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METHOD OF EXTRUDING A BLOATED CLAY PRODUCT

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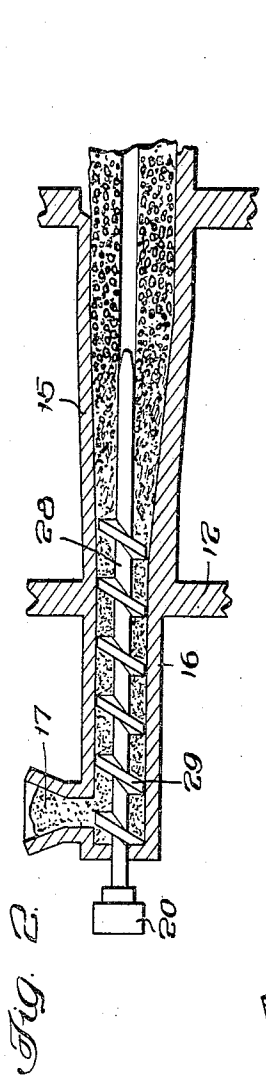


Fig. 2.

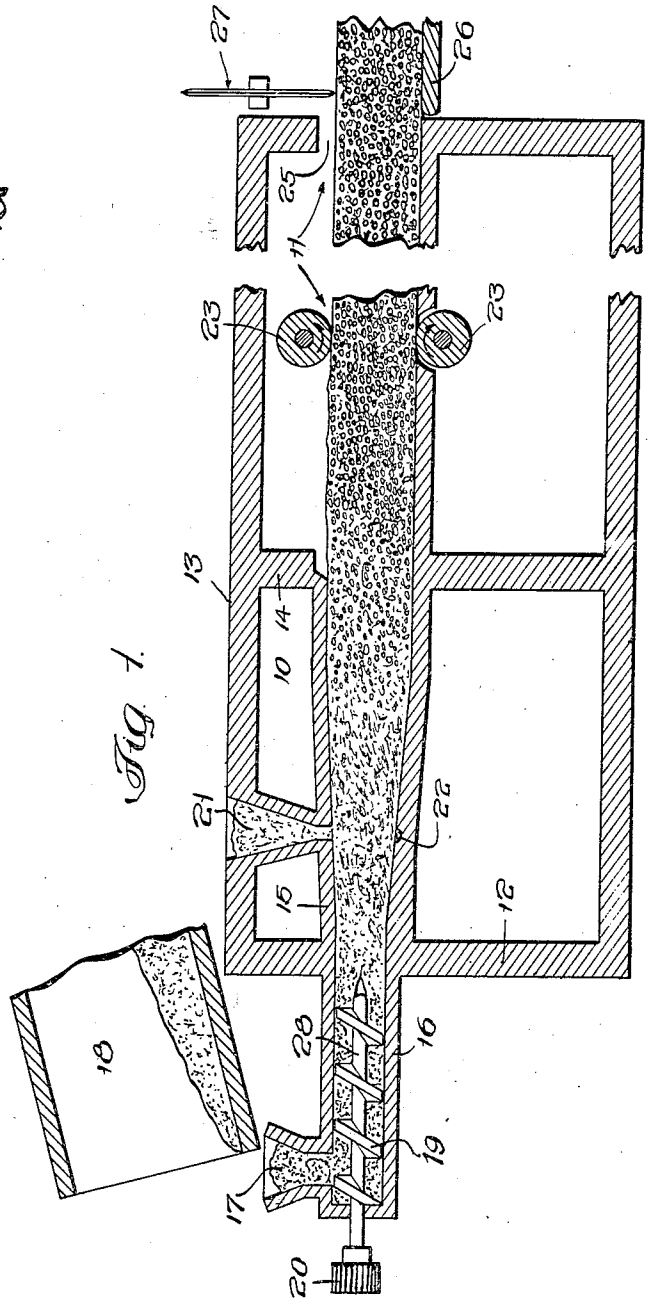


Fig. 1.

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UNITED STATES PATENT OFFICE

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METHOD OF EXTRUDING A BLOATED CLAY PRODUCT

Application filed November 29, 1929. Serial No. 410,419.

This invention relates to method of extruding a bloated clay product.

The method of the present invention is employed especially in the production of building units composed of bloated clay or other argillaceous material of the character set forth and described in co-pending application Serial No. 382,358, filed July 31, 1929, Cellular building material.

In the production of this material according to the present process, it is necessary to feed the raw material in granular form, and preferably preheated to a non-bloating temperature, into the throat of a die, the discharge end of which is located within a heat zone of sufficient intensity to cause the granular material, while still within the die, to coalesce or fuse together into a pliable or plastic mass, within which the evolution of gas causes the formation of non-communicating cells or cavities, with the result that the mass as a whole will begin to bloat or swell while still confined by the walls of the die.

This bloating or swelling within the die creates a pressure which is utilized to cause the extrusion of the material in the form of a continuous slab or column which emerges from the mouth of the die, and is slowly pushed from behind by the oncoming material, which causes the column to progress through the bloating zone and into an annealing zone, where it is gradually cooled to handling temperature.

In order to utilize the pressure occasioned by the expansion of the bloating material within the die, for the purpose of extruding the column, it is necessary to maintain a resistance within the throat of the die, and this, in the present instance, is afforded by the provision of adequate means for constantly feeding granular material behind the advancing column, and maintaining a pressure from the rear which assists the pressure occasioned by bloating in causing an unbroken column of uniform dimensions to advance continuously from the mouth of the die.

In addition to the pressure from the rear which is thus provided, it may be desirable, in the production of relatively long or weighty slabs or columns of material, to provide adequate means for pulling the column forward at a speed commensurate with its production and discharge, and to regulate the various factors involved, in such a way that the bloating of the raw material into column form, and the forward feeding of the column itself, will be properly synchronized, so that the material will have a substantially uniform cellular structure throughout, and will maintain the proper dimensions imparted to it by the die.

In order to more fully illustrate the details of the present method, the process will be described as carried out in the kiln illustrated in the accompanying drawings, wherein—

Figure 1 is a sectional elevation of the kiln partially broken away to reduce its linear dimensions; and

Fig. 2 is a modification in the form of the die employed where the production of a tubular column is desired.

The kiln is constructed to afford a bloating chamber 10 and an annealing chamber 11, the latter being broken out at the center.

The bloating chamber comprises an end wall 12 and a top wall 13, and between the bloating chamber and the annealing chamber is a partition wall 14, the lower margin of which is elevated sufficiently to permit the column of bloated material to advance from the bloating chamber to the annealing chamber.

The bloating chamber has entered therethrough the discharge mouth of a die 15, the throat 16 of which, as shown, projects outwardly from the end wall 12 of the bloating chamber. In order to provide for the increase in volume due to the expansion of the material within the bloating chamber, the mouth of the die, as shown, is flared or tapered and extends inwardly through the bloating chamber to subject the material while still in the die to the high temperature maintained within the bloating chamber, so that the material will coalesce and expand while still confined by the die and will then emerge from the mouth of the die in the form of a continuous column having

exterior dimensions imparted to it by its passage through the die.

The throat of the die, as shown, is provided with a hopper 17 into which the granular material is preferably fed from a rotary kiln 18 of well known character, which serves as a preheater and discharges the argillaceous or other earthy material while still in granular form maintained at as high degree as possible without causing fusion of the particles of any suitable clay used. This preheating temperature will ordinarily range between 1500° F. and 1900° F.

Within the throat of the die is located a suitable feeding and packing device 19, which, as shown, may be in the form of a screw conveyor feeder of the character ordinarily employed in a brick machine, which is constantly rotated by suitable means such as a gear 20 located at the end of the feeder shaft. This arrangement possesses an advantage in that it serves to constantly and uniformly feed forward granular material and at the same time maintains a constant pressure from the rear, which thus closes the die at the rear end and compels the material, under the bloating pressure, to emerge from the open mouth of the die in the form of a continuous slab or column.

Although in most cases it will be found desirable to flare or enlarge the mouth of the die, to facilitate the emergence of the bloated column from the only orifice afforded for its escape, this flaring or enlargement will be limited in degree and insufficient to compensate completely for the increase in volume, due to bloating, so that an internal pressure will at all times be maintained within the die itself. This provides what I call a zone of confinement for the material while undergoing bloating, and the density of the resulting material can be regulated by proper configuration of the die and by assisting or retarding the advance of the completed column, so that the degree of confinement of the bloating material will be regulated with due regard to all of the factors involved, which include the degree of heat imparted to the bloating zone, the length of time in the hot zone, the pressure of the oncoming raw material from the rear, the configuration of the die, and the resistance to advance of the already completed column, which may be increased or relieved by the use of rollers or other feeding means.

By proper correlation of these various factors, not only may the cellular structure of the bloated material be maintained uniform, but also the density may be regulated within considerable limits.

In order to prevent adhesion of the bloated material to the walls of the die when subjected to a bloating temperature of from 2000° F. to 2300° F., it is desirable to provide a lubricant for the inner walls of the die, which lubricant is preferably of a nature which will part within itself, such as graphite, sand, talc, or the like, and in the present drawings I have shown a hopper 21 which discharges through the wall of the die for the purpose of discharging a thin layer or coating of such parting medium upon the surface of the material at or prior to the time when it begins to fuse and become sticky. The parting material will likewise be fed to the side walls and bottom wall of the die by the provision of a channel or channels 22 which serve to convey the parting medium to the surfaces in question.

In order to assist the bloated column in its forward travel, I have shown a pair of feed rollers 23 which are located within the cooler temperature of the annealing chamber, and obviously the feeding rollers may be multiplied to the extent desired to adequately provide for the forward feeding of the column irrespective of the length thereof. The bloated column is discharged through an orifice 25 in the end wall of the annealing chamber, at which point it passes onto a table or support 26, where it may be cut into blocks of the desired dimensions by the action of cutting disks 27 or other suitable cutting means.

It is obvious that the die may be of any suitable shape or configuration, but for the purpose of producing building blocks, a die which has a rectangular mouth will ordinarily be employed, since this portion of the die affords the wall surfaces which ultimately mold or form the column into its desired cross sectional configuration.

In Fig. 2 I have shown a modification which is illustrative of a method which may be employed in the production of a column of tubular form. In this case the stem or mandrel 28 of the worm feed 29 is extended into the bloating zone to a sufficient degree to subserve the purposes of a core in supporting the advancing column up to the time that the granular particles have fused and coalesced together, and in fact up to a point in close proximity to the mouth of the die.

It will be understood that the mechanism here shown serves merely for purpose of illustration, and that other adequate means for feeding, compacting and advancing the material may be employed without departing from the spirit of the invention.

In carrying out the process, the preheated material, in granular form, will be fed continuously from the preheater into the hopper, so that a constant supply will be maintained in the throat of the die, in an amount commensurate with the feeding speed of the worm. This always insures the maintenance of adequate pressure at the rear of the die to resist the forces occasioned by the expanding of the material within the bloating zone.

As the continuous column of graular ma-

terial advances slowly into the mouth portion of the die, and is subjected to the bloating temperature maintained within the bloating chamber, the surface of the granular column will first begin to fuse and to form a continuous surface skin or coating, which confines the gases generated within the interior of the mass, so that these gases, in expanding, will form minute non-intersecting cells throughout the fused and plastic mass.

As the material advances it will become more thoroughly bloated, and in order to facilitate its advance under these conditions, it is desirable to flare or diverge the walls of the die in a degree commensurate with the rate of expansion, the feeding speed of the worm, the degree of confinement which it is desired to maintain during the bloating interval, and to the resistance afforded by the column of material previously extruded from the die. By the time the column merges from the mouth of the die, it will be bloated to a sufficient extent to be self-sustaining, although somewhat plastic, and will thus preserve the form given to it during its progress through the die.

As it passes from the relatively high temperature of the bloating chamber to the lower temperature of the annealing chamber, the column will lose its plasticity, and by gradually cooling it, it will become annealed and toughened and relieved from the danger of inner fracturing, due to a sudden transition in temperature. The annealing chamber should be of sufficient length to permit the slab or column to cool down practically to room temperature before its emergence from the annealing chamber, at which point it may be severed into blocks or units of the desired dimensions.

The invention is one which maintains continuity in the production of the cellular material, and at the same time utilizes in large measure a pressure created by the bloating of the material itself as a means for insuring its continuous extrusion from the die, so that it becomes necessary only to maintain a constant feed from the rear in order to effect a constant advance of the slab of material, although the additional assistance afforded by rollers or the like may be desirable in continuous commercial production.

Although it is desirable to co-ordinate the various factors involved, including the flaring mouth of the die in such a way that the flaring will be less than enough to completely compensate for the progressive expansion due to bloating, so that a positive inner pressure will be developed and maintained, which is utilized in the positive extrusion of the bloated column from the open mouth of the die, and although this inner pressure may be supplemented by the thrust of the incoming raw material from the rear, nevertheless, I desire it to be understood in the claims and elsewhere that I do not desire to limit myself to any particular or specific degree of confinement of the material within the die, since these factors may be varied to a considerable extent without departing from the spirit of the invention.

By the term "confinement," therefore, I mean the condition imposed upon the material during the bloating period, which requires that the bloating shall occur while the material is subjected to the restriction of the surrounding walls of the die, which give a predetermined cross sectional definition to the emerging column, as distinguished from a process in which the bloating material is free from the restraint of a surrounding wall, which, permits emergence only in the direction of advance of the material. Such a restraint or confinement would be afforded by a die which was so flared or otherwise configured as to practically compensate for the progressive expansion due to bloating, in which case the advance of the bloated column would be due, mainly if not entirely, to the thrust imparted from the rear by the oncoming raw material fed through the throat of the die.

By the use of rollers or similar feeding devices which serve to draw forward the completed column, a factor is introduced which permits variation in the density of the material, since it is possible to regulate the feeding speed of the rollers to advance the column at a rate slightly slower than the normal rate of extrusion, which would thus tend to increase the pressure within the die and correspondingly increase the density of the structure, whereas an added increase in the feeding speed of the rollers would tend to reduce the pressure with a corresponding reduction in density.

Although a screw feeder has been illustrated by way of exemplification, it is not the intention to limit the invention to this method of feeding, since a reciprocating feeder might be employed to produce a similar result, and if the rate of reciprocation were sufficiently rapid, the continuity of the feeding action would be practically unimpeded.

If, however, a screw feeder is employed, the pitch of the screw should be sufficiently small to prevent the material from backing up and to maintain the pressure at the rear required to compel extrusion from the forward end of the die.

Furthermore, the screw feeder could be operated intermittently if desired, the principal requirement being to maintain a sufficiently rapid feeding of raw material to maintain continuity in the column of bloated material.

Various other modifications in detail may be introduced without departing from the spirit of the invention.

I claim:

1. The method of producing cellular material which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material.

2. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material.

3. The method of producing cellular material which consists in feeding a column of granular earthy material from the rear and under continuous feeding pressure into a heat zone maintained at a bloating temperature, and in confining the column of constantly fed material while subjecting said column to the bloating temperature to cause fusion and coalescence of the granular material into a continuous cellular column and in utilizing the pressure due to expansion within the zone of confinement, to cause continuous extrusion of the column.

4. The method of producing cellular material which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material, and in thereafter causing the bloated material in column form to advance from the bloating zone to an annealing zone.

5. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material, and in thereafter causing the bloated material in column form to advance from the bloating zone to an annealing zone.

6. The method of producing cellular material which consists in feeding a column of granular earthy material from the rear and under continuous feeding pressure into a heat zone maintained at a bloating temperature, and in confining the column of constantly fed material while subjecting said column to the bloating temperature to cause fusion and coalescence of the granular material into a continuous cellular column and in utilizing the pressure due to expansion within the zone of confinement, to cause continuous extrusion of the column, and in thereafter causing the bloated material in column form to advance from the bloating zone to an annealing zone.

7. The method of producing cellular material which consists in preheating granular earthy material slightly below the fusing point, feeding the preheated material while in granular form into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect the fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material.

8. The method of producing cellular material which consists in preheating granular earthy material slightly below the fusing point, continuously feeding the preheated material while in granular form into a heat zone, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material.

9. The method of producing cellular material which consists in preheating granular earthy material slightly below the fusing point, feeding a column of said preheated granular earthy material from the rear and under continuous feeding pressure into a heat zone maintained at a bloating temperature, and in confining the column of constantly fed material while subjecting said column to the bloating temperature to cause fusion and coalescence of the granular material into a continuous cellular column and in utilizing the pressure due to expansion within the zone of confinement to cause continuous extrusion of the column.

10. The method of producing cellular material which consists in preheating granular earthy material slightly below the fusing point, feeding a column of said preheated granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material, and in thereafter causing

the bloated material in column form to advance from the bloating zone to an annealing zone.

11. The method of producing cellular material which consists in preheating granular earthy material slightly below the fusing point, continuously feeding a column of said preheated granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material, and in thereafter causing the bloated material in column form to advance from the bloating zone to an annealing zone.

12. The method of producing cellular material which consists in preheating granular earthy material slightly below the fusing point, feeding a column of said preheated granular earthy material from the rear and under continuous feeding pressure into a heat zone maintained at a bloating temperature, and in confining the column of constantly fed material while subjecting said column to the bloating temperature to cause fusion and coalescence of the granular material into a continuous cellular column and in utilizing the pressure due to expansion within the zone of confinement, to cause continuous extrusion of the column, and in thereafter causing the bloated material in column form to advance from the bloating zone to an annealing zone.

13. The method of producing cellular material which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in ejecting the bloated material from the zone of confinement.

14. The method of producing cellular material which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in ejecting the bloated material from the zone of confinement in the form of a continuous column of bloated material.

15. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature and in confining the material around its sides and at the rear while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in forwardly ejecting the bloated material from the zone of confinement.

16. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature and in confining the material around its sides and at the rear while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in forwardly ejecting the bloated material from the zone of confinement in the form of a continuous column of bloated material.

17. The method of producing cellular material which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, surrounding the material with a layer of parting material, confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in ejecting the bloated material from the zone of confinement.

18. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature, surrounding the material with a layer of parting material, confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in ejecting the bloated material from the zone of confinement in the form of a continuous column of bloated material.

19. The method of producing cellular material which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, surrounding the earthy material with a layer of parting material, confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material.

20. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature, surrounding the earthy material with a layer of parting material, confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material in the form of a continuous column of bloated material.

21. The method of producing cellular ma-

terial which consists in feeding granular earthy material into a heat zone maintained at a bloating temperature, and in confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, and in ejecting the bloated material from the zone of confinement in the form of a continuous column of bloated material and in mechanically assisting the movement of the column from the heat zone.

22. The method of producing cellular material which consists in continuously feeding granular earthy material into a heat zone maintained at a bloating temperature, surrounding the earthy material with a layer of parting material, confining the material while in granular form and while in the heat zone, in order to effect fusion and bloating of the material while subjected to confinement, the bloated material being extruded from the zone of confinement under pressure due to expansion of the material in the form of a continuous column of bloated material and in mechanically assisting the movement of the column from the heat zone.

In witness that I claim the foregoing I have hereunto subscribed my name this 22nd day of October, 1929.

KEMPER SLIDELL.