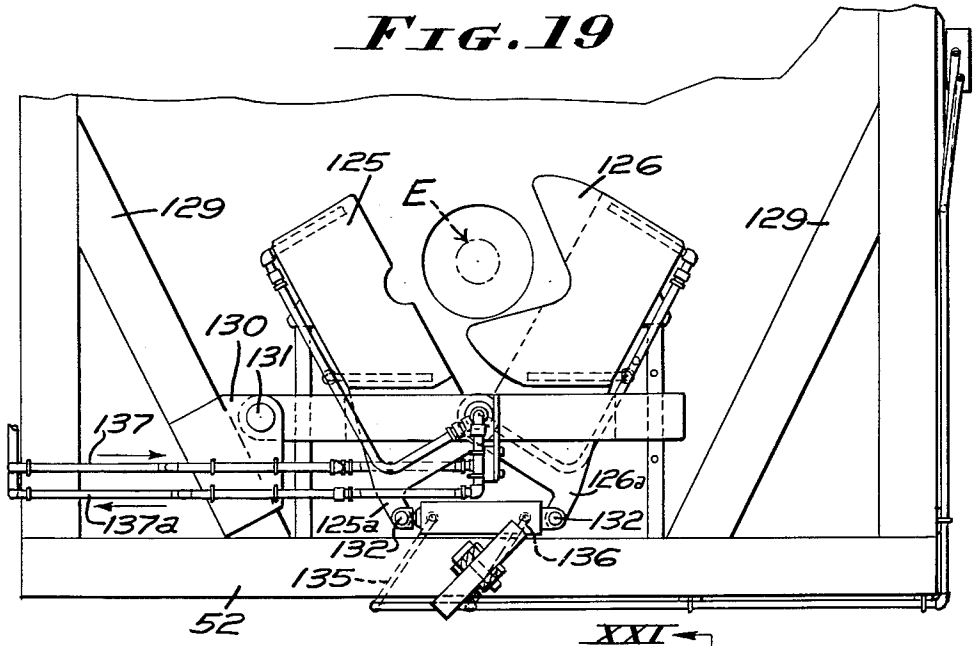


FIG. 20

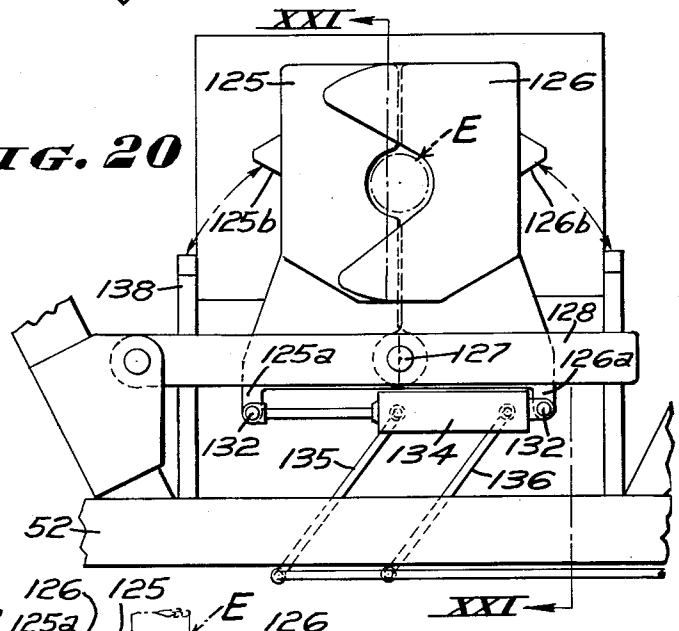
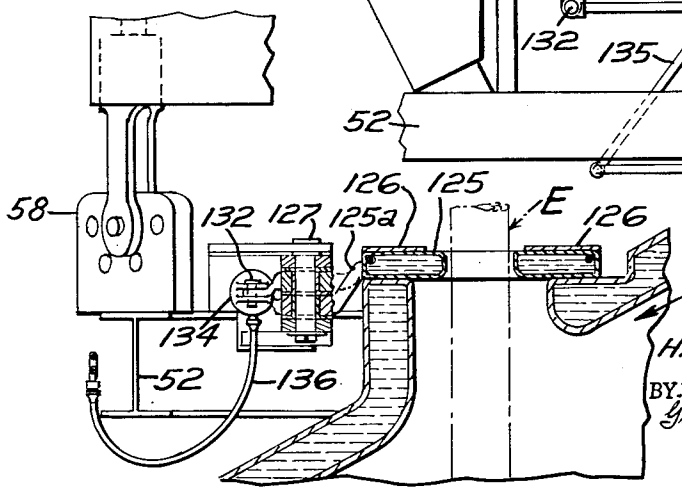


FIG. 21



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FIG. 23

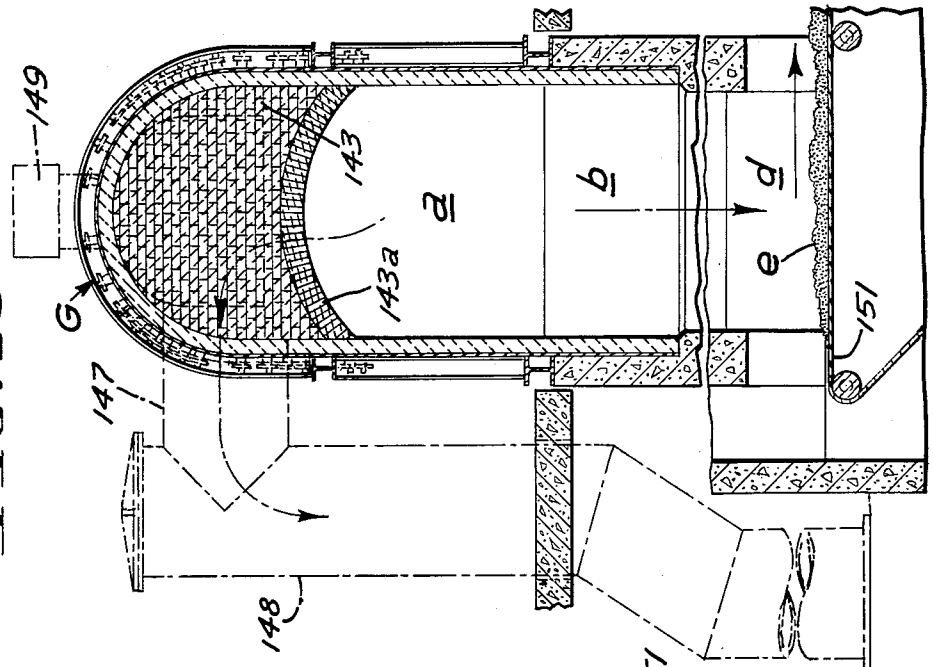
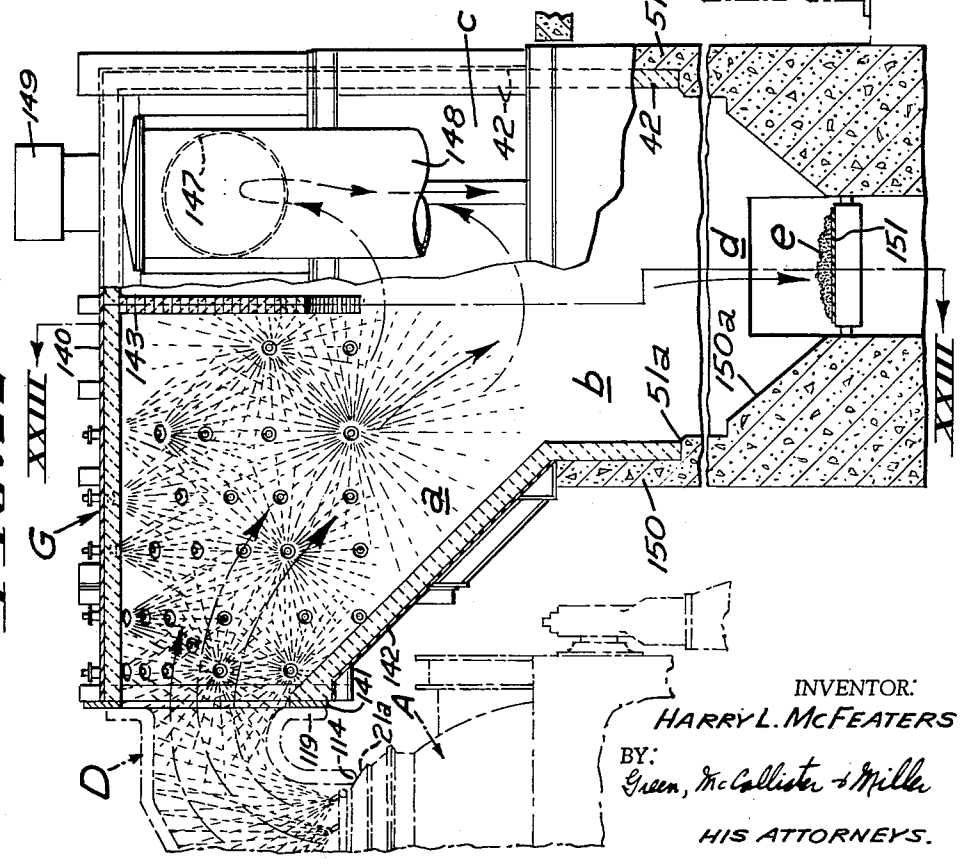


FIG. 22



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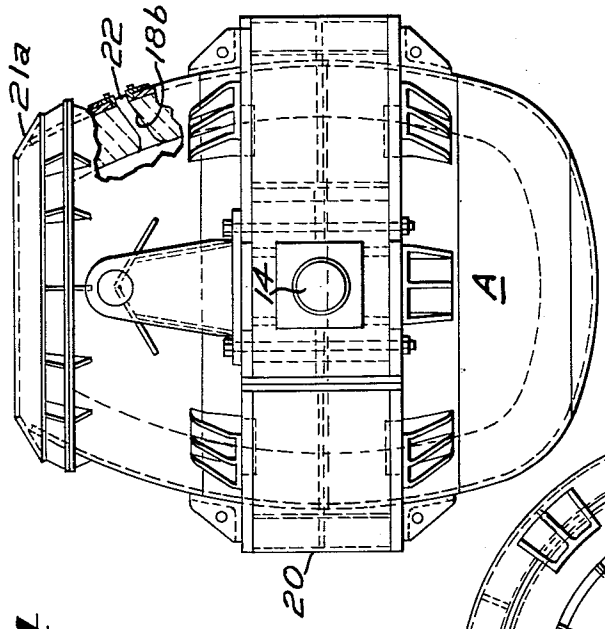


FIG. 25

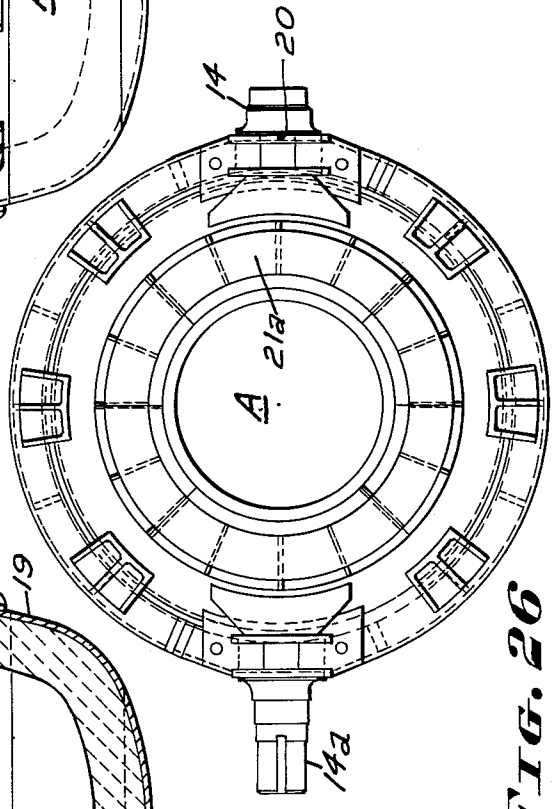


FIG. 26

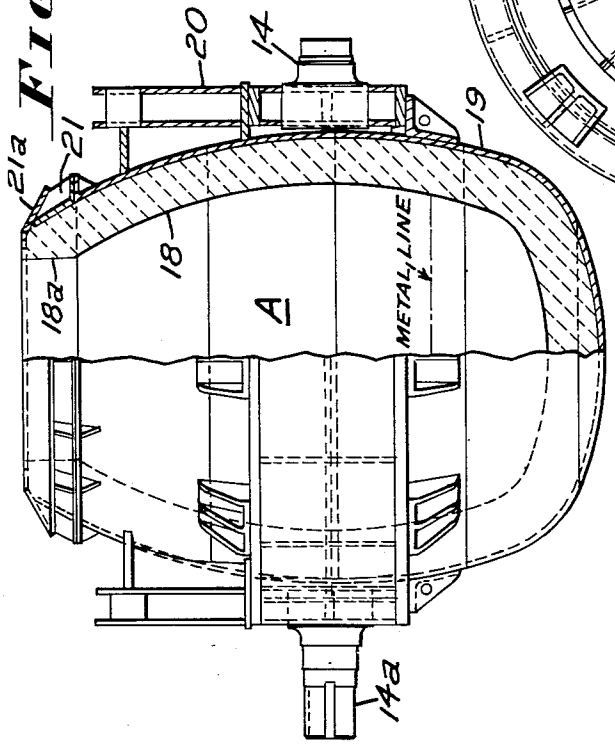


FIG. 24

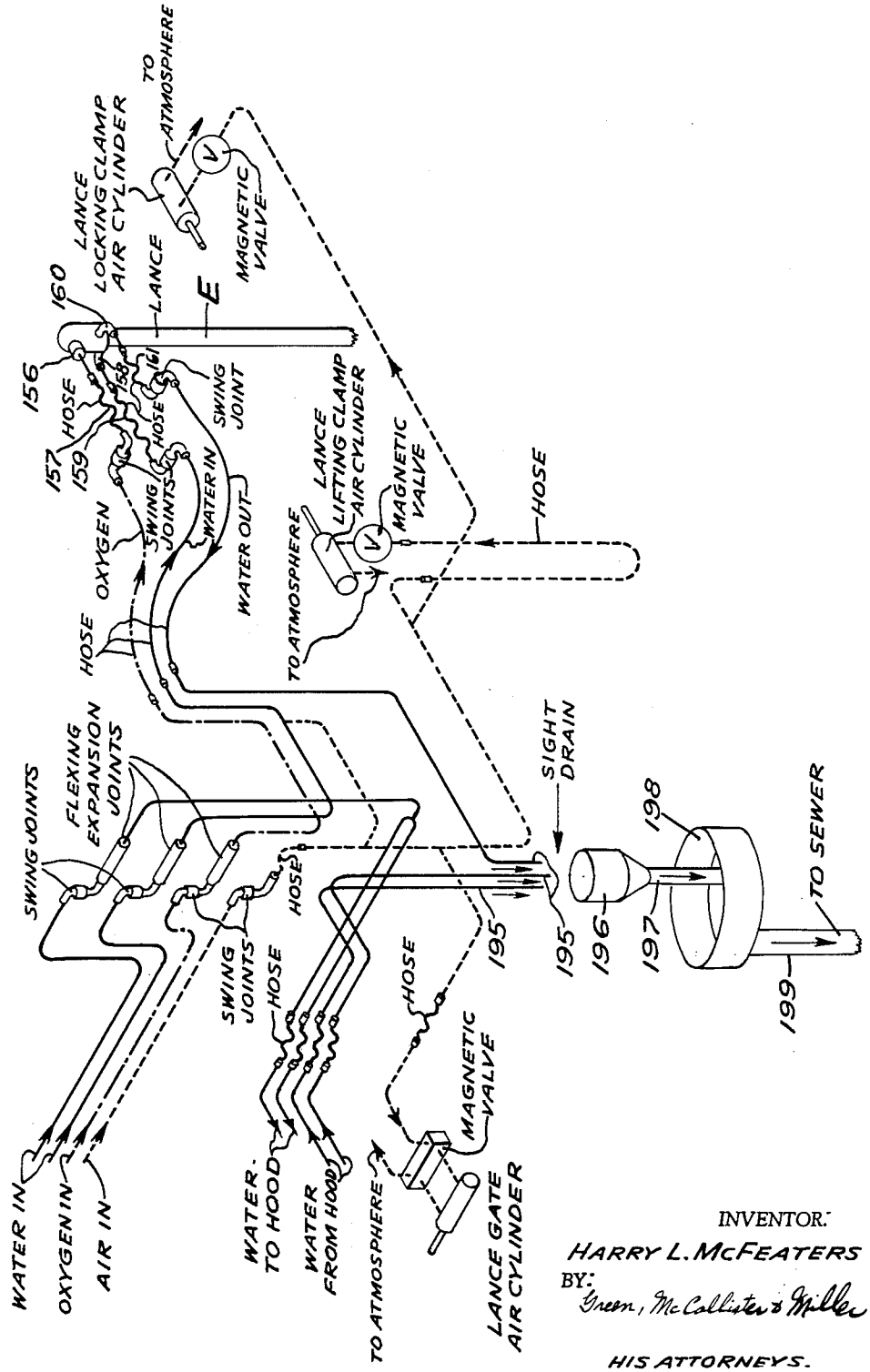
INVENTOR:
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HOOD POST CRANE

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FIG. 27



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United States Patent Office 3,026,102 Patented Mar. 20, 1962

3,026,102

HOOD POST CRANE

Harry L. McFeaters, New Castle, Pa., assignor to Pennsylvania Engineering Corporation, New Castle, Pa., a corporation of Pennsylvania

Filed Mar. 18, 1958, Ser. No. 722,257
26 Claims. (Cl. 266—35)

This invention pertains to a new and improved operating layout, system or procedure for a converter type of vessel or furnace such as used in refining metal.

A phase of the invention deals with handling equipment to be used with a vessel or converter for refining metal, such as steel, and for facilitating the employment of such a vessel and increasing its efficiency and effectiveness of operation. Another phase deals with the processing and handling of hot, contaminant-laden discharges from the mouth of a generator to avoid atmospheric contamination and recover metal oxides, etc., that may be carried as fume, as dust particles or as vapor with the discharge. A further phase deals with apparatus for improving the operation of a converter from the standpoint of the aspiration or air during the melting or refining operation.

As pointed out in my Patent No. 2,803,450, it is important to avoid the direct discharge of fumes, flame and gas from a mouth of a vessel directly into the atmosphere, both from a standpoint of the well being of the community and from the standpoint of minimizing airplane spotting by night. The problem has become particularly important in view of the increased acceptance of the so-called oxygen (LP) blow type of refining operation. Also, in such a type of operation, problems have arisen in connection with the employment of an overhead-introduced oxygen blow lance, its positioning and withdrawal, and in connection with the charging and pouring of the vessel, and with further charging during the melting operation, such as with slag-forming materials including lime, mill scale, etc.

In providing a suitable apparatus and layout to meet the needs of such an installation and provide a solution to the many problems involved, the factor of space limitations has to be considered. In other words, I have found that the installation should be such that it can be adapted to conventional mill space that may be available for conventional mill installations which include overhead cranes. I have been able to develop a construction and layout which can be installed for efficient operation of one or more melting or converter vessels in substantially the same space that has heretofore been allocated for open hearth and electric furnace installations. Because of the need for raising and lowering a hood that is employed to collect the discharge from each vessel and for handling the oxygen lance, the factor of head room space is particularly important.

It should be noted that the discharge from a vessel, such as an oxygen blow vessel or converter, may be within a temperature range in the neighborhood of about 3,000 to 3,100° F. and particularly so, in connection with larger size vessels of, for example, 80 tons capacity or more. Thus, the apparatus employed should not only be able to withstand such temperatures with minimum maintenance, but should be capable of doing so without danger of explosions, and in such a manner as to fully take care of the large volume of the discharge, particularly during the blowing operation, and in such a manner, that refining of the metal may be accomplished with full and maximum efficiency.

I have determined that overshadowing all the problems and factors involved is the need for suitable supporting and handling apparatus, not only for the hood, but also for the oxygen lance. It should be flexible from the standpoint of individual required operations as to the hood

and lance and as to the converter, itself, and in such a manner that the lance may be cleaned and, if necessary, replaced as the need may arise. Although lances are water-cooled and when properly constructed will last for about 100 to 120 heats without cleaning, I have found that they will last for about 1,000 heats when periodically cleaned. Atmospheric air normally contains about 79% nitrogan, and the velocity of flow of an oxygen blow tends to aspirate the atmospheric gases into the mouth of the vessel. Thus, a much better refined product, closely approaching in quality that of the open hearth steel, may be attained by substantially eliminating the sucking-in of atmospheric gases.

In general, I have devised apparatus and an apparatus layout or system that meets the many factors and problems presented in this connection, that does so in a practical and efficient manner, and that permits any desired usage of the converter vessel, including the additions of clean scrap metal and of slag forming materials, and a proper charging and pouring of the vessel.

It has thus been an object of my invention to meet the factors and solve the problems involved and to provide improved apparatus for cooperative use with a metal melting, refining vessel or converter;

Another object is to provide a system which will assure a new and improved operative cooperation and functioning between a vessel, a hood and a lance;

Another object has been to provide a commercially practical embodiment of my inventive discoveries;

A further object has been to improve and facilitate the operation and the resultant product produced by a converter melting type of metal refining or conditioning process;

A still further object has been to provide improved apparatus for receiving, controlling and processing the discharge from a converter vessel and for controlling and facilitating its operation;

These and other objects of my invention will appear to those skilled in the art from my description of the illustrated embodiment thereof;

In the drawings, FIGURES 1*a*, 1*b* and 1*c* are plan views of a layout or system constructed and employed in accordance with my invention wherein centrally-disposed, slag-material-handling apparatus (see FIGURE 1*b*) is employed with a pair of converter vessels and their attendant lance and hood apparatus;

More specifically, FIGURE 1*a* is a layout of a left hand converter system, FIGURE 1*b* is a plan of the centrally-disposed material-handling system, and FIGURE 1*c* is a plan of a right hand converter system that is similar in construction, apparatus and operation to the system of FIGURE 1*a*;

FIGURE 2 is an end view in elevation on the scale of FIGURES 1*a*, 1*b* and 1*c*, showing a converter vessel in vertical operating position and its relationship with spark trap apparatus; a hood is shown in a raised and out-swung position with respect to the converter and the spark trap apparatus;

FIGURE 2*a* is a greatly enlarged sectional detail through the wall of spark trap apparatus, such as illustrated in FIGURE 22, and showing a typical mounted relationship of cooling-fluid or water-spray means;

FIGURE 3a is a front or side view in elevation of the converter vessel, hood, spark trap apparatus, and of a ladle car of and on the same scale as FIGURE 1a; it will be noted that the apparatus of 1*c* is of the same construction as the apparatus of FIGURE 1a and thus, that FIGURE 3*a* is also representative of the apparatus of FIGURE 1*c*, except that it is turned 180°;

FIGURE 3*b* is a side or front view in elevation on the same scale as and taken along the line III*b*—III*b* of FIGURE 1*b*;

FIGURE 4 is a view in elevation, taken along the line IV—IV of FIGURE 1*a*, and on the same scale as that figure; it particularly illustrates mast, jib and swing frame features of post crane apparatus employed in accordance with my invention; this view shows the general arrangement of the post mechanism;

FIGURE 5 is an enlarged horizontal section taken along the line V—V of FIGURE 4, through the post crane apparatus;

FIGURE 6 is a fragmental section in elevation on the scale of and taken along the line IV—IV of FIGURE 5;

FIGURE 7 is a plan detail of a swing arm or frame jib of a hood part of the post crane apparatus and on a slightly enlarged scale with respect to FIGURE 1*a*;

FIGURE 8 is a vertical fragmental view on the scale of FIGURE 7 and showing outer portions of the hood jib of FIGURE 4, and particularly showing a swing jib hoist employed to change lances;

FIGURE 9 is a vertical view in elevation and partial section on the scale of FIGURES 7 and 8 and showing details of the construction of operating means for raising and lowering the hood frame;

FIGURE 10 is a somewhat diagrammatic or schematic view in elevation showing support and hoisting means for a lance crane or jib of the post crane apparatus and on the scale of FIGURES 1*a*, 1*b*, 1*c* and 4;

FIGURE 11 is an enlarged fragmental horizontal section, taken along the line XI—XI of FIGURE 10;

FIGURE 12 is a fragmental vertical view on the scale of FIGURE 11 and taken at right angles to FIGURES 10 and 11;

FIGURE 13 is a fragmental horizontal section on the scale of FIGURES 11 and 12 and taken along the line XIII—XIII of FIGURE 12;

FIGURE 14 is an enlarged fragmental plan, partially in section, illustrating details of a pair of lance clamping means of which the left hand one of this figure is carried by the hood jib and its swing arm, and the right hand one is carried by a fixed part of the post crane that projects outwardly as an arm or jib from the central part of the post crane apparatus;

FIGURE 15 is a side view in elevation and partial section of the structure of and on the same scale as FIGURE 14;

FIGURE 16 is an enlarged plan view, partially in section, showing quick-coupling top connections to a head or closing cap part of the lance, whereby oxygen may be supplied centrally thereto, cooling fluid may be supplied thereto about the oxygen-carrying portion, and heated fluid may be removed therefrom;

FIGURE 17 is a side view in elevation and partial section on the same scale as and showing the structure of FIGURE 16;

FIGURE 18 is an enlarged side view in elevation and partial section, showing a converter vessel and its hood in a sealed or operating position with respect to each other, and illustrating details of the construction of the hood and of duct means for delivering additions, such as slag-forming materials, through the hood to the converter;

FIGURE 19 is a greatly enlarged fragmental plan view of a self-centering, sealing-off or lance gate means that is mounted on the hood to close or seal-off a lance opening in the upper portion of the hood when the lance is in an operating position with respect to the converter vessel; this figure is enlarged with respect to FIGURE 18;

FIGURE 20 is a view similar to FIGURE 19, but showing the gate means in a closed or sealed relationship about the lance, whereas FIGURE 19 shows it in an open relation, such that the lance top or head part may be lowered or raised through the hood;

FIGURE 21 is a vertical view in partial section and on the same scale as and of the apparatus of FIGURE 20 and taken along the line XXI—XXI of FIGURE 20;

FIGURE 22 is a vertical view in elevation and partial section, on the scale of FIGURE 3*a*, showing the operating relationship between a converter, its hood and spark trap apparatus, including exhaust piping; the spark trap apparatus, its construction, as well as its sludge collecting means are illustrated in detail;

FIGURE 23 is an elevation in partial section on the same scale as and of the apparatus of and taken along the line XXIII—XXIII of FIGURE 22;

FIGURE 24 is a vertical view in elevation and partial section through a converter, such as shown in FIGURES 1*a* and 1*c*, which is adapted for utilization with the hood and other apparatus shown; this view is on a scale intermediate between FIGURES 1*a* and 18;

FIGURE 25 is a view in elevation taken at right angles to and on the same scale as the vessel of FIGURE 24;

FIGURE 26 is a top plan view of and on the same scale as the vessel of FIGURE 24;

And FIGURE 27 is a somewhat diagrammatic layout illustrating operating connections for cooling fluid, such as water, for oxygen supply to the lance, and for pneumatic or pressure fluid to operate air motors or cylinders; this view also illustrates a so-called sight gravity feed or drain of heated water or fluid that is returned centrally along the post crane apparatus to the sewer or to a fluid reconditioning system.

The Operating Layout

Referring particularly to FIGURES 1*a*, 1*b* and 1*c*, I have shown a two unit converter installation or layout employing the principles of my invention. The converter vessels or metal-refining units A and their attendant apparatus are shown located at opposite ends of a centrally-disposed additive supply system that includes a car dump track hopper, grating unit or storage area O, and an additive-supply weighing and distribution unit or structure P. The unit P includes conveyors, elevators, weighing and discharge hoppers which may be employed for supplying additives, such as mill scale and lime, to oppositely-disposed endwise-moving conveyors, one of which **225** supplies additives to the left hand converter and the other of which **218** supplies them to the right hand converter. Both of the converter vessels are of the same construction and are designated as A.

Referring particularly to FIGURES 1*a*, 1*c* and 2, a post crane apparatus, structure or unit, designated as B, is operatively mounted for movement between an "out" position I and an "in" or converter vessel cooperating position II. As shown particularly in FIGURES 3*a*, 4 and 18, an inlet sealing ring or portion **114** of enclosing walls of a hood unit D is adapted to make a sealing fit with a top lip or sealing edge **21***a* of a mouth portion of the converter A when the post crane apparatus B is at position II. It will be noted that the hood D provides a fume-discharge-receiving cover for the vessel A. At the same time, an outlet sealing flange portion **119** (see FIGURES 2, 3*a*, 18 and 22) of the converter A makes a sealing abutment with an inlet sealing face flange portion **141** of a fume processing receiver or spark trap apparatus G. It will be noted that the hood D (see FIGURE 3*a*) is shown of relatively short length to provide a direct flow path between the vessel A and receiver G. The inlet and outlet portions of the hood D are also shown at right angles to each other, as are the mouth portion of the vessel A and the inlet portion of the receiver G. Further, the bottom of the inlet portion of the receiver G is shown in substantial alignment with the top or lip of the mouth portion of the receiver A. As shown, the hood D provides a direct connection between the furnace vessel A and the fume processing receiver G, is of an integral, non-partible, tubular, dual shell wall construction, is positioned for movement into a cooperating fluid-sealing-off relation between the vessel A and the receiver G and for movement out of such relation to permit the vessel to be charged, tilted, repaired, etc. As shown in FIGURE 4, the hood is flexibly suspended by chains or cables in such

a manner as to center itself into, seek and find an effective seating relation between the receiver G and the vessel A and particularly, on the sealing edge **21***a* of the vessel when the sealing ring **114** of the hood is lowered into a cooperating relation therewith. This eliminates the need for a sectioned, refractory-lined, intermediate connection collar between a vessel and its hood and whose sections are partible and swing horizontally-outwardly therebetween.

Flame, fume, smoke, vapors, etc., are directly discharged into the hood D and are subjected to cooling water spray jets of sufficient intensity or force to provide a wall-screening curtain of fluid along the inner surface of the hood D to protect it and to condition and cool-down the fume or discharge from an entering temperature of about 3000 to 3100° F. to a temperature of discharge from the hood of about 2500° F. The intensity pressure of the spray from the jets is at least slightly greater than the force or pressure of movement of the fume through the hood D as, for example, effected or at least partially induced by an exhaust fan (not shown) that may be located within or in connection with an exhaust conduit **148** that leads from spark trap or fume receiving and processing apparatus G.

For an installation employing about 80 ton net converters, I have successfully used spray nozzles with about a ⅜ inch opening and which have about a 12 inch peripheral or circumferential spacing along the inside of the hood D. Such nozzles will provide jets that are of sufficient velocity to cut through the gases or fumes when the sprays are projected at about 120 pounds per square inch. The jet sprays not only protect the inner wall of the hood, but help to immediately solidify slag and other vaporized solids.

As shown in FIGURES 22 and 23, the discharge or outflow of fume from the hood D is flowed into the spark trap apparatus G where it is subjected to additional cooling and conditioning action. As shown particularly in FIGURES 2*a* and 22, cooling fluid jets in the refractory wall of the spark trap apparatus G spray water or cooling fluid in a substantial mist form as the fume or discharge moves therethrough. Sludge and condensed particles from the fume or discharge are collected at the bottom of the spark trap, while the now-cooled and treated gases are discharged therefrom at a temperature of about 500° F. into the down or discharge conduit **148** which may carry them to a final conditioning apparatus (not shown), but such as indicated in my Patent No. 2,803,450.

Referring again to FIGURES 1*a* and 1*c*, charging metal may be supplied to each converter A by tilting it on its side and employing a charging ladle car K which moves on side tracks J. On the other hand, slag may be removed from each converter by slag cars M and refined metal by ladle cars N which operate on opposite side tracks L. It will be noted that each converter A is mounted for tilting in opposite directions, so that it can be easily charged, poured or tapped.

Referring particularly to FIGURES 1*a*, 3*a*, 4 and 18, the hood D is shown provided with a top opening through which a suitable oxygen or blow lance E may project, and also through which it may be raised and lowered to, as shown in FIGURES 1*a*, 1*c* and 2, drop it in a lance pit Q, at which it may be cleaned or reconditioned. At the same time, a substitute lance E may be picked-up for use. Although in FIGURES 1*a* and 1*c*, I have shown only one lance pit Q, it will be apparent that any number may be provided, as needed. In this way, lances can be periodically cleaned and reused until they are worn out, at which time, they may be removed from the pit by an overhead crane and a new lance substituted.

The post crane apparatus B has, as shown, out-swing arm, frame or jib means, generally designated as C, which is moved about the central post of the apparatus B to swing it between the previously mentioned positions I and II. The swing arm means comprises a swing arm or jib frame **76** for raising and lowering the lance E into and out of an operating position within the converter A (see FIGURE 4). It will be noted from FIGURES 3*a* and 4, that in its upper position, the lance E clears the mouth and lip of the converter A and its lower end portions lie within the hood D. In its lower position, the end portion of the lance E is located at a suitable level with respect to the melt line, for example, with an 18 inch spacing that is suitable for the refining operation. In FIGURE 4, I have shown a scale R for indicating the positioning of the inner end portion of the lance E within the mouth of the converter to visually indicate it for reference and control purposes.

The swing arm means C also comprises a swing arm or jib frame beam structure **52** of fixed vertical mounting with respect to the apparatus B that carries a swing jib or auxiliary hoist **167** for handling the lance E when it is to be lowered through the hood D into a pit, such as Q. The hoist **167** is also used when a new or replacement lance E is to be lifted out of a pit Q, to be carried up into the hood D, and then to a position above the converter A. A hood frame structure **56** carries the hood D and moves with it as an integral part thereof when the hood is raised into and out of a sealed or cooperating relationship with the upper lip edge of the converter A, and swung into and out of position with the inlet flange of the spark trap G. When raised, the hood D is free to be swung on its beam jib structure **52** out of a cooperating and sealing relationship with the entry or inlet end of the spark trap G, and to be carried with the lance E from position II to position I of FIGURES 1*a* and 2.

It should be noted that service utilities, such as water, oxygen, air, electric wiring, etc., are positioned to extend along a hollow center post or axis of rotation of the post crane apparatus B and along, see also FIGURE 27, easily disconnecting swing joints, so that the apparatus including lance E, may be readily connected and disconnected for maintenance and repair. In addition, flexible expansion joints are provided to permit necessary raising and lowering movements and in this connection, flexible hose may also be employed. The swing joints may be of conventional construction, such as supplied under the trademark Barco.

It will be noted that, in accordance with my invention, the converters A are blown by means of the lances E with the hoods D tightly in place, not only with the converters A, but with respect to the spark traps G. This, with a self-centering, sealing or closing off lance gate means **125**, **126** shown in FIGURES 18, and 19 to 21, substantially eliminates aspiration of atmospheric air and nitrogen of the air during the refining operation. The construction and mounting of the hood D with respect to each converter A is such that the hood, in effect, constitutes a top for the converter. Thus, some vaporized metal oxides, etc., may be condensed and returned to and carbon monoxide gas burned to carbon dioxide in the converter for minimizing the loss of value content of the melt and of the heating content of the gases. It will also be noted that the hood D has a short and abrupt-turn right-angle side outlet which further minimizes losses.

FIGURE 18 shows duct means F for supplying the additives, such as lime and mill scale, through the hood D to the converter A at any time while the hood is in place over the converter. As previously pointed out, such additives may be supplied by unit P.

The raising and lowering of the swing jib **76** for the lance E may be constructed to provide approximately 15 feet lift or movement of the lance. The raising and lowering of the swing jib for the hood may be constructed to provide a lesser movement of about 18 to 24 inches.

As shown in FIGURES 5, 6 and 9, I have provided three drive means for the post crane B, one **35** for rotating it as a unit along with its jib means C, a second **95** for raising and lowering the lance jib, and a third **73** for raising and lowering the hood jib. For simplicity, electrical motors have been utilized in this connection.

The lance E is provided with two sets or pairs of clamping means. An upper pair or set is actuated by fluid motor 188 (see FIGURES 14 and 15), and is carried by the lance jib 76 (see FIGURE 4) to normally grip the lance at all times when the lance is being raised and lowered by the lance jib, and except when it is to be replaced by means of the auxiliary hoist 167. A second set or pair of clamps is mounted on the vertically-fixed jib 52 of the jib means C and is actuated by fluid motor 177 (see FIGURE 14) to grip the lance below the first-mentioned set of clamps when the lance is in its lowered position within the converter and again to aid in supporting it and to prevent pivot action when the lance is raised to its uppermost position of FIGURE 4.

Structural Details

As shown particularly in FIGURES 2, 3*a*, 4 and 5, the floor level of the mill has been designated as **10**. Beam-supported, removable grating **10'**, on the same level as the floor **10**, is shown in FIGURE 3*a* to provide easy access to operating parts of the converter A. As shown in FIGURE 2, the lance pit Q is provided by an opening in the floor **10** that is carried on an under pit floor **9** by upright support members **11**. The converter A is shown mounted, at least as to its trunnion and operating means, below the floor level on a base **12** which carries a pair of transversely spaced-apart trunnion stands **13** and their associate trunnion bearings, see particularly FIGURES 2 *and* 3*a*.

The vessel A has, as shown in FIGURES 3 and 24, central pinion or trunnion end shafts **14** and **14***a*. One shaft **14***a* serves as the drive through a speed reducing, intermeshing gear train or unit **15**. The larger gear of the gear unit **15** is keyed to the shaft portion **14***a* and the other or smaller gear is keyed to a conventional reversible motor drive unit **16**, in order that the converter may be tilted or revolved to present its mouth portion at any suitable position for charging and discharging it.

As shown in FIGURES 24 to 26, the converter A has an inner refractory lining of rounded convolute shape to correspond to the shape of the normal wear and thus, minimize such wear particularly, during the blowing operation. The inner refractory wall **18** terminates at its upper end in a substantially vertical pour lip or mouth portion **18***a*. The refractory wall is of substantially the same thickness along its extent, with a slight widening from its melt line to further increase its wear resistance. An outer metal shell or casing **19** encloses the refractory wall **18** and is reinforced by an outer frame **20** to carry the end shafts **14** and **14***a*.

At its mouth or upper end, the vessel or converter A has a separate reinforcing framework **21** which carries an inwardly-upwardly declining metal sealing rim or lip portion **21***a*. As shown particularly in FIGURE 18, it is this portion which is engaged by the sealing ring portion **114** of the hood D to provide a sealing fit with respect thereto at the time of the refining operation and of fume discharge. As shown in FIGURE 25, the converter vessel may be provided with a tap open portion **22** in its metal casing and a corresponding through open portion **18***b* in its refractory wall. A conventional tap hole plug (not shown) may be employed to close off the tap hole thus provided.

In FIGURES 2, 4, 5 and 6, I have illustrated how the post crane B is securely bolted to the floor **10**. In FIGURE 6, it will be noted that the floor has suitable openings therethrough to bypass cooling water, operating air, oxygen and electrical connections. The bottom of the hoist crane B has a fixed-position or under-support frame, stand or table **25** that extends therebeneath and carries a top or ring gear and track supporting plate **26**. An upwardly-projecting bull wheel or annular ring member **27** is secured to project upwardly from the plate **26** and has outwardly-beveled inner ring gear or annular rack portion **27***a* to mesh with a beveled drive gear, pinion or wheel **28** and rotate the post crane about its central axis. A drive shaft **29** on which the drive gear or pinion **28** is secured is carried by bearings **30** at its ends which are suspended from an upper rotatable support frame or table structure **31**. A side housing skirt or plate **32** projects downwardly from the upper support frame **31**, as also disclosed in FIGURE 6. The drive shaft **29** has a drive wheel gear train **33** which is actuated through speed reducer **36** (see FIGURE 5) by a reversible electric motor **35**. The beveled gear **28** is thus driven at a relatively slow speed to advance it along the teeth of the ring gear portion **27***a* and effect rotation of the upper frame structure **31** about the lower or stationary frame structure **26**. As shown particularly in FIGURE 5, a magnetic brake **35***a* is provided for controlling the operation of the motor **35**.

As shown in FIGURES 5 and 6, the upper frame or table structure **31** also rotatably journals or carries a pair of beveled guide roller wheels **38** that are mounted to project downwardly therefrom at an outer position with respect to the beveled drive wheel **28**. The rollers **38** engage and move along an outer outwardly-declining track or rail portion **27***b* of the annular ring member **27** for rotative movement therealong during the rotation of the upper table **31**.

The central portions of the stationary table **25** and the rotatable table **31** are open vertically to receive a hollow central tube or post member **40**, along which electrical wiring, etc., are adapted to extend. The tube **40** at its upper end carries an enlarged collar **41** whose lower flange portion **41***a* is provided with pins **42**. The limits of crane rotation may be controlled by manual switches or by conventional electric limit switches for the driving motor. As shown particularly in FIGURES 5 and 6, the pins **42** are adapted to drop into one of several cross slots **37***a* in a disc ring **37** that is secured to the top of the table **31** to prevent rotation of bearing housing with respect to the post crane deck. An enlarged shaft portion **43** is secured to the collar **41** and about the central post or tube **40** and has bearing portions **43***a* to engage upon an inner bearing wall portion **31***a* of the rotating table **31**.

The enlarged bearing shaft portion **43** terminates in a reduced lower shaft portion **44** which is engaged at its upper and lower end portions by spaced-apart guide and bearing rings **39** that are carried by an inner wall portion **25***a* of the bottom or stationary frame structure **25**. A washer ring **45** and end positioning nut **46** are carried on a lowermost portion of center post or tube **40** to seal off the above positioned bearings and hold the shaft construction in position in a fixed relationship as to the bottom frame structure **25**.

Four substantially equally-peripherally spaced-apart upright channel-shaped support members **50** are secured at their bottoms to project upwardly from the upper or rotating table or frame structure **31**, as shown particularly in FIGURES 5 and 6 of the drawings. A ladder **50***a*, see FIGURE 4, may be secured in position along one of the upright beams or channels **50**, to facilitate inspection and repair of the apparatus.

The upright support members **50** are reinforced by cross frame beams **51** substantially intermediate or midway of their lengths, and at their upper end portions, by inner portions of channel frame **52** constitute the fixed jib or outwardly-projecting support arm structure. The structure provided by **52** has a fixed vertical positioning, but will swing or turn with the upper table **31**. As shown in FIGURE 4, the vertically-fixed jib frame or support arm structure **52** has side rails **52***a*, so that an operator may walk therealong. The fixed jib or support arm structure **52** is shown reinforced by side bracket members **53** (see FIGURES 2 and 4) which are secured at their one ends to the bottom of the fixed jib **52** and at their other ends to the upright members **50**.

As shown in FIGURES 2, 3*a*, 4 and 8, the hood D, in effect, provides one hoist jib of the post crane, since it is provided with upwardly-projecting lugs **58** that project from its frame **56**, see also FIGURE 18. The lugs **58**

are mounted in side pairs along the frame **57** and suspend the hood D by means of front and back side chain pairs **59** on each side of the frame. As shown particularly in FIGURE 4, each side chain pair is tied together by adjustable links **60** and are supported by idler sprockets **61** that are rotatably mounted on the jib frame **52**. Thus, each pair of side links **60** is connected to a single side-mounted main chain **62** (see also FIGURE 7) that is mounted on an idler sprocket **63** that is rotatably positioned on the jib frame **52**.

In FIGURE 8, I have shown a manually-operated swing lever arm or handle **64** which may be provided to manually swing the auxiliary hoist **167** that is carried by swing jib **168** which is pivoted on shaft **65** as indicated, for example, at **169***a* with respect to upright member or beam **169**. It will be noted that the lever arm **64** is secured on a shaft **65** that is rotatably mounted on the jib frame **52** and carries swing jib **168**. Each main link chain **62** (see FIGURE 9) of the main side pair is shown connected to a head part **66** of one of a pair of screw-down units **67** (see FIGURE 9) that are employed to raise and lower the hood D. In this connection, a screw jack, fluid cylinder or other suitable type of raising and lowering device may be employed, although for the purpose of illustration, I have shown a screw jack type. FIGURE 9 shows details of the construction of an outer telescopic sleeve part **66** that is secured to move with the chain **62** and over an inner sleeve part **66***a* that is secured to a fixed mounting of the unit **67**. An operating shaft or rod **69** is slidably carried by the inner sleeve **66***a*, is connected to chain **62**, and has a lower adjustable threaded portion **69***a*. The shaft or rod **69** is prevented from turning by a fixed key **57** that is held by inner sleeve member **66***a*. The key **57** fits vertically-slidably in a longitudinal keyway or groove portion **69***b* of the shaft **69**. A closed end, central tubular column **68** projects upwardly through the intermediate support frame **51** and is secured to the fixed housing of the unit **67** to receive the lower threaded end portion **69***a* of the operating rod or shaft **69**. An internally-threaded screw-down collar or sleeve **70** is carried on the threaded portion **69***a* and has a worm gear **71** meshing with a worm **72** of a drive shaft of an electric motor unit **73**. Magnetic brake **74** is shown for use with the motor **73**. The sleeve **66***a* prevents dirt from getting into the threads. It will also be noted that the unit is constructed so that the screw is easy to remove.

As disclosed particularly in FIGURES 4, and 10 to 13, the swing jib or support arm structure for the lance E has been designated as **76**. Its extreme upper and lower positions when it is being utilized with a converter vessel and hood assembly are shown in FIGURE 10. The lance jib **76** is secured at its inner end to a vetrically-slidable, box or rectangular-shaped upright beam or post member **77**. The member **77** projects downwardly along the post crane B and is slidably supported with respect to the vertically-fixed jib structure **52** by a slide guide or mount **78**, and opposed rotatable guide rollers or wheels **79** and **90**.

As shown particularly in FIGURE 11, the guide roller **79** is rotatably carried on a pin shaft **80** that is secured between a pair of support arms **81** that project from the structure **52**. The opposed slide guide or mount **78** has an inwardly-offset guide portion to receive the post **77** and is mounted on the structure **52** by bolts **78***a*. The post **77** is provided on its opposite sides with slide strips **77***a* which, on one side, cooperate with the inwardly-offset guide portion of the guide mount **78**, and which on the opposite side of the post **77**, cooperate with annular end portions **79***a* of the guide rollers **79** and **90**.

The lance mast may be raised and lowered by cable, rack and pinion or other means, but for illustrative purposes, I have shown cable means. As shown particularly in FIGURES 10 to 13, the lower end of the post **77** has bearings **83** which rotatably carry a pulley wheel **84**. Dual cable means **85** interleaves over the groove portions of the pulley wheel **84**, and at one end is fixed or anchored at **86** to one of the upright members **50** of the post crane apparatus B. The cable means **85** also passes between the post member **77** and guide roller or wheel **90** that may be rotatably secured (see FIGURE 5) to one of the upright members **50** between a pair of upright members **98** and **98'** by a mount **91**. The cable means **85** also passes over an idler pulley wheel **87** that is rotatably mounted on the fixed jib frame **52** by bearing means **88**. It will be noted that the cables are connected to an equalizer arm, so that if one cable should break, the other cable will support the lance until repairs can be made. As shown particularly in FIGURES 5 and 10, the cable means **85** then interleaves about a cable wind sheave **89**, in order that it may be extended and shortened in length to move the post **77** and the jib **76** from the dot-and-dash "down" position to the full line "upper" position of FIGURES 4 and 10.

As shown in FIGURE 5, the winding drum or sheave **89** is actuated by a meshing gear train **92**, shaft **93**, gear reduction unit **94**, and a reversible electric motor unit **95**. A conventional magnetic brake unit is employed with the motor **95** to retain or lock it in a desired position. The weight of the jib **76** facilitates its "down" movement, while the power of the motor is instrumental in effecting its "up" movement.

In FIGURES 5, 12 and 13, I have illustrated a support structure comprising a supplemental vertical upright beam **98** and cross beams **99** which carries a series of vertically spaced-apart electrical trip switches **100**. The switches **100** have pivoted trip fingers **102** that are adapted to engage a trip finger or pin **103** that is adjustably carried by clamping means **104** on a slotted, mounting angle piece **105** that is secured along the side of the upright post **77**. As shown particularly in FIGURE 13, the post **77** also carries an outwardly-projecting indicator and guide arm structure **106**, **109** whose pointer finger **107** cooperates with the scale R (of FIGURE 4) to indicate the position of the end of the lance E with respect to the melt level in the converter A when the lance is in its lowered position. It will be noted that the indicator scale R is carried by support tabs **108** that project from one of the upright beam members **50**. The same positioning of R and its accessories is shown in FIGURES 4, 5 and 13.

In FIGURES 12 and 13, I have shown a counterweight system for the post **77** which includes a guide assembly **102** having a vertical guide rod secured at its ends to extend between table **31** and a top portion of upright beam **98**. Guide arm member **109** carries a guide tube **102***a* that rides on the guide rod to slidably carry a counterweight (not shown). Counterweight cable **102'** is secured to the arm **106**. In FIGURE 12, the counterweight assembly is shown in its "down" position that corresponds to the "down" position of post **77**.

As shown particularly in FIGURE 18, the hood D has a metal inner lining **110** and a spaced-apart outer lining or casing **111** which together define water passageways or water jacketing therebetween. If necessary, they may be reinforced in their mounted relationship with respect to each other by sparsely spaced through-bolts. Butt joints are used for the inner wall. Any inside ribbing is secured to project only from the outer wall to minimize heat transfer between walls. It will be noted that it is highly important to avoid hot spots along the inner lining **110**, such as at high points, to avoid convex connecting surfaces, and if any welds are made, to make them beyond the bend or joint which they may represent. The inside lining **110** is thus relatively smoothly contoured. Cooling water is introduced through a plurality of upper and lower inlets, such as **112**. Warmed or heated water is exhausted through a plurality of outlets, such as **113**. It will be noted that I have provided outlets at high points in the water jacket to eliminate so-called hot spots. As shown in this figure, the hood is re-

inforced and supported by the vertically-fixed jib frame structure 52.

The lower open mouth portion of the hood D is defined by an annular, rounded, sealing ring or nose 114 that is defined by the inner and outer linings 110 and 111. An inside spray system is shown made up of quadrant headers 115 supplied and mounted in a spaced apart relationship about the inner periphery of the ring 114 by through-connections 116. Each connection 116 is connected to cooling water inlet piping 117 for supplying the cooling water to a series of peripherally spaced-apart and tilted spray jet units 118, all of which operate simultaneously to spray jets along the full inner periphery of the hood from the area of the sealing ring 114, upwardly along the periphery of the walls of the inner lining 110. The proportioning of the cooling water for the hood is such that more water circulates through the top or hottest portions than through the lower or cooler portions.

The hood D has a lance opening substantially centrally through its top portion that is defined by a planar sealing flange portion 120 to cooperate with and receive the self-centering sealing-off lance gate means 125, 126 which will be hereinafter described in detail. The purpose of the gate means is to seal-off the entry of the lance E into and through the hood D while the apparatus is in its operating position. The hood also has a water-jacketed outlet sealing flange 119 of substantially vertically planar face to abut with and provide a wiping type of sealing joint with inlet flange 141 of the spark trap G (see also FIGURES 2 and 22).

The hood D also has an upwardly-projecting side inlet portion 121 that is water-jacketed and carries a fixed portion 122 of telescopic, additive-supplying assembly F. As shown in FIGURE 18, the lower sleeve portion 122 of the telescopic assembly F is fixed to the frame structure 52 while an upper and inwardly-positioned feed tube portion 123 is carried by a conveyor mounting of the additive system. As a result, when the hood D is raised and lowered with respect to the converter the tubing members 122 and 123 will slide with respect to each other to maintain the connection therebetween, without disturbing the aligned feed mounting of either of the members. It may be noted that the telescopic additive chute may be a swing arm device.

In FIGURES 18 to 21, I have illustrated lance gate sealing-off means that is cooperatively employed between the lance E and the hood D to seal-off the opening therebetween when it is in a closed relationship and to open sufficiently to freely bypass the lance E at its upper head when the lance is to be removed or dropped into a maintenance pit Q, see FIGURE 1*a*. This gate means comprises a pair of cooperating opposed fingers 125 and 126 which are pivotally mounted by a pin 127 on a cross-support, swinging bar member 128 to provide for self-alignment about the lance. The vertically fixed frame 52, as shown in FIGURE 19, is provided with corner reinforcing members 129 and one of these carries a bifurcated collar 130 to which an end of the bar 128 is secured by a pin means 131. The fingers 125 and 126, at their back end portions, have projecting operating arms 125*a* and 126*a* that are connected by pins 132 to opposite ends of an actuating fluid (air) motor 134. Guide ears on the gate finger 126 (see FIGURES 19 and 20) enable the entire gate mechanism to swing on center about the lance.

It will be noted that the motor 134 is mounted for movement between the operating arm portions 125*a* and 126*a* to effect opening and closing of the fingers 125 and 126, and is supplied with fluid by air pressure lines 135 and 136. The amount of opening of the fingers is controlled by stop abutments 125*b* and 126*b* which, as shown, in their outer positions strike or abut against outwardly-projecting stop bars 138. The stop abutments also return the gate to a central position irrespective of any misalignment of the lance. As shown in FIGURES 19 and 21, the fingers 125 and 126 are water jacketed and are supplied with cooling fluid by pipe connection 137 and exhausted of heated water by pipe connection 137*a*.

Referring particularly to FIGURES 22 and 23, the spark trap apparatus G has an outer metal casing or housing 140 and an inner refractory lining 142. A face plate or inlet sealing flange 141 is positioned about its inlet opening to serve as an abutment and sealing and wiping surface with respect to a water jacketing back flange portion 119 (see FIGURES 3*a* and 4 and 18) of the hood D. The fume and gas discharge from the hood D enters an upper and larger chamber portion *a* of the spark trap apparatus G which serves as an outer and temperature-reducing chamber. In this connection, the refractory lining 142 is provided with a series of spaced openings 142*a* (see also FIGURE 2*a*) therethrough within each of which a cooling water spray unit 145 is positioned.

It will be noted that the spray units 145 have a housing 143 which is secured to the outer metal lining 140, and a threaded, fluid-inlet, connector nipple 144*a*. The tube 144 of the unit extends within an initial-thickness, circular portion 142*a* of the refractory wall. As also shown in FIGURE 2*a*, the refractory wall has a cone-shaped inwardly-diverging opening 142*b* through the major portion of its thickness that converges backwardly to the circular or annular minor thickness portion 142*a*. This assures the desired mist type of spray into the chamber *a*.

The fume discharge moves downwardly (see FIGURE 22) through the chamber *a* of the unit G into a bottom chamber *b* and then upwardly along an under-passageway into a secondary gas treatment chamber *c* of reduced size with respect to the primary chamber. The now-cooled gases are thus slightly compressed before they are discharged through an outlet 147 into a down-flow discharge or exhaust conduit 148. The conduit 148 may be connected outside the mill building to a final cleaning apparatus (not shown). The spark trap has an explosion valve 149. At its lower end, the unit G is enclosed by an outer cement or concrete wall 150. A chamber *d* is provided beneath the chambers *a* and *b* by inwardly-downwardly converging portions 150*a* of the wall 150 to discharge sludge and condensed or dropped out particles *e* upon a continuously-removing belt conveyor 151.

The refractory lining 142 of the unit G may be of conventional refractory brick work and has a nose or partition wall 143 that segregates the primary chamber *a* from the secondary chamber *c*. As shown in FIGURE 23, partition wall 143 is supported by bridge wall 143*a*. This apparatus in addition to serving as a condenser for suspended and vaporized particles, etc., also serves to finally reduce the temperature of the discharge gases to such a value (in the neighborhood of 500° F.) that it may be finally cleaned by suitable final cleaning apparatus.

The lance E, as shown particularly in FIGURES 2, 3*a*, 4 and 14 to 17, has an outer tubular member 154, an intermediate tubular member 155, and an inner tubular member 153. Oxygen is supplied internally of the central, axial or inner tubular member 153 by quick-change connector 156 and flexible tubing 157, see also FIGURE 27. Cooling water or fluid is introduced to the chamber defined between the intermediate tube 155 and the inner tube 153 by flexible tubing 159 and quick-change coupling 158. On the other hand, heated or warmed fluid is exhausted from an outer chamber defined between intermediate tubing 155 and outer tubing 154 through quick-change coupling 160 and flexible hose 161.

It should be noted that the lance E is closed-off near its bottom end portion as to the two cooling chambers defined by the tubing members 153, 154 and 155, but is open to exhaust oxygen supplied by the inside of the tubing 153. The intermediate tube 155 terminates a

short distance above the closure for the two cooling chambers, in order that cooling water will move downwardly along the inner chamber defined between the tubes **153** and **155** and will return upwardly along the outer chamber defined between the tubes **154** and **155**. As shown in FIGURE 17, the chambers defined between the tubes **153**, **154** and **155** are closed off at the top by a top cap member or closure **162**.

As shown particularly in FIGURES 8 and 17, the lance E has a head or housing cap **164** secured thereto and provided with a hook eyelet **165**, so that it may be either directly or indirectly through a link **167***b*, engaged by a hook **164***a* of the auxiliary hoist crane **167**. In FIGURES 3*a*, 4 and 7, I have shown the auxiliary hoist **167** that is carried by the swing jib **168**. The hoist is shown swingably (see FIGURE 7) carried by a pivot **169***a* on an upright extension frame **169** of the fixed jib structure **52** to swing when the shaft **65** is turned by hand lever **64**. The hoist **167** is adapted to raise and lower the lance E into and out of the hood D, particularly where the lance is to be placed in the lance pit Q and is to be replaced by another lance. The construction of the post crane is also such that the conventional overhead shop crane may also be employed for this purpose.

As disclosed particularly in FIGURES 1*a*, 1*c* and 14 and 15, I have provided upper and lower pairs of clamping finger assemblies for supporting the lance E and essentially, during the blowing operation. The lower clamping finger mechanism **170** is carried in an inwardly-projecting suspended relationship from a downwardly-projecting extension portion **171** of the vertically-fixed jib frame structure **52**. The pneumatically operated motor **177** and its operating mechanism for the clamping arm **170** is of the same type as will be described in connection with the upper clamping arm. Complementary clamping fingers **172** are pivotally mounted by a bolt and nut assembly **173** on the end of the arm **170** for swinging movement between open and closed positions about the lance E. The end of each finger **172** is pivotally connected on **174** to an operating link **175**. The links **175**, at their other ends, have a common pivot connection **176** to a connecting slide and piston rod assembly (of a type shown as to the fingers **179**) of the pneumatic motor **177**, in order that movement of the piston towards the fingers **172** will open them and movement of the piston away from the fingers will close them about the lance. It will be noted that the links provide a toggle type of lever when the clamp is closed.

The fingers of the lower clamping arm **170** are, in accordance with my invention, closed about the lance E when it is in its lowered and raised positions of FIGURE 4 but are opened when the lance is being moved between these positions or is being replaced. On the other hand, upper clamping arm **178** which is securely mounted on the lance jib **76** has complementary clamping fingers **179** that are retained in a closed position about the lance E to support it during the raising and lowering movement effected by the jib **76**. However, when the auxiliary hoist **167** has been hooked into the eyelet **165** in preparation for moving the lance, the fingers **179** are, however, opened and maintained in an open position until a replacement lance has been pulled-up into position by the hoist.

As shown particularly in FIGURES 14 and 15, the fingers **179** are pivotally connected together by a central pivot pin **180** for swing movement, and have links **179***a* similar to **175** of clamp **170**, that are pivoted together at their back ends by a pin **181**. The pin **181** pivotally secures the ends of the links **179***a* to a piston rod slide extension **182** of a pneumatic motor **188**. The fingers **179** have extension legs that are pivotally connected at their ends by pins **83** to the links **179***a*.

The piston rod **182** moves within journaled portions of the housing **184** and has a slotted barrel **185** which slides on a pin **186** projecting from housing **184**. A back portion **187** of the piston rod is connected to the back end of the slide barrel **185** and to the pneumatic motor **188** by suitable coupling joints. The maximum inward and outward movements of the slide portion **185** is controlled by a lug **189** that operates a roller switch arm **190** of an electric limit switch that is mounted on a post **191** of the housing **184**. When positive fluid pressure is supplied to the inner end of the motor **188** through line **188***a*, the piston and the rod **182** move forwardly to open the fingers **179**. On the other hand, when positive fluid pressure is applied through line **188***b* to the outer end of the motor **188**, the piston assembly moves backwardly to close the fingers **179**. In FIGURES 14 and 15, I have shown a control valve **192** which may be of an electric solenoid type to reverse the supply of fluid to the motor **188** and thus, reverse its direction of movement.

FIGURE 27 shows the connecting layout for fluid lines which includes the oxygen supply, the cooling fluid or water and the pneumatic pressure fluid for operating the pneumatic motors. It also somewhat diagrammatically illustrates how warmed cooling fluid is carried off to the sewer along a down-feed carried by the post crane apparatus B. That is, warm water is delivered by piping **195** (see also FIGURE 4) into a collector funnel **196**, from there moves down a return tube **197** into a sight pan **198**, and from the bottom of the pan **198**, moves downwardly along a second tube **199**. Thus, the operator may easily determine the temperature of and amount of return flow of heated cooling fluid.

Referring to FIGURES 1*b* and 3*b*, additives such as lime and mill scale which are stored in the car dumping hopper O may be provided in a quantity sufficient for 24-hour service. The two types of materials may be segregated in the area and loaded on a continuous, motor-driven, under-positioned conveyor **202**, as they are needed. A motor-driven bucket elevator **203** is positioned at the end of the belt conveyor **202** to raise the material to a position scale hopper **205** and lime hoppers **206** and **207**, to discharge the material on a transverse or shuttle conveyor **204**. The materials may be selectively delivered to any one of the hoppers **205**, **206** or **207** through their delivery openings **205***a*, **206***a* and **207***a* by moving the shuttle conveyor **204** to a proper position. Material is taken from each of the above-mentioned hoppers, respectively, by continuously-forwardly moving under-positioned, continuous, belt conveyors **208**, **209** and **210**, and is elevated to a delivery level by motor-driven bucket elevators **211**, **212** and **213**, respectively. Material from the hopper **205** is delivered from its bottom chute **205***b* upon the conveyor **208**, material from hopper **206** is delivered through its bottom chute **206***b* on the conveyor **209**, and materials from the hopper **207** is delivered from the bottom chute **207***b* to the conveyor **210**.

Material is delivered from the elevator **211** through a down-chute **214** into a two-part or bifurcated delivery chute **215***a*, and from opposite ends of the chute **215***a*, into equal-size weighing hoppers **216** and **217**. Each hopper has a delivery chute. The hopper **217** is adapted to deliver material from its spout **217***a* upon a longitudinal, continuously-moving, main belt conveyor **225** which cooperates with and delivers weighed and selected charges of material to the additive assembly F (see FIGURE 18) of the hood D of the left hand converter A. The hopper **216** is adapted to deliver weighed and selected charges of material from its spout **216***a* upon a longitudinal, continuously-moving, main belt conveyor **218** which feeds additives to the assembly F of the right hand converter A.

Material raised by the elevator **212** is delivered by a chute **215** upon a cross-belt motor-driven conveyor **219** which is reversible to alternately deliver the material, as desired, to side-positioned storage hoppers **220** and **221**

through their delivery openings 220*a* and 221*a*. Material from each of these hoppers is delivered, as needed, through down-chute portions 220*b* and 221*b* (see FIGURE 3*b*) upon an under-positioned, continuous, reversible, motor-driven, belt conveyor 224 and from such conveyor, either upon the left hand main side belt conveyor 225 or upon the right hand main side belt conveyor 218.

Material raised by the elevator 213 is delivered by chute 214' to a two-part or bifurcated down-distribution and delivery chute 215', to oppositely-positioned and equal-size weighing hoppers 216' and 217', and from each of the hoppers through delivery spouts 216'*a* and 217'*a*, respectively, to the main conveyors 225 and 218.

It will be recognized that a blow process in the nature of an oxygen process involves highly intense heat. Although the blow lance is water-cooled and its nozzle may be spaced anywhere from about 20 to 60 inches above the surface of the melt in the vessel, its period of useful life without cleaning or replacement is somewhat limited and thus, provision has been made for convenient repair and replacement by providing the post structure with swing means and with means for lifting and lowering the lances into and out of a pit. Cleaning and repair may thus be effected on one lance while another is being used.

The hood construction is such as to facilitate the use of the lance without drawing in atmospheric air into the system and of fume discharge from the vessel into the atmosphere. In addition, the hood has been provided with slidable portions as to its chute means, so as to enable the convenient introduction of lime, mill scale and similar additions for producing a slag and facilitating the melting operation as well as providing an improved refined metal product. The hood is not only supported by its raising and lowering means and safety latch means employed therewith, but also in its "down" or operating position by the fact that its inlet portion is supported on the rim shelf that extends around the mouth of the vessel.

It will be noted that I have provided a centrally-located unit which may be termed a hood and lance post crane apparatus. It makes possible a maximum saving of plant space, facilitates the employment of one or more metal refining vessels, and makes possible a fully coordinated functioning and utilization of the hood, of its associated apparatus, and of the blow lance. By way of example, cooling fluid conduits, motor energizing circuits (fluid and electrical), supporting mechanism, etc., are employed in a coordinated manner and are carried by a common swingable or rotatable post structure. Such post structure makes possible a simultaneous movement of lance supporting means and hood supporting means into and out of an operating alignment with the refining vessel.

The upper and lower clamp units for the lance are adjustable on the supporting structure to which they are secured to make possible adjustment and readjustment of the position of the lance in a horizontal plane, in order to maintain an optimum blowing position for the lance. In this connection (see FIGURES 14 and 15), the bolt and nut assemblies that secure the clamping units or assemblies on their support structures are mounted in enlarged or slotted holes in the latter to permit adjustment by loosing the bolts. Provision has also been made to make possible adjustment of the hood in a horizontal plane so as to provide it with a properly aligned contact on both the converter vessel and the spark trap apparatus. The hood, due to its method of suspension by the disclosed flexible chain or cable means will properly center itself on the top sealing flange of the vessel and align with the sealing flange of the spark trap apparatus to effect a fluid-tight seal. This is highly advantageous over a rigid type of suspension for the hood.

In developing my apparatus, I have found that other methods of handling a hood and lance are less flexible in operation. I make possible a complete and fast manipulation of the hood and lance from an operator's pulpit. The hood may be swung away from the vessel to permit emergency charging or servicing by an overhead traveling crane. In addition, the hood can be quickly raised or lowered to effect a seal or to control aspirated air from the ambient atmosphere. The lance can be effectively positioned for more effective blowing, as visually indicated; it can also be swung away from the vessel for servicing or replacing of it or for emergency charging or servicing of the vessel. Both the hood and lance are replaceable as a unit. This may now be done in an area that is a safe and convenient distance away from the converter vessel. Thus, servicing, charging and other operations may be effected at the vessel with the unrestricted use of the conventional overhead traveling cranes.

It should be noted the cooling water sprays are employed in the hood to primarily effect a cooling of the exhaust gases or fume. However, they are applied in such a manner as to also protect the inner shell or wall of the hood, in effect, by providing a protective inner film wall therealong. The fluid motors, shown such as those for opening and closing the sealing gate for the lance, for opening and closing the clamping units, and for other operations, may be operated by air of any other suitable non-inflammable fluid medium. The auxiliary hoist 167 facilitates the handling of the lance at area I, independently of the conventional overhead traveling shop crane that will ordinarily be employed at this time in connection with the converter vessel.

Referring particularly to FIGURES 24 to 26, inclusive, the refining vessel or converter has, what I have found to be the best possible shape for minimum maintenance and maximum useful life of the refractory wall, as well as for maximum efficiency in the refining operation. In this connection, the melt line is located below the horizontal or trunnion support axis of the vessel and the refractory lining has a smoothly rounded concave shape of maximum diameter at the support plane and slopes or converges inwardly from such plane towards upper and lower end portions of the vessel. The side curvature of the vessel corresponds to what I have found to be a substantial wear conformation of a blow-induced flame therein, as effected by an oxygen lance. This is highly effective in minimizing wear and tear on the lining.

What I claim is:

1. In a furnace having a vessel for refining metal provided with a fluid effluent discharging open mouth portion, a fluid effluent receiver having an inlet portion projecting at substantially right angles to the mouth portion of said vessel when said vessel is in an upright position, a hood of integral tubular shell wall construction and having enclosing walls defining a downwardly-projecting inlet portion to fit with and seal-off the mouth portion of said vessel, the enclosing walls of said hood defining a side outlet portion to fit with and seal-off the inlet portion of said receiver, means for raising and lowering said hood and its inlet and outlet portions directly into and out of a sealing relationship with respect to the mouth portion of said vessel and the inlet portion of said receiver, and separate means to swing said hood into and out of a vertically-aligned position with respect to said vessel.

2. In a furnace apparatus as defined in claim 1 wherein, a vertically-projecting post structure is provided, said raising and lowering means for said hood is mounted on said post structure, and said swing means comprises said post and a stand rotatably positioning said post.

3. In an apparatus as defined in claim 1 wherein, said receiver has refractory walls defining a primary chamber leading from its said inlet portion, said receiver has a partition wall defining a secondary and outlet chamber, a plurality of spray means are positioned

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,026,102 March 20, 1962

Harry L. McFeaters

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 9, line 52, for "vetrically" read -- vertically --; column 10, line 31, for "102" read -- 101 --; column 17, line 44, after "jib" strike out -- portion --; same column, line 46, after "jib" insert -- portion --.

Signed and sealed this 17th day of July 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

wherein, clamping means is carried by said second jib frame to engage and suspend said lance, sealing means is operatively carried by said first-mentioned jib frame to cooperate with said lance and the open top portion of said hood to seal-off the opening when said lance is extending into said hood, and means operatively connected to said sealing means to move it into and out of a sealing relationship with said lance and the open top portion of said hood.

26. In a furnace having a tiltable metal refining furnace vessel provided with an open discharge mouth portion that faces upwardly during the refining of metal within the vessel, a fume receiver and conditioner having a side inlet portion, a hood of integral tubular shell wall construction whose enclosing walls define an inlet portion to closely fit with the mouth portion of said vessel and receive fluid effluent discharged therefrom, the enclosing walls of said hood defining an outlet portion to closely fit with the inlet portion of said receiver to discharge the fluid effluent therein, a post crane having means to suspend said hood in a substantially vertically aligned relation above said vessel and raise and lower it directly into and out of a fitting relation between said vessel and said receiver, said hood having its inlet and outlet portions positioned at substantially right angles to each other and being of relatively short length to define a top closure for said vessel when in a fitting relation with respect to said vessel and said receiver, telescopic chute means having one part mounted in a fixed position to receive additive materials and having a second part projecting through a second open portion in said hood to supply additive material to said vessel, and said parts of said chute means being constructed to slide with respect to each other and retain their connected relationship when said hood is raised and lowered.

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