Dec. 5, 1967 A. P. KONGER 3,356,013

METHOD OF AND APPARATUS FOR PACKAGING BRICKS

Filed June 13, 1966 2 Sheets-Sheet 1

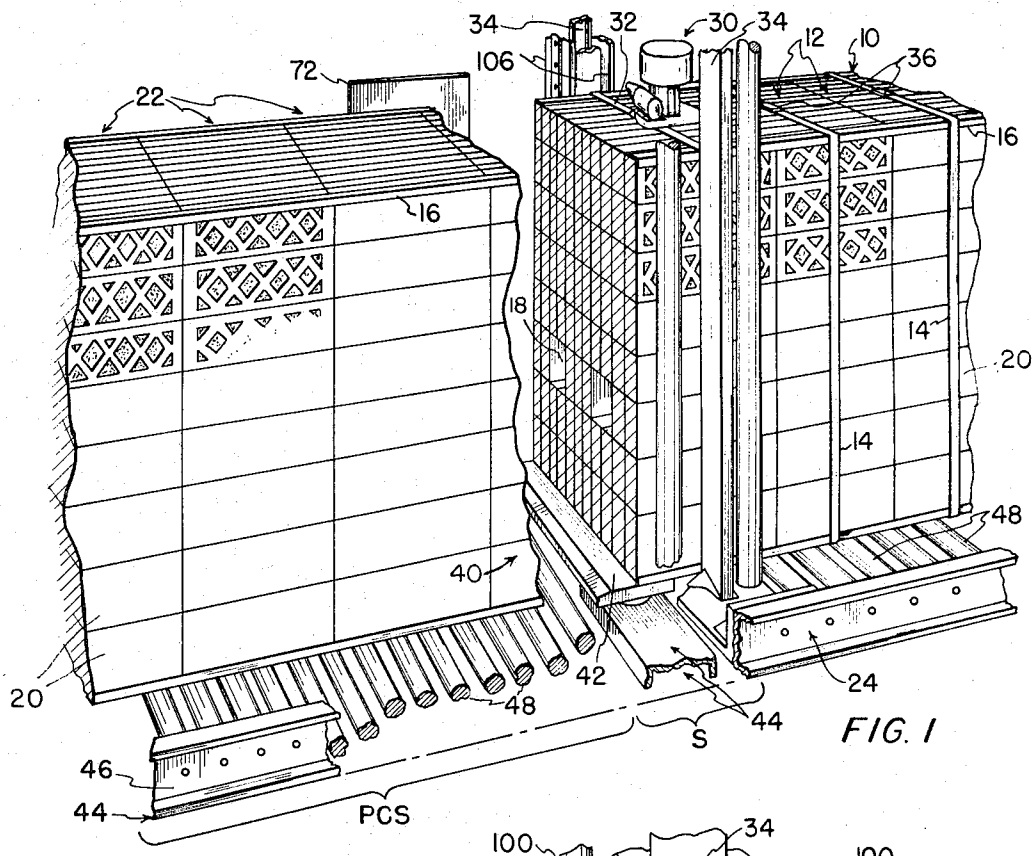


FIG. 1

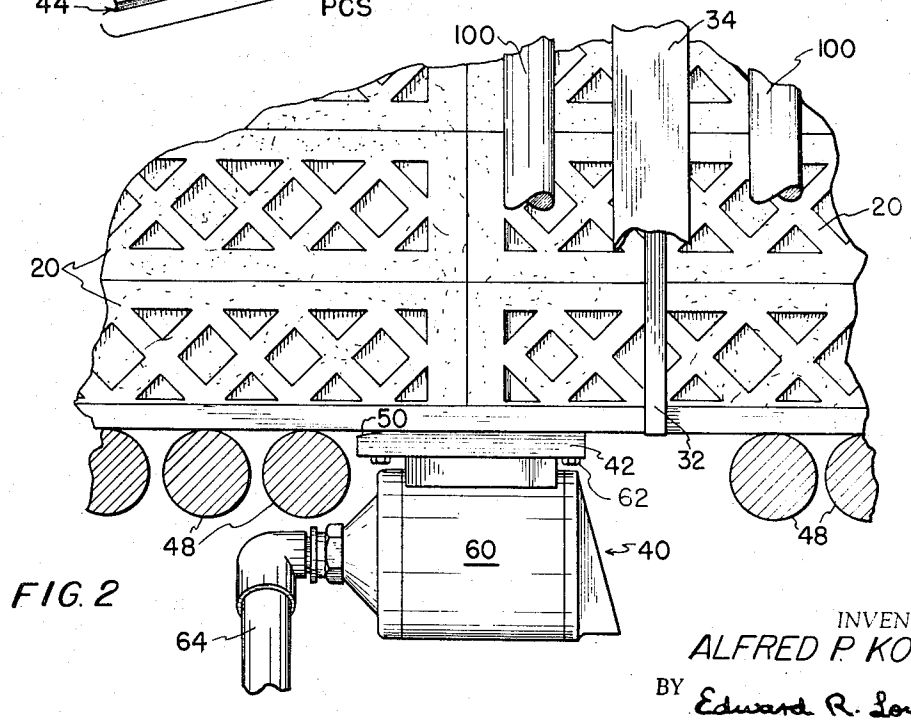


FIG. 2

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METHOD OF AND APPARATUS FOR PACKAGING BRICKS

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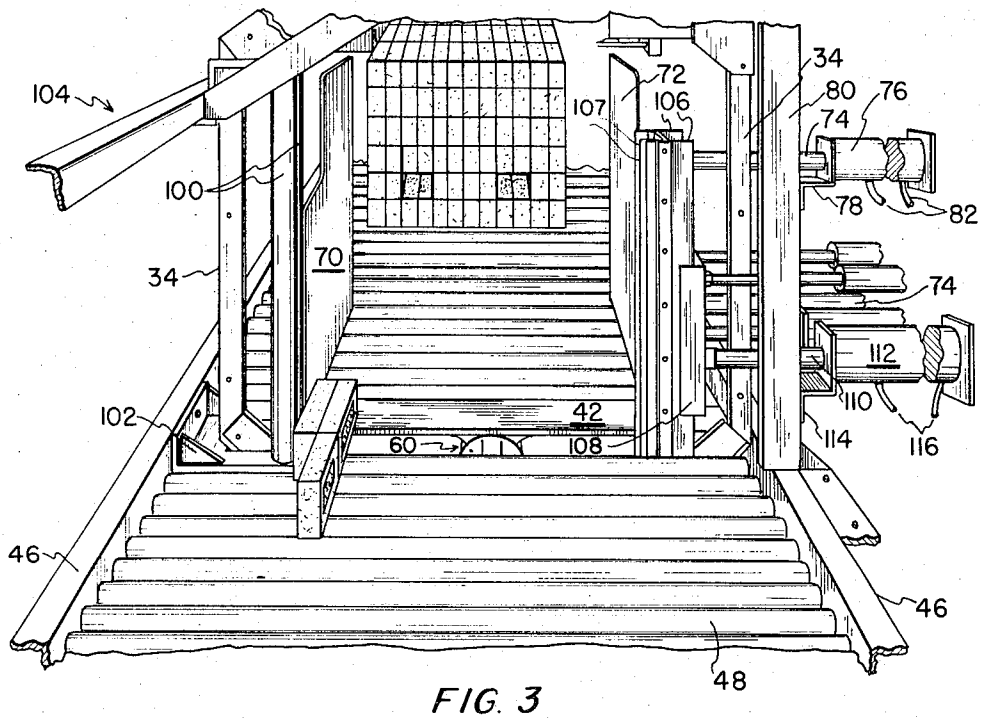


FIG. 3

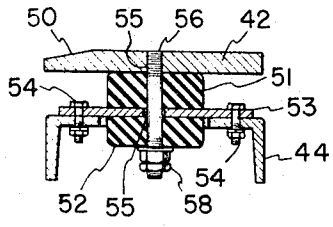


FIG. 5

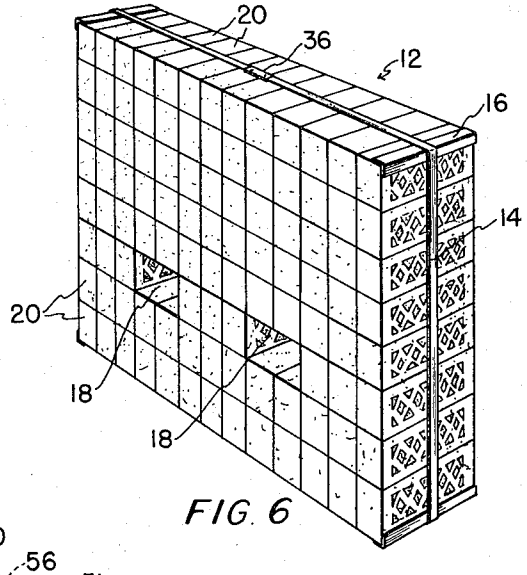


FIG. 6

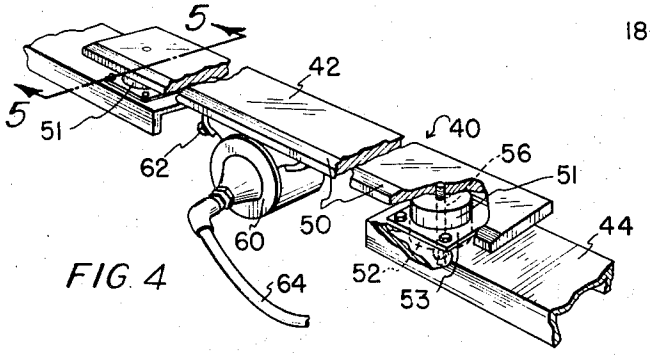


FIG. 4

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3,356,013

METHOD OF AND APPARATUS FOR PACKAGING BRICKS

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Filed June 13, 1966, Ser. No. 556,958
5 Claims. (Cl. 100—3)

The present invention relates to a method of and an apparatus for packaging bricks, and has particular reference to the application of steel strapping to individual stacks of bricks to provide tightly compacted unit packs which are then assembled upon one another to produce a larger composite unit or brick package consisting of a number of the individual unit brick packs which are held together in their assembled relationship by elongated protective corner strips common to all of the packs and which underlie all of the straps and, in addition to their protective function, serve to hold adjacent packs in contiguity.

In recent years a major step toward the efficient and economical handling of bricks has been the development of a brick package consisting of a number of individual pack units, each of which is encircled by a single peripheral loop of metal strapping, with the various pack units being maintained in longitudinal alignment and contiguity by longitudinally extending corner strips at the four corners of the package and about which the various metal straps are positioned. At one or two locations in the pack, openings for the forks of a lift truck are provided by omitting a few longitudinally aligned bricks and, additionally, before the metal straps are applied, elongated paper, cardboard, wooden, or, more recently, elastomeric corner protectors are folded around each of the four longitudinally extending corners of the package to provide L-shape corner strips which are confined in position by the application of the metal straps from cutting into the adjacent corners of the bricks and they also serve the purpose of tying the various unit packs together in substantial contiguity against longitudinal separation. It is to this general type of brick package that the present invention pertains.

Although brick packages of the general type briefly outlined above has materially reduced the cost of brick handling, they have not proven altogether satisfactory from the standpoint of package stability. It has been found that frequently a brick package which, as it leaves the strapping station, exhibits good compression and stability, is found to be loose at the time it arrives in the field. Considering the individual unit packs of such a brick package, although the bricks which comprise such a unit pack may immediately after the strapping operation has been performed be tightly banded together, separation of the bricks tends to occur under the slightest provocation, as for example under the joggling influence of the boxcar, highway truck or other transportation medium. Furthermore, lateral separation forces come into existence each time the brick package is lifted by a fork truck and the resultant brick separation is cumulative so that after a given package has been thus handled a few times the brick separations will not close again when the package is released by the fork truck.

The causes for such latent brick package instability are well known by brick manufacturers and the strapping machine industry alike. Principal among them is the presence of loose kiln sand within the confines of the brick package. This sand is a result of the kiln process and it adheres to bricks throughout the stacking operation so that intimate nesting of adjacent bricks in the stack is prevented by the intervening sand particles. Thus when a given stack is strapped to produce a unit brick pack, an appreciable quantity of loose sand remains within the

pack. In the static condition of the pack at the time it is initially encircled with a loop of strapping, the brick pack may have good compression and the strap may exhibit the proper tension when tested with the fingers. However, as soon as handling of this brick pack takes place as heretofore described and repeated internal stresses are applied to the same, the interface motion between adjacent bricks causes the sand to settle out with the net result that the strap becomes progressively loose, even to the point where the pack will come apart during unloading operations utilizing a fork truck. Recognition of the adverse effects of entrapped sand in brick packages is evidenced by prior attempts to eliminate such sand by the use of compressed air which is directed against the stacked bricks at the strapping station. Such a procedure however is not altogether satisfactory due to the dust problem which arises and also due to the fact that intimate encounter of all brick surfaces with the air jets is not attainable.

Another and equally important reason for latent package looseness is particularly prevalent with textured antique brick where the uneven surfaces of the bricks prevent true rectangular nesting of adjacent bricks. Such antique type bricks invariably are provided with high spots in the form of burrs or irregular pyramidal protuberances often ranging in height to as much as one-quarter of an inch. These protuberances may exhibit good compressional characteristics in an axial direction so that they will resist crumbling under full strap tension in the static condition of the brick pack, but as soon as the pack is subjected to handling the lateral forces which are applied thereto as a result of relative brick displacements will shear, fracture or otherwise rupture these protuberances or crumble them to powder form and, again, loosening of the strapped brick pack will result.

Since textured brick is subject to a combination of both loose sand entrapment and the abrasion or other collapse of surface irregularities, few brick packages are able to withstand the handling which is ordinarily encountered in transporting them from the kiln to a given scene of brick installation. Although many of the brick packages may arrive intact at the scene of installation, internal brick damage where a loose package is concerned is not an infrequent continugency, some bricks being completely fractured and other possessing latent or hidden fractures which are not readily visible and which therefore constitute a hazard in the erected brick structure.

A third reason for brick package looseness frequently exhibits itself directly at the strapping station and a predicated upon the reluctance of steel strapping to slide easily around the four corners of the individual brick packs. After the loose loop of strapping has been initially shrunk upon a pack and actual tensioning takes place, the tensioning wheel or roller which is employed for tensioning purposes is obliged to overcome successively the frictional resistance which is offered to the strapping at each of the four corners involved but, frequently, the maximum tension of which the tensioning wheel is capable is largely dissipated in the first three proximate corners so that the remote corner does not receive adequate tension to draw the strapping tightly around all four sides of the pack. This phenomenon of strapping procedure, when coupled with occluded sand and brick surface irregularities presents brick packaging problems which have long plagued the industry.

The present invention is designed to overcome the above-noted limitations that are attendant upon the packaging of bricks and, toward this end the invention contemplates the provision of a novel method of brick packaging wherein stacks of bricks are strapped to produce individual brick packs and wherein the thus strapped brick packs are posi-

tioned in end-to-end relationship and maintained in such relationship by longitudinal corner strips as heretofore described in connection with conventional brick packaging, but in which the stacks which, when strapped, make up the individual brick packs, are subjected to high frequency vibration immediately prior to and during the strapping operation, thus resulting in a completed brick package which will retain its stability indefinitely throughout all of the contingencies which are encountered during the commercial handling of the package from the time it leaves the strapping station at the kiln to the time it is delivered in the field.

It is well known that various articles, particularly granular materials and also certain bulk articles may be compacted to smaller proportions by subjecting them to high frequency vibration so that they will settle by gravity and assume a more intimate or condensed relationship for packaging purposes. Thus, containers are sometimes vibrated to agitate the contents thereof while filling, to the end that a greater mass, by weight, may fill a given container. However, where vibratory effects are applied to prepositioned rectangular articles which themselves are incompressible, no appreciable reduction in volume takes place. In fact, vibration alone offers no advantage even when subsequent packaging, either in containers or by strapping or tying, is resorted to. However, in the case of textured brick, high frequency vibration coupled with lateral stack compression and simultaneous strapping so as to impart additional compressional forces to the brick stack in centripetal fashion in all inward directions, offers numerous advantages for an unexpected nature.

In the first place, according to the present invention, vibration takes place while the stack of bricks is "in the open" so to speak so that the loose sand is shaken from the stack and is thus isolated, none of this released sand being packaged. Vibration takes place while the stack closely approaches the strapping station so that much of the sand is shed from the stack before it undergoes strapping and vibration is continued during the strapping operation where centripetal forces are applied to the stack to compact it in all directions so that not only does a final sand evacuation take place but any sand particles which fail to become dislodged at this time will seek a common level or find their way into the porous surface regions of the bricks where they will assume innocuous out-of-the-way positions and not impede brick contiguity. This "settling" of the hard-to-dislodge particles takes place in four directions with respect to each brick, i.e. vertically in both directions, and transversely in both directions with respect to the major axes of the brick pack.

Secondly, the high frequency vibration which is applied to the stack of bricks during the actual strapping operation results in a forced abrasion of adjacent brick surfaces, each upon the other, so that the various pyramidal or other protuberances on the surfaces of the bricks are literally worn away progressively as the tension in the applied strapping increases. During such abrasion, the particles or products of abrasion which are created due to disintegration of the protuberances are carried away from the stack under the vibratory influences which are prevalent so that they offer no obstacle to the attainment of ultimate brick contiguity. Whereas a protuberance which, in the absence of vibration might withstand full strapping tension, in the presence of such vibration will be subjected to lateral forces tending to shear, rupture and ultimately grind such protuberance to nothingness and carry away the products of abrasion.

Finally, the effects of vibration upon the stack during the strapping operation allows the strapping to "flow" so to speak around the four corners of the brick packs with comparative ease. Thus, the tensioning wheel or other tensioning instrumentality employed for strap tensioning purposes, will exert a far reaching and equalized tensioning influence which extends completely around the pack so that equal tension will ultimately result in each of the four linear spans of the strapping loop at all four sides of the pack. Still further, according to the present invention, the vibratory effects which are applied to the stack are not uniform with respect to each brick in the stack. Positive vibration is applied only to the bricks in the lowermost tier of bricks in the stack. Thus, the bricks are not vibrated in unison, nor is the "container" i.e. the strapping which ultimately binds the package, vibrated so that it does not impart its vibratory motions to the bricks. The bricks are prepositioned in approximate face-to-face relationship and the amplitude of vibratory motion involved is not so great as to disturb relative brick orientation. There is no tumbling of articles and each brick which originally is bounded on four sides by four other bricks, retains its positional relationship with respect to such four bricks throughout the entire vibration cycle so that when vibration has ceased and the strapping operation is complete, such a brick remains confronted by the same four adjacent bricks as opposed it during the initial stacking operation. Because adjacent bricks retain their opposed positional relationship during the entire vibratory cycle, the aforementioned abrasive action between adjacent opposed brick surfaces will take place. Each pair of opposed brick surfaces will, due to pogressive compressional forces tending to bring them together under the influence of progressive tensioning in the strapping exert a rapid and repeated abrasive action each upon the other. Thus, any high spot or protuberance existing on either surface will rapidly be worn away whereas, with indiscriminate tumbling of loose articles, there is no assurance that such a high spot or protuberance would encounter sufficient abrasion to eradicate it.

The provision of a method of packaging bricks such as has briefly been outlined above constitutes the principal object of the present invention.

Another and important object of the invention resides in the provision of a commercially practical apparatus by means of which the above outlined method may conveniently be carried out. This object is accomplished by the maintenance of an assembly line type of conveyor system wherein the bricks are assembled at a stacking station and conducted in successive stacks to a strapping station. The individual stacks consist of vertically arranged tiers of bricks supported on their stretcher sides and each stack is of one brick width with the various bricks in each tier being disposed in side face to side face contiguity. As the various succesive stacks approach the strapping station, a pair of opposed compression plates at a pre-compression station engage the opposite sides of the stacks for truing purposes and also for the application of relatively light compression to the stacks. The conveyor system is of the intermittent type and each indexing operation thereof serves to bring the leading stack on the conveyor into accurate register with a strapping chute and at the strapping station and to convey a previously strapped stack from such station. At a region which is common to the exit end of the pre-compression station and to the entrance end of the strapping station, a vibrator plate of full conveyor width is caused to underlie the trailing edge regions of all of the bricks in the lowermost tier of bricks at the strapping station, as well as the leading edge regions of all of the bricks in the lowermost tier of bricks awaiting entry into the strapping station. Thus, upon energization of the vibrator plate, vibratory effects are imparted to both adjacent stacks, i.e. the stack undergoing strapping at the strapping station and the next adjacent stack awaiting entry into the strapping station and, at such time, undergoing pre-compression.

An additional feature of the present apparatus resides in the provision of auxiliary compression means directly at the strapping station to individually apply relatively high inward compression to the stack from the opposite sides thereof during the time that the loose loop of strapping is being shrunk upon the stack, and to augment the

centripetal compression which is offered to the stack during actual strap tensioning. This latter means is in the form of a pair of compression jaws which are of full stack height and which engage the opposite sides of the stack for individual stack truing and compression purposes, particularly in the medial vertical regions of the stack where the strapping has less tendency to exert inward force upon the stack than it does in the corner regions.

It is to be distinctly understood that the apparatus illustrated herein represents merely one practical embodiment which has been developed for the commercial application of the present brick packaging method and that other apparatus capable of performing the essential method steps of the invention are contemplated and may be developed in the future. Therefore, irrespective of the particular apparatus employed, the essential features of the invention remain substantially the same.

Numerous other objects and advantages of the invention, not at this time enumerated, will become readily apparent as the nature of the invention is better understood.

In the accompanying two sheets of drawings forming a part of this specification, one illustrative embodiment of the present brick packaging method, together with the best known means for carrying out this method have been disclosed.

In these drawings:

FIG. 1 is a fragmentary perspective view, partly in section, of a portion of an exemplary form of brick packaging apparatus by means of which the present method may be effectively carried out, the view being taken in the immediate vicinity of the strapping station;

FIG. 2 is an enlarged fragmentary side elevational view of a portion of the structure shown in FIG. 1 and illustrating specifically a stack-vibrating unit employed in connection with the invention;

FIG. 3 is an end perspective view of the apparatus taken from the discharge end thereof;

FIG. 4 is a perspective view of a fragmentary portion of the apparatus framework in the vicinity of the vibrating station and showing the vibrator assembly operatively applied thereto;

FIG. 5 is a sectional view taken on the vertical plane represented by the line 5—5 of FIG. 4 and in the direction of the arrows; and

FIG. 6 is a perspective view of a strapped brick pack unit showing the same severed from a larger brick package which has been packaged according to the present invention.

Referring now to the drawings in detail, a typical brick package which has been assembled from individual bricks and strapped according to the method of the present invention appears in FIG. 1 and has been designated in its entirety at 10. The package is comprised of a plurality of individual self-sustaining unit packs 12, one of which is shown in FIG. 6. The package 10 does not deviate appreciably in outward appearance from a conventional brick package and, in the exemplary form which has been selected for illustration herein, the arrangement is generally cubic and consists of four of the unit packs 12 arranged in contiguous face-to-face longitudinal alignment. Each unit pack is banded by a metal steel strap 14 and the various unit packs are held together against longitudinal separation by longitudinally extending corner protectors or strips 16 which are L-shape in transverse cross section and underlie the various straps 14 as is customary in connection with similar brick packages. At selected regions of the package 10 longitudinal rows of bricks are omitted in stacking the bricks, thus defining openings 18 which preferably extend completely through the package and which are designed to receive the tines of a fork lift truck by means of which the package as a whole may be transported.

The specific dimensions of the individual bricks and their stacked disposition may be varied but for exemplary purposes herein each unit pack 12 may be considered to be comprised of textured standard American bricks 20 supported on their stretcher sides with the corresponding bricks of adjacent packs being disposed in end-to-end contiguity.

As previously stated, the brick package 10 described above does not differ in outward appearance from a conventional brick package and it differs structurally therefrom only in that it possesses greater stability under conditions of handling and greater stability under conditions of handling and transportation, this stability being imparted to it, as will be described presently, by reason of its method of assembly according to the present invention.

Referring now to FIGS. 1 and 3, the preliminary procedure involved in producing the package 10 wherein unit stacks 22 of bricks are erected at a loading station (not shown) and conducted on a live conveyor assembly 24 to a strapping station S for production of the unit packs 12 is incidental to the present method and no claim is made herein to any novelty associated with this procedure per se. Such a procedure has been illustrated and described in detail in the aforementioned copending application, Ser. No. 497,050 now Patent No. 3,329,262 which issued July 4, 1967 and reference may be had thereto for a full understanding thereof. It is deemed sufficient for purposes of disclosure herein to state that the individual brick stacks 22 are erected at the strapping station in end-to-end contiguity as shown in FIG. 1 and that the live roll conveyor 24 is indexed in step-by-step fashion to advance the stacks forwardly in succession to the strapping station S where they are individually strapped by a conventional strapping machine 30 which may be a Signode or other machine. During such intermittent advancing of the stacks 22, the angular material which forms the corner strips 16 is progressively applied under tension to the four longitudinal corners of the continuously stacked bricks as they are advanced toward the strapping station. At this latter station a loop of steel strapping 32 is caused to encircle each unit stack 22 by means of a conventional strapping chute 34 from which the strapping is forcibly pulled by means of the strapping machine 30 to shrink the loop 32 upon the stack. Thereafter the strapping machine 30 tensions the loop and applies a seal 36 (FIGS. 1 and 6) to the overlapping end portions of the loop after which the free end portion of the strapping is severed to free the thus created unit pack 12 from the source of strapping, all in the manner of conventional strapping machine operation. The severed strap, in thus binding the bricks 20 of the unit pack 12 together, also captures the various lengths of corner strip material 16 which have been applied to the stack. The thus banded unit packs 12, securely bound to one another by reason of the tension in the corner strip material 16, are periodically advanced on the conveyor 24 and, at a suitable severing station (not shown) they may be separated into individual brick packages 10 of four unit packs each or of any other desired brick pack multiple.

Still referring to FIGS. 1 to 3 inclusive, according to the present invention, means are provided for imparting vibratory effects to each brick stack 22 while it is undergoing strapping at the strapping station, and also for imparting such vibratory effects to the next adjacent stack which immediately precedes the strapping station. Accordingly, the conveyor 24 has associated therewith a pneumatic vibrator unit or assembly 40 (see also FIG. 4) which is secured to the conveyor plate proper 42 and which, during each strapping operation, serves to support thereon the trailing edge regions of all of the bricks 20 in the lowermost tier of bricks of the unit stack 20 undergoing strapping, and also the leading edge regions of all of the bricks in the lowermost tier of bricks of the next succeeding unit stack awaiting entry into the strapping station during the next apparatus cycle.

Specifically, the conveyor 24 involves in its general organization a stationary framework 44 including opposed side rails 46 between which there extends the usual series of live rolls 48. The rolls 48 are power driven in unison, suitable control means, which forms no part of the present invention and which therefore has not been disclosed, being provided for periodically indexing the rolls to advance the stacked bricks supported thereon toward the strapping station S in increments of motion equal to the longitudinal extent of one unit stack.

The live rolls 48 are interrupted at the strapping station S and have interposed therebetween at substantially the horizontal level of the rolls the aforementioned vibrator unit or assembly 40. This vibrator unit is shown in detail in FIGS. 2 and 4. The aforementioned vibrator plate 42 is in the form of an elongated bar having a smooth planar upper surface provided with a bevelled edge 50 to facilitate sliding movement of the various bricks onto the plate. The plate extends completely across the effective reach of the conveyor 24 and the end regions thereof are yieldingly supported on portions of the conveyor framework 44 by means of respective flexible mounts (FIG. 5) each including upper and lower tubular compression members 51 and 52 of rubber or other suitable resilient elastomeric material which straddle a mounting plate 53 secured by bolts 54 to a portion of the framework 44, the plate 53 being provided with a clearance opening 55 therethrough for reception of a floating centering stud 56 which depends from the underneath side of the plate 42 and passes through both compression members 51 and 52. A nut and washer assembly 58 retains the various parts of the flexible mount in position.

A pneumatic vibrator motor 60 is bolted as at 62 to the underneath side of the vibrator plate 42 at an appropriate medial region of the latter and is adapted to be supplied with compressed air through a flexible conduit 64 leading from a suitable source (not shown) of such air. The vibrator motor 60 may be of any conventional construction, there being numerous commercially available motors capable of imparting the necessary vibratory effects to the plate 42 and the bricks 20 supported thereon, one such motor which has been found satisfactory for the purposes intended being manufactured and sold by Vibro-Plus Products, Inc. of Stanhope, N.J. and designated as Model EP 40. Irrespective however of the particular vibratory mechanism employed the essential features of the invention remain substantially the same. Vibratory motors of the general type disclosed herein consist essentially of a motor housing within which there is disposed an eccentric or unbalanced rotor of appreciable mass and which, when rotated at relatively high speeds, imparts vibratory motion to the housing within which it is rotatably journalled. The particular disposition of the motor 60 on the underneath side of the vibrator plate 42 is not critical and, although the motor is shown in FIG. 4 as being substantially centered between the ends of the plate, it is within the purview of the present invention to secure the motor at other locations along the plate.

Referring again to FIGS. 1 and 3, a region which spans several unit stack lengths along the conveyor 24 constitutes a pre-compression station and has been designated by the bracket PCS. At this station means are provided for centering the various unit stacks 22 on the conveyor reach and also for imparting to the bricks contained therein a predetermined degree of compression in the transverse direction of the conveyor. Accordingly, a fixed pressure plate or compression jaw 70 extends vertically upwardly from the upper side of the conveyor reach and is opposed by a movable compression plate or jaw 72. The movable jaw 72 is carried on the distal ends of a plurality of plungers 74 which project from respective pneumatic cylinders 76 supported on brackets 78 which in turn are carried by vertical standards 80 which project upwardly from the framework 44 of the conveyor 24. Flexible conduits 82 connect the various cylinders 76 to a source of compressed air and suitable control valve means (not shown) is provided for supplying air selectively to the opposite ends of the cylinders 76 to control the operation of the movable pressure plate or jaw 72.

Means are provided directly at the strapping station S for similarly imparting to the individual brick stacks 22 a relatively great degree of inward compression in the transverse direction of the conveyor 24, such compression taking place during the actual strapping operation. Accordingly, a pair of slightly spaced apart compression rollers 100 extend upwardly from the conveyor reach and have their lower ends rotatably journalled in a bracket 102 secured to one of the side frame members 46 of the conveyor framework. The upper ends of the compression rollers 100 are rotatably journalled in portions of a conveyor superstructure 104. On the opposite side of the conveyor 24, the rollers 100 are opposed by a pair of vertically disposed movable compression bars 106, each bar being carried by a bracket 108 supported on the outer end of a plunger 110 which projects from a cylinder 112 mounted on a bracket 114 secured to one of the standards 80. Flexible conduits 116 are provided for conducting compressed air to the opposite ends of the cylinders 112. The plungers and cylinders 110, 112 and the mountings and controls for the latter are similar to those described in connection with the movable pressure plate 72. In order to protect the sides of the bricks 20 from undue abrasion, the two compression bars 106 are each provided with a suitable elastomeric or other resilient brick-engaging contact strip 107.

A description of the operation of the above-described brick packaging apparatus 10 will suffice largely for a description of the method involved in the present invention, although it is to be distinctly understood that the practicing of the method is not dependent upon any particular apparatus. In its broadest aspect the method of the present invention may be carried out by any apparatus having associated therewith mechanism for effecting vibration of successive brick stacks at a strapping station, a means for compressing the stack in a transverse direction, and strapping facilities for binding the stack during vibration of the latter so that the plane of the strapping loop extends in a transverse direction.

Assuming that the necessary control facilities are provided for effecting the required machine operations such as the periodic indexing of the conveyor 24; the inward projection of the movable pressure plate 72 toward the fixed pressure plate 70 to apply pre-compression to the next several brick stacks 22 approaching the strapping station; the similar inward projection of the two compression bars 106 to compact the brick stack at the strapping station during vibration and strapping thereof; energization of the vibratory motor 60 to agitate the stack; and actuation of the strapping machine 30; the unit stacks 22 are initially set up or erected at the loading station and, from thence they are periodically advanced in step-by-step fashion toward the strapping station S. During this intermittent advancement of the unit stacks, the corner strip material 16 is applied under tension in the manner set forth in the aforementioned application of Martin et al., Ser. No. 497,050.

The indexing of the conveyor 44 is so controlled that as the leading unit stack 22 of bricks approaches the strapping station S, the lower leading transverse edge of such stack will come to rest as shown in FIG. 2 in an approximately centered position on the vibrator plate 42. The preceding unit stack will, at this time, have been pushed forwardly on the conveyor to a position wherein its lower trailing edge will rest on the plate 42 with the two stacks 22 existing in substantial contiguity. At this time energization of the vibrator motor 60 will take place while at the same time the cylinders 76 will be actuated so as to project the plungers 74 therefrom and cause inward movement of the movable pressure plate 72 toward the fixed pressure plate 70, thus aligning the stacks 22 which are disposed

between these pressure plates with the strapping station and also applying a moderate degree of inward transverse pressure to the bricks of such stacks. At the same time, the strapping machine **30** will be set into operation.

It is to be observed at this point that the vibratory effects of the vibrator plate **42** will be imparted to both unit stacks **22** which are partially supported on the vibrator plate **42** and these vibratory effects will be distributed to all of the bricks in the two stacks. Due to the resilient mounts at the opposite ends of the vibrator plate **42**, vibration is confined largely to the vibrator assembly **40** itself and to the two unit stacks **22** supported thereon with only a modicum of vibration being transmitted to adjacent brick stacks or to the framework in the immediate vicinity of the strapping station. In this manner the noise level is maintained within reasonable limits.

During such vibration of the two stacks in the vicinity of the strapping station S, the prepositioned bricks **20** in the stacks do not noticeably change their positional relationship with respect to one another although a minute rubbing action between the various opposed brick surfaces takes place. In the leading stack at the pre-compression station PCS, the bricks are compressed together in the transverse direction of the stack so that the major surfaces of the bricks are thus subjected to such rubbing or abrasive action. Vibration of the bricks therefore serves a two-fold purpose. Firstly it serves to agitate the bricks and thus shake loose any adhering particles of sand which have been carried over from the kiln. Where high textured or antique brick is concerned, the irregular surface configuration thereof is such that the adjacent opposed surfaces of the fresh bricks in the stack will not initially be in completely intimate face-to-face contact so that the loosened sand particles may readily find their way by gravity downwardly through the stack crevices for discharge therefrom. Secondly, due to the relatively light degree of inward or transverse compression imparted to the stack as a whole by the two pressure plates **70** and **72**, a certain amount of abrasion or self-sanding of the opposed major faces of the bricks will occur, thus wearing down any high spots or protuberances, of which there are many on antique type brick. The abrasion of such protuberances creates additional "sand" which also is carried downwardly through the stack crevices by gravity to a point of discharge. As vibration continues and the two pressure plates continue to exert their compressional forces on the stack, the various bricks move slowly into more intimate contact, all the while shedding kiln sand and the products of abrasion. As soon as the strapping operation which is being performed upon the next preceding stack directly at the strapping station S has been completed to produce one of the finished strapped unit packs **12**, stack compression is relieved momentarily and an indexing operation of the conveyor **24** serves to advance such unit pack from the strapping station and transfer the next succeeding unit stack (now partially depleted of sand and somewhat intimately compressed) to the strapping station where it shares its supported position on the vibrator plate **42** with a succeeding unit stack which has been advanced to the leading position in the pre-compression station PCS.

The new and thus partially treated stack at the strapping station becomes subjected to simultaneous vibration, compression and strapping as soon as the vibration motor **60** and strapping machine **30** are energized in the normal progression of the apparatus cycle. At the time these instrumentalities are energized, the movable pressure bars **106** are caused to move toward the fixed pressure rollers **100** to engage the stack between the bars and rollers and thus apply a relatively great degree of compression in a transverse direction to the stack. The net effect of this combined vibration and transverse compression is similar to the effect previously produced at the pre-compression station only it is somewhat intensified. At the pre-compression station most of the larger particles of sand are removed from the stack, leaving only the fines to be removed. Furthermore, the adjacent bricks now being in more intimate relationship than they were at the time of the arrival of the stack at the pre-compression station, and being under greater compression, are more thoroughly "scrubbed" by the resulting abrasive action. Finally, since the surfaces of antique type brick is highly porous, such fines as do not have time to settle through the stack to a region of discharge will become entrapped between adjacent opposed brick surfaces but they will not appreciably impede brick surface-to-surface intimacy or contiguity because these fines readily find nesting places within the numerous surface pores of the bricks so that in the ultimate analysis of the combined vibrational and compressional phenomena involved, adjacent bricks are to all intents and purposes in complete contiguity and no further reduction in over-all stack volume can take place regardless of the degree of compression imparted thereto.

In addition to the transverse compression which is offered to the vibrating stack at the strapping station S by the pressure bars **106** and rollers **100**, further and centripetal compression is offered the stack as a result of the strapping operation. As soon as slack has been taken up in the encircling loop **32** of strapping and the tensioning operation is initiated, this additional compression is imparted to the stack, thus intensifying the abrasive action which takes place between the major faces of the bricks, and also exerting vertical compression on the stack to augment the static vertical compression normally prevalent by reason of the weight of the individual bricks, one upon another. In this manner, not only are the vertical opposed major faces of the bricks subjected to an abrasive sand removal operation, but so also are the horizontal minor surfaces of the bricks.

The apparatus is cyclic in its operation and a single apparatus cycle may be regarded as embodying such operations as take place in-between successive conveyor indexing operations during which time a fresh unit stack **22** arriving at the pre-compression station PCS is preliminarily treated as heretofore described, and a preliminarily treated unit stack arriving at the strapping station is further treated and strapped. The apparatus is readily susceptible to semi-automatic operation under push-button control, or to fully automatic operation.

The invention is not to be limited to the precise method steps described herein, nor to the exact structural arrangements shown in the accompanying drawings as various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, while the method, as described, embodies the step of vibrating each unit stack **22** while simultaneously strapping the same, it is within the purview of the invention to vibrate the stack while under transverse compression to produce the necessary interfacial abrasion and removal of the products of abrasion and to thereafter resort to the strapping operation while maintaining such transverse compression in the absence of vibration. Such a procedure is not as effective as is the case when vibration is maintained throughout the strapping operation since without vibration the strapping is not assisted in its flow around the four corners of the stack. However, strapping of a previously vibrated stack of bricks which are maintained under forced compression will produce a unit pack possessing greater stability than has heretofore been possible with conventional brick packaging methods. Furthermore, while the various unit packs **12** are shown and described herein as being circumscribed by flat metal straps **14** under tension, the present method and apparatus contemplates the use of wire for the banding operation. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention, what I claim and desire to secure by Letters Patent is:

1. The method of producing a substantially sand-free

compact rectangular unit pack of kiln-produced bricks consisting of superimposed tiers of individual bricks disposed in face-to-face contiguous relationship and arranged in transverse rows, and a tensioned metal band encircling the pack and extending around the four longitudinal corners thereof and serving to hold adjacent bricks in contiguity, said method comprising: arranging the bricks to produce a stack in which the bricks assume a pre-positioned relationship conforming to their final positions in the pack, placing the stack under transverse compression to force adjacent bricks hard against each other while simultaneously vibrating the stack bodily as a unit to produce interfacial abrasive rubbing of such adjacent bricks against each other and consequent removal by gravity of adhering kiln sand together with the products of abrasion, and finally tensioning the band about the thus treated stack to produce the unit pack.

2. The method of producing a substantially sand-free compact unit pack of bricks as set forth in claim 1, wherein the step of tensioning the band about the stack is effected by drawing the band peripherally about said four longitudinal corners of the stack and is conducted simultaneously with stack vibration and transverse stack compression to the end that dynamic friction incident to the vibration will enhance the flow characteristics of the metal band in passing over said corners.

3. The method of producing successive compact rectangular unit packs of kiln-produced bricks which are substantially free of kiln sand, each unit pack consisting of superimposed tiers of individual bricks disposed in face-to-face contiguous relationship and arranged in transverse rows, and a tensioned metal band encircling the pack and extending around the four longitudinal corners thereof and serving to hold adjacent bricks in contiguity, said method comprising: assembling the bricks of each pack at a stacking station to produce a stack in which the bricks assume a pre-positioned relationship conforming to their final positions in the pack, conducting the thus assembled stacks in longitudinal alignment in a forward direction to a pre-compression station, a strapping station and an unloading station, successively and in the order named; subjecting successive stacks at the pre-compression station to transverse compression to force adjacent bricks hard against each other while simultaneously vibrating the stacks bodily as a unit to produce interfacial abrasive rubbing of such adjacent bricks against each other and consequent removal by gravity of adhering kiln sand together with the products of abrasion, and

maintaining such transverse compression and vibration of the succesive stacks at the strapping station while simultaneously tensioning the bands about the thus treated stacks to produce the unit packs.

4. Apparatus for packaging kiln-produced bricks and comprising: conveyor means for transporting a plurality of closely positioned unit stacks in a longitudinal row forwardly in a longitudinal direction from a stacking station, through a pre-compression station, and a strapping station to an unloading station successively and in the order named, means for indexing the conveyor to advance the stacks one unit stack at a time, said pre-compression station and said strapping station being disposed in such close proximity to each other that a stack which is disposed at the strapping station is in close proximity to the next adjacent following stack at the pre-compression station, means at said precompression station and engageable with the opposite lateral sides of at least said next adjacent following stack for subjecting such stack to transverse compression to force the opposed surfaces of adjacent bricks against each other, means at said strapping station for likewise subjecting a stack at said latter station to transverse compression, means at said precompression station for imparting high frequency vibration to said next adjacent following stack to produce interfacial abrasive rubbing of such adjacent bricks against each other incident to transverse compression of such stack and consequent removal by gravity of adhering kiln sand together with the products of abrasion, and means at said strapping station for applying metal binder straps to a stack at said latter station.

5. Apparatus for packaging kiln-produced bricks as set forth in claim 4, wherein the means at the pre-compression station for imparting high frequency vibration to said next adjacent following stack comprises a vibratory plate positioned in the path of movement of the stack and engageable with the underneath faces of such stack.

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