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APPARATUS FOR COMPACTING GRANULAR MATERIALS

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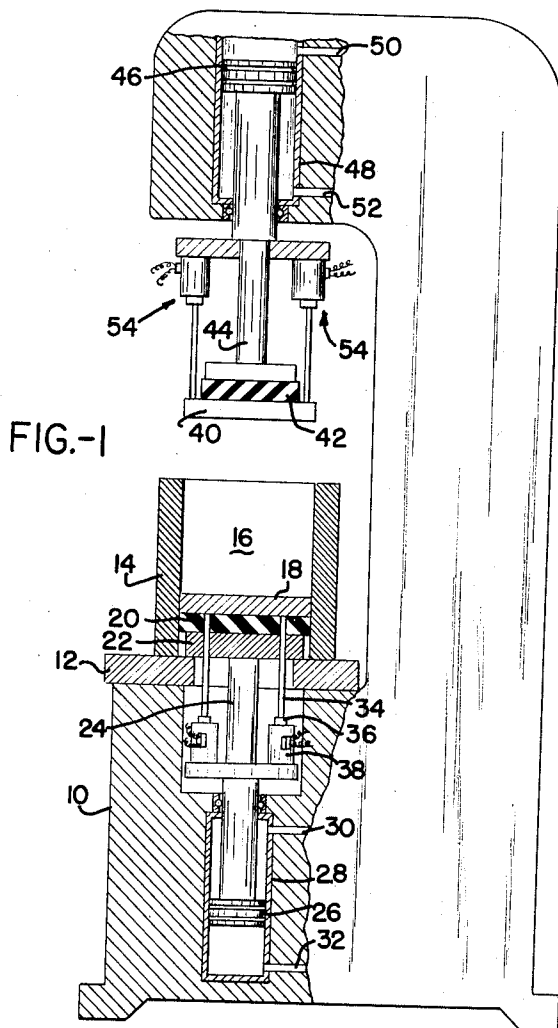


FIG.-1

FIG.-2

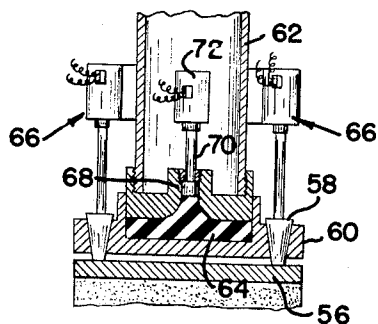


FIG.-3

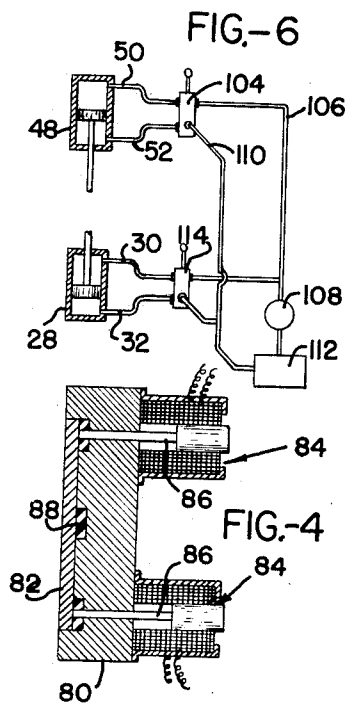
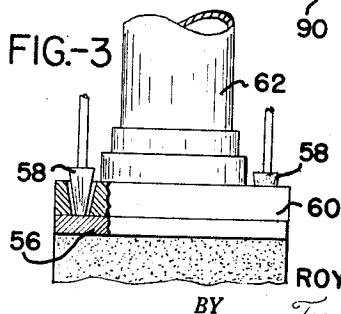


FIG.-4

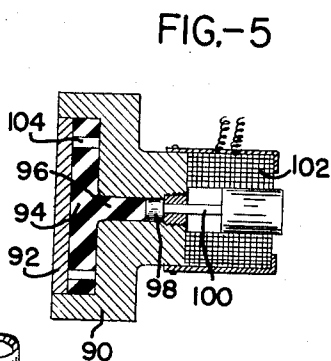


FIG.-5

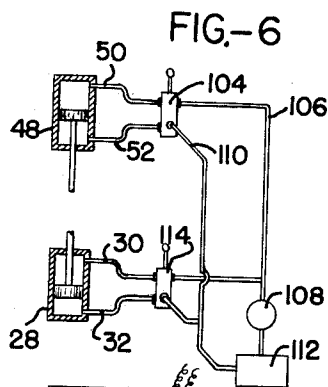


FIG.-6

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1

2,909,826

APPARATUS FOR COMPACTING GRANULAR MATERIALS

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2 Claims. (Cl. 25—41)

This invention relates to a method and apparatus for compacting granular materials, and particularly to an apparatus for compacting granular materials into bricks, tiles, or the like for subsequent firing to produce an article of commerce such as a wall or floor tile, fire brick, or the like.

A preferred way of manufacturing ceramic articles, particularly those of relatively simple shape such as brick and tile, includes the step of compacting dry, that is, substantially dry granular materials to the desired shape and then firing the article in a kiln. To arrive at high quality workpieces in this manner requires that the granulated material be compacted to a uniform density throughout whereby, when the article is fired in a kiln, it will be subjected to uniform shrinkage throughout and an accurately dimensioned finished product will be had.

Due to the fact that some of the granulated materials, particularly if they are extremely fine or moist, tend to cling together and pack down without any lateral shifting, it is quite difficult to maintain such conditions as will insure a product of uniform size and quality.

Having the foregoing in mind, it is a primary object of the present invention to provide an apparatus for compacting such granular materials that absolutely uniform workpieces can be produced.

Another object of the present invention is the provision of a compacting apparatus so as to produce workpieces of uniform density throughout.

A particular object of the present invention is the provision of a compacting apparatus so as to substantially eliminate from the compacted workpieces any air pockets.

A still further object of the present invention is the provision of a compacting apparatus characterized in that granular materials from relatively fine and relatively dry materials to relatively coarse and relatively moist materials all can be handled in the compacting apparatus, and in every case the work members exhibiting the desirable characteristics of being free of air pockets and of uniform density throughout.

These and other objects and advantages of this invention will become more apparent upon reference to the following specification taken in connection with the accompanying drawings, in which:

Figure 1 is a more or less diagrammatic view of a press structure adapted for use in the practice of this invention;

Figure 2 is a fragmentary view of the pressing platen of the press of Figure 1 showing a somewhat modified arrangement thereof;

Figure 3 shows the pressing platen of Figure 2 as it appears when it is engaging the material to be pressed;

Figure 4 is a fragmentary sectional view showing the manner in which the present invention can be adapted to the side wall of a mold cavity;

Figure 5 is a view like Figure 4 but showing the modified arrangement for use in connection with the side wall of a mold cavity; and

2

Figure 6 is a diagrammatic representation of the hydraulic circuit for controlling the press of Figure 1.

Referring to the drawings somewhat in more detail, the press of Figure 1 comprises a frame 10 having a bolster plate 12 adapted for supporting a mold 14 having a cavity 16 within which granular material is to be compacted to form a work member which will subsequently be cured by the application of heat in a kiln.

The mold 14 comprises a movable mold bottom 18 resting on a resilient rubberlike pad 20 which, in turn, rests on a plate 22 that engages the plate 12 when in its lowermost position. The mold bottom 18 is movable upwardly by upward movement of plate 22 to eject a work member from mold cavity 16. Plate 22 is connected to the upper end of a ram 24 having a piston head 26 reciprocable in cylinder 28, to which lead the supply conduit means 30 and 32.

Connected to plate 18 and extending downwardly are the rods 34 having armatures 36 on their lower ends positioned to be influenced by solenoids 38. The armatures 36 and solenoids 38 represent electromagnetic vibrator means and are merely representative of one form which such a vibrator means can take. A vibrator of this nature is characterized by being readily variable in frequency by adjusting the frequency of the electric supply thereto, or by adjusting the physical characteristics of the movable portions of the vibrator such as the weight of the moving parts or the spring bias thereon.

The vibrator means, in being connected by rods 34 with mold bottom 18, will cause the said mold bottom to vibrate when energized thereby to agitate granular material disposed within the mold whereby to produce a uniform distribution of the material within the mold cavity and to eliminate air pockets that might be contained within the means.

Positioned above the mold cavity is a pressing member 40 backed up by resilient rubber-like pad 42 carried on the lower end of a ram 44 having a piston 46 receivable in cylinder 48 which has the conduit means 50 and 52 leading thereto.

Pressing member 40, similarly to mold bottom 18, has an electromagnetic vibrator means 54 connected thereto, by means of which pressing member 40 can be vibrated whereby, when the pressing member is in engagement with material in the mold cavity to be compacted, the said material will be agitated and distributed within the mold cavity and if the weight of the parts connected with the pressing member is sufficient the vibration of pressing member 40 will actually bring about compacting of the material without the application of any additional pressure to the pressing member. This application, however, also contemplates a supply of pressure fluid through conduit 50 to the upper end of cylinder 48 during the compacting of material in the mold cavity, if necessary, in order to arrive at a sufficiently dense work member.

In Figure 2 the pressing member 56 is carried on the bottom of the tapering rods 58 receivable in correspondingly shaped sockets in member 60 on the lower end of a ram 62 that corresponds with ram 44 in Figure 1.

A rubber-like block 64 is disposed between the lower end of ram 62 and member 60, and the electromagnetic vibrator means 66 are provided which are connected between ram 62 and pressing member 56. Electromagnetic vibrator means 66 provide for vibration of pressing member 56 similarly to what was provided in the Figure 1 construction, except that in the Figure 2 arrangement the pressing member 56 is free to shift laterally slightly within the mold cavity thereby facilitating the shifting of the material within the mold cavity to arrive at a more compact condition thereof.

3

The Figure 2 construction also provides means for effecting strong vibration of pressing member 56 while it is bearing against the material within the mold cavity. This is accomplished by forming the resilient rubber-like pad 64 with a neck portion 68 that is engaged by the lower end of plunger 70 of the electromagnetic vibrator means 72.

It has been found that a resilient rubber-like material such as pad 64, when enclosed, will act as a fluid and, because of this energization of vibrator means 72, will produce a strong vibration of pressing member 56 even though the pressing member is under considerable pressure due to thrusts being exerted on ram 62. This vibration of pressing member 56 would add to and augment the thrust of pressing member 62, thereby enabling a workpiece to be compacted to the usual density with the exertion of a smaller thrust on ram 62 or to a greater density with the same thrust.

In addition to the benefits of the vibration of pressing member 56, in arriving at a compact work member, if the pressing member 56 is vibrated at a very high frequency, say, on the order of several hundred cycles per second during the pressing operation, it will tend to form a very smooth surface on the work member where it is engaged by pressing member 56.

According to the present invention it is also proposed to provide vibratory side wall members for the mold cavity which would be particularly beneficial when compacting relatively large brick-like work members, because the vibratory side wall members would tend to reduce the friction between the material being compacted and the side walls whereby a more uniformly compacted and a more dense workpiece could more easily be arrived at.

In Figure 4 the side wall 80 of a mold has a recess therein, in which fits a liner plate 82 and to which liner plate there is connected an electromagnetic vibrator means 84 as by means of the rods 86. Energization of the electromagnetic vibrator means will cause vibration of the liner plate 82 in the manner described in connection with the mold bottom and pressing members previously described. The recess in side wall 80 of the mold may include pockets in which are located rubber-like blocks 88 which will assist in vibrating the liner plate, and which will also tend to prevent clattering of the liner plate by the striking thereof against the bottom of the recess.

In Figure 5 I show a side wall 90 of a mold with a liner plate 92 in a recess thereof with a rubberlike block 94 within the recess beneath the liner plate, and with the block having a neck 96 engaged by the head 98 of a rod 100 leading to the electromagnetic vibrator means 102. Energization of the electromagnetic vibrator means 102 in the Figure 5 construction will lead to vibration of the mold side plate in the same manner as was described in connection with the vibration of member 60 in Figure 2.

Figure 5 also shows how the plate 92 could be backed up with one or more pillar elements 104, which would sustain the thrusts imposed on liner plate 92 during a compacting operation.

The vibratory side plates, in addition to assisting in the distribution of granulated material within the mold cavity and the compacting thereof, will also be beneficial in assisting in the stripping of the compacted workpiece from the mold by tending to loosen the workpiece, particularly if the liner plates were vibrated at high frequency, where-

4

by an additional localized compacting of the work member in the region of the liner plates would take place thereby providing a slight clearance between the liner plates and the work member that would permit it readily to be removed from the mold cavity.

Figure 6 illustrates a simple hydraulic system for the manual control of the press in Figure 1, wherein a manually operated reversing valve 104 is connected between conduits 50 and 52 leading to cylinder 48, the pressure conduit 106 leading from the discharge side of 108 and the exhaust conduit 110 leading to the reservoir 112.

Similarly, the manually operated reversing valve 114 is connected between the conduits 30 and 32 leading to cylinder 28 and the said pressure and exhaust conduits. Any suitable control system, however, could be utilized with the press of the present invention having associated therewith the vibrator means for vibrating one or more portions of the mold cavity within which granulated material is placed for being compacted.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In an apparatus for compacting granulated materials; a mold having a plurality of walls refining a cavity and including a movable top wall, a holder for one of said walls having a recess therein, a resilient block in the recess confined therein by said one wall, and means carried by the holder for exerting a vibratory force on said resilient block whereby said one side wall is vibrated by said block, said block completely filling the space in the recess formed therein by said wall, and the said means acting on an area of said block which is substantially smaller than the area of the block engaged by said wall.

2. In an apparatus for compacting granulated materials; a mold having a plurality of walls defining a cavity and including a movable top wall, a holder for one of said walls having a recess therein, a resilient block in the recess confined therein by said one wall, and means for exerting a vibratory force on said resilient block whereby said one side wall is vibrated by said block, said means comprising an electromagnetic vibrator having a vibratory plunger engaging a substantially smaller area of said block than is engaged by said one wall.

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