April 15, 1958 M. F. DE LUCA 2,830,770

GRANULATING MACHINE

Filed March 12, 1954 2 Sheets-Sheet 1

Fig. 1.

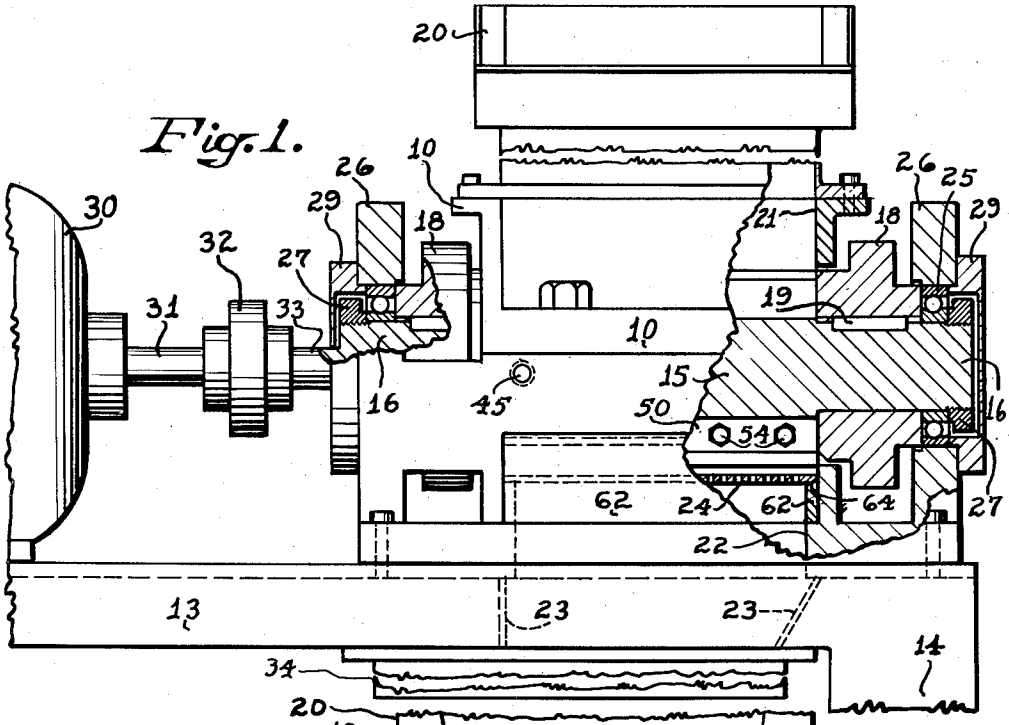
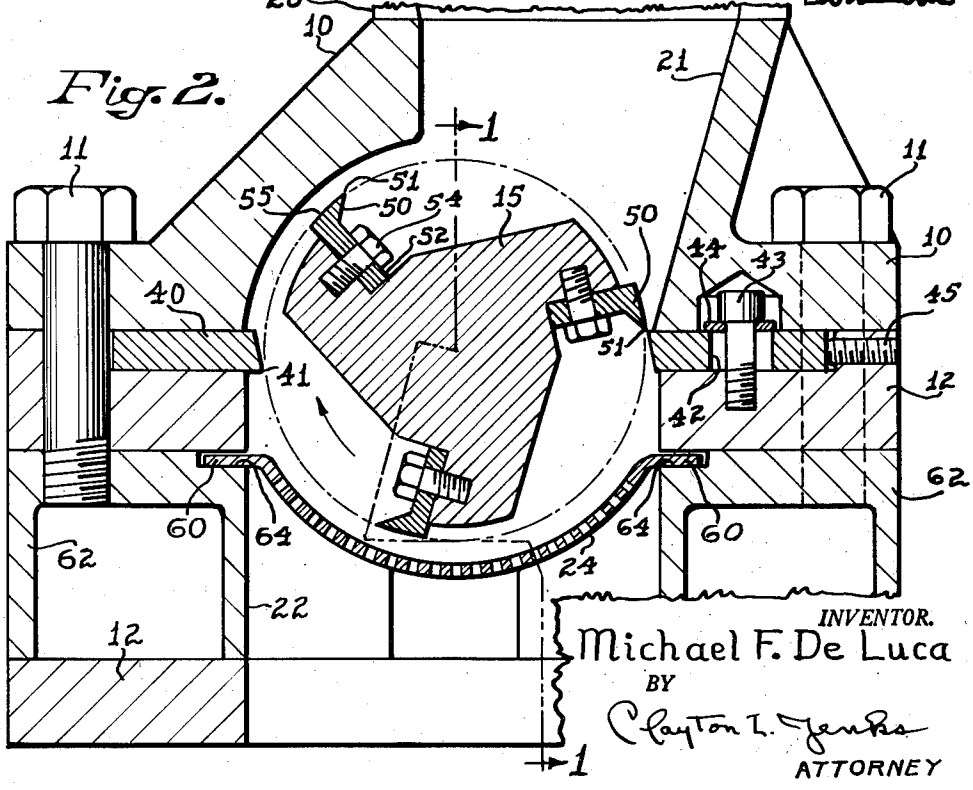


Fig. 2.



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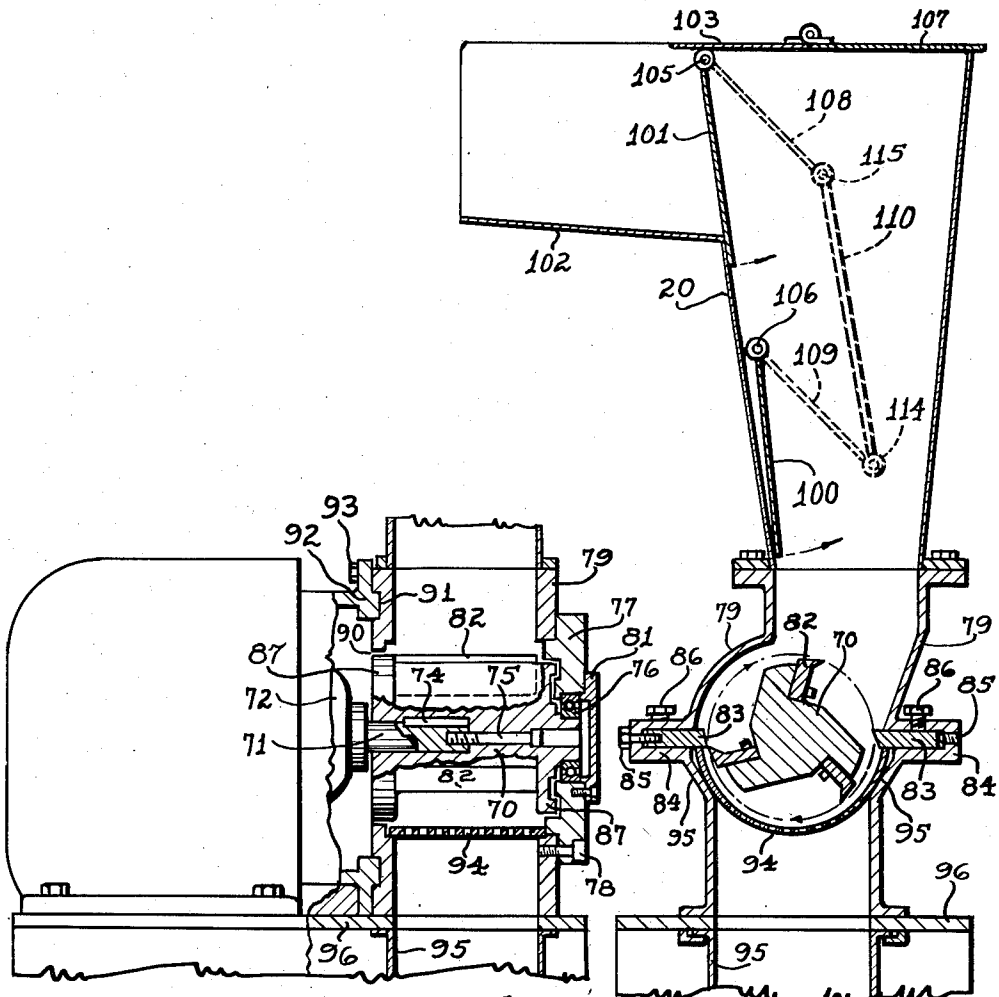

Fig. 3.

Fig. 4.

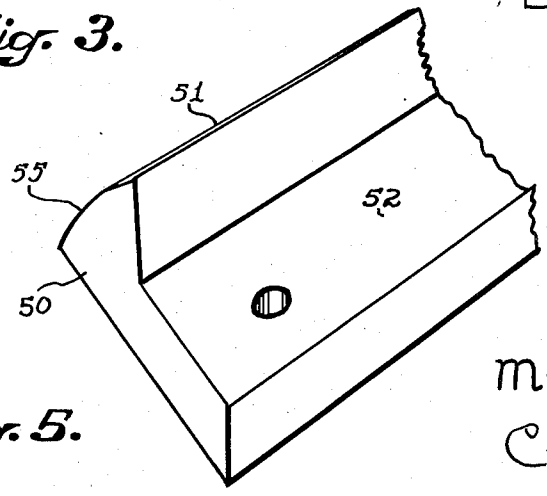

Fig. 5.

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GRANULATING MACHINE

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8 Claims. (Cl. 241—73)

This invention relates to granulating machines, and more particularly to a machine adapted for cutting, granulating, or pulverizing various materials, such as scrap leather, plastics, etc.

A conventional machine designed for this purpose has comprised a set of stationary knives cooperating with blunt edged rotary knives which have served both to cut and to break the material into small particles by a combined cutting and impact action. A screen is located below the rotary knives to separate the finely divided material from the larger particles, but the screen tends to become clogged and the material lodges between the knives so that the machine motor may be stalled or require a heavy power input. It is necessary to remove the screen at frequent intervals for the purpose of cleaning it, and this should be accomplished without interfering with the accurate setting of the knives. Moreover, the stationary knives should be so adjustably positioned that they may be easily set in cutting contact with the rotor knives to provide a required cutting action without dismantling the machine. Even more important is the need for a type of rotary knife which is primarily a cutting tool and which will aid in feeding the material to the cutting zone as distinguished from the centrifugal action of hurling the uncut fragments outwardly. Moreover, the massive structure of the rotor in a large size machine has made it difficult to see the interior of the machine when it has to be cleaned or the screen removed or the knives inspected. Hence, there should be adequate access to the rotor without requiring removal or disturbances of the stationary knives or a dismantling of the machine. It is also found that when material is fed to the hopper above the rotary knives, a blast of material is thrown outwardly and may injure the operator, so that it is desirable to provide a baffling gate which will admit the material and yet serve for the operator's protection.

It is the primary object of this invention to overcome the above disadvantages and to provide a rigidly constructed granulating machine for both large and small size units which may be economically built and efficiently operated for granulating various types of material.

A further object is to provide a structure wherein the screen may be easily removed for cleaning the machine and access may be had for inspecting the rotor knives but which does not require removing the stationary knives or disturbing their setting relative to the rotary knives.

A still further object is to provide a granulating machine with a new type of rotary cutting knife which will cut the fragmentary material more by a direct shearing action than breaking it by impact and which is so shaped that it aids in feeding the fragments to the cutting zone and minimizes the power requirements.

Another object is to provide a machine of this type with a baffling gate in the feed hopper which will prevent any substantial amount of the pulverizing material from being thrown outwardly when the operator opens

the hopper to feed the machine and yet will permit feeding large fragments or pieces without obstruction within the hopper. Other objects will be readily apparent in the following disclosure.

Referring to the drawings:

Fig. 1 is a fragmentary elevation, partly in section, showing a large sized granulator, the sectioned portions of the view being taken on the line 1—1 of Fig. 2;

Fig. 2 is a vertical central section, partly broken away, of the machine of Fig. 1;

Fig. 3 is an elevation, partly broken away, of a small sized type of granulator having the rotor carried in part by the motor shaft;

Fig. 4 is a vertical section of the machine of Fig. 3 and which shows baffling gates in the feed hopper; and

Fig. 5 is a perspective view of one of the rotary knives removed from the massive central rotary unit.

Referring first to Figs. 1 and 2, the machine there illustrated comprises an upper hollow casing part 10 (Fig. 2) separate from and removably connected as by means of bolts 11 to a lower hollow casing 12 which is in turn bolted to a table top 13 (Fig. 1) provided with suitable supporting legs 14. The casing parts 10 and 12 provide a substantially cylindrical space for a massive rotor casting 15 of required shape. The rotor 15 is integral with or has its ends shaped to form a shaft 16 projecting axially at both ends of the cutting zone. Two fly wheels 18 are preferably formed integral with the shaft 16 but are shown as connected thereto by keys 19. These fly wheels and the massive rotor block 15 provide the needed momentum to give a smooth cutting action. The upper casing member 10 has a flat top which supports and is bolted to a feed hopper 20 (shown in Fig. 4) communicating with the space 21 within the upper casing. The lower casing 12 is shaped to provide an exit space 22 for the material that has been granulated, and this communicates with hopper walls 23 mounted within the table 13 which directs the granulated material into a suitable receptacle 34 removably supported beneath the table. A perforated metal screen 24 of suitable mesh is removably mounted below but out of contact with the rotor knives near the upper end of the passage 22 in the lower casing. This screen holds the fragments in the cutting zone until fine enough to pass through the screen mesh. The shaft ends 16 are suitably mounted in ball bearings 25 of standard construction carried in upstanding walls 26 of the machine frame. Screw caps 27 suitably threaded to the arbor ends 16 hold the rotor in proper position relative to the bearings. An end cap 29 cooperates with the casing to enclose the bearings. An electric motor 30 or other suitable drive has its shaft 31 connected through a suitable coupling 32 with a reduced projecting end 33 of the rotor shaft, and the motor characteristics are preferably such that the rotor is power driven at a desired constant speed.

One primary feature of this invention comprises a special cutting knife construction. Relatively stationary knives 40 having their ends slightly bevelled to present a straight cutting edge 41 are adjustably mounted in a recess in the upper face of the lower casing 12 and at the junction between the upper casing 10 with the lower part 12. Each knife 40 is a long, rectangular bar provided with an elongated transverse slot 42. A cap screw 43 has its head or a washer 44 suitably bearing against the knife at the sides of the slot, and this cap screw is threaded into the lower casing part 12 and serves to clamp the knife 40 in an adjusted position. The knife may be thrust inwardly by means of a set screw 45 suitably threaded into the lower casing body 12 after the cap screw 43 has been retracted to loosen the knife. Thereafter, setting the cap screw 43 holds the knife rigidly in position. To replace or adjust the knife, the clamping bolts 11 are re-

moved and the upper casing **10** is lifted from contact with the lower casing, thus exposing the knives **40**. Each of the knives is preferably adjustably mounted the same as is shown at the right hand side of Fig. 2.

Although a standard shape of knife may be employed with the other features of this machine, I have found that a superior efficiency is had with a special type of rotary knife. This rotary knife **50**, shown particularly in Figs. 2 and 5, has an extending claw-like projection **51** provided with a sharp straight edge which is positioned and shaped to aid in feeding the material to the cutting edge **41** of the stationary knife **40** and cut the same. These claw-shaped knives may be each made as an integral body of hardened steel, or the outer claw end **51** may be a separate hard body removably mounted on the inner portion of the knife. As shown, the central rotor body **15** may be cut away to provide flat faced notches that permit the flat arm **52** of each knife to be mounted substantially radially of the rotor. Set screws **54** serve to removably secure the arms of the claw knives on the rotor cutter block **15**. It will be appreciated that after these rotary cutter knives have been mounted in place with their cutting edges located at equal distances from the axis of rotation, the stationary knives **40** will be suitably adjusted so that the respective cutting edges will just clear and so cut material adequately therebetween.

The shape of the cutter knife **50** may be varied somewhat, but it is desirable that this part be primarily a knife and not a breaker hammer and yet that it have sufficient strength and mass to deliver a needed impact blow to the material and force the knife therethrough. As shown in Figs. 2 and 5, a claw-like projecting portion **51** of the cutter knife is arranged at substantially right angles to a radius of the rotor and to the face of the arm portion **52** of the tooth. The outer face **55** of the claw may be flat or it may be ground to the arc of a cylinder so that the whole face will make a substantially rubbing contact with the edge **41** of the stationary knife and thus minimize any tendency for material to clog between the two knives. The claw projects forwardly in the direction of rotation so that its edge may be considered as a peripheral portion of an imaginary cylinder around the rotor. The included angle at the cutting edge **51** of the claw subtended between the two converging faces of the V-shaped claw is between 20° and 60° and preferably from 40° to 50° although considerable variation may be had. However, if the angle is too acute, the cutting knife will be unnecessarily thin and therefor weak and unable to withstand the shocks of the granulating action. If the angle is too blunt or appreciably greater than about 60°, the knife will then serve more as a breaker hammer than a cutter. Hence, it is preferable that this edge be reasonably sharp and lie within the specified angular requirements which provide a thick portion or heavy mass at the back of the tooth to aid in driving the tooth edge through the body being cut.

This claw type of cutter knife or tooth tends to grab the material and to move it forward into the cutting zone between the two knives. The oversized material is held above the arcuate shaped screen **24** and the claws seize that material and hurl it upwardly against the left hand stationary knife **40**. Similarly, the claws above the rotor block grab the material that is coming down through the chute **21** and force it against the right hand stationary knife **40**. In this structure, the claw knives force the material into the cutting zone rather than leaving the feeding action to a matter of chance as determined largely by the gravity of the material descending through the upper hopper and the rotary motion of the knives. A suitable number of stationary knives are provided. The two shown are arranged substantially diametrically of the rotor. Also, there may be any suitable number of the claw knives **50** on the rotor, only three being shown for the sake of clarity of illustration. It is also feasible to set the knives at an angle to the rotor axis and grind their cutting edges to lie in a cylinder, so that they are shaped as parts of a helix.

An important feature of this construction provides for inspection and removal of the screen **24**. This screen is shaped as an arcuate portion of the periphery of a cylinder and is arranged concentric with the axis of the rotor, so as to maintain a screening surface at a desired distance from the rotor knives. The screen has outwardly extending flanges **60** which are removably supported on blocks **62** which may be hollow or as desired. The lower casing wall **12** is provided with an opening, and preferably one on each side of the rotor, in which a closure block **62** is removably positioned. The block may be substantially a parallelopipedon in shape and is as long as the screen. Each block is provided with a groove **64** within which a flanged end **60** of the screen **24** lies, and the upper faces of these flanges may, if desired, be engaged and clamped into position by the upper casing **10**, although this clamping action is not necessary. The blocks **62** are removably held in place by the bolts **11** which secure the upper casing **10** to the lower casing **12**. Each bolt, as shown in Fig. 2, projects downwardly through a thin portion of the lower casing **12** above the opening carrying the block and it is threaded into the upper wall of the removable block **62**, so that the clamp bolt **11** serves to draw that closure block up against the under face of the cut-out portion of the casing part **12** and at the same time to clamp the two casing parts **10** and **12** securely together. It will thus be seen that by removing the bolts **11** from threaded engagement with the blocks **62**, the latter may be slid outwardly and the screen **24** then removed through either opening as thus provided These block openings are sufficiently large so that the operator may see readily into the casing and determine the knife settings or for other purposes.

A simplified and smaller type of granulating machine is shown in Figs. 3 and 4. In this construction, the granulator rotor **70** is carried at one end directly by the shaft **71** of the constant speed electric motor **72** which drives the rotor. The shaft **71**, which is suitably mounted in bearings in the motor casing, is connected by a key **74** to the granulator rotor **70**. The rotor is bored axially at one end to provide a socket for the projecting end **71** of the motor shaft. A long cap screw **75** threaded into a socket in the outer end of the motor shaft **71** projects through an axially bored hole in the rotor, and the head of this cap screw engages a shoulder in the bore and so holds the parts together. This cap screw may be suitably adjusted or removed by means of a screw driver. Thus the granulator rotor is carried at its left hand end solely by the bearings (not shown) of the electric driving motor.

The right hand end of the rotor **70** is carried in ball bearings **76** suitably mounted within a central opening in an annular cap **77** which is bolted by cap screws **78** to the casing wall **79** of the granulator. The inner and outer raceways of the ball bearings **76**, which may be of suitable construction, are carried within the central opening of cap **77**. They are located by shoulders on the rotor **70** and cap **77** and held in place by a further small cap **81** that is secured by cap screws to the larger cap **77**. A circular flange on the small cap engages the outer raceway as shown. The casing **79** forms a vertical hollow pipe-like structure having short arcuate walls shaped to define a space within which the rotor **70** and its knives **82** may revolve. The knives may be made as above described. The stationary knives **83** are mounted in elongated bosses **84** projecting diametrically from the casing. The bosses are recessed internally to provide space for the elongated knife body of rectangular cross section. Set screws **85** threaded through the ends of the boss engage the long back of the knife **83** and serve for adjusting the two ends of the knife inwardly. A cap screw **86** suitably threaded through the wall of the boss **84** serves to fix the knife **83** in a stationary position relative to the rotor. Thus, in this construction, the

two stationary knives are put into place from the inside of the casing and may be readily adjusted.

The rotor **70** may have formed integral therewith two fly wheels **87** which have sufficient mass to provide a required momentum, but these may be omitted and the casing parts shaped accordingly to provide a closure. The left hand fly wheel **87** is located in a circular opening **90** in the left hand casing wall, and the right hand fly wheel **87** is shaped to fit inside the cap **77**. The left hand wall of the granulator casing may be suitably connected to the motor casing. As shown, the wall may have a circular groove **91** interfitting with a projecting circular flange **92** on the electric motor casing, and screws **93** serve to hold the granulator wall rigidly in position relative to the motor casing.

The screen **94**, which may be made of metal and provided with suitably sized openings therethrough for the passage of the powdered material, lies beneath the rotor in the space provided by the upwardly flaring walls **95** of the rotor casing. The screen is located just below the stationary knives **83** with its edges close to or engaging the knives and so is held from turning in its setting.

It will be evident that the casing may be removed from the rotor by taking out cap screws **93**. Since the ball bearings are carried by the cap **81** fastened to the casing **77**, this serves to slide the ball bearings off the end of the rotor shaft but leaves the rotor supported at its left hand end on the motor shaft. The rotor **70** may be removed from the motor shaft by taking out the connecting cap screw **75** from the shaft **71** of the electric motor. Also, if desired, the end cap **77** with its ball bearings, cap **81** and the rotor with its fly wheels may be taken out through the right hand opening in the casing wall without disassembling the latter from the electric motor casing. This provides for removal or cleaning of the screen. The lower portion of the hollow casing connects through a suitable passage **95** formed by baffle walls under the table **96**, which carries the granulator and motor, to a receptacle suitably located for receiving the granulated material.

Another feature of the invention, which is also employed in the construction of Fig. 1, but not shown therein for lack of space, comprises hinged gates **100** and **101** so mounted inside the hopper **20** as to prevent material from being thrown outwardly into the face of the operator when he attempts to feed the granulator. This hopper **20**, which is removably bolted to the top of the granulator casing, may have an outwardly projecting platform **102** onto which the fragments to be pulverized are laid. The hopper is closed at the top by wall **103** which has a hinged or removable cover **107** providing direct access from above to the interior of the hopper. The interior of the hopper is substantially unobstructed so that large pieces or fragments of material may be fed to the knives.

The upper gate **101** is fixed on a hinge pin **105** suitably mounted for rotation in holes in the opposite casing walls. The hopper walls **20**, the top **103** and the gate **101** form a complete enclosure above the rotor, so that during normal operation of the machine any material thrown upwardly by the knives is compelled to fall back into the granulating zone. The lower gate **100** is also fixed on a hinge pin **106** rotatively carried by the opposite casing walls, and that gate **100** normally lies in an inoperative and non-obstructing position close to the hopper wall. The two pins **105** and **106** project beyond one casing wall where they carry rigidly fixed thereto two arms **108** and **109**, respectively. These arms are connected at their outer ends by a pivoted linkage **110**. Thus, the arm **108** is fixed relative to the swinging gate **101** so that the two parts must move together and the arm **109** is fixed to move with the gate **100**, and the link **110** compels them to move together. When the operator lifts on the outside arm **108** or **109** or pushes material against

the upper gate **101**, the gate **101** moves inwardly and the gate **100** is swung towards the right to close off the lower portion of the passage in the hopper. These gates and linked arms are so constructed that the lower gate **100** will be swung up far enough into the hopper to prevent material from being hurled past it when the upper gate is opened sufficiently to permit a new charge to be dropped into the hopper. This charge will lie on the lower gate until its weight is adequate or manipulation of the gate by the operator will serve to drop the charge into the granulator.

The operation of the machine will be apparent from the above disclosure. The stationary knives are suitably adjusted relative to the rotary knives, and the motor drive serves to cut the material between the two sets of knives. The claw shape of the rotary knives drags the material upwardly from the screen and downwardly from the hopper entrance into the cutting zone of the associated stationary knife. These claws are particularly effective when large pieces of scrap, for example, are fed into the hopper. Such a machine requires frequent inspection and cleaning or removal of the screen below the knives. This is effected in the construction shown in Fig. 2 simply by removing the closure block **62** from one or both of the walls of the casing, and the screen is withdrawn through the opening. Likewise, the rotor may be readily removed, together with its fly wheels **18**, after separating the upper casing part **10** from the lower part **12**, the bearing supporting walls **26** being likewise made in halves and similarly separable. In the construction of Figs. 3 and 4, it is merely necessary to unbolt the end cap or annulus **77** from the casing walls **79** and to remove the connecting screw **75** from the motor spindle in order to remove the rotor. Also, the rotor may be left in position and by removal of the cap screws **93** the granulator casing may be moved laterally toward the right and away from the electric motor. Since the bearings **76** are supported on the annulus **77**, which in turn is carried by the casing **79**, this serves to remove the bearings intact and to leave the rotor hanging from the motor shaft with its right hand end free. This provides for removing and cleaning the screen **94**. The gates in the hopper form a safety device. When the upper swinging gate **101** is pushed open either by crowding material past it or by lifting upwardly on the outside linkage **110** and its connected arms, this serves to swing the lower gate **100** upwardly to a position where it closes the bottom of the hopper and prevents the outward passage of the granulating material. The new charge rests on the lower gate **100** until it is ultimately dropped into the granulator, when the upper gate swings back to a closed position.

It will now be appreciated, in view of the above disclosure, that various modifications may be made in this granulating machine and that the different inventive features hereof may be employed in other related constructions. Hence the specification is to be interpreted as describing preferred embodiments of the invention and not as imposing limitations on the appended claims.

I claim:

1. A granulating machine comprising a casing providing a granulating chamber having an outlet passage therebeneath and an upper inlet passage for feeding material to be cut, at least one stationary cutter knife movably mounted on and having a beveled cutting edge projecting inwardly from the casing, means for adjustably fixing the blade in position, a power driven, massive fly wheel type of rotor rotatably mounted in said chamber which has knife supporting surfaces, a set of rotary claws, each shaped as an outwardly projecting longitudinal arm terminating in a V-shaped knife projecting laterally thereof in the direction of rotation, means for securing the claw arms on said surfaces of the rotor in a balanced relationship, each stationary and rotor knife having a continuous cutting edge extending throughout the ef-

fective length of the chamber, each rotor knife revolving close to and cooperating with the entire effective length of the beveled edge of the stationary knife for a shearing operation and having an outer peripheral face which lies substantially in the cylindrical path of revolution of the knife edge and substantially in a plane with the outer beveled face of the stationary knife where the knife edges meet for a shearing action, the inner face of each V-shaped knife making an angle of from 20° to 60° with the outer peripheral face of the claw and projecting forwardly to provide a space radially inwardly of the cutting edge which insures that the rotary claw picks up and delivers the material to the blades and that only the rotary knife edge strikes the material initially at cutting contact in a shearing action, and a screen beneath and close to the claw knives which passes only the finer granular material to the outlet passage.

2. A cutter according to claim 1 in which the claw shaped knife has a cutting edge and a thick back formed by two converging faces subtending an angle at the knife edge which is substantially between 40° and 50°.

3. A granulating machine comprising a casing having two separable superimposed upper and lower casting parts providing a granulating chamber therebetween and an upper inlet and a lower exit passage therefor, said parts having opposed upper and lower faces, inwardly projecting stationary cutter knives movably mounted for inward adjustment between said faces, means for adjusting each knife inwardly and fixing it in a cutting position, means for removably securing the casting parts together, a power driven rotor mounted within the casing chamber which has rotary knives cooperating with the stationary knives to cut material therebetween, a hopper communicating with the inlet passage above the rotor for delivering material to the knives, an arcuate screen below the rotor and above the exit passage, said lower casting part having a closure opening below and remote from said upper face and the stationary knife and opposite to the normal screen position which has its vertical and longitudinal dimensions greater than those of the screen and is sized for ready removal of the screen therethrough, and a removable closure block for the opening which supports the screen and provides access to and removal of the screen without disturbing any knife setting.

4. A granulating machine according to claim 3 in which the lower part of the casing has an upper surface provided with recesses carrying the stationary knives and arranged for replacement thereof when the upper casing part is removed, and means for securing the casing parts and closure block together and holding the screen in position.

5. A granulating machine comprising a casing having upper and lower separable casing parts forming a granulating chamber, a hopper thereabove and a screen below, a set of inwardly projecting, adjustably mounted stationary knives mounted on the top of the lower casing part and projecting into said chamber, a power driven rotor axle projecting at both sides of the chamber, a massive rotor within the chamber which is rigid with the axle, said rotor having knives thereon cooperating with the stationary knives to cut material therebetween, fly wheels on each end of the rotor axle outside of the granulating chamber, bearings for both ends of the rotor axle located outside of the chamber and said fly wheels and mounted on the lower casing part and removably positioned by the upper casing part, said rotor and fly wheels being removable as a unit with the bearings when the upper casing part has been removed, said lower casing wall having an exit for granulated material and a lateral opening below its top and remote from the stationary knives which is sized and arranged for the removal of the screen therethrough, and a closure block for said opening which is removable without disturbing the knives.

6. A granulating machine comprising a casing wall defining a granulating chamber, stationary knives on the casing wall which adjustably project into the chamber, a rotor having knives cooperating with the stationary knives for cutting material therebetween, a screen mounted below the rotor, an electric motor casing fixed relative to said wall, an electric motor in said casing having a projecting shaft, means for removably securing one end of the rotor to the motor shaft so that said end is supported solely by the motor, bearings for the free end of the rotor, and a support for the bearings removably mounted on the wall, said support and bearings being removable as a unit so as to expose the rotor.

7. A granulating machine according to claim 6 in which the bearing support is an annulus surrounding the bearings and adjacent rotor end and comprising a cap secured to the annulus which holds the bearings in an assembled relation to the annulus, so that removal of the annulus separates the bearings from the rotor and leaves the rotor supported solely by the motor shaft.

8. A granulating machine according to claim 7 in which the screen is an arcuate body and the casing wall has upwardly flaring side portions supporting the screen below the stationary knives, the casing wall having an opening closed by the annulus and cap which provides for removal of the screen therethrough.

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