(No Model.) 2 Sheets—Sheet 1.

T. M. COCHRANE.

MACHINE FOR COMPRESSING FUEL.

No. 541,069. Patented June 18, 1895.

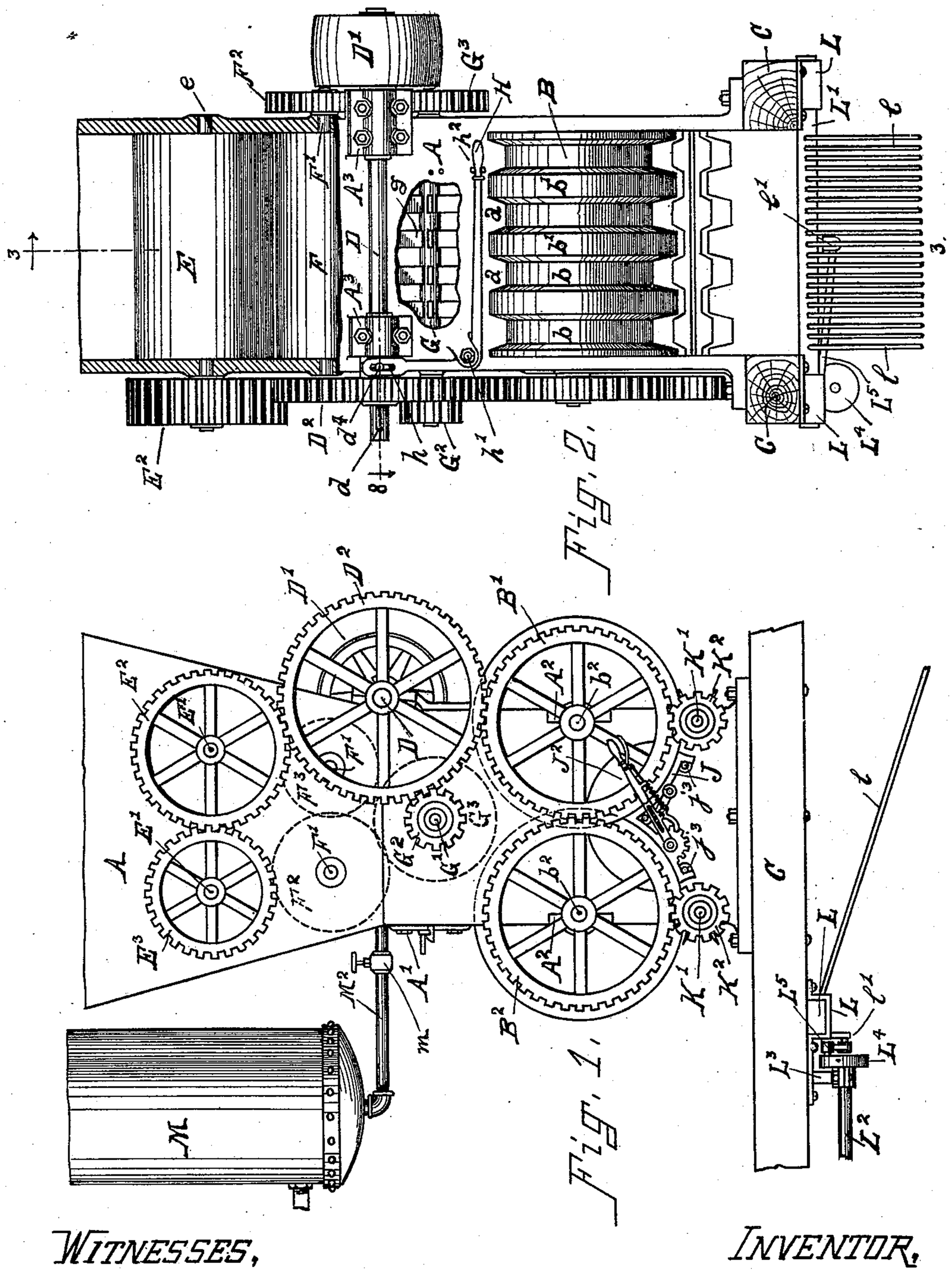

Fig. 2.

Fig. 1.

WITNESSES,

Tad Bailey.

William Q. Olden.

INVENTOR,

Thomas M. Cochrane,

by N. DuBois, his Atty.

(No Model.) 2 Sheets—Sheet 2.

T. M. COCHRANE.

MACHINE FOR COMPRESSING FUEL.

No. 541,069. Patented June 18, 1895.

Fig. 8.

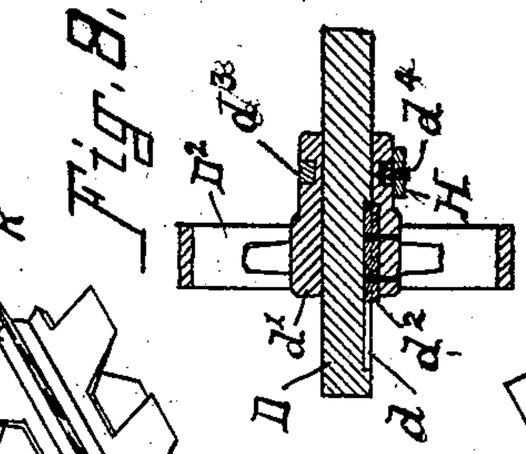

Fig. 4

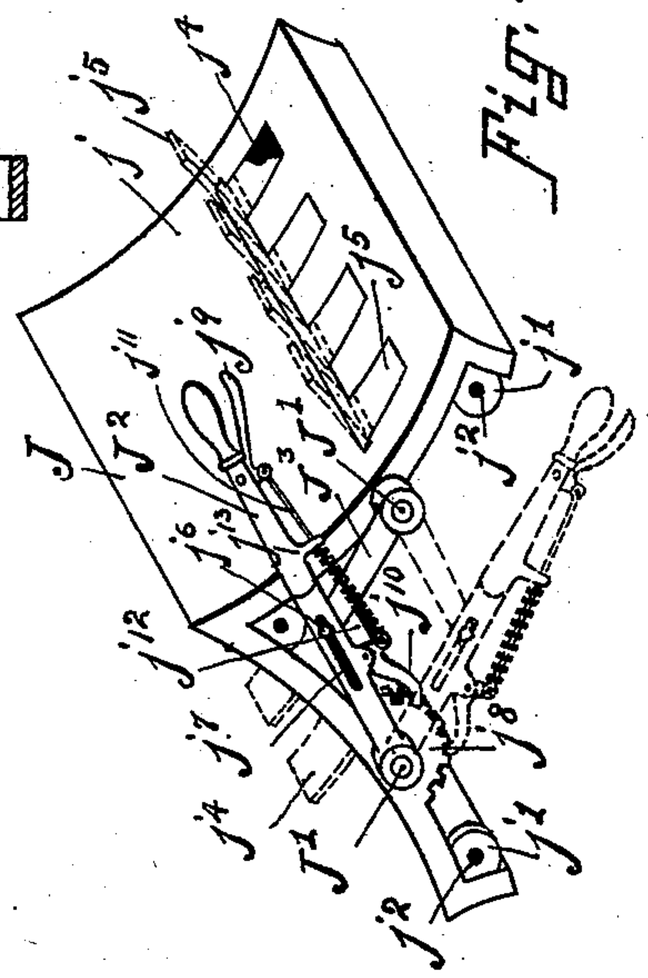

Fig. 6.

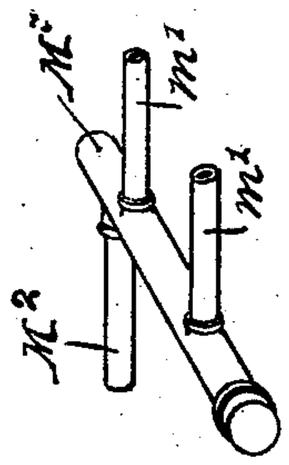

Fig. 5

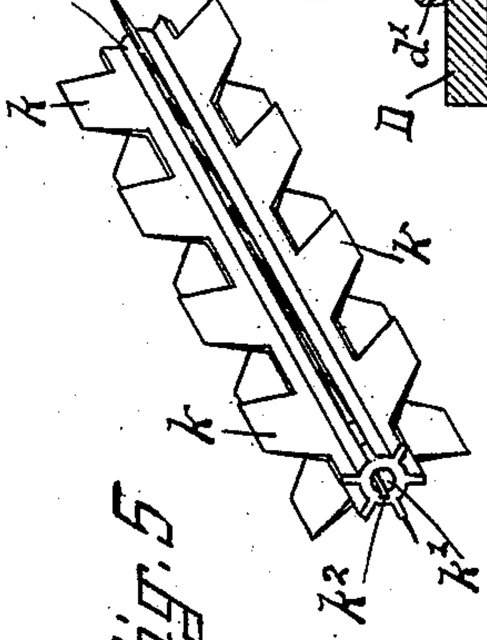

Fig. 1.

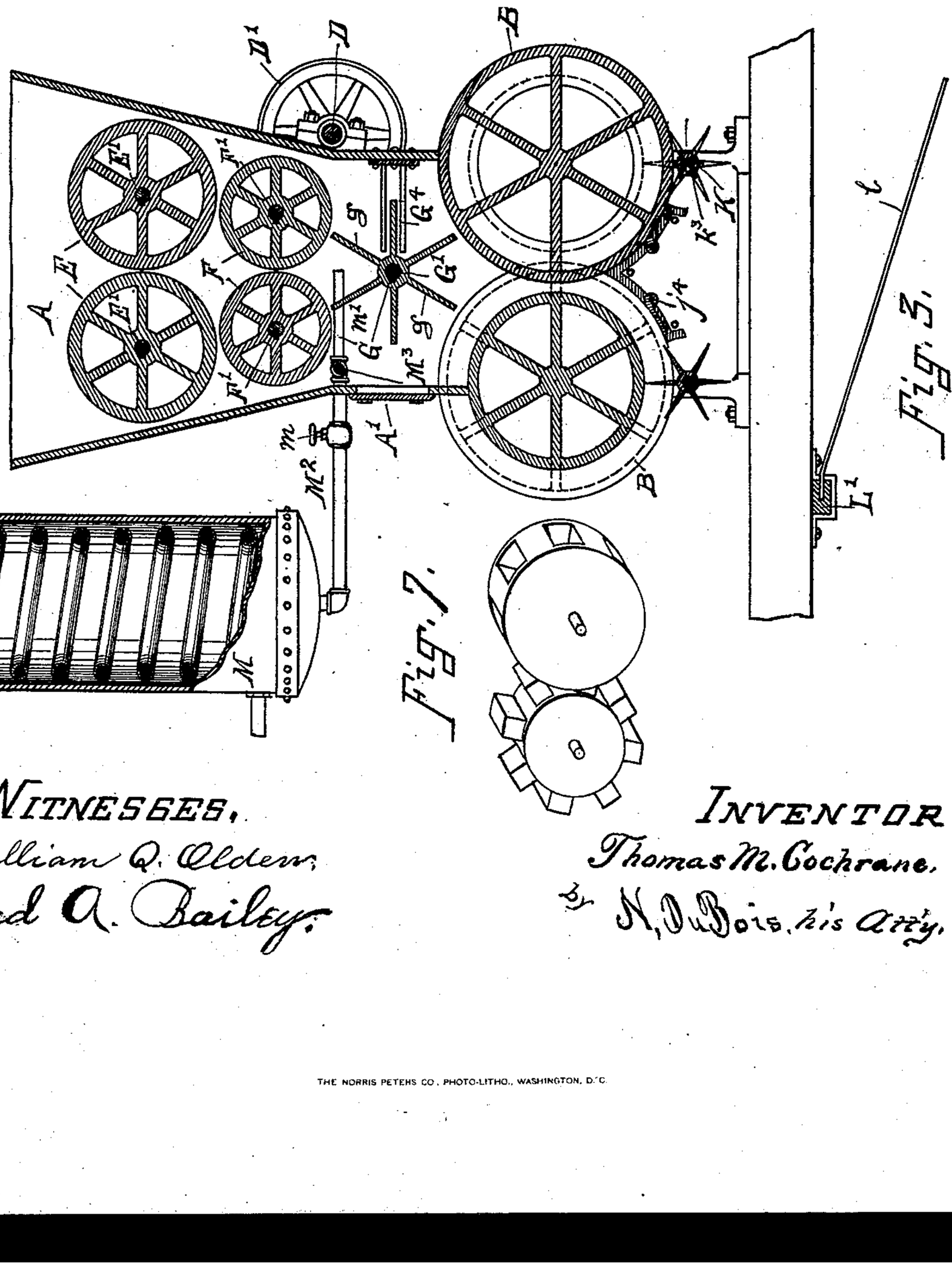

Fig. 2.

Fig. 7.

WITNESSES,
William Q. Alden.
Jad A. Bailey.

INVENTOR
Thomas M. Cochrane.
by N. D. Bois, his Atty.

UNITED STATES PATENT OFFICE.

THOMAS M. COCHRANE, OF SPRINGFIELD, ILLINOIS.

MACHINE FOR COMPRESSING FUEL.

SPECIFICATION forming part of Letters Patent No. 541,069, dated June 18, 1895.

Application filed March 26, 1894. Serial No. 505,111. (No model.)

To all whom it may concern:

Be it known that I, THOMAS M. COCHRANE, a citizen of the United States, residing at Springfield, in the county of Sangamon and State of Illinois, have invented certain new and useful Improvements in Machines for Compressing Fuel, of which the following is such a clear, full, and exact description as will enable those skilled in the art to which it pertains to make and use my said invention.

My invention relates to machines of that class which employ two or more compressor rolls provided with molds and co-operating with each other to compress coal dust, slack or other combustible material into suitably shaped molds so as to form fuel blocks or bricks in convenient form for use, and which may be compactly piled for transportation.

One of the purposes of my invention is to provide compressor rolls of novel and improved construction adapted to form the fuel composition into continuous strips or into blocks or bars which may be used as fuel in their entirety, or which if desired, may be subdivided by mechanism provided for that purpose into bricks of any suitable and convenient size.

I am aware that compressor rolls have heretofore been used having in their periphery contiguous molds adapted to form a single small fuel brick in each mold, but machines having compressor molds of that kind are incapable of producing fuel sticks which may be advantageously used in many situations, as for example under steam boilers where there is a large area of grate surface which in order to attain the best results, must be evenly covered with fuel. The fuel sticks produced by my machine are substantially uniform in size and are especially adapted for this purpose, as they may be made to cover the entire grate surface, are convenient to handle, and save much labor in stoking, and also are in very convenient form for transportation, as they may be very compactly piled.

Another purpose of my invention is to provide means whereby the fuel strips or blocks produced as above described may be subdivided into small bricks or blocks suitable for use in grates, stoves, &c.

Other purposes of my invention are to provide simple and effective means for crushing and pulverizing the slack or other material to be used in forming the fuel bricks, to provide simple and effective means for incorporating with the pulverized slack or other material a suitable controllable quantity of binding material such as coal tar, asphaltum or other suitable material, to provide means to prevent the pulverized fuel material from falling down between the rolls and being discharged before the operation of compressing is begun to provide means to receive the discharged fuel bricks and carry them to a suitable receptacle, and to provide suitable supporting frame work, and mechanism adapted to actuate the compressor rolls, the crushing and pulverizing rolls, the mixing mechanism, the cutting off mechanism and the discharging mechanism, so that all may co-operate uniformly and in time as hereinafter set forth.

With these purposes in view my invention consists of certain novel features of construction and combinations of mechanism shown in the annexed drawings and hereinafter fully described and specifically claimed.

In the drawings, to which reference is hereby made, Figure 1 is a side elevation of the complete mechanism. Fig. 2 is an end elevation of the complete mechanism, a part of the hopper being broken away, so as to show the crushing-rolls, the pulverizing-rolls, and the mixer inside of the hopper. Fig. 3 is a vertical longitudinal section through the machine on the line 3 of Fig. 2. Fig. 4 is an enlarged detached perspective view of the shield and connected parts. Fig. 5 is an enlarged detached perspective view of the cutter. Fig. 6 is an enlarged detached perspective view of one-half of the cross-head of the distributing-pipe within the hopper. Fig. 7 is a detached perspective view, on a reduced scale, of an alternative form of compressor-roll. Fig. 8 is a detached partial horizontal longitudinal section through the shaft D and the wheel D^2 on the line 8 of Fig. 2, and shows the means for sliding the wheel D^2 on the shaft.

Similar letters indicate like parts in all of the views.

The main frame or shell A containing and supporting the operating mechanism is rectangular in form, and its upper end is flared outward as shown, so as to form a hopper of indefinite length adapted to receive the coal

dust or slack which is to be compressed into fuel bars or bricks. The flared or hopper part of the frame is preferably made integral with the lower rectangular part of the frame, but the hopper may be a separate structure which may be connected with the lower rectangular part of the frame in any suitable manner.

The frame A rests on and is suitably secured to fixed sills C.

On one side of the frame A is a door A′ by means of which access may be had to the interior of the machine.

On the sides of the frame A are boxes A^2 in which the journals of the compressor rolls turn.

The sides of the shell are cut away to conform to the channels and flanges on the rolls and form tongues *a* which fit in the channels and serve to scrape out any material adhering in the channels.

The compressor rolls B are both alike, are cylindrical in form, and preferably have alternate and equal peripheral channels *b* and flanges *b′*. Instead of the rolls having circumferential channels and flanges as shown in Figs. 2 and 3, rolls having equal longitudinal channels and corresponding equal longitudinal flanges on the periphery of the rolls as shown in Fig. 7 may be used without departing from my invention. The rolls having circumferential channels produce continuous strips of compressed fuel which may be divided into bricks or blocks of convenient size by the cutting mechanism hereinafter described. The rolls having longitudinal channels and flanges produce bars or sticks of compressed fuel substantially uniform in size which may be used entire, or may be subdivided in any suitable and convenient manner. Where the last named compressor rolls are used the revolving cutting mechanism herein described is dispensed with. The rolls have at their ends journals b^2 which turn in the boxes A^2 on the frame A. The rolls revolve toward each other and the flanges on one of the rolls work in the channels on the other roll. The rolls are parallel to each other and are set at such distance apart that the space between the periphery of any one of the flanges and the bottom periphery of the channel in which it works is equal to the thickness of the block of compressed fuel passing between the rolls. Intermeshing cog wheels B′ and B^2 are secured to the journals b^2 of the rolls B. The main shaft D is supported and turns in boxes A^3 on the frame A. The pulley D′ is secured to one end of the shaft D and the cog wheel D^2 is secured to the other end of the shaft D. The pulley D′ is connected by a belt with a steam engine or other suitable motor furnishing power by which the machine is driven.

The crushing rolls E are keyed to shafts E′ which turn in suitable bearings *e* in the sides of the frame A. The wide faced cog pinion E^2 is secured to the shaft E of one of the rolls, and the cog pinion E^3 is secured to the shaft E′ of the other roll. The pinion E^3 meshes with and is driven by the pinion E^2. The rolls E turn toward each other so as to crush and carry down material interposed between the rolls. The pulverizing rolls F are keyed to parallel shafts F′, and the shafts turn in suitable bearings in the frame A. Intermeshing cog wheels F^2 are secured to the shaft F′.

The mixer G which has radial arms *g* is secured to the shaft G′, which turns in suitable bearings in the sides of the frame A. The wide faced pinion G^2 is secured to one end of the shaft G′ and the cog wheel G^3 is secured to the other end of said shaft. The cog pinion G^2 meshes with and is driven by the cog wheel D^2, and the cog wheel G^3 meshes with and drives the cog pinion F^2, which in turn meshes with and drives the cog pinion F^3 thereby causing the pulverizing rolls to revolve toward each other so as to pulverize the material received from the crushing rolls and turning the mixer so as to incorporate the binding material with the pulverized material as hereinafter explained. Within and secured to the shell A are inwardly projecting rods G^4 between which the arms *g* of the mixer G pass in revolving, thereby kneading and mixing the binding material into the pulverized fuel material.

In the shaft D is a channel *d*. The wheel D^2 has a long hub *d′* in which is a feather d^2 and the hub slides on the shaft D guided by the feather *d*. On the hub *d′* is a yoke d^3 having a pin d^4 which works in the slot *h* in the shifting lever H. The shifting lever H has its fulcrum *h′* on the side of the shell A. Pins h^2 serve to retain the lever H in position when the wheel D^2 is in gear with and driving the cog pinions B′ and E^2. By raising the lever H the wheel D^2 is slid outward on the shaft D so as to disengage the cog wheel D^2 from the cog pinion B′ and at the same time keep it in gear with the cog pinions E^2 and G^2. By this means the compressor rolls B may be started and stopped at pleasure without stopping the crusher rolls, the pulverizing rolls, and the mixer. This mechanism enables the crushing rolls, the pulverizing rolls and the mixer to be operated independently of the compressor rolls, so as to fill the space in the shell above the compressor rolls with the fuel material, in order that there may be sufficient pressure of the material on the upper surfaces of the compressor rolls to fill the channels in said rolls, so that as soon as the compressor rolls are started they will begin to compress the fuel material.

When the machine is in operation the several rolls are run at such speed that the amount of material brought down between the crushing rolls and the pulverizing rolls is just sufficient to meet the requirements of the compressor rolls, in order that the material may be compressed by the compressor rolls as fast as it is received from the pulverizing rolls and conveyed away from the machine as hereinafter described.

The shield J is clearly shown in Fig. 4 and

consists of an angular plate having two upper concave surfaces *j* which conform to the peripheries of the rolls B. On the under side at the front and rear edges of the shield are lugs j' having holes j^2 adapted to receive bolts j^3 by means of which the shield is connected with and supported on the frame A. In the concave surfaces of the shield J are openings j^4 which, when the shield is in position are in juxtaposition to the channels *b* in the rolls B. Parallel shafts J′ of somewhat greater length than the shield are supported and turn in suitable bearings on the shield. Doors j^5 fitting in the openings j^4 are secured to and turn with the shafts J′. To one of the shafts J′ the lever J^2 is secured. To the other shaft J′ the arm J^3 is secured. A pin j^6 on the arm J^3 works in the slot j^7. A toothed segment j^8 is integral with the under side of one part of the shield J. A hand piece j^9 is pivotally connected near the upper end of the lever J^2 and the pawl j^{10} is pivotally supported near the lower end of the lever J^2. A rod j^{11} connects the hand piece j^9 with the pawl j^{10}, and a spring j^{12} on the rod j^{11} reacts against a suitable lug j^{13}, on the lever J^2 to hold the pawl j^{10} in engagement with the segment j^8 so as to lock the lever in any desired position. The doors j^5 are adapted to fit in the channels *b* in the compressor rolls B and when the lever J^2 is pushed downward the doors rise, as clearly shown by dotted lines in Fig. 4, and fill the channels in the rolls.

When the machine is first started and the compressor rolls are at rest and the crushing and pulverizing rolls are running and carrying the fuel material down on top of the compressor rolls, the doors j^5 are raised as described, so as to prevent the fuel material from running out through the channels in the rolls B. When the space between the pulverizing rolls and the compressor rolls has been sufficiently filled the lever J^2 is raised, thereby withdrawing the doors j^5 from the channels *b* and the rolls B are then set in motion and begin to compress the fuel material within the channels *b* as already described.

The cutter consists of a cylindrical body K provided with integral radial blades *k*. The body K is pierced by a longitudinal hole *k*′, and has a longitudinal channel k^2 to receive a key k^3 by which the body K is secured to the shaft K′ which passes through the hole *k*′. There are two of these cutters, one for each compressor roll. The cog pinions K^2 are secured to the cutter shafts K′ which are supported in suitable bearings on the shell A and the pinions mesh with and are driven by the cog wheels B′ and B^2 respectively. The cutters K revolve more rapidly than the compressor rolls B. Hence when the compressed fuel in the channels *b* is carried around adjacent to the cutters, the blades *k* will in succession be forced into and through the compressed fuel in the channel *b*, thereby cutting off from the mass of compressed fuel in the channel a block or brick in length approximately equal to the distance between the points of the blades *k*, and as the blade which has made the cut continues to revolve it forces the detached brick or block out of the channel *b* whence it falls onto the vibrating screen bars whence it is conveyed to any suitable receptacle.

The vibrating screen bars and the means for operating same are clearly shown in Figs. 1 and 2. Suitable guides L are secured to the under sides of the sills C. The transverse bar L′ moves in the guides L. The screen bars *l* are parallel to each other in an inclined position relative to the bar L′, and their upper ends are secured to the bar L′. The shaft L^2 is supported and turns in any suitable hanger L^3 secured to one of the sills C, and has at one end a crank wheel L^4 secured to the shaft. The shaft L^2 may be rotated by a belt and pulley or other suitable means. A block *l*′ is secured to and extends downward from the bar L′. A pitman rod L^5 connects the crank wheel L^4 with the block *l*′, so that as the crank wheel L^4 revolves a reciprocating motion will be imparted to the bar L′ and the connected bars *l*. The fuel bricks removed from the channels *b* by the blades *k* fall down on the inclined bars *l* down which they slide into any suitable receptacle. The reciprocating movement of the bars *l* facilitates the downward movement of the fuel blocks on the bars, and any dust coming from the machine passes between the bars, so that the fuel bricks are delivered in the receptacle in good condition and free from dust.

A tank M adapted to contain the binding material is supported in any suitable manner adjacent to the shell A. Within the tank is a coil M′ of steam pipe which when heated by steam obtained from any convenient source, and passing through the coil, serves to heat and liquefy the binding material, preferably asphaltum or coal tar, which is contained in the tank, so that it may flow freely through the pipe M^2 into the shell A and be incorporated with the pulverized fuel. In the pipe M^2, which is preferably inclosed in a steam jacket not shown, is a cock *m* which serves to control the quantity of binding material delivered through the pipe. The cross pipe M^3 is secured to the inner end of the pipe M^2 and has inwardly projecting laterals *m*′ by which the binding material is distributed through the pulverized fuel material.

The operation of the mechanism is as follows: The hopper above the crushing rolls having been charged with a quantity of coal dust, slack or other material, and the tank M having been supplied with binding material, steam is admitted to the coil M′ to liquefy the binding material. The lever H is raised to shift the cog wheel D^2 out of mesh with the cog wheel B′ but leaving it still in mesh with the cog pinions E^2 and G. The shaft D is then set in motion thereby starting the crushing rolls, the pulverizing rolls and the mixer. The cock *m* is then turned to admit the binding

material to the cross head by which it is distributed within the shell. The lever J^2 is pressed down to raise the doors j^5 into the channels *b*. At this stage of the operation the compressor rolls are at rest. The rolls E and F are then run independently of the compressor rolls B until they have crushed, pulverized and carried down material sufficient to fill the space above the compressor rolls to the desired extent. In the meantime the mixer is constantly stirring and kneading the pulverized material and is incorporating therewith the binding material discharged through the cross head M^3. Instead of running material between the rolls E and F to fill the space above the rolls B, the pulverized material may be inserted through the door A'. When the space above the rolls B has been filled as described, the lever J^2 is raised to depress the doors j^5 and withdraw them from the channels *b*. The lever H is also depressed to slide the wheel D^2 into mesh with the wheel B' thereby revolving the rolls B toward each other, so that the flanges on one roll compress the fuel material in the corresponding channels in the other roll. As the rolls B continue to revolve the compressed material is carried around in the several channels of the rolls until it encounters the revolving cutters by which it is cut into blocks or bricks which fall on the inclined bars *l* by which they are conveyed to any suitable and convenient receptacle.

I am aware that circumferentially channeled rolls provided with circumferential flanges have heretofore been used for divers purposes, but I am not aware that parallel rolls having circumferential channels and circumferential flanges between said channels have been used in such relation to each other that all of the flanges on each of the rolls co-operate respectively with all of the contiguous channels in the opposite roll in such manner that all of said flanges serve to simultaneously compress fuel into strips, bars or sticks substantially uniform in size in all of said channels. I am also aware that scrapers have heretofore been used to remove adhering material from corrugated rolls. I therefore do not claim broadly the use of circumferentially channeled and flanged rolls but confine myself to the use of parallel channeled and flanged rolls when constructed as described and employed in the relation to each other herein set forth; neither do I broadly claim the use of scrapers to remove material from the channels in the compressor rolls, but restrict my claim to scrapers of the form herein described and applied as herein set forth.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a fuel compressor, the combination of the main frame, the crushing rolls, the pulverizing rolls, and the longitudinally channeled and flanged compressor rolls supported and turning on said frame, the mixer supported and turning between the pulverizing rolls and the compressor rolls, and the means adapted to rotate said crushing rolls, pulverizing rolls, mixer, and longitudinally channeled compressor rolls, as set forth.

2. In a fuel compressor, the combination of the main frame, the crushing rolls, the pulverizing rolls and the compressor rolls supported and turning in said frame or shell, the mixer between the pulverizing rolls and the compressor rolls supported and turning in the main frame, the tank connected with the shell adapted to contain binding material and provided with means for distributing same within said shell, and means adapted to rotate said crushing rolls, pulverizing rolls, mixer and compressor rolls, substantially as shown and described, and for the purpose stated.

3. In a fuel compressor, the combination of the main frame or shell, the crushing rolls, the pulverizing rolls, the mixer and the compressor rolls supported within said shell or frame and adapted to rotate toward each other, the rotating cutters having blades working in channels in said compressor rolls, and means adapted to rotate said crushing rolls, pulverizing rolls, mixer, compressor rolls and cutters, substantially as set forth and for the purpose stated.

4. In a fuel compressor, the main frame or shell, the crushing rolls, the pulverizing rolls, the mixer and the compressor rolls having circumferential channels and corresponding circumferential flanges: in combination with the shield supported on the main frame conforming to the compressor rolls and having movable doors adapted to fit in the channels of said rolls, the rotary cutters having blades fitting in the channels of the compressor rolls, means adapted to operate said doors, and means adapted to rotate said crushing rolls, pulverizing rolls, mixer and channeled compressor rolls, as set forth and for the purpose stated.

5. In a fuel compressor the combination of the main frame, the parallel longitudinally channeled compressor rolls supported and turning on said frame, the tongues working in the channels in said compressor rolls and integral with the sides of said main frame or shell, and adapted to simultaneously clean all of the channels in both of said parallel compressor rolls, and means adapted to rotate said compressor rolls, as set forth.

6. In a fuel compressor, the combination of the main frame or shell provided with a door, the rotatable crushing rolls, the rotatable pulverizing rolls, the rotatable mixer having radial arms, the inwardly extending arms secured to the shell contiguous to the mixer arms, the circumferentially channeled rotatable compressor rolls, the shield conforming to and having movable doors fitting in the channels in said rolls, the rotatable cutters having blades working in the channels in the com-

pressor rolls, means adapted to rotate the crushing rolls, the pulverizing rolls, the mixer, the compressor rolls and the cutters substantially as set forth, and for the purpose stated.

7. In a fuel compressor, the means adapted to rotate the crushing rolls, the pulverizing rolls and the mixer independently of the compressor rolls, to wit: the rotatable drive shaft supported on the main frame, the cog wheel adapted to slide on said shaft also adapted to mesh with pinions connected with the crushing rolls, the compressor rolls and the mixer respectively, also adapted to be disengaged from said pinion on said compressor roll when said cog wheel slides in one direction on said shaft, and to be engaged with said pinion when said cog wheel slides in the opposite direction on said shaft: means adapted to slide said cog wheel on said shaft: wide faced cog pinions secured to one of the crushing roll shafts and the mixer shaft respectively, and adapted to mesh with and be driven by said cog wheel: in combination with the main frame or shell: the crushing rolls having intermeshing cog gears, one of which is driven by said sliding cog wheel: the pulverizing rolls having intermeshing cog gears; the mixer having at one end a cog wheel, meshing with and driving one of the cog gears on one shaft of the pulverizing rolls, and having at the other end a wide faced pinion meshing with and driven by said first named sliding cog wheel: and the parallel compressor rolls having intermeshing cog gears, one of which engages with and is driven by said sliding cog wheel; all co-operating substantially as set forth.

8. In a fuel compressor, the means adapted to convey the compressed fuel away from the compressor rolls, to wit: the transverse bar adapted to oscillate, the inclined bars connected with said transverse bar, the rotatable crank wheel, and the pitman rod connecting said transverse bar with said crank wheel: in combination with the main frame, parallel rotatable compressor rolls supported on said frame, and means adapted to rotate said compressor rolls substantially as set forth.

9. In a fuel compressor, the shield having upper surfaces conforming to the compressor rolls, the shafts supported and turning on said shields, the doors secured to and turning with said shafts, the adjustable lever secured to one of said shafts, the arm secured to the other of said shafts and connected with said adjusting lever; in combination with, the main frame, means for connecting said shield with said frame, and rotatable compressor rolls supported on said frame, substantially as set forth and for the purpose stated.

10. In a fuel compressor, the tank adapted to contain binding material, the steam coil within said tank the pipe connecting the tank with the main frame or shell, the cock in said pipe, the cross head on said pipe, and the laterals on said cross head; in combination with, the main frame or shell, rotatable compressor rolls supported on said frame, and means adapted to rotate said compressor rolls, as set forth and for the purpose stated.

11. In a fuel compressor, the combination of the supporting sills, the main frame or shell having a flared upper part and supported upon said sills, the door on said frame, the main drive shaft supported and turning on the frame, the pulley secured to said shaft, the cog wheel sliding longitudinally on said shaft, the shifting lever fulcrumed on the main frame and connected with said sliding cog wheel, the crushing roll shafts, the pulverizer shafts, and the mixer shaft supported and turning in said main frame or shell, the crusher rolls, the pulverizer rolls, and the mixer, secured to said shafts respectively, the intermeshing cog gears on the crushing roll shafts, the intermeshing cog gears on the pulverizing roll shafts, the cog wheel on the mixer shaft, the wide faced cog pinion on the mixer shaft meshing with and driven by the sliding cog wheel, the parallel rotatable compressor rolls supported and turning in said main frame, the intermeshing cog wheels secured to said rolls respectively, one of said wheels meshing with and driven by said sliding cog wheel, the shield conforming to said compressor rolls and provided with movable doors fitting in the channels of said rolls, means for operating said movable doors, the cutter shafts supported and turning in the main frame, the cutters having radial blades adapted to work in the channels of said compressor rolls and secured to said shafts, the cog wheels secured to the cutter shafts and meshing with and driven by the cog gears on the compressor rolls, the tank connectible with the main frame or shell, the steam coil within said tank, the pipe connecting said tank with the interior of the shell, the oscillating frame supported on the sills below the compressor rolls, and the means adapted to oscillate said frame, all co-operating substantially as set forth and for the purpose stated.

In witness whereof I have hereunto subscribed, at Springfield, Illinois, this 17th day of March, 1894.

THOMAS M. COCHRANE.

Witnesses:
WILLIAM Q. OLDEN,
TAD A. BAILEY.