Dec. 24, 1968 C. B. DEAN 3,417,538

KILN LINER BLOCK SUPPORTING STRUCTURE

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Fig. 1

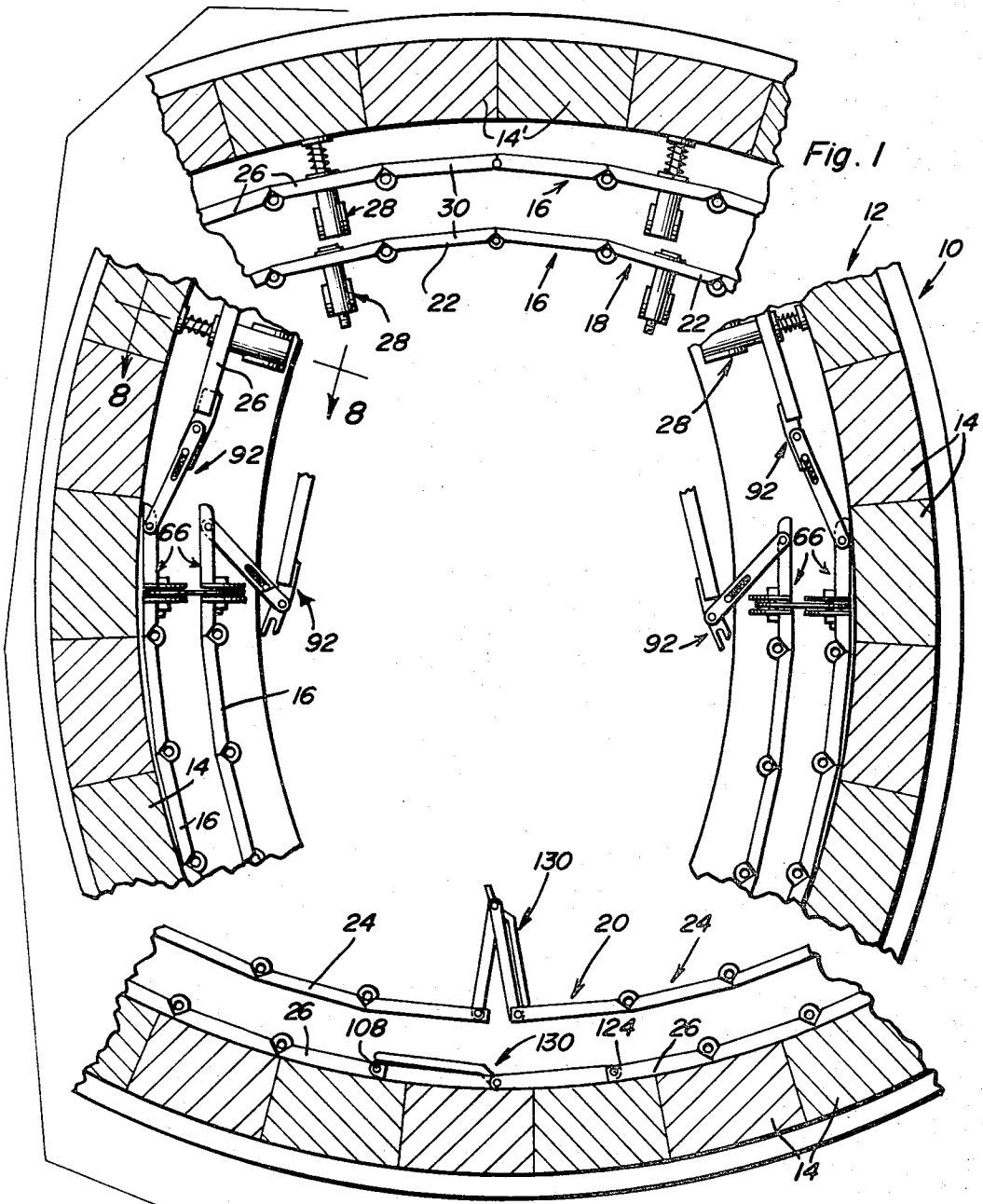
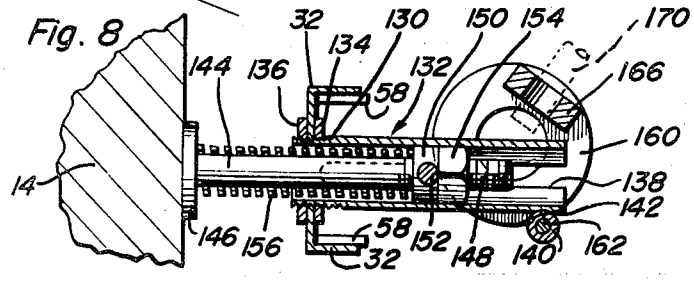


Fig. 8



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KILN LINER BLOCK SUPPORTING STRUCTURE

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Fig. 2

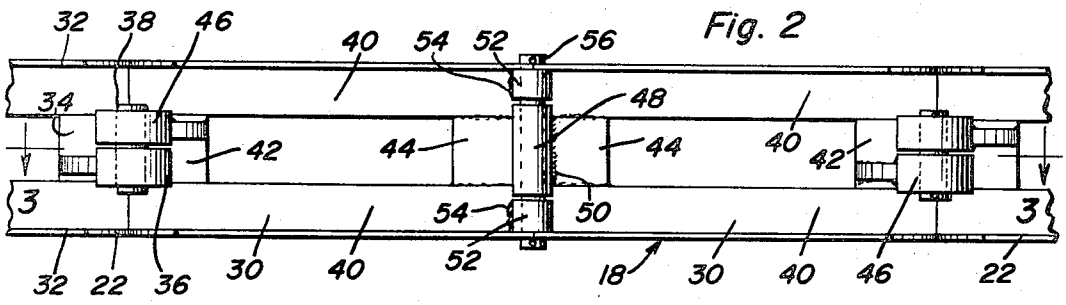


Fig. 3

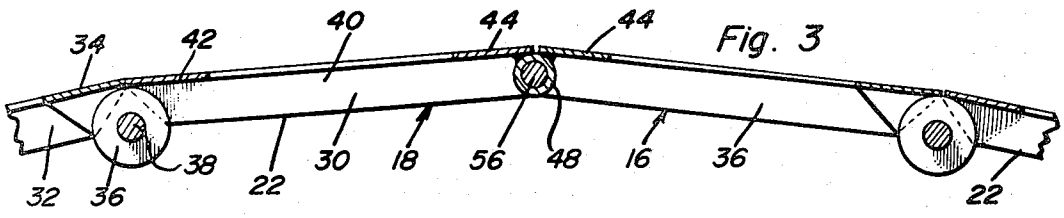


Fig. 4

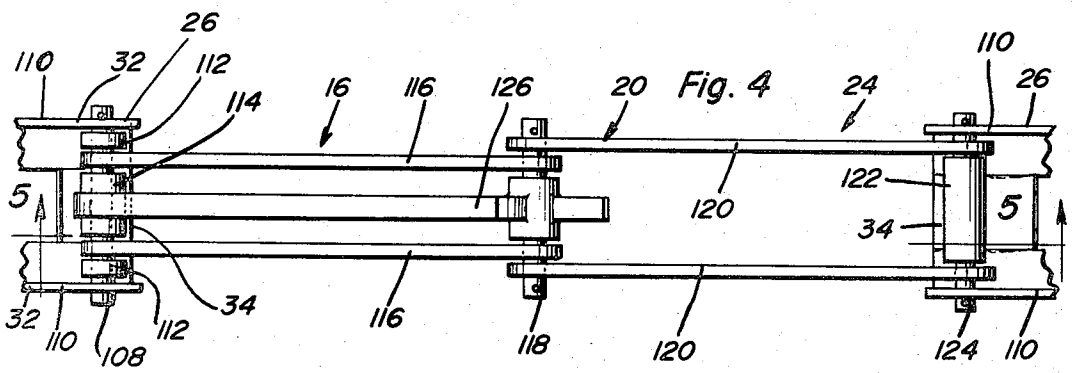
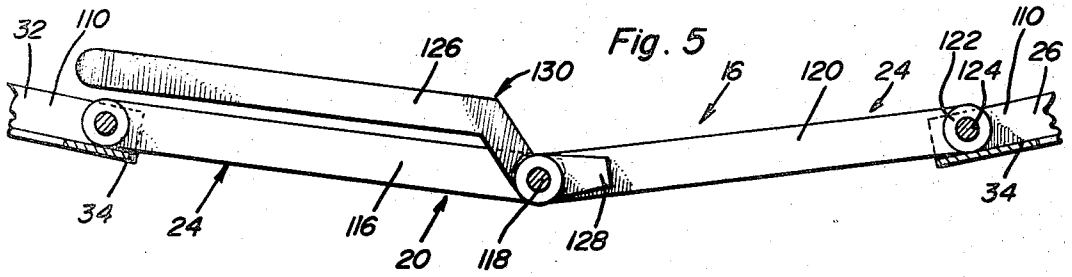


Fig. 5



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KILN LINER BLOCK SUPPORTING STRUCTURE

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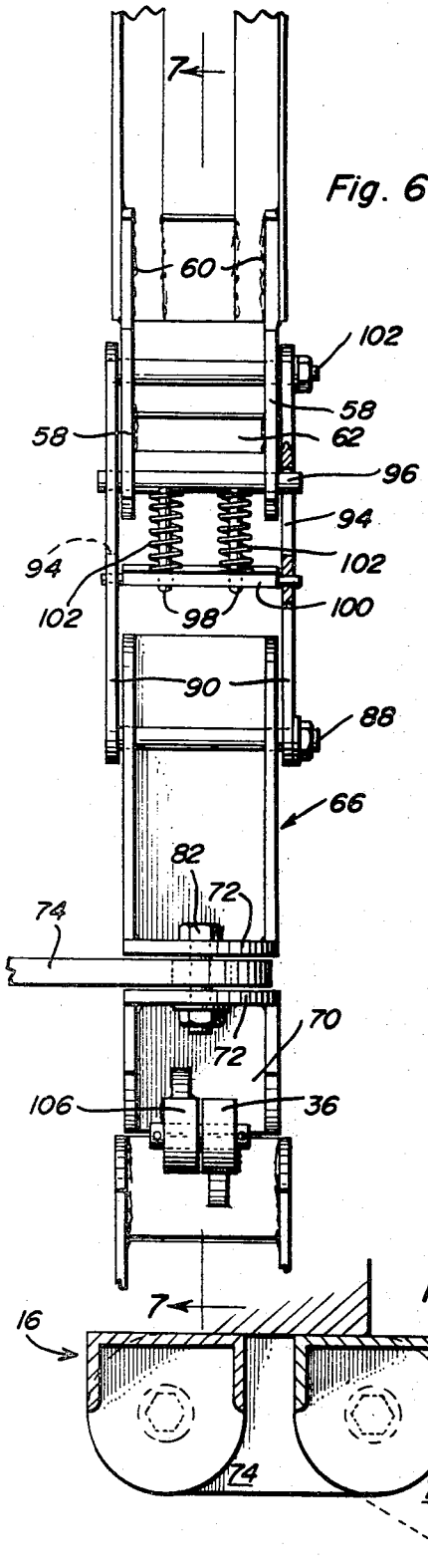


Fig. 6

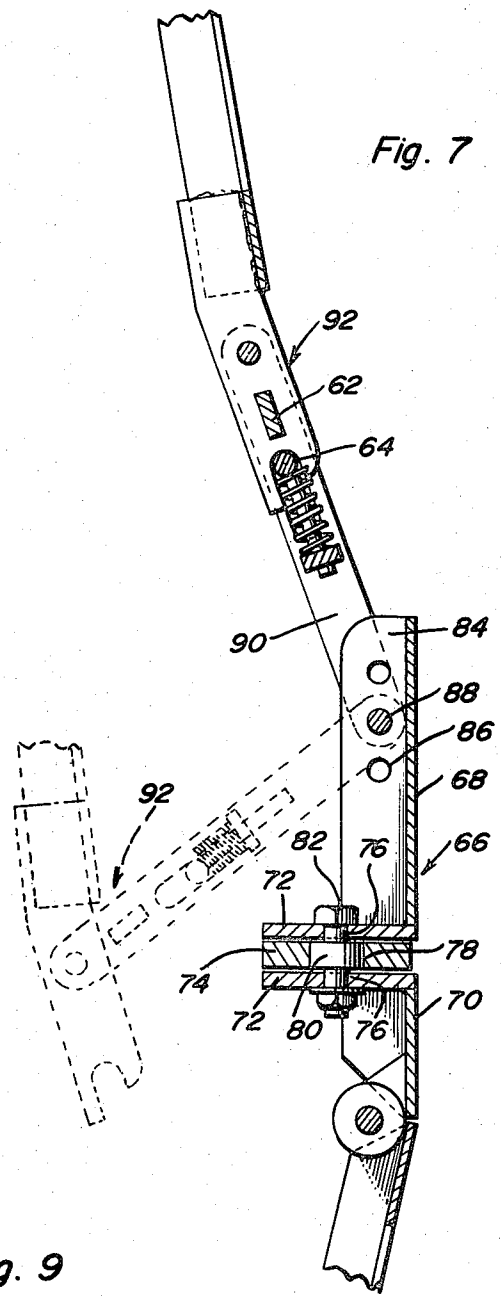


Fig. 7

Fig. 9

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3,417,538

KILN LINER BLOCK SUPPORTING STRUCTURE

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ABSTRACT OF THE DISCLOSURE

Twin side-by-side downwardly opening and generally semi-circular arch assemblies adapted to support upper portions of longitudinally spaced circumferential courses of kiln liner blocks, the arch assemblies each including opposite side support means adapted to be supported from lower portions of an associated kiln and from which the opposite side lower portions of the arch assemblies are supported for limited vertical movement and each of the arch assemblies including a pair of generally quarter circular arch sections joined at the top of the corresponding arch assembly for relative pivotal movement about an axis extending longitudinally of the associated kiln with the corresponding pair of support means on each side of the arch assemblies being supported from one another for swinging movement by means of a horizontal connecting link having its opposite ends pivotally connected to the corresponding support means for rotation relative thereto about generally vertical axes.

The kiln liner block supporting structure of the instant invention is specifically adapted to enable one course of circumferentially extending kiln liner blocks to be erected and supported from one of the arch assemblies while the other arch assembly has all of its liner block supporting portions thereof inwardly displaced for swinging through the first arch assembly and positioning on the remote side thereof to support the next circumferential course of liner blocks while the uppermost key blocks of the first erected circumferential course of kiln liner blocks are being cut to size and fitted in position. In this manner, the two arch assemblies of the kiln liner block supporting structure may be "walked" longitudinally of the associated kiln while the latter is being relined or constructed.

The main object of this invention is to provide a kiln liner block supporting structure that will be operable to support kiln liner blocks of two adjacent circumferential courses of liner blocks of a kiln and alternately sequentially advanced longitudinally of the kiln.

Another object of this invention is to provide a kiln liner block supporting structure in accordance with the immediately preceding object and including axially spaced side-by-side downwardly opening generally semi-circular arch assemblies supported from one another and individually by opposite side support means adapted to be supported from the lower portions of an associated kiln and which may be readily "walked" longitudinally of an associated kiln without involving disassembly of either of the arch assemblies which together form the kiln liner block supporting structure of the instant invention.

Yet another object of this invention is to provide a kiln liner block supporting structure which may be readily modified for use in construction of different size kilns and which therefore may be repeatedly used in the construction of numerous different size kilns.

A further object of this invention is to provide a kiln liner block supporting structure in accordance with the preceding objects and which is constructed in a manner adapting the semi-circular arch assemblies thereof to be alternately sequentially "walked" longitudinally of an associated kiln by a minimum number of workmen.

A final object of this invention to be specifically

enumerated herein is to provide a kiln liner block supporting structure in accordance with the preceding objects which will conform to conventional forms of manufacture, be of simple construction and easy to use so as to provide a device that will be economically feasible, long lasting and relatively trouble-free in operation.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a fragmentary vertical sectional view taken substantially upon a plane passing through one longitudinal portion of a horizontally disposed kiln and with the kiln liner block supporting structure of the instant invention operatively associated with and supporting one circumferential course of liner blocks in position within the kiln and with the inwardly displaced position of the other arch assembly of the supporting structure being illustrated in phantom lines;

FIGURE 2 is a fragmentary enlarged bottom plan view of the center of that portion of the arch assembly illustrated in solid lines in the upper portion of FIGURE 1;

FIGURE 3 is a fragmentary vertical sectional view taken substantially upon the plane indicated by the section line **3—3** of FIGURE 2;

FIGURE 4 is a top plan view of the center portion of the arch assembly illustrated in solid lines in the lower portion of FIGURE 1;

FIGURE 5 is a fragmentary vertical sectional view taken substantially upon the plane indicated by the section line **5—5** of FIGURE 4;

FIGURE 6 is an enlarged elevational view of that portion of the arch assembly illustrated in solid lines in FIGURE 1 of the drawings in the left hand portion of FIGURE 1 and as seen from the right hand side of FIGURE 1;

FIGURE 7 is a fragmentary vertical sectional view taken substantially upon a plane indicated by the section line **7—7** of FIGURE 6 and with alternate positions of two components of the arch assembly illustrated in phantom lines;

FIGURE 8 is an enlarged fragmentary sectional view taken substantially upon the plane indicated by the section line **8—8** of FIGURE 1; and

FIGURE 9 is a fragmentary horizontal sectional view taken substantially upon a plane passing through the vertical center of the left hand portion of FIGURE 1 and illustrating the manner in which the arch sections may be "walked" through each other.

Referring now more specifically to the drawings the numeral **10** generally designates a kiln structure including a lining assembly referred to in general by the reference numeral **12** consisting of longitudinally spaced circumferential courses of liner blocks **14**.

When a kiln is being constructed or relined, the blocks **14** in the lower portions of each circumferential course of blocks may be readily placed in position and retained in position by gravity. However, the upper or arched portion of each circumferential course of liner blocks **14** must be held in position until the uppermost opposite side key blocks **14'** are cut to the exact desired size and keyed in position.

When constructing a new kiln or relining an existing kiln, it has heretofore been the practice to erect a supporting structure in position within the kiln to support each circumferential course of kiln liner blocks **14**. Then, after the final uppermost key blocks **14'** were in position, the previously erected supporting structure would be partially dismantled and shifted slightly longitudinally of the kiln prior to the setting in place of the next circum-

ferential course of liner blocks. This manner of placing each circumferential course of liner blocks in position wastes considerable time since the cutting to size and the positioning of the two uppermost key blocks **14'** takes considerable time and while these two key blocks are being cut and placed in position all other work in lining the kiln had to cease and thereafter the supporting structure had to be dismantled and re-erected in position to support the next circumferential course of blocks before the next course of blocks could be placed in position.

The present invention, however, utilizes a pair of arch supporting assemblies which may be erected in position and alternately readily slightly collapsed both transversely and vertically and "walked through" each other subsequent to being transversely and vertically expanded and repositioned for supporting the next circumferential course of liner blocks.

The arch supporting assemblies which together form the kiln liner block supporting structure of the instant invention are each generally referred to by the reference numeral **16**. Each assembly **16** includes a semi-circular and downwardly opening upper portion **18** and a semi-circular upwardly opening lower portion **20**. The upper portion **18** consists of a pair of opposite side quarter-circular arch sections **22** and the lower portion **20** includes a pair of quarter-circular opposite side lower sections **24**.

Each of the upper sections **22** includes a plurality of pivotally interconnected link segments **26**, each provided with a jack assembly referred to in general by the reference numeral **28**. In addition, each upper section **22** includes an upper link segment **30**. The link segments **26** each include opposite side longitudinally extending angle members **32** interconnected at their opposite ends by means of a transverse member **34** and the adjacent ends of the link segments **26** include transversely registered mounting bosses **36** through which opposite end portions of a pivot pin **38** are secured whereby the adjacent ends of the link segments **26** are pivotally interconnected. However, the mounting bosses **36** project inwardly from the transverse members **34** and the adjacent edge portions of each pair of adjacent transverse members **34** define abutment surfaces preventing adjacent link segments **26** from being pivoted to fully aligned positions whereby each upper section **22** is limited to an arcuate configuration.

The link segments **30** include similar opposite side angle members **40** interconnected at corresponding ends by means of transverse members **42** and **44** and each transverse member **42** includes a mounting boss **46** which is transversely registered with the adjacent mounting boss **36** and rotatably receives therethrough the corresponding pivot pin **38**. The transverse member **44** of the right hand link segment **30** has a sleeve **48** secured thereto by welding **50** and the adjacent ends of the angle members **40** of the left hand link segment **30** have a pair of sleeves **52** secured thereto by welding **54**. The sleeves **52** are axially spaced and aligned and receive therebetween the sleeve **48** and a pivot pin **56** is secured through the sleeves **48** and **52**.

The lower end of each lower segment **26** has a pair of mounting arms **58** secured thereto by welding **60** and the arms **58** project below the lower end of the lowermost link segments **26** and are interconnected by means of a transverse brace **62**. The lower free ends of the arms **58** are provided with endwise outwardly opening notches **64** and each of the arch assemblies **16** includes a pair of opposite side supporting link structures generally referred to by the reference numerals **66**. The structures **66** include a pair of end assemblies **68** and **70** which are generally channel-shaped in configuration and include parallel adjacent flange portions **72** which pivotally receive therebetween a corresponding end portion of a connecting link **74**. The flange portions **72** are suitably apertured as at **76** and each of the end portions of the connecting link **74** is apertured as at **78** and has a sleeve **80** disposed therein. A pivot pin **82** is passed through each pair of corresponding apertures **76** and the associated sleeve **80**. Accordingly, it may be seen that the connecting links **74** may be swung a full 360 degrees about each of the pivot fasteners **82** and that the two connecting links **74** thereby support the opposite side portions of the arch assemblies **16** from each other and for swinging movement of each pair of supporting link structures **66** about the pivot pin **82** carried by the other supporting link structure **66**.

The opposite side flange portions **84** of the end assembly **68** are provided with pairs of aligned apertures **86** spaced longitudinally of the end assembly **68** and a pivot pin **88** is secured through one pair of the apertures **86** and the apertured end portions of a pair of link arms **90**, which together with the arms **58** form an articulated link structure generally referred to by the reference numeral **92** and which may be either fully extended in the manner illustrated in FIGURES 6 and 7 of the drawings in solid lines or collapsed in the manner illustrated in phantom lines in FIGURE 7 of the drawings. The link arms **90** are slotted as at **94** and slidably receive the opposite end portions of a transverse locking shaft **96** therein. The locking shaft includes a pair of parallel laterally projecting pins **98** which are slidably received through a cross brace **100** extending between the arms **90** and a pair of compression springs **102** are disposed about the pins **88** between the locking shaft **96** and the cross brace **100** and thereby urge the locking shaft **96** toward the ends of the slots **94** remote from the cross brace **100**.

As can best be seen from a comparison of FIGURES 6 and 7 of the drawings the locking shaft **96**, when its end portions are seated in the notches **64**, locks the link arms **90** to the mounting arms **58** against angular displacement relative to the latter. However, when the opposite ends of the locking shaft **96** are withdrawn from the notches **64**, the link arms **90** may be pivoted relative to the mounting arms **58** through the pivot connection defined by the pivot shaft or fastener **102** extending between the overlapped end portions of the link arms **90** and the mounting arms **58**.

Accordingly, it may be seen that the lower end portions of the upper sections **22** defined by the mounting arms **58** may be inwardly and downwardly displaced so as to vertically and transversely contract the upper portion **18** of one arch supporting assembly **16** for movement through the other arch supporting assembly **16**.

Each of the lower sections **24** also includes a plurality of link segments **26** although the link segments **26** of the lower sections **24** do not include the jack assemblies **28** to be hereinafter more specifically referred to.

The lower end of each of the supporting link structures **66** includes a mounting boss **106** which is transversely registered with the uppermost mounting boss **36** of the corresponding side of the lower portion **20** and the lower ends of the left hand link segments **26** include pivot pins **108** passed through the corresponding flange portions **110**, a pair of journal bosses **112** carried by the corresponding angle members **32** and a mounting boss **114** carried by the corresponding transverse member **34**. The mounting boss **114** is axially aligned with and spaced between the mounting bosses **112** and corresponding end portions of a pair of link arms **116** are journaled on the pivot pin or fastener **108** between the mounting bosses **112** and the mounting boss **114**. The other pair of corresponding ends of the link arms **116** are rotatably journaled on a pivot pin or fastener **118** which is also rotatably received through corresponding end portions of a similar pair of link arms **120** carried by the lower right hand link segment **26**. The ends of the link arms **120** remote from the pivot fastener **118** are received between the flange portions **110** of the lower right hand link segment **26** and a journal sleeve **122**

carried by the transverse member **34** of the lower right hand link assembly **26**, the link arms **120** being pivotally secured to the corresponding link segment **26** by means of a pivot pin or fastener **124** secured through the flange portions **110**, the corresponding ends of the link arms **120** and the journal sleeve **122**. In addition, one end of a lever arm **126** is rotatably journaled on the pivot pin or fastener **118** and includes a short camming end portion **128** which may be utilized, upon inward swinging movement of the free end of the lever arm **126**, to engage the liner blocks **14** and cam the pivot pin or fastener **118** radially inwardly of the kiln **10** so as to swing the pairs of link arms **116** and **120** past their center positions.

Accordingly, it may be seen that the lower sections **24** are connected by means of an articulated link structure referred to in general by the reference numeral **130** and comprising the two pairs of link arms **116** and **120**. The articulated link structure **130** of course may be utilized to bracingly space the adjacent ends of the lowermost link segments **26** apart or to shift the pivot pins **108** and **124** toward each other whereby the lower portion **20** of each arch assembly **16** may be transversely and vertically contracted.

After each arch assembly **16** has had its upper portion **18** as well as its lower portion **20** transversely and vertically contracted that arch assembly **16** may be "walked through" the other arch assembly **16** and immediately thereafter be transversely and vertically expanded into position forming a full arch assembly for supporting the next course of liner blocks **14**.

The jack assemblies **28** are carried by each of the link segments **26** of the upper sections **22** and include a mounting sleeve **132** externally threaded on one end portion as at **134** and secured between corresponding angle members **32** centrally intermediate their opposite ends by means of a pair of jamnuts **134** and **136** threadedly engaged with the mounting sleeve **132** inwardly and outwardly of the corresponding angle members **32**.

The ends of the mounting sleeves **132** remote from the externally threaded end portions **130** are provided with diametric slots **138** which open outwardly of the corresponding ends of the mounting sleeves **132**. In addition, the mounting sleeves **132** also have sleeves **140** secured thereto in any convenient manner such as by welding **142**.

Each of the jack assemblies **28** includes an extendible rod portion **144** having a diametrically enlarged head **146** on one end portion and externally threaded on the other end portion as at **148**. A sleeve **150** is slidably disposed on the externally threaded end portion **148** of the rod portion **144** and includes a pair of diametrically oppositely projecting stub pins **152** which are slidably received in the slot **138**. Further, an internally threaded nut **154** is threadedly engaged on the threaded end portion **148** behind each of the sleeves **150** and thereby adjustably limits axial shifting of the rod portion **144** toward the left relative to the sleeve **150** as seen in FIGURE 8 of the drawings.

The stub pins or shafts **152** project outwardly from the slot **138** and a pair of cam disks **160** connected by means of a transverse pin **162** are mounted on each of the mounting sleeves **132** by the pin **162** being rotatably received through the sleeve **140**. The cam disks **160** are also interconnected by means of an apertured brace **166** and the opposite end portions of the pins **142** are engaged by the peripheral portions of the cam disks **160**. In FIGURE 8 of the drawings the cam disks **160** are shown in position being rotated in a counterclockwise direction so as to urge the pins **152** toward the left so as to thus extend the rod portion **144** outwardly into contact with the opposing liner block **14**. After the head **146** has engaged the liner block **14**, continued movement of the cam disks **160** in counterclockwise directions will of course only further shift the sleeve **150** to the left as illustrated in FIGURE 8 of the drawings so as to more tightly compress the expansion spring **156**. When the cam disks **160** have been rotated to a position with the transverse brace **166** abutting the mounting sleeve **132** the points of contact of the pins **152** with the cam disks **160** will be shifted past a position diametrically opposite the pivot pin **162** whereby the cam disks **160** will be maintained in these limit positions. However, when it is desired to shift one arch assembly **16** through the other arch assembly **16**, the cam disks **160** are rotated in counterclockwise directions by means of a handle-defining tool **170** engaged with each of the transverse braces **166** which will enable the rod portions **144** to be almost fully retracted and the heads **146** to abut against the adjacent ends of the mounting sleeves **132**. When the jack assemblies **28** are thus retracted, the corresponding arch assembly **16** may be passed through the other arch assembly **16** in the manner illustrated in FIGURES 1 and 9 of the drawings. With continued reference to FIGURE 9, it may be seen that the left hand arch assembly **16**, after its jack assemblies **28** have been retracted and its articulated link structures **92** and **130** have been collapsed, may be swung through the other arch assembly **16** to the position thereof illustrated in phantom lines in FIGURE 9 before the articulated link structures **92** and **130** are again extended and the piston rod portions **144** of its jack assemblies **28** have again been projected for engagement with the next circumferential course of line blocks being erected.

Thus, it may be seen that after one of the arch assemblies **16** has been utilized to brace and hold in position all but the key blocks **14'** of the corresponding course of liner blocks the other arch assembly **16** may be vertically and transversely contracted and passed through the arch assembly still in use for positioning on the opposite side thereof. Then, the lower liner blocks **14** of the next course of liner blocks as well as all but the uppermost key blocks **14'** of the next course of blocks may be placed in position while the key blocks **14'** of the first course of liner blocks are being finally cut to exact shape and placed in position. By this construction, there is no delay in shifting from one course of liner blocks to the other while the first course is having its key blocks precisely cut and fitted and there is literally no disassembly of the arch assemblies **16** when shifting from one course of blocks to another except for unlocking the articulated link structures **92** and **130** and retracting the various jack assemblies **28**, which steps can be readily carried out by a minimum of workmen. Further, inasmuch as each of the arch assemblies is constructed of a plurality of pivotally interconnected link segments **26**, the arch assemblies **16** may be constructed of different sizes and readily changed in size by the addition or deletion of one or more link segments **26**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modificatoins and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A kiln liner block supporting structure for use in relining existing kilns and constructing new kilns, said structure including a pair of side-by-side downwardly opening generally semi-circular arch assemblies adapted to support longitudinally spaced circumferential courses of kiln liner blocks, opposite side support means adapted for support at opposite sides of a kiln being lined, said arch assemblies each including opposite side portions movable toward and away from each other, the lower portions of the opposite side portions of each of said arch assemblies being mounted from the corresponding support means for limited vertical movement and limited

movement of said opposite side lower portions toward and away from each other as well as movement through the plane in which the other arch assembly is disposed, whereby said assemblies may be "walked through" each other.

2. The combination of claim 1 wherein said arch assemblies each include a plurality of end aligned arch sections joined at adjacent ends for movement of said opposite side lower portions thereof toward and away from each other.

3. The combination of claim 2 wherein each of said arch assemblies includes a pair of generally quarter-circular and aligned sections whose adjacent ends are jointed for swinging movement of the remote end portions of said arch sections toward and away from each other.

4. A kiln liner block supporting structure for use in relining existing kilns and constructing new kilns, said structure including a pair of side-by-side downwardly opening arch assemblies including opposite side lower portions movable toward and away from each other, support means interconnecting corresponding opposite side lower portions of said assemblies and from which the lower portions of each assembly are supported for limited vertical and lateral movement toward and away from each other as well as movement through the plane in which the other arch assembly is disposed, whereby said assemblies may be "walked through" each other.

5. A kiln liner block supporting structure for use in relining existing kilns and constructing new kilns, said structure including a pair of side-by-side upstanding annular frame assemblies each being expandable and contractable between expanded generally circular configurations and contracted configurations of reduced height and width sufficient to enable said frame assemblies each, when contracted, to be passed through the other frame assembly, said assemblies being adapted to support longitudinally spaced circumferential courses of kiln liner blocks, said frame assemblies each when expanded, including opposite side portions thereof adapted to be supported in stationary position within and from a kiln being lined and from which the corresponding opposite side portions of the other frame assembly are supported, when said other frame assembly is contracted, for successive movement of the last-mentioned opposite side portions generally radially inwardly of said other frame assembly and toward the plane of the expanded frame assembly, through said plane, and then radially outwardly of said other frame assembly and away from the side of said

plane remote from the side thereof on which said other frame assembly was first disposed, whereby said frame assemblies each may be alternately contracted and passed through the other frame assembly before again being expanded.

6. The combination of claim 5 wherein corresponding opposite side portions of said frame asemblies are supported from each other by means of horizontally elongated connecting links each pivotally secured to the corresponding opposite side portions of said frame assemblies for swinging movement throughout a full 360° arc relative thereto about upstanding axes.

7. The combination of claim 6 wherein said frame assemblies each include four end aligned generally semi-circular sections consisting of two upper sections and two lower sections.

8. The combination of claim 7 wherein the adjacent ends of said upper sections are pivotally secured together for swinging movement of the remote ends of said upper sections toward and away from each other.

9. The combination of claim 7 wherein the adjacent ends of said lower sections are connected by means of an expandable link structure extending therebetween.

10. The combination of claim 7 wherein the adjacent ends of each pair of upper and lower sections are connected together by said opposite side portions of said frame assemblies and which comprise expandable link structures.

11. The combination of claim 4 wherein said arch assemblies each include a plurality of generally radially outwardly projecting and generally radially inwardly retractable jack assemblies spaced thereabout.

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