

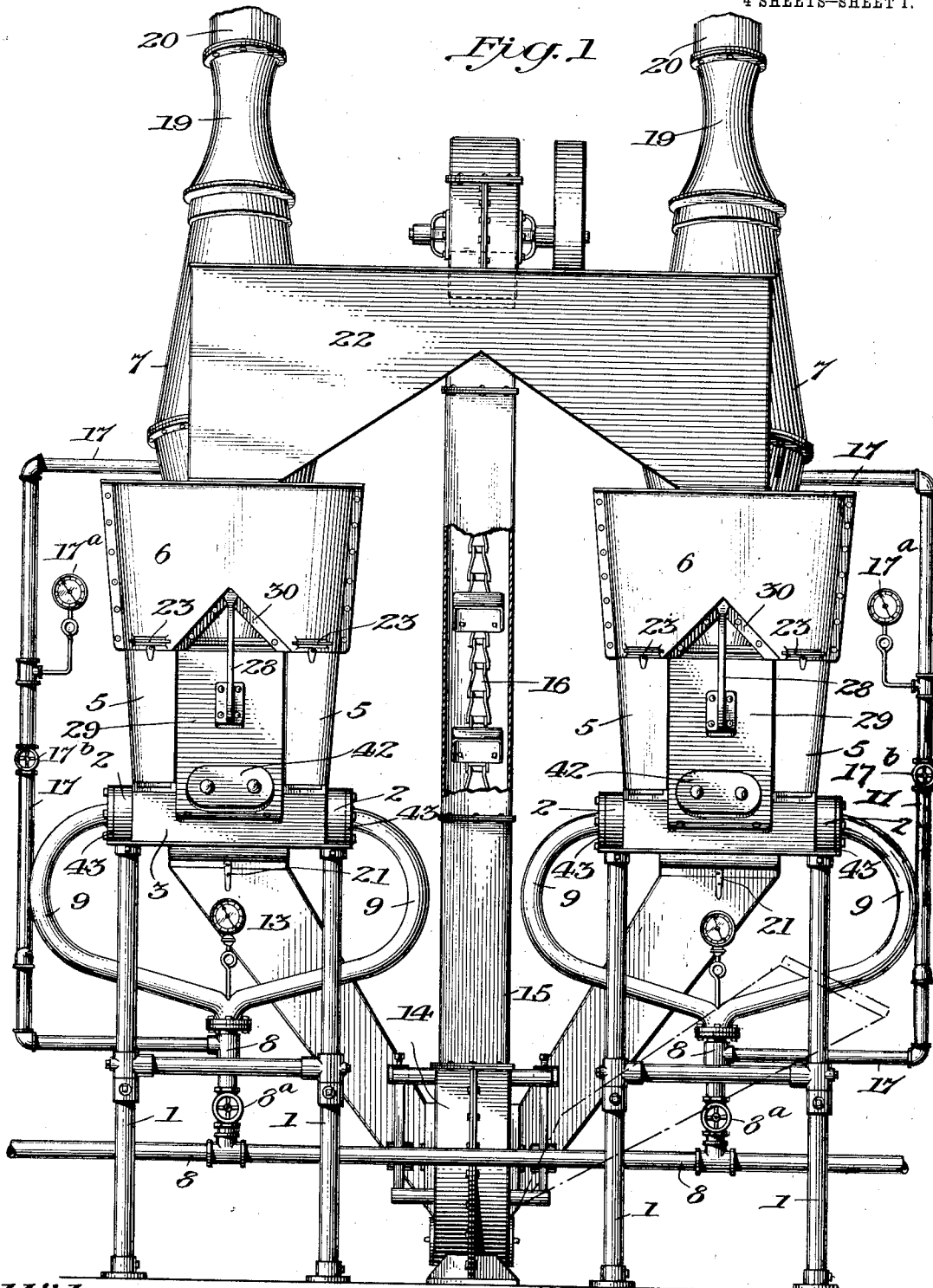
H. LUCKENBACH,
PULVERIZER.

APPLICATION FILED MAY 21, 1912.

1,058,313.

Patented Apr. 8, 1913.

4 SHEETS—SHEET 1.



Witnesses:

S. J. Henderson
Fred A. Klinge

Inventor:

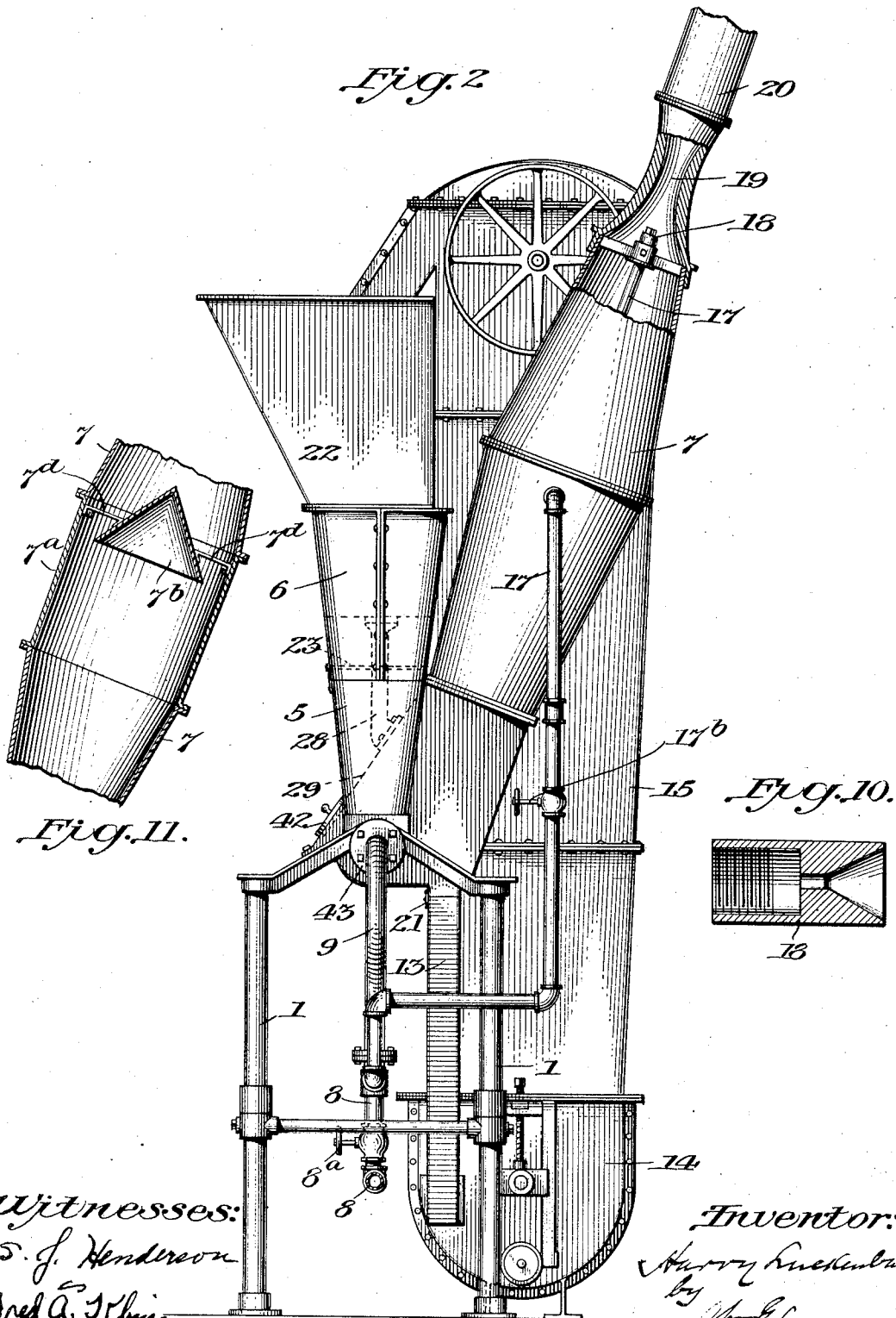
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4 SHEETS—SHEET 2.



Witnesses:

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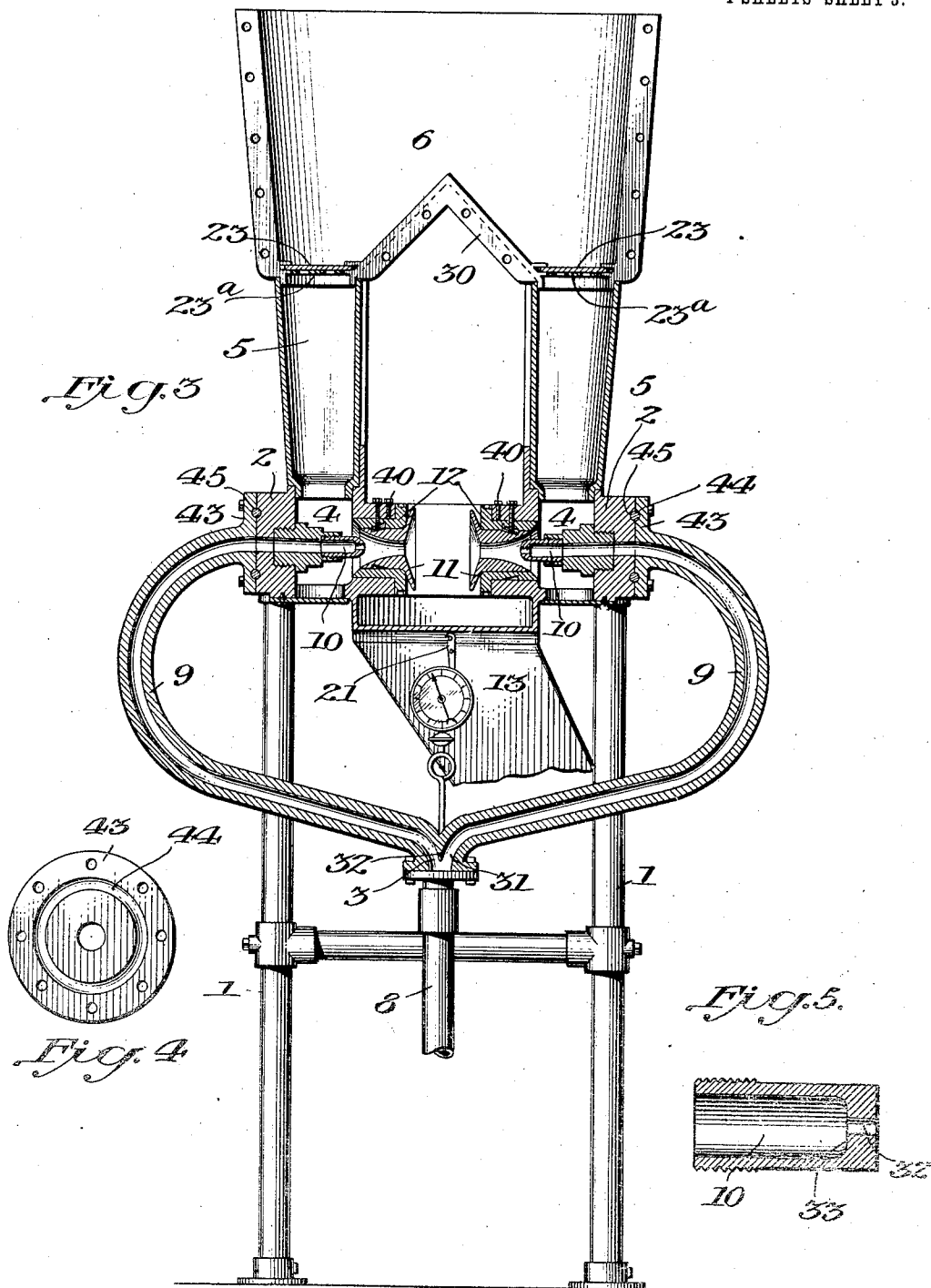
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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

Fig. 6

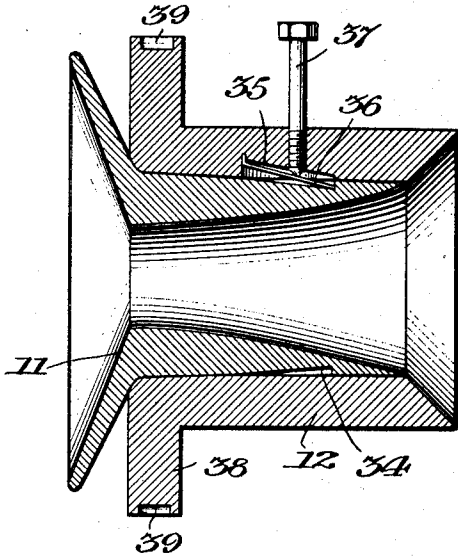


Fig. 7

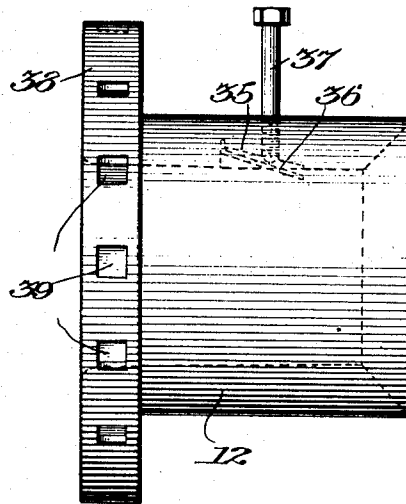
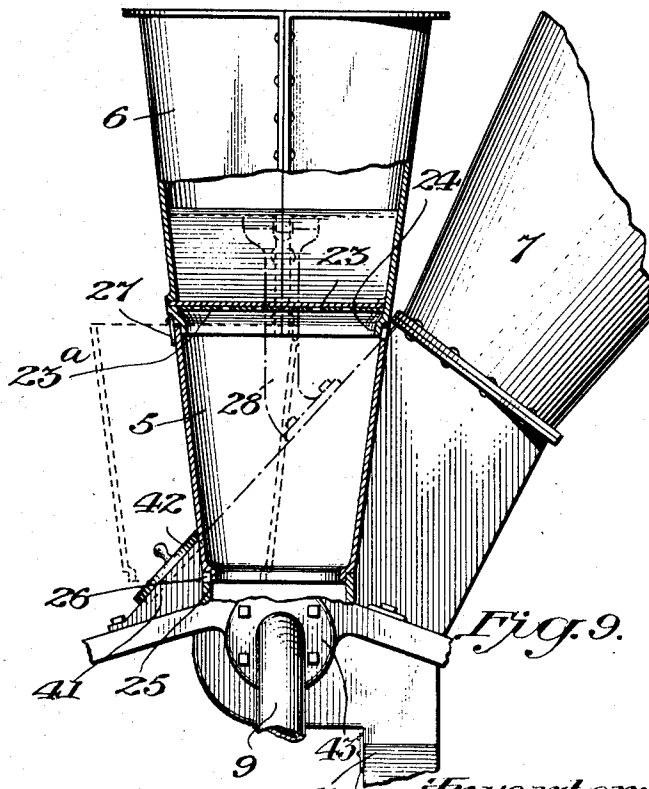
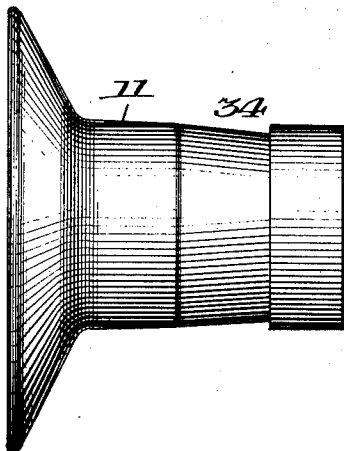


Fig. 8



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UNITED STATES PATENT OFFICE.

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PULVERIZER.

1,058,313.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARRY LUCKENBACH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pulverizers; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to rock pulverizers of the type in which crushed or granulated rock or material is forcibly projected by oppositely disposed carrying-currents so that by the forcible impact of the material carried by one stream against the material carried by the other stream will grind, or by attrition, at the focal point, convert the granular material into a fine or impalpable dust of the mesh desired.

The invention has for its object to provide an improved construction whereby the impact of the material may be materially increased by making it possible for the opposing currents to meet each other with greater force, and at the same time to minimize the wear of the parts, by causing the opposite streams or currents to approach each other in a more direct line without deflection, which deflection when permitted causes the granular material to abrade against parts of the apparatus in front of the discharge nozzles for the impelling currents before issuing from the wearing tubes and resulting in a material destruction of said parts in a relatively short time and consequent necessity for renewal.

It has further for its object to provide a construction so as to obtain a more regular or uniform supply and projection of the opposing currents at the focal point of discharge for attrition of the material, thereby avoiding the objections found to an unequal supply of the opposing currents, or in other words to avoid one of the impelling currents having greater force than the other opposing impelling current at the focal point so that by equalizing the impelling currents at the focal point a more minute pulverization of the material is obtained and with more rapidity.

It has also for its object to provide an improved construction whereby the bushings together with the discharge or wearing tubes at the focal point may be more readily removed when necessary for repairs or replacement, thus saving time and labor.

It has also for its object to provide a construction by which the wearing or discharge tubes may be more securely held within their bushings so that they are better adapted to resist the tendency of the forcible impelling currents to loosen or move out of place the wearing tubes in their bushings which has been the case heretofore.

It has further for its object to provide an improved construction whereby freer and more ready access may be had to the bushings and their wearing or discharge tubes and the relating parts adjacent thereto when examination or repairs are necessary.

It has further for its object to provide a construction which makes it possible to readily remove the legs of the supply hopper when necessary to have access thereto when occasion requires.

It has also for its object to provide means for sustaining the hopper when its legs are to be removed without the necessity of "jacking-up" the hopper, which also insures the parts being always maintained in proper alinement or relation to each other.

It has further for its object to provide an improved exhaust pipe through which the pulverized material is removed from the pulverizer and in which exhaust pipe the out-flowing dust laden current may be permitted to expand so that heavier particles carried in the out-going current may be allowed to fall into the boot of the elevator so as to be returned to the hopper while the lighter particles are carried off through the exhaust pipe or flue to the receiving bins.

It has further for its object to provide for intercepting the larger particles from the finished product in the exhaust pipe when material of relatively light specific gravity is being pulverized, by imposing a baffle plate or member in the exhaust pipe which will deflect the out moving current and afford an opportunity for the larger particles to drop in the pipe while the finer and lighter particles will be carried past the baffle member and out through the pipe to the bins.

It has also for its object to provide an

improved means for connecting the pulverizer and exhaust flue with the boot of the elevator so as to prevent the ingress of cold air into the pulverizer and exhaust pipe or flue which if permitted would tend to condense the superheated steam forming the out-going current and also tend to cool the material being pulverized as well as that which has been pulverized, the temperature of which it is desirable to keep as high as possible so as to facilitate the pulverizing operation, and so as to aid in the freer discharge of the pulverized material in a dry state or condition.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, the invention consists in the features which will be hereinafter more particularly described and then sought to be clearly defined by the claims, reference being had to the accompanying drawings forming a part hereof, and in which:

Figure 1 is a front elevation of the apparatus in its preferred form, embodying a twin set or arrangement of the pulverizer; Fig. 2 is an end elevation of the apparatus; Fig. 3 a vertical section through a pulverizer embodying features of the invention; Fig. 4 is a front view of flange on the goose-neck of the apparatus; Fig. 5 is a longitudinal section through the discharge or jet nozzle; Fig. 6 is a longitudinal section through the bushing and wearing tube; Fig. 7 is a side view of the bushing; Fig. 8 is a side view of the wearing tube; Fig. 9 is a detail view of a portion of the apparatus with the hopper and discharge leg in section; Fig. 10 is a section through the exhaust nozzle in the exhaust pipe; and Fig. 11 is a detail view showing the cylindrical section of the exhaust pipe and its baffle, portions of the exhaust pipe being broken away.

In the drawings the numeral 1 designates upright standards constituting the frame of the apparatus and which may be of any approved construction. Upon this frame is located the body 2 of the pulverizer which comprises a chamber 3 and wing-compartments 4 with which through side ducts or legs 5 communicates a hopper 6, and from the chamber 3 there extends an exhaust pipe 7, the connections between the mentioned parts and between the chamber 3 and exhaust pipe 7 having close fitting joints so as to exclude air at such points. A pipe 8 leads from a boiler for generating highly superheated steam and by means of a goose-neck 9 connects with the wing-compartments 4 wherein its ends are provided with jet nozzles 10. These nozzles stand opposite to each other, and in front of them, connected with the side walls of the chamber 3, are wearing tubes 11 fitting in bushings 12 attached to flange portions of the side walls to the chamber 3, so that the impelling agent

issuing from the nozzles will be projected into and through the wearing tubes whereby suction is created in said tubes such as to carry crushed or granulated rock or material from the wing-compartments 4 into the chamber 3 from oppositely disposed points so that there will be violent impact between the material of the opposing streams at the focal point and thus by forcible impact and attrition of the particles reduce them to an impalpable dust, the lighter particles of which are carried off through the exhaust pipe 7 while the coarser particles will be deposited through a tailings chute 13 into the boot 14 of an elevator leg 15 through which operates an endless chain of buckets 16 to carry the deposited particles to the top of the apparatus where they are deposited into the hopper 6 for further treatment in the pulverizer. The degree of fineness to which the material may be reduced is regulated by controlling the volume of the highly superheated steam entering the goose-neck by a controlling valve 8^a in the pipe 8. The carrying of the finer particles through the exhaust pipe 7 is effected by suction created in the exhaust pipe by highly superheated steam injected from a pipe 17 having at its upper end a nozzle 18 which has substantially the same formation as the nozzles 10, except that its mouth is concave or flaring as illustrated in Fig. 10, said nozzle 18 being centered below the contracted throat 19, preferably of the form illustrated, of the pipe 20. The pipe 17 is provided with a pressure-gage 17^a and a valve 17^b so as to determine and control the pressure of the superheated steam for the purpose of regulating the degree of suction in the exhaust pipe. The exhaust pipe 7 is enlarged or swelled at its middle portion, and preferably has the form of two truncated cones, so as to form an expansion chamber wherein larger particles carried with the out-flowing current will separate from the finer pulverized particles which will be carried out through the terminal, the larger particles dropping to the base of the exhaust pipe and being conducted by the chute 13 to the boot of the elevator leg. The upper end of the chute 13 fits closely against the lower portion of the exhaust pipe and is secured thereto by suitable means, for instance by a pivoted catch 21, while its lower end fits closely against the entrance to the elevator boot, so that no external air can enter the exhaust pipe between it and the tailings chute 13, thus preventing the entrance of air which would tend to condense the superheated steam passing through the exhaust pipe, and this makes it possible to maintain in a heated condition the pulverized material carried through the exhaust pipe and the larger deposited particles which are carried back into the pulverizer chamber, the

maintenance of such heat aiding in the more efficient pulverizing of the material in the apparatus.

When material of relatively light specific gravity is being pulverized the suction in the exhaust pipe is apt to carry off considerable of the larger particles with the finished product notwithstanding the expansion chamber provided for separating the heavier from the lighter particles. Accordingly under such conditions, I provide the exhaust pipe with an intermediate section 7^a, which preferably has straight sides, in which is positioned a baffle 7^b of appropriate form, preferably of hollow truncated or conical shape, which may be supported from the side walls of the section by straps or brackets 7^a in such manner as to leave an open space between it and the walls of the section. This baffle will check the out-moving current and intercept the material so that the larger particles will be given an opportunity to fall downward while the finer and relatively lighter particles will be carried by the deflected current around the baffle and then out of the pipe to the depositing bins. When, however, the material to be pulverized is not of very light specific gravity this intermediate section and its baffle may be removed and the two sections of the truncated exhaust pipe bolted one to the other as illustrated in Fig. 2 of the drawing and thus used without the baffle-member.

The hopper 6 may be supplied with granulated rock or other material through the supply hopper or box 22 at the top of the apparatus. The said hopper is provided above each of its conducting legs with a slide valve 23 to control the passage of material into the legs and to enable the supply to be entirely cut-off when it is desired to remove the legs. I have observed in practice when unusually fine or small material is to be further comminuted to a finer mesh that upon opening the slide valve for feeding the material from the hopper to its feed legs portions of the material in the form of dust may under some conditions escape at the joint between the hopper and legs or at the point of application of the legs. To avoid this an apertured bottom 23^a may be located next to the under side of the slide valve, the apertures being large enough for the passage of material from the hopper into its conducting legs and thus the escape of such dust-like particles to the outside of the apparatus is avoided. This apertured bottom however is not an essential under all conditions and accordingly may be omitted without departing from other features of the invention. The legs are made removable so that prompt and ready access may be had thereto or to the wing-compartments 4 in the event of the same becoming clogged by material too

large to be projected into the pulverizing chamber, and for that purpose each leg has the upper end of one of its walls cut away as indicated at 24 and the lower portion of the seat 25 for the legs is cut away as at 26 so as to enable the leg to be slid from under the hopper as indicated most clearly in Fig. 9 of the drawing. When the leg is in position under the hopper it is held in place by a suitable fastening for instance by a pivoted hook 27. To enable the legs to be removed, the hopper is supported independently of the legs by means of bracket 28 which at its lower end is bolted to the inclined wall 29 at the base of the exhaust pipe, and the upper end of the bracket is preferably forked so as to straddle flanges of the hopper at the peaked bottom 30 of the hopper as illustrated in Figs. 1 and 9 of the drawing.

For the best results it is important that the impelling agent passing through the goose-neck 12 should in volume and force be substantially the same in the two branches of the goose-neck, otherwise the discharge of the impelling agent through the two discharge nozzles 4 will not be of equal force and volume and, if not so, impact is not as complete as when the two impelling streams are equal at their points of discharge from the goose-neck. In order to overcome this defect by insuring an equal supply of the impelling agent in both branches of the goose-neck, I provide at the union or junction of the two members, at the coupling or union 31, a web 32 which extends down into the coupling or union to a point below the plane of divergence of the goose-neck members from the coupling as illustrated so that the impelling agent supplied through the pipe 8 will be caused to split or divide at the union or fork of the goose-neck practically before entering the two branches of the goose-neck so that an equal volume will be compelled to pass into each of the two members of the goose-neck and thus insure an equal supply of the agent at the point of discharge from the nozzles of the two members. At times existing conditions are such that they tend to cause a greater supply of the impelling agent to pass through one member of the goose-neck than through the other member but by providing the splitting web at the point indicated such tendency is guarded against and a uniform supply given to both members of the goose-neck and resulting in the advantage specified. I have also observed in practice that owing to unevenness in the parts to which the flanges 43 of the ends of the goose-neck are bolted it is very difficult, if not practically impossible, notwithstanding that gaskets are applied to the faces of the flanges, to get a perfectly air or steam tight joint at such points, and it is important at

these points that the tightest joint possible should be effected. In order to provide such a joint I have formed an annular groove 44, in the face of each flange and place in the groove a ring 45 of round and comparatively soft metal, such as copper, which will partially project outside of the annular groove and bear against the sides of the apparatus to which the flanges 43 are bolted. This annular ring, round in cross section, will conform to any irregularities of the surface to which the flanges 43 are bolted and in the manner mentioned a practically air, gas, or steam tight joint is effected at the points indicated.

In the use of a discharge nozzle of the ordinary construction there is a tendency of the escaping fluid to flare outwardly at the mouth of the discharge orifice of the nozzle and then to contract into the line of projection of the stream of the steam or air, thus forming a bulb-like vacuum chamber at the discharge mouth which tends to somewhat weaken the force of the projected stream of steam or gas. It also has the objection that the bulb-like formation of the escaping steam or air tends to force more or less of the granular material passing down the legs of the hopper against the walls of the chamber 3, at or adjacent to the wearing tubes 11 and bushings 12 and thus causes said parts to rapidly wear out. To overcome these objections I construct the nipple of the jet nozzles with a discharge orifice 32 whose length is substantially twice its diameter and I form at the rear of the orifice 32 a substantially square or abruptly set-off shoulder 33 and give to the interior of the nozzle to the rear of the shoulder 33 a practically straight wall of substantially the same diameter throughout its length as illustrated in Fig. 5 of the drawing. This construction eliminates the formation of the vacuum bulb mentioned and causes the stream of superheated steam or other impelling agent to escape from the nozzle in direct straight lines, the stream diverging in a straight line beyond the mouth of the discharge so that the granular material in the wing-compartments is sucked and projected directly into the wearing tubes 11 from whence it discharges into the chamber 3, thus overcoming the objections noted and making certain or positive the efficiency of the pulverizing devices. In order to prevent particles clogging in the wearing tubes and in order to increase the suction in such tubes when employed in association with the construction of nozzle described, I form the bore of the wearing tubes so as to taper from the end of the jet nozzles toward the flaring mouth or rim of the wearing tubes as illustrated in Figs. 3 and 6. This allows the jet nozzles which lie partially within the wearing tubes to project the impelling agent

in a straight line within the wearing tubes and to entrain the material to be pulverized without forcing or driving it against the side walls of the bushings and wearing tubes at the entrance thereto, and causes stronger suction for drawing or sucking into the tubes the granulated or crushed material from the wing-compartments which material is projected with great force from the wearing tubes by the streams injected by the nozzles so that the opposing streams meet with violent impact between the flaring lips or mouths of the wearing tubes so as to be finely pulverized. It will thus be seen that there is such a co-action between the nozzles and the wearing tubes each formed as described that the highest efficiency is obtained by such combined features, and the objections noted to other constructions effectually overcome.

In order to admit of the comparatively easy removal of the wearing tubes from the bushings when necessary for replacement by new ones the inner wall of the bushing and the outer wall of the wearing tube are slightly tapered or flared from the rear toward the discharge mouth of the wearing tubes so as to facilitate the removal of the tubes from the bushings and thus overcoming the objection to the tight fit between the two which has been found to exist when each had straight walls. In order to hold the wearing tubes in the bushings against the tendency of the force of the projected stream to force the wearing tubes from the bushings, I form in the exterior walls of the wearing tubes an inclined recess 34 preferably made by reducing the diameter of the wearing tube as illustrated in Figs. 6 and 8, and I fit in a recess 35 formed in the bushing a spring plate 36 and pass through the bushing a set screw 37 to bear against the spring plate so as to press the same into the recess in the wearing tube, the end of the plate bearing against the shoulder formed by such recess so as to securely hold the wearing tube in the bushing. By loosening the set screw, the spring plate will recede from the recess in the wearing tube and thus permit removal of the latter. It will thus be observed that the wearing tube is held securely in place against the force of the stream projected from the jet nozzles.

To facilitate the removal of the bushings without the necessity of taking the apparatus apart or disturbing the position of the nozzles, I provide in the peripheral flange 38 of each bushing a series of sockets 39 adapted to receive the bent ends of a pair of tongs; and to facilitate reaching the bushings with these tongs and to have access to the screws 37 which lock the wearing tubes in place and to the screws 40 which lock the bushings in place, I form in the wall of the pulverizer chamber an elongated opening 41

opposite to the parts mentioned so that access may be had to said parts; and to prevent the escape of the pulverized material through this opening when the apparatus is in operation I provide a cover 42 for the opening which when applied prevents interference with the proper working of the parts in pulverizing the material.

It will be observed that the top inclined wall of the lower portion of the exhaust pipe extends over and below the upper end of the front wall of the pulverizing chamber which increases the cross-area capacity of the space wherein the impact occurs (see Figs. 2 and 9) so that there is a more uniform spreading out of the pulverized material in substantially equal volume at opposite sides of the point of impact and this tends to create a freer out-flow or escape of the pulverized material without choking caused by interfering air currents. It also enables the opening 41 for the passage of a tool to remove the bushings 12 to be located at a more convenient angle and position relatively to the bushings and entirely to the front or in advance of the feed legs so that the tool can be manipulated to better advantage and without interference by the presence of the feed legs. It will also be observed that the bottom of the pulverizing chamber on the side next to the tailings chute is substantially straight or not upwardly inclined so that material settling in the bottom of the pulverizing chamber together with material separated in the expansion chamber of the exhaust pipe may slide into the tailings chute. These features have been found to be of material advantage in the working of the pulverizer.

The various features of improvement which have been particularly specified are the result of close observation and experimenting in the actual working of a pulverizer of this type, and in actual practice it has been found that the various features specified for the invention have positively overcome the objections found to exist in actual practice, and that such a coöperation exists between the parts arranged in relation to each other as specified that one part exerts a modifying influence on the action of the other so that results are obtained which are different from those following from the use of one of the parts without its properly associated member.

I have mentioned the use of highly superheated steam as the impelling agent because of the improved results obtained by its use, but it is obvious that features of the invention in the construction of the parts might be employed if steam, air or other gas under pressure, whether heated or not, were used in place of highly superheated steam even though the results be not as satisfactory.

I have illustrated and described with par-

ticularity the preferred details of construction of each of the essential parts of the apparatus but it is obvious that changes in details of construction in some of the parts can be made without affecting other features of the invention described, and without departing from the invention as endeavored to be defined by the appended claims.

Having described my invention and set forth its merits what I claim is:—

1. In a pulverizer of the type described wherein the material is pulverized by the impact of two opposing streams which carry the material to be pulverized, a conveyer for conducting the impelling agent comprising a plurality of tubular members having oppositely disposed nozzles, a coupling from which said members diverge, means for supplying an impelling agent to said coupling, and a web interposed between said diverging tubular members and extending into the coupling below the plane of divergence of the tubular members from the coupling for dividing the impelling agent and directing substantially an equal supply to each diverging member, substantially as described.

2. In a pulverizer of the type described, a plurality of members having oppositely disposed discharge nozzles for the supply of an impelling agent to entrain material to be pulverized, said nozzles having nipples each formed with a discharge orifice whose length is substantially double its diameter and a shoulder at the rear of the discharge orifice substantially at right angles to the axis of the discharge orifice, the bore of said nozzle being substantially straight with parallel walls, in combination with wearing tubes in front of the nozzles, said tubes having a tapering bore from their rear toward their discharge mouths, and said nozzles lying partially within the wearing tubes, substantially as described.

3. In a pulverizer of the type described, a plurality of members having oppositely disposed discharge nozzles, a pulverizing chamber having bushings provided with wearing tubes substantially in line with the discharge nozzles and opening into the pulverizing chamber, said tubes being formed with a peripheral recess, a locking plate carried by each bushing opposite to the peripheral recesses of the tubes, and means for depressing the plates into locking engagement with the tubes to hold the tubes in place against the force of an impelling agent projected from the nozzles, substantially as described.

4. In a pulverizer having a pulverizing impact chamber and tubular members provided with oppositely disposed nozzles for directing material under fluid pressure in pulverizing impact in said chamber, a feed hopper, removable conducting legs between the hopper and pulverizing chamber, said

legs being in substantially fluid-tight connection with the hopper and pulverizing chamber to prevent entrance of fluid to said chamber, and means for supporting the feed hopper independently of said legs, substantially as described.

5. In a pulverizer of the type described, a pulverizing chamber, a feed hopper having a peaked bottom, removable conducting legs between the hopper and pulverizing chamber for feeding material from the hopper to the pulverizing chamber, an exhaust pipe leading from the pulverizing chamber, and a bracket connected to the exhaust pipe and fitting in the fork of the peaked bottom of the hopper to support the hopper independently of the conducting legs, substantially as described.

6. In a pulverizer having a pulverizing impact chamber and tubular members provided with oppositely disposed nozzles for directing material under fluid pressure in pulverizing impact in said chamber, an exhaust pipe leading from the impact chamber and formed between its ends with an expansion chamber, a chute leading off from the lower portion of the pulverizing chamber and exhaust pipe, and a regulatable pressure jet in the exhaust pipe above its expansion chamber to modify the grading effected in the expansion chamber and control the discharge of lighter material carried above said chamber, substantially as described.

7. In a pulverizer of the type described, an impact pulverizing chamber, an exhaust pipe leading off from said chamber and having an inclined top wall extended over and below the adjacent upper end of the pulverizing chamber at the impact portion of the chamber, and a chute leading off from the opposite side of the pulverizing chamber and exhaust pipe, substantially as described.

8. In a pulverizer of the type described, an impact pulverizing chamber having a curved wall merging into a substantially straight bottom to the chamber, an exhaust pipe leading off from the chamber and having an expansion chamber between its ends, and a chute leading off from the exhaust pipe below its expansion chamber and from the straight bottom of the pulverizing

chamber opposite to its curved wall, substantially as described.

9. In a pulverizer of the type described wherein the material is pulverized by impact under opposing currents of an impelling agent and having means to control the impelling agent to regulate the fineness of reduction of the material, a pulverizing chamber, an exhaust pipe leading off from said chamber and formed with an intermediate expansion chamber to modify the force of the blast escaping from the pulverizing chamber and effect a separation of the heavier from the lighter pulverized material in the exhaust pipe, and a tailings spout in air tight communication with the exhaust pipe and the pulverizing chamber to receive the heavier particles from the pulverizing chamber not entering the exhaust pipe and particles separated from the lighter particles in the exhaust pipe and prevent the entrance of air from outside into the exhaust pipe and pulverizing chamber, substantially as described.

10. In a pulverizer of the type described, a pulverizing chamber, a feed hopper in communication therewith, an exhaust pipe for conducting pulverized material from the chamber, a tailings spout in air tight communication with the exhaust pipe and pulverizing chamber to receive heavier particles from the pulverizing chamber not entering the exhaust pipe and particles separated in the exhaust pipe from the lighter pulverized material carried off through the exhaust pipe and prevent outside air entering the exhaust pipe and pulverizing chamber, an elevator boot in close-joint connection with the discharge end of the tailings spout, and an elevator leg with carrier for lifting the material from the boot to the top of the pulverizer, said boot being in substantially air tight communication with the tailings spout and the elevator leg, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY LUCKENBACH.

Witnesses:

CHAS. S. HYER,
WM. G. HENDERSON.