No. 804,065. PATENTED NOV. 7, 1905.

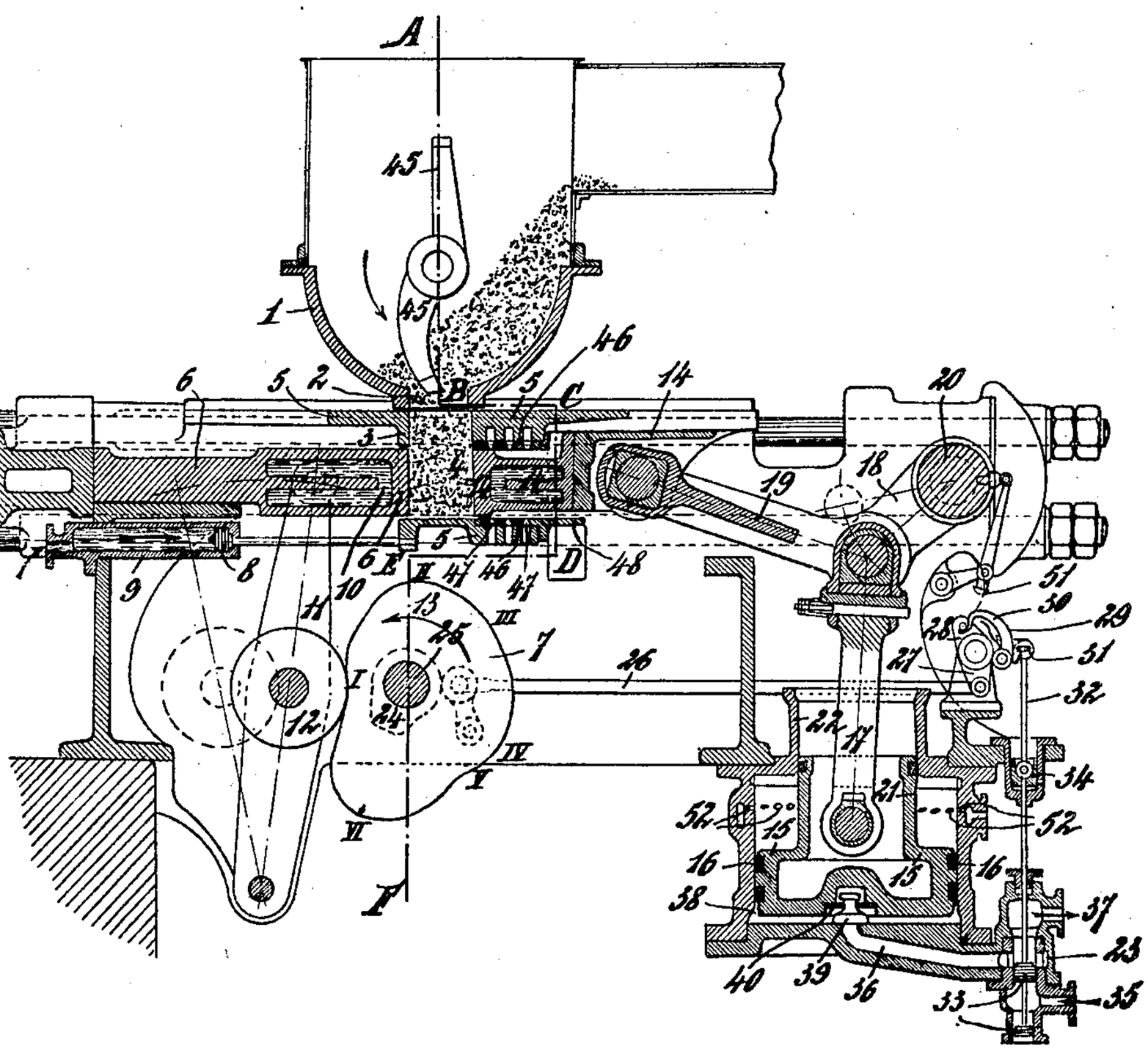
H. A. STEVEN.

BRIQUET MAKING PRESS OR APPARATUS.

APPLICATION FILED MAR. 8, 1905.

5 SHEETS—SHEET 1.

Fig. 1.



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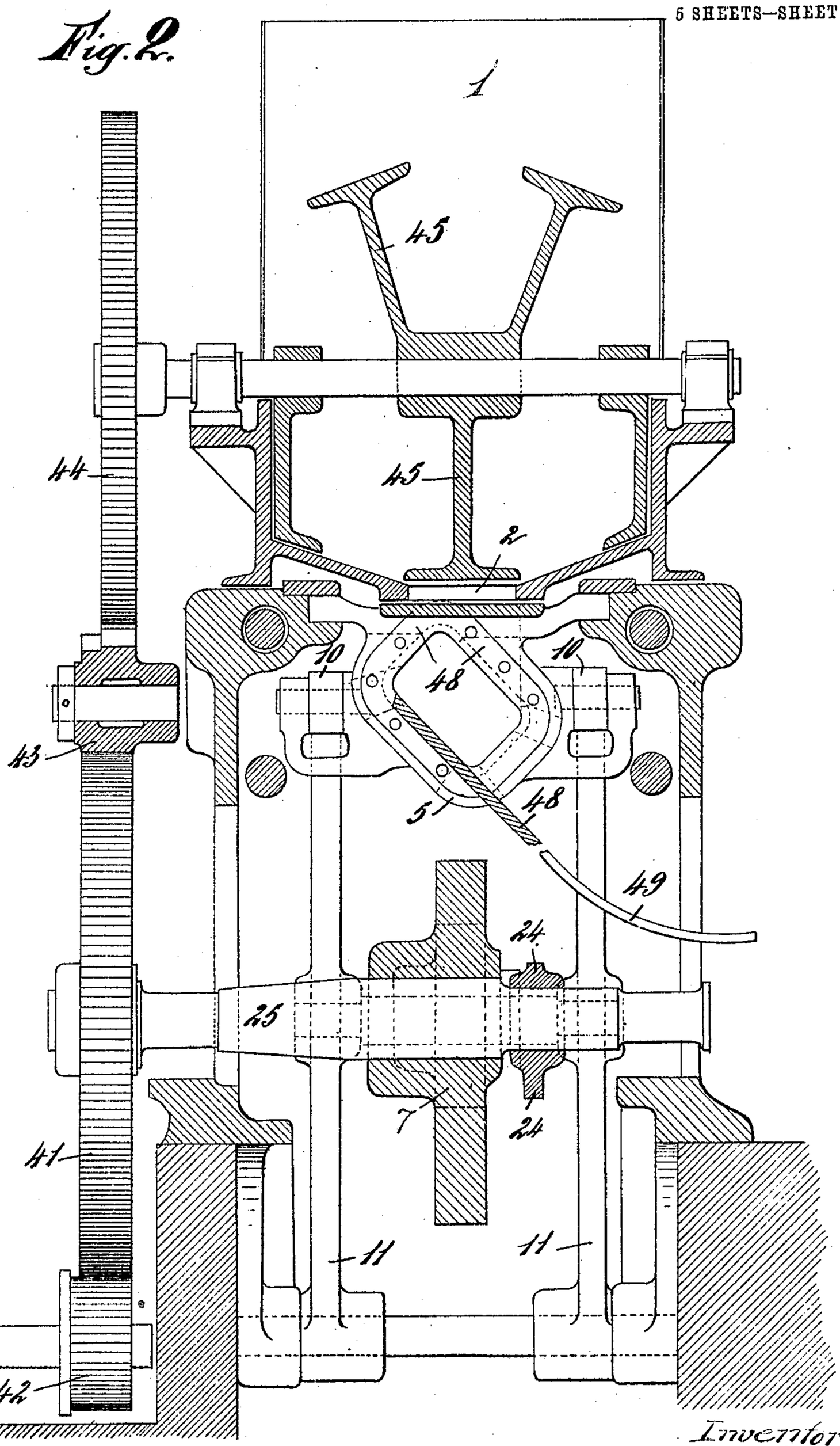
5 SHEETS—SHEET 2.

Fig. 2.



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5 SHEETS—SHEET 3.

Fig. 3.

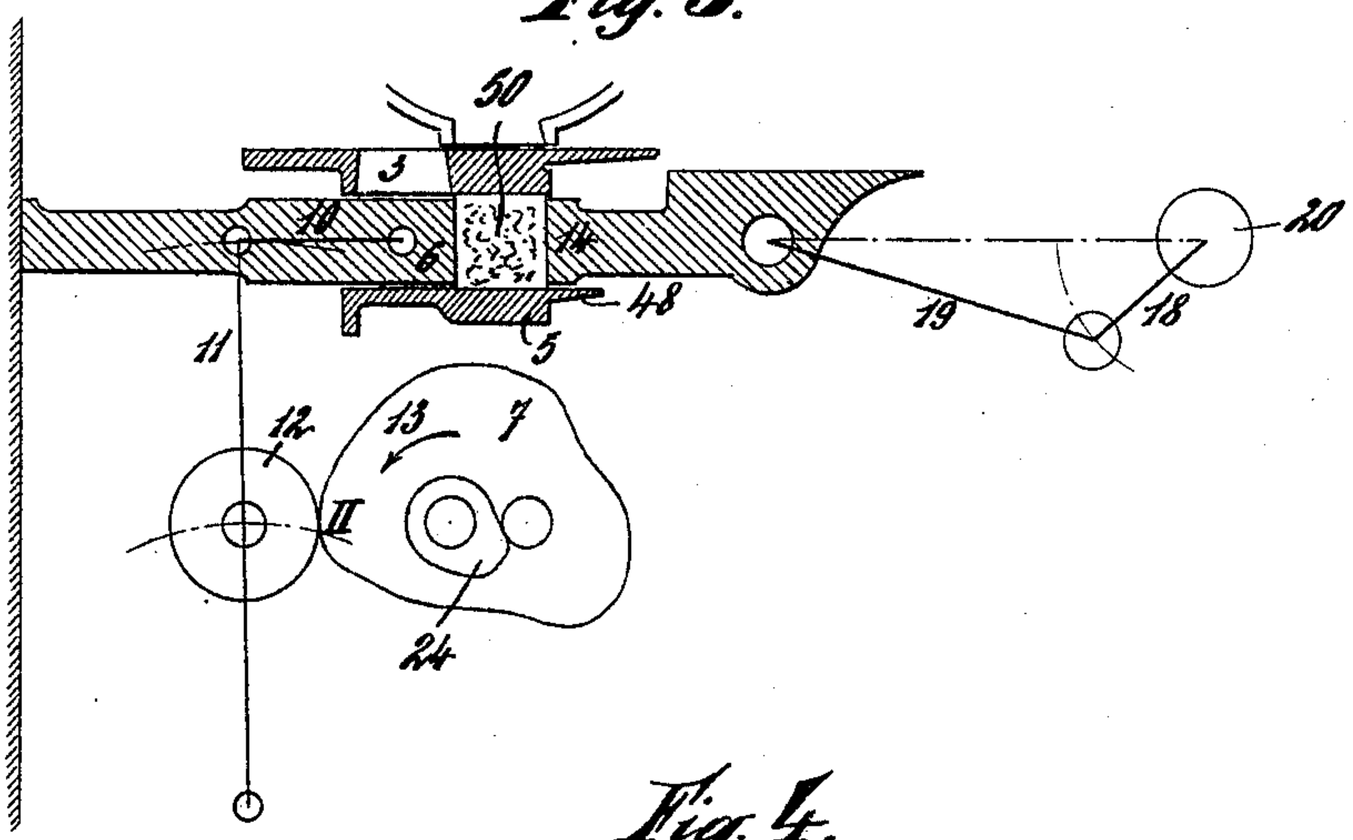


Fig. 4.

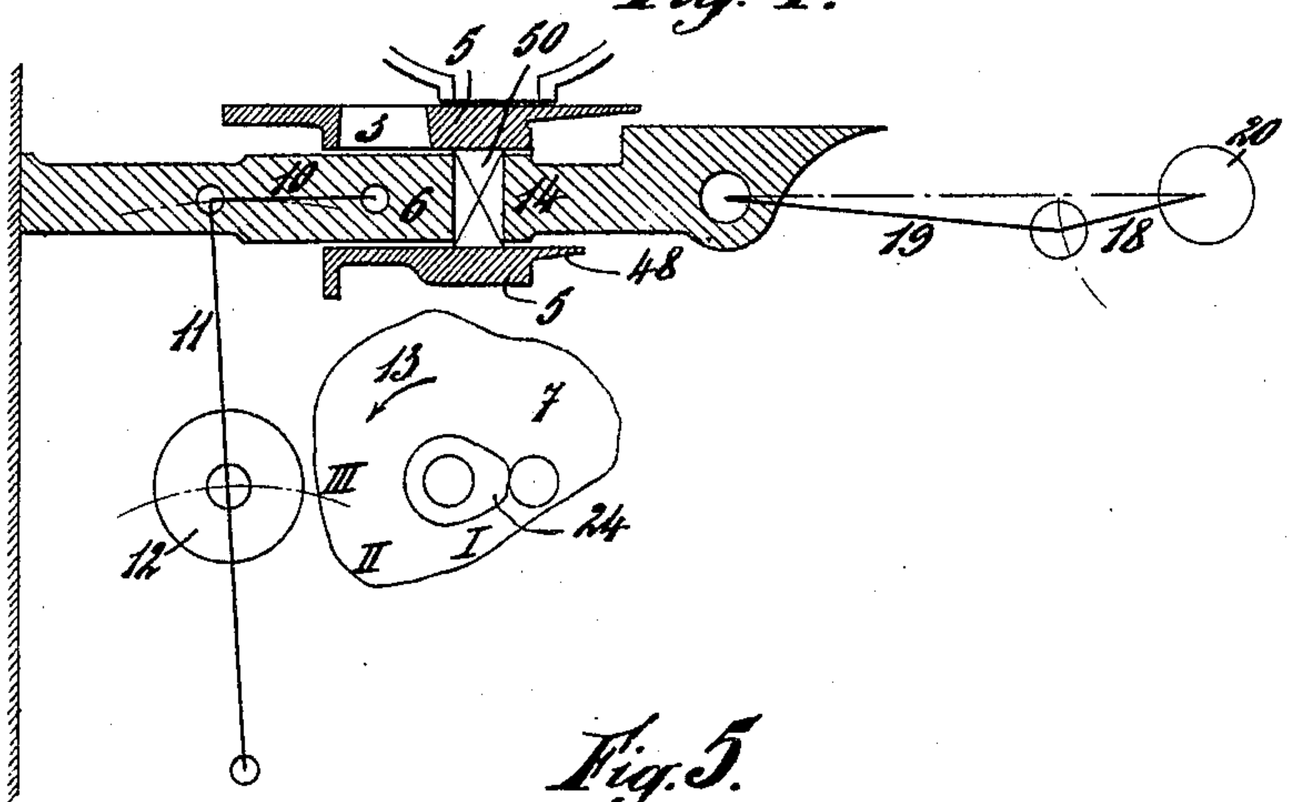
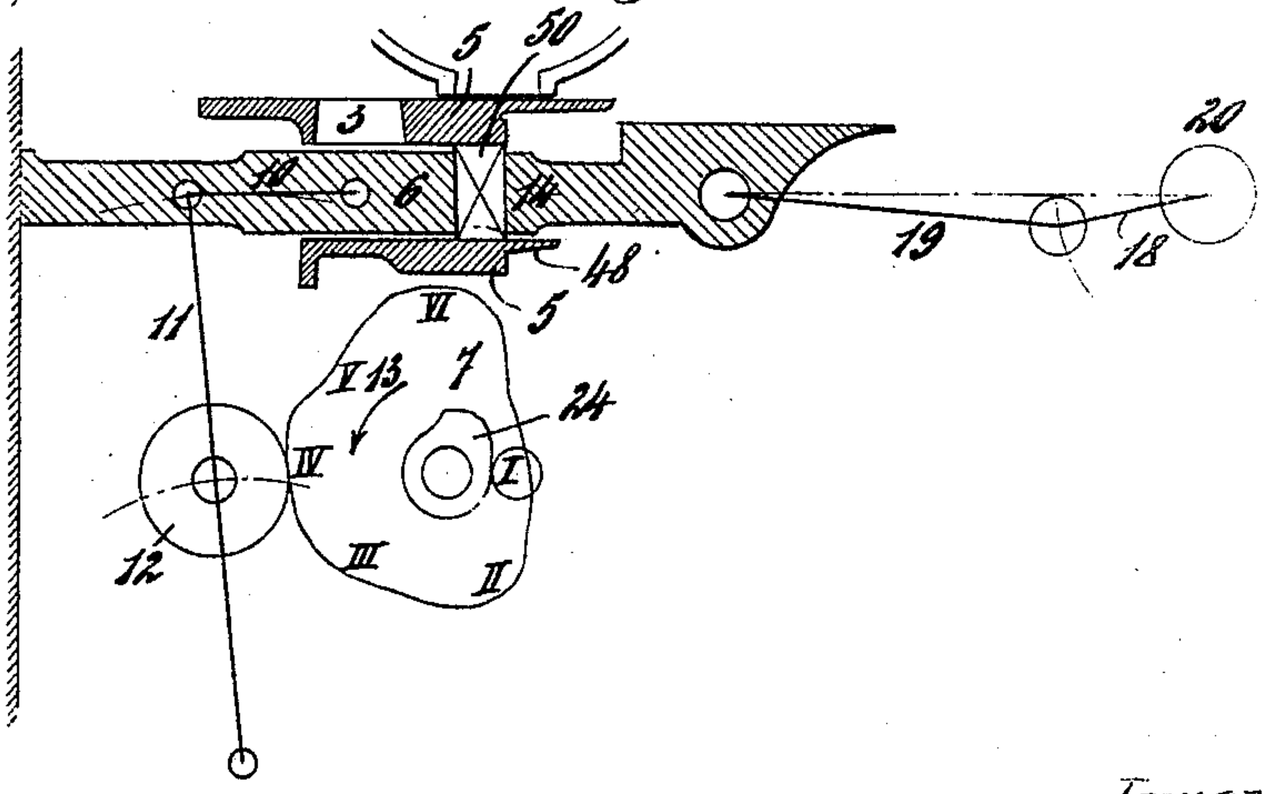


Fig. 5.



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5 SHEETS—SHEET 4.

Fig. 6.

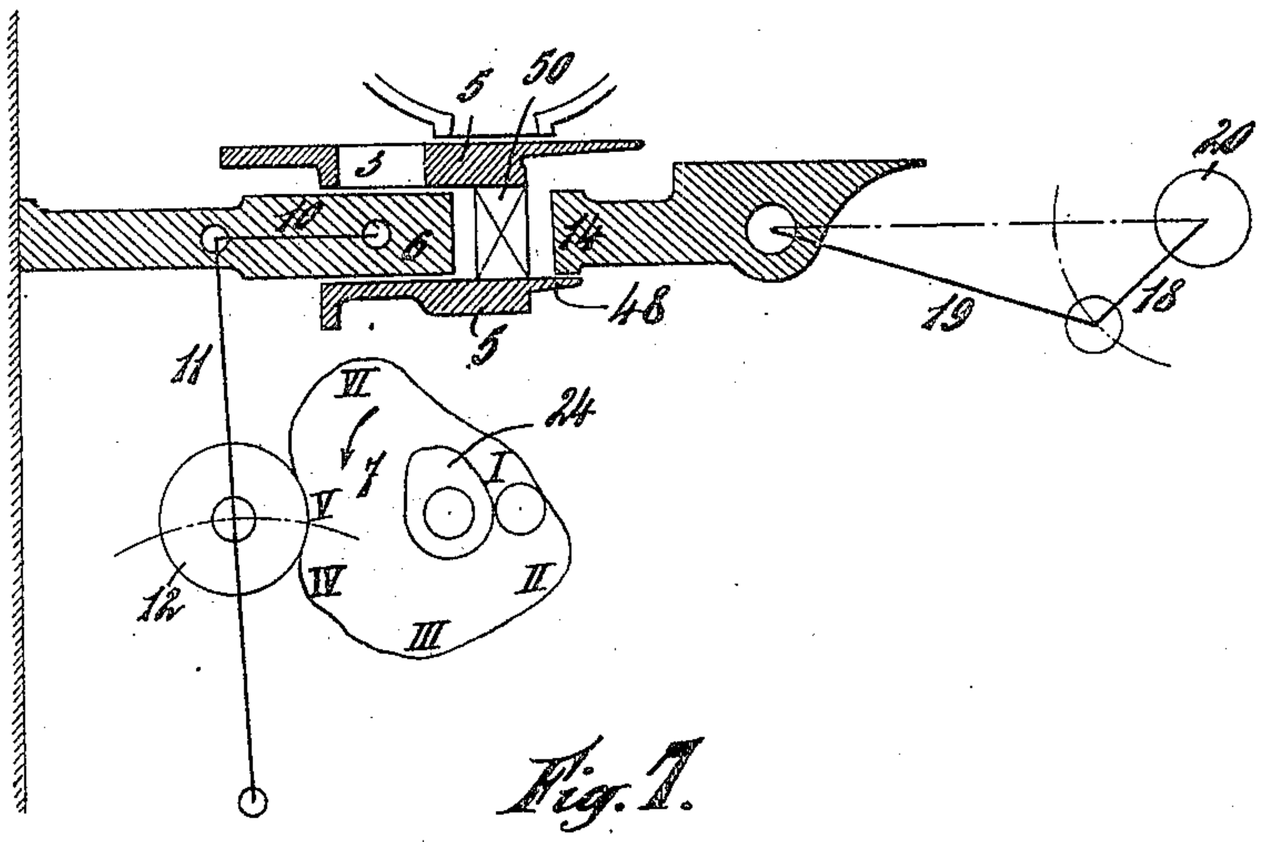
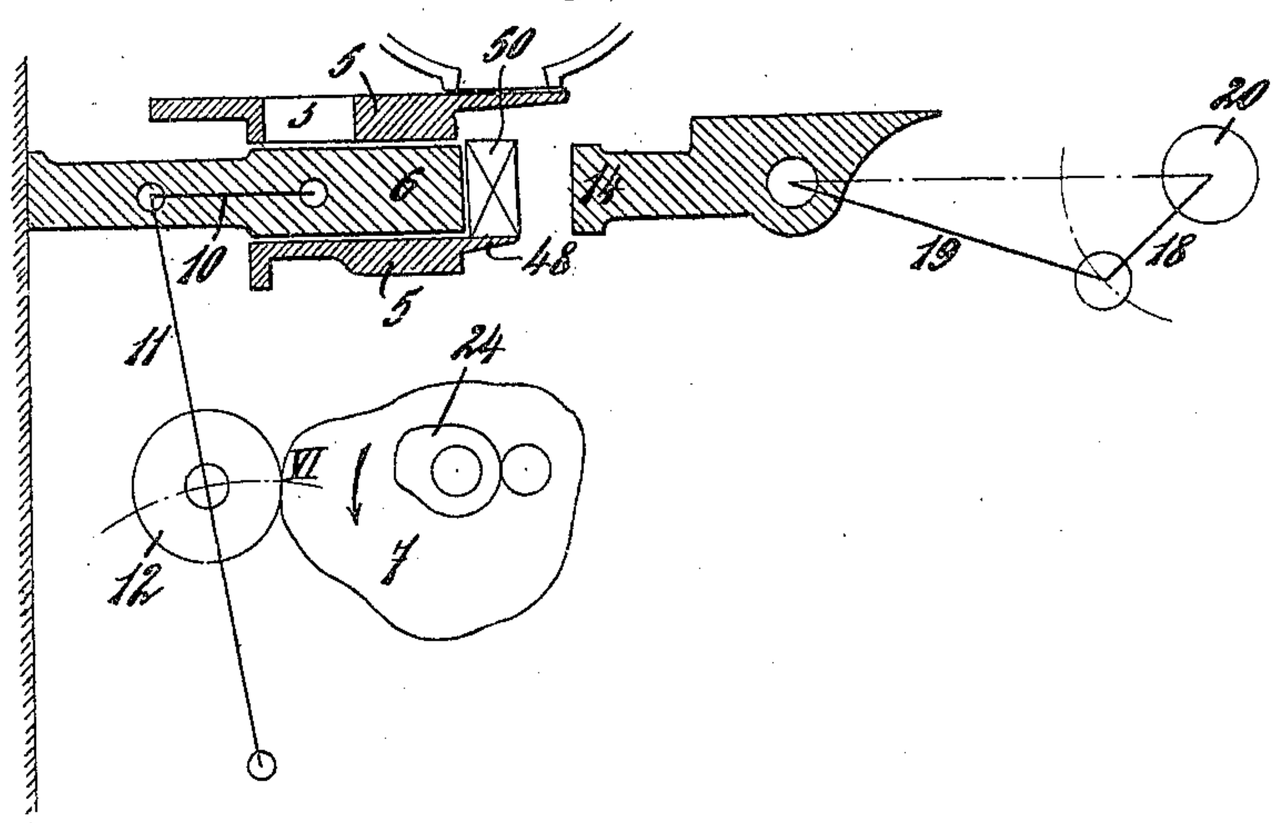


Fig. 7.



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5 SHEETS—SHEET 5.

Fig. 8.

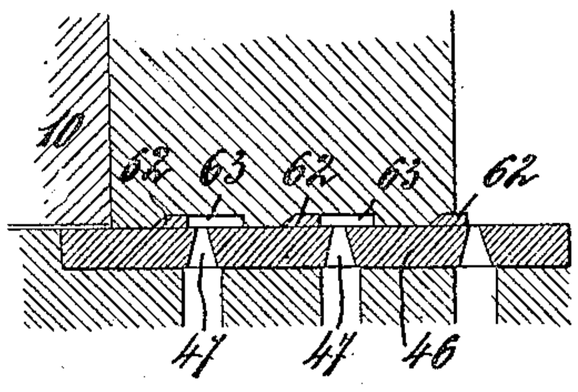


Fig. 9.

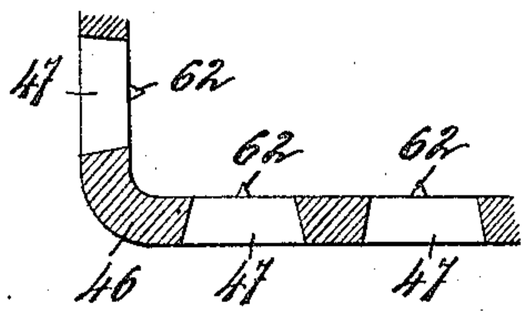


Fig. 10.

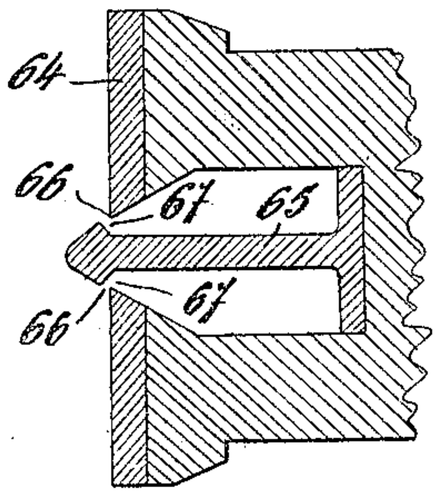


Fig. 11.

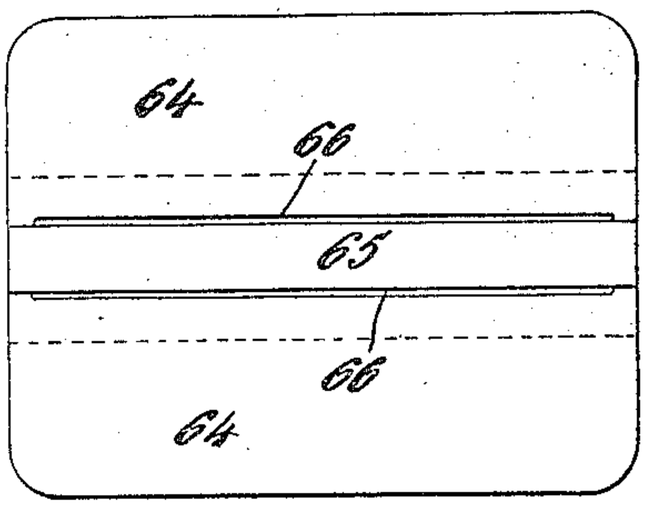
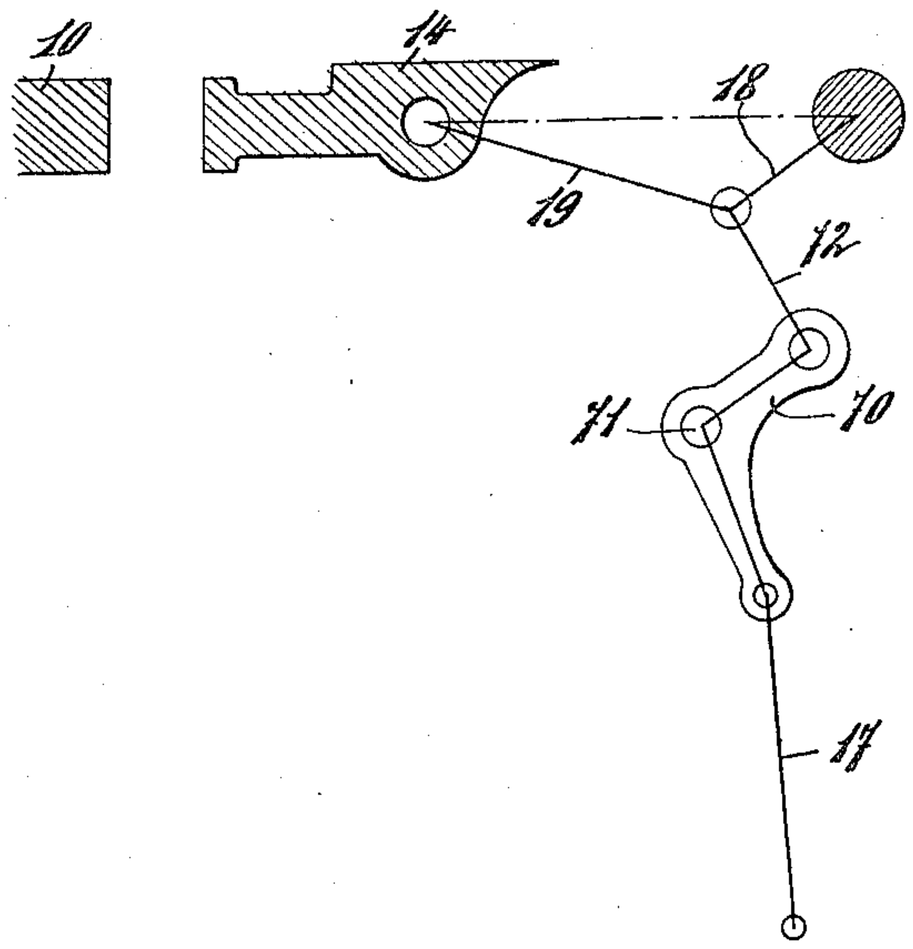


Fig. 12.



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UNITED STATES PATENT OFFICE.

HENRI ACISCLO STEVEN, OF CHARLEROI, BELGIUM.

BRIQUET-MAKING PRESS OR APPARATUS.

No. 804,065. Specification of Letters Patent. Patented Nov. 7, 1905.

Application filed March 8, 1905. Serial No. 249,010.

To all whom it may concern:

Be it known that I, HENRI ACISCLO STEVEN, a subject of the King of Belgium, residing at Charleroi, Belgium, have invented certain new and useful Improvements in or Relating to Briquet-Making Presses or Apparatus, of which the following is a specification.

This invention relates to improvements in that kind of presses or apparatus for making fuel briquets and the like in which the material is compressed in molds by means of compression-pistons.

The object of the invention is to simplify the construction of machines of that kind so as to considerably reduce their cost price and at the same time to produce a machine giving a large output and requiring very little attendance, giving uniform and powerful elastic compression-work acting on the whole surface of the briquet and on the whole mass of it, the compression automatically stopping the moment the supply of the agglomerate substance becomes insufficient, all risk of breakages and accidents thus being avoided, said machine also expelling the water or moisture from the mass being compressed and simultaneously polishing the surface of the briquet, so as to obtain hard products of uniform density, ready at once for transport and for use, of good keeping qualities and very durable.

The means for attaining this object consist, chiefly, in the special arrangement and construction of the mold and of the compression-piston and in the driving of these parts in such a manner as to effect quite a special work of compression.

It is well known that in order to give to conglomerate material uniform density recourse is generally had to double compression, obtained by the simultaneous action of two compression-pistons. In order, however, to obtain double compression by means of a single compression-piston, presses have been designed in which the mold is driven at a given moment, either by a mechanically-driven compression-piston or by connecting organs of the latter, against a piston which remains stationary during the compression. These latter presses are necessarily of complicated construction and besides absorb too much motive power and do not by any means give the briquet uniform density, as the compression and the speed of movement of the material treated do not depend merely on the mechanical movement of the piston, but also on the variable nature of the material, and consequently the speed of the mold carried along with the piston does not correspond to the speed of movement of the material during compression, and the mold, although it does move in the direction of the work of the piston, still acts both against the realization of a complete compression reaction at that face of the briquet which is opposite that on which the compression-piston acts directly and continuous and uniform compression of the agglomerate material.

In the machine according to this invention the mold is evenly moved toward a stationary piston in the direction of the operative movement of the compression-piston; but the driving-gear of the mold is independent of that of the compression-piston and is arranged in such manner that at a given moment of the compression period there should be a complete agreement between the speed of movement of the mold and the speed of movement of the material being treated, so that at that moment the pressure on both faces of the briquet is balanced and double compression is attained in a complete manner by a reaction of pressure transmitted direct by the material without any resistance of the wall of the mold.

The independence of the two movements of the piston and of the mold from each other is rendered still more complete by the use of a compression-piston actuated by an elastic fluid under pressure, (steam &c.,) and by a special arrangement of the driving-gear for the mold in such manner that though driven in the direction of the active travel of the piston the mold is free to move in the same direction and, if necessary, can follow the inner pressure—that is to say, move with the briquet in the course of formation completely independently of the piston. This combination of a compression-piston operated by an elastic fluid and of the special independent drive for the mold enables, moreover, the latter to be arranged so as to move with a greater speed than that of the material treated, so that not only pressure on both faces of the briquet is balanced, but also an excess of pressure is obtained on the face opposite that on which the piston acts directly. This possibility of increasing in case of necessity the speed of advance of the mold relatively to the movement of the briquet in the course of formation is utilized in the machine according to this invention at the end of the compres-

sion period for polishing the lateral surface of the briquet and at the same time expelling water and steam from the whole surface of the latter through perforations or conduits made in the mold and communicating with the external atmosphere, said conduits, owing to the movement of the mold, coming in contact with the whole surface of the briquet.

The method of working and the above-described arrangements allow, moreover, the drive for the mold to be arranged in such manner that it effects a whole series of special movements. The mold passes beyond the bottom of the stationary piston, so as to eject the briquet, and the piston can therefore be made permanently stationary. In view of the strong compression, however, the briquet remains adhering to the surface of the bottom of the mold. As the latter is made fixed, it is again the mold that is made to bring about the disengagement by a slight recoil previously to the removal from the mold.

In short the operative gear of the mold is such that it produces the filling of the material, direct compression reaction by the material so as to balance the pressure at a given moment, or even to produce an excess of pressure at the side of the fixed bottom, the polishing of the surface and the extraction of water, the disengagement of the briquet from the bottom, and the removal from the mold.

The arrangement of the piston operated by steam in combination with a free mold does away with every other apparatus, (hydraulic &c.,) for equalizing the pressure on the briquet and enables the compression-piston to adapt itself to the degree of compressibility of the material treated and to any differences in the quantity supplied.

In order to simplify the valve-gear of the steam-piston and to adapt it to the work of the compression-piston, the steam-cylinder is made single-acting and is preferably vertical, the weight of the piston and of the parts connected to it being utilized for the return of the piston and for the recoil of the compression-piston, a cushion of steam kept back during the exhaust serving as a dash-pot and preventing the piston from actually striking against the bottom of the cylinder.

The steam-piston is combined with safety devices, which bring about the exhaust of steam and cut off admission or limit the stroke of the steam-piston when the press is working idle or with insufficient supply of material for making briquets.

A press according to this invention is illustrated, by way of example, in the accompanying drawings.

Figure 1 is an elevation in longitudinal section. Fig. 2 is a cross-section on the irregular line A B C D E F of Fig. 1. Figs. 3 to 7 illustrate diagrammatically the working together of the compression-piston and of the mold. Figs. 8 and 9 are respectively longitudinal and cross-sections of a mold slightly modified with a view to facilitate the discharge of water. Figs. 10 and 11 are respectively a longitudinal section and a front elevation of a compressing-piston with orifices for the discharge of water. Fig. 12 is a modified construction of the gear operating the compressing-piston.

The coal-paste or other material for the manufacture of briquets is fed from the hopper or distributer 1 through an opening 2, Fig. 1, and enters through an orifice 3 the chamber 4 of the mold 5, brought by its own gear below the orifice 2. The mold 5 executes a reciprocating movement, in which it is guided on the fixed piston or bottom 6 and on the frame of the machine. The movement is imparted to the mold by a cam 7, acting against a suitable opposing pressure—for instance, that of a piston 8 of a cylinder 9, &c., always full of steam. The action of the said piston 8 is to press the mold by means of connecting-rods 10 and 11 and a roller 12 against the surface of the cam 7, rotating in the direction of the arrow 13. The compression-piston 14 is guided in a guide of the frame and in the interior of the mold 5. The piston 14 is driven by a steam (or other compressed-fluid) piston 15, preferably arranged in a vertical cylinder 16 and having its connecting-rod 17 acting on a flexible bend or toggle-joint constituted by levers 18 and 19, pivoted, on the one hand, to a fixed pivot 20 and, on the other hand, to the movable compression-piston 14.

The connecting of the steam-piston 15 to the compression-piston 14 by means of a toggle-joint results in a progressive increase of the effort on the compression-piston in accordance with the requirements of compression, which must be always gradual. This connection results also in reducing to a minimum the stroke of the piston 15, and therefore the consumption of steam. The steam-piston 15 is provided with an extension 21, serving to guide the piston in a correponding reduced part 22 of the cylinder 16.

The valve-gear 23 of the steam-cylinder 16 is operated by a cam 24, keyed to the same spindle 25 as the cam 7 and acting by means of a rod 26 on levers 27 and 28, the latter of which carries a pawl 29, controlled by a spring 30 and engaging with a free lever 31, attached to the rod 32, operating the piston-valves 33 33 and provided besides with an air-brake or dash-pot 34.

Steam enters at 35 and passes into the cylinder 16 through the port 36 and escapes through the exhaust-outlet 37.

The advance of the piston 15, bringing about the compression of the agglomerate material by the compression-piston 14 and the mold 5, is produced by the admisson of steam, while the descent of the piston 15, pro-

ducing the return of the piston 14, is produced by the weight of the piston 15 and of the rods 17 18 19.

In order to prevent shocks during the descent of the piston 15, a steam-cushion is provided at 38 at the end of the stroke in the cylinder 16 below the piston 15. To that end the piston 15 is provided with a valve 39, freely suspended in a disk 40, so as to project beyond the end of the piston and at the same time to have the desired clearance for moving when the piston approaches the bottom of the cylinder. On the descent of the piston this valve comes to rest against the exhaust-opening 36 in the bottom of the cylinder, and thus traps a quantity of steam before the piston can strike the bottom of the cylinder. The quantity of steam thus trapped forms an elastic cushion preventing the piston from striking the bottom of the cylinder.

The shaft 25, carrying the cams 7 and 24, receives its movement from a toothed wheel 41, driven by a pinion 42, operated from a counter-shaft. An intermediate pinion 43 transmits the rotary movement to a toothed wheel 44, operating the stirring apparatus 45 in the hopper.

In the mold 5 is a jacket or lining 46, provided with grooves or openings 47, communicating with the external atmosphere and enabling gases, steam, and water to escape during a portion of the compression period. The cell in which the briquet is formed is inclined relatively to the horizontal line, Fig. 2, so as to produce a briquet in an inclined position ready to slide out downward. This enables a slide 48 to be secured to the mold, the said slide receiving the briquet ejected from the mold by the movement of the latter relatively to the fixed bottom 6, so that the briquet will slide along an inclined plane 49, which brings it out of the machine.

The cam 7, rotating in the direction of the arrow 13, is adapted to communicate to the mold 5 during the compression the advance movement in the direction parallel to the operative travel of the compression-piston 14 toward the fixed piston 6, but independent of the speed of movement of the said compressor. The shape of the cam 7 is, moreover, such that the mold is given the composite movement previously herein specified.

Owing to the pressure of the steam-piston 8 the roller 12, which is connected to the mold, rests against the surface of the cam 7, so that it can follow the surface of the latter, but can also become disengaged, if necessary, from the surface against which it rests under the influence of the movement of the briquet which is being compressed.

In Fig. 1 the mold is shown in the filling position, the least projecting point I of the cam 7 being in contact with the roller 12. The cam 7 in its rotation pushes the mold 5 forward, and when its point II is in contact with the roller 12, Fig. 3, the material to be agglomerated is inclosed between the fixed piston 6 and the compression-piston 14. At the same moment the valve-gear operated by the small cam 24 admits steam into the cylinder 16, and the compression-piston 14, driven forward, compresses the material.

The resistance offered by the material owing to the pressure against the inner wall of the mold 5 has the tendency to push the mold forward in the direction of the operative travel of the compression-piston 14. As the mold is practically free in that direction, it can obey that pressure, (in opposition to the weak pressure of the small steam-piston 8,) and the roller 12 becomes separated from the cam 7, Fig. 4. The material can therefore at that moment produce direct and without any resistance such a reaction on the face of the fixed piston 6 that the pressure on the fixed piston 6 is practically the same as on the compression-piston 14.

It need scarcely be stated that owing to the independence of movement of the mold and of the compression-piston the cam, if necessary, could be provided, beginning at the point II, with a projection or eccentricity such that the roller 12, and therefore the mold 5, would be carried during the compression by the cam itself at a greater speed than that of the movement of the material, so that the mold would be brought by the cam into the position shown in Fig. 4 or even beyond. This working would result in certain cases in producing, by means of the movement of the mold, a greater pressure on the side of the fixed piston 6. It is obvious that with such a form of cam there will be a moment between the points II and III when the independent movement of the mold will result in balancing the pressure on both faces. There is, however, an advantage from the point of view of better utilization of the elasticity of pressure by means of the action of the steam-piston, from the point of view of obtaining greater duration of the double compression within the period of time limited by the travel of the parts, as well as from the point of view of obtaining uniform products by means of varying raw materials in allowing the mold to obey directly and automatically the inner pressure and in not exaggerating the eccentricity of the cam at the point corresponding to the beginning of the production of double compression.

It is necessary for the purpose hereinafter described to accelerate the speed of advance of the mold toward the end of the operation, to which acceleration corresponds an increase in the eccentricity of the cam extending from the point III to the point IV, Fig. 5. During the time that the compression-piston 14 maintains double pressure on both sides of the briquet the mold 5 advances toward the fixed piston 6, the result being a polishing of the surface of the briquet owing to the friction of the wall of the mold against the ma-

terial; but at the same time, owing to the presence of the perforations 47, Fig. 1, in the wall of the mold, any water, gas, or steam contained in the material are expelled, this expulsion being the result of the inner pressure as well as of the movement of the said perforations 47 in the wall of the mold on the lateral surface of the briquet. While the cam 7 continues to rotate in order to arrive at the point V, Fig. 6, the compression-piston 14 ceases to compress the steam-valve gear operated by the cam 24, opening the exhaust in the steam-cylinder 16, Fig. 1, the piston 14 returns to its original position, and at the same time the recess on the circumference of the cam 7 enables the mold 5 to follow the impulse of its steam-piston 8, Fig. 4, and also to recede to a very small extent; but as the briquet 50 strongly adheres to the wall of the mold the said mold carries with it the briquet, and thus disengages it from the wall of the fixed piston or bottom 6, to which it also adhered. This disengagement enables the subsequent ejection of the briquet to take place by the advance of the mold toward the said fixed bottom 6. This latter movement is produced by the roller 12 traveling on the surface of the cam from the point V to the point VI, Fig. 7. The mold advances toward the fixed piston 6 until the latter has passed beyond the outer surface of the mold and disengaged the briquet 50, which is thus pushed onto the slide or chute 48, secured to the mold, so that it comes out from the machine completely finished. While the cam is turning to bring its point I opposite the roller 12 the mold under the action of the steam-piston 8 returns with great speed to its initial filling position, Fig. 1, in order to continue its work in the manner described. The arrangement could also be made such that the mold would move to eject the briquet by moving in the direction of the compression-piston 14 and passing beyond it either during its recoil or at the moment where it stops.

When the charges of material in the mold are sufficient, the reciprocating movement of the compression-piston 14 continues in a regular manner under the action of the steam-engine 15 16; but when owing to a charge being insufficient the steam-piston 15 reaches the limit of its stroke a projection or tappet 51, Fig. 1, depending from a socket on the lever 18 of the flexible bend, strikes the pawl 29, and thus brings about the opening of the exhaust.

The pawl, in combination with the projection or tappet 51, constitutes, therefore, a safety device which prevents the apparatus from passing beyond the dead-point when the press is working idle or with insufficient material for forming an agglomerate block. The operation of the pawl is thus a signal notifying that the supply of material to the mold is not sufficient for forming a good briquet.

A second safety device may be provided for counteracting shocks in case the pawl should fail to act. This device consists in the arrangement of holes 52 in the wall of the cylinder 16 at the normal limit of the stroke of the piston 15. These openings are in communication with the atmosphere and during the normal working of the piston enable air to be drawn in and expelled. When the piston passes beyond the normal limit of its stroke and covers the openings 52 by its upper portion, it imprisons the air, &c., in the upper chamber of the cylinder. This cushion of air forms a spring and deadens any shock of the piston 15 striking against anything, owing to insufficient resistance being present in the mold 5.

The compression-piston 14, owing to the elasticity of its driving-gear and to its combination with the mold with independent movement, can be adapted to the variations of compressibility of the material treated and of the quantity of the charge without the good quality of the briquets being affected.

In order to increase the useful effect of the ports 47 of the mold for discharging water from the briquet being formed, pins 62 can be arranged on the wall of the mold 46, so that during the movement of the briquet in the mold under pressure grooves 63 are formed on the circumference of the briquet, the said grooves by the empty space that they form serving as filters and at the same time as canals through which water passes in order to escape through the perforations 47. (See Fig. 8, longitudinal section, and Fig. 9, cross-section, of the mold.)

In order to increase the discharge of the water, water-outlets can also be made in the compressing-pistons by means of plates 64, secured to the pistons 6 and 14, between which is fixed a punch 65, intended for making notches on the briquets, a small space 66 between the projections of the punch 65 and the plates 64 forming grooves 66 and enabling water to come out in the direction indicated at 67. (See Figs. 10 and 11.) This arrangement by means of the punch 65 enables a fairly wide passage 66 to be obtained, which passage is not exposed to the direct action of the compression, so that in this way the coal is prevented from coming out through the ports 66, while water can freely pass.

In order that it may not be necessary to make the steam-cylinders 16 of too large a diameter in presses for manufacturing large briquets or several briquets simultaneously, for which purpose great power is required, and at the same time in order to reduce to a considerable extent the expenditure of steam, a bell-crank lever 70 may be used, pivoted at 71 and connected to the toggle-joint levers 18 19 by an intermediate rod 72. (See Fig. 12.) In this way at the starting of the piston 15 a small travel of the latter produces a great

movement of the compressing-piston 14, while at that moment the resistance to be overcome is very small, while at the end of the stroke the piston 15 travels nine to twelve times as great a distance as the piston 14 at the moment when great compressive power is required.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a briquet-press the combination of a movable compression-piston, means for reciprocating the compression-piston, a stationary piston, arranged axially with the compression-piston, a movable mold coöperating with the compression-piston and the stationary piston, said mold receiving the material of which the briquet is formed and being free to move along with and in the direction of the operative movement of the compression-piston owing to the friction between the briquet and the walls of the mold, and positive means for moving the mold in the direction of the operative movement of the compression-piston.

2. In a briquet-press the combination of a movable compression-piston, means for reciprocating the compression-piston, a stationary piston arranged axially with the compression-piston, a movable mold for the briquet cooperating with the compression-piston and the stationary piston; positive means for moving the mold in the direction of the operative movement of the compression-piston and elastic means tending to move the mold in the direction opposite to the operative movement of the compression-piston and capable of being overcome by the friction between the material forming the briquet and the walls of the mold.

3. In a briquet-press the combination of a movable compression-piston, a main frame, a cylinder mounted on the frame and having inlet and outlet steam-ports, means for controlling said ports, a steam-operated piston movable within the cylinder, a connecting-rod pivoted to the steam-piston, a rod pivoted to the compression-piston, a rod pivoted to the main frame and also to the connecting-rod and the compression-piston rod, a stationary piston arranged axially with the compression-piston, a movable mold coöperating with the compression-piston and the stationary piston, said mold receiving the material of which the briquet is formed and being free to move along with and in the direction of the operative movement of the compression-piston owing to the friction between the briquet and the walls of the mold, and positive means for moving the mold in the direction of the operative movement of the compression-piston.

4. In a briquet-press the combination of a movable compression-piston, a main frame, a vertical cylinder having inlet and outlet steam-ports, means for controlling said steam-ports, a piston actuated by the steam during its upward operative stroke and caused to move downward by its own weight, means for transmitting the movements of the steam-piston to the compression-piston, means for entrapping a cushion of steam between the piston and the lower end of the cylinder, a stationary piston arranged axially with the compression-piston and a mold for the briquet cooperating with the compression-piston and the stationary piston and movable independently of the compression-piston.

5. In a briquet-press the combination of a movable compression-piston, means for reciprocating the compression-piston, a stationary piston arranged axially with the compression-piston, an inclined mold for the briquet cooperating with the compression-piston and the stationary piston and movable independently of the compression-piston, means for moving the mold in the direction opposite to that of the operative stroke of the piston until the briquet is detached from the stationary piston, means for moving the mold in the same direction as the operative stroke of the compression-piston until the briquet is clear of the mold, said means operating during the movement of the compression-piston in the opposite direction and a discharge-slide for the briquet secured to the mold.

6. In a briquet-press the combination of a movable compression-piston, means for reciprocating the compression-piston, a stationary piston arranged axially with the compression-piston, a mold for the briquet laterally perforated adjacent to the compression-piston, means for moving the mold in the same direction as but quicker than the compression-piston during its operative stroke until the briquet is forced into the perforated portion of the mold by the stationary piston.

7. In a briquet-press the combination of a movable compression-piston, means for reciprocating the compression-piston, a stationary piston arranged axially with the compression-piston, a mold for the briquet coöperating with the compression-piston and the stationary piston and movable independently of the compression-piston, and groove-forming projections on the internal face of said mold.

8. In a briquet-press the combination of a movable compression-piston formed with water-discharge conduits in its compression-face, means for preventing solid matter from passing into said conduits, means for reciprocating the compression-piston, a stationary piston arranged axially with the compression-piston and a mold for the briquet coöperating with the compression-piston and the stationary piston and movable independently of the compression-piston.

9. In a mechanism of the class described, the combination of a stationary piston, a movable mold adapted to slide longitudinally of said stationary piston, a compression-piston secured contiguous to said mold and stationary piston, a cylinder secured at an angle to

the plane in which said compression-piston is adapted to move, a piston secured within said cylinder, levers pivotally connected and pivotally secured to said compression-piston, means connecting said levers to said piston within said cylinder, whereby reciprocating movement will be imparted to said compression-piston, when said cylinder-piston is actuated, and a valve mechanism secured contiguous to said cylinder and coacting with said cylinder-piston for operating the same.

10. In a mechanism of the class described, the combination with a support, of a bodily-movable mold carried by said support, a cylinder carried by said support contiguous to said mold, a piston positioned within said cylinder and connected to said mold, said cylinder and piston providing means whereby said mold may be moved to its normal position for receiving material, a compression-piston carried by said support contiguous to said mold, pivotally-connected lever members secured at one end to said support and at their opposite end to said compression-piston, and means capable of moving said lever means for reciprocating said compression-piston.

11. In a mechanism of the class described, the combination with a support, of a bodily-movable mold carried by said support, a cylinder carried contiguous to said mold, a piston mounted in said cylinder, means connecting said piston and mold, said piston capable of moving said mold to its normal position for receiving material, and compression means secured contiguous to, and coacting with said mold.

12. In a mechanism of the class described, the combination with a support, of a bodily-movable mold carried by said support, a cylinder carried by said support and positioned parallel to said mold, a piston mounted within said cylinder, means connecting said mold and piston, said piston adapted to be moved longitudinally in said cylinder for retaining said mold in its normal position for receiving material to be molded, and compression means secured contiguous to and coacting with said mold.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HENRI ACISCLO STEVEN.

Witnesses:
A. GRAEB,
MAURICE GERBCAULT.