C. A. ANDERSON.

MOLD FOR FORMING CONCRETE SILOS.

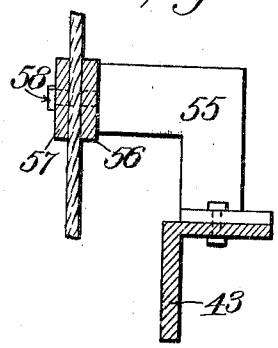
APPLICATION FILED FEB. 24, 1909.

984,993.

Patented Feb. 21, 1911.

5 SHEETS—SHEET 1.

Fig. 9.



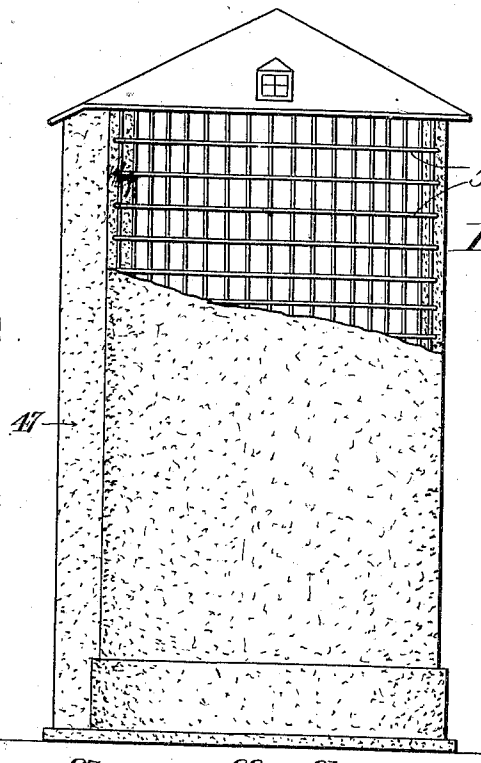
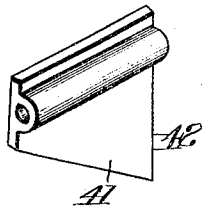


Fig. 1

Fig. 14.



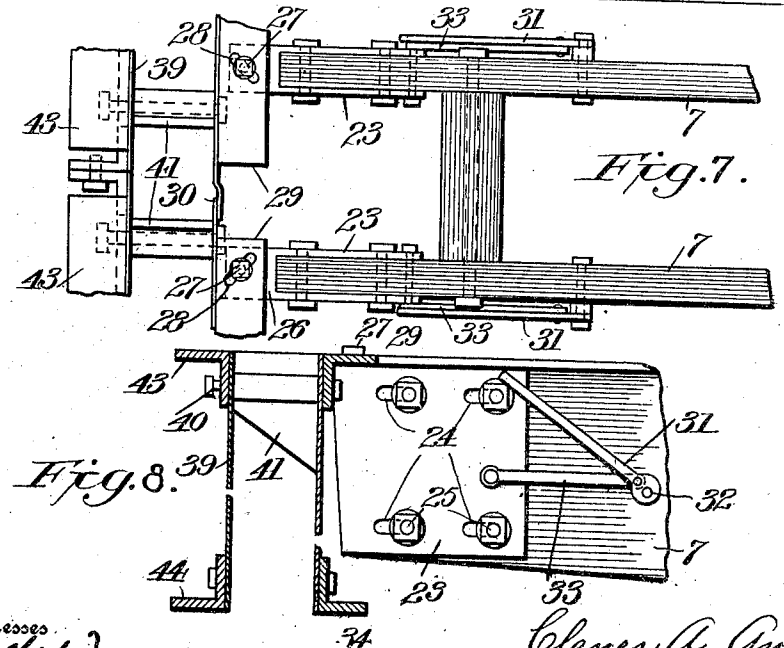


Fig. 7.

Fig. 8.

Witnesses.

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Fig. 2.

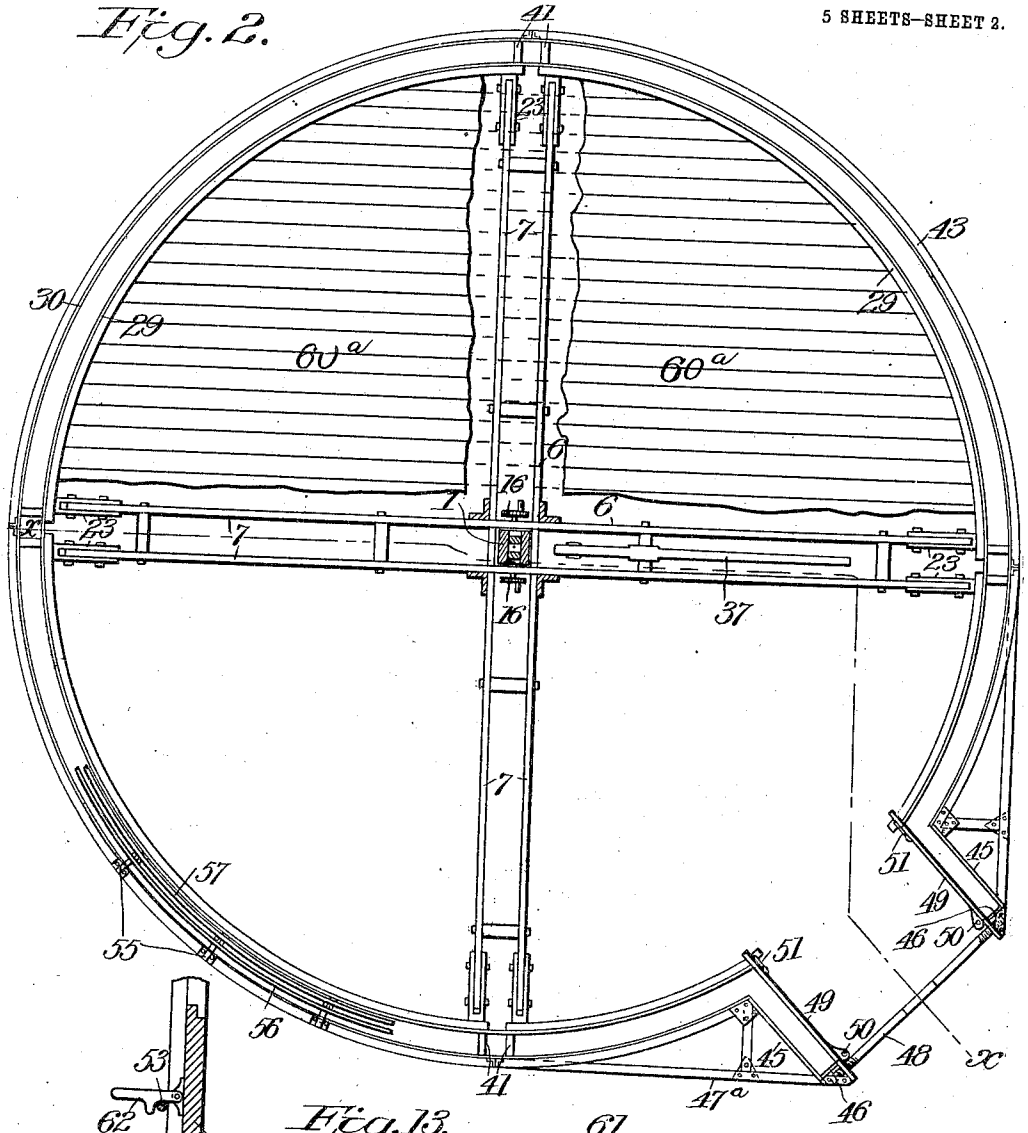


Fig. 12.

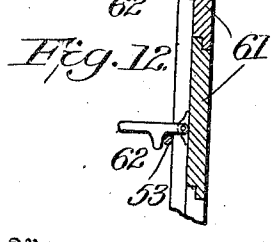
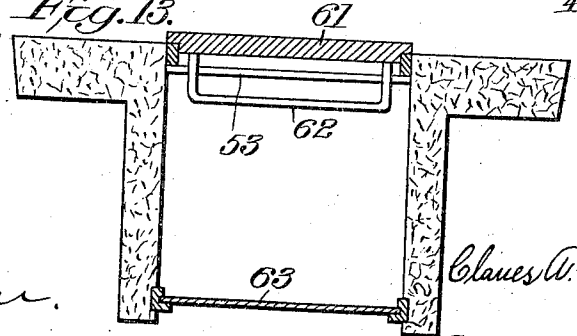


Fig. 13.



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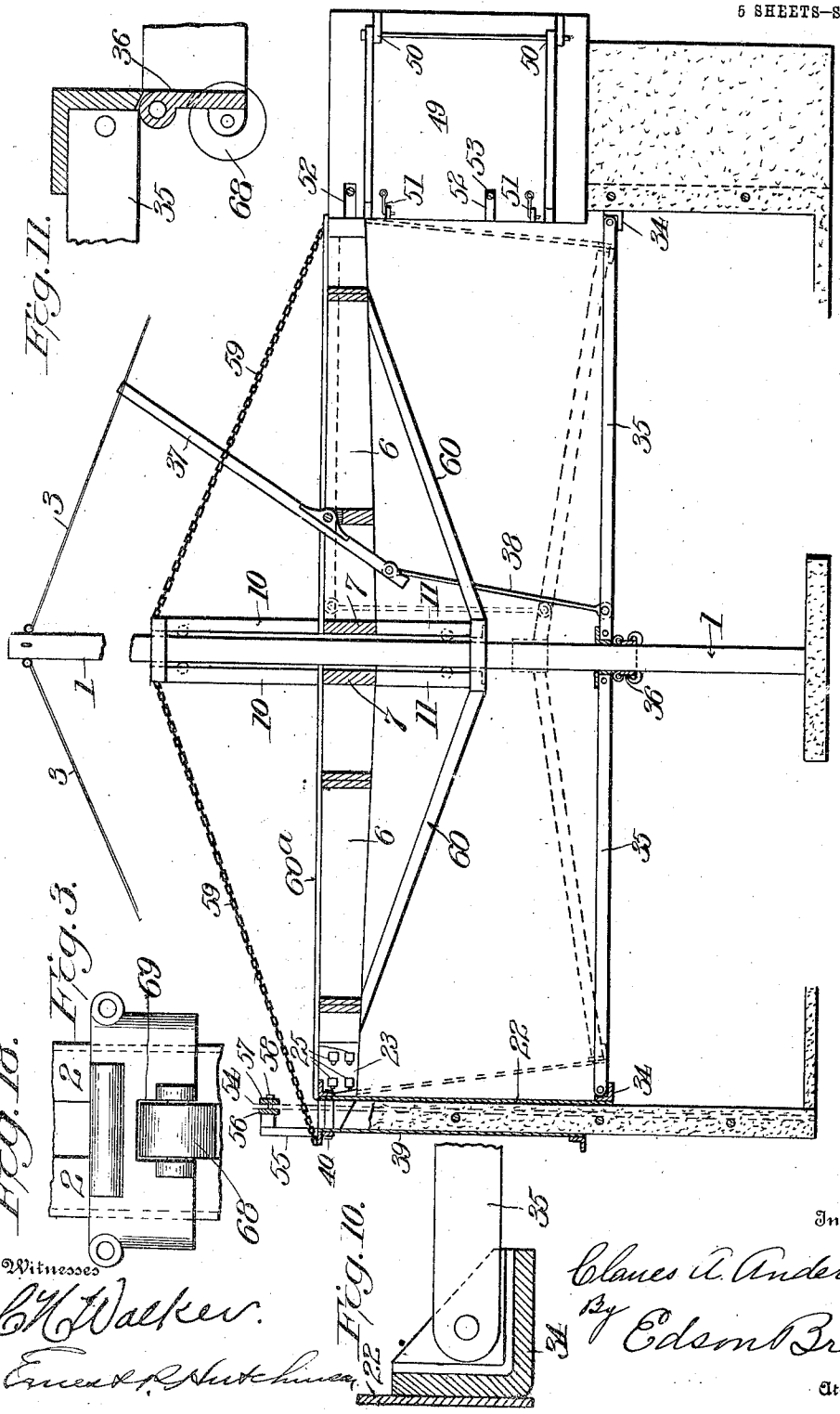

Fig. 11.

Fig. 3.

Fig. 18.

Fig. 10.

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5 SHEETS—SHEET 4.

Fig. 5.

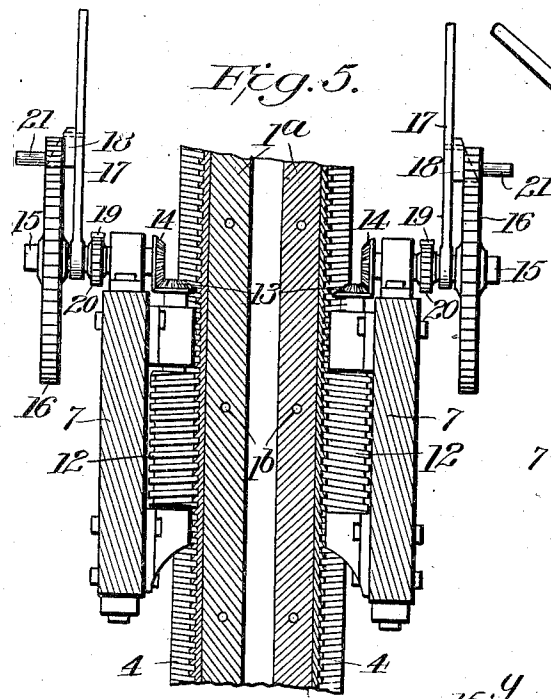


Fig. 6.

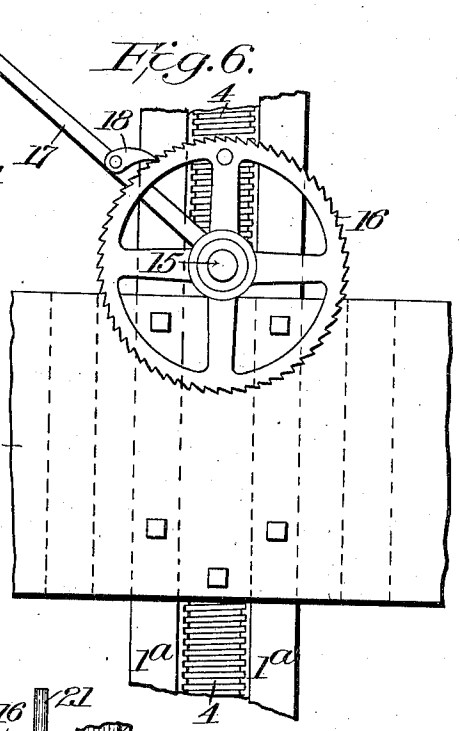
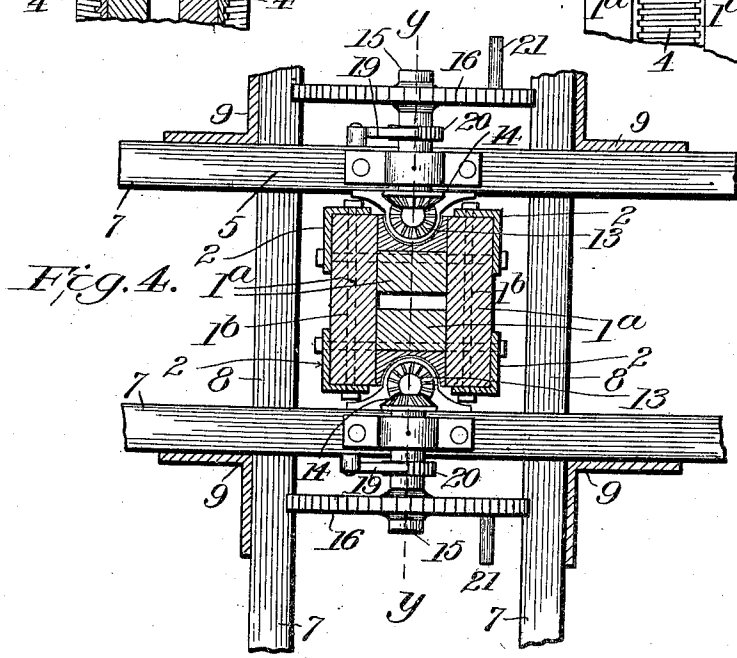


Fig. 4.



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5 SHEETS—SHEET 5.

Fig. 15.

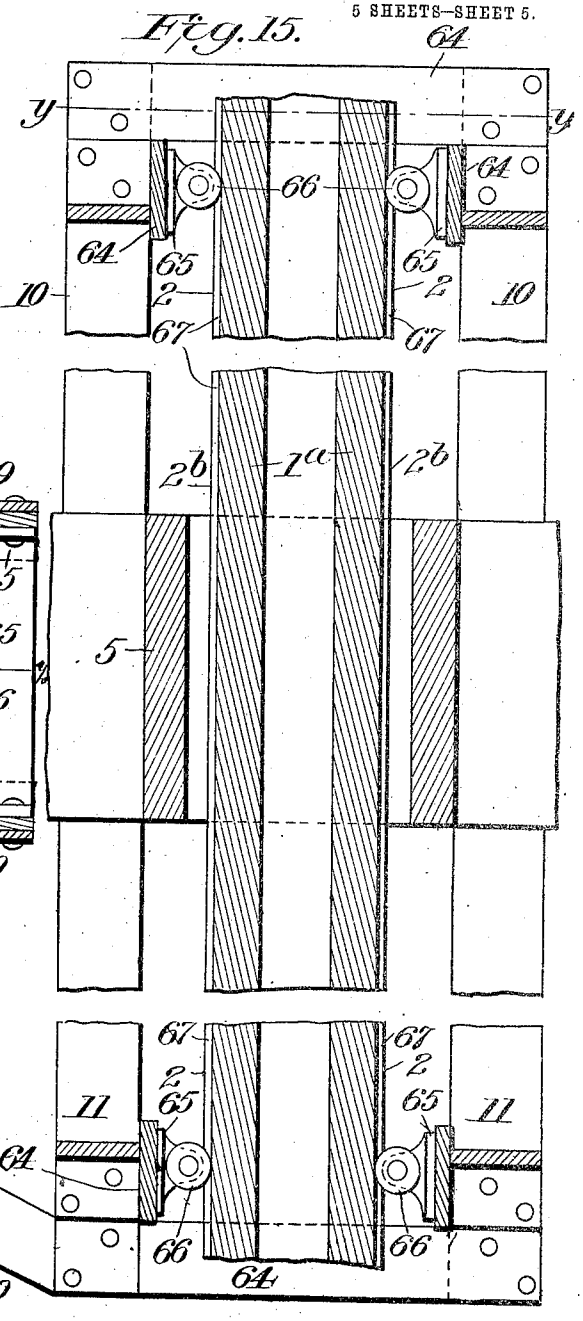


Fig. 16.

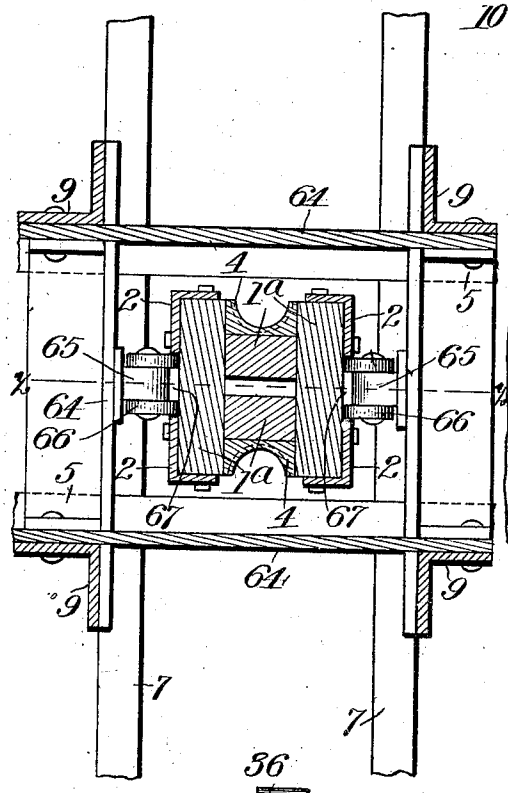
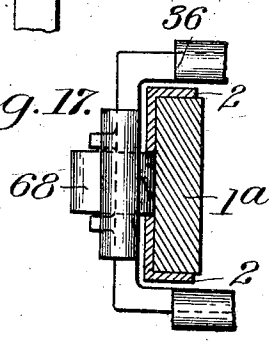


Fig. 17.



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UNITED STATES PATENT OFFICE.

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MOLD FOR FORMING CONCRETE SILOS.

984,993. Specification of Letters Patent. Patented Feb. 21, 1911.

Application filed February 24, 1909. Serial No. 479,843.

To all whom it may concern:

Be it known that I, CLAUES A. ANDERSON, a citizen of the United States, residing at St. Charles, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Molds for Forming Concrete Silos; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to molds for concrete structures especially designed for building silos.

This apparatus belongs to the class of molds in which are employed a mast supported in the axis of the structure, a sleeve vertically movable on the mast and guided thereby, arms extending outward from the sleeve, mold walls adjustably connected to the arms, and means for raising and supporting the sleeve, arms and mold walls step by step as the work progresses.

The main object of this invention is to improve previous molds of this type thereby producing one which is thoroughly practical and meets the demands of the trade in simplicity of construction and reduced cost of construction.

Subsidiary objects are to provide for securing greater rigidity of the mold walls so that they will not give when the concrete is tamped; for constructing an external chute integral with the walls of the silo, for securing greater safety in raising and lowering the mold; for making the walls more even and plumb, by preventing the mold from swinging on the mast; for increasing the speed with which the mold may be moved from one stage to the next higher stage so that this operation can be performed in about ten minutes; for making the adjustment of the mold walls more accurate whereby the mold will be exactly the same size at each stage; for securing greater convenience in placing the concrete in the mold; for strengthening the mast thereby reducing chance of accident; for supporting vertical reinforcing rods without interfering with placing concrete in the mold; for placing horizontal reinforcing rings in the concrete so that they extend across the chute and prevent the sides of said chute from spreading; and for disconnecting the outer mold wall when the structure is completed, and lowering said outer mold wall at the outside and the inner mold wall, together with the sleeve and supporting arms, on the inside of the building, after which the apparatus may be quickly taken apart and removed.

The invention consists in the features of construction and combinations of devices which accomplish these objects and which are hereinafter described and claimed.

In the accompanying drawings, illustrating the preferred embodiment of my invention: Figure 1 is an elevation of a concrete structure or silo formed by my mold, partly broken away to show the horizontal and vertical reinforcing rods. Fig. 2 is a plan view of the mold. Fig. 3 is a vertical sectional view on the line *x*—*x* of Fig. 2, also showing a portion of concrete wall already molded. Fig. 4 is an enlarged sectional view of the mast taken above the radial arms supporting the mold walls and showing more particularly the mechanism for raising the sleeve. Fig. 5 is a vertical sectional view on the line *y*—*y* of Fig. 4. Fig. 6 is a broken side view of the sleeve, mast and mechanism for raising the former on the latter. Fig. 7 is an enlarged broken plan view of the outer end of one of the radial arms showing the means of connecting it to the inner mold wall and also the means of connection between the inner mold wall and the outer mold wall. Fig. 8 is a broken side view showing the same parts. Fig. 9 is a detailed view of one of the brackets and the rings for supporting the vertical reinforcing rods. Fig. 10 is an enlarged detailed view showing the hinge-connection between the lower edge of the inner mold wall and one of the radial arms attached to the lower sleeve. Fig. 11 is an enlarged detailed view of the hinge-connection between said lower sleeve and the inner end of said arm, Figs. 12 and 13 are detailed views showing how the doors are fitted to the building, especially how the inner sectional door is secured to the portions of the horizontal reinforcing rods which extend across the chute. Fig. 14 is a detailed view of one of the spacing blocks used between the inner and outer mold walls. Fig. 15 is an enlarged vertical section on the line *z*—*z* of Fig. 16 showing

the roller bearings for the upward and downward extensions of the sleeve carrying the radial arms which support the mold walls. Fig. 16 is a horizontal section on the line y—y of Fig. 15, and Figs. 17 and 18 are broken detailed views of the lower sleeve showing how the roller bearings are mounted thereon.

Referring more particularly to the drawings, 1 designates the mast which is preferably made of four timbers 1^a secured by bolts 1^b also passed through angle irons 2 at the corners of the mast. The lower end of the mast may be anchored in any suitable manner and its upper end is preferably secured by guys 3. To opposite sides or faces of the mast there are secured grooved rack bars 4.

A sleeve 5 is fitted around the mast and from said sleeve extend radial arms 6. As shown, each of said radial arms is composed of two parallel beams 7. Two of these beams extend entirely across the mold at opposite sides of the mast forming a part of the sleeve, the other two sides of said sleeve comprising short sections 8 of similar shape in cross section as said beams. Angle irons 9 are placed in the outer corners formed by the crossing beams and extend some distance above the sleeve, as at 10, and also some distance below said sleeve, as at 11, Fig. 3. Worm shafts 12 are carried by suitable brackets secured to the sleeve and mesh with the grooved rack bars 4. Each worm shaft is provided with a beveled pinion 13 at its upper end meshing with a beveled pinion 14 on a horizontal shaft 15 carrying a hand wheel 16. A lever 17 is also mounted on the shaft 15 and carries a pawl 18 adapted to engage ratchet teeth on the periphery of the hand wheel, whereby greater power may be exerted to turn said wheel. A dog 19 is mounted on the sleeve to engage a ratchet wheel 20 on the shaft 15 to lock said shaft and prevent the worm shafts from turning back and allowing the sleeve to move down. It will be noted that the provision of a hand wheel at each side of the mast with a lever on each wheel, as well as a handle 21, makes it possible for several men to take part in the operation of raising the sleeve. When it is desired to lower said sleeve, the dog 19 may be thrown back out of engagement with the ratchet wheels 20 and the hand wheels turned in the reverse direction under control of the operators. This hoisting mechanism is much safer than drums and cables which have heretofore been used.

The inner mold wall 22 is loosely fastened to the outer ends of the radial arms 6 by means of adjustable shoes 23 shown best in Figs. 7 and 8. One of these shoes is attached to the end of each of the beams 7 so that two are arranged close together. The vertical faces of each shoe which embrace the end of a beam are formed with horizontal elongated slots 24 through which the fastening bolts 25 are passed. The horizontal extending portion 26 of the shoe carries an upwardly projecting bolt 27 engaging an inclined slot 28 in the angle iron 29 secured to the upper edge of the inner wall. Said inner wall, as shown in Fig. 7, is made in sections which overlap, as at 30, between each adjacent pairs of shoes. Each shoe may be moved on its beam by means of a cam lever 31 pivoted at 32 to the beam and connected to the shoe by the link 33.

It will be observed that an angle iron 34 is secured to the lower edge of the inner wall to strengthen the same. Radial arms 35 are hinged to this angle bar and at their other extremities to a second sleeve 36 mounted around the mast. Said second sleeve, which is arranged below the sleeve 5, is adapted to be raised to cause the inner wall to be contracted as shown in dotted lines in Fig. 3. When contracted, said wall is inclined inward and downward from the radial arms 6. The sleeve 36 is raised and lowered by means of a lever 37 pivoted between the two beams 7 forming one of the radial arms 6, said lever being connected by the rod 38 with one of the arms 35, as shown in Fig. 3.

The outer mold wall 39 is continuous and is supported from the upper edge of the inner mold wall by means of bolts 40 passed loosely through both walls and through spacing blocks 41. Said bolts are made long enough to permit the outer wall to be expanded, when desired. Each of the spacing blocks has a downward extension 42 at the end thereof which engages the inner wall. This is to prevent the bolts 40 from sagging too much when the outer wall is expanded, the object in expanding said wall being, of course, to separate it from the outer face of a section of concrete wall which has been formed in the mold. The outer wall is preferably strengthened by upper and lower angle bars 43 and 44, respectively arranged at its upper and lower edges.

It will be noted from Fig. 2 that the extremities of the outer wall are spaced apart, as are also the extremities of the inner wall. Outwardly projecting extensions 45 are arranged at the extremities of the outer wall and are bent at their outer edges, as at 46, to provide for molding the outer edges of the walls of the chute 47 (Fig. 1.). Braces 47^a connect the extensions 45 with the outer mold walls as illustrated in Fig. 2. The extremities of said extensions are connected by an oppositely threaded tie-bar 48 whereby said outer mold wall may be expanded or contracted by turning said tie bar in one direction or the other. Doors 49, hinged as

at 50 to the bent outer edges 46 of the extensions 45, constitute continuations of the inner mold wall corresponding to said extensions of the outer mold wall. Said doors are provided with suitable latches 51 whereby they may be detachably secured to the ends of the inner mold wall. These latches may be raised and the doors swung outward when the mold is to be separated from a section of concrete wall already formed therein and raised to the next higher position.

Each of the doors 49 has one or more slots 52 (two being shown in Fig. 3) in its inner edge to permit horizontal reinforcing rings 53, placed at intervals in the concrete wall, to pass across the chute. It is essential to have these rings 53 continuous and unbroken in order to prevent the concrete walls at each side of the chute from spreading under pressure of the contents of the building or silo. The opening of the doors will disengage these slots from said rings so that the latter will not interfere with the raising of the mold.

It has been found advantageous to place vertical reinforcing rods in the concrete wall as well as horizontal rings. To support the vertical rods 54, I provide brackets 55 preferably secured to the angle bar 43 at the upper edge of the outer mold wall. These brackets extend above the mold and over the space between the outer and inner walls thereof. Said vertical reinforcing rods are adapted to be clamped between two half rings 56 and 57, one of which is rigidly secured to the brackets 55, while the other is adjustably connected to the first one by means of bolts 58 arranged at suitable intervals. By loosening these bolts 58, said half rings will be released from the vertical reinforcing rods and allow the mold to be raised after which said half rings may be tightened again upon said rods to hold them in proper position while the next section of concrete is being formed. I prefer to use twisted reinforcing rods because they adhere better to the concrete.

Chains 59, or other suitable flexible connections are secured to the upward extensions 10 of the angle irons arranged in the outer corners of the sleeve 5. These chains are designed to be attached to the upper edge of the outer mold wall when the mold is being raised but they are detached therefrom and moved out of the way while the concrete is poured into the mold and tamped. It will be noted that as the brackets 55, supporting the vertical reinforcing rods, extend well above the mold, there are no obstructions to hinder the pouring and tamping of the concrete. Braces 60 are arranged below the radial arms 6 and are connected to the downward extensions 11 of the angle bars 9. A platform 60^a is laid across the radial arms 6 to support the workmen. In operation, the concrete is dumped upon this platform and then transferred to the mold.

In Figs. 12 and 13, I have illustrated how doors may be fitted to the chute. The inner door, as there shown, is made in separately removable sections 61, each of which carries a pivoted latch 62 adapted to be turned down over the portion of one of the reinforcing rings 53 which passes across the chute. The outer door 63 may be hinged or arranged in any suitable manner.

The extremities of the upward and downward extensions 10 and 11 are braced by cross bars 64 running both ways, as shown in Figs. 15 and 16. To the bars 64 arranged at the sides of the mast not having the grooved racks, there are secured roller brackets 65 carrying rollers 66 which fit in grooves 67 formed between the adjacent edges of the angle bars 2. These roller bearings insure free movement of the sleeve 5 on the mast and prevent said sleeve from twisting thereon. They also take strain off of the worm shafts 12 and serve to hold them in proper alinement with the racks. The sleeve 36 is also provided with roller bearings 68 which engage the grooves 67, said rollers being mounted in slots 69 formed in said sleeve, as illustrated in Figs. 11, 17 and 18.

The construction of my mold, as hereinbefore explained, is so simple that it may be disengaged from a section of molded concrete, raised and placed in position to form the next higher section in only about ten minutes time. Before the mold is raised, by means of the worm shafts operated by the hand wheels 16, the chains 59 are connected to the outer mold wall, the clamping rings 56 and 57 are loosened from the vertical reinforcing rods, the inner and outer mold walls are respectively contracted and expanded by simply moving the lever 37 and giving the tie-rod 48 a couple of turns, and the doors 49 are swung open. After the mold has been raised, the mold walls are returned to their former positions by moving the lever 37 and turning the tie-rod 48 in the opposite direction. The doors are then closed and latched, the clamping rings tightened upon the vertical reinforcing rods, and the chains disconnected from the outer mold wall whereupon the mold is ready for forming the next section of concrete. It will be noted that the mold is not filled all the way up to the top but that the concrete stops below the spacing blocks, see Fig. 3. When the wall of the silo is completed, the outer mold wall or shell may be released from the inner mold wall by removing the spacing blocks and bolts on which they are mounted, said outer shell being then lowered to the

ground on the outside of the building. The inner shell can then be lowered on the inside of the building by the hoisting apparatus after first retracting the shoes 23 by means of the levers 31. My mold, therefore, does not have to be taken apart up in the air, as is necessary in some previous constructions, and which is a troublesome and perilous undertaking.

Attention is directed to the accuracy of adjustment which is obtained by my construction. When adjusted, the mold will be exactly the same size at each position throughout the construction of the entire wall. The use of the worm shafts permits the hoisting mechanism and sleeve carrying the same to be fitted closely around the mast thereby preventing the mold from swinging and insuring a perfectly plumb concrete wall. The evenness of said wall is also preserved by the rigidity of the mold walls which are braced at the bottom as well as at the top so that they do not give when the concrete is tamped in the mold.

I claim:

1. The combination, with a mast, a sleeve mounted to slide thereon, and radial arms secured to said sleeve, of an inner mold wall fastened to said arms, an outer mold wall, separate spacing blocks arranged between said walls, headed bolts passed loosely through said walls and spacing blocks, and normally extending beyond the outer wall for the purpose specified means to contract the inner wall, means to expand the outer wall, and means to raise said sleeve on the mast.

2. The combination, with a mast, a sleeve mounted to slide thereon, and radial arms secured to said sleeve, of an inner mold wall fastened to said arms, an outer mold wall, separate spacing blocks arranged between said walls, headed bolts passed loosely through said walls and spacing blocks, and normally extending beyond the outer wall for the purpose specified said spacing blocks having downward extensions at the ends which engage the inner wall for the purpose specified, means to contract the inner wall, means to expand the outer wall, and means to raise said sleeve on the mast.

3. The combination, with a mast, a sleeve mounted to slide thereon, and radial arms secured to said sleeve, of an inner mold wall fastened to said arms, an outer mold wall suitably supported away from the inner wall, a second sleeve mounted to slide on the mast, radial arms hinged to said second sleeve and to the inner wall, a lever pivoted on one of the arms secured to the first sleeve, a connecting rod from said lever to one of the arms hinged to the second sleeve whereby said latter sleeve may be raised and the inner wall is simultaneously contracted on all sides, means to expand the outer wall, and means to raise said sleeves together on said mast.

4. The combination, with a mast, a sleeve mounted to slide thereon, and radial arms secured to said sleeve, of an inner mold wall loosely connected at its upper edge to said arms, an outer mold wall suitably supported and spaced away from the inner wall, a second sleeve mounted to slide on the mast, radial arms hinged to said second sleeve and to the lower edge of the inner wall, means to raise said second sleeve whereby said inner wall is simultaneously contracted on all sides and caused to assume an inwardly inclined position all around, means to expand the outer wall, and means to raise said sleeves together on the mast.

5. The combination, of a mast, rack bars arranged longitudinally of said mast, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with said rack bars, and means to turn said worm shafts, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

6. The combination, of a mast, grooved rack bars arranged longitudinally of said mast, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with said rack bars, and means to turn said worm shafts, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

7. The combination, of a mast composed of a plurality of timbers some of which project beyond the others forming longitudinal grooves, rack bars secured in said grooves, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with said rack bars, and means to turn said worm shafts, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

8. The combination, of a mast, rack bars arranged longitudinally of said mast, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with said rack bars, means to turn said worm shafts, and ratchet mechanism to lock said shafts against reverse turning, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

9. The combination, of a mast, rack bars arranged longitudinally of said mast, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with

said rack bars, beveled pinions on said worm shafts, horizontal shafts carrying beveled pinions meshing with those on the worm shafts, hand wheels for turning said horizontal shafts, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

10. The combination, of a mast, rack bars arranged longitudinally of said mast, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with said rack bars, beveled pinions on said worm shafts, horizontal shafts carrying beveled pinions meshing with those on the worm shafts, hand wheels for turning said horizontal shafts, and hand levers pivoted around said horizontal shafts and having pawls to engage ratchet teeth on the peripheries of said hand wheels, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

11. The combination, of a mast, rack bars arranged longitudinally of said mast, a sleeve fitted around said mast, worm shafts carried by said sleeve and meshing with said rack bars, beveled pinions on said worm shafts, horizontal shafts carrying beveled pinions meshing with those on the worm shafts, hand wheels for turning said horizontal shafts, ratchet wheels on said horizontal shafts, and dogs pivoted on said sleeve and adapted to engage said ratchet wheels for the purpose specified, with inner and outer mold walls, radial arms mounted on said sleeve and supporting said walls, and means to contract the inner wall and to expand the outer wall.

12. The combination, with an outer mold wall, of radial arms, each comprising a pair of adjacent beams, a sectional inner mold wall the sections of which overlap between each pair of beams constituting one of said arms, and shoes having horizontal sliding connection with the ends of said beams and oblique sliding connection with said inner wall sections whereby said inner wall may be adjusted to change its diameter.

13. The combination, with an outer mold wall, of radial arms, each comprising a pair of adjacent beams, a sectional inner mold wall the sections of which overlap between each pair of beams constituting one of said arms, shoes having horizontal sliding connection with the ends of said beams and oblique sliding connection with said inner wall sections, and means to slide said shoes on said beams to change the diameter of said inner wall.

14. The combination, with a mast having grooves in opposite sides thereof, of a sleeve mounted to slide on said mast, upward and downward extensions of said sleeve, roller bearings carried by said extensions and fitting the groves in the mast, radial arms secured to said sleeve, mold walls supported by said arms, and means to raise said sleeve on the mast.

15. The combination, with a mast having grooves in opposite sides thereof, of a sleeve mounted to slide on said mast, roller bearings carried by said sleeve and fitting the groove in the mast, radial arms secured to said sleeve, inner and outer circular mold walls supported by said arms, a second sleeve mounted around the mast, arms hinged to said second sleeve and to said inner mold wall, means to move said second sleeve on the mast relative to the first sleeve whereby said inner mold wall may be contracted, roller bearings carried by said second sleeve and fitting the grooves in the mast, and means to raise both sleeves together on said mast.

In testimony whereof, I affix my signature, in presence of two witnesses.

CLAUES A. ANDERSON.

Witnesses:
JOHN A. BLOMQUEST,
L. J. JOHNSON.