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MASONRY STAVE SILO

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2 Sheets-Sheet 1

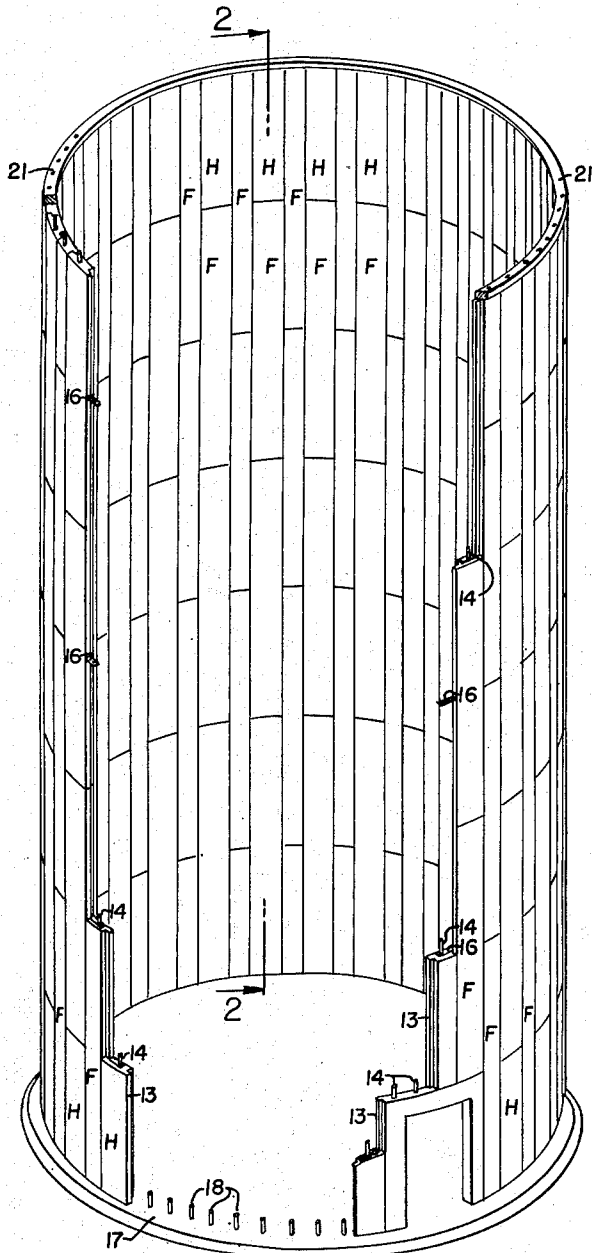


Fig. 1

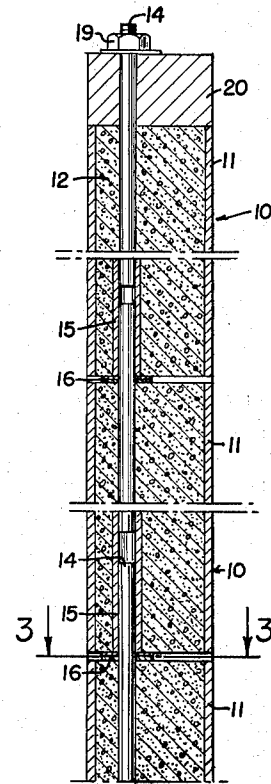


Fig. 2

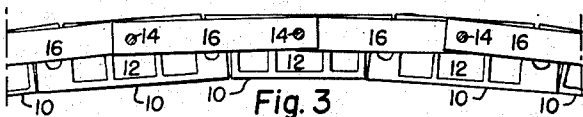


Fig. 3

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MASONRY STAVE SILO

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1 Claim. (Cl. 72-6)

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This invention relates to silos, or analogous structures, and more particularly to a stave type construction therefor, and has as an object to provide a novel and improved interassociation of conventional structural elements in and as a silo.

A further object of the invention is to provide an improved stave member susceptible of practical and efficient use in the construction of silos.

A further object of the invention is to provide an improved prefabricated unit assembly of conventional tile block elements constituting a reinforced stave adapted for use in the construction of silos.

A further object of the invention is to provide a novel and improved, reinforced, masonry stave unit susceptible of interlocking association with similar such units in and to constitute a silo.

A further object of the invention is to provide improved means for vertically and circumferentially reinforcing a masonry stave silo as an incident of its erection.

A further object of the invention is to provide improved, prefabricated, masonry stave building units susceptible of interfitted association in a condition of lateral and longitudinal reinforcement incidental to their assembly.

A further object of the invention is to provide an improved, reinforced, stave building unit constituted from conventional masonry block elements in a form and arrangement adaptable to a variety of practical uses; that is simple and economical of production; that is convenient and facile of practical use; and that presents a pleasing and weather-resistant surface finish.

With the foregoing and other objects in view, my invention consists in the construction, arrangement, and combination of elements as hereinafter set forth, pointed out in my claim, and illustrated by the accompanying drawings, in which—

Figure 1 is a somewhat diagrammatic, perspective elevation, partially broken away to better illustrate otherwise concealed relationships, of a silo construction typically embodying the principles of the invention. Figure 2 is a fragmentary, detail section, on an enlarged scale, taken substantially on the indicated line 2-2 of Figure 1 with portions of the view broken away to conserve space. Figure 3 is a fragmentary, detail section, on a relatively reduced scale, taken substantially on the indicated line 3-3 of Figure 2. Figure 4 is a perspective view of a typical, conventional ceramic block having the form and construction adapting it to use in and for the purposes of the invention. Figure 5 is a perspective

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view of a half stave unit constituted from blocks of the type shown in Figure 4 to give effect to the principles of the invention. Figure 6 is a view similar to Figure 5 illustrating an alternative half stave construction within the contemplation of the invention. Figure 7 is a perspective view of a full length stave constituted from blocks of the type shown in Figure 4 in a manner similar to the half stave showing of Figure 5. Figure 8 is a longitudinal section, on a relatively enlarged scale, taken substantially on the indicated line 3-3 of Figure 7, intermediate portions of the view being broken away to conserve space and to better illustrate otherwise concealed construction.

Hollow, baked tile blocks are conventionally available and extensively used in the form and style illustrated by Figure 4, and it is a primary purpose of the invention to utilize the manifest and known advantages of such blocks in the construction of silos and analogous structures. As shown in Figure 4, the conventional block, illustrated generally by the numeral 10, has a hollow, rectangular, main body portion 11 substantially square in face elevation and of a thickness materially less than its width or height, webs 12 longitudinally of the block interior in parallel with the block closed ends to define a relatively greater central channel through the block and somewhat smaller end channels at the sides of said central channel, and integral ribs 13, preferably hollow, outstanding oppositely from the block closed ends in coplanar relation with one of the block faces in a proportion adequate to cover one-half of the associated block end and to project perpendicularly from the block end a like distance, whereby to leave a notched corner at each side of the block lesser face adapted to receive and interlock with the rib 13 of a reverse-ly-associated block 10.

In accordance with the principles and to realize the advantages of the invention, multiple blocks 10 are end registered in longitudinally aligned succession and permanently interengaged to constitute stave units of appropriate length adapted to marginally interact through an overlapping of their rib 13 marginal extensions when arranged in alternately reversed, upstanding succession. The stave units constituted as hereinafter set forth are adapted for longitudinal extension to attainment of a desired wall height through longitudinally aligned superposition of successive like units and since the advantages of the invention are realized by breaking or staggering of the lateral joints between superposed units of a given

assembly, it is expedient to provide half length as well as full length such units in an alternation of particular construction adapting the half length units for interfitting relation between full length units in the starting and finish courses of the ultimate construction.

Figures 5 and 6 typify half length stave units embodying the principles of the invention and representative of the alternative particular construction appropriate for use with the full length stave units hereinafter described; the units shown in said views being identical save for an arrangement permitting of their use in oppositely-faced position. Each of the half stave units illustrated is comprised from four of the conventional blocks 10 arranged in registration of their open ends and in longitudinal alignment of their ribs 13 and webs 12, whereby to register the channels through the blocks as continuous, intercommunicating passages. The desired number of blocks 10 being end registered and aligned as shown, the passage through the block assembly resulting from aligned registration of the block central channels is filled with an appropriate, initially-plastic mixture, such as cement or concrete, and a reinforcing rod of metal in an appropriate size is imbedded in the filling material to extend longitudinally through the block assembly central passage adjacent one of the face walls of the assembly, said rod being positioned adjacent that face wall of the assembly which is to be outermost in the ultimate structure. As shown in Figure 5, the rod 14 is adjacent the greater block face which includes the coplanar rib 13 extensions, thus conditioning the unit for erection with its block major face surface outermost, while in Figure 6 the rod 14 is shown as more nearly adjacent the block lesser face area typical of the block body portion 11, thereby conditioning the unit for use with its narrower vertical face outermost and its major face area directed inwardly. However related to the block, or unit, major face area, the rod 14 of each half stave unit is disposed longitudinally of the assembly to project some distance above and outwardly beyond an end of a terminal block 10 which is thus identified as comprising the upper end of the unit, and said rod 14 has a length adequate to extend through the block assembly from such upper end projection to engagement of its other end within a tube or hollow cylinder 15, such as a short length of pipe, disposed to complete the length of reinforcement longitudinally and interiorly of the unit and to open through and in flush relation with the unit lower end as a socket for the accommodation of a rod 14 upper end projection from a separate unit. Manifestly, half stave units of the form and construction typified by Figures 5 and 6, alike save as to particular location of the associated rod 14 and tube 15 relative to the block 10 greater or lesser faces, may be constituted from any appropriate number of blocks 10 convenient for the development of units one-half the length of the full length units with which they are designed to coact and in a number and proportion of particular rod 14 arrangements suited to completion of the ultimately desired structure, the use of four conventional blocks 10 in each such half stave unit, as illustrated, being practical and expedient when the block elements 10 have a customary individual dimension of one foot longitudinally of the stave unit.

The full length staves characteristic of the invention and represented by the showings of Figures 7 and 8 are constituted from blocks 10 end-

registered and aligned as in the case of the half stave units, and each full length stave unit is reinforced by one or more rod 14 and tube 15 assemblies longitudinally traversing the stave unit central passage resulting from alignment of the constituent block central channels and imbedded, adjacent one or the other of the stave unit faces, in the initially-plastic material filling such central passage and rigidly interbonding the block elements of the stave. Further conforming with the half stave unit organization, at least one rod 14 and tube 15 assembly of each full length stave is disposed in the longitudinal median plane of its unit and there immobilized by the setting of the filling material wherein it is imbedded to provide a rod 14 projection beyond the unit upper end and to terminate the tube 15 as a socket opening flush with and through the unit lower end; alternative positioning of the unit reinforcement adjacent the greater or the lesser of the unit face areas conditioning the so-distinguished full length stave units for use in marginally-interlocked, alternately-faced relation with similar stress-accommodating disposition of the successive unit reinforcements. Differing from the half length stave unit organization, each of the full length stave units is comprised from just twice the number of blocks 10 utilized in each half stave unit, thus determining a full stave length twice that of the half stave unit, and in addition each full length stave unit is provided at its midlength with a pair of like, non-extensible, preferably-metallic links 16 each formed with holes adjacent its ends spaced apart a distance corresponding to the spacing between center rods 14 of marginally-interlocked, laterally successive stave units. The holes in the ends of the links 16 are sized to slidably receive and freely accommodate the rods 14 and said links are flat and relatively thin, so that a pair of the links end-overlapped and engaged by means of their registered holes with a rod 14 may extend oppositely and radially from the rod through the block joint at the midlength of the stave unit reinforced by the rod and project laterally of and beyond the unit opposite sides, as is clearly shown in Figures 7 and 8. The links 16 of each full length stave unit are assembled on the associated rod 14 as an incident of stave unit element assembly prior to charging of the stave unit central passage with filling material and any desired angularity of said links relative to the stave faces is determined before the filling material sets and hardens, thereby to permit the filling material to imbed and rigidly immobilize the links 16 as a permanent part of the associated stave unit. As will be readily apparent, the links 16 of each full length stave unit will be closer to one than to the other of the unit faces, depending upon the relation of the rod 14 to which they are anchored with respect to said faces, and the relative angularity of the link lateral projections may be initially adjusted to dispose the holes therein for engagement with rod 14 elements of adjacent, marginally-interlocked stave units in various angular associations.

Through the use of conventional, like blocks 10, stock reinforcing rod and tube material, readily-available, end-apertured links 16, and cement or concrete filler, the half and full length stave units shown and above described are susceptible of convenient, economical production in a base yard or at the use site and are adapted for facile handling, transportation, and erection without recourse to unusual and expensive equipment.

Though obviously adapted for use in the development of a variety of particular structures, the half and full length stave units developed as hereinabove disclosed to give effect to the principles of the invention are particularly designed for cooperation as and in the form of a silo, or analogous hollow, cylindrical structure, in the manner illustrated and hereinafter described.

An appropriate number and assortment of half length stave units H and full length stave units F having been fabricated in accordance with the foregoing teachings, and the significant dimensions of such units being known, a circular, level base 17, which may include a floor area, is developed in the desired size at the selected site, preferably through the use of concrete, and a succession of like, spacedly-parallel, metal stobs 18, conveniently of material the same as that utilized for the rods 14 of the stave units, is fixed in and to upstand a short distance vertically above said base 17 in a spacing of elements corresponding to the distance between centers of adjacent, marginally-interlocked stave units and to define the desired circular plan of the structure. As a practical convenience, the stobs 18 may be welded or otherwise fixed to and in spaced parallelism transversely of a flexible metal band in a uniform lateral projection beyond one of the band sides and the so-equipped band end-closed as an annulus and edge sunk in the soft concrete of the base to appropriately position and space the stobs.

Given the base 17 and associated projecting stobs 18, however constructed, half length stave units H are engaged by means of their tube 15 sockets with alternate stobs 18 to upstand vertically above the base in an arrangement effective to direct the stave face nearest the associated rod 14 exteriorly of the structure, thereby to dispose the rod 14 reinforcements of the units adjacent the structure exterior in position to counteract the tensional stresses affecting the structure wall as a consequence of charge interiorly of the structure, and full length stave units F having a rod 14 relationship alternative to that of the H units employed are reversely faced relative to said H units and engaged by means of their sockets 15 with the stobs 18 between the positioned H units, thereby annularly completing the first course of the structure through overlap and interlock of the notched stave unit margins determined through alignment of the constituent block ribs 13. As a consequence of the correlations hereinabove described, the rod 14 ends upstanding above the respective positioned H units are spaced and located to enter and be engaged through the holes in the free ends of the links 16 extending laterally from the adjacent F units at the level of the H unit upper ends, and such consequent linking of each H unit upper end to the adjacent F units is readily accomplished as an incident of F unit installation in a manner to complete a belt of links 16 interconnecting the unit rods 14 circumferentially of the structure for inhibition of adjacent stave separation and further reinforcement of the stave assembly against destructive stresses. Quite apparently, each stave unit H has its rod 14 projection engaged by the ends of the two links 16 outstanding from the units F on the opposite sides thereof, and the said link ends overlap each other against the stave H and in the same manner as the two link 16 ends imbedded in the stave unit F overlap in engagement with the rod 14 of such unit.

The first annular course of the structure, as well as altitudinally successive courses, may be

continuous and closed against access there-through, if desired, or, as is more commonly the case, some or all of the annular courses may be interrupted by an altitudinal succession of doors or access openings defined by appropriate frames furnished with removably-associated closure members, and the frames determining such doors or openings may be of prefabricated masonry construction sized and adapted for interlocking coaction with the stave units F and H, as indicated in Figure 1, may be form-cast in place during erection of the structure, or may be constituted from wood or metal either at the site or as prefabricated units, as is well understood and commonly practiced in the erection of conventional analogous structures.

Upon completion, the first annular course of the structure presents an alternated succession of stave units H and F, symmetrically staggered as to height, each furnished with a rod 14 projection at its upper end, and the successive annular courses requisite to attainment of the desired structure height are conveniently developed through the use of the alternatively reinforced types of stave units F in alternately faced adjacency and end engagement of their sockets 15 with the rod projections of the first course staves, the links 16 of the stave units F interconnecting adjacent stave rods 14 as above set forth to provide an effectively-continuous, circular band at every half stave interval of the structure height while the socket and rod cooperation between successive elements of each vertical stave assembly perfects a continuously-effective reinforcement thereof.

The ultimate altitude of the structure being determined by upper ends of a final row of stave units F, the final annular course of the erection is completed by means of stave units H inter-fitted to close between the spacedly upstanding half lengths of the terminal units F in the manner characterizing the first annular course, thereby constituting the upper end margin of the structure as a circular succession of coplanar stave unit ends having each a rod 14 end projecting upwardly therefrom. When desired, it is feasible to thread the rod 14 end projections of the final annular course of stave units for cooperation with nuts 19, as represented by Figure 2, and to utilize said threaded rod ends and nuts to clamp and secure a finish cap 20 of any appropriate material in place and in position to cooperate with and support a roof structure (not shown) in a conventional manner. Alternatively, the terminal rod 14 projections may be left unthreaded for imbedded engagement within a concrete or cement cap 21 form-cast on and to cover the stave ends of the final annular stave course, as indicated in Figure 1, and the ultimate roof, if any, may be based upon and rise from said cap 21.

It is to be noted that a silo, or comparable structure, constructed and erected in conformity with the principles hereinbefore elaborated is a vertically and circumferentially interlocked masonry assembly stressed to withstand the expansive and disruptive forces of a charge interiorly thereof without the slightest dependence upon mortar joints, bonds or seals. While not essential to the structural integrity of the assembly, the joints between abutting ends and lap-engaged sides of the stave units may be mortar-bonded, grouted, or otherwise sealed and the interior wall of the structure may be seal-

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coated or plastered, either or both, in the interest of water and weather tightness.

Since changes, variations, and modifications in the form, construction, and arrangement of the elements shown and described may be had without departing from the spirit of my invention, I wish to be understood as being limited solely by the scope of the appended claim, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

A masonry silo composed of interlocking prefabricated long and short stave units, said long units being substantially twice the length of said short units, each long unit comprising a plurality of identical hollow masonry blocks in abutting end to end axially aligned relationship, a continuous concrete filler extending through said blocks to provide a unitary structure, a metallic reinforcing rod embedded in said filler and projecting from one end of said long unit and terminating short of the opposite end, a metallic socket embedded in said filler in telescoping engagement with said rod and terminating in a substantially flush opening at said opposite end, a pair of metal links secured to said rod substantially midway of the length of said long unit and projecting laterally from opposite sides of said long unit and an aperture adjacent the outer end of each link, each short unit comprising a plurality of identical hollow masonry blocks in abutting end to end axially aligned relationship, a continuous concrete filler extending through said last named blocks to provide a unitary structure, a metallic reinforcing rod embedded in said last named filler and projecting from one end of said short unit and terminating short of the opposite end,

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a metallic socket embedded in said last named filler in telescoping engagement with said last named rod and terminating in a substantially flush opening at said opposite end of said short unit, a base, an annular series of spaced studs projecting upwardly from said base and into said sockets to position and secure the lower course of said stave units in place, said upper and lower courses comprising alternately disposed long and short stave units, the courses between said upper and lower courses comprising long stave units, the joints between laterally adjacent staves being in staggered relationship, the projecting rod portions extending through the apertures of a pair of adjacent links and extending into the sockets of the next vertically aligned stave unit to tie said stave units in assembled relationship and the projecting rods of the upper course of stave units engaging apertures in a cap whereby to provide a masonry silo in which said studs, said sockets, said links and said rods constitute the sole means for retaining said staves in assembled relationship.

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