Feb. 22, 1966 I. W. LAKIN 3,236,397

ARTICLE HANDLING APPARATUS

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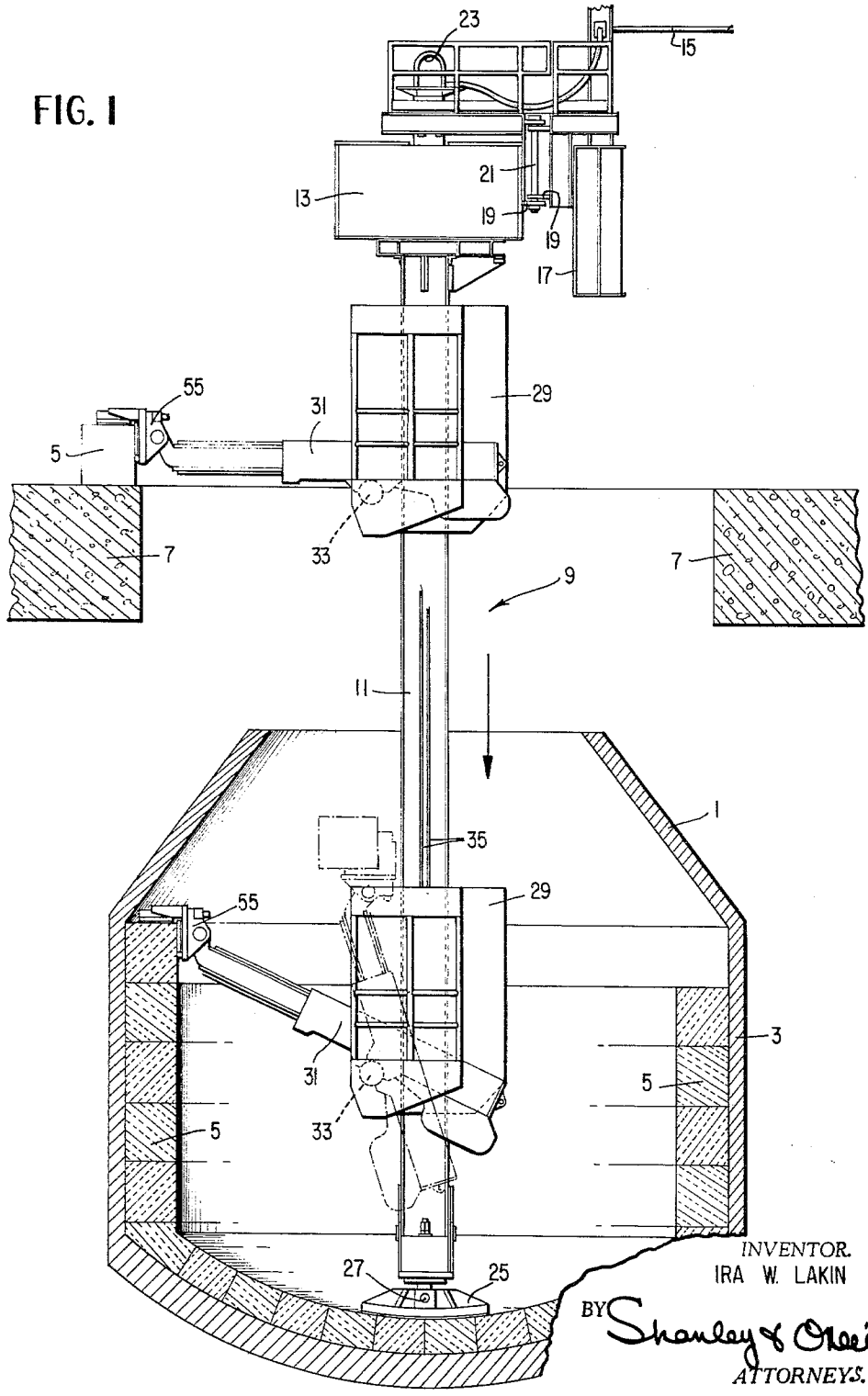
FIG. 1



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ARTICLE HANDLING APPARATUS

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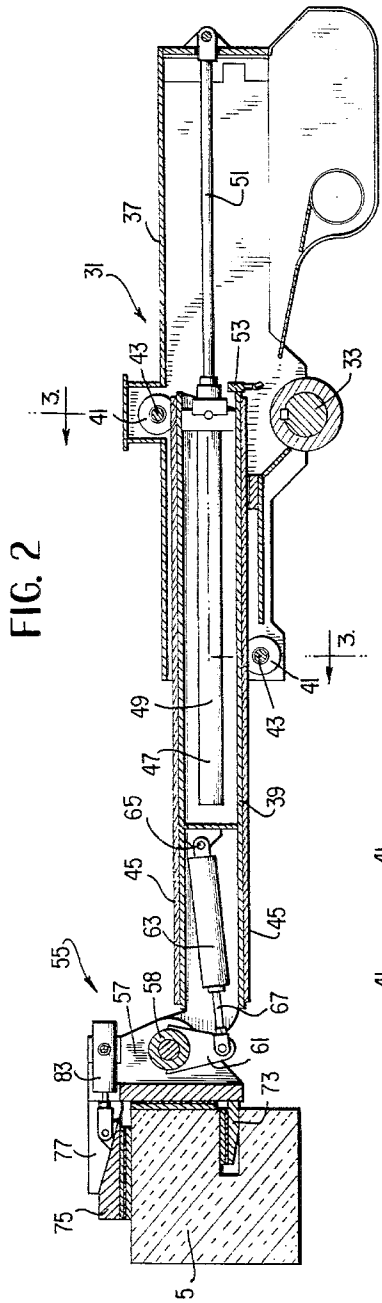

FIG. 2

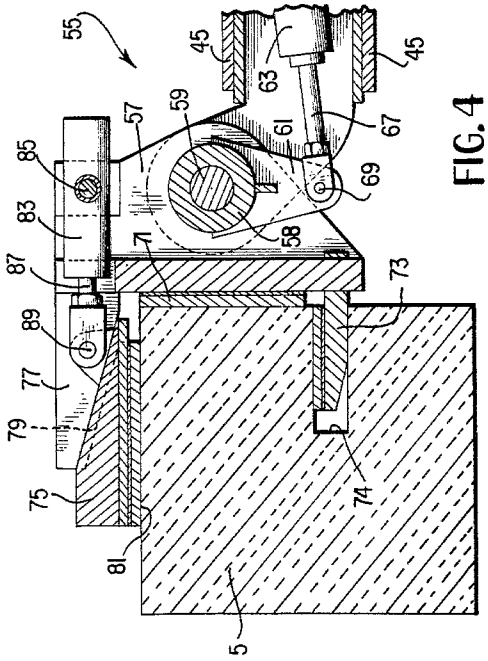

FIG. 4

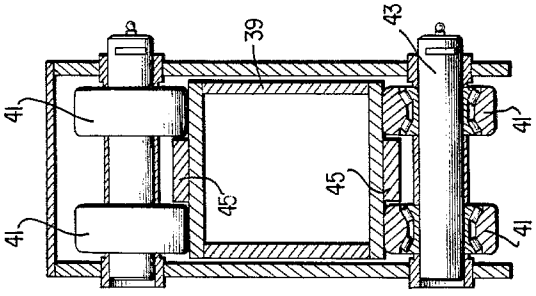

FIG. 3

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ARTICLE HANDLING APPARATUS

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6 Claims. (Cl. 214—1)

The present invention relates to article handling apparatus, more particularly of the type adapted for use in the assembly of structures of generally circular cross sectional configuration, such as furnaces, silos and the like, in which the apparatus is used to build the structure around it and is then removed from the completed structure. The invention will be illustrated by the way of example in connection with the construction of the lining of a furnace, but it is to be expressly understood that the apparatus has use in many other environments.

It is an object of the present invention to provide article handling apparatus which will have increased versatility of movement for positioning articles in a desired location and orientation relative to the apparatus.

Another object of the present invention is the provision of article handling apparatus particularly well adapted for the assembly of structures that are of generally circular cross sectional configuration in a horizontal plane.

Still another object of the present invention is the provision of article handling apparatus having improved means for grasping and manipulating the articles handled.

Finally, it is an object of the present invention to provide article handling apparatus which will be relatively simple and inexpensive to manufacture, easy to assemble, operate, maintain and repair, and rugged and durable in use.

Other objects and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawings, in which:

FIGURE1 is an elevational view partly in cross section of apparatus acocrding to the present invention;

FIGURE 2 is an enlarged cross sectional view of the article handling arm of the apparatus of the present invention;

FIGURE 3 is a further enlarged cross sectional view taken along the line 3—3 of FIGURE 2; and

FIGURE 4 is a further enlarged view of a portion of the structure shown in FIGURE 2.

Referring now to the drawings in greater detail, there is shown a basic oxygen furnace or converter 1 including a shell 3 of generally circular cross sectional configuration as viewed in a horizontal plane. The present invention will be illustrated in connection with the operation of lining shell 3 with ceramic blocks 5 of refractory material of the nature of firebrick. The lining operation in the illustrated environment comprises removing blocks 5 from a storage position on floor 7 above converter 1 and lowering them through the open upper end of the converter and placing them one on top of the other about the interior of converter 1 until the entire interior of converter 1 is lined with blocks 5 up to the top thereof. To this end, of course, the blocks 5 are specially shaped to conform to the internal contours of shell 3.

The apparatus of the present invention by which this operation is carried out is indicated generally at 9, and includes an upright column 11 which at its upper end carries a motor housing 13. An electrical conduit 15 enters motor housing 13 to supply power to the electrical motors (not shown) in housing 13 that operate the equipment. The upper end of the apparatus is releasably supported on a girder 17 of the plant by means of ears 19 supported by girder 17 and carried by the upper end of apparatus 9, which are alignable with each other to receive a bolt 21

that releasably secures the upper end of apparatus 9 to girder 17. Also at the upper end of apparatus 9 is an eye 23 by which the apparatus may be bodily lifted and lowered and moved lengthwise of the plant by cranes (not shown) when bolt 21 is removed.

The weight of the apparatus rests through column 11 on a foot 25 that is supported within a lower portion of converter 1 on the bottom thereof. Foot 25 is pivotally mounted on the bottom of column 11 by means of an axle 27 so that foot 25 will adjust to the contours of the bottom of the converter regardless of the position of column 11.

An operator's cab 29 is mounted for bodily vertical movement on and relative to column 11, and also for horizontal swinging movement on and relative to column 11. Cab 29 carries an arm 31 which is pivotally mounted thereon for vertical swinging movement on an axle 33. Power means (not shown) in cab 29 are provided for swinging arm 31 relative to cab 29 and for swinging cab 29 relative to column 11. Cables 35 operated from the motors in motor housing 13 raise and lower cab 29, while an electrical conduit (not shown) extends downwardly along the far side of column 11 to cab 29 to power the electrical motors (not shown) in cab 29 that drive pumps (not shown) for actuating fluid motors that swing arm 31 vertically and that operate portions of the arm as described below.

Arm 31 is in the form of a casing 37 which is of hollow rectangular construction. A boom 39, also of hollow rectangular construction, is telescopically mounted within casing 37 and rides on anti-friction rollers 41 mounted on horizontal axles 43 carried between the sidewalls of casing 37. Elongated strips 45 parallel to the length of boom 39 are carried by boom 39 between rollers 41 and serve to guide boom 39 relative to rollers 41.

Boom 39 is extended and retracted relative to casing 37 by means of a fluid motor 47 comprising a cylinder 49 carried within boom 39 and a piston rod 51 secured at its end remote from the piston (not shown) to a portion of casing 37. Fluid motor 47 is actuated by being supplied by fluid under pressure from a source of fluid pressure (not shown) such as a pump on the operator's cab, through conduits (not shown) communicating with opposite ends of cylinder 49 on opposite sides of the piston of fluid motor 47, so that admission of fluids under pressure to one side of the piston extends boom 39 longitudinally relative to casing 37, while admission of fluid under pressure to the interior of cylinder 49 on the opposite side of the piston moves boom 39 relative to casing 37 in a direction to retract it so that boom 39 telescopes within casing 37. A detent 53 is selectively movable into the path of the rear end of boom 39 in an extended position of the boom as seen in FIGURE 2, thereby to prevent rearward movement of boom 39 and to relieve the load from the fluid pressure circuit that actuates boom 39. Of course, in a retracted position of detent 53, boom 39 can be retracted.

A clamp 55 is carried by the outer end of boom 39 and comprises a body 57 mounted for vertical swinging movement relative to boom 39 on a sleeve 58 that is mounted for pivotal sliding movement on an axle 59 carried by the outer end of boom 39. An arm 61 is provided that is in unitary assembly with sleeve 58 and that extends radially outwardly of axle 59. A fluid motor 63 mounted within the outer end of hollow boom 39 swings arm 61 to swing clamp 55 vertically relative to boom 39. Specifically, fluid motor 63 is mounted for vertical swinging movement on and relative to boom 39 about an axle 65, while a piston rod 67 having a piston (not shown) at one end disposed in the cylinder fluid motor 63 is pivotally interconnected at its other end to arm 61 by means of

wrist pin 69. Fluid conduits (not shown) communicating with a source of fluid pressure (not shown) apply fluid pressure selectively to either side of the piston within fluid motor 63 thereby to extend or retract piston rod 67 to swing clamp 55 vertically relative to boom 39.

Body 57 of clamp 55 also carries a backup plate 71, and has a fixed lower jaw 73 below backup plate 71. Plate 71 and jaw 73 have working faces that are disposed in planes perpendicular to each other. Jaw 73 is adapted to enter a recess 74 in an article to be handled, such as a block. A movable upper jaw 75 is also carried by body 57 of clamp 55. Means are provided for moving jaw 75 relative to body 57, including a fixed arm 77 that extends outwardly from body 57 above backup plate 71. Jaw 75 is mounted for sliding movement on arm 77, and jaw 75 and arm 77 have sliding contact with each other along a uniplanar interface 79 that is inclined from its outer end downwardly toward fixed jaw 73 and inwardly toward boom 39. In other words, the planes of interface 79 and the working face of fixed lower jaw 73 converge rearwardly while the plane of working face 81 of movable jaw 75 remains parallel and perpendicular to the other working faces.

A fluid motor 83 is provided for urging movable jaw 75 forwardly and rearwardly. Motor 83 is mounted for vertical swinging movement about trunnions 85 carried by body 57 of clamp 55. A piston rod 87 extends forwardly from fluid motor 83 and carries on its rear end a piston (not shown) fluid-urged in either direction by fluid from a source (not shown) of relatively high pressure fluid communicating with opposite ends of the cylinder of fluid motor 83 through conduits (not shown). At its forward end, piston rod 87 is pivotally interconnected with movable jaw 75 by a wrist pin 89 for vertical swinging movement relative to jaw 75 about pin 89. By the arrangement just described, therefore, movable upper jaw 75 moves forwardly and rearwardly with its working face 81 at all times parallel to the working face of fixed lower jaw 73 and with the working faces both of fixed lower jaw 73 and of movable upper jaw 75 at all times perpendicular to the forward or working face of backup plate 71. Upon rearward movement of movable upper jaw 75, its working face 81 approaches fixed lower jaw 73 because of the cam action of interface 79, and upon forward movement of movable upper jaw 75 its working face 81 recedes from fixed lower jaw 73. The rearward movement of jaw 75 tends to draw the block back against backup plate 71 thereby firmly and accurately to position the block relative to the apparatus.

Axles 33, 59 and 65 and wrist pins 69 and 89 and trunnions 85 are all parallel to each other.

The overall operation of apparatus according to the present invention is shown somewhat schematically in FIGURE 1. As is there broadly indicated, the apparatus of the present invention picks up a block from floor 7, tilts upwardly and descends and enters converter 1 and then swings the block downwardly to the lowermost full line position of FIGURE 1 to place the block in its appropriate position in the lining of the converter. In more detail, with the operator's cab in the upper position of FIGURE 1, arm 31 is swung vertically until clamp 55 is about the level of the blocks stored on floor 7 and arm 31 is swung horizontally until lower jaw 73 is pointing toward the recess 74 in one of the blocks. Boom 39 is then extended by operation of fluid motor 47 until fixed lower jaw 73 enters recess 74. Then fluid motor 83 is actuated to draw movable upper jaw 75 rearwardly, whereupon working face 81 descends upon and clamps against the upper surface of block 5. The block 5 is thus firmly clamped between fixed lower jaw 73 and movable upper jaw 75.

Arm 31 is then swung upwardly and cab 29 is lowered to the phantom line position shown in FIGURE 1. Then, arm 31 is swung downwardly from the phantom line position to the full line position at the bottom of FIGURE 1. Fluid motor 63 is then actuated until the block 5 assumes the desired level position shown at the bottom of FIGURE 1, and arm 31 is lowered until the block just rests in the position shown at the bottom of FIGURE 1 in its proper place in the converter lining. Fluid motor 83 is then actuated in the reverse direction to move movable upper jaw 75 forwardly and upwardly to release the block from clamping between jaws 73 and 75, after which clamp 55 is withdrawn by vertical swinging of arm 31 and clamp 55, and cab 29 is then raised, with the arm 31 in the phantom line position shown at the bottom of FIGURE 1, to find and place another block 5.

The lining of the entire converter can be carried out with column 1 remaining in a single position, inasmuch as cab 29 is mounted for bodily vertical movement and also for horizontal rotative movement on and relative to the column, while arm 31 is mounted for vertical swinging movement relative to cab 29, and clamp 55 is mounted for vertical swinging movement on and relative to boom 39 of arm 31.

From a consideration of the foregoing description, therefore, it will be evident that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with a preferred embodiment, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

What is claimed is:

1. Article handling apparatus for lining a furnace comprising an elongated longitudinally extensible arm; support means for the arm; means mounting the arm for horizontal swinging movement and vertical swinging movement and bodily vertical movement relative to the support means, said latter means including a vertical column and an operator's cab, means mounting said cab on said column for bodily vertical movement of said cab relative to said column, and foot means for supporting the bottom of the column on the bottom of the furnace; article clamping means; and means mounting the article clamping means on an outer portion of a longitudinally extensible portion of the arm for vertical swinging movement relative to the arm.

2. Article handling apparatus as claimed in claim 1, and means acting between the clamping means and said extensible portion of the arm to swing the clamping means vertically relative to the arm.

3. Article handling apparatus as claimed in claim 1, the clamping means including a pair of jaws, means for pulling one of the jaws toward the arm, and cam means for moving said one jaw toward the other jaw as said one jaw moves toward the arm.

4. Article handling apparatus as claimed in claim 3, said pulling means comprising a fluid motor, and means mounting the fluid motor for vertical swinging movement relative to the clamping means and to said one jaw about a pair of spaced parallel axes.

5. Article handling apparatus comprising an arm, clamping means, means mounting the clamping means on the arm for swinging movement relative to the arm, the clamping means including a pair of jaws, means for pulling one of the jaws toward the arm, said pulling means comprising a fluid motor and means mounting the fluid motor for vertical swinging movement relative to the clamping means and to said one jaw, and cam means for moving said one jaw toward the other jaw as said one jaw moves toward the arm.

6. Article handling means comprising an arm, clamping means mounted on the arm, the clamping means including a pair of jaws, means for pulling one of the jaws toward the arm, said pulling means comprising a fluid motor

and means mounting the fluid motor for vertical swinging movement relative to the clamping means and to said one jaw about a pair of spaced parallel axes, and cam means for moving said one jaw toward the other jaw as said one jaw moves toward the arm.

References Cited by the Examiner

UNITED STATES PATENTS

1,281,570	10/1918	Hodge	264—30
1,584,442	5/1926	Every	214—15
1,797,494	3/1931	Campbell.	
2,531,473	11/1950	Saunders	264—30
2,574,131	11/1951	Steinbrecher	294—88 X
2,785,813	3/1957	Tofflemire	214—141
2,822,094	2/1958	Greer.	
2,861,701	11/1958	Bergsland et al.	
3,033,389	5/1962	Abarotin et al.	
3,066,805	12/1962	Sullivan.	
3,067,895	12/1962	Van Wyk et al.	214—658

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