July 1, 1952 J. F. KEYS 2,601,712

APPARATUS FOR MANUFACTURING BLOCKS

Filed Aug. 29, 1947 2 SHEETS—SHEET 1

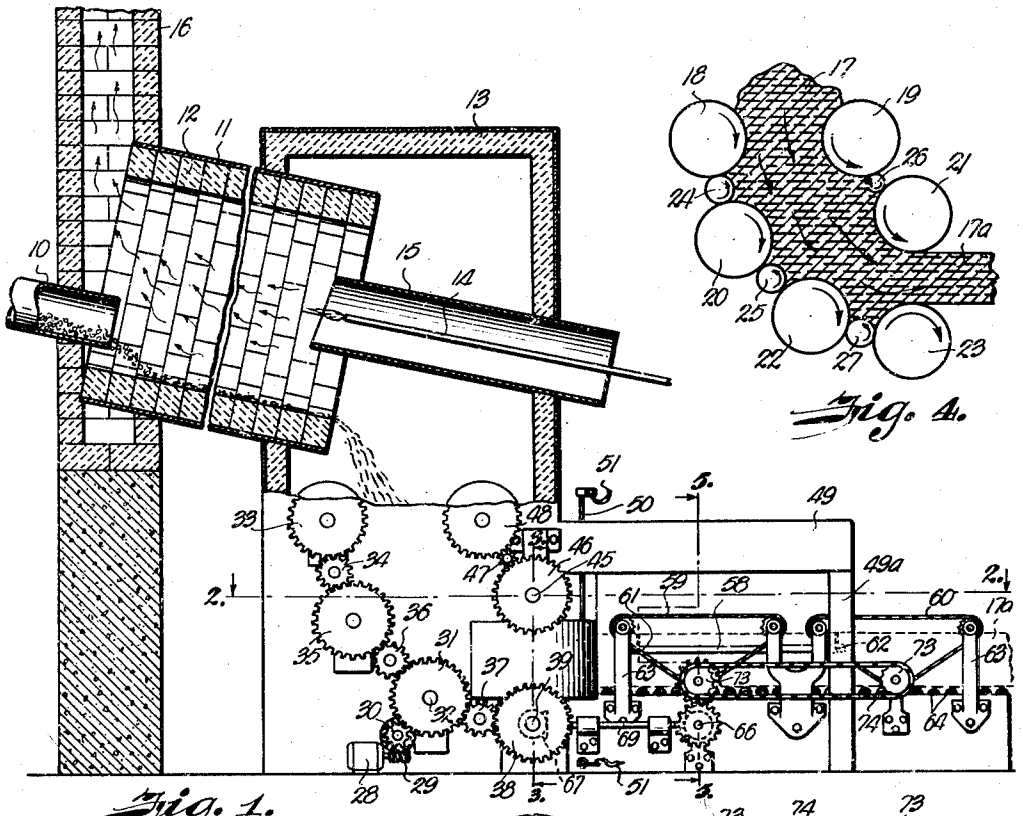


Fig. 1.

Fig. 4.

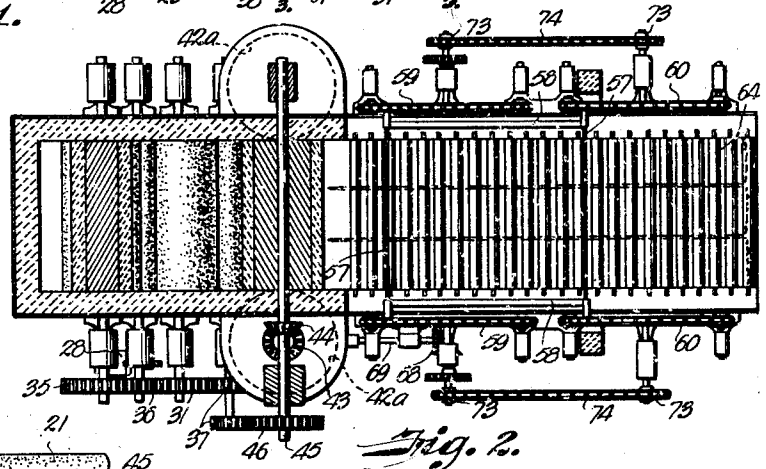


Fig. 2.

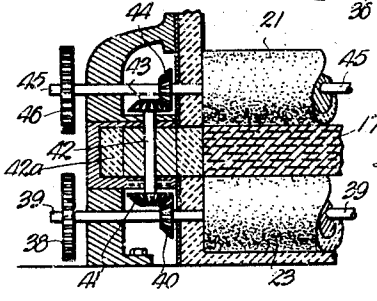


Fig. 3.

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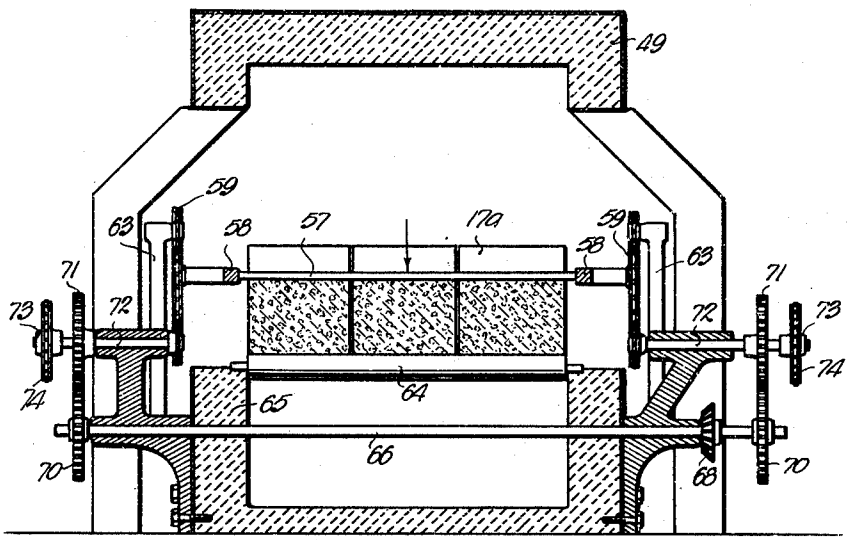


Fig. 5.

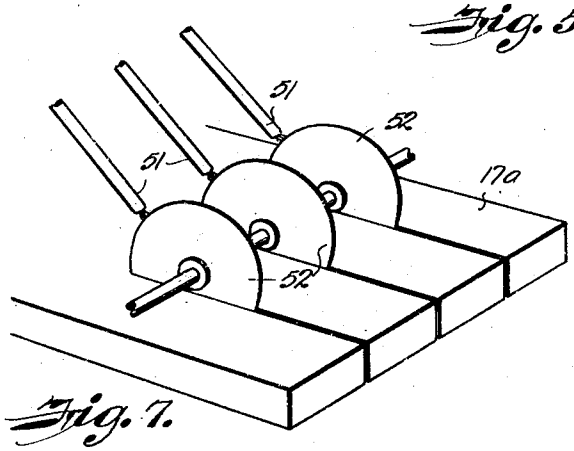


Fig. 7.

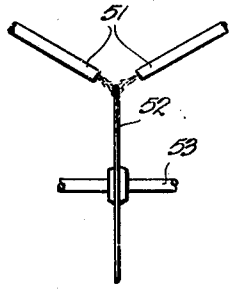


Fig. 8.



Fig. 6.

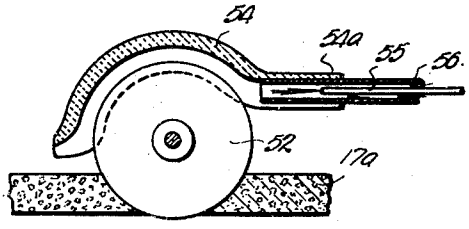


Fig. 9.

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APPARATUS FOR MANUFACTURING BLOCKS

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9 Claims. (Cl. 25—21)

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This invention relates to improvements in an apparatus for manufacturing light weight blocks in which an expansible material is heated to a plastic or semifluid consistency and the mass formed into a bar or strip which is cut longitudinally and transversely into blocks of the desired size.

At present it is conventional practice to incorporate expanded or light weight argillaceous material such as clay and shale into building blocks by heating and expanding the material, then crushing it, mixing it with a bonding material such as cement, and forming the blocks by molding.

The instant invention proposes the manufacture of light weight blocks formed of vitrified or partially vitrified clay or shale by heating the starting material until it reaches glossy phase, the entrapped or chemically generated gases bloating it into a cellular mass having the consistency of a highly viscous fluid; the mass is molded, and blocks are cut from the molded material while in a heated state, thereby reducing the number of steps necessary to produce blocks by conventional method, reducing the cost of manufacture and improving the character of the products.

An object is to provide rolls of different surface texture in the forming stage, some of which adhere to the mass and cause it to advance, the others being nonadherent and furnishing contour surfaces designed to establish the size and shape of the bar or strip. If other than flat surface is desired, a pattern may be imprinted from relief design on one or more of the nonadherent rolls.

A further object is to provide longitudinal and transverse cutters synchronized with the movement of the bar to cut it into regular and uniform size blocks.

Other and further objects of the invention will appear from the following description.

In the accompanying drawings which form a part of the instant specification and are to be read in conjunction therewith, like reference numerals are used to indicate like parts in the various views.

Fig. 1 is a side elevational view of a machine embodying the invention with parts shown in section;

Fig. 2 is a plan view taken along the line 2—2 in Fig. 1 in the direction of the arrows;

Fig. 3 is a view taken along the line 3—3 in Fig. 1 in the direction of the arrows;

Fig. 4 is a schematic view of the forming rolls

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indicating the manner in which the viscous mass moves between the rolls and is formed into a bar;

Fig. 5 is a sectional view taken along the line 5—5 in Fig. 1 in the direction of the arrows;

Fig. 6 is an enlarged detail of one of the blades used for longitudinally slitting the bar;

Fig. 7 shows an enlarged perspective of a disk type slitter;

Fig. 8 shows a modified type of heater for the disk type slitters shown in Fig. 7;

Fig. 9 is a second modification of a heating mechanism for the disk type slitters shown in Figs. 7 and 8.

To facilitate an understanding of the machine for manufacturing blocks according to the proposed process, the operations or steps will be briefly described in the sequence in which they occur. Any expansible ceramic material such as clay, shale or vitrifiable substance such as slag, in which may be formed minute cells or bubbles by heating, is charged to a rotary kiln and the kiln fired either externally or internally to heat the material to incipient vitrification or fusion. The mass in a semimolten state is discharged from the kiln into the forming or molding section of a machine where it is rolled into a bar. In this section of the machine the forming rolls are of refractory material such as carborundum or fire resistant ceramics. Some of the rolls are preferably surfaced with material which tends to adhere to the surface of the heated mass. These rolls serve to advance the mass through the molding or forming stage. Other rolls in the forming stage have nonadherent surfaces and serve as the shaping rolls.

On discharge from the forming section, the formed bar, still in a highly heated condition and of high viscosity, is slit longitudinally by stationary blades or rotating disks. The slitters are of heat resistant material and are themselves heated either electrically or by burners to a temperature considerably higher than that of the bar in order to greatly reduce the viscosity in the immediate vicinity of the cut, thus facilitating the cutting and also obtaining a smooth surfaced cut and uniform textured edges of the ultimate block units.

Reciprocated vertically by a synchronized drive mechanism are blade cutters carried by a frame which sever the heated bar transversely. These blades are likewise heated to produce even textured end surfaces to the block units.

Thus it will be seen that the viscous mass of semifused substance discharged from the kiln is passed first through the forming section of the

machine from which it is extruded in the form of a bar or strip. In a highly heated state the bar is advanced along a supporting conveyor where it is cut longitudinally and transversely into uniform sized blocks or tiles. After cutting, the blocks are run through an annealing stage where they are gradually cooled at controlled temperatures to assure internal uniformity of texture.

Referring to the drawings, the machine may be logically described and explained by the separate zones or stages into which the block-making procedure is divided. The material to be heated and expanded is introduced through chute or pipe 10 into a rotating kiln comprising an outer metallic shell 11 lined with a fire resistant ceramic or firebrick 12. The mechanism for rotating the tubular kiln has been omitted from the drawings in the interest of simplicity since vessels of this type are conventional in the manufacture of light weight aggregate, cement and other types of vitrified or semifused products. The discharge end of the vessel is enclosed within an insulated housing 13. The interior of the vessel is fired by burners 14 positioned within a tube 15 extending through the housing and into the vessel. Combustion gases flow through the rotating vessel in the direction shown by the arrows, counterflow to the material being heated, and pass off at the opposite end through a flue 16. The rotating kiln is of sufficient length and the heat of the combustion gases sufficiently high to raise the material charged to the kiln to a temperature of incipient fusion. In this state it is partially coalesced and semimolten and flows from the kiln into the lower portion of housing 13 where the rolls of the forming section are located.

In Fig. 4 is shown diagrammatically the manner in which the viscous mass 17 passes through the sets of forming rolls in the forming section. Upper rolls 18, 19, 20 and 22 are surfaced with a heat resistant material adapted to produce a degree of adherence between the contacting surfaces of the rolls and the viscous mass. Thus the mass is forced downwardly through the forming section in the direction indicated by the arrows. The lower horizontal rolls 21 and 23, and the vertical rolls 42*a*, serve as the shaping surfaces and mold the mass into the bar shape indicated at 17*a* in which form it is extruded from the forming section. Small rolls 24, 25, 26 and 27 formed of non-adherent material run in contact with the large rolls 18, 19, 20, 21 and 22, and by filling the spaces therebetween help support the viscous mass during the forming operation. They also serve to press the material from the larger rolls. These small rolls revolve in an opposite direction to the larger rolls, but since their surface contact with the mass is relatively small with relation to the larger rolls, and since they are formed of non-adherent material, the mass movement of the viscous body is in the direction shown. The drive for the forming rolls is through separate trains of meshing gears, and for the cutting mechanism through a connecting shaft from one of these gear trains to the sprocket and chain mechanism upon which the transverse cutter frame is mounted.

Referring to the forming roll drive, power or rotative energy is supplied from a prime mover such as a motor, shown diagrammatically at 28. A worm 29 on the motor shaft drives pinion 30 which meshes with gear 31. This latter gear is mounted on shaft 32 which carries roller 22. The other forming rolls along the rearward side of the viscous mass, identified by numbers 18, 20, 24, 25, 27 and 23, are driven by meshing gears and pinions numbered 33, 34, 35, 36, 37 and 38. The drive from this train of gears to the rolls supporting the forward side of the viscous mass is through bevelled gear 40 on shaft 39 which shaft also carries roll 23. Gear 40 meshes with bevelled gear 41 on vertical shaft 42 which shaft also carries vertical rolls 42*a* best shown at Fig. 3. At the top of the vertical shaft is a third bevelled gear 43 driving gear 44 on shaft 45 which carries roll 21. Also on shaft 45 is mounted gear 46 and from this latter gear are driven pinion 47 and gear 48. Pinion 47 is mounted upon the shaft which carries roll 26 and gear 48 rotates the shaft which carries roll 19.

To cut the formed bar 17*a* as it is discharged from the forming section into blocks of the desired size, a cutting mechanism is located adjacent the discharge rolls 21, 23 and 42*a*. Wholly or partially surrounding this mechanism is an insulated housing or oven 49. As shown in Fig. 1, this housing comprises a roof supported on standards 49*a*. The sides of the cutting mechanism and conveyor preferably are open to permit some of the radiant heat to escape from the surface of the cut blocks so that the block surfaces will solidify; however, it is contemplated that the entire mechanism may be enclosed to retain the heat during the cutting operation if desired. To longitudinally split the bar, stationary blades 50 such as shown in Fig. 6 are positioned at spaced intervals across the width of the bar to slit it into strips of equal width. The number of cutting blades used will depend upon the size of the block and the width of the bar to be cut. The blades are preferably made of Carborundum or other material resistant to high temperatures and are shaped to slit the bar as it passes. The blades are equipped with electrical connections 51 so current can be passed therethrough and their temperature maintained substantially higher than that of the bar by resistance heating. In place of the stationary blades 50, rotating cutter disks 52, shown in Figs. 7, 8 and 9, may be used to slit the bar longitudinally. These disks are mounted on shaft 53 supported upon the frame of the cutting mechanism and driven from a suitable source of power not shown. The disks must likewise be made of heat resistant material and maintained at substantially higher temperature than that of the bar 17*a*. Electric current passed as an electric arc between the edges of the disks and electrodes 51 as shown in Fig. 7 may be used to keep the disks heated. The current passing from the electrodes to the disks is grounded through connections to shaft 53, not shown. Also the disks may be heated by running the disk rims through the arc formed between two electrodes as shown in Fig. 8. An alternative method of heating the disks is shown in Fig. 9. In this construction a shield or segmental shroud 54 is placed over each of the cutters and combustion gases introduced beneath the shield through an inlet pipe 54*a*. These combustion gases are generated by fuel supplied through pipe 55 and air through the annular space between the fuel pipe and an air inlet tube 56.

The transverse severing of the bar is done by blades or cutting elements 57 shown best in Fig. 5. These transverse blades are mounted on a horizontal frame 58. The frame is pivoted upon and reciprocated by two sets of chains 59 and 60 on opposite sides of the bar shown in Figs. 1, 2 and 5. The cutter frame 58 is pivoted to chains 59 at 61 and to chains 60 at 62. Each of the

chains supporting the transverse cutter frame is supported by and run over three sprockets, two of the sprockets located on the same level, the third sprocket positioned intermediate the two first mentioned sprockets and somewhat below. Since the four chains are driven in the same direction and at the same rate, the pivots 61 and 62 follow the travel of the chains in a triangular circuit. This maintains the cutting frame at all times in a horizontal position and reciprocates it in a manner to make vertical cuts in the bar at regular intervals as the heated bar 17a is moved along the conveyor of the cutting mechanism. The additional heat for raising the temperature of the transverse blades 57 is furnished by resistance heating. Electrical connections not shown to conducting frames 58 carry the blade heating current to said frames. Thence current from one frame flows through cutter blades 57 to the other frame in order to maintain the blades at a higher temperature than that of the material being cut. The sprockets over which chains 59 and 60 operate are supported on suitable standards or supports shown at 63.

On being discharged from the forming section of the machine the bar of heated, expanded, light weight material 17a is supported by and moves upon conveyor rollers 64. The shafts of the rollers 64 are mounted in base 65 indicated diagrammatically in Fig. 5.

To drive the cutting mechanism, power is transmitted from shaft 39 of the forming section to shaft 66 of the cutter through two sets of bevelled gears 67 and 68, at opposite ends of transmission shaft 69. Shaft 66 is positioned below the conveyor roll 64 and rotates in bearings mounted in the frame of the cutter. At opposite ends of shaft 66 are gears 70 meshing with gears 71 on stub shafts 72. On the outer extremities of the stub shafts are sprockets 73 over which run chains 74 and on the inner ends are the sprockets which drive chains 59 and 60. Chains 74 on opposite sides of the cutter transmit rotative energy from gears 71 to the lower intermediate sprockets over which chains 59 and 60 pass. Thus it will be seen that power taken from shaft 39 is transmitted through shaft 69 to shaft 66, thence through gears 70 and 71 to shaft 72 and finally through sprockets and chains by which cutter frame 58 is reciprocated.

Briefly recapitulating and following the material and procedure from the time it is charged to the kiln to its discharge from the cutting mechanism, an expansible clay, shale or other fusible or vitrifiable material is introduced to kiln 11 through chute 10. In the kiln it is brought to incipient fusion or to a temperature sufficiently high to produce minute bubbles or a cellular structure therein. The heated mass coalesced and in a semimolten state is discharged between the rolls of the forming section as indicated in Fig. 4. From the forming section the heated mass is discharged as a bar or strip, usually rectangular in cross section, as indicated in Figs. 5 and 7. Immediately on discharge from the forming section and while the bar is still in a highly heated state, but surface cooled sufficiently to maintain its formed integrity, it is advanced to the cutting mechanism. In the cutting mechanism it is slit longitudinally by either stationary or rotating cutters such as shown in Figs. 6 to 9, inclusive. After slitting, the strips or bars are cut transversely by heated cutters 57 mounted upon frame 58 reciprocated through the cutting cycle by chains 59 and 60.

On discharge from the cutting mechanism the blocks pass from conveyor rolls 64 through an annealing zone or furnace where they are cooled at a predetermined rate in order that they have a uniform texture. The annealing step is a conventional operation in many different manufacturing procedures and has, therefore, been omitted from the drawings to simplify the showing. After being annealed and cooled, the blocks are ready to be stored or shipped.

Thus it will be seen that there has been produced in a continuous operation light weight blocks or tiles. The procedure includes a series of successive steps whereby blocks or tiles are cut from a bar or strip of hot highly viscous substance by reducing the viscosity at the cut, through heated cutters, to a low viscosity, easily cut substance. The process eliminates the slow, tedious, expensive steps of individually molding the blocks, eliminates entirely the necessity of a binder and assures blocks of uniform texture and weight.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a machine for forming argillaceous material, means for heating the material to a bloated, highly viscuous formable state, a hopper for receiving the heated material, said hopper having an outlet port in its lower portion, drivers having endless material-adhesive surfaces engaging opposite sides of the heated material in the hopper, means for moving said drivers in a direction to advance the heated material toward said outlet thereby to extrude the material therethrough, the periphery of said outlet port comprising a ring of formers having endless nonadhesive surfaces engaging the material as it passes through the port.

2. In a machine for forming argillaceous material, means for heating the material to a bloated highly viscuous formable state, a hopper for receiving the heated material, said hopper having an outlet port in its lower portion, a pair of opposed walls in the hopper each comprising a series of rollers disposed side by side in such close relationship as to substantially prevent extrusion of the material between adjacent ones of the rollers, at least some of said rollers having their peripheral surfaces formed of a substance adhesive to said heated material, power means for turning said last rollers in a direction to advance the heated material toward said outlet port thereby to extrude same therethrough, and the periphery of said outlet port comprising a ring of nonadhesive rollers engaging the material as it passes therethrough.

3. In a machine for forming argillaceous material, means for heating the material to a bloated highly viscuous formable state, a hopper for receiving the heated material, said hopper having

an outlet port in its lower portion, a pair of opposed walls in the hopper each comprising a series of rollers disposed side by side in engagement with one another, the alternate rollers of each series having their peripheral surfaces formed of a substance adhesive to said material, the remaining rollers having nonadhesive peripheral surfaces, means for turning the adhesive rollers in a direction to advance the material toward said outlet port thereby to extrude same therethrough and turning the nonadhesive rollers in the opposite direction.

4. In a machine for forming argillaceous material, means for heating the material to a bloated highly viscuous formable state, a hopper for receiving the heated material, said hopper having an outlet port in its lower portion, a pair of opposed walls in the hopper each comprising a series of rollers disposed side by side in engagement with one another, the alternate rollers of each series having their peripheral surfaces formed of a substance adhesive to said material, the remaining rollers of each series having nonadhesive peripheral surfaces, power means for turning the adhesive rollers in a direction to advance the material toward said outlet port thereby to extrude same therethrough and turning the nonadhesive rollers in the opposite direction, and the periphery of said outlet port comprising a ring of nonadhesive rollers engaging the material as it passes therethrough.

5. In a machine for forming argillaceous material, a rotary kiln for heating the material to a bloated, highly viscous formable state, a covered hopper directly connected to the discharge of said kiln to receive the heated material therefrom, said hopper having an outlet port in its lower portion, drivers having endless material adhesive surfaces engaging opposite sides of the heated material in the hopper, means for moving said drivers in a direction to advance the heated material toward said outlet thereby to extrude the material therethrough, the periphery of said outlet port comprising a ring of formers having endless, non-adhesive surfaces engaging the material as it passes through the port.

6. In a machine for forming argillaceous material, a rotary kiln for heating the material to a bloated, highly viscous formable state, a covered hopper directly connected to the discharge of said kiln to receive the heated material therefrom, said hopper having an outlet port in its lower portion, a pair of opposed walls in the hopper each comprising a series of rollers disposed side by side in such close relationship as to substantially prevent extrusion of the material between adjacent ones of the rollers, at least some of said rollers having their peripheral surfaces formed of a substance adhesive to said heated material, power means for turning said last rollers in the direction to advance the heated material toward said outlet port thereby to extrude same therethrough, and the periphery of said outlet port comprising a ring of non-adhesive rollers engaging the material as it passes therethrough.

7. In a machine for forming argillaceous material, a rotary kiln for heating the material to a bloated, highly viscous formable state, a covered hopper directly connected to the discharge of said kiln to receive the heated material therefrom, said hopper having an outlet port in its lower portion, a pair of opposed walls in the hopper each comprising a series of rollers disposed side by side in engagement with one another, the alternate rollers of each series having their peripheral surfaces formed of a substance adhesive to said material, the remaining rollers of each series having non-adhesive peripheral surfaces, power means for turning the adhesive rollers in a direction to advance the material toward said outlet port thereby to extrude same therethrough and turning the non-adhesive rollers in the opposite direction, and the periphery of said outlet port comprising a ring of non-adhesive rollers engaging the material as it passes therethrough.

8. In a machine for forming argillaceous material, a rotary kiln for heating the material to a bloated, highly viscous formable state, a covered hopper directly connected to the discharge of said kiln to receive the heated material therefrom, said hopper having an outlet port in its lower portion, a pair of opposed walls in said hopper each comprising a series of rollers disposed side by side in engagement with one another, the alternate rollers of each series having their peripheral surfaces formed of a substance adhesive to said material, the remaining rollers of each series having non-adhesive peripheral surfaces, power means for turning the adhesive rollers in a direction to advance the material toward said outlet port thereby to extrude same therethrough, and the periphery of said outlet port comprising a ring of non-adhesive rollers engaging the material as it passes therethrough.

9. In a machine for forming argillaceous material, means for heating the material to a bloated, highly viscous formable state, a hopper for receiving the heated material, said hopper having an outlet port in its lower portion, a pair of opposed walls in the hopper each comprising a series of rollers disposed side by side in engagement with one another, the alternate rollers of each series having their peripheral surfaces formed of a substance adhesive to said material, the remaining rollers having non-adhesive peripheral surfaces, and means for turning the adhesive rollers in a direction to advance the material toward said outlet port thereby to extrude same therethrough.

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