May 27, 1969

D. R. STAUFFER

3,446,292

IMPACT HAMMER DEMOLITION APPARATUS

Filed Jan. 5, 1967

Sheet 1 of 2

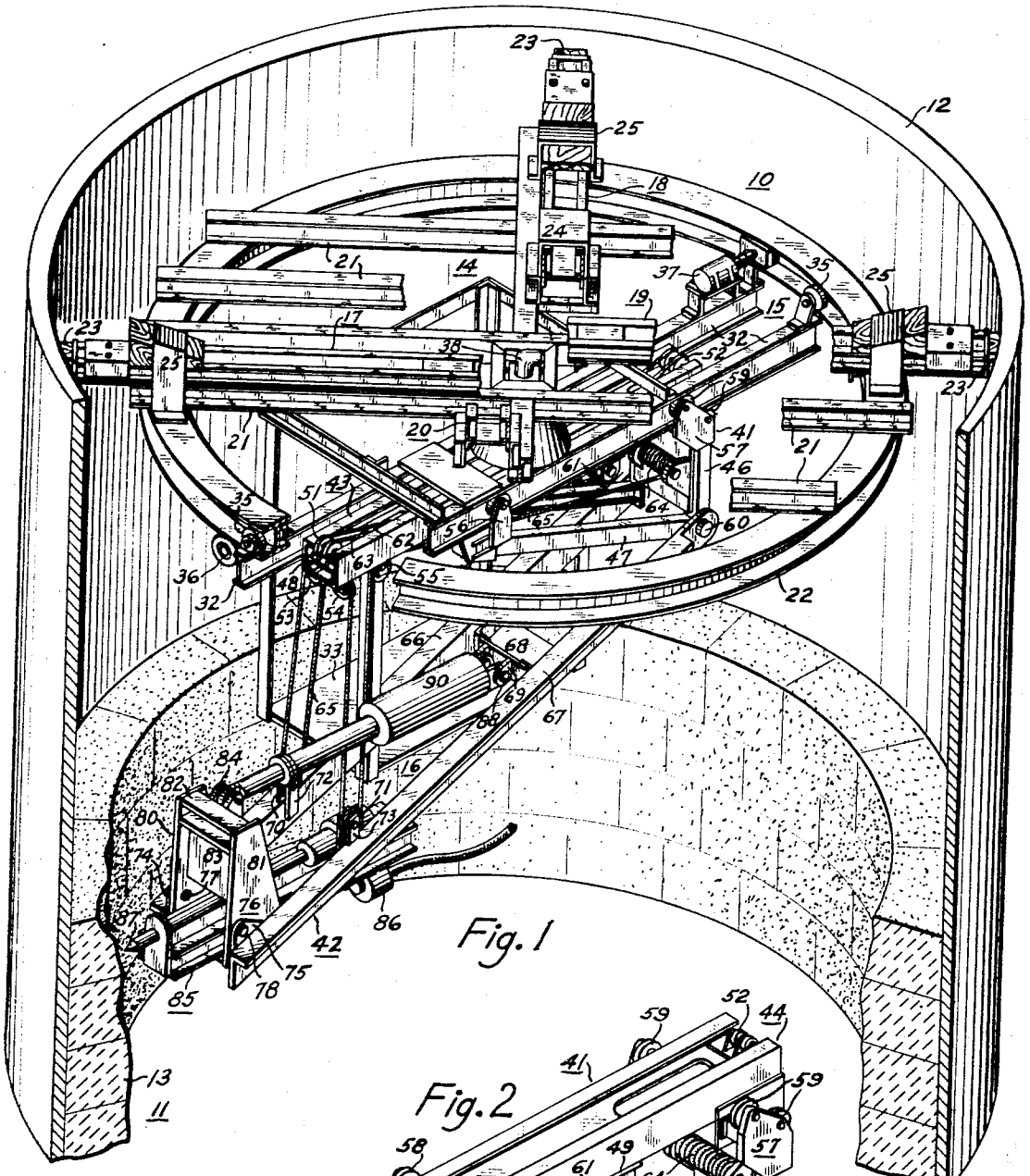


Fig. 1

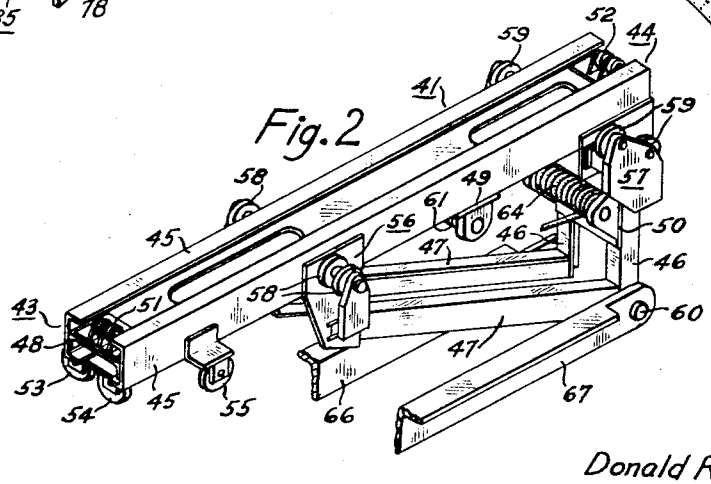


Fig. 2

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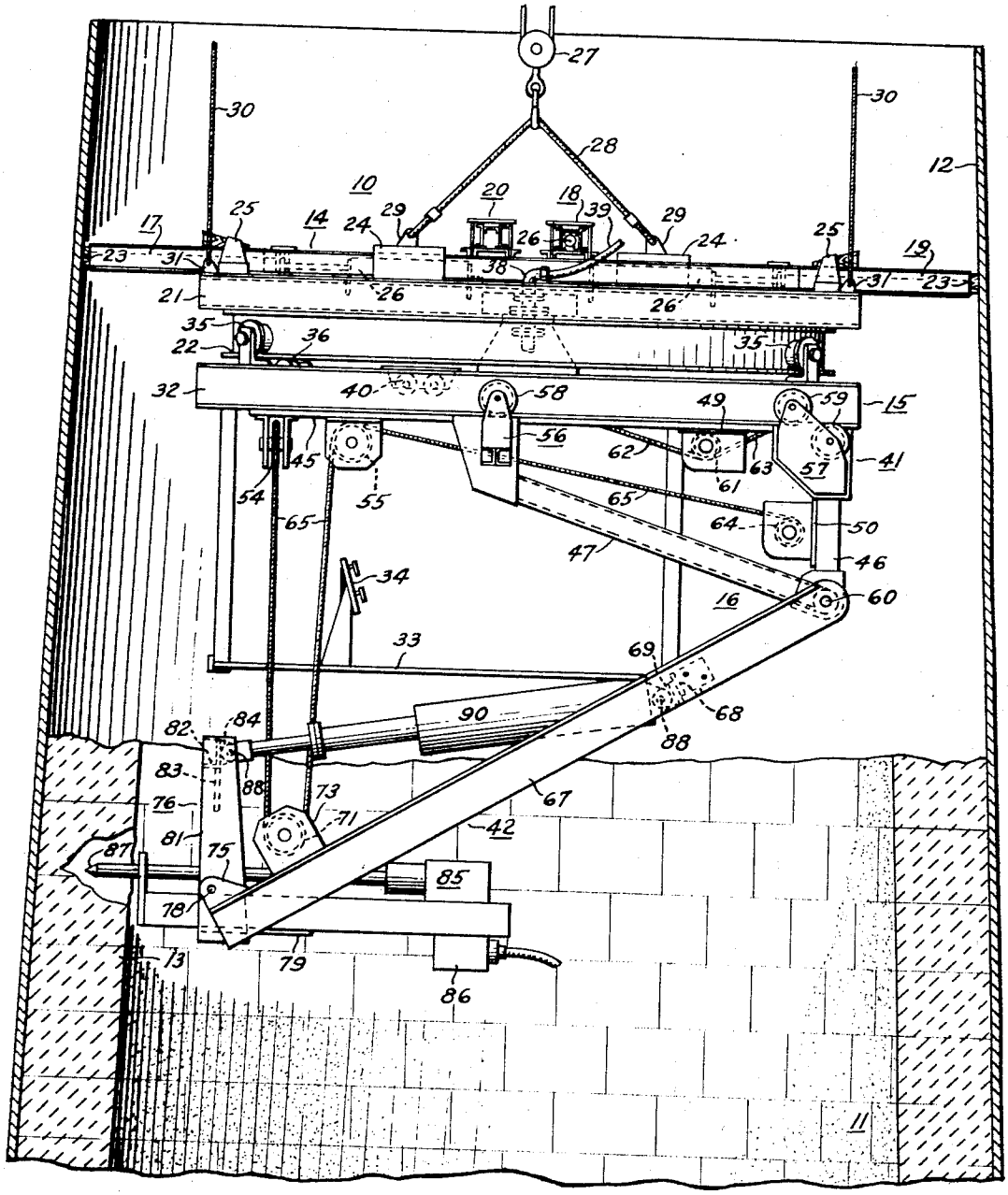


Fig. 3

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United States Patent Office 3,446,292
Patented May 27, 1969

3,446,292

IMPACT HAMMER DEMOLITION APPARATUS

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Filed Jan. 5, 1967, Ser. No. 607,556
Int. Cl. E21c 11/00, 9/00, 3/02
U.S. Cl. 173—35
1 Claim

ABSTRACT OF THE DISCLOSURE

Impact hammer demolition apparatus, having a suspended supporting framework, adapted to be progressively lowered into a tall, refractory-lined structure to cut out its lining. The framework supports a parallel, horizontally rotatable track assembly upon which moves a trolley. A cable operated boom, pivotally connected at one end to the trolley, has at its outer end an impact hammer. At each positioned location of the track assembly the outer end of the boom can be raised or lowered to bring the hammer into engagement with a vertical band of refractory.

Background of the invention

This invention relates in general to impact hammer demolition apparatus and more particularly to improved suspended apparatus of this type which can be progressively lowered, in a minimum of moves, into a tall structure, such as a blast furnace, to cut out its refractory lining.

Large refractory lined structures, such as blast furnace stacks, must periodically be taken out of service for repairs or replacement of the linings which, over a period of years, are reduced in thickness due to wear or spalling. Before a new lining can be installed in such a structure the old lining must first be removed. Heretofore, such a lining was removed by laborers working from a scaffold suspended from the superstructure above the top of the stack. These men cut out the old lining with air hammers, pry bars, sledge hammers and other hand tools. More recently efforts have been made to use tractor mounted hammers on such a scaffold but space limitations severely restricts maneuverability of such a machine.

Summary of the invention

It is an object of this invention to provide a scaffold mounted power-operated device including a power hammer which may be raised as a unit to the top of a large refractory lined structure, suspended within the structure, operated to cut-away sections of the refractory, lowered in a series of steps as the lining is cut-out, and then easily removed when the job has been completed.

The rig can be suspended at a number of locations within a large refractory lined structure and manipulated, at each location, by rotating the device and by raising or lowering its working end to deliver powerful hammer blows against the lining and thereby remove a broad band of refractory around the interior of the stack. The rig can easily be operated by one man. The power-operated hammer is both reciprocably and vertically movable and can be rotated through a complete circle, or more, without reversing direction, to cut a broad band of lining from the structure, adjacent each location at which the scaffold is positioned.

Brief description of the drawing

Referring to the drawings:

FIG. 1 is a perspective view of the demolition apparatus of this invention suspended within a blast furnace stack.

FIG. 2 is a perspective view of a portion of the apparatus of this invention.

FIG. 3 is a side elevation of the apparatus of FIG. 1.

Description of the preferred embodiments

Referring to the drawings there is shown demolition rig **10**, embodying the principles of the invention, suspended within blast furnace stack **11**, having steel shell **12** and refractory lining **13**, the upper part of which has been removed. Demolition rig **10** comprises top platform or support framework **14**, trolley runway or track assembly **15**, and trolley-boom-breaker support assembly **16**.

Top platform **14** comprises four extensible beam assemblies **17**, **18**, **19**, and **20** beneath which are support beams **21** secured to circular I beam track **22**. Each beam assembly has at its outer end a soft wood block **23** and is held in position and guided by an inner bracket **24** and an outer bracket **25** both of which are secured to support beams **21**. Beam assemblies **17**, **18**, **19** and **20** and brackets **24** and **25** are shown in partial detail in FIG. 1. Associated with each beam assembly is a suitable reciprocably movable power cylinder **26**, for example a 4" bore 24" stroke cylinder. Each cylinder is fastened to a support beam **21** and has its piston in engagement with the associated beam assembly. The cylinders are operated to extend the outer end of each assembly into contact with shell **12** to stabilize the rig when it is in operation and to withdraw the assembly from contact with the shell when the rig is to be moved. Beam assemblies **17**, **18**, **19** and **20** extend slightly offset from center but generally radially of top platform **14** and are at a 90° angle to one another. With beam assemblies **17**, **18**, **19** and **20** withdrawn to their innermost positions rig **10** is small enough to be lowered from the top of the furnace into stack **11** by means of hoisting equipment, not shown, and falls **27** bridled by cables **28** to cable brackets **29** secured to top platform **14**. Additional cables **30** are secured to platform cable brackets **31** for safety purposes and to further stabilize the rig.

Trolley runway or track assembly **15** comprises spaced parallel trolley beams **32** and operators platform **33** upon which is mounted control panel **34**. Runway assembly **15** is suspended from track beam **22** by means of trolley wheels **35** which are secured by the usual wheel brackets bolted to beams **32** so that wheels **35** run on the upper portion of the lower flange of beam track **22**. Runway assembly **15** can be rotated through 360°, or more, by means of one or more drive means **36**, which can be, for example, pneumatic tractors that are secured to assembly **15** in any convenient location so that the drive wheel of each drive means is in contact with I-beam track **22**. Brake means **37** locks trolley runway assembly **15** in position and prevents it from moving during operation of the rig. Between trolley beams **32**, adjacent their mid-sections, is swivel joint **38** which is connected at its upper end to hose **39** that leads to a compressed air supply system, not shown. The lower end of swivel joint **38** is connected to a manifold, not shown, from which run hoses to the hereinafter described several pieces of pneumatic equipment on the rig. Between trolley beams **32** and forward of swivel joint **38** are trolley beam cable guide sheaves **40**, utilized for a purpose hereinafter described.

Trolley-boom-breaker-support assembly **16** comprises trolley **41**, and boom-breaker-support assembly **42**. Trolley **41** is reciprocably movable between trolley beams **32** and is supported by these beams, as hereinafter more fully described.

Trolley **41** generally comprises a pair of spaced fabricated sections **43** and **44**, each having an upper channel member **45**, a vertical angle member **46**, extending downwardly from the back end of channel member **45**, and a

diagonal bracing member 47, which connects the vertical member 46 with the midsection of channel member 45. Sections 43 and 44 are joined by connector channel member 48 which extends longitudinally of upper channel members 45, adjacent their midsections; hoist plate 49, connecting the bottom flanges of members 45; and hoist plate 50, which extends across angle members 46. Secured to the top front and back ends of connector channel member 48, interposed between upper channel members 45, are front and back cable guide sheaves assemblies 51 and 52 respectively. At the front end of trolley 41 beneath channel members 45 are cable guide sheaves 53 and 54, which extend transversely of members 45. A single cable guide sheave 55 is secured to the lower outside of channel member 45 of section 44. Secured to each of sections 43 and 44 are front and back trolley wheel assemblies 56 and 57, respectively. Each front trolley wheel assembly 56 has two spaced wheels 58, suitably journaled, in the same horizontal plane, which ride on the upper surfaces of the bottom flange of a trolley beam 32, one wheel on each side of the beam web. Each back trolley wheel assembly 57 has two wheels 59, suitably journaled and in the same vertical plane, which ride on the outer bottom flange of a trolley beam 32, one wheel riding on the top outside portion of the lower flange and the other wheel in contact with the bottom outside portion of the same flange. Adjacent the bottom end of each vertical angle member 46 of spaced sections 43 and 44 is hinged bolt assembly 60. Trolley hoist 61 is secured to the bottom of hoist plate 49. Trolley hoist 61 has its drum divided to accommodate two cables 62 and 63, which are connected to the hoist and reeved through trolley beam cable guide sheaves 40 and trolley front and back cable guide sheaves 51 and 52, in a manner well known to those skilled in the art, to control the reciprocable movement of trolley 41 upon trolley beams 32. Connector channel 48 is slotted to allow for the passage of the cables 62 and 63. Another hoist, boom hoist 64 with a single cable 65, is mounted on hoist plate 50 of trolley 41.

Boom-breaker-support assembly 42 includes fabricated side members 66 and 67, which are pivotally connected at their back ends by means of hinge bolt assemblies 60 to the bottom of angle members 46 of sections 43 and 44 of trolley 41. Stiffener bracket 68 connects side members 66 and 67, intermediate their back ends and midsections, and secured to this bracket are hinge clips 69. Cable guide sheaves 70 and 71, journaled in brackets 72 and 73, are mounted on side members 66 and 67, respectively, intermediate their midsections and front ends. Pivot pin brackets 74 and 75 are mounted on side members 66 and 67 respectively, adjacent their front ends. Hammer or breaker support 76 is pivotally connected to side members 66 and 67 by means of pivot bolts 77 and 78, which are secured in brackets 74 and 75. Breaker support 76 includes bottom plate 79 at the front end of which are perpendicularly secured side arms 80 and 81. Pivot bolts 77 and 78 pass through the lower portions of side arms 80 and 81, respectively. Channel bracket 82 connects the upper ends of arms 80 and 81, and plate 83 extends between them and acts as a stiffener. Hinge clips 84 are secured to the back web of channel bracket 82. Removably secured to bottom plate 79 is a heavy duty pneumatic hammer or breaker 85, which has its own air operated feed motor 86 that controls, to a limited extent, reciprocable movement of the breaker. Breaker 85 has moil or chisel point 87. Pivotally attached to the front end to breaker support channel bracket hinge clips 84 and at the back end to stiffener bracket hinge clips 69, as by pins 88, is pneumatic hydraulic ram 90, such as a tendem air-oil cylinder, having a 32" stroke. Actuation of ram 90 causes breaker support 76 to pivot about bolts 77 and 78 to maintain breaker 85 at the desired operating angle. Boom-breaker-support 42 can be made to pivot about hinge bolt assemblies 60 of trolley 41 so that breaker 85, at the front end of support 42, can be moved up and down

through a vertical plane by operating boom hoist 64 to release or reel-in attached cable 65 which is reeved through cable guide sheaves 53, 54, and 55 of trolley 41 and cable guide sheaves 70 and 71 on boom-breaker-support side members 66 and 67.

Trolley runway assembly drive means 36, trolley hoist 61, boom hoist 64, breaker 85, breaker feed air motor 86, and ram 90 are all connected to control panel 34 on platform 33 so that these units can be operated remotely by one operator. In like fashion all air lines to these units ars connected to the manifold at the lower end of swivel joint 38.

To remove a furnace lining, rig 10 is first assembled at ground level and then raised to the top of the furnace. Rig 10 is then lowered into the stack by means of falls 27 which are connected to rig top platform or support framework 14 through cables 28. When the rig is at the desired elevation the falls are locked and platform extensible beam assemblies 17, 18, 19 and 20 are moved outward by means of power cylinders 26 so that the blocks 23 at the ends of these assemblies are brought adjacent to furnace shell 12 or lining 13. Boom hoist 64 is activated to raise the front end of boom-breaker-support assembly 42 to its highest position, and ram 90 is actuated to pivot breaker support 76 so as to place hammer or breaker 85 in a horizontal position. Moil point 87 of breaker 85 is moved into contact with the inner surface of lining 13 by operating breaker feed air motor 86 or by operating trolley hoist 61, which would cause boom-breaker-support assembly 42 to move horizontally on trolley beams 32. Breaker 85 is then activated to cause moil point 87 to cut into lining 13. When necessary, ram 90 is activated to pivot support 76 and breaker 85 mounted thereon so that its moil point 87 can be rocked up and down, in pry-bar fashion, to dislodge loosened refractory. The rig operator can continue removing the lining in one of two ways. He can operate breaker 86 to remove the lining in a series of vertical cuts by lowering the end of boom assembly 42 and gradually moving trolley-boom-breaker-support assembly 16 forward on trolley beams 32 and/or by moving breaker moil point 87 forward by means of breaker feed air motor 86. When the lower limit of boom assembly 42 is reached, drive means 36 is activated to rotate trolley runway assembly 15 in a horizontal plane a short distance. Breaker 85 on boom assembly 42 is again raised to its top position and another vertical cut made in the same fashion. This sequence of operation is continued until trolley runway assembly has rotated through 360° and a broad band of lining has been removed. If the operator is not satisfied with this method of operation he can remove the lining in a series of horizontal cuts bp progressively rotating trolley runway 15 through 360° to cut out a narrow band of refractory before lowering boom assembly 42 to cut out a lower narrow band of refractory. Only after a broad band of refractory material has been cut from the furnace lining in this fashion is it necessary to retract platform extensible boom assemblies 17, 18, 19 and 20 and move the rig to a lower position in stack 11. As the rig is lowered in a blast furnace stack, the stack widens and the boom assembly must be further extended to contact shell 12. When the entire lining 13 of stack 11 has been removed, rig 10 is raised to the top of the furnace and then lowered to the ground.

The foregoing has described a novel rig for removing the lining from a large structure. Such a rig operated by one man has been used in several blast furnace stacks, as large as 40' 10½" in diameter and 70' high, to remove lining material where 8 to 25 men had previously been required to accomplish the same task. In addition to being an efficient and economical means of removing a stack lining, the rig of this invention minimizes the dangers of what previously had been a hazardous job.

I claim:

1. Apparatus for removing the sidewall lining from a structure comprising:

(a) a support framework adapted to be suspended in said structure,

(b) linear track means mounted on said support framework and adapted to be rotated in a horizontal plane,

(c) a trolley adapted to be moved reciprocably along said track means,

(d) a boom, having a first end and a second end, pivotally connected adjacent said first end to said trolley,

(e) hammer means pivotally mounted adjacent said boom second end,

(f) means to raise and lower said boom second end to engage with said hammer pivotally mounted thereon, at any one position of the track means, said structure sidewall lining at a plurality of locations in the same vertical plane.

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U.S. Cl. X.R.

173—43; 299—70