Oct. 4, 1949. A. F. HOWE 2,483,638

BRIQUETTING MACHINE

Filed July 31, 1946 3 Sheets-Sheet 1

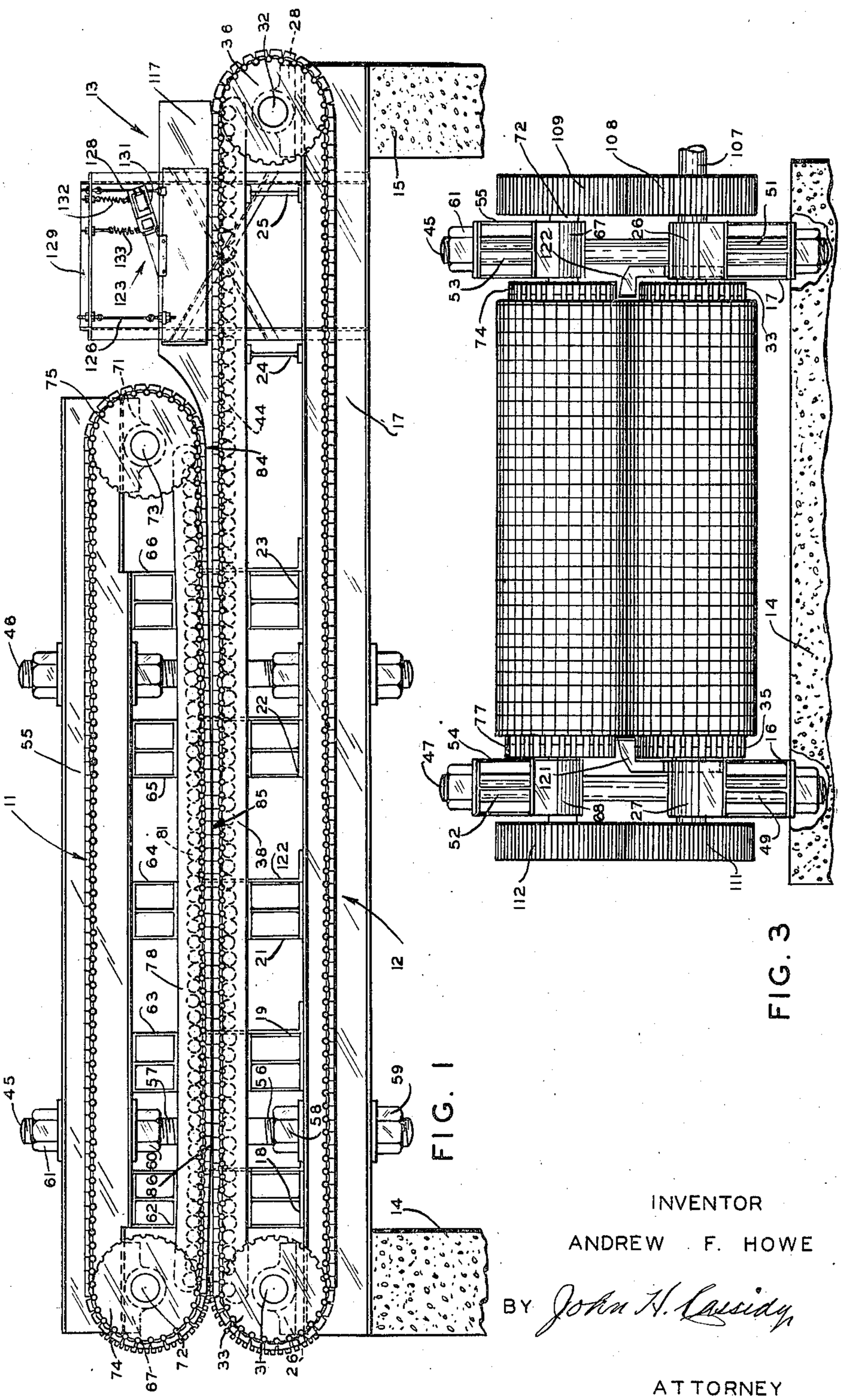

FIG. 3

FIG. 1

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Oct. 4, 1949. A. F. HOWE 2,483,638

BRIQUETTING MACHINE

Filed July 31, 1946 3 Sheets-Sheet 2

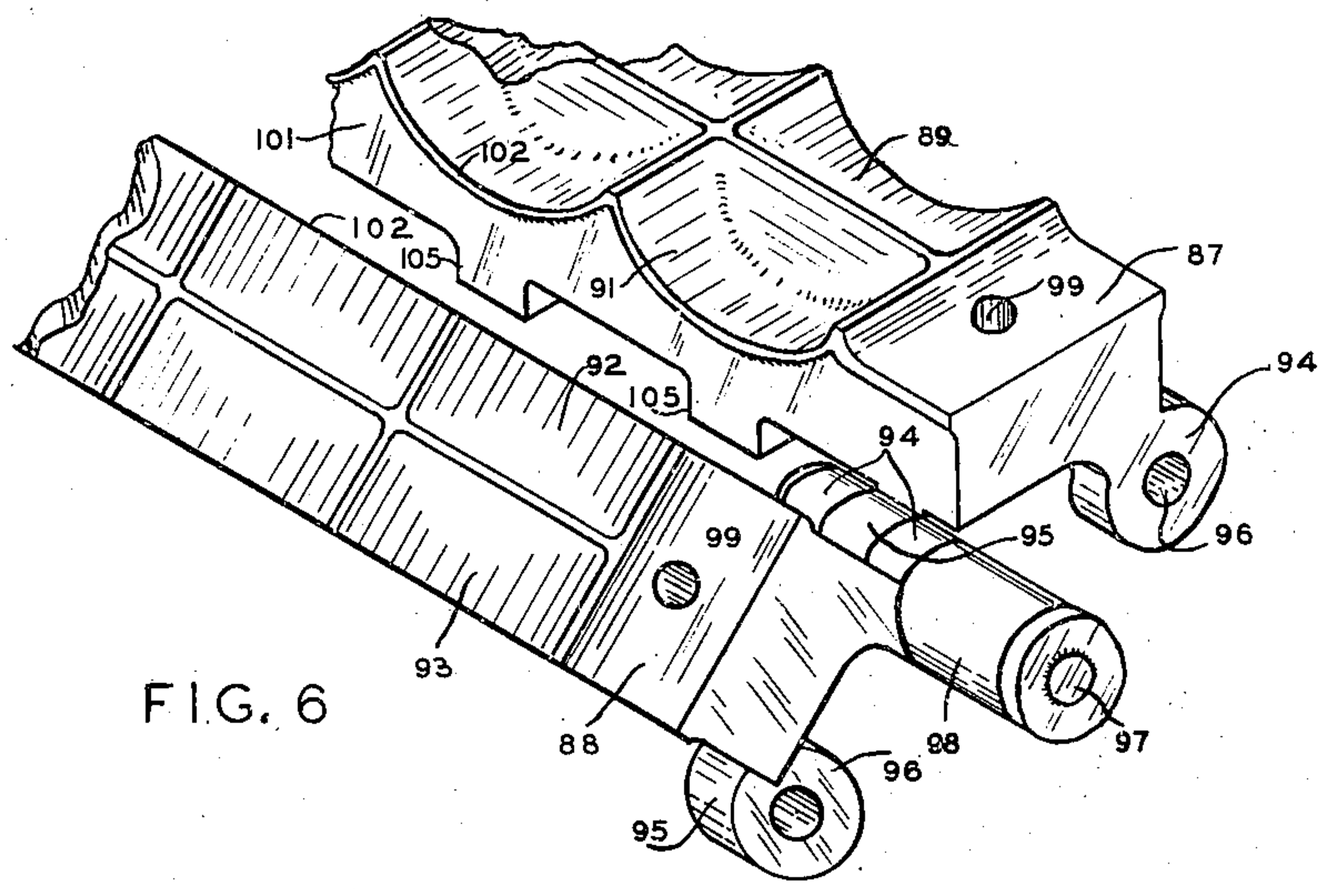

FIG. 6

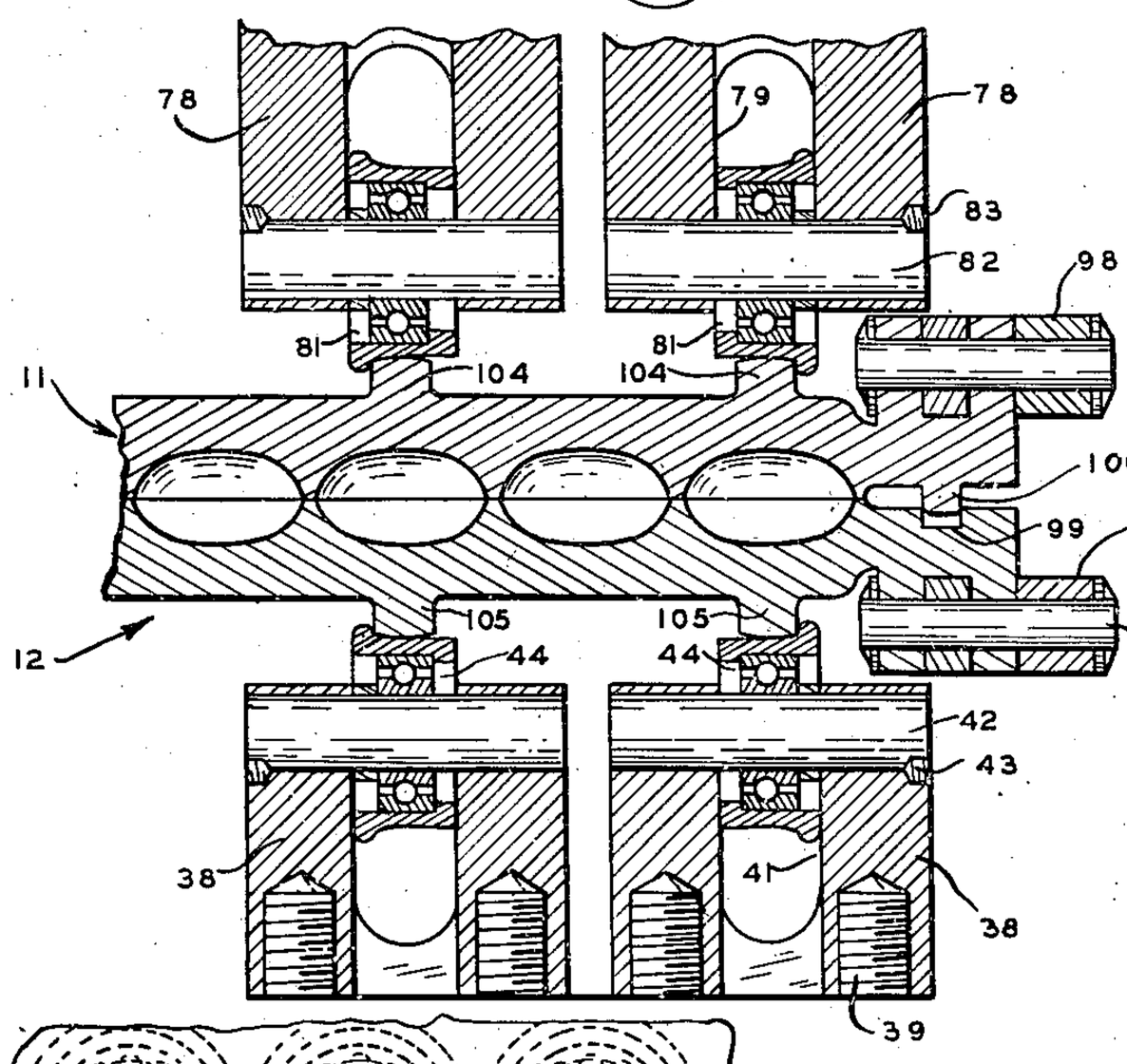

FIG. 7

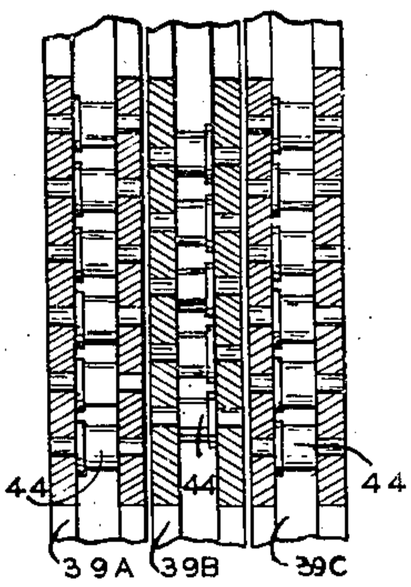

FIG. 9

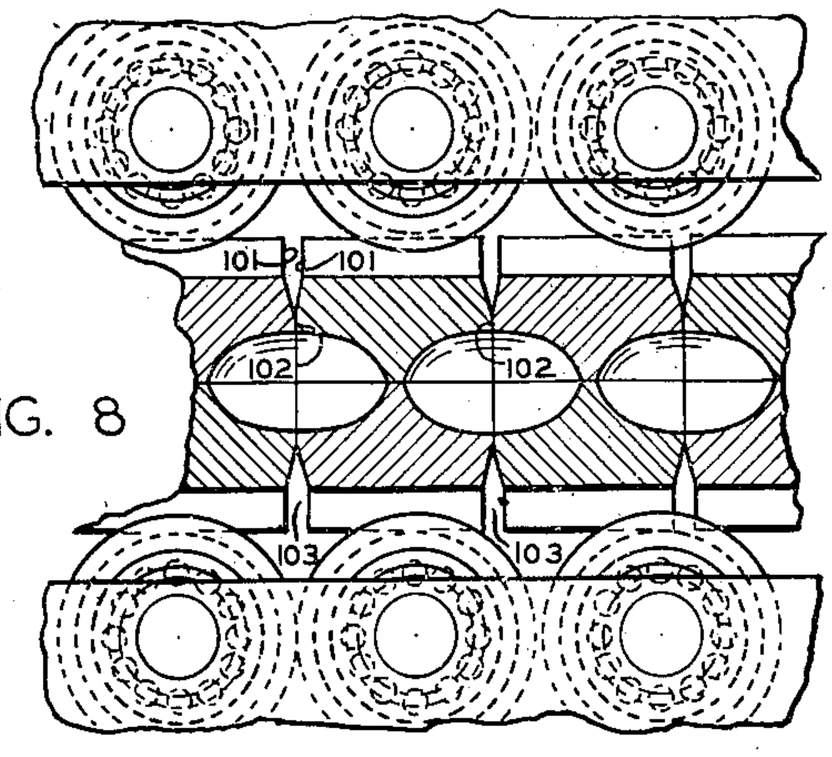

FIG. 8

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Oct. 4, 1949. A. F. HOWE 2,483,638

BRIQUETTING MACHINE

Filed July 31, 1946 3 Sheets-Sheet 3

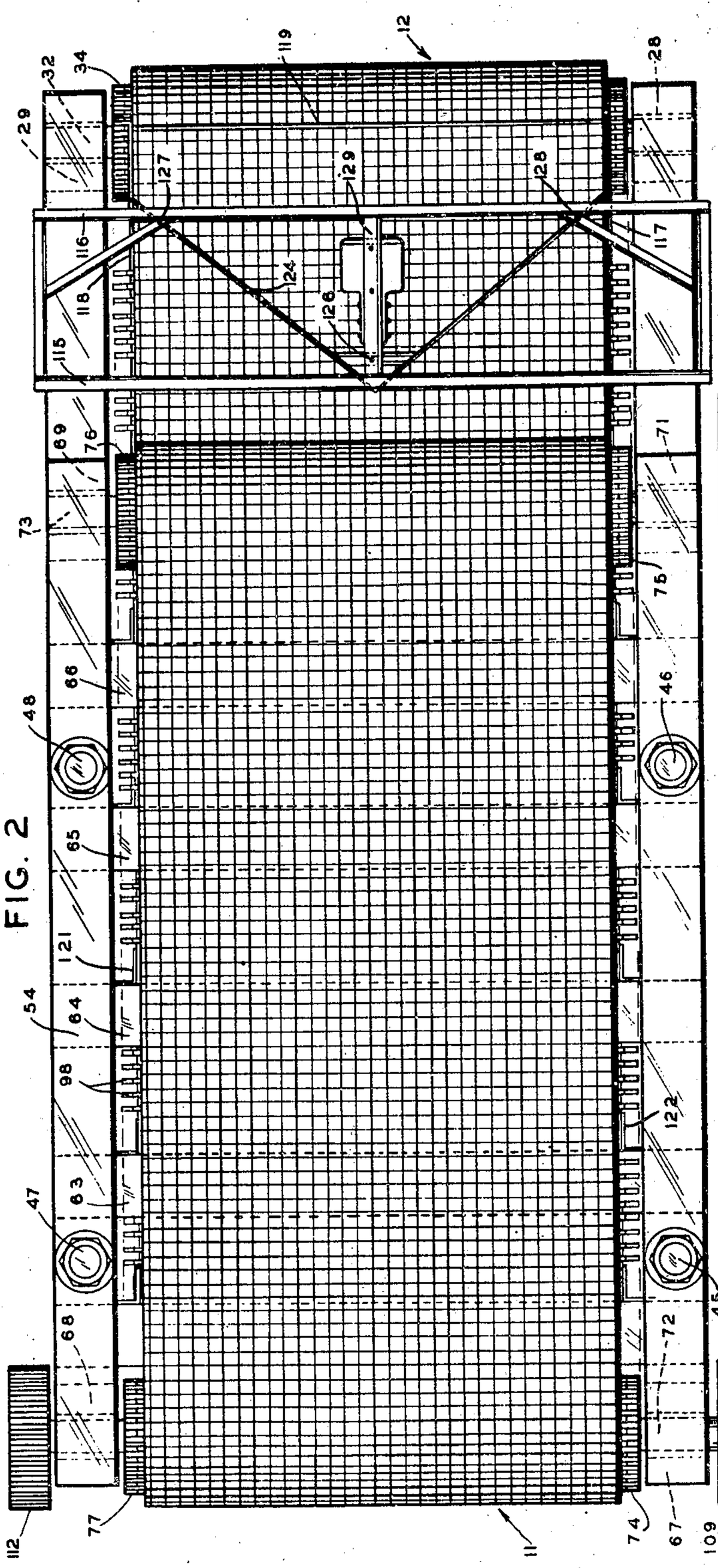

FIG. 2

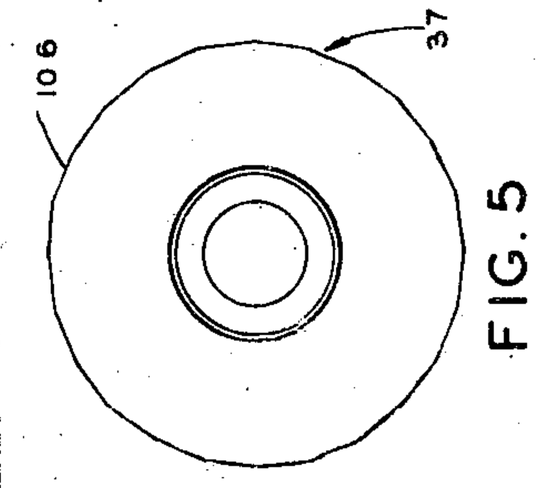

FIG. 5

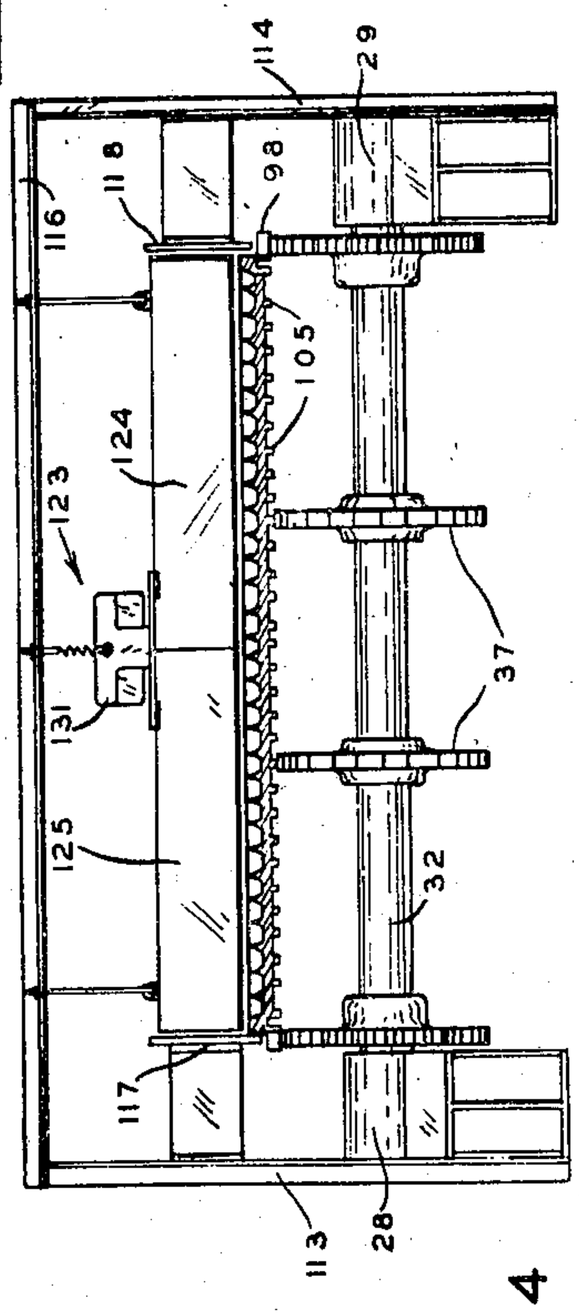

FIG. 4

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Patented Oct. 4, 1949 2,483,638

UNITED STATES PATENT OFFICE

2,483,638

BRIQUETTING MACHINE

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Application July 31, 1946, Serial No. 687,354

6 Claims. (Cl. 18—21)

1

This invention relates to a method and machine for briquetting heated coal particularly by retaining the coal masses compressed in the molds for a period of seconds until the elasticity of certain tacky and viscous substances therein has been overcome.

Briquetting machines are known in the art and take several different forms. One briquetting machine known as the drum type briquetter comprises two rotating drums between which the material is fed to mold the briquettes in complementary half mold sections carried on the peripheral surfaces of the drums. The use of this machine requires that a binding agent first be added to the coal to enable the formed briquettes to retain their shape. Also, the time for holding the briquettes in its mold in this machine is in the order of a fraction of a second. Other machines have been proposed which briquette heated coal without the addition of a binder, and such machines operate upon the impact theory for setting the tacky substances in the heated coal to give to the briquette rigidity, and form. These machines require impact forces of higher order, usually ranging from 15,000 to 30,000 foot-pounds, for each pound of fuel briquetted, which fact obviously imposes upon them an economic handicap. Still other machines have been proposed in which the fuel is heated in a mold and compressed therein by a weighted mold section for a period of time.

All of these machines have enjoyed only a limited amount of commercial success for a variety of reasons.

In some instances the briquettes are retained in the molds for such limited periods that the elasticity of the natural tars in the coal are not overcome, and upon discharge from the machine the briquettes break due to expansion. Also, due to the presence of unexpelled and entrained gases, internal stresses are set up in the briquettes which cause their disintegration. In addition, these machines also experience a large amount of breakage due to the sticking of the briquette in the mold. Another disadvantage, arising from the adherence of the briquette in the mold results in decreased production. Thus as briquette filled molds rather than empty molds, are continuously presented, the production of the machine is decreased proportionately. Further, and with regard to particular types of prior art machines, the large power requirements of some make their use economically infeasible. Even in reclaiming waste or slurry coal the cost of operating on such coal to put it into usable form must

2

necessarily compete with other types of fuel. These limitations are definitely defined and processing costs must fall within these limits. Thus a briquette which is formed in a machine requiring that the coal be impregnated with a binder will not compete with briquettes formed in a machine in which the added cost of impregnating the coal with a binder is obviated and so on.

It is, accordingly, a primary object of the instant invention to teach a method and to provide a machine which will overcome all of the foregoing enumerated difficulties.

More specifically it is an object of the invention to teach an improved method for briquetting heated bituminous coal in which the heated coal is compressed to a predetermined fractional volume of the original mass and the same confined for a period of seconds until the elasticity of certain viscous and tacky constituent thereof has been overcome.

With specific reference to the apparatus, it is an object of the invention to provide a briquetting machine in which material such as heated bituminous coal may be formed into briquettes without the addition of a binder; which will discharge the molded briquettes without sticking and without breakage due to internal gas pressures, and which will increase materially the speed of molding such as to constitute a marked advancement in the art.

Other objects and advantages will become apparent as the description proceeds and a more comprehensive understanding to the invention will be afforded from the following detailed specification when considered in conjunction with the accompanying drawings in which

Fig. 1 is a vertical sectional view of a briquetting machine embodying the instant invention,

Fig. 2 is a plan view thereof,

Fig. 3 is an end view of the machine looking into its discharge end,

Fig. 4 is another end view of the machine looking into the same at its feeding end,

Fig. 5 is a side view of one of a plurality of supporting wheels carrying the mold sections of the machine.

Fig. 6 is a fragmentary view of one of the mold sections employed in the machine illustrating in perspective the breaking feature of the mold compartments,

Fig. 7 is a cross-sectional, fragmentary view of the machine's molding sections,

Fig. 8 is a fragmentary, longitudinal sectional view of the machine's molding sections, and

Fig. 9 is a diagrammatic view illustrating the

staggered arrangement of the truck supports for the machine's molding sections.

As illustrated in Fig. 1, the invention in a preferred form contemplates a briquetting machine comprising an upper mold section 11, a lower mold section 12, and a material feeding mechanism 13. The entire machine is supported on a suitable framework carried on a foundation which may take the form of two concrete footings 14 and 15.

The frame comprises two lower beams 16 and 17 which extend throughout the length of the machine and which are supported on the footings 14 and 15. To these two beams a plurality of transverse sections 18, 19, 21, 22, 23, 24, and 25 are secured. Also carried on the beams 16 and 17 and at the ends thereof are two bearings 26 and 27 and two journals 28 and 29 which support for rotation two shafts 31 and 32. These shafts have splined or keyed thereto four sprocket wheels 33, 34, 35 and 36 respectively over which the lower mold section is carried. Also mounted on these shafts is a plurality of supporting wheels 37 such as is illustrated in Fig. 5.

Immediately above the transverse sections are a plurality of tracks 38 which are attached to these sections as by the studs 39 (Figs. 1 and 7). The tracks 38 extend substantially throughout the length of the lower mold section and are channelled as at 41 throughout their length. At spaced intervals along the tracks 38 there extends transversely of the tracks a plurality of shafts 42 which are keyed in place by the studs 43. Each of the shafts 42 mount ball bearing trucks 44 upon which the lower mold section 12 rides.

The upper mold section 11 is similarly constructed and is supported above the lower mold section by four large diameter bolts 45, 46, 47 and 48. These bolts extend through sleeves in the center web sections 49 and 51 of the lower beams 16 and 17 and similarly through sleeves in the center web sections 52 and 53 of two upper beams 54 and 55. Each of the bolts, for example, bolt 45, have threaded sections 56 and 57 which extend to the ends of the bolts and which receive respectively the nuts 58—59 and 60—61. By means of this arrangement the upper mold section 11 is vertically adjustable relatively to the lower mold section 12 in a manner which is apparent.

As in the lower mold section, the beams 54 and 55 of the upper section have secured thereto a plurality of transverse sections 62, 63, 64, 65 and 66. Here also the upper beams support two bearings 67 and 68 and two journals 69 and 71 which retain for rotation the shafts 72 and 73. The shafts 72 and 73 have attached thereto four sprocket wheels 74, 75, 76 and 77 and also a plurality of the supporting wheels 37.

Fixed to the transverse sections of the upper mold section 11 are a plurality of upper section tracks 78 which extend substantially the full length of the upper mold section. These tracks are similar to the lower section tracks 38, the same having center channels 79 (Fig. 7) extending throughout their length in which a plurality of ball bearing trucks 81 are carried at spaced intervals on shafts 82 keyed to the tracks 78 as by the studs 83.

The essential difference to be noted between the lower tracks 38 and the upper tracks 78 is that the latter are formed to support their trucks 81 in the form of an extended length terminating in arcs of fixed radii. With this arrangement of the tracks, it will be noted that the upper mold section cooperates with the lower mold section to apply varying pressures to the material compressed therebetween which gradually increases from a point 84 to a point 85 where it reaches a maximum pressure. This maximum pressure continues in application to a point 86 where by virtue of the shape of the tracks 78 it begins to decrease gradually toward the discharge end of the machine.

Both of the upper and lower sections are made up of a plurality of individual segments (Fig. 6) such as 87 and 88. Throughout their length each of these segments carry a plurality of quarter-mold compartments such as 89, 91, 92 and 93. At both of its ends each segment is provided at one side with a single dog 95 and a double dog 94. These dogs are drilled with holes 96 through which a connecting pin 97 is inserted. The single dog 95 of each segment is arranged to be carried between the double dog 94 on the proceeding segment which together with the pin 97 extending through both provides the connecting link. Each connecting pin 97 is provided with a hardened sleeve 98 which rides in the teeth of the various sprocket wheels heretofore described and which deliver to the respective mold sections the propelling force transmitted through selected ones of these sprockets.

To properly align the mold compartments of the upper section with those of the lower section, a pin and hole aligning means is resorted to. Thus each of the segments of the lower mold section 12 are drilled at their ends with holes 99. In a similar manner each of the segments of the upper mold section 11 carries at their ends beveled pins 100 which move into engagement with the holes 99 of the segments of the lower section to accurately align the molding compartments of both sections.

Each face of the mold section segments is depressed or channelled throughout its length as at 101. This channelling provides a flange 102 which cooperates with a similar flange on the next adjacent segment when both are in horizontal position, which flange seals the joint between the two segments. The channelled face 101 of each segment further provides with a similar face on the next adjacent segment a space 103 through which extra material, not formed into the briquette, may fall.

For supporting the segments of each mold section the segments of the upper section 11 are provided with a plurality of bearing flanges 104 and the segments of the lower section with bearing flanges 105 as viewed in Fig. 7. It will be noted that the bearing flanges 105 of the lower section 12 ride on the trucks 44 of the lower tracks 38 and the bearing flanges 104 of the upper section 11 on the trucks 81 of the upper tracks 78.

In order to provide even support for both of the mold sections their trucks are arranged in their respective tracks in a staggered manner as is illustrated for the tracks of the lower section in Fig. 9. Here it will be noted that the truck 44 of track 39*a* is aligned transversely with the truck 44 of the track 39*c* and the truck 44 of the track 39*b* occupies an offset position with both of the trucks of the tracks 39*a* and 39*c*. This arrangement of the trucks supporting both of the mold sections is carried out throughout their entire length and provides an even distribution of the load on the trucks, and maintains the sections level at their points of contact.

It will be noted that the bearing flanges of each mold section segment has a flat surface which must be accommodated for by the supporting wheels on which they ride. Accordingly, each of the supporting wheels **37** is shaped at its periphery with a series of flat surfaces **106** which cooperate with the bearing flanges of each molding section segment. Since the driving sprocket teeth receive the sleeved connecting pins of the mold section segments, this problem is not presented in connection with the sprockets and accordingly all that is necessary is that the teeth of the sprockets be spaced properly.

The machine is driven by means of a suitable prime mover which is connected to an extension **107** of the shaft **31**. This extension of the shaft has splined or keyed thereto a gear **108** which meshes with a gear **109** connected onto the shaft **72**. To provide for the even distribution of the driving forces, the other end of the shaft **31** has connected therewith a gear **111** which meshes with a similar gear **112** attached to the other end of the shaft **72**. The teeth of the gears **108**, **109**, **111** and **112** are designed to mesh properly when the upper and lower sections are brought into correct adjustment by means of the bolts **45**, **46**, **47** and **48**.

The material which is to be briquetted is fed into the machine by means of the feeding mechanism **13**. The component parts of this portion of the machine are supported on a framework comprising in part, two upright sections **113** and **114** which carry the horizontal top frame members **115** and **116**. Supported on the upright **113** is a side board **117**, and on the upright **114** a side board **118** both of which retain the material on the lower molding section until it reaches a point where it is compressed between the upper and lower mold sections. An end board **119** connecting with the two side boards **117** and **118** also prevents material from falling rearwardly from the lower molding section. Two brackets **121** and **122** support the side boards **117** and **118**, respectively, so as to extend between the upper and lower molding sections to the points of their contact and also prevent the extrusion of material.

To secure a briquette of uniform texture it is essential that a substantially even bed of material be fed between the two molding sections. In order to provide for this, a vibrator **123** operates in conjunction with the feeding mechanism. This vibrator comprises a plow which is formed from two blades **124** and **125** arranged in V-formation. The plow members **124** and **125** are supported on adjustable links **126**, **127** and **128** which depend from the upper framework of the feeding mechanism **13**. This upper framework carries a transverse bar **129** from which depends a vibrating device **131** to which is attached the plow members **124** and **125**. This vibrating device **131** may take any suitable form such as an electric vibrator and the same may be resiliently suspended from the cross member **129** as by the springs **132** and **133**.

By means of the vibrator **131** the plow members **124** and **125** are continuously vibrated longitudinally of the lower mold section **12** which vibratory action in addition to performing a smoothing function tamps the material fed into the machine to provide a substantially even bed.

Having thus described the apparatus which forms part of the invention, a teaching of the method for briquetting coal, which is carried out by this device together with the theory upon

which this method is believed to be based, will now be given. It is to be expressly understood, however, that no limitation is to be imposed and the invention is not to be limited to any hypothetical principle advanced.

It is to be recalled that the method herein taught applies particularly to the briquetting of heated bituminous coal without the addition of a binder. Under such teaching it is possible to feed the heated coal directly from the heating retort into the machine above described for forming the same into briquettes. In this case straight bituminous coal, or a mixture of bituminous coal with anthracite coal or coke up to 40 per cent of the latter ingredients, may be molded. Further the heated coal may be processed in the retort to any desired degree of devolitalization or carbonization, provided that the heating operation is carried to a point where the natural tars of the bituminous coal or coal mixtures are heated to a degree such as to become viscous and tacky, and moreover that such heating is not carried to the point where these substances are no longer present in the material to act as a binder for the briquette.

It is to be further pointed out that the method taught lends itself particularly well to the reclamation of slurry or waste coal which is first treated to remove the foreign matter therefrom, greatly reducing the ash content thereof.

Under the method of the instant invention, any of the aforedescribed fuels may be briquetted by first heating them in retort until the natural tars or other substances having such qualities are made tacky and viscous. In such state, this material is then fed to the briquette machine, aforedescribed, where it is fed between the upper and lower mold sections **11** and **12**. Here the machine is first adjusted by means of the bolts **45**, **46**, **47** and **48** until the upper and lower mold sections of the machine make proper contact between the points **85** and **86** such as to form closed mold compartments between these points. The feeding mechanism is then adjusted by moving the plows **124** and **125** vertically to the proper height to provide for a measured bed of the heated fuel on the lower mold section **12**. It is to be noted that the density of the briquette being formed is governed by the depth of the fuel bed, there being no other adjustment providing for this particular factor. As the fuel bed of measured thickness is moved between the upper and lower mold sections it will be observed (Fig. 1) that the same is gradually compressed from the point **84** to the point **85**. Under this operation the entrained gases in the fuel are gradually expelled before the fuel mass is moved into the full mold compartments formed by the coacting quarter mold compartments of the upper and lower mold sections. From the point **85** to the point **86** the coal is retained in the mold for a period of time which may be in the order of several seconds. Under the theory of the instant teaching, it is believed that this prolonged molding period in which the mass of the material is compressed to a predetermined fractional volume of the original measured bed and is confined in the molds for a period of seconds overcomes the elasticity of the viscous and tacky substances in the coal. Moreover it is believed that this prolonged molding time operates to expel additionally entrained gases and that the combination of these two operations renders the molded briquettes incapable of breaking due to

its adherent elasticity or to entrained gases. It is also conceivable that the prolonged molding time may operate as a cooling period in which the viscous and tacky substances become set due to loss of heat. In any case it has been found by imperical means that a briquette which is retained in the mold for a period of time, in the order of several seconds, will not break upon its release from the mold.

Although the operation of the machine is now thought to be apparent, it is considered advisable to treat in detail the novel feature of the machine which prevents the adherence of the formed briquette upon discharge. Here the novel arrangement of the mold compartments which calls for the segmentation of them in a manner heretofore described, is responsible for these results. Thus, as will be seen in Fig. 6, as the lower mold section is moved and the segment **88** is broken away from the segment **87**, it will be apparent that the briquette which is carried in these two quarter mold compartments can adhere to the same on one-fourth of its surface area, only. Obviously the upper quarter portion of this compartment has moved out of contact with the briquette, and regardless to which quarter section of the mold compartment the briquette adheres, it can stick on only one-fourth of its surface area. The weight of the briquette in such case is sufficient to overcome any adhering force and the sticking of the briquette in the mold is entirely eliminated. Moreover, and in view of the fact that the sticking of briquettes in the molds is substantially eliminated, briquette filled mold compartments are not presented during the molding operation and here again greatly increased production is effected.

Various changes may be made in the details of construction, within the scope of the appended claims, without departing from the spirit of this invention. Parts of the invention may be used without the whole and improvements may be added while retaining some or all of the advantages of the invention.

I claim:

1. In a briquetting machine, a mold section taking the form of a continuous belt and comprising a plurality of segments carrying a plurality of mold compartments thereon, an elongated frame supporting shaft bearings and journals on its ends, a shaft mounted for rotation at each end of said frame, two sprocket wheels attached to each of said shafts, means for connecting said segments together having extensions engageable in teeth in said sprocket wheels, and a plurality of supporting wheels carried on each of said shafts intermediate of said sprockets, each of said supporting wheels having a plurality of flat surfaces disposed radially at their peripheral edge which surfaces mesh with bearing flanges carried on said segments.

2. Apparatus as claimed in claim 1 including track means for supporting a horizontal length of said mold section comprising a plurality of channelled members supported on transverse beams forming a part of said frame, and a plurality of ball bearing trucks mounted for rotation about pins extending through said channelled members at spaced intervals, said trucks being aligned transversely of the track means in alternate channelled members.

3. In a briquetting machine, a lower frame mounted on supports and comprising two beams

crossed with a plurality of transverse members carried on top of said beams, a drive shaft bearinged on one end of said lower frame mounting gears on the ends thereof, a second shaft journalled on the other end of said lower frame, two sprocket wheels mounted on each of said shafts, a plurality of supporting wheels carried on each of said shafts intermediate of said sprocket wheels, a continuous mold section carried over said sprocket and said supporting wheels comprising a plurality of hinged segments having on one face thereof a plurality of quarter-mold compartments, a track supported on top of said transverse members extending substantially the width of said mold section and comprising a plurality of channelled members mounting trucks spaced at intervals throughout their length and in staggered fashion to provide a distributed load supporting means said track being capable of supporting a substantially horizontal portion of said mold section to present half-mold compartments, an upper frame carried on a plurality of uprights extending from the beams of said lower frame, said upper frame comprising two beams crossed with a plurality of transverse members fixed to the underneath side of said beams, a shaft bearinged in one end of the upper frame and mounting on its ends two gears which mesh with the gears supported on the lower frame and a second shaft carried on the other end of said upper frame, an upper mold section substantially the same as that of the lower mold section carried over a plurality of sprockets and supporting wheels fixed to said shafts of said upper frame, and a track depending from the transverse members of said upper frame comprising a plurality of channelled members mounting a plurality of trucks in staggered fashion for evenly supporting a portion of said upper mold section, said upper track being shaped to present a surface of said upper mold section for contact with the horizontal portion of said lower section which surface terminates in arcs of predetermined radii.

4. Apparatus as claimed in claim 3 including adjusting means carried on said uprights for adjusting said mold sections relative one to the other.

5. Apparatus as claimed in claim 3 including means for feeding onto said lower mold section a bed of material with a substantially level top of uniform height.

6. Apparatus as claimed in claim 3 including means providing for the adjustment of said upper and lower sections relative one to the other and means for feeding a bed of material onto said lower section with a substantially level top of uniform height.

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