Oct. 24, 1944. C. H. COVEY 2,361,272

SILOS AND THE LIKE AND THE PRODUCTION THEREOF

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FIG. 1.

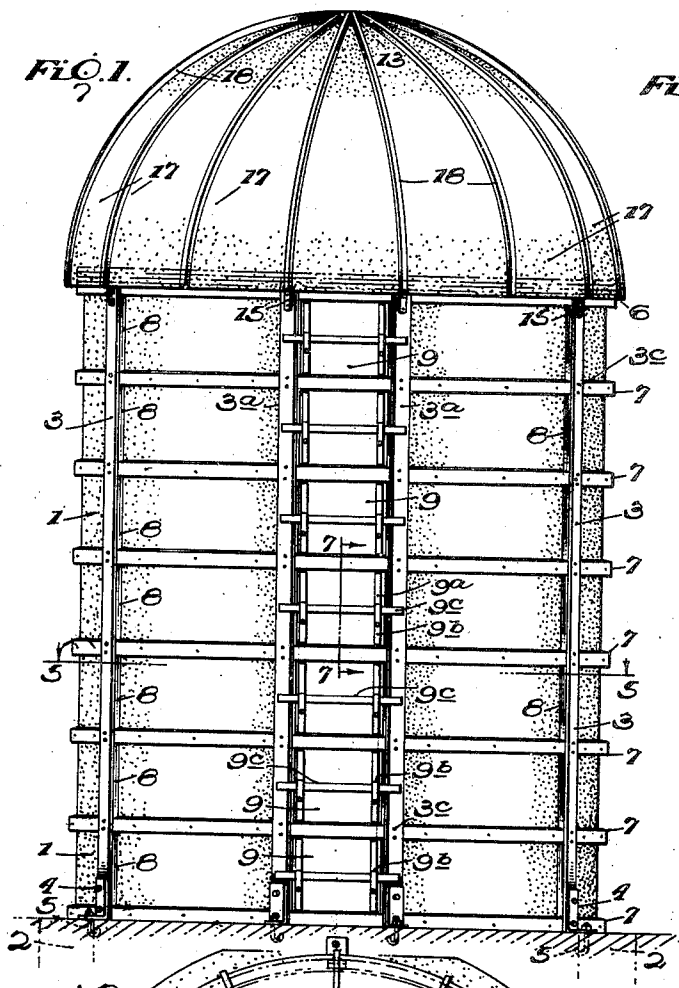


FIG. 3.

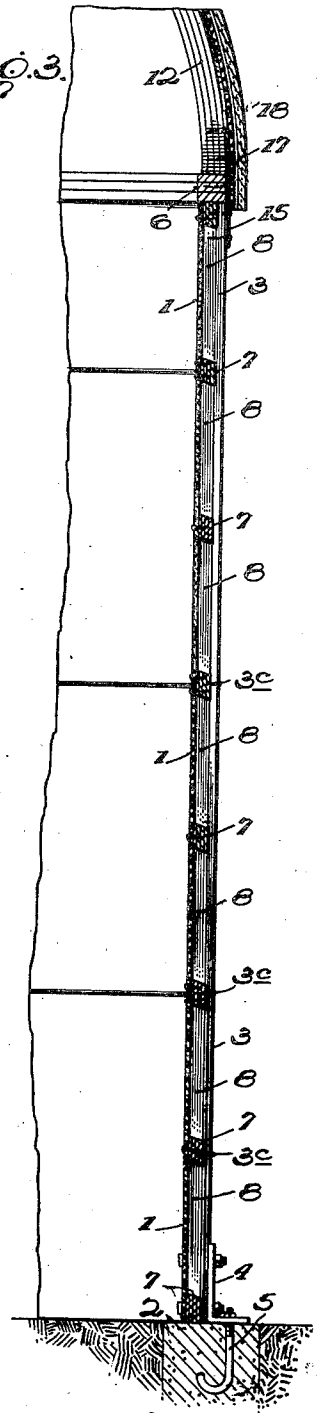
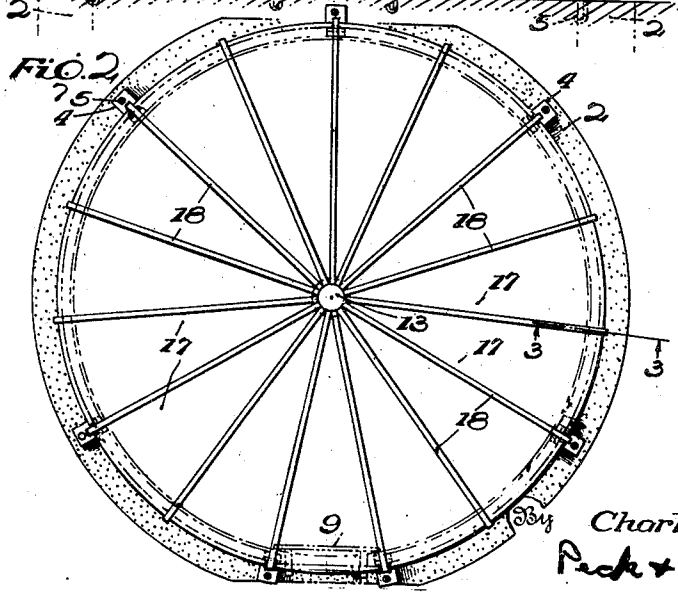


FIG. 2.



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SILOS AND THE LIKE AND THE PRODUCTION THEREOF

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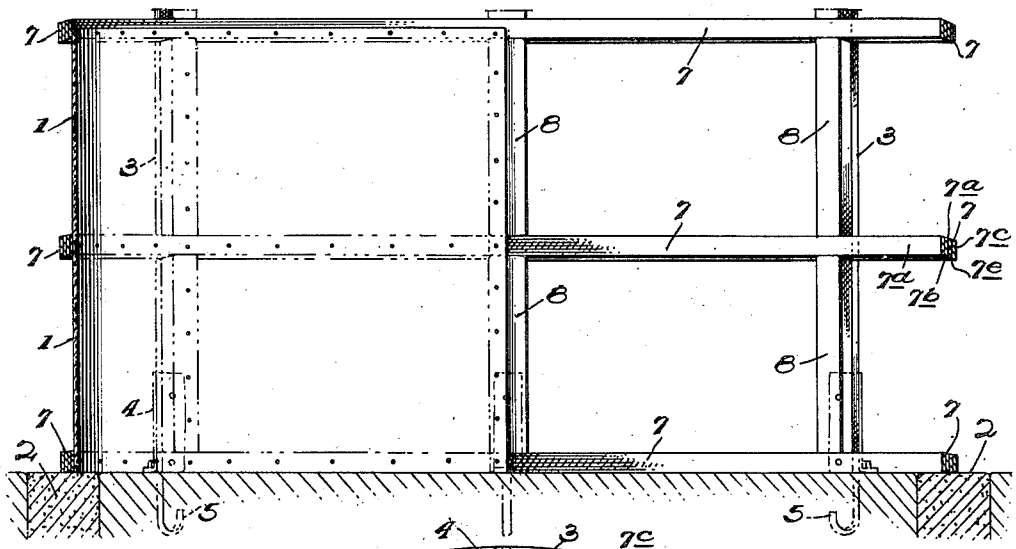

FIG. 4

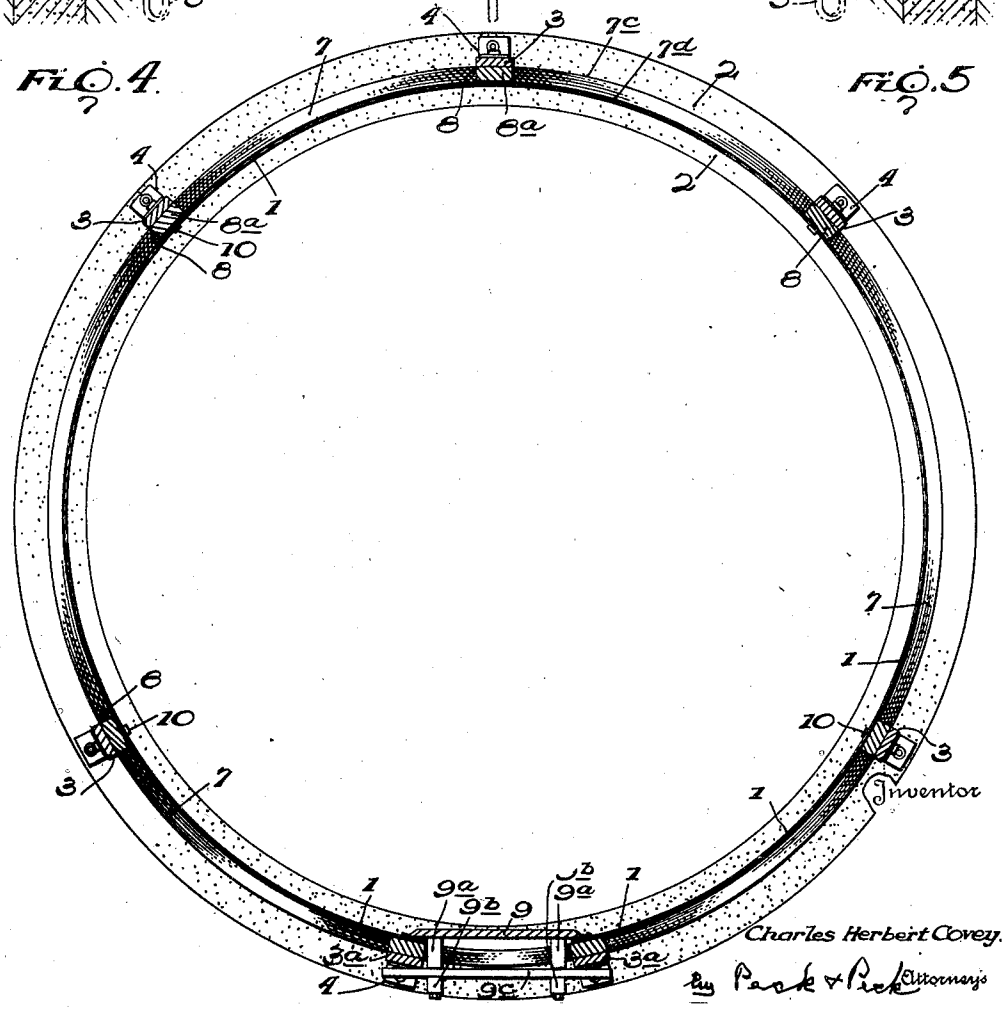

FIG. 5

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Fig. 6.

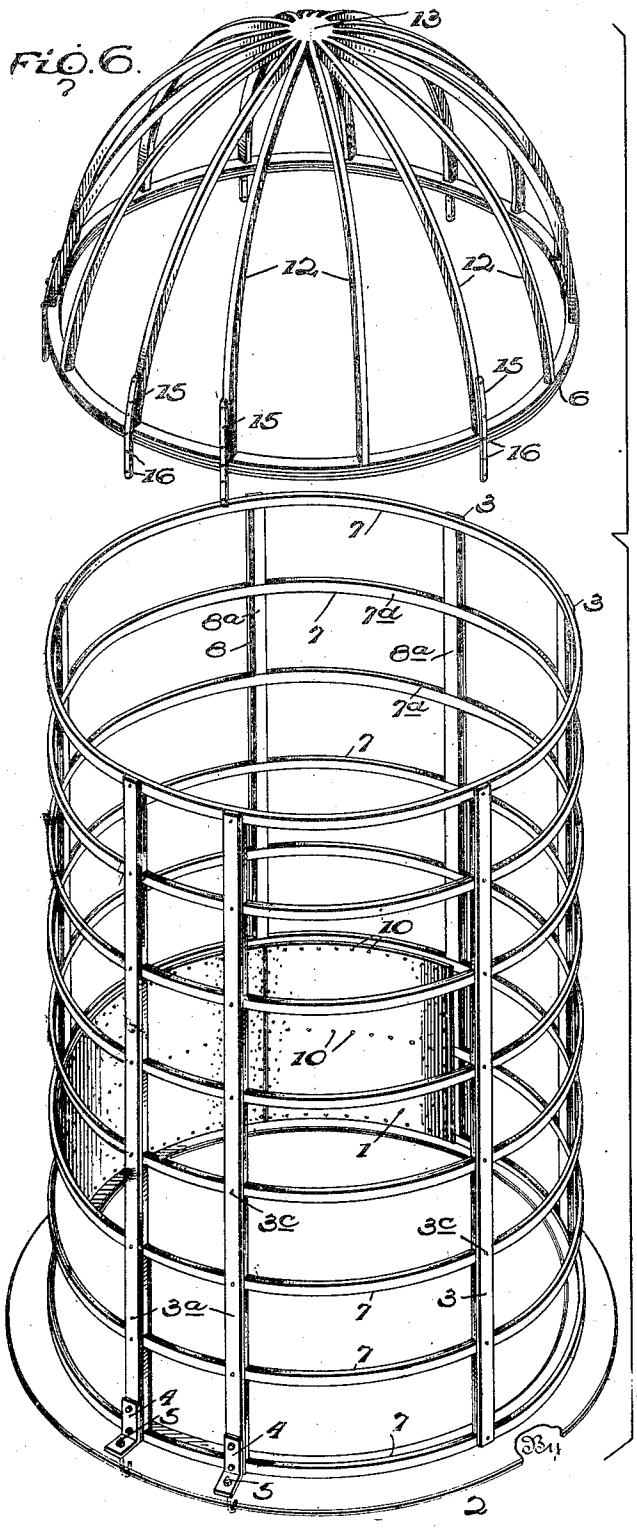

Fig. 7.

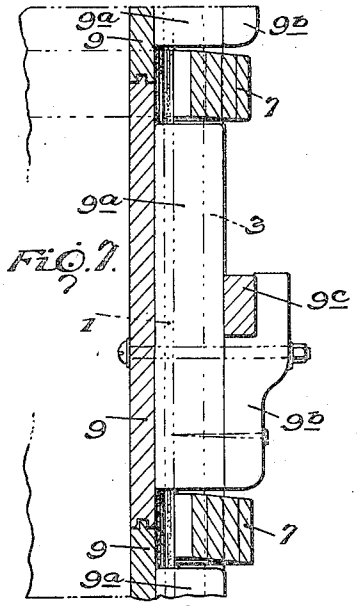

Fig. 8.

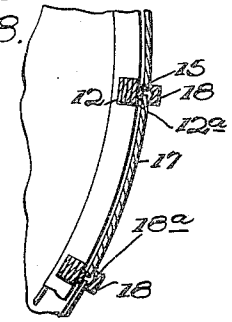

Fig. 9.

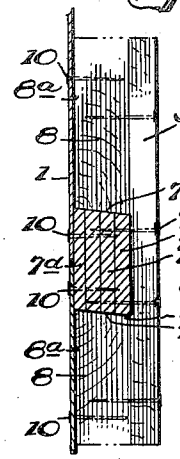

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FIG. 10.

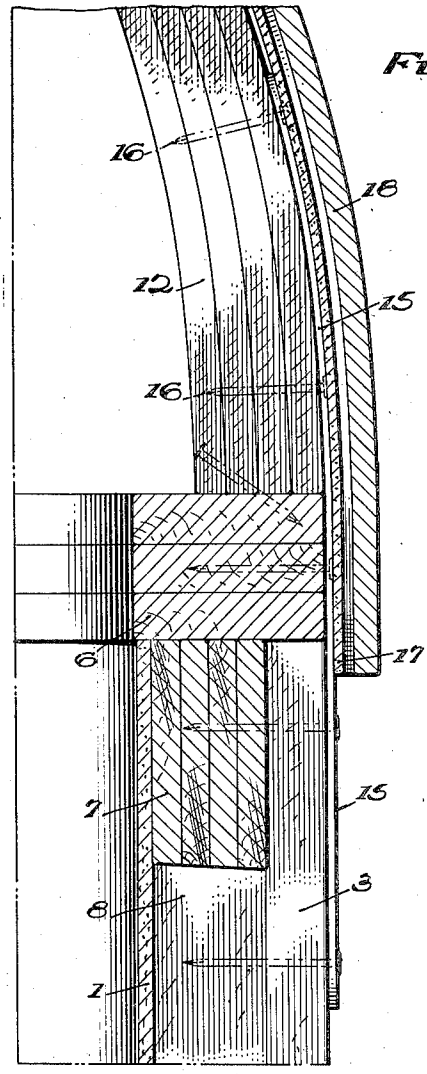


FIG. 11.

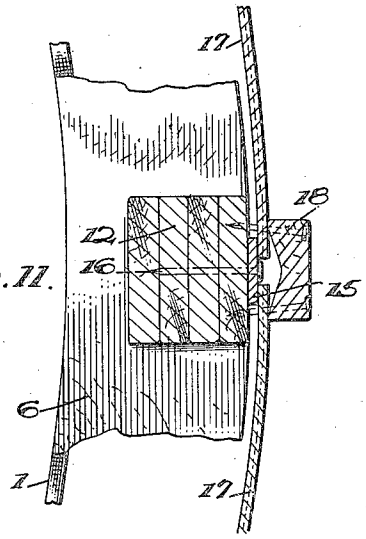


FIG. 11a

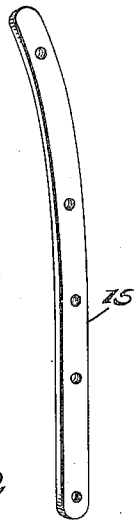
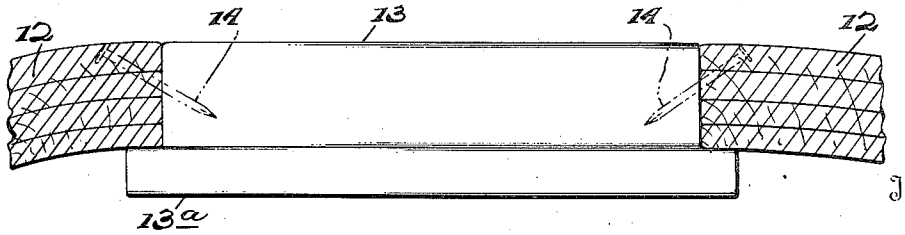


FIG. 12



Inventor

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Patented Oct. 24, 1944

2,361,272

UNITED STATES PATENT OFFICE

2,361,272

SILO AND THE LIKE AND THE PRODUCTION THEREOF

Charles Herbert Covey, Marietta, Ohio, assignor to The Marietta Concrete Corporation, Marietta, Ohio, a corporation of Ohio

Application May 5, 1942, Serial No. 441,841

5 Claims. (Cl. 20—1.4)

This invention relates to silos, and the like, and the production thereof; and the objects and nature of the invention will be made apparent to those skilled in the art by the following explanation of a method followed in producing or erecting an example embodiment of the invention, and by the following description of the accompanying drawings disclosing a preferred mechanical expression or embodiment of the invention from among other constructions, arrangements, combinations, and modifications within the spirit and scope of the invention.

It is an object of the invention to provide a silo of such improved structure and organization as to be economical in production as well as in the materials and parts employed with an end in view of eliminating to the irreducible minimum the use of metal and other materials now required for other purposes during the continuance of the present emergency.

Another object is the production of an improved silo having a useful life of several years for the successful storage of feed and the like on the farm, the major structural parts and elements of which are composed of comparatively inexpensive pre-formed natural and/or synthetic wood, with the ends in view of very substantially reducing the time required for production of the silo in situ, and reducing the cost of production, as well as the cost of the completed structure.

A further object of the invention is to provide a silo comprising an easily and comparatively quickly erected surrounding framework of such organization and nature as to rigidly support, secure and maintain an inner circular lading-contacting and sustaining wall of the silo, and to facilitate the method of constructing said wall of series of thin hard impervious sheathing boards so tempered or formed as to be resilient and capable of bending to arcuate form without cracking or creasing and of being thus secured to said framework.

A further object of the invention is to provide a silo organization and an advantageous method whereby the desirable qualities of peculiar thin hard impervious wall or sheathing boards can be successfully utilized and such boards can be applied to form the lading contacting inner wall of such silo.

And another object of the invention is to provide an improved silo roof organization of such formation and structure as to permit the successful inclusion therein of said resilient hard very thin wall or sheathing boards to thereby utilize the desirable qualities thereof.

With the foregoing and other objects in view, such as those developed, by the following specification, my invention consists in certain novel features, structures, combinations, and an advantageous method of production or erection, as more fully hereinafter explained and specified by the appended claims.

Referring to the accompanying drawings, forming a part hereof—

Fig. 1 is a side elevation of an example embodiment of a silo of the instant invention.

Fig. 2 shows the same in top plan.

Fig. 3 is a vertical section thereof, on the line 3—3, Fig. 2.

Fig. 4 is a partial vertical section taken in the plane of the line 4—4, Fig. 5, showing in part a horizontal course of the hard board lading contacting wall.

Fig. 5 is a horizontal section on the line 5—5, Fig. 1.

Fig. 6 is a somewhat diagrammatical perspective of the silo supporting framework showing therein the hard board wall partially built up, and the roof spider frame composed of laminated wood arched on bent rafters, separated from said framework before the hard board covering sheets have been applied thereto.

Fig. 7 is a detail vertical section on the dotted line 7—7, Fig. 1, showing one of the silo opening doors in vertical section.

Fig. 8 is a detail horizontal section through a portion of the roof showing hard board roof covering sheets, rafters thereunder, and sheet securing capping strips.

Fig. 9 is an enlarged detail vertical section also taken on the line 3—3, Fig. 2.

Fig. 10 is a detail vertical section through meeting portions of the roof and silo body.

Fig. 11 is a horizontal section through a part of the roof showing a portion of Fig. 8, enlarged.

Fig. 11*a* is a detail perspective of one of the roof securing straps.

Fig. 12 is an enlarged detail vertical section through a pair of roof rafters, showing the roof center piece in side elevation.

I gain certain advantages and new results in the art of silos and the like, by the inclusion in a silo of a lading enclosing and contacting vertical cylindrical or annular wall built up of sheets of certain peculiar wall or sheathing hard boards 1, flexed to arcuate form and while thus held separately secured to a supporting structure, preferably with the end and longitudinal edges of the secured arcuate hard boards substantially abutting the edges of adjacent boards and forming

joints that can be effectively sealed, with such inner wall so built up provided with a hard smooth or glazed inner lading contacting surface that is resistant to the moisture, acids, and other deleterious actions and influences of the ensilage and feed usually stored in silos.

I have discovered that certain preferably oblong hard resilient so-called sheathing or wall boards of commerce can be successfully employed in silos for the above noted purpose, particularly such boards that in effect constitute synthetic wood. These boards can be purchased in large quantities at comparatively low prices, as they are produced by large quantity production methods, usually in various different sizes. As at present advised by practical experience in construction of the instant invention, I usually employ such boards that are on the order of about one-quarter inch thick, twelve feet in length and four feet in width, but of course my invention is not limited to such dimensions.

These boards that I employ are produced and sold in flat form, but are exceedingly hard with at least one very hard impervious side surface that is smooth, glazed or calendered under very heavy pressure, and such boards must be so tempered or otherwise constructed as to be resilient and capable by application of the necessary pressure, of flexing under tension from the flat form to arcuate form of the desired radius required by any particular silo installation. Such boards must be capable of thus flexing to arcuate form against the tension of the board to return to its normal flat form, with out cracking, breaking, wrinkling or otherwise being damaged. These boards are resistant to moisture, weather conditions, and the liquid, acids, gases, etc. generated by stored ensilage and feed, as well as of substantial tensile strength and resistant against puncturing, yet are capable of being secured by nails or the like extending transversely therethrough. These thin hard boards while very hard and strong are relatively light in weight and capable of being sawed or cut to reduce the sizes thereof, as where a smaller board section is required to fill in a space of the silo inner wall during erection.

These very hard thin boards included in the structure of the instant invention, are preferably internally impregnated with oil or hydrocarbon lubricant-like substance introduced into the wood fibre under high pressure during the manufacture of the board. Such boards have a useful life of many years even when exposed to weather and conditions present in a silo of the instant invention.

For example, I have discovered that various hard boards of commerce that possess the general characteristics hereinbefore described, can be successfully employed in silo construction for the purposes of my invention. For example, among others, hard boards made under or substantially in accordance with the disclosures of U. S. Patent No. 1,663,505, and possibly subsidiary patents, are extremely hard and resilient, preferably are internally oil impregnated, and are capable of being flexed under pressure to the required arcuate forms without injury, and are in effect stronger and more durable than wood lumber, and are exceptionally resistant to moisture, etc., and the water absorption characterisic thereof is relatively low. These thin hard boards are usually produced from separated vegetable fibres and the natural cementitious materials of the wood or vegetable product, under tremendous pressure in the presence of heat to in effect produce a synthetic wood.

Other hard boards, whether or not produced in accordance with the disclosures of the hereinbefore identified U. S. patent, can be employed for the purposes of the instant invention, where such other thin hard boards are so tempered or otherwise formed as to be capable of flexing, under tension, without injury, to the required arcuate forms and are characterized by strength and resistance to weather and silo conditions, as hereinbefore pointed out.

The production of a peculiar supporting structure type enabled me to successfully attain in a silo and the like, the new results flowing from the provision of a lading contacting and restraining wall built up of the peculiar very thin hard boards I, hereinbefore described.

I disclose a specific embodiment as an example supporting structure, from among others within said type.

In the example shown, I provide a suitable base for the silo. For instance, I happen to show an annular concrete base **2**, without intending to so limit the invention. On this base, I mount a suitable vertical annular supporting studding. For example, I show an annular or circular series of laterally spaced vertical wooden studs, uprights, or posts **3**, each at its lower end seated on the top of said base and by any suitable means rigidly fixed thereto against lateral strains. For instance, I happen to show each stud or upright secured by being bolted or otherwise fixed to the vertical upstanding end of an angle bracket **4**, the horizontal arm of which rests on the base and is secured thereto by a nut and bolt **5**, or the like, with the bolt anchored in the concrete.

The studding, in this example, extends vertically throughout the length of the vertical body of the silo, substantially to the silo roof. The studding can be composed of any suitable number of posts, studs or uprights **3**, uniformly or otherwise spaced apart, while two of such uprights **3***a*, are so spaced apart as to define the vertical door opening or openings, that usually extend vertically substantially throughout the length of the silo body. These supporting uprights **3***a*, hence serve as the door posts or frame.

These posts or uprights **3**, **3***a*, are usually all alike, and each usually is composed of a length of pre-formed or cut lumber.

For example, without so limiting my invention, I have successfully employed for this studding, unbroken usually equal lengths of stock lumber one inch by four inches in cross section. Where such limber is employed to form the circular studding each post or upright **3**, **3***a*, can be, if so desired, fixed to the base with its wide flat side facing inwardly toward the central portion of the circle of surrounding uprights.

The supporting posts or uprights **3**, **3***a*, forming the circular studding are, preferably, rigidly united at their upper ends, by any suitable means. For instance, where the upper extremities of the wood posts end in a common horizontal plane, I place a horizontal usually flat annular unbroken ring or hoop **7**, of the approximate diameter of the circular studding, on the top ends of said posts **3**, **3***a*, and rigidly secure the same to the upper end of each post.

I have successfully employed for this purpose, a multi-layer plywood ring **6**, of strength and rigidity, which permits the application of securing nails or the like driven down through the

ring into the posts 3, 3a, on the upper ends of which said ring is seated.

Within the circular studding and throughout the vertical length thereof, I arrange a vertical series of vertically-spaced horizontal unbroken circular wood hoops 7, each of which is fixed to each post 3, 3a, of said studding, by bolts, nails, or other securing means. In the example embodiment disclosed, each hoop is secured to each post 3, 3a, preferably by nails or the like 3c, driven inwardly into the hoop through the accessible outer wide flat sides of the posts.

Each hoop 7, is of substantial longitudinal thickness, and provides substantially flat parallel top and bottom faces 7a, 7b, a longitudinal external substantially cylindrical circumferential surface 7c, and a concentric longitudinal inner cylindrical surface 7d, of substantial width. These hoops are preferably, in this example embodiment, all alike, and are surrounded by and secured to the circular studding 3, 3a, at uniformly vertically spaced intervals, with the hoops in longitudinal axial alinement. so that the inner longitudinal cylindrical surfaces 7d, are in longitudinal alinement. The external circumferential surfaces 7c, of these hoops fit and traverse the inner flat sides of all of the uprights 3, 3a, and are fixedly secured thereto as hereinbefore described.

The preferably similar strong rigid wood hoops of like diameter, are of ample radial and longitudinal width and thickness, being each, in this example embodiment, composed of multi-layer plywood wherein the multiplicity of layers are made up of relatively short thin strips of wood that overlie each other to break joints and form an unbroken circle; said strips being rigidly secured together by transverse nailing or otherwise.

Each of the uprights 3, 3a, substantially throughout its vertical length. is provided with a series of longitudinal vertical filler pieces. such as longitudinal wooden blocks 8, filling the spaces longitudinally of the upright and between the hoops 3, 3a, that traverse the inner vertical flat sides of the upright. These vertical filler blocks 8, fit the flat vertical inner sides of each upright and are rigidly secured thereto as by nailing or otherwise, while the opposite ends of each block snugly fit and abut the end faces of the adjacent hoops 7, between which it is located. Thus. if so desired, in the particular example embodiment shown, each block 8, can in width substantially equal the width of the upright, and in radial thickness substantially equal the radial width of the hoop.

The purpose being to provide the inner longitudinal block faces 8a. of substantial width, flush with the inner vertically wide cylindrical surfaces 7d, of the hoops 7, or in other words to locate the multiplicity of vertical surfaces 8a, of blocks 8, flush with the axially alined inner cylindrical surfaces 7d, of all of the hoops 7, and thus provide a rigid and strong backing and supporting structure for the arcuate thin hard boards 1, that constitute the inner lading-contacting and restraining wall of the silo. This backing and supporting structure thus is made up of a vertical series of preferably, uniformly vertically spaced horizontal cylindrical surfaces 7d, and a multiplicity of vertical surfaces 8a, flush with or in the same vertical planes as said surfaces 7d, and interposed between and distributed around the circles thereof.

The lading-contacting and restraining wall 1, extends vertically throughout the length of the lading receiving body of the silo, and is unbroken and cylindrical or annular throughout its length except for the door opening or openings, where the lading containing space is normally closed and sealed by a vertical series of separately removable doors 9.

The wall 1, terminates at the opposite door post-forming uprights 3, 3a, and is unbroken around the body of the silo from one post 3a, to the other post 3a. This inner wall is composed of the specified thin hard boards, that are usually long and relatively narrow and very thin, say, of a quarter inch gauge more or less. These boards extend in horizontal series or courses throughout the vertical length of the wall, with each course extending around the wall from one post 3a, to the other post 3a, with the boards of each course substantially abutting at their vertical end edges, and with the longitudinal edges of the boards of each course substantially abutting the longitudinal edges of the boards of the adjoining longitudinal courses. These abutting ends and longitudinal edges of the boards form joints for proper sealing against leakage. The boards of each course are held in longitudinal arcuate form and tightly against the surfaces 7d, 8a, traversed thereby, by means fixedly securing such boards to the hoops 7, and the fillers 8. The boards, in this particular example embodiment, are thus secured, by nails 10, or the like, driven from the inside of the wall, through such boards, and through the surfaces 7d, and 8a. For this purpose, cement covered nails or the like, can be employed. if so desired. These securing means can be variously distributed throughout the areas of each board to rigidly hold the same in the required arcuate form and tightly against the contacted surfaces 7d and 8a, against distortion.

These hard thin resilient boards are laid with their glazed smooth resistant side surfaces forming the inner smooth lading-contacting uniformly concave surface of the wall, to permit the lading composed of ensilage or feed to freely slide uniformly down said wall and expand and pack solidly or closely thereagainst, and not objectionably adhere thereto and form air pockets or the like in the ensilage. likely to cause spoilage.

The smooth or glazed side surfaces of these thin hard boards are of such resistant character as to avoid the necessity of applying thereto an added waterproofing or other coating.

The thin hard boards that we prefer to employ are more or less rough on one side face, while calendered, smooth or glazed on the other side. I use the smooth or glazed side to form the inner surface of the wall, while the somewhat roughened opposite side form the outer side of the wall, exposed to the weather where not covered by the hoops and uprights surrounding said inner wall, but the resistant nature of these hard boards that I employ, is such that it is not necessary to apply a protective or other coating to such outside surfaces, unless desired for decorative purposes.

In the example embodiment illustrated, the several long arcuate thin hard boards 1, of each horizontal course or series of the lading contacting wall, are arranged longitudinally end to end with their long edges horizontal and all of said boards are curved to the radius of the inner circumference 7d, of the hoops. The number of boards 1, in each horizontal course depends on the diameter of the hoops 7, employed.

The alined horizontal hoops 7, are preferably

spaced apart uniformly relatively short vertical distances so that each longitudinally arranged plate 1, will be backed by and seat against the inner cylindrical surface of several hoops. For example, without desiring to so limit my invention, where the long thin hard boards employed are more or less four feet wide and twelve feet long, the horizontal hoops are usually spaced apart vertically a suitable distance, for example, about twenty-one inches.

The hoops 7, are of sturdy or heavy and rigid construction, say of a vertical length or thickness of about three or four inches, and are about the same in radial width, but these dimensions are not of the essence.

In the example embodiment illustrated, the top annular flat faces 7*a*, of the hoops 7, are bevelled outwardly and downwardly from their inner cylindrical surfaces 7*d*, to their outer cylindrical circumferential surfaces 7*c*, to drain water and moisture outwardly away from the exterior surface of the annular lading restraining wall 1, and permit such water, etc., to travel down the exterior vertical surfaces and discharge by gravity from the annular depending drip edge 7*e*, formed by the meeting faces of the circumferential surface 7*c*, and the face 7*b*, which inclines downwardly and outwardly in approximate parallelism with top face 7*a*.

The door opening 5, between the parallel spaced uprights 3*a*, is spanned by the vertical series of hoops 7, and thus in effect, is thereby divided into a vertical series of openings, each normally closed by a separate door 9, each such door being normally removably upheld by a hoop 7.

Each door is, in this example embodiment, composed of a vertical flat board or panel 9, located within the silo behind the two uprights 3*a*, and adapted to be held outwardly, in opening closing position, with its opposite ends held into contact with the end portions of hard board secured to uprights 3*a*. Each door is formed with fixed battens 9*a*, extending outwardly through the door opening, and between the uprights, and at their outer ends, beyond said uprights provided with fixed upstanding brackets 9*b*, adapted to receive a vertically removable and applicable elongated door clamping bar 9*c*, that extends transversely in front of the two uprights 3*a*, for clamping the door in rigid closed position. This bar 9*c*, can also constitute a ladder rung.

The vertical outwardly extending battens 9*a*, rigid with the door, at their bottom edges abut against and rest on the top end face of the adjacent hoop 7, to support and uphold the door in its desired vertical position. When the door panels are in closed position, their horizontal top and bottom edges engage, if so desired interfit, with the corresponding edges of like doors above and below. When the clamping bars 9*c*, are removed, doors can be inwardly removed from the door opening, usually one by one, as the silo lading is gradually removed, and such door opening can be closed as the silo is gradually filled, by applying the doors outwardly to the door openings, from within the silo.

I disclose an example embodiment of a peculiarly advantageous silo roof designed to permit the utilization therein of a roof covering comprising resilient thin hard board sheets, possessing substantially the characteristics of the hard boards forming the silo inner lading contacting wall. The example shown produces, preferably, a so-called dome roof that is mounted on the strong rigid horizontal top circular hoop 6, of the silo body, which in effect forms the roof base on which the lower ends of the roof rafters 12, are seated and from which they converge upwardly and centrally along curved or arched lines, to the elevated central key block 13, to which the upper ends of all of said rafters are fixed as by nails 14, or other suitable fastening means. In this example, I prefer to form said center block of wood or the like to anchor the nails 14, or other means securing the rafters to the center piece, This center piece, in this example, provides a vertical body preferably cylindrical with a surrounding horizontal supporting abutment or flange 13*a*, of enlarged diameter on which the bottom edges of the upper ends of the rafters rest with their end faces substantially abutting the vertical body or hub rising from said horizontal flange. The upper portions of said rafters radiate from said center body, and diverge outwardly and downwardly to the horizontal hoop 6.

The rafters 12, are preferably all alike in form and dimensions, and of like arcuate or arched formation, and each, in this example, is composed of multi-layer plywood, built up in a suitable shaping and nailing form. Each rafter is, in this example, preferably, rectangular in cross section, with a wide flat top or outer longitudinal edge.

This spider-like supporting structure comprising the outwardly and downwardly relatively fixed rafters 12, seated on and rising from the base hoop 6, is by suitable means, rigidly and strongly anchored to the circular vertical supporting structure of the silo body. For instance, in the example illustrated, I employ for this purpose, strong long bendable, or flexible, preferably, thin flat narrow straps 15, one for each rafter 12. Each rafter 12, has one of said straps 15, fixed thereto longitudinally, and preferably centrally, along its top or outer longitudinal edge wall, with said strap extending downwardly below the rafter lower end, and vertically across the circumferential surface of hoop 6, and downwardly therefrom longitudinally of a silo upright 3. The strap is rigidly secured to said parts, by suitable means, such as bolts, or strong wood screws 16, or the like, passing through appropriate holes previously formed in the strap into the wood rafters and other parts. Thus, each strap 15, will be fixedly secured to an upright 3, and its particular rafter, and also, if so desired, to the hoop 6.

The spider-like roof frame work, is thus provided, to successfully carry, receive, and maintain a tight thin hard board covering, which in this example, consists of a series of preferably similar triangular elongated very thin preferably oil impregnated resilient hard board sheets 17, capable of bending under pressure without cracking or injury, in other words, hard board of the characteristics hereinbefore described. The sheets 17, are cut from flat boards, and these sheets 17, can be very thin, for instance of the order of about one-eighth of an inch in thickness, more or less. Each sheet 17, is of a length to extend from the center piece 13, down over two adjacent rafters 12, preferably across the circumference of hoop 6, and downwardly along the outer surface of a silo frame upright 3, covering the strap 15, of the particular rafter. The flexible resilient sheet is bent to the curvature of the rafter and to the transverse curvature of the hoop 6, and is held in such arcuate forms by nails or other means securing the sheet marginal

portions to the rafters, hoop and uprights. The sheets 17, cover all of the triangular spaces between the rafters, with the opposite longitudinal marginal edge portions of each sheet covering about one-half the width of the top longitudinal flat faces of the two adjacent rafters on which said sheet is located. Thus the opposite longitudinal edges of each sheet approximately meet and abut the corresponding edges of adjacent sheet over the rafters. The seams thus formed between the sheet edges over the rafters are preferably filled and covered with any suitable sealing compound.

The approximately meeting longitudinal edge portions of the sheets along the top flat longitudinal faces of the rafters are fixedly held down to said rafters and are covered by exterior longitudinally elongated wood capping strips 18, which are suitably rigidly secured to the rafters, as by nails or the like extending through the capping strips, the two sheets thereunder, into the rafters. These exterior strips can extend from the center piece 13, along the rafters, and the sheet margins thereon, and downwardly over the sheet margins across hoop 6, and onto upright 3, if so desired. The under sides 18*a*, of capping strips can be grooved throughout their lengths, to a transverse flattened concavity, and the top longitudinal faces of the rafters can be of any suitable formation throughout the length thereof, if so desired, for the purpose of tightly fitting, covering and clamping the meeting marginal portions of the hard roof covering sheets.

The hard glazed, smooth, water and weather resistant surfaces of the thin hard board sheets 17, applied to and covering the roof, form the exposed exterior surfaces of such roof covering. In other words, said sheets 17, are secured to the roof with said glazed surfaces constituting the exterior faces of the sheets that are exposed to the weather.

If so desired, the silo and the roof can be equipped with a vertical chute and chute cover, not shown, of any suitable arrangement and structure, such for instance as are commonly employed in the art.

All lumber and wood parts employed in the construction of the silo, including the plywood rafters 17, and hoops 6, and 17, are preferably impregnated with any suitable preservative, according to methods and liquids commonly employed in the art of treating wood to increase the durability and useful life thereof.

The following method is substantially followed in erecting or producing the silo or the like, of the instant invention at the situation where the silo is to be located.

A suitable foundation is prepared, and the uprights 3, 3*a*, of the required length for the particular installation are erected on and at their lower ends fixed to said foundation, forming the circular series of uprights of the diameter and number of uprights required for the particular installation.

The bottom hoop 7, of the required external and internal diameters for the particular installation is properly located on the foundation within the circle of uprights 3, 3*a*, and the uprights are lined up in parallelism against the outer circumference of said hoop, and each upright is fixedly secured to said hoop as by nails or the like as hereinbefore described.

The series of similar laminated wood hoops 7, required for a particular installation, are preferably made at the place of silo production or erection by the use of a suitable portable clamping, nailing, and shaping form that is adjustable to produce such hoops of any desired diameter within limits. The relatively thin short wood strips can be assembled in such form in the required curved overlapping joint-breaking relation and secured rigidly together to produce a series of similar hoops of like diameter required for the particular silo to be erected at such location. By the use of such form, each of the series of hoops 7, for the silo, can have visible marks applied thereto indicating where the door post uprights 3*a*, and the other uprights 3, should fit the outer circumferential surfaces of said hoops.

The bottom or first hoop can be seated on the foundation, and then the uprights 3, 3*a*, can be erected on the foundation around said hoop and fixedly secured to the foundation and to said hoop, instead of first erecting the series of uprights and then centering the bottom hoop on the foundation and within said circle.

With the circle of uprights surrounding and secured to the bottom hoop 7, the wood filler blocks 8, are applied to the uprights 3, 3*a*, and fixedly secured thereto with their lower end faces abutting the top end face of said fixed hoop 7. Thus, each upright has a filler block arranged longitudinally thereof and fitting its inner face, with the inner side face of the block flush with the inner circumferential surface of the hoop, and rising from the hoop perpendicular to the horizontal plane thereof.

The next hoop 7, is then seated on the top ends of the circular series of similar vertical blocks 8, and centered within the circle of uprights and fixed to each upright. Vertical filler blocks are then seated at their lower ends on said last mentioned hoop and secured to the uprights, as are the first mentioned series of said blocks, to form the second circular series of filler blocks.

And the remaining series of hoops and filler blocks are then successively applied and secured, up to the top hoop 6, of relatively enlarged diameter, which can be then applied and secured to the top ends of the uprights and the top series of filler blocks 8. However, said top hoop can be applied, if so desired, at some previous stage in the production or erection of the silo.

The silo supporting frame can thus be rapidly and economically erected or produced from parts of relatively low cost, that are readily available in substantially standard or stock sizes and shapes.

My method of building up the thin hard board lading-contacting wall 1, of the silo, can, if so desired, be economically and rapidly carried on step by step as the assembly of the uprights, filler blocks and hoops proceeds.

Thus, when the erection of the framework has reached the stage where a certain number of hoops 7, have been applied and secured, for instance, say, when the third hoop from the bottom has been fixed in place, although this is dependent on the width of the hard boards to be used and the vertical spacing of the hoops. The frame erection can then cease, until the lower or first horizontal course or series of hard boards is applied to the inner circumferences of the said first assembled hoops and the inner surfaces of the adjacent filler blocks. This first step in applying the hard boards, is begun, when a sufficient number of lower hoops are fixed in place to properly back and secure the hard boards of the horizontal bottom or first course of such

boards. The flat resilient hard boards, to form this course are introduced into the circle of hoops, and one by one are held vertically on edge with their longitudinal edges horizontal, then by the operation of suitable means, pressure is horizontally and outwardly applied to the outer side of the central portion of the length of such board, to bend or flex the board against the opposing areas of the surrounding surfaces of the filler blocks 8, and the inner circumferential surfaces of the hoops, to thus hold the board seated against said surfaces and bent to the same radius as that of said surfaces. The board is thus held in said arcuate form firmly against said surfaces, while the board is secured rigidly thereto, by the application of nails or other fastening means driven from the inside of the silo through the board and into the filler blocks and hoops.

The remaining boards of said first horizontal course are successively applied, pressed to arcuate form and secured in a like manner, to complete the series of arcuate boards all of like radius fitted end to end and extending horizontally from one upright 3*a*, around the inner side of the silo to the opposite upright 3*a*.

The horizontal bottom longitudinal edges of the boards of this first series of wall boards, fit down tightly on the floor or base of the silo and the joint thereby formed is usually tightly sealed against leakage. When, the bottom portion of the silo inner wall has thus been completed, the application and securing of another upward series of hoops 7, and filler blocks 8, is completed to receive the second upward horizontal course of thin hard boards, which are introduced one by one in flat form, and flexed by pressure to the required arcuate form and thus held while secured by nailing as were the boards of the first course, and this is continued step by step until the hoops and filler blocks are completed to the top hoop 6, of the silo.

The hard boards of each horizontal course above the first course, have their lower horizontal longitudinal edges abutting the top longitudinal edges of the boards of the next course below.

Suitable manually-operated portable expansible and contractile pressing means, adjustable to various silo hoop diameters, can be employed, within the silo, for bending the hard boards within the silo, and thus holding the same while being secured. For instance, I have successfully employed a portable hand carried and operated device, for this purpose having a supporting stem capable of being expanded and contracted by hand operated leverage or screw threaded connections, said stem, at its opposite ends, having heads that are horizontally arcuate, so that the device can extend horizontally within the silo with one end contacting a board to be bent and pressed, and the other end contacting a diametrical portion of the silo wall such as a hoop or filler block. One or more of such devices can be employed along different diameters of the silo for simultaneously and detachably bending, pressing and holding one or several hard boards.

By the foregoing method, whether the boards are bent and held by hand, or by suitable means, while being secured by nailing or otherwise, the inner hard board wall can be quickly and economically built and completed within the supporting frame work.

All joints such as those between the meeting end and longitudinal edges of the hard board struts 1, of the lading contacting inner wall of the silo, and those between the edges of the roofing sheets 17, and the rafters and capping strips, and other joints where sealing against moisture or leakage is desirable, are preferably calked by the use of a suitable flowable calking compound applied under pressure by any suitable or standard calking gun. I prefer to employ a suitable calking compound of commerce, or other flowable calking compound that is non-shrinking, water proof, that does not deteriorate under exposure to air, and that cures to a substantially permanent adhesive film possessing expansion and contraction characteristics under temperature changes. This calking compound can be applied under pressure to said joints from within and/or from without the hard board lading contacting wall, and other parts.

Specific sizes or dimensions, appearing herein merely as examples, are not of the essence of the invention.

While a specific example embodiment has been disclosed, for purposes of explanation, it is to be understood that the instant inventive concept may be reduced to various modified and other mechanical embodiments within the spirit and scope of the following claims.

What I claim is:

1. A silo body comprising an exterior encircling series of spaced rigidly fixed supporting studs extending throughout the length of said body, a pair of said rigid adjacent spaced studs forming the door posts of a longitudinal opening substantially throughout the length of said body; a vertical series of axially-alined spaced non-metallic hoops of unbroken circular rigid formation and substantial length and radial width, arranged within said exterior circular series of studs and extending substantially throughout the length of said body, each hoop being rigidly secured to and supported by said exterior surrounding series of studs and bracing the same and having its circumferential portion rigidly seated against the inner vertical sides of said studs, said hoops spanning said longitudinal opening and dividing the same into a vertical series of door openings, said hoops providing interior cylindrical surfaces of like diameter; an interior lading-contacting and restraining wall rigidly fixed with respect to and facing the inner surfaces of said surrounding series of supporting studs, said wall extending longitudinally through and rigidly fixed to the inner cylindrical surfaces of said hoops; and doors for said door openings.

2. A silo body comprising a surrounding exterior circular series of rigidly-held vertical spaced body supporting wood studs extending substantially throughout the length of said body; a vertical series of axially-alined spaced laminated-wood horizontal hoops of unbroken circular formation of like diameters arranged longitudinally of and located within and rigidly secured to and supported by said circular series of exterior studs, each hoop being of solid rigid formation providing inner and circumferential cylindrical surfaces of substantial vertical lengths and top and bottom end surfaces of substantially radial widths; annular series of vertical wood spacing fillers located between the hoops of said vertical series respectively, with said fillers facing and rigid with the inner vertical side portions of the studs that are located between the hoops, the inner vertical sides of said fillers being flush with the inner cylindrical surfaces of the hoops, each annular series of fillers at its opposite ends abutting the wide end surfaces of the adjacent hoops between which said series is located; and a sub-

stantially cylindrical lading contacting and restraining wall facing and backed by and fixed to the cylindrical inner surfaces of said hoops and the inner surfaces of said fillers rigid with said supporting studs and hoop ends.

3. A silo having a vertically elongated side opening, and an exterior supporting frame, laterally-spaced rigid upright studs forming door posts for said longitudinal opening, said frame including a vertical series of fixed horizontal spaced rigid door-supporting hoops extending transversely of the vertical inner sides of and rigid with said door posts and spanning said longitudinal opening and dividing the same into separate door openings, said hoops being of substantial vertical length and radial thickness and of rigid wood formation; and closure means for said door openings, including a vertical door opening inwardly and closing outwardly with respect to the door posts and top and bottom hoops of its door opening and movably resting on and supported by the bottom hoop of said opening.

4. A silo body comprising an upstanding substantially surrounding supporting framework providing a rigid surrounding backing including surrounding spaced rigid backing surfaces and series of spaced surrounding vertically disposed rigid backing surfaces, said several series being of like radius, in combination with a substantially cylindrical upright lading-restraining and contacting wall arranged within and backed by said series of rigid surfaces and fixed thereto, said wall comprising normally-flat resilient thin nonmetallic hard board sheets each characterized by its smooth hard impervious side surface and by its capability of being forcibly flexed to arcuate form without cracking or damaging such smooth surfaces, said sheets in arcuate form being secured with their end and longitudinal edges abutting with the joints thus formed, sealed and covered by said rigid backing surfaces, said smooth hard surfaces of said sheets forming the smooth substantially flush and unbroken lading contacting surface of said wall, resistant to the chemical and other actions of the ensilage within said wall and promoting the free downward movement thereof.

5. A silo body comprising an exterior encircling series of spaced fixed supporting wood studs extending substantially throughout the length of said body; a vertical series of horizontal spaced axially-alined circular hoops of rigid wood formation having substantially cylindrical circumferential and inner cylindrical backing surfaces both of substantial vertical lengths, and radially wide top and bottom end surfaces; said hoops being surrounded by and rigidly fixed to said studs with said exterior circumferential surfaces of the hoops fixedly seated against the vertical inner sides of said exterior studs, said studs providing annular horizontal series of rigid vertical backing portions between the pairs of hoops, said backing portions having inner vertical backing faces flush with the inner cylindrical backing surfaces of the hoops, said vertical backing portions providing opposite ends fixedly seated against said top and bottom end faces of the adjacent hoops; and a substantially cylindrical upright lading-contacting and restraining wall arranged within said hoops and seated against and fixed to said flush backing surfaces of said flush backing surfaces of said hoops and said vertical backing portions rigid with said studs.

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