Nov. 6, 1956 W. RUTTEN 2,769,409

CONSTRUCTION OF DOME-SHAPED ROOFS

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FIG. 1.

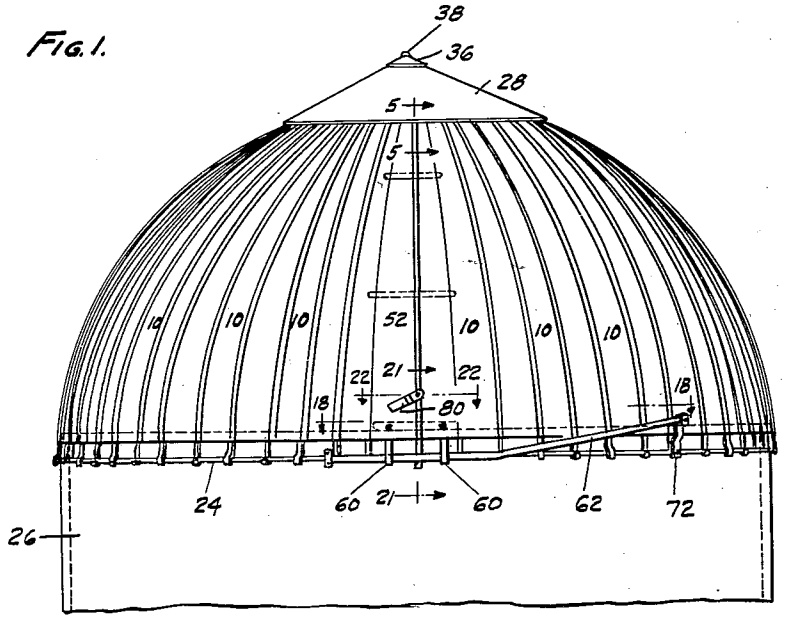
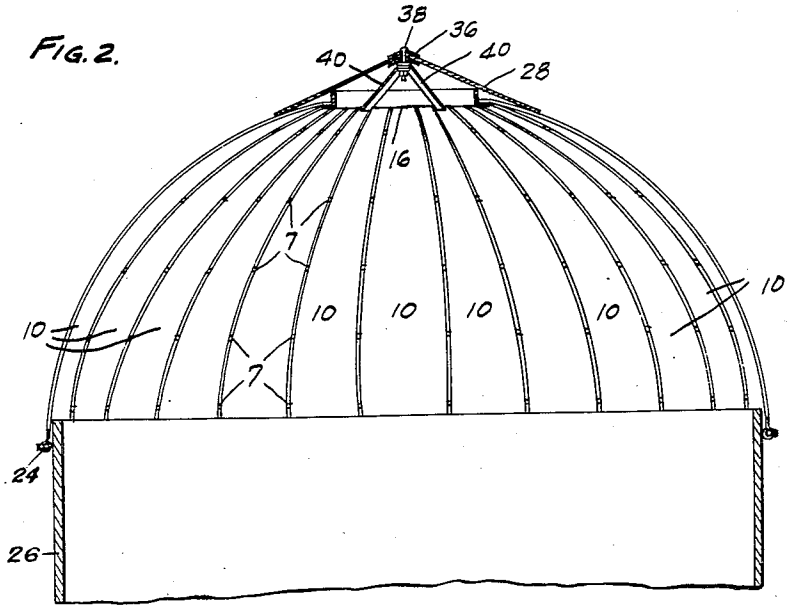


FIG. 2.



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CONSTRUCTION OF DOME-SHAPED ROOFS

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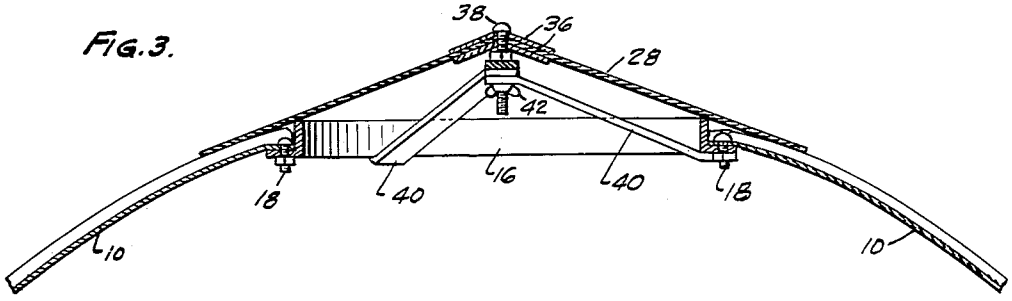
FIG. 3.



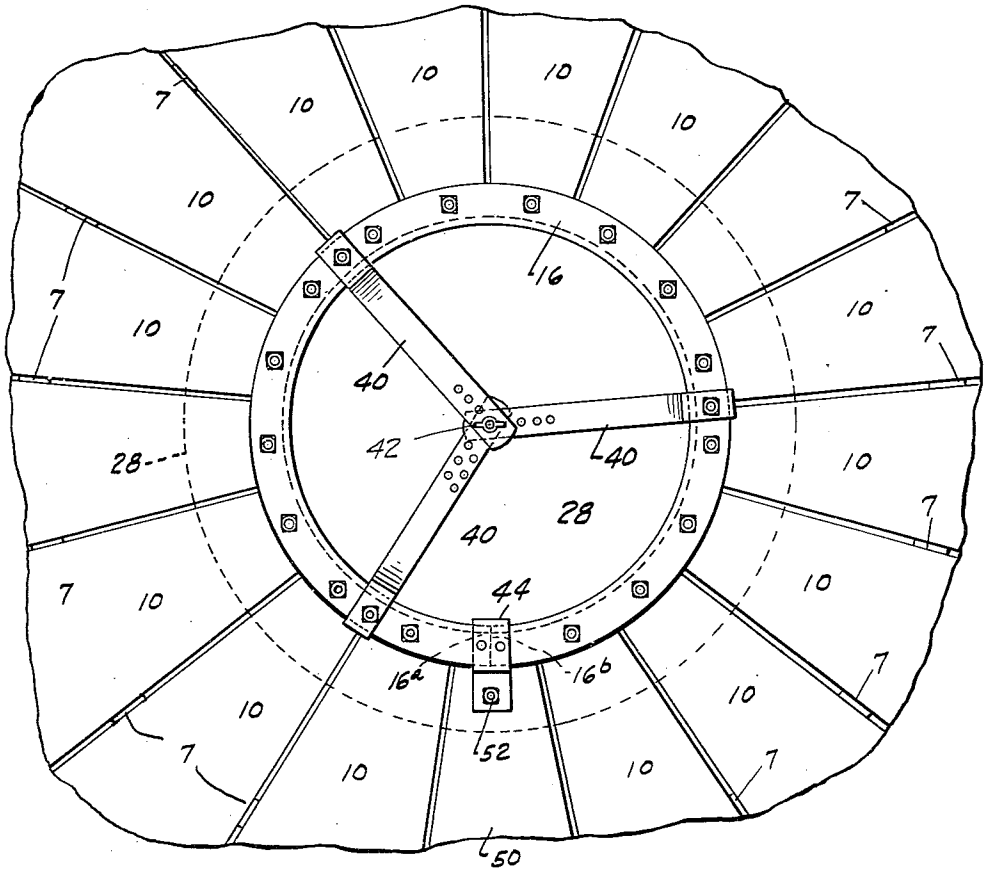


FIG. 4.

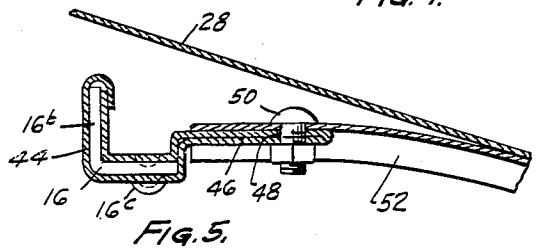


FIG. 5.

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FIG. 7.

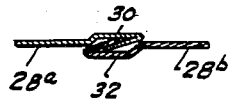


FIG. 6.

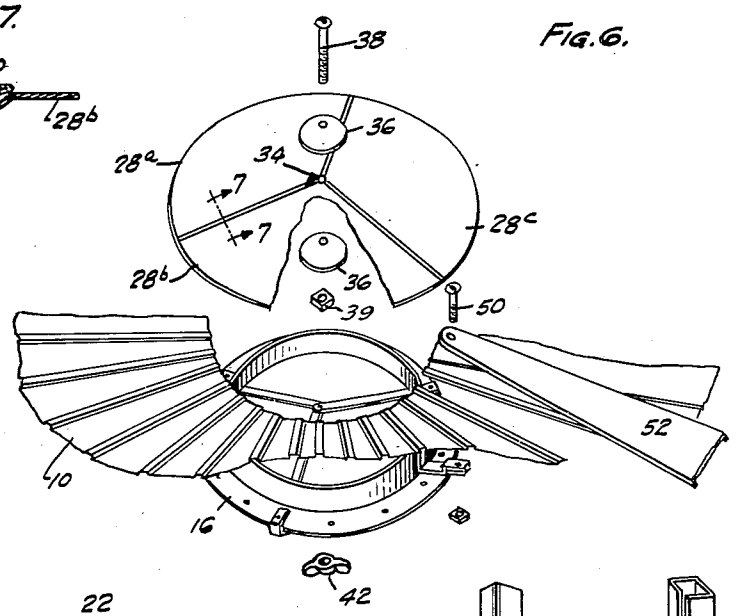


FIG. 12.

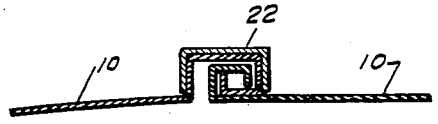


FIG. 10.

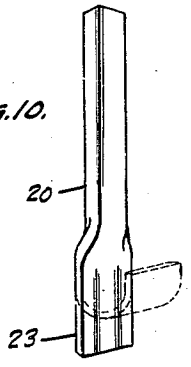
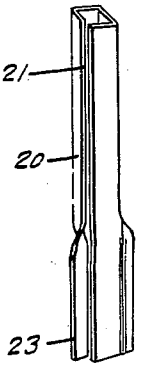


FIG. 11.



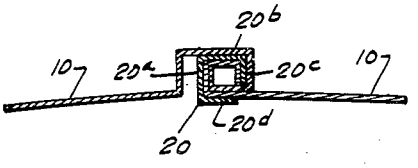


FIG. 9.

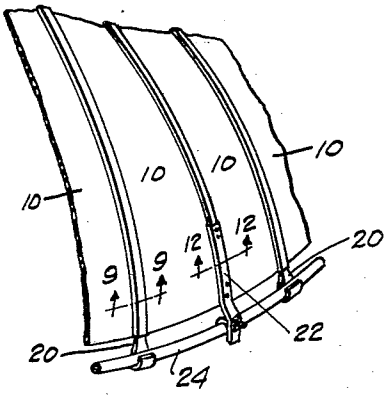


FIG. 8.

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CONSTRUCTION OF DOME-SHAPED ROOFS

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FIG. 16.

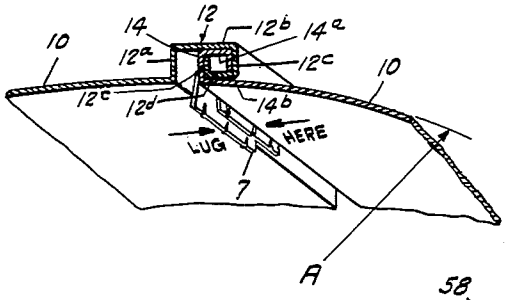


FIG. 13.

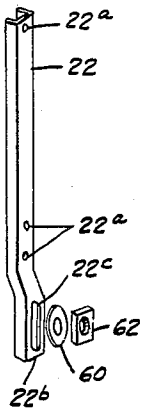


FIG. 14.

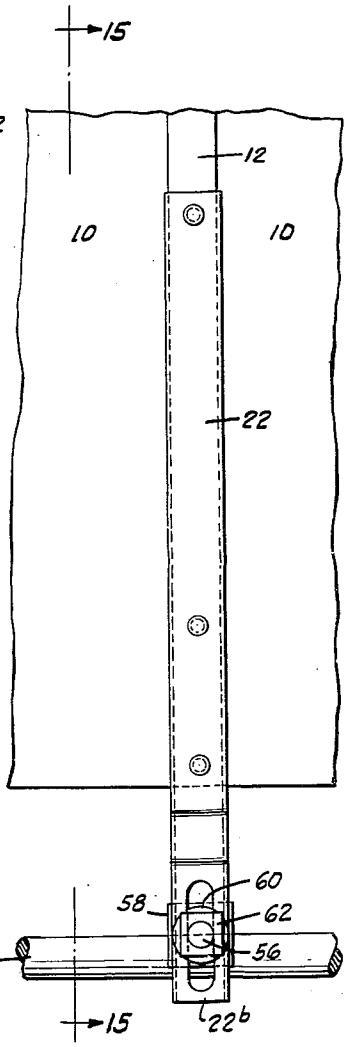
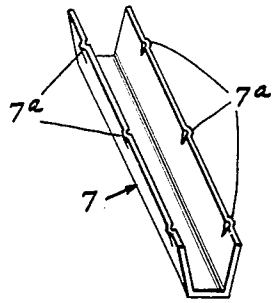


FIG. 17.



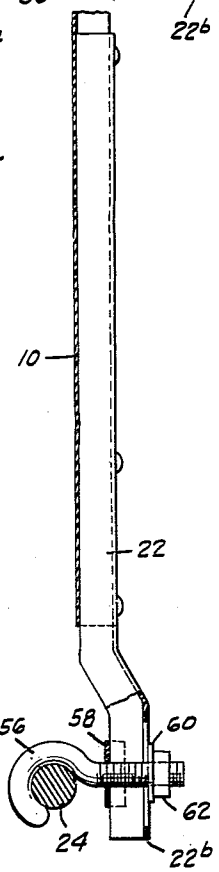


FIG. 18.

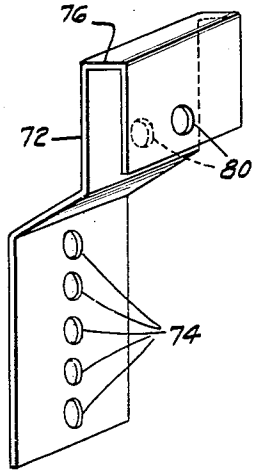


FIG. 15.

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CONSTRUCTION OF DOME-SHAPED ROOFS

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FIG. 19.

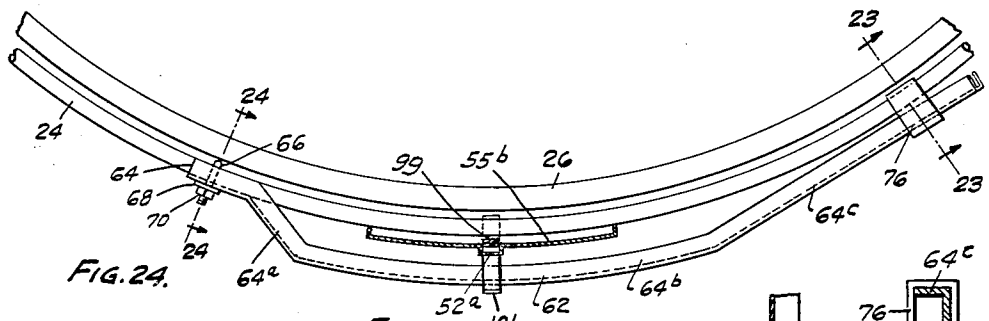


FIG. 24.

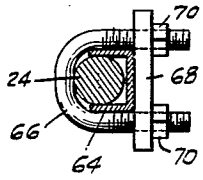
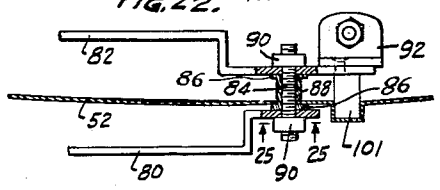


FIG. 22.



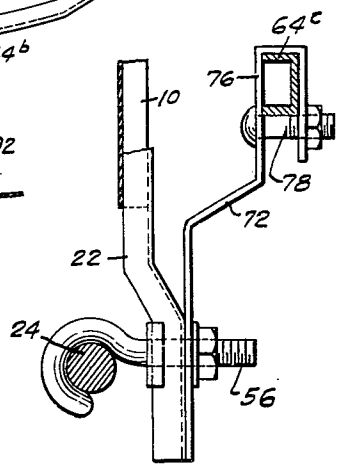


FIG. 23.

FIG. 20.

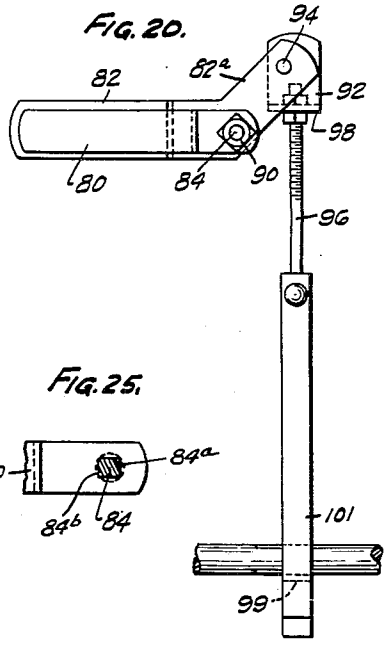
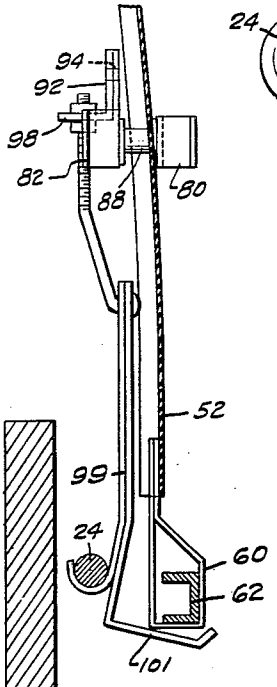


FIG. 25.



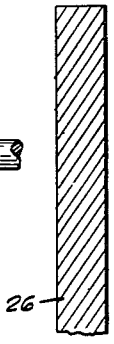


FIG. 21.

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United States Patent Office

2,769,409

Patented Nov. 6, 1956

2,769,409

CONSTRUCTION OF DOME-SHAPED ROOFS

Walter Rutten, Plainfield, Ill.

Application June 19, 1952, Serial No. 294,380

6 Claims. (Cl. 108—32)

My invention relates to improvements in the construction of dome-shaped roofs employed on silos and other similar buildings where dome-shaped roofs are desirable.

My invention relates more particularly to the construction of dome-shaped roofs of the type which employ a plurality of arcuately shaped roof segments connected by intermeshing or interlapping marginal lock channels and which are fastened at their upper ends to a center ring and at their bottom ends to the top silo hoop.

Silo roofs of the type to which this application is directed may be of the general type shown in United States Patent No. 2,151,234, issued to Peter Rutten and Walter Rutten on March 21, 1939.

The principal object of the present invention is to provide improvements in the design, construction and assembly of dome-shaped roofs of the type described.

A further object of the invention is to provide an improved construction whereby a more rigid and stronger roof is obtained.

A further object of the invention is to provide an improved construction of the roof door and means associated therewith for guiding its movement during opening or closing of the same.

A further object of the invention is to provide improved door opening means on both the inside and the outside of the silo roof.

A further object of the invention is to provide an improved construction of roof cap and means for fastening the same in position on the roof.

A further object of the invention is to provide improved anchoring means for attaching the lower ends of the roof sheets to the silo hoop.

Other objects and advantages will be more apparent from the following description in which reference is had to the accompanying drawings, upon which:

Fig. 1 is a side elevational view of a dome-shaped roof built in accordance with my improved construction;

Fig. 2 is a cross-sectional view thereof;

Fig. 3 is an enlarged cross-sectional view through the roof cap and associated parts;

Fig. 4 is a fragmentary bottom plan view thereof;

Fig. 5 is a cross-sectional view through the center ring and door support bracket, taken on line 5—5 of Fig. 1;

Fig. 6 is a fragmentary exploded view showing generally the roof cap, center ring, door and fragments of the roof sheets or segments;

Fig. 7 is a fragmentary cross-sectional view through the roof cap taken on line 7—7 of Fig. 6;

Fig. 8 is a fragmentary perspective view of a portion of the roof and silo hoop showing the manner in which the roof sheets or segments are connected to the same at their lower edge;

Fig. 9 is a cross-sectional view through a pair of adjacent roof sheets and one of the auxiliary anchor feet, and is taken on line 9—9 of Fig. 8;

Fig. 10 is a front perspective view of one of the auxiliary anchor feet showing in dotted lines the way the lower end of the same is bent upwardly about the silo hoop;

Fig. 11 is a back perspective view of the same;

Fig. 12 is a sectional view through adjoining roof sheets or segments provided with fixed anchor members, and is taken on the line 12—12 of Fig. 8;

Fig. 13 is an exploded perspective view showing the parts of the fixed anchor member with the silo hoop being shown in cross-section in the eye bolt;

Fig. 14 is an enlarged fragmentary side elevational view of the fixed anchor member, roof sheets and silo hoop;

Fig. 15 is a section thereof taken generally on the line 15—15 of Fig. 14;

Fig. 16 is a fragmentary perspective view of adjoining roof sheets or segments showing one of the locking lugs which I employ in position therein;

Fig. 17 is a perspective view of the locking lug;

Fig. 18 is a front perspective view of the door track support bracket;

Fig. 19 is a diagrammatic plan sectional view taken generally above the door track and associated parts;

Fig. 20 is a side elevational view of the door handle mechanism;

Fig. 21 is a cross-sectional view showing the door handle in position and is taken generally on the line 21—21 of Fig. 1;

Fig. 22 is a cross-sectional view through the door and handle mechanism, taken generally on the line 22—22 of Fig. 1;

Fig. 23 is a cross-sectional view through the track and support bracket at the upper end of the same taken generally on the line 23—23 of Fig. 19;

Fig. 24 is a cross-sectional view showing the attachment of the track at the opposite end and is taken generally on the line 24—24 of Fig. 19; and

Fig. 25 is a detail sectional view taken on the line 25—25 of Fig. 22 showing the manner in which the handles are fastened on the turning bolt.

In Fig. 1 of the drawings I have shown a side elevational view of a dome-shaped roof of the type to which this invention relates. The roof may be formed by connecting together a plurality of arcuate sector-shaped segments 10, whose non-parallel edges are bent upon themselves and adapted to interlock with the edges of adjacent sections in a manner to permit limited movement between the sections. Thus, for example, as shown in Fig. 16, the right non-parallel edge of a section 10 is formed with a flange 12, having the vertical wall 12*a*, the top 12*b*, a side 12*c*, an inwardly turned flange 12*d* and an upwardly bent flange 12*e*. Each of the sections 10 has an opposite non-parallel edge which has a ledge formed with an upwardly bent edge 14, a top ledge 14*a*, and a downwardly bent edge 14*b*. It will be noted that the downwardly turned edge 14*b* is spaced from the main portion of the roof section so that there is sufficient space to permit the portion 12*d* of an adjacent roof section to slide beneath it.

The above described bent-over edges are adapted to be interlocked by sliding one bent-over edge into the edge of the adjacent section, this being done advantageously by starting the bottom edge portion 14 of a section to be added into the upper end of the flange 12*a* of an adjacent section and sliding the section downwardly until it is in the correct position in interlocking engagement throughout its length with the section to which it is joined. In this general manner the roof structure of silos made up of interconnecting sectors is assembled.

Referring now to Figs. 1 to 4, the roof sectors 10 may be connected at their upper ends to a center ring 16 by bolt members 18 or in any other suitable manner, the lower ends of the sectors 10 being connected by anchor

members 20 and 22 to the silo hoop 24 that is usually found adjacent the top end of the usual silo 26. The center ring 16 is also adapted to support a center cap 28 which may compromise separable sections 28*a*, 28*b* and 28*c*, fastened together to form a cone-shaped structure by interconnecting edge ledges 30 and 32, the assembly including a central opening 34 at the top of the same. I provide a pair of cone-shaped washer members 36 on both sides of the opening 34, and fasten a stove bolt 38 therethrough. A nut 39 securely connects the washers and the cap together.

The cap as thus assembled may be supported over the center ring 16 by means of a plurality of tie straps 40 which are fastened to the center ring 16 and bent upwardly at an angle to receive the bolt 38 through any one of a series of openings in their ends. I provide a wing nut 42 for fastening the cap member securely to the tie straps.

In this manner it can be seen that the top cap can be easily assembled from flat comparatively thin sheet metal, and by the use of tie straps from the center ring, the same may be fastened down securely over the top of the roof after the roof sections have been assembled together. This structure insures a tight, strong and rigid top cap and one which is not easily capable of being blown off by high winds or which will permit rain or wind to enter the top of the silo roof. In addition, the top cap assists the bolts 18 in keeping the top ends of the roof sections firmly in position.

The top ring 16, as shown, may be in the form of an angle iron adapted to be bent into a circle with the meeting edges 16*a* and 16*b* fastened together by a strap member 44 of comparatively rigid metal which is bent as shown in Fig. 5 about the channel-shaped ring member 16 and a pair of embossments 16*c* made therein to effectively hold the strap member on the ring and the ends of the ring together. The strap member has a ledge 46 provided with an opening 48 to receive a bolt member 50 that extends through an opening in the top of the door section 52.

Means for fastening the lower ends of the roof sections 10 will now be described. I prefer to alternate fixed anchor members 22 and anchor feet 20 about the periphery of the silo, although it will be understood that this may be varied as desired.

The anchor feet 20, as best shown in Figs. 8 to 11, may comprise a sheet of comparatively thin metal which is generally formed to the hollow square shape shown in Fig. 11, having a slot 21 adjacent one side of the same and having the lower end of the tube thus formed flattened out, as shown at 23, at the lower end of the same. The tubular section may be slid upwardly from the lower end of two adjacent roof sections 10 as shown in Fig. 9, to interlock between the interlocking edges of the sections, the walls 20*a*, 20*b* and 20*c* of the foot 20 engaging upon three sides of portions of the edges of two adjacent roof sections, with the lower edge 20*d* underlying one edge of one of the roof sections. The flattened portion 23 may now be bent around the silo hoop 24 to the dotted line position, as shown in Figs. 8 and 10. In this way the lower ends of the connected sheets are securely held down about the edge of the silo.

The fixed anchor members 22, as best shown in Figs. 12 to 15, are channel shaped with bolt or rivet openings 22*a*, one adjacent the upper end and two adjacent the lower end, the lower end having an outwardly bent portion 22*b* with an elongated opening 22*c* therein. The anchor member 22, as best shown in Fig. 12, is adapted to embrace the medial ribs 10*a* of each roof section 10 and be fastened thereto by bolts or screws as shown, with the lower end of the anchor member depending downwardly below the lower edge of the roof sheets. I fasten the same to the silo hoop 24 by means of a hook bolt 56 which passes through an opening in a U-shaped clip member 58, the opening 22*c*, a washer 60 and a fastening nut 62. The clip member which embraces the

edges of the anchor member 22 provides rigidity at this point so that the same will not become bent when the bolt is fastened.

As previously explained, the door 52 may be mounted by means of the bolt 50 upon the strap member 44 at its upper end. In order to open the door it is desirable to swing it about the bolt 50 either to the right or left as may be desired. In the construction shown, I have provided means for swinging the door to the right and guiding the same throughout its movement so that gusts of wind will not blow the door about its pivot or bend it out of shape if it should become loose. Thus as shown, the door is provided with a pair of guide brackets 60 which have a loop therein to surround a channel-shaped track member 62. The track 62 as shown, has a portion 64 which is fastened by means of a U-bolt 66 to the silo hoop 24, the U-bolt assembly including a plate 68 and a pair of nut members 70 for fastening the plate down against the track 64. The track then has an outwardly bent portion 64*a* and an elongated portion 64*b* parallel to the hoop 24, the end 64*b* terminating at an upwardly angle in a portion 64*c* which is fastened to a bracket 72 supported on one of the hook bolts 56 which fasten the anchor means 22 to the silo hoop 24.

The bracket 72, as can be seen in Fig. 18, is provided with a flattened portion having a plurality of bolt holes 74 so that the height of the end of the track 64*c* may be adjusted as desired, the track fitting between the channel-shaped end 76 of the bracket and being held in place by a bolt member 78 which fastens through the openings 79 in the channel-shaped portion of the bracket.

Means for opening or closing the door may include handles on both the inside and the outside of the silo roof, the handle 80 being on the outside of the door and the handle 82 being on the inside. Both of the handles are mounted upon a bolt 84 which has the squared sides 84*a* received within the square openings 84*b* of the handles. The handle assembly may further include a pair of washers 86 and a collar 88 which spaces them apart, the handles being assembled together on the bolt by means of the nut members 90. Thus, when either the handle 80 or the handle 82 is operated the door latch assembly will be moved.

The door latch assembly which locks the door in either an open or closed position may be mounted upon an upwardly directed arm 82*a* on the door handle 82 and may include a bracket 92 pivotally connected thereto on a pivot 94. The latch mechanism may include the elongated bolt 96 which may be adjustably secured on the ledge 98 of the bracket 92 and carry suspended therefrom a hook member 99 which in the raised position shown in Fig. 20 engages the silo hoop 24 to prevent movement of the door either away from the silo or about its pivot bolt 50. The other hook member 101 may extend down below the bottom edge of the track member 62 to limit the distance which the door may be pulled away from the edge of the silo when it is open. Both of the hook members are adapted to lie within the center door channel groove 52*a* of the door 52.

After the roof has been assembled and in order to secure the greatest rigidity possible, I have provided locking lugs 7 which are preferably driven into the space at the interlocking edges of adjacent roof sheets at designated locations. Thus, for example, in a 17 foot roof, I prefer to have five rows of locking lugs driven into place as shown to provide the maximum of rigidity and strength to the roof. In order to prevent workmen from placing these lugs indiscriminately, I have provided indicia embossed in the inner surface of the roof sheets, as shown in Fig. 16, at all of the points where the lugs 7 are to be located.

It will be noted that each of the lugs 7 has a plurality of outwardly pressed ribs 7*a* which engage in the surface of the edges of the roof sheets to securely hold

the lugs against movement due to the swinging or swaying of the roof during high wind or under other conditions. As a result of the use of the ribs 7a, once the lugs are hammered into position, they are usually fixed for the life of the silo.

As a further means of securing greater rigidity and strength in roofs of the type described, I have formed the roof sheets 10 about an arc A which may in effect be to the diameter of the silo for which the roof is provided. Thus by forming the roof sheets so that a radius is formed around the lower end of the roof sheets so that the roof has the same circumference generally as the silo, the individual sheets through their interlocking flanges have a tendency to brace each other much more effectively than if the roof sheets were straight rather than curved.

With the construction above described, when the roof segments 10 are assembled to form the conical dome, the marginal flanges of one segment will be interlocked with the marginal flanges of adjacent segments, and when thus assembled there will be freedom for lateral spreading and contracting of the segments to adjust the conical dome to the exact size of the silo to which it is applied. After this has been done, the lugs 7 are hammered into position, as previously described, and a strong, rigid conically shaped dome roof has been provided. In view of the fact that each of the roof segments is rigidly anchored to the silo hoop which is around the top of the silo wall, it can be seen that the possibility of any of the roof sheets or the entire dome being broken away or loosened by a strong wind is greatly lessened.

Due to the construction of the silo door and the manner in which it is latched either in open or closed position, there is no possibility of the door being blown away or being bent or multilated by rough or hard usage of silo operators. Further, the provision of both inner and outer door handles for opening the silo door provides convenient access to the interior of the dome from either the inside or the outside of the silo.

By reason of fastening the roof cap to strap members which extend upwardly from the top ring and are secured directly to the apex of the cap, the cap may be pulled down effectively over the edge of the top ring and the ends of the roof sectors so that the possibility of rain or snow getting into the roof under the roof cap is largely eliminated. Further, this construction provides an additional support for holding down the top ends of the roof sectors after they have once been bolted to the top ring.

While I have illustrated and described a specific embodiment of the invention, it will be apparent to those skilled in the art that changes and modifications may be made in the exact details shown, and I do not wish to be limited in any particular; rather what I desire to secure and protect by Letters Patent of the United States is:

1. The combination with a dome-shaped silo roof of the type made up of a plurality of arcuate sector shaped roof segments having interlocking flanges, an L-shaped ring member attached to the upper end of each segment and a hoop surrounding a silo to which said dome-shaped roof is anchored about its top, of a sector-shaped door for said roof, said door pivoted at its upper end about a bolt on said ring member, a track connected to said silo hoop adjacent the lower end of said door, said track spaced away from and generally concentric to said hoop and inclining upwardly from said hoop and means associated with said door for guiding the lower end thereof on said track, said means including a pair of brackets attached to the lower end of said door, each bracket having a loop portion encircling said track.

2. The combination with a dome-shaped silo roof of the type made up of a plurality of arcuate sector-shaped roof segments having interlocking edge flanges, an L-shaped ring member attached to the upper end of all of said segments and a circular hoop surrounding a silo to which said dome-shaped roof is anchored about its top, of an arcuate sector-shaped door for said roof, said door pivoted at its upper end on a bolt on said ring member and adapted to swing to open position in an arc about the same, an arcuate door track connected to said silo hoop adjacent the lower end of said door and extending upwardly at an angle around a portion of said silo roof, and latch means at the lower end of said door for locking said door to said hoop and to said track in either a closed or in an open position.

3. The combination with a dome-shaped silo roof of the type made up of a plurality of arcuate sector-shaped roof segments having interlocking edge flanges, an L-shaped ring member attached to the upper end of all of said segments and a circular hoop surrounding a silo to which said dome-shaped roof is anchored about its top, of an arcuate sector-shaped door for said roof, said door pivoted at its upper end on a bolt on said ring member and adapted to swing to open position in an arc about the same, an arcuate track connected to said silo hoop adjacent the lower end of said door and extending upwardly at an angle around a portion of said silo roof, a bracket having a loop encircling said track mounted on the lower end of said door for guiding said door on said track, and latch means at the lower end of said door for locking the door to said hoop and to said track in either a closed or in an open position.

4. The combination with a dome-shaped silo roof of the type made up of a plurality of arcuate sector-shaped roof segments having interlocking edge flanges, an L-shaped ring member attached to the upper end of all of said segments and a circular hoop surrounding a silo to which said dome-shaped roof is anchored about its top, of an arcuate sector-shaped door for said roof, said door pivoted at its upper end on a bolt on said ring member and adapted to swing to open position in an arc about the same, an arcuate door track parallel to and connected to said silo hoop adjacent the lower end of said door, means connected to the lower end of said door for guiding the same on said track, and latch means for locking the same to said hoop and to said track in either an open or a closed position.

5. The combination with a dome-shaped silo roof of the type made up of a plurality of arcuate sector-shaped roof segments having interlocking edge flanges, and L-shaped ring member attached to the upper end of all of said segments and a circular hoop surrounding a silo to which said dome-shaped roof is anchored about its top, of an arcuate sector-shaped door for said roof, said door pivoted at its upper end on a bolt on said ring member and adapted to swing to open position in an arc about the same, an arcuate track connected to said silo hoop adjacent the lower end of said door, said track parallel to said silo hoop for a portion of its length and then extending at an angle in an upward direction, a bracket having a loop encircling said track mounted on the lower end of said door for guiding said door on said track, and latch means at the lower end of said door for locking the door to said hoop and to said track in either a closed or in an open position, said latch means including an operating handle on both the inside and the outside of said door, a pair of hook-shaped members suspended therefrom, one adapted to engage said hoop and one adapted to engage said track.

6. The combination with a dome-shaped silo roof of the type made up of a plurality of arcuate sector-shaped roof segments having interlocking edge flanges, and L-shaped ring member attached to the upper end of all of said segments and a circular hoop surrounding a circular silo to which said dome-shaped roof is anchored about its top, of an arcuate sector-shaped door for said roof, said door pivoted at its upper end on a bolt on said

ring member and adapted to swing to open position in an arc about the same and at the same time in a horizontal arc about the radius of the silo, the lower edge of said door being curved and substantially parallel to the periphery or circumferential curvature of the silo, an arcuate track connected to said silo hoop adjacent the lower end of said door parallel to the lower edge of said door and then extending from the door opening upwardly at an angle around said silo, a bracket mounted on the lower end of said door, said bracket having a loop encircling said track for guiding said door on said track as the door is moved open or shut, and latch means for locking said door to said hoop and track in either a closed or in an open position.

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