Jan. 7, 1941. G. W. BORTON 2,227,435

CRUSHING MACHINERY

Filed Feb. 21, 1938 3 Sheets-Sheet 1

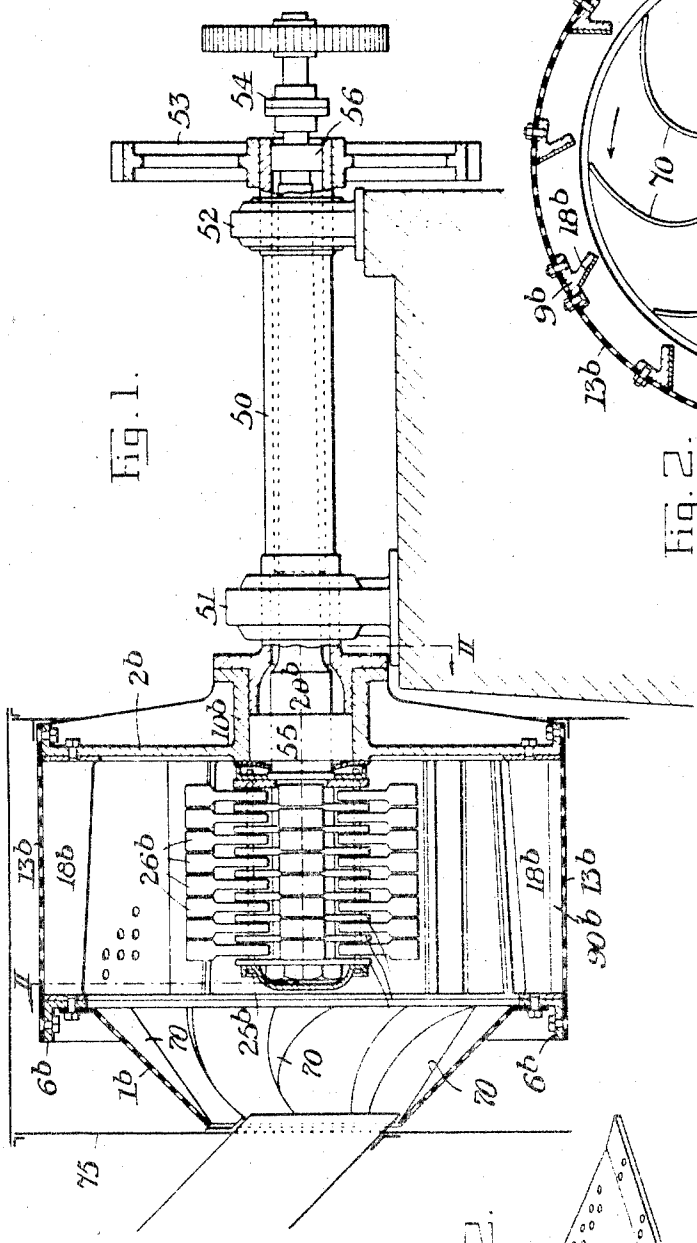


Fig. 1.

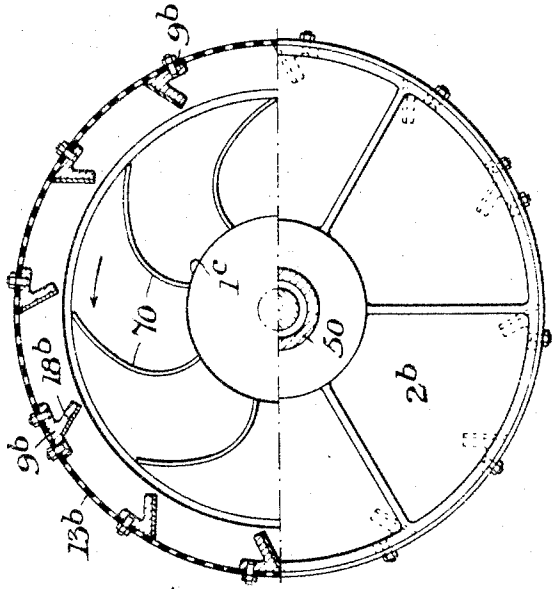


Fig. 2.

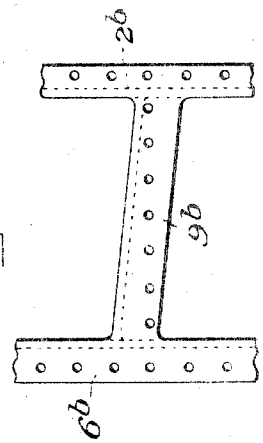


Fig. 3.

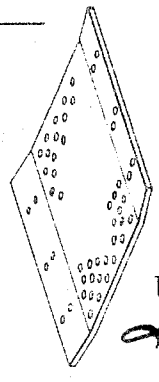


Fig. 12.

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CRUSHING MACHINERY

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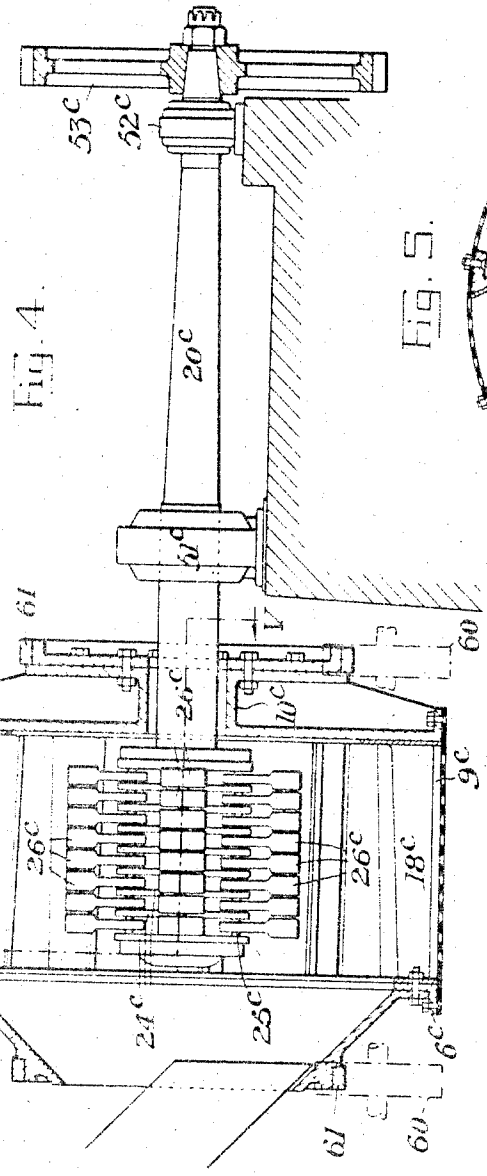


Fig. 4.

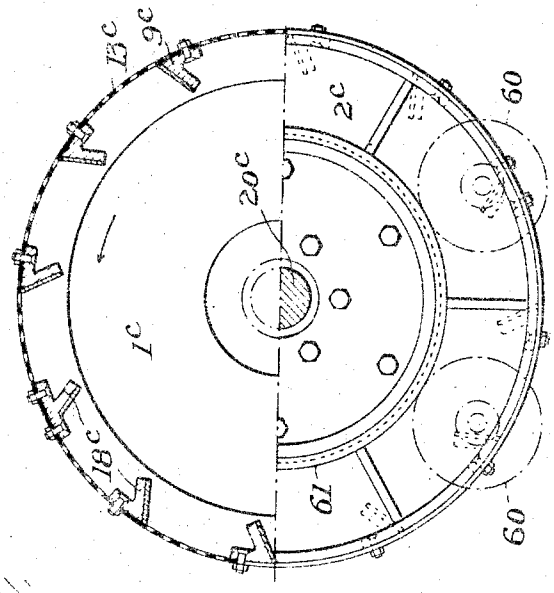


Fig. 5.

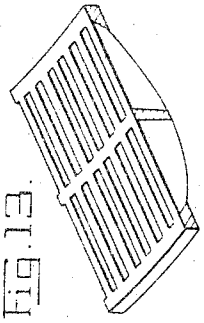


Fig. 13.

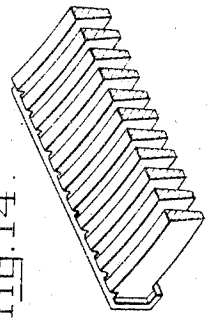


Fig. 14.

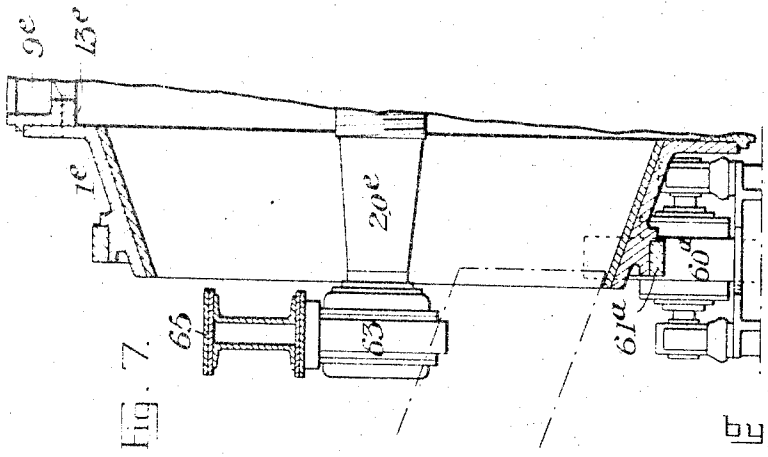


Fig. 7.

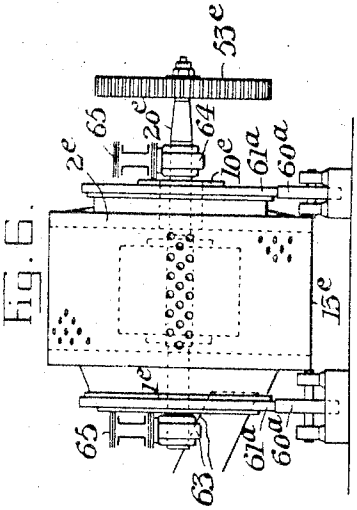


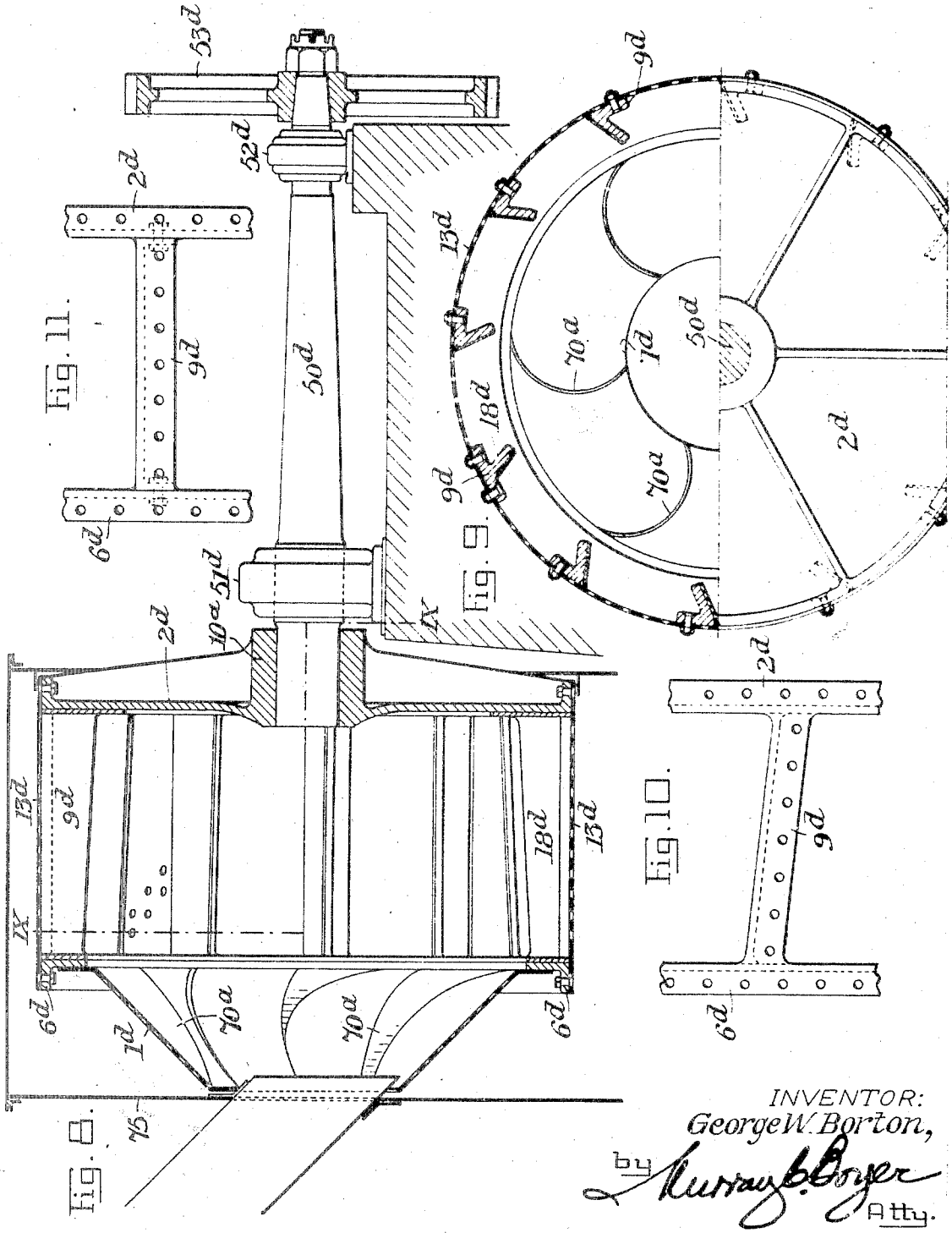
Fig. 6.

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CRUSHING MACHINERY

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Patented Jan. 7, 1941 2,227,435

UNITED STATES PATENT OFFICE

2,227,435

CRUSHING MACHINERY

George W. Borton, New Lisbon, N. J., assignor to Pennsylvania Crusher Company, New York, N. Y., a corporation of New York

Application February 21, 1938, Serial No. 191,764

6 Claims. (Cl. 83—11)

My present invention relates to apparatus for breaking, crushing, or comminuting various materials such as ore, rock, coal, and/or the like, and is a continuation in part of my application for patent filed February 3, 1931, Serial No. 513,190 (now Patent No. 1,948,504), and my application for patent filed February 26, 1934, Serial No. 713,045 (now Patent No. 2,108,793).

My invention comprises improved apparatus well adapted for the free reception of material to be crushed or broken, which may be run-of-mine or other size initially, and it includes a rotatable drum which may be of relatively large diameter having circular or annular end members or frame sections which may be of special conformation, and a peripheral wall disposed between said end members or frame sections. The peripheral wall may be partially or wholly apertured for the discharge of the broken material, and for such purpose, this wall may include screen sections of suitable character. These screen sections may be apertured plates of any usual type, and/or they may be in the form of integral frames with spaced bars, which bars may be arranged circumferentially of the wall of the drum or parallel with the longitudinal axis thereof, as may be necessary or desirable in connection with the particular material being crushed. The screen plates or the grids are supported by longitudinal members forming parts of the drum structure, and these longitudinal members may be integral with one or both of the end members or frames making up the drum, or they may be in the form of structural members such as I- or T-beams, connecting said end frames or members and holding the same in spaced relation. One of the end frame sections or members may have the shape of the frustum of a cone in longitudinal section and serve as a chute or hopper for the delivery of material to the crushing chamber, and both end members or frame sections may be provided with trunnions or other suitable supports whereby the drum may be mounted for rotation. The cone-shaped feed section may be provided with vanes to control delivery of material into the drum, and these vanes may be straight or curved. With this drum I may employ a hammer-carrying rotor structure, and I may support the rotor structure entirely independently of the drum. The rotor structure may rotate in the same direction as the drum or opposite thereto, but at a much greater speed.

In addition, the crushing chamber provided by the drum is equipped with lifting shelves, which may be adjustably mounted, whereby material delivered to such crushing chamber, preferably through the receiving end, which may be cone-shaped or otherwise, may be continually lifted and dropped in the path of the hammers for impact thereby until broken to a size that will freely pass through the screen plates or through spaces between the bars of grid sections if and when the latter are employed. The lifting shelves may be diagonally disposed or mounted for angular adjustment longitudinally and radially of the drum.

A further object of my invention is to provide a structure of the general type referred to, with outboard shafts supporting the drum and/or the hammer-carrying rotor disposed within the same; one of said shafts being hollow and carrying bearings for the other shaft, and both drum and rotor being mounted for rotation in space at the ends of the respective shafts.

A further object of my invention is to provide a structure of the general type referred to, with an outboard shaft supporting the drum which is mounted for rotation in space at the end of said supporting shaft.

A further object of my invention is to provide a crushing structure in which the drum may be arranged to revolve in roller supporting roller bearings, and in which the hammer-carrying rotor structure is supported wholly independently of such drum.

These and other features of my invention are more fully disclosed hereinafter, reference being had to the accompanying drawings, more or less diagrammatic in character, in which:

Figure 1 is a longitudinal sectional view of a form of crushing structure within the scope of my invention, showing an overhung hammer-carrying rotor disposed with a rotating drum or cage.

Fig. 2 is a sectional view on the line II—II, Fig. 1.

Fig. 3 is a fragmentary view illustrating a detail within the scope of my invention.

Fig. 4 is a longitudinal sectional elevation of another form of structure wherein the drum is supported entirely independently of the hammer-carrying rotor and its operating means.

Fig. 5 is an end elevation of the structure shown in Fig. 4, partly in section, on the line V—V.

Fig. 6 is a view in elevation of another form of structure within the scope of my invention.

Fig. 7 is a longitudinal section of the feed end of a structure such as that shown in Fig. 6.

Fig. 8 is a longitudinal sectional view of a crushing structure within the scope of my invention, in which the cage or drum is carried at the end of an outboard shaft, mounted in suitable bearings, and which omits the hammer-carrying rotor structure.

Fig. 9 is a sectional view on the line IX—IX, Fig. 8.

Figs. 10 and 11 are fragmentary views illustrating details within the scope of my invention, and

Figs. 12, 13 and 14 illustrate forms of screen plates or grids which may be employed to form the wall of the crushing drum.

My improved crushing apparatus comprises a rotatable drum, with openings in the peripheral wall for discharge of the crushed material, and end frames or members connected thereto and provided with supporting means which may be mounted in suitable bearings so that such drum may be freely rotated, or the drum may be supported by roller bearings. In some instances, the screen supporting portions of the peripheral wall of the drum may be integral with one or both of the end frames, and in other instances, the end frames may be connected by longitudinal beams which, in turn, support the screen plates or grids. In most instances, the longitudinal connections will provide spaces arranged circumferentially of the drum and adapted for the reception of screen plates or grids made up of spaced bars, through which the material, when broken to the desired size, may be discharged. In lieu of this, a wall of foraminous or reticulated character, continuous in extent, may be employed.

The structure illustrated in Figs. 1, 2, et seq., comprises a rotating cage or drum in overhung position carried by an out-board shaft with a hammer-carrying rotor structure disposed within the drum. In this arrangement, the cage is carried by a sleeve shaft suitably supported in bearings, while the hammer-carrying rotor is supported at the end of a shaft centrally disposed with respect to the sleeve shaft carrying the drum. The overhung weight of the drum, as well as the weight of the rotor structure, is partially compensated for by the weight of the respective shafts and the weight of a gear wheel carried by the end of the sleeve shaft and through which motion is imparted thereto.

This form of my improved crushing structure may comprise a drum having a conical feed end 1^b substantially like those illustrated in Figs. 1 and 2, of my prior Patent No. 2,608,793, and an imperforate end wall 2^b. The conical feed end may be apertured for the passage of fines accompanying the material being crushed. These parts may be connected together in spaced relationship by longitudinal members 9^b, which may be integral with the end wall 2^b, as shown in Fig. 3, or such elements may be independent members 90^b, as indicated in Fig. 1, secured to the end walls or members 2^b and 6^b by suitable bolts. This form of structure is shown as provided with screen plates 13^b, and these screen plates may be of the type illustrated in the patent of John H. Doerres, No. 1,563,173, and shown in Fig. 12, or of any other type commonly employed in coal breakers of the Bradford type. Grids of the type illustrated in Figs. 13 and 14, may be employed in lieu of such screen plates.

Lifting shelves 18^b of the fixed or adjustable type may be employed in the form of crushing apparatus shown in Fig. 1, or, if desired, webs on the longitudinal members 9^b may serve as lifting shelves, as illustrated in Fig. 2.

When the end sections or members 2^b and 6^b are integral with the longitudinal members 9^b, the latter may be arranged at an angle to the longitudinal axis of the drum, as clearly indicated in Fig. 3, which also indicates lifting shelves as integral with said longitudinal members.

The end wall or frame 2^b carries a central hub 10^b attached to a hollow shaft **50**, the latter extending outwardly some distance away from said wall 2^b, and being supported by bearings **51** and **52**. A gear wheel **53** is carried by the end of this hollow shaft, and motion may be imparted thereto through the medium of a pinion on a driving shaft (not shown), or such gear wheel may be driven in any other manner. The hammer-carrying rotor structure may be of the type illustrated in Fig. 1, of my prior Patent No. 2,108,793, having hammers of any suitable or usual type, indicated at 26^b, hung from supporting rods 25^b, carried by the usual spaced disks 24^b.

The rotor structure shown in Figs. 1 and 2 is carried by a shaft 20^b which passes through the hollow shaft **50** and may be connected at its outer end by a coupling **54** to any suitable form of motor or other driving mechanism. The hub 10^b of the wall 2^b of the drum carries a roller bearing **55** (or bearing of other suitable type) for the shaft 20^b, and a bearing **56** of suitable or similar type is disposed near the extreme outer end of the hollow shaft. Both of these shafts are in motion at the same time, the inner shaft being driven at a much greater speed than the outer hollow shaft, and they may move in the same direction, or in opposite directions, as may be best adapted for the particular crushing work in hand. As may be readily understood, the shafts 20^b and **50** may be driven by a single source of power.

In Figs. 4 and 5, I have shown a form of structure somewhat similar to that illustrated in Figs. 1 and 2, in which the drum is mounted entirely independently of the hammer rotor and its shaft. While various forms of mounting may be employed, more or less common in the mounting of the drum or shells of Bradford breakers, in the present instance the end sections 1^c and 2^c of the drum are shown as supported by rollers **60** forming a cradle; the drum having annular rim portions or trunnions **61** engaging the same. These rollers may be driven by suitable means to impart the desired motion to the drum, and such rollers may be toothed and the annular portions **61** of the drum may also be toothed for driving engagement therewith or, in lieu of this, the rollers **60** may be idlers and the drum may carry a gear wheel driven by suitable means, which may include a power transmitting pinion meshing with such gear. In this arrangement, the rotor, consisting of the usual disks 24^c, and the hammers 26^c hung from rods 25^c carried by such disks in the usual manner, may be carried by an overhung shaft 20^c, mounted in bearings 51^c and 52^c, the end of such shaft carrying a gear 53^c to which motion may be imparted by suitable means, through a power transmitting pinion meshing with such gear, or otherwise. In this arrangement, there is no contact of the hammer rotor and its operating mechanism with the drum; the open hub 10^c of the end wall 2^c providing for the free passage of the shaft 20^c. The

drum and rotor may be independently driven in the same or opposite directions, as may be necessary or desirable, and at different speeds. The speed of the drum, of course, will be less than the speed of the hammer rotor. As in the other structures, the drum will have lifting shelves 18c of suitable character, and they may be integral with the longitudinal members 9c connecting the end members, or they may be independent members secured to such longitudinal members. In like manner, such longitudinal members may be integral with one or both of the end members, or they may be independent elements of I- or T-cross section, to which said end members are secured.

In Fig. 6, I have shown another form of structure in which the hammer-carrying rotor is supported wholly independently of the drum. In this construction, the drum is shown as supported by rollers 60a, engaging the annular portion 61a, in a manner substantially similar to the structure illustrated in Figs. 4 and 5, so as to be capable of movement independently of the hammer-carrying rotor structure, which is supported by a shaft 20e, and the latter is carried by or journaled in suspended bearings 63 and 64 which may be hung from structural supports 65, or other means disposed externally of and at the opposite ends of the drum. The drum may be of the same type as those illustrated in Figs. 1 and 4, or like that illustrated in Fig. 1 of my prior Patent No. 2,108,793.

In this arrangement, there is no contact of the hammer-carrying rotor and its operating mechanism with the drum, the end wall 2e having a hub 10e providing for the free passage of the shaft 20e, while the opposite end of said shaft passes through the opening in the cone-shaped feed member 1e. The shaft 20e may carry a gear wheel 53e to which motion may be imparted in any suitable manner whereby the hammer-carrying rotor may be driven. As in the other structures, the drum and rotor may be independently driven in the same or opposite directions, as may be necessary or desirable. The speed of the drum, of course, will be less than the speed of the hammer-carrying rotor. As in the other structures, the drum will have lifting shelves, and they may be of the type illustrated in Figs. 2 and 5, or of the type illustrated in Fig. 3.

In lieu of supporting the drum by means of the rollers 60 and 60a, engaging rings 61 or 61a carried by the drum, in structures of the type illustrated in Figs. 6 and 7, I may arrange suspended bearing supports for the drum, of a character substantially similar to those illustrated at 63 and 64, the drum having hollow trunnions journaled in said suspended bearings. The shaft carrying the hammer rotor may pass through these trunnions, and this shaft may be journaled in bearings disposed within the trunnions, or such shaft may be extended beyond the bearings supporting said trunnions and hung in independent suspended bearings. Any usual form of driving means may be employed to rotate the drum, and the hammer-carrying rotor may be independently driven by suitable means.

In the structure illustrated in Figs. 1 and 2, I have shown the cone-shaped feed end member provided with vanes, indicated at 70. While in some instances, these vanes may be straight, that is to say, parallel with the axis of rotation, they may be curved, as illustrated in Fig. 2. Their purpose is to prevent material from cascading directly into the bottom of the drum and avoid the formation of a bed of uncrushed material that would retard free screening of the material broken by the hammers. The vanes serve to divide the feed and elevate it part way during rotation of the drum.

The structure illustrated in Figs. 8 and 9 comprises a rotating cake or drum in overhung position carried by an outboard shaft. In this arrangement, the shaft is suitably connected to the end wall of the drum and supported in bearings. The overhung weight of the drum is partially compensated for by the weight of the shaft, and the weight of a gear wheel or speed reducing mechanism carried by the end of the same and through which motion is imparted thereto.

This form of my improved crushing structure may comprise a drum having a conical feed end 1d and an imperforate end wall 2d, and omits the hammer mechanism; the coal or other material fed into the drum being broken by dropping from the shelves of the same. The conical feed end may be apertured for the passage of fines accompanying the material being crushed. These parts may be connected together in spaced relation by longitudinal members 9d, which may be integral with the end wall 2d and a ring 6d to which the conical feed and is secured. If desired, the members 9d may be straight, and may be independent members secured to the end wall 2d and ring 6d, by suitable bolts, as indicated in Fig. 11.

The structure illustrated in Figs. 8 and 9 is shown as provided with screen plates 13d, which may be of usual character, disposed externally of the frame made up of the end wall 2d, ring 6d, and connecting members 9d. If desired, the wall of the drum may be composed of plates of the type illustrated in the Doerres patent before referred to, or of any other type commonly employed in coal breakers of the Bradford type. Lifting shelves of the fixed type may be employed, and the webs 18d of the longitudinal members 9d may serve as lifting shelves, as illustrated in Fig. 9. When the end wall or member 2d and the ring 6d are integral with the longitudinal members 9d, the latter may be arranged at an angle to the longitudinal axis of the drum, as indicated in Fig. 10, which also indicates the lifting shelves as being integral with said longitudinal members.

The end wall or member 2d carries a central hub 10d attached to a shaft 50d, the latter extending outwardly some distance away from said wall and being supported by bearings 51d and 52d. A gear wheel 53d may be carried by the end of this shaft, or a suitable form of speed-reducing mechanism may be attached thereto, to which motion may be imparted through the medium of a pinion on a drving shaft (not shown), or such gear wheel or speed-reducing mechanism may be driven in any other manner.

The cone section 1d, forming the feed end of the drum, is preferably provided with vanes 70a, which are curved, as indicated in Fig. 8 and 9, and the function of these vanes is to insure a more even delivery of material to the drum; such vanes serving to divide the mass of charged material and elevate it part-way before delivery to the drum. During this time some of the fines may pass through the openings in the wall of the conical feed section.

While I have illustrated and referred more or less particularly to a drum having a foraminous wall, it will be understood that, in some instances, the wall of the drum may be imperforate, or

portions thereof may be imperforate. When imperforate drums are employed, the material broken by the hammers may be carried to the end of the same and discharged through openings disposed circumferentially of the drum at or adjacent the end opposite the feed end. Delivery of the material to such end may be effected by means of inclined lifting shelves of the type illustrated in Fig. 3.

The rotating drums illustrated in Figs. 1 and 8, may be enclosed in a casing or housing 75 as indicated therein, although it will be understood that such casing is not essential for the successful operation of these particular forms of my improved crushing apparatus. And, if desired, all forms of the crushing structures illustrated may be enclosed in casings or housing of the same character as those illustrated in Figs. 1 and 8.

While I have in Figs. 1, 2, et seq., drums in which the peripheral apertured wall is substantially continuous, it will be understood that other forms of foraminous or reticulated walls may be employed and that they may be sectional in character; in the form of substantially flat perforated plates and/or grid plates, which may be flat or curved. In Fig. 12 I have shown a plate structure which may be employed in constructing the drum walls; such plate being of the type illustrated in the patent of Doerres, hereinbefore referred to. In Figs. 13 and 14, I have shown forms of grid plates, with bars in spaced relation; Fig. 13, showing the bars extending longitudinally of the drum, and Fig. 14 showing the bars extending circumferentially of the drum.

The material to be crushed may be fed to the several forms of apparatus herein described and shown in the several drawings, by a chute 80.

From the foregoing description, it will be apparent that simple and efficient means are provided for accomplishing the objects of the invention, and while the elements shown and described are well adapted to serve the purposes for which they are intended, it is to be understood that the invention is not limited to the precise constructions set forth, but includes within its scope such changes and modifications as may be made within the terms of the appended claims.

I claim:

1. In a crushing structure and in combination, a rotatable drum comprising a circular end wall, a ring section spaced from said end wall, longitudinal members connecting and spacing said end wall and ring section, an apertured peripheral wall enclosing said longitudinal members, the ring section and the rim portion of said end wall and secured to the several members, a hollow shaft carried by and extending outwardly from said end wall and forming the sole support for said drum which overhangs from its end, a hammer-carrying rotor structure mounted within said drum entirely clear of its walls, a shaft from which said hammer mechanism overhangs within the drum; said shaft being supported by the circular end wall and the hollow drum-carrying shaft, and means for independently driving said shafts.

2. In a crushing structure and in combination, a rotatable drum comprising a circular end wall, a ring section spaced from said end wall, longitudinal members connecting and spacing said end wall and ring section and flanged to form lifting shelves disposed internally of the drum, an apertured peripheral wall enclosing said longitudinal members, the ring section and the rim portion of said end wall and secured to the several members, a hollow shaft carried by and extending outwardly from said end wall and wholly supporting said drum, a hammer-carrying rotor structure mounted within said drum entirely clear of its walls, a shaft for said hammer mechanism supported by the circular end wall and the hollow drum-carrying shaft, and means for independently driving said shafts.

3. In a crushing structure and in combination, a rotatable drum comprising a circular end wall, a ring section spaced from said end wall, longitudinal members connecting and spacing said end wall and ring section, a cone-shaped shell secured to said ring section and having an enlarged feed opening centrally disposed, an apertured peripheral wall carried by and enclosing said longitudinal members, ring section and the rim portion of the end wall, a hollow shaft carried by and extending outwardly from said end wall and wholly supporting the drum, a hammer-carrying rotor disposed within the drum clear of its walls, a shaft therefor disposed within the hollow shaft, bearing supports for said rotor-carrying shaft; one bearing being mounted in the end wall and the other in the outer end of the hollow shaft, and means for driving said drum and hammer mechanism independently of each other.

4. In a crushing structure of the character described and in combination, a drum mounted for rotation and comprising a frame carrying an apertured peripheral wall; said frame including annular elements at opposite ends of the drum and longitudinal flanged members diagonally arranged with respect to the longitudinal axis of the drum and providing internally disposed lifting shelves and the longitudinal members connecting and spacing the annular members and supporting the peripheral wall, a rotatable shaft entering said drum from one end and overhanging therein, a hammer-carrying rotor structure supporting a plurality of radially extending hammers mounted on the end of said overhanging shaft out of contact with the drum, bearings for said shaft disposed externally of the drum, means for driving the drum, and means for driving said overhanging shaft independently of the means for driving the drum.

5. In a crushing structure of the character described and in combination, a rotatable drum comprising a circular end wall, a ring section, longitudinal flanged sections connecting said end wall and ring section and providing internally disposed lifting shelves, screen plates overlying said longitudinal elements, the ring section and the rim portion of the end wall and providing a foraminous shell for the drum, a cone-shaped feed member connected to the ring section externally of the drum and having an enlarged central opening; said cone-shaped feed member providing a trunnion at its smallest diameter, a trunnion carried by the circular end wall, revoluble supporting means for said trunnions, curved vanes carried by the cone-shaped feed member for regulating feed to the drum; the shelves formed by the longitudinal sections serving to lift material delivered by the cone-shaped feed section, means for rotating the drum on its revoluble supports, a hammer-carrying rotor internally disposed with respect to the drum and wholly independently of the latter and adapted to act upon material discharged from the shelves, an outboard shaft passing through said end wall and carrying said hammer mechanism, bearings supporting said shaft entirely independently of

the drum, and means for driving said shaft independently of the means for revolving the drum.

6. In a crushing structure and in combination, a rotatable drum comprising a circular end wall, a cone-shaped ring section spaced from said end wall; said ring section having internally disposed vanes, longitudinal members connecting and spacing the cone-shaped ring section and said end wall, an apertured peripheral wall enclosing said ring section, longitudinal members and the rim portion of said end wall and secured thereto, an elongated shaft fixed to said end wall and extending outwardly therefrom and forming the sole support for the rotatable drum, a plurality of bearings supporting said shaft in horizontal alignment, and means for driving said shaft including a gear wheel connected to the free end of the same; said shaft and gear wheel substantially balancing the weight of the drum.

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