Oct. 25, 1949. A. H. DUGGAN ET AL 2,486,266

METHOD AND APPARATUS FOR MANUFACTURING BLOCKS FROM VARIOUS MATERIALS

Filed June 8, 1945 3 Sheets-Sheet 1

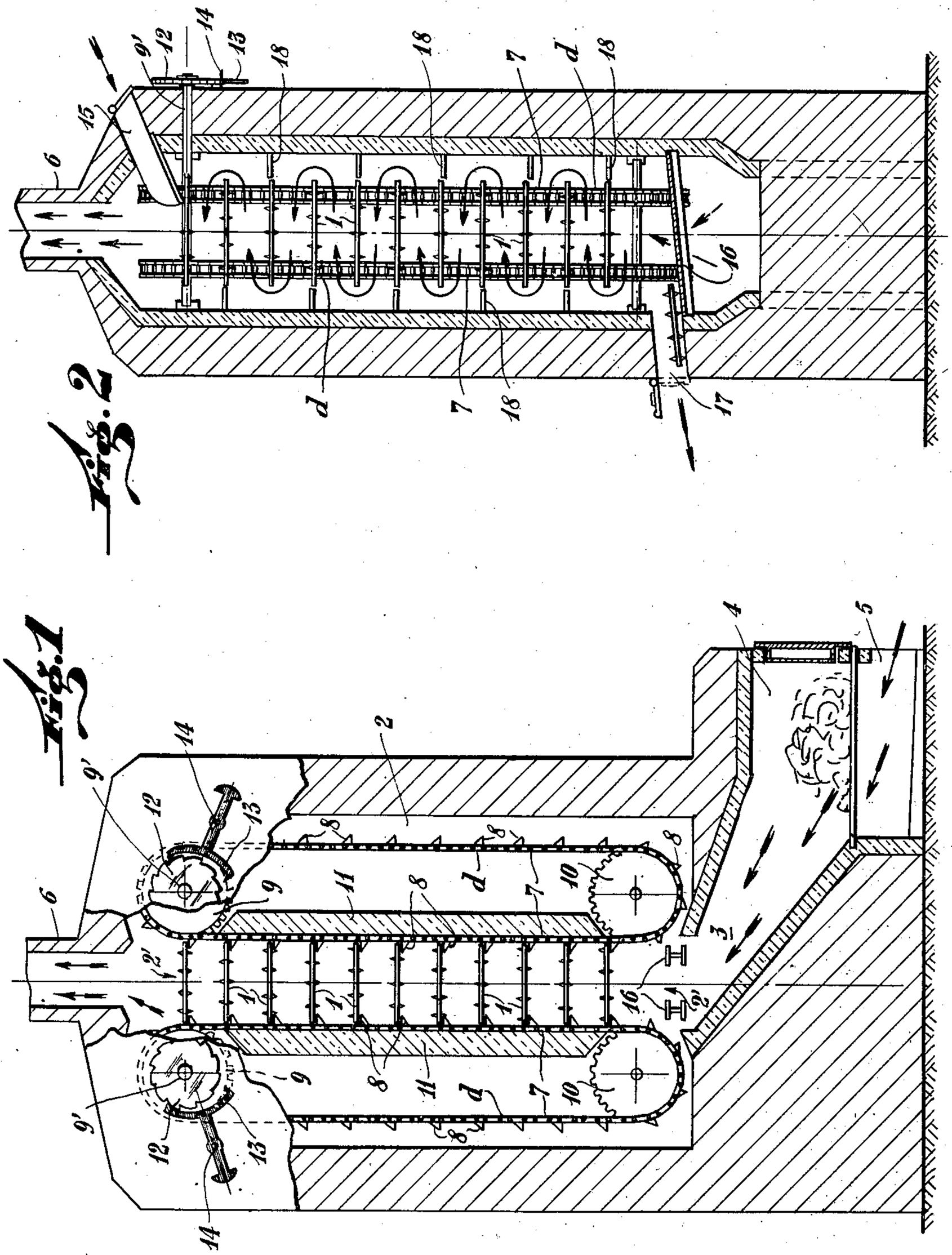


Fig. 2

Fig. 1

INVENTOR
Alejandro Heriberto Duggan
Rodolfo Pedro Boote
BY Eugenio David Du Bois
Juan C. Jacobi,
ATTORNEY

Oct. 25, 1949. A. H. DUGGAN ET AL 2,486,266

METHOD AND APPARATUS FOR MANUFACTURING BLOCKS FROM VARIOUS MATERIALS

Filed June 8, 1945 3 Sheets-Sheet 2

Fig. 3

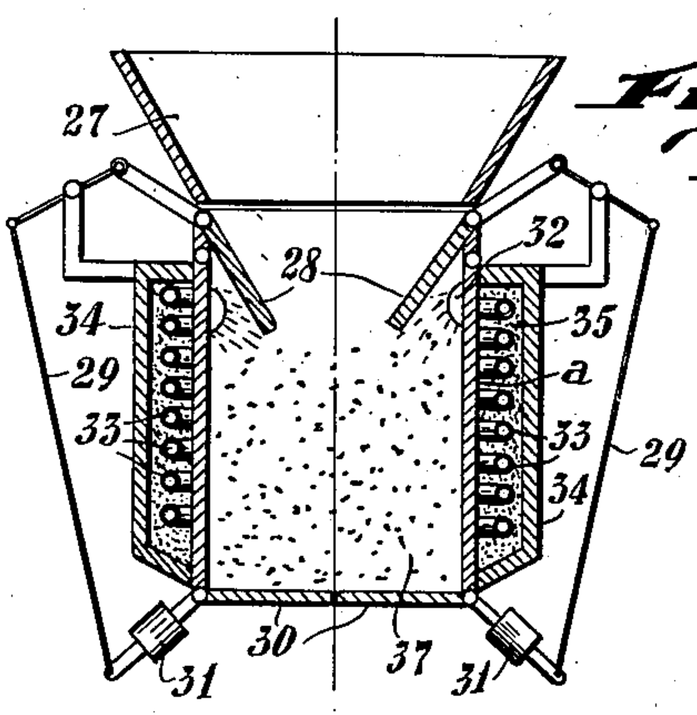
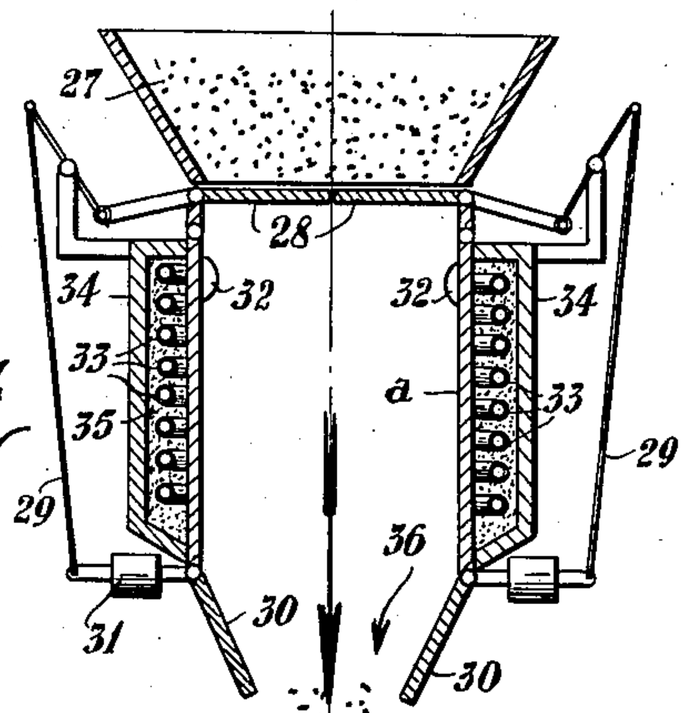
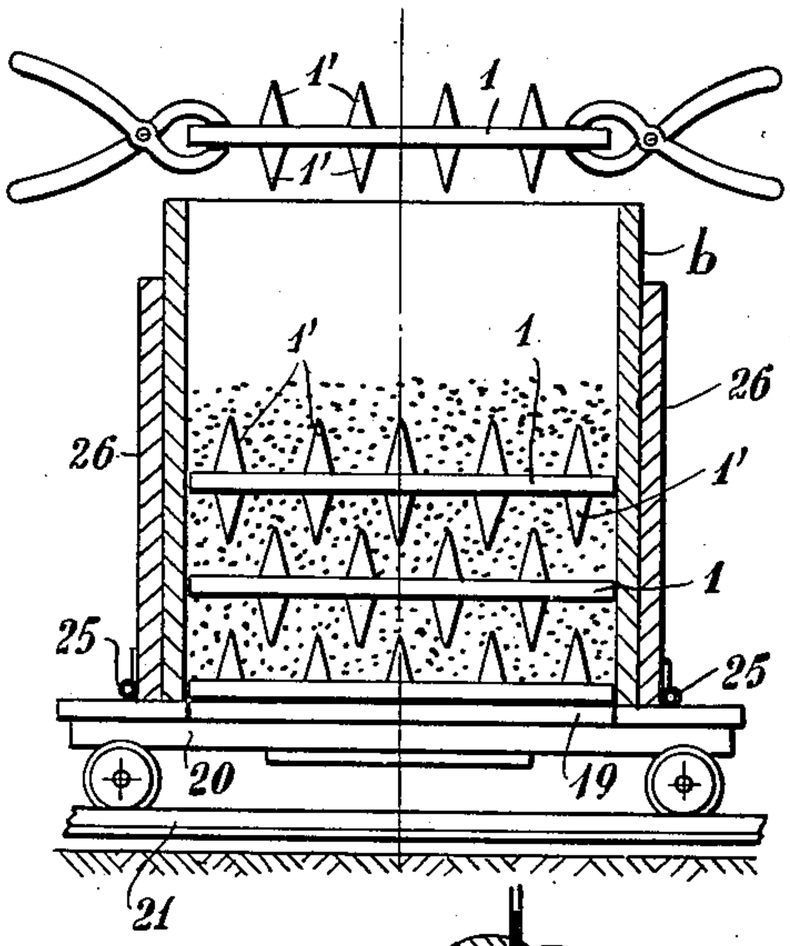
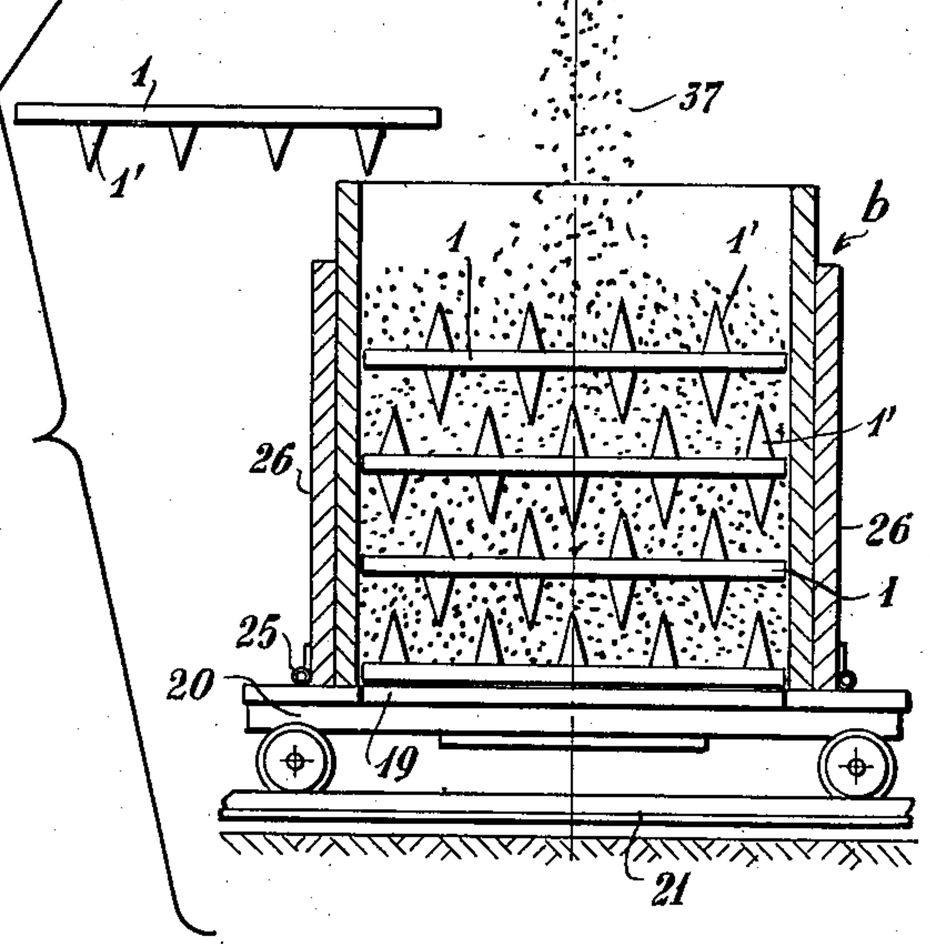


Fig. 4







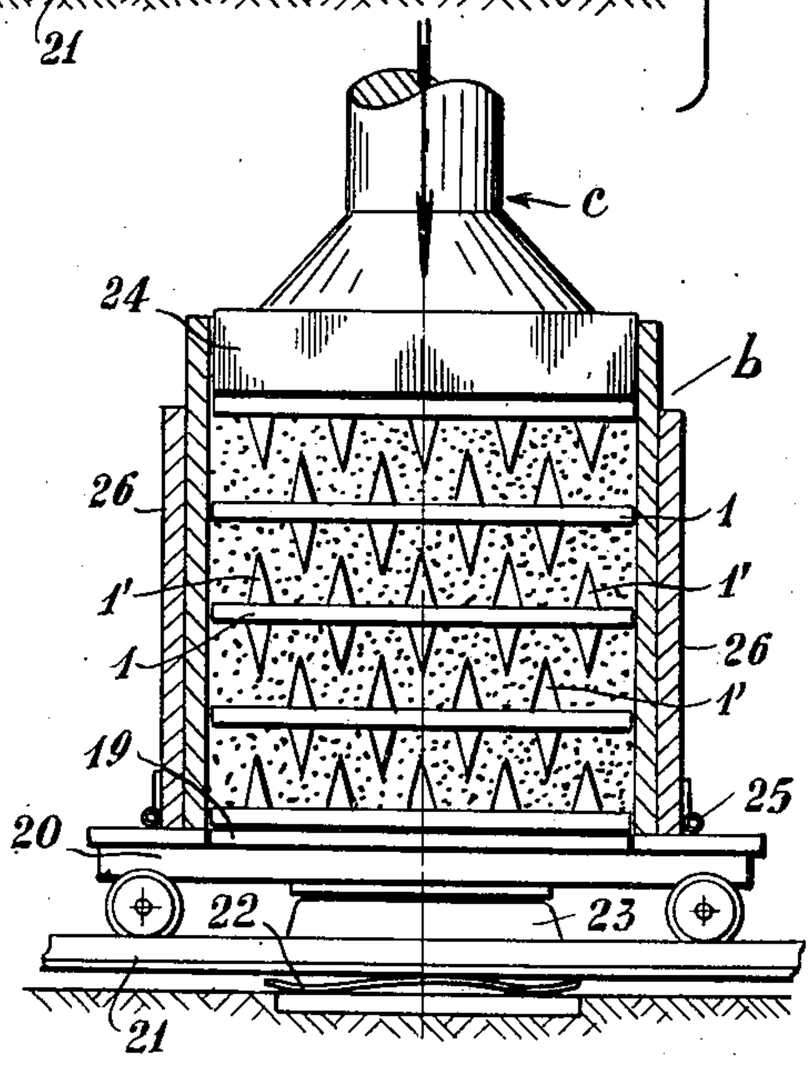


Fig. 5

INVENTOR
Alejandro Heriberto Duggan
Rodolfo Pedro Toots
Eugenio David DuBois
BY Ivan P Jackof,
ATTORNEY

Oct. 25, 1949. A. H. DUGGAN ET AL 2,486,266

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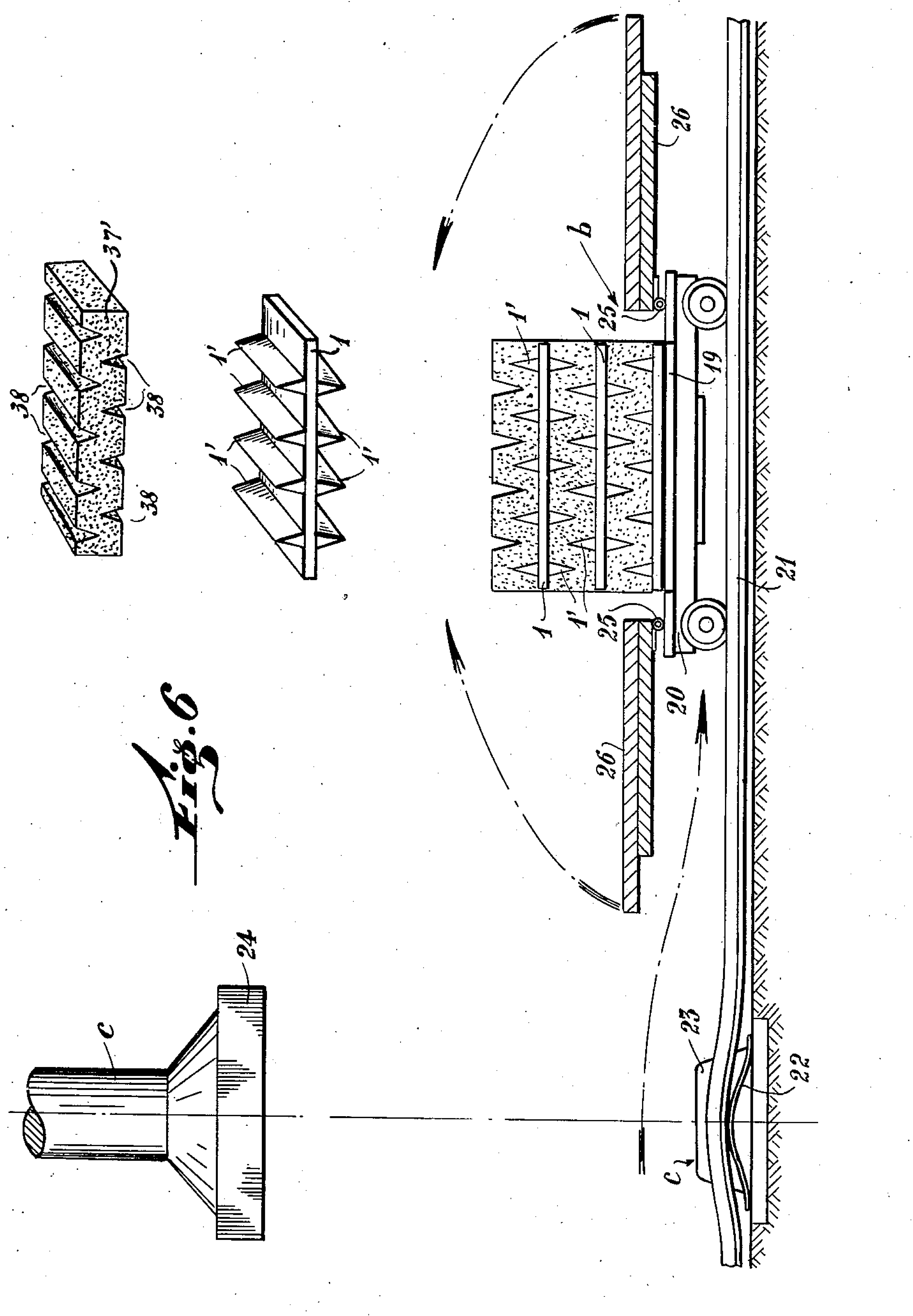

Fig. 6

INVENTOR
Alejandro Heriberto Duggan
Rodolfo Pedro Toots
BY Eugenio David DuBois
Ivan P. Tashof
ATTORNEY

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UNITED STATES PATENT OFFICE

2,486,266

METHOD AND APPARATUS FOR MANUFACTURING BLOCKS FROM VARIOUS MATERIALS

Alejandro Heriberto Duggan, Rodolfo Pedro Toots, and Eugenio David Dubois, Venado Tuerto, Argentina

Application June 8, 1945, Serial No. 598,396
In Argentina May 3, 1945

12 Claims. (Cl. 18—34)

1

This invention relates to an apparatus for and a method of manufacturing blocks from various materials, and more particularly to the manufacture of blocks formed of compressed vegetable, mineral or animal substances.

There are several systems for compressing various materials into blocks, but in view of the fact that these materials sometimes are relatively hard to compress, the application of these systems on a large industrial scale is expensive and complicated so that the price of the finished product does not compensate the manufacturing costs thereof.

The compression of vegetable materials is particularly difficult due to the inherent elasticity of these materials which, after compression, tend to regain their original volume. Thus, recourse must be had to an adequate method of heating the materials in order to fuse the resins or colloidal substances contained in the materials subjected to the heat treatment, so that the thermoplastic action of these resins keeps together the block structure after compression.

Now, since generally vegetable materials are poor heat conductors, it is necessary not only to generate high temperatures when utilizing ovens or presses with heating devices, but it is also necessary to extend the heat treatment through a considerable period of time since, due to the low thermal conductivity of vegetable materials, it takes a certain time for the heat energy to deeply penetrate into the material and to cause the desired thermoplastic effects throughout the thickness of the material.

However, it is not always possible to apply the heat treatment referred to hereinabove, since an excessive heating of the material might produce an over-heating of the outer surfaces of the block with the consequent modification or spoiling of the product.

Taking into account the above difficulties, experiments have been carried out with intermediate heating devices capable of applying the heat directly to the blocks during compression. These experiments have been carried out with metallic plates provided with sharp pins which, extending beyond a line corresponding to half of the thickness of the block under compression, operate as heat injectors, since these metallic plates are heated prior to their insertion between the blocks so that they may act both as compressing and heating members which simultaneously improve the bond of the bulk under compression.

The latter feature constitutes the basis of the

2

manufacturing method according to the present invention which, in conjunction with the various constructive details, solves the problem of heating the thermoplastic systems in blocks formed of materials having low thermal conductivity.

In effect, as the compressed materials receive the heat from all directions, the thermoplastic effect required for converting the material into a compact block or tablet is reached in a very short time.

The manner in which the various devices have been combined to obtain the heating of the plates, preparation of the material and the compression of the same is quite noteworthy, since in the first mentioned step a vertical oven is used which, including a pair of conveyers allows of the loading of the heating plates in such a manner that, without the utilization of a driving force, the conveyers are driven by the weight of the plates referred to hereinbefore, the descending movement of the plates being controlled by a regulating mechanism, so that these plates remain within the oven during a time sufficiently long to acquire a high temperature capable of heating the bulk of the previously measured material when inserted immediately afterwards in a mold located on a carriage, so that it can be loaded outside the press.

Among the several objects and advantages of the present invention, there is the possibility of combining the devices and operating steps so as to provide for a large scale production since due to the fact that the the separating plates operate simultaneously as heating members, the press can be charged with a large amount of material.

A further object of the present invention consists in that, for the manufacture of the blocks, every type of press without heating can be utilized, as the plates interposed between the portions of the treated material operate as heating members.

A still further object of the invention consists in facilitating the manufacture of blocks of reduced dimensions without requiring a press for each block since due to the utilization of the separating plates, blocks of every thickness can be produced in a continuous process, as the loading is carried out in series, and since the same press simultaneously compresses the different portions resulting from the subdivision of the bulk.

A further object of the invention consists in providing blocks for different industries, such as the manufacture of combustible briquettes or blocks for the construction industry besides

facilitating the compression of fibrous, pulverulent or scaly materials into tablets with the consequent reduction in volume and facility of handling and transportation. The conditioning of these materials is particularly advantageous for forage materials and especially for bran or cribble which, on being compressed and thermoplastically compacted, not only exhibits the advantages mentioned hereinbefore, but also is transformed into an improved product due to the toasting operation to which it has been subjected.

A still further object of the invention consists in providing a method of manufacuring compressed products on a substantially economical basis achieved by means of the multiple action of each operating step.

The further objects and advantages of the present invention will become apparent from the following specification when taken in connection with the accompanying drawings forming part of the specification and in which:

Fig. 1 is a side elevational view of the oven designed to heat the plates which later, on being applied as separators between the blocks, operate as heating members of the material during the compression. This view corresponds to the frontal part of the oven, which is illustrated partly in section in order to show the conveyers which support these plates during the descending movement caused by their own weight and governed by escapement devices shown on the entire portion of the frontal wall.

Fig. 2 is a lateral view of the same heating oven illustrating the entrance and outlet ports for the plates.

Fig. 3 is a graphic illustration disclosing the manner in which the material is measured and prepared in order to obtain blocks of like proportions; this figure discloses the step of preparing the material in the duct, while the portion of the material previously loaded into the mold is closed by means of a preheated plate.

Fig. 4 illustrates the device shown in the previous figure during the operating step comprising the transference of the material from the preparing duct to the mold for forming another block.

Fig. 5 is a graphic illustration of the step during which the mold transported to the press, receives the compressing plate to compress simultaneously all blocks obtained due to the separation provided by the plates; during this step the same plates, operating as heating devices, expedite the melting of the fusible substance in the material to obtain the thermoplasticity which provides the bonding of the block, and finally

Fig. 6 is a graphic illustration of the step corresponding to the discharge of the mold in order to illustrate the blocks after compression.

In the figures, same or like elements or parts have been designated with the same reference numerals or characters.

As can be observed in the drawings, the essential elements of the plant operating according to the method of manufacture of this invention are: an oven shown in Figs. 1 and 2 and designed to heat the plates 1 operating later as heating elements, a material conditioning and dosifying duct *a*, a mold *b* which receives the same material, and a press *c* where the content of the mold *b* is compressed.

The oven shown in Figs. 1 and 2 comprises a chamber 2 intercommunicating by means of

a conduit 3 with a fire-grate 4 the ash-pan 5 of which forms simultaneously the air entrance port of the oven; chamber 2 opens into a chimney 6 designed to provide the necessary draft.

Chamber 2 includes a pair of conveyers *d* formed of chains 7 whose links are provided with angular supports 8 which, with their portions looking towards the other conveyer, provide a support for the heating plates 1. Thus, conveyers *d*, on penetrating into passage 2′ of chamber 2 constitute a pair of twin ladders, since each angular support of the conveyer cooperates with the respective support of the other conveyer.

Chains 7 of conveyers *d* pass between cog-wheels 9 and 10 of like diameters and are located on the same vertical line, so that the chains, and particularly those portions corresponding to passage 2′ follow a substantially vertical line with respect to the partitions 11 of refractory material which determine the limits of passage 2′.

Cog-wheels 9, which are located in the upper portion of the oven, are mounted on a shaft 9′ provided with a cog-wheel 12 co-operating with a respective anchor 13 fast to a shaft 14.

Since each conveyer is provided with an anchor 13, the operation of either conveyer is controlled by the intermittent movement of the anchors so that an intermittent movement of the conveyers is obtained.

The upper portion of chamber 2 comprises an entrance port 15 (Fig. 2) which coincides with the entrance end of passage 2′ so that when plates 1 are introduced in the passage, these plates will slide down the passage until reaching the upper part of the conveyers *d* which present simultaneously a pair of angular supports 8 at this end of the passage. Thus, as plates 1 are introduced through entrance port 15, the plates are caught by conveyers *d* which, due to the weight of the plates, are put in intermittent movement, so that the plates gradually descend through passage 2′ until reaching the lower part thereof where they are deposited on rails 16 and leave the oven through outlet port 17. Consequently, plates 1 which are fed into the oven through entrance port 15, constitute the driving elements of conveyers *d* which rotate with an intermittent movement controlled by the oscillations of anchors 13.

As can be seen in Fig. 2, chamber 2 includes a plurality of horizontal partitions 18 projecting in the form of blades from the chamber walls towards conveyers *d* in passage 2′, so that the combustion gases generated in fire-grate 4, instead of ascending directly along the sides of the conveyers, are deviated by blades 18 and are compelled to ascend in zig-zag through the spaces formed between the gradually descending plates 1. This zig-zag flow of the combustion gases is caused by the alternate arrangement of blades or partitions 18 on the opposite walls of the chamber (Fig. 2).

Molds *b* are provided with a floor 19 resting on a carriage 20 whose wheels run on rails 21 passing under press *c*. In the portion of the track passing under the press, rails 21 are slightly raised by springs 22 which are sufficiently strong to support carriage 20 and the fully loaded mold *b*, since the purpose of these springs is to enable carriage 20 to pass by a support 23 forming part of press *c*. However, since these springs yield under the pressure exercised by plate 24 of press *c* when the latter compresses the material within

mold *b*, carriage **20** comes to rest against support **23** thus avoiding that an excessively high pressure is applied to the axles of the carriage.

Floor **19** of mold *b* is provided with a set of hinges **25** fastened to walls **26** which, as can be observed in the drawings, constitute a parallelopiped in the operative position of the mold (Figs. 3, 4 and 5), but which can be tilted as shown in Fig. 6 in order to facilitate the extraction of the compressed blocks.

In its upper part, preparing duct *a* is provided with a charging hopper **27** including a gate **28** in its passage communicating with the interior of the duct, this gate being mechanically coupled by means of a transmission **29** to a discharge gate **30**, the latter being located in the lower part of the preparing duct and constituting the floor which supports the material during the loading of the duct. Discharge gate **30** opens when the counterpoises of a balance **31** yield under the weight of the material in duct *a*, so that by adjusting the position of these counterpoises it is possible to dosify the amount of material to be prepared in the duct.

In its upper part, preparation duct *a* is provided with a vapor jet **32** designed to moisten the material as it enters the duct and, as can be seen in the drawings, a heating coil **33** surrounds the walls of the duct this heating coil being protected by a shell **34** including sand or other thermally conductive material **35** in order to evenly distribute the heat generated by coil **33** throughout duct *a*. Thus, the heat of the vapor used to regulate the moisture content of the material is also used for heating purposes.

Duct *a* is mounted at a certain distance above rails **21** so that mold *b* on carriage **20** may be brought precisely under discharge gate **30** of the preparing duct to receive the successively prepared portions of material, as explained hereinbefore.

Both surfaces of plates **1** are provided with a plurality of pins **1'** which may be formed as cutters or prongs, as desired. These pins are of an angular profile and thus constitute wedges which, on penetrating into the material, cause a lateral displacement in addition to that normally caused by the compression in a direction indicated by the arrow in Fig. 5.

The dimensions of plates **1** are equal to those of floor **19** of mold *b*, so that with the walls of the mold in their operative position, the plates which are interposed between the material, constitute separating partitions in order that each portion of the material included between plates **1** can be transformed into a block of treated material.

As can be observed in the various figures, all plates **1** are provided with wedge-like pins on both of their surfaces, except for the plate contacting floor **19** and that located on top of the compression unit, these plates possessing only one surface with pins.

With the elements as described, the manufacturing method is carried out as follows:

The combustion gases coming from fire-grate **4** ascend through conduit **3** and flow through passage **2'** of chamber **2**. When plates **1** are fed through entrance port **15**, the plates slide towards the upper part of passage **2'** where they are met by supporting members **8** of conveyers *d* operated by the weight of the plates as indicated in Fig. 1. As already explained hereinbefore, the descending movement of plates **1** is governed by the alternate movement of anchors **13**, so that plates **1** are subjected in chamber **2** to a heat treatment

extending over a sufficiently long period of time and capable of elevating the temperature of the plates to a point adequate for the following heating of the material to be treated.

On reaching the lower part of passage **2'**, plates **1** slip from the supporting members **8** of conveyers *d* and fall down on rails **16** from which they can be extracted through outlet port **17** as soon as they are required in the process.

Simultaneously, mold *b* must be placed below conditioning duct *a* which should be loaded in a manner indicated in Fig. 3 and which receives the material **37** to be treated in its hopper **27**.

This material **37** may be a vegetable, mineral or animal substance since as already expressed hereinbefore, the object of the process according to the invention consists in agglomerating or forming blocks with substances of all origins, provided that heat can be applied to obtain a thermoplastic process and to achieve a permanent bond after compression.

Among these materials can be mentioned the residues of milled cereals which, when converted into compressed blocks, can be utilized as forage material and can be transported without packing with the consequent reduction in volume of the goods to be transported.

First a hot plate of the simple type provided with pins on only one of the surfaces thereof must be placed on floor **19** of mold *b*.

With entrance gate **28** in its open position and discharge gate **30** closed, duct *a* is charged with the material which is moistened by means of the vapor coming from jet **32**. Due to heating coil **33**, the material is heated to a certain temperature while it is simultaneously weighed by means of counterpoises **31**. When the material within tube *a* has reached a certain weight which overcomes counterpoises **31**, the material automatically causes tthe opening of gate **30** and the closure of entrance gate **28**.

The measured materials fall down into mold *b* and immediately afterwards the operator should apply another hot plate **1**, while a subsequent portion of the material is being prepared and weighed in tube *a*. The newly measured material is automatically discharged on reaching the required weight and falls down into mold *b* where another hot plate **1** should be immediately placed on top of the dosified material. Thus, measured portions of material **37** separated by hot plates **1**, are successively piled up in mold *b*, as can be seen in Figs. 1, 3 and 4.

After completing the load of mold *b*, the upper hot plate **1** is placed on top of the pile, this upper plate being naturally of the simple type having pins on only one surface thereof, since the upper surface of the plate should be completely smooth in order to be able to contact plate **24** when the entire unit is placed under press *c*.

When carriage **20** is placed under press *c*, its weight and the weight of the load is not sufficient to overcome springs **22** so that there is no difficulty in passing over support **23** and stopping the carriage directly over this support.

On being actuated by the pressure, plate **24** compresses the contents of mold *b* which, together with carriage **20** overcomes springs **22** and latter is pressed against support **23** designed to withstand high pressures.

Due to the fact that heating plates **1**, interposed between the measured portions of material **37**, are not supported but merely guided by walls **26** of mold *b*, when the pile is compressed by

plate 24, all portions of the material are compressed in series to a small volume.

During compression, pins 1' of the plates 1 penetrate into the material and, due to the fact that these pins are designed as wedges, a lateral displacement of the material fibres is obtained causing a better interlock of the bulk of the material. Hence, in addition to the displacement in a direction indicated by the arrow in Fig. 5, caused by the compression, the material is also laterally displaced with the consequent solidification and compression in all directions.

Due to previous heating of plates 1 in the oven, according to Figs. 1 and 2, these plates, on being interposed as intermediate members in the material loaded into mold *b*, operate as heating means of the materials not only with their principal surfaces but also with pins 1' which penetrate into the material. Thus, all parts of the materials are subjected to a heat treatment and even when materials having low thermal conductivity are treated according to the process of the invention, the heat energy is evenly distributed throughout the entire bulk of the material, since pins 1' convey the heat directly through the thickness of the treated material, so that the resins, tars or other fusible substances are extracted from the enclosing medium and are mixed with the material. These resins, tars or other fusible substances act as a bonding substance for the compressed material and, after a certain period of time, each portion of the material compressed between two plates 1', is converted into a block 37' which, in addition to acquiring the form defined by both plates, is in fact nearly sectioned by the incisions 38 made by pins 1' during compression.

Incisions 38 improve the condition of the finished product which, due to these incisions, can be easily subdivided into pieces of a more convenient size.

As already pointed out hereinbefore, material 37 may be a vegetable, animal or mineral substance, the above process thus being utilizable in a plurality of industries. Hence, the blocks may take the form of combustible briquettes made of homogeneous or heterogeneous substances. In one of its main applications, material 37, if constituted by residues of milled cereals such as bran, it can be transformed into compact blocks which can be transported, exported or subjected to a plurality of other operations without affecting either the compact structure or the food value of these blocks which, to the contrary, is considerably improved during the torrefaction or heating step between the plates, as already explained hereinbefore.

Resuming, the process or method of manufacturing blocks 37' comprises the steps of heating metallic plates 1, inserting or interposing these plates between portions of a material 37 to be treated, thus forming in the interior of a mold *b* a plurality of portions of the materials stacked one on the other and separated by heating plates 1, compressing this stack of material to a high degree of compactness, keeping the compression of the stacked portions of the material until the separating plates have cooled off, and finally opening mold *b* and extracting blocks 37' of compressed material.

Hence, these blocks are obtained by means of a thermoplastic solidification during which the resins, tars or glues contained in the material, are fused and dispersed thus acting as binder substances. Furthermore, the material to be

treated may be moistened and preheated prior to compression.

It is to be understood that this invention is not limited to the details of procedure hereinbefore specifically described for the purpose of illustration but that many variations and modifications may be made without departing from the spirit of this invention as set forth in the appended claims.

We claim:

1. The process for the production of blocks from pulverulent vegetable material having a thermoplastic binder therein, comprising heating a plurality of metallic plates provided with spaced projecting portions distributed uniformly over the face thereof, so as to heat the plates and projecting portions to a temperature sufficient to supply substantially all the heat necessary to soften said thermoplastic binder and produce a coherent block, assembling the plates successively in a mold for sliding movement relative thereto, feeding the pulverulent vegetable material carrying said thermoplastic binder between successive plates as they are assembled with the mold to form an assembly of plates separated by material and applying pressure to the end plates of the assembly to uniformly compress the material axially of the mold and laterally between the projecting portions of the plates while simultaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of said projections, and maintaining said pressure until the plates have cooled and a series of coherent blocks of material are formed.

2. The process for the production of blocks from pulverulent vegetable material having a thermoplastic binder therein, comprising heating a plurality of metallic plates provided with spaced projecting portions distributed uniformly over the face thereof, so as to heat the plates and projecting portions to a temperature sufficient to supply substantially all the heat necessary to soften said thermoplastic binder and produce a coherent block, assembling the plates successively in a mold for sliding movement relative thereto, feeding the pulverulent vegetable material carrying said thermoplastic binder between successive plates as they are assembled with the mold to form an assembly of plates separated by material, applying pressure to the end plates of the assembly to uniformly compress the material axially of the mold and laterally between the projecting portions of the plates while simultaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of said projections, and maintaining said pressure until the plates have cooled and a series of coherent blocks of material are formed, separating the mold sections and removing the block and plate assembly therefrom.

3. The process for the production of blocks from pulverulent vegetable material having a thermoplastic binder therein, comprising heating a plurality of metallic plates provided with spaced wedge-shaped fins projecting from the face thereof and distributed uniformly over the plates, so as to heat the plates and projecting portions uniformly to a temperature sufficient to supply substantially all the heat necessary to soften said thermoplastic binder and produce coherent blocks, assembling the plates succes-

sively in a mold for sliding movement relative thereto, feeding the pulverulent vegetable material carrying said thermoplastic binder between successive plates as they are assembled and about the projecting fins of said plates to form an assembly of plates separated by material and applying pressure to the end plates of the assembly to uniformly compress the material both axially of the mold and laterally between the wedge-shaped fins while simultaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of said projections, and maintaining said pressure until the plates have cooled and a series of coherent blocks of material are formed.

4. The process for the production of blocks from pulverulent vegetable material having a thermoplastic binder therein, comprising heating a plurality of metallic plates provided with spaced projecting portions distributed uniformly over the face thereof so as to heat the plates and projecting portions uniformly to a temperature sufficient to supply substantially all the heat necessary to soften said thermoplastic binder and produce a coherent block, the projections of certain of said plates being offset laterally from certain of other said plates, assembling the plates successively in a mold for sliding movement relative thereto, the plates being so assembled that the projections on adjacent faces of each successive plate are offset one from the other, feeding the pulverulent vegetable material carrying said thermoplastic binder between successive plates as they are assembled to produce therein uniform corrugated sheets of material separated by plates, and applying pressure to the end plates of the assembled plates and material to uniformly compress the material while simultaneously softening the thermoplastic binder of the vegetable material by heat of said plates at a plurality of spaced points disposed to correspond to the spacing of said projections and maintaining such pressure until the plates have cooled and a series of coherent blocks of material are formed.

5. The method of manufacturing blocks from pulverulent vegetable materials containing a thermoplastic binder therein comprising heating metallic plates having a series of spaced wedge-shaped projections upstanding from their faces, inserting the heated plates separately in a mold, delivering determined quantities of the vegetable material between the faces of adjacent plates as they are placed in the mold, applying pressure to the plates in a direction longitudinally of the wedge-shaped projections to compress the material between adjacent plates and to cause the projections to exert pressure on the material in a direction substantially normal to said first mentioned direction while simultaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of the wedge-shaped projections and maintaining said pressure until the plates have cooled.

6. The method of manufacturing blocks from pulverulent vegetable material containing a thermoplastic binder therein comprising the steps of heating heat conductive plates having a plurality of spaced wedge-shaped projections upstanding therefrom to a temperature sufficient to supply all the heat necessary to soften said thermoplastic binder, inserting between adjacent pairs of

the heated plates measured quantities of vegetable material, applying pressure to the plates to cause the projections to pass into the material to at least one half the depth thereof while simulaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of the wedge-shaped projections, and cooling the plates with the compressed material therebetween.

7. The method of manufacturing blocks from pulverulent vegetable material containing a thermoplastic binder therein comprising the steps of preheating metallic plates with a plurality of upstanding spaced wedge-shaped projections thereon, introducing alternately a plate and a measured quantity of the material into a collapsible mold, placing a plate on the stack so-formed in the mold, applying pressure to the stack to cause the wedge-shaped projections to penetrate the material and thereby uniformly heat the interior thereof and compress the material laterally therebetween while simultaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of the wedge-shaped projections, maintaining the stack in a compressed state until the plates have cooled, and thereafter collapsing the mold and removing the compressed material from between the plates.

8. The method of manufacturing blocks from pulverulent vegetable material containing a thermoplastic binder therein comprising placing in a mold a preheated metallic plate having a plane face and a second face with a plurality of upstanding spaced wedge-shaped projections extending into the interior of the mold, introducing a quantity of the vegetable material having present said thermoplastic binder into the mold, placing a series of preheated plates having spaced wedge-shaped projections upstanding from opposite faces thereof in the mold with quantities of the material therebetween, said spaced projections on one plate being offset with respect to the spaced projections on the other plate delivering a further quantity of said material to the upper face of the uppermost preheated plate of the series, placing a further preheated plate having a plane face and a face having upstanding wedge-shaped projections on the series with the projections extending into the material, applying pressure to the plane faces of the two outer preheated plates to cause the material to be compressed and the projections to enter the material and compress the latter in a direction normal to the direction of compression between said plates while simultaneously softening the thermoplastic binder of the vegetable material by the heat of said plates at a plurality of spaced points disposed to correspond to the spacing of the wedge-shaped projections, maintaining said pressure until the plates have cooled, and thereafter removing the plates.

9. An apparatus for the production of blocks from pulverulent material comprising a mold having a bottom, and side walls hinged to the bottom and an open top, a plurality of pressure plates insertable within said mold and slidable therein, said plates being adapted to be spaced apart within the mold by material, the top and bottom of said plates being provided with wedge-shaped projections on the interior faces thereof and each of the plates intermediate the top and bottom plate being provided with wedge-shaped

projections on both faces thereof, the projections from the face of each adjacent plate being offset one from the other.

10. The apparatus of claim 9 wherein the plate projections consist of a series of elongated wedge-shaped fins uniformly distributed over the faces of the plates and adapted to exert lateral pressure upon material positioned between the plates upon the application of axial pressure to the plates.

11. The method of producing blocks from pulverulent vegetable material comprising moistening and preheating pulverulent vegetable material having a thermoplastic binder therein, heating a plurality of metallic plates provided with spaced projections distributed uniformly on the face thereof to a temperature sufficient to supply all of the heat necessary to soften the thermoplastic binder of the vegetable material to produce a coherent block, assembling said plates successively in a mold for sliding movement relative thereto, feeding the pulverulent vegetable material having present said thermoplastic binder between successive plates as they are assembled in the mold, said assembled plates being separated by material, and applying pressure to the end plates of the assembly to uniformly compress the preheated vegetable material while simultaneously softening the thermoplastic binder thereof by the heat of said plates at a plurality of spaced points disposed to correspond to the spaced projections of said plates, said pressure being applied until the plates are cooled, and a series of coherent blocks of vegetable material are formed.

12. The method of producing blocks from pulverulent residues of milled cereals comprising moistening and preheating said milled residues having a thermoplastic binder therein, heating a plurality of metallic plates provided with spaced

projections distributed uniformly on the face thereof to a temperature sufficient to supply all of the heat necessary to soften the thermoplastic binder of the milled residues to produce a coherent block, assembling said plates successively in a mold for sliding movement relative thereto, feeding the milled residue material having present said thermoplastic binder between successive plates as they are assembled in the mold, said assembled plates being separated by material to compress the preheated milled residues, and applying pressure to the end plates of the assembly to uniformly compress the preheated milled residue material while simultaneously softening the thermoplastic binder thereof by the heat of said plates at a plurality of spaced points disposed to correspond to the spaced projections of said plates, said pressure being applied until the plates are cooled, and a series of coherent blocks of milled residue material are formed.

ALEJANDRO HERIBERTO DUGGAN.
RODOLFO PEDRO TOOTS.
EUGENIO DAVID DUBOIS.

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