Feb. 17, 1959 J. C. HOLM 2,873,920

CRUSHER

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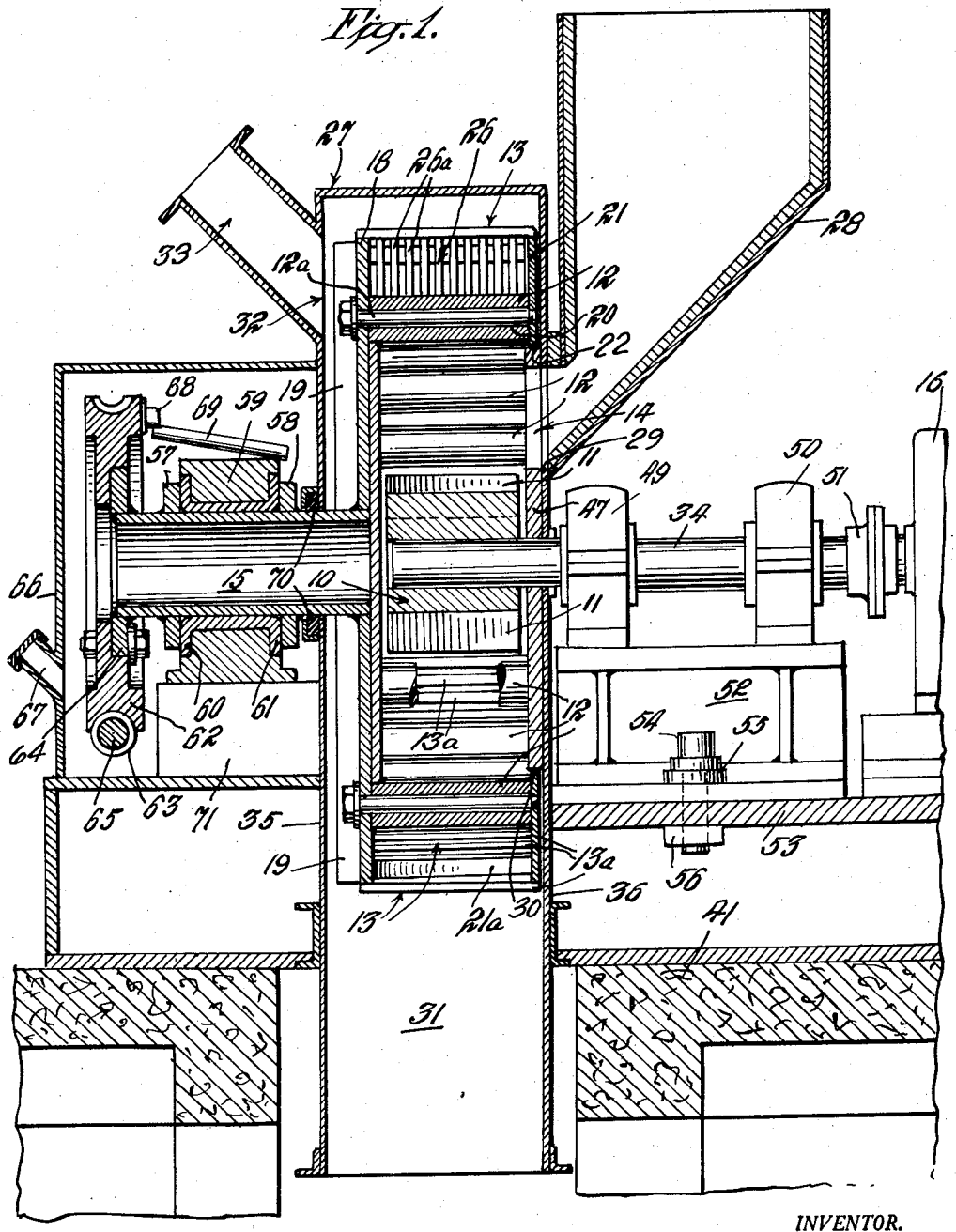
Fig. 1.



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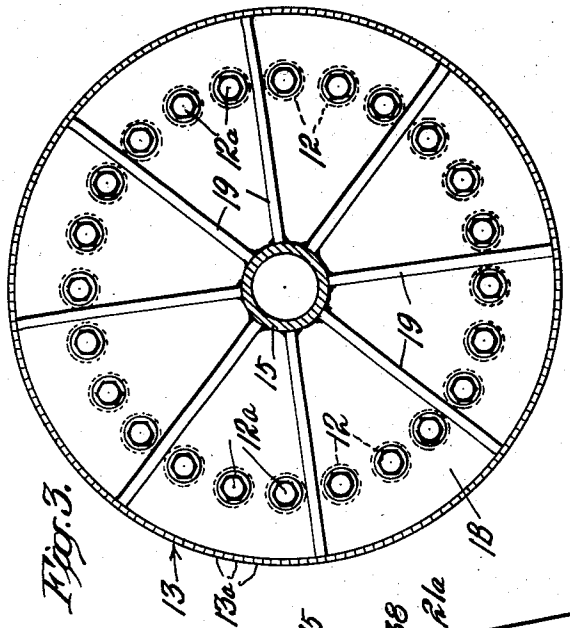

Fig. 3.

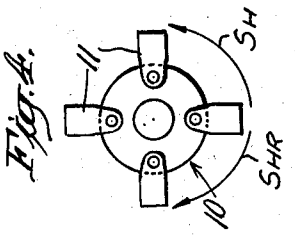

Fig. 4.

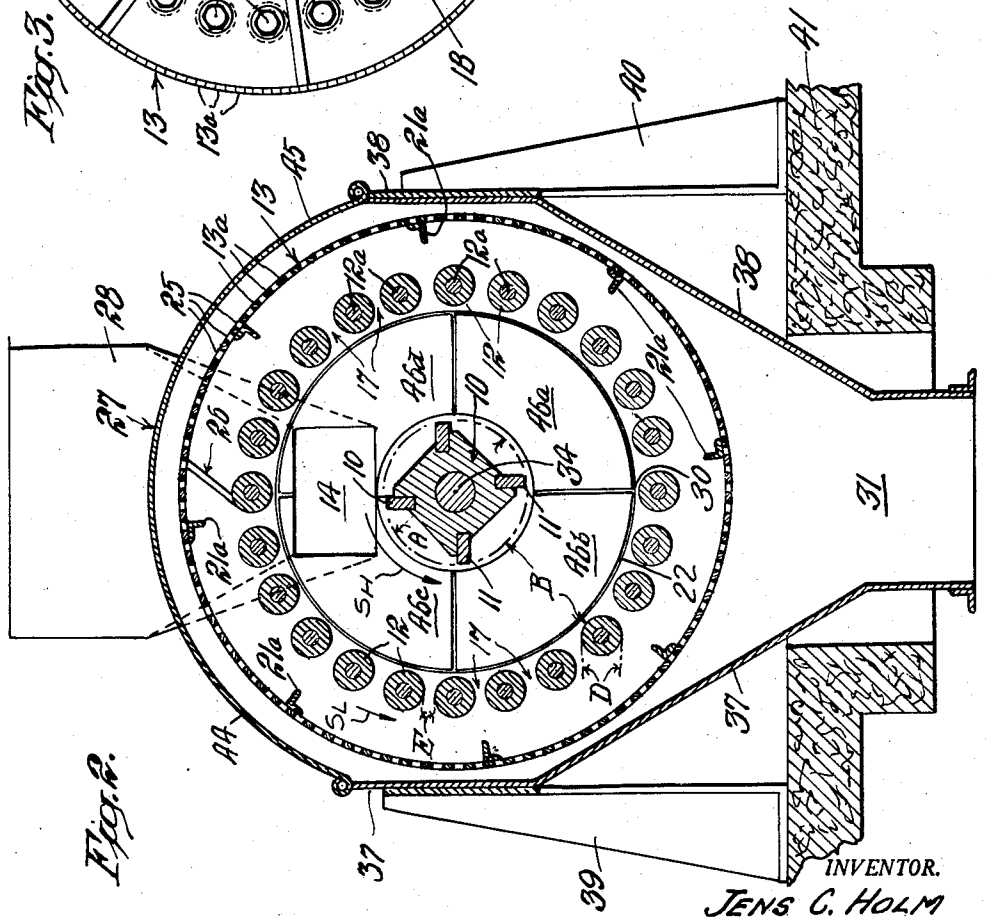

Fig. 2.

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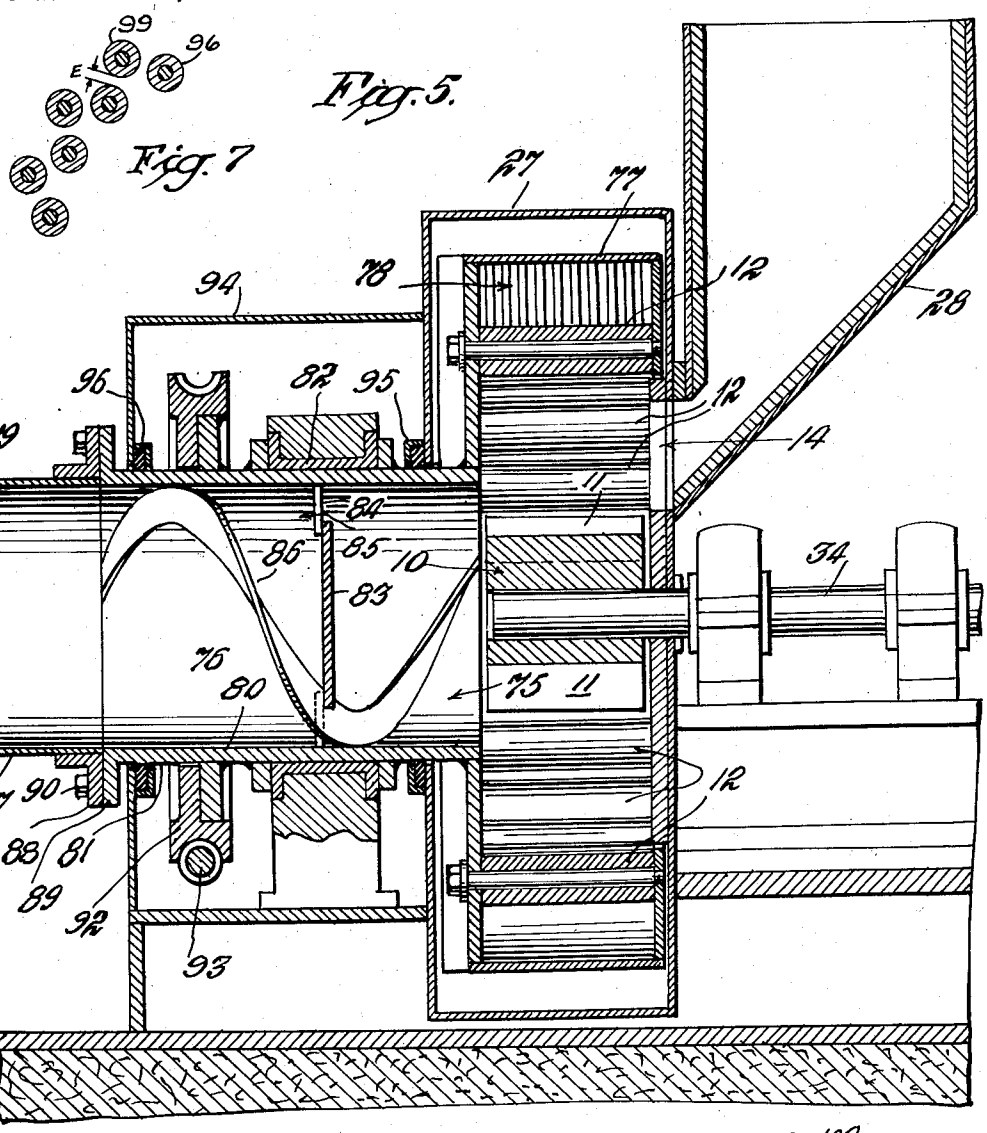

Fig. 5.

Fig. 7

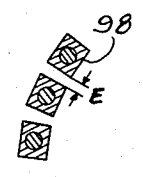

Fig. 8

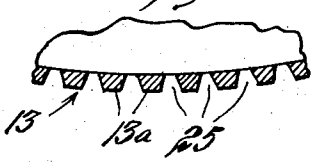

Fig. 6.

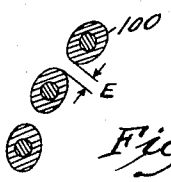

Fig. 9

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CRUSHER

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Application October 31, 1955, Serial No. 543,922

12 Claims. (Cl. 241—80)

This invention relates to a rotary type crusher for reducing frangible material.

An object of this invention is the reduction of frangible material and the recirculation of the material requiring further reduction.

Another object of the invention is to repeatedly subject the frangible material to the impact action of hammers rotating at a high speed until reduced to a given size.

Another object of the invention is to provide a crushing machine which discharges the reduced material of proper size and recirculates the oversized material into the path of the high speed hammers.

A further object of the invention is to provide a crusher for reducing wet material.

A still further object of the invention is to provide a crushing machine for reducing frangible materials to fine particles and removing the particles by an air stream.

Other and further objects will be apparent from the following description taken in connection with the drawings in which:

Fig. 1 is a longitudinal sectional view of the crusher;

Fig. 2 is a cross sectional view of the crusher;

Fig. 3 is an end view of the breaker and screen member;

Fig. 4 is a fragmentary sectional view of another embodiment of the rotor;

Fig. 5 is a longitudinal sectional view of the crusher for producing fine particles;

Fig. 6 is a fragmentary sectional view of the screen shown in Fig. 2;

Fig. 7 illustrates a portion of a double row of the breaker bars;

Fig. 8 illustrates rectangular breaker bars; and

Fig. 9 illustrates elliptical breaker bars.

The crusher comprises a rotor **10** having a set of hammers **11** for hitting frangible material with impact blows, sending it against the rotating breaker means or bars **12** encircling the rotor **10**. A classifying screen **13** exteriorly encircles the breaker means and rotates therewith. The screen separates the reduced material by discharging the pieces of the desired size or less and retaining the oversize material within the crusher for further reduction by the hammers and breaker bars. The material is introduced into the crusher through an opening **14** between the breaker means **12** and the rotor **10** and is discharged through the bottom of the screen **13**.

The rotor **10** is supported on the end of the shaft **34** which is coupled to and driven by a prime mover such as an electric motor **16**. The rotating hammers **11**, subscribing a hammer circle having a diameter A (Fig. 2), have surfaces substantially radial to the shaft **34** and extending longitudinally to the axis for hitting material dropped in the crusher. The hammers are of the replaceable type and are secured in fixed position. As shown in Fig. 2, the hammers are adapted to rotate in one direction. Hammers may be provided striking surfaces on both sides so that the directions of rotation of the rotor may be reversed. This is illustrated in the embodiment shown in Fig. 4 in which the hammers have faces on opposite sides and are pivotally mounted on the rotor.

The breaker means or bars **12** are spaced a distance B from the hammer circle Fig. 2, and extend longitudinally to the hammers **11** to form breaker surfaces facing the hammers to receive the projected material. The bars **12** are uniformly spaced to provide spaces **17** having a width E for passing material through to the screen and oversize pieces back into the breaker chamber.

The breaker bars **12** are equally spaced from the shaft **15** and rigidly secured thereto by a supporting means comprising a flat, circular plate **18** welded or otherwise fastened to the end of the shaft or trunnion **15** and having radially extending support beams **19** stiffening the plate **18** and rigidly securing the plate **18** to the shaft **15**. The breaker bars **12** are preferably cylindrical in shape with a longitudinal bore **20** extending therethrough. Each of the bars are secured to the plate **18** by means of a long bolt or threaded shaft **12***a* extending through an opening in the plate **18** and the bore **20** of the respective bar and threading into the rim **21** positioned at the other end of the bar **12**. Supports **21***a* are peripherally arranged securing the rim **21** to the plate **18** along the outer edge. The screen bars **13***a* are mounted on the outer edges of the plate **18** and rim **21** to form the screen **13**. The rim is thus securely held to the plate **18** by the bolts **12***a*, supports **21***a* and bars **13***a*. The rim has an inner circular edge **22** forming a circular opening with the circular lining on the rotor **10**. The bars have a diameter D and the holes or openings **23** are spaced so that the surfaces of the bars are spaced the distance E through which material may readily pass to the screen **13** and back into the crushing chamber or zone.

The space E of the bars **12** is smaller than the size of the material entering the crushing zone and larger than the size of the material passed by the screen **13**. The bars **12** instead of being cylindrical may be shaped to have a flat comminuting surface **98** facing the hitting surface of the hammers **11** on the surfaces or may have a convex elliptical surface **100** facing the hammers **11**.

The screen bars **13** are secured to the outer edge of the supporting plate **18** and flange **21** and uniformly spaced to provide selective rectangular slots **25** therebetween. The screen bar **13** has a triangular or trapezoidal cross-section so that the slots **25** are expanding divergently outward. The reduced material passes through the space between the bars and drops onto the screen **13**. The material passing between the breaker bars collects on the screen **13** and is tumbled and shifted by the rotation of the screen so that the material of the desired size passes through the screen. The oversized material is carried up to the top of the breaker by a grated scoop **26** positioned between a breaker bar and a screen bar and dropped into the path of the rotor hammers for further fragmentation. The scoop is formed by a row of spaced bars **26***a* extending between one of the breaker bars and one of the screen bars and firmly and rigidly secured to the bars. The scoop bars are set at an angle to a radial line so that material is picked up and passed through the breaker bars and carried upwardly above the rotor **10**. The angle of the scoop to a radial line is such as to carry the material over the rotor before it is passed from the screening zone between the bars into the crushing zone. A single scoop is shown but a plurality of scoops may be provided to provide a substantially even flow of material from the screening zone. The screen may also be made from screen cloth, woven

wire, screening or perforated plates, or any other screening material normally used for screening by wrapping such material around the breaker assembly and securing it thereto.

A casing **27** enclosing the comminuting members has a feed chute **28** for passing material to the rectangular opening **14** in the side of the breaker assembly between the lining **47** of rotor **10** and the rim **21**. The crushed material of the proper size passing through the screen **13** drops out of the casing through the discharge chute **31**. In order to prevent dust from escaping from the crusher, a port **32** is provided in the casing **27** and is connected by means of the conduit **33** to a dust collector. The dust collector sucks the dust out of the crusher by a reduced pressure.

The breaker means **12** and the screen **13** are rotatably mounted on the shaft **15** which is axially aligned with the shaft **34**. The casing **27** has sides **35**, **36** extending between the end walls **37** and **38**. The end walls are supported by pillars **39** and **40** which are securely embedded in a concrete base **41**. The side walls **36** extend above the end walls **37** and **38** and have an upper semicircular edge **42**, **43**. The top of the casing has covers **44**, **45** pivotally mounted to the top edge of the end walls **37**, **38** for opening the top of the casing to inspect the comminuting members and sealing the casing by resting on the edges **42**, **43**. The rectangular opening **14** is provided in the wall **36** to permit the passage of material from the feed chute **28** into the comminuting members in the casing **27**. The opening **14** is positioned intermediately between the end walls **37**, **38** and above the hammer circle subscribed by the rotating hammers **11** and the breaker bars **12**. The port **32** is formed in the upper portion of the wall **35**. The wall **36** is provided with wear-resistant lining plates **46***a*, **46***b*, **46***c*, and **46***d*. All the plates together form a circle and fit in the opening **30** formed by the rim **21**. A mechanical seal is mounted around rotor shaft **34**. The upper plates **46***c* and **46***d* are formed to fit around the opening **29** in the wall **36** to pass the material into the crusher.

The shaft **34** and rotor **10** are supported by bearings **49** and **50** and are connected through coupling **51** to a motor **16**. The rotor and bars are mounted on a frame **52** slidably mounted on a pair of fixed runners **53** secured to the base **41**. Thus, the rotor **10** and the resistant plate **47** may be conveniently withdrawn from the crusher for inspection and replacement of worn hammers or parts. The frame **52** is located in position on the stationary runners **53** by bolts **54** fitting through bosses **55** and nut **56** on the frame and runners, respectively.

The shaft or trunnion **15** has flanges **57**, **58** between which the bearing **59** is positioned. The bearing **59** supports the shaft **15** in axial alignment with the rotor shaft **34**, and the flanges **57**, **58** restrict the axial movement of the shaft **15** to a minimum. The bearing **59** has flanges **60** and **61** engaging the flanges **57**, **58** on the shaft **15**. The shaft **15** is turned by means of a gear **62** and a worm **63**. The gear **62** is bolted to the flange **64** which is rigidly secured to the end of the shaft **15**. The worm **63** is driven by an electric motor or other suitable power source (not shown) by means of shaft **65**. The bearing **59** and gear **62** and worm **63** are sealed in the casing **66**. A supply of oil is introduced into the casing **66** through the spout **67** immersing the worm and lower teeth of the gear **62** in a bath of lubricating oil. The gear **62** carries one or more cups **68** adjacent the peripheral edge thereof to pick up oil from the reservoir in the bottom of the casing **66** and carry it to the upper position for supplying the oil guide **69**. The oil guide **69** distributes the oil over the bearing **59** to lubricate the surfaces between the flanges **57** and **60** and **58** and **61**, and the surfaces of the shaft **15** and the bearing **59**. An oil seal **70** is provided on the shaft **15** in the casing wall **35** to exclude dust and other abrasive material from entering the chamber. The bearing **59** is mounted on the base **71** which is in turn supported by the base **41**. Thus, the shafts **15**, **34** are held from axial movement and in axial alignment during operation. The breaker means **12** is rotated slowly by means of the gear **62** and worm **63**. The rotor **10** is turned at a high rate of speed, S_H.

The rotor may have pivoted hammers as shown in Fig. 4 and the fixed hammer may have striking surfaces back to back so that the rotor may be reversed in direction. The breaker bars **12** and the rotor **10** are preferably driven in the same direction with the rotor **10** turning at a high speed. The breaker bars **12** are rotated at a substantially slower speed SL to carry the oversize material to the top of the crushing zone. The rotor **10** and the breaker bars **12** may be rotated in the same direction S_{HR} or in opposite directions. It is preferable to reverse the relation of the direction of rotation by reversing the direction of rotation of the rotor **10** so that it will not be necessary to change the angle of the scoop **26**.

The breaker bars **12** have been described and illustrated as having circular breaker surfaces. The bars may be rectangular in shape with flat striking surfaces. Also, instead of a single row of breaker bars, a double row of breaker bars **96** and **99** may be provided with the spaces between the bars being of a sufficient width to pass material having a size of the entering material. The material may be picked up by the scoop or scoops in the screening zone and dropped back through the spaces into the rotor. The material hit by the hammers passes between the bars of the first row and strikes the second row of bars.

The material that is initially hit by the hammers against the breaker means may, in the embodiment described and illustrated, either pass between the bars after reduction into the screening zone and be carried up to the top of the crusher from where it may be dropped into the rotor again or the oversized material, instead of passing through the bars, may collect in the bottom of the breaker means and be tumbled therein accumulating until there is a sufficient amount so that the hammers engage the material tumbling on top of this accumulated pile. The hammers will strike these top pieces to further reduce them. The breaker bars may carry some of the pieces between them over the top of the crushing zone and drop the pieces into the rotor.

This material tumbling in the bottom of the breaker means assists in keeping the breaker bars clean when wet sticky material is fed to the crusher. The continual rotation of the breaker bars and the rubbing of the bars by the accumulated material maintains the bars substantially free of foreign matter so that the impact surfaces remain hard. In comminuting wet material the classifying screen **16** may be dispensed with and the material directly discharged from the breaker means.

The spacing E will depend upon the speed of rotation of the breaker means **12** and the speed of rotation of the hammers **11**. The greater the speed, the wider the spacing E may be. The diameter of the rotor **10** and the distance B will depend upon the material to be crushed, the speed of rotation of the rotor **10**, the size of the entering material and the size of the material finally passing through the screen **13**.

Another embodiment of the invention is shown in Fig. 5 in which the screen **13** is replaced by a solid plate **77** thereby retaining the material within the rotating members. The frangible material is introduced into the crusher in a similar manner to the embodiment of Figs. 1 and 2. Instead of the material being reduced to a given large size and passing through the screen **13**, it is retained within the rotating members and reduced to fine particles that are removed from the crusher by a stream of air entering through the opening **14** and leaving the

chamber through the passage formed by the tubular trunnion 76. The air is drawn out by suction means such as a fan (not shown), and the particle laden stream passes through a cyclone separator (not shown) to clear the air of the particles and collect them at the bottom of the separator.

The frangible material is introduced into the crusher through the opening 14 and hit by hammers 11 of the rotor 10 against the breaker means 12. The scoops 78 are provided to carry the material between the breaker bars to above the rotor and reintroduce the material into the comminuting zone. The material is reduced to fine particles and is removed by suction means through the discharge outlet 75 and the discharge passage 79 in the trunnion 76.

The trunnion 76 is tubular in shape and has an inner cylindrical wall 80 forming the discharge passage 79 and has an outer surface 81 forming a journal fitting in the bar 82. A helical conveyor 86 is mounted on the wall 80 and rotates to return oversized material entering the passage 79 to the comminuting zone. Recessed in the passage 79 from the discharge opening 75 is an impact plate 83 supported by spaced struts 84 to provide openings 85 through which the pulverized material passes. Oversized material projected into the passage 79 hits the impact plate and drops onto the surface 80 to be returned by the conveyor 86. The outer end of the trunnion 76 is coupled to a conduit 87 by means of the flanges 88 and 89 and bolts 90. The conduit 87 is connected to the suction means (not shown). The bearing 82 is similar to the bearing 59 shown in Fig. 1, and a gear 92 is similar to the gear 62 which is securely fastened to the trunnion 76. A worm 93 similar to the worm 63 engages the gear 92 to rotate the trunnion 76 and the breaker means 12. The casing 94 encloses the bearing 82 and the gear 92 and worm 93. Dust seals 95 and 96 are provided at each end of the trunnion 76 to seal the chamber enclosed by the casing 94. The breaker means 12 are similarly mounted to the circular supporting plate 18 shown in Fig. 1 and described in connection therewith. The circular drum-shaped means may comprise a plurality of plates bolted to the supporting plate 18 and the flange or rim 21. The rotor 10 is mounted in a similar manner on the shaft 94 supported by bearings 49 and 50, and rotated by a motor or other means (not shown).

The material is carried in the bars 12 and the circumferential plate 77 in a similar manner as the bars 12 and screen 13 in the embodiment of Fig. 1. The material is reintroduced through the spaces 17 until the material is fragmentized to be carried by the moving air stream.

Various modifications and changes may be made in the crusher without departing from the invention as set forth in the appended claims.

I claim:

1. A crusher comprising a rotor with driving means for turning said rotor and having hammers for fracturing and hitting frangible material against breaker means spaced from said rotor, second driving means, rotatable breaker means coupled to said driving means and having longitudinally extending breaker bars encircling said rotor to receive the impact of material projected by said rotating hammers and reduce the material to a given size, and said bars being circumferentially spaced to pass the material outwardly through the bars for classification and discharge of the material and to return the oversize material through said bars for further reduction, a rotatable classifying screen encircling said breaker means and spaced therefrom to form a classifying chamber and means for coupling said classifying screen to said second driving means rotating said classifying screen about said rotor, and material return means secured to said classifying screen in said chamber to rotate therewith about said rotor for carrying oversize pieces above the center of rotation of said rotor and dropping the pieces through the breaker bars into the path of said hammers for further reduction by the impact of the material with said hammers and said breaker means.

2. A crusher as claimed in claim 1 wherein said first driving means is adapted for turning said rotor at a high speed and said second driving means is adapted for turning said breaker means and classifying screen at a low speed in the same direction as said rotor.

3. A crusher as claimed in claim 1 wherein said first driving means is adapted for rotating said rotor in one direction and said second driving means is adapted for rotating said breaker means and said classifying screen in the opposite direction.

4. A crusher comprising a rotor with driving means for turning said rotor and having hammers for fracturing and hitting frangible material against breaker means spaced from said rotor, second driving means having a radially extending supporting member integral therewith, breaker means mounted on said radially extending supporting means and having longitudinally extending breaker bars encircling said rotor to rotate with said second driving means and to receive the impact of the material projected by said rotating hammers and reduce the material to a given size, said bars being circumferentially spaced to pass the material outwardly through the bars for classification and discharge and to return the oversize material to said bars for further reduction, a classifying screen means encircling said breaker means and spaced therefrom to form a classifying chamber to discharge properly sized material from said chamber, said screen means being secured to said radially supporting means to rotate with said breaker bars, and material return means secured to said screen means and said breaker bars to rotate therewith about said rotor for carrying oversize pieces above the center of rotation of said rotor and dropping the pieces through the breaker bars into the path of said hammers for further reduction by the impact of the material with said hammers and said breaker means.

5. A crusher comprising a rotor, driving means for turning said rotor and having hammers for fracturing and hitting frangible material against breaker means spaced from said rotor, breaker means and classifying screen means formed as an integral member, means for rotating said integral member, said rotatable breaker means having longitudinally extending breaker bars encircling said rotor to receive the impact of material projected by said rotating hammers and reduce the material to a given size, said bars being circumferentially spaced to pass the material outwardly through the bars for classification and discharge of the material to return the oversize material through said bars for further reduction, said classifying screen encircling said breaker means and spaced therefrom to form a circumferentially extending classifying chamber for passing the proper size material out of the crusher and retaining the oversize material and having material return means secured to said screen and said breaker bars for carrying said oversize material above the center of rotation of said rotor and dropping the pieces through the breaker bars and into the path of said hammers for further reduction by the impact of said material with said hammers and said breaker means.

6. A crusher as claimed in claim 1 wherein said breaker bars are cylindrical in shape.

7. A crusher as claimed in claim 1 wherein said classifying screen comprises longitudinally extending screen bars spaced to form rectangular slots diverging outwardly.

8. A crusher as claimed in claim 1 wherein a feed opening for introducing material into said crusher is positioned at the side of said crusher above said rotor and within the periphery of said breaker means.

9. A crusher as claimed in claim 1 wherein said hammers are pivotally mounted on said rotor and said rotor is turned in either direction.

10. A crusher as claimed in claim 1 wherein said breaker means comprises two concentric rows of cylindrical breaker bars with the bars of the outer row spaced outwardly from the space between two bars of the inner row and each outer bar spaced from said inner adjacent bars a distance for returning the oversize pieces into the path of the rotating hammers.

11. A crusher as claimed in claim 1 wherein said breaker bars have a flat comminuting surface facing the rotor.

12. A crusher as claimed in claim 1 wherein said breaker bars have convex elliptical surfaces facing the rotor.

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