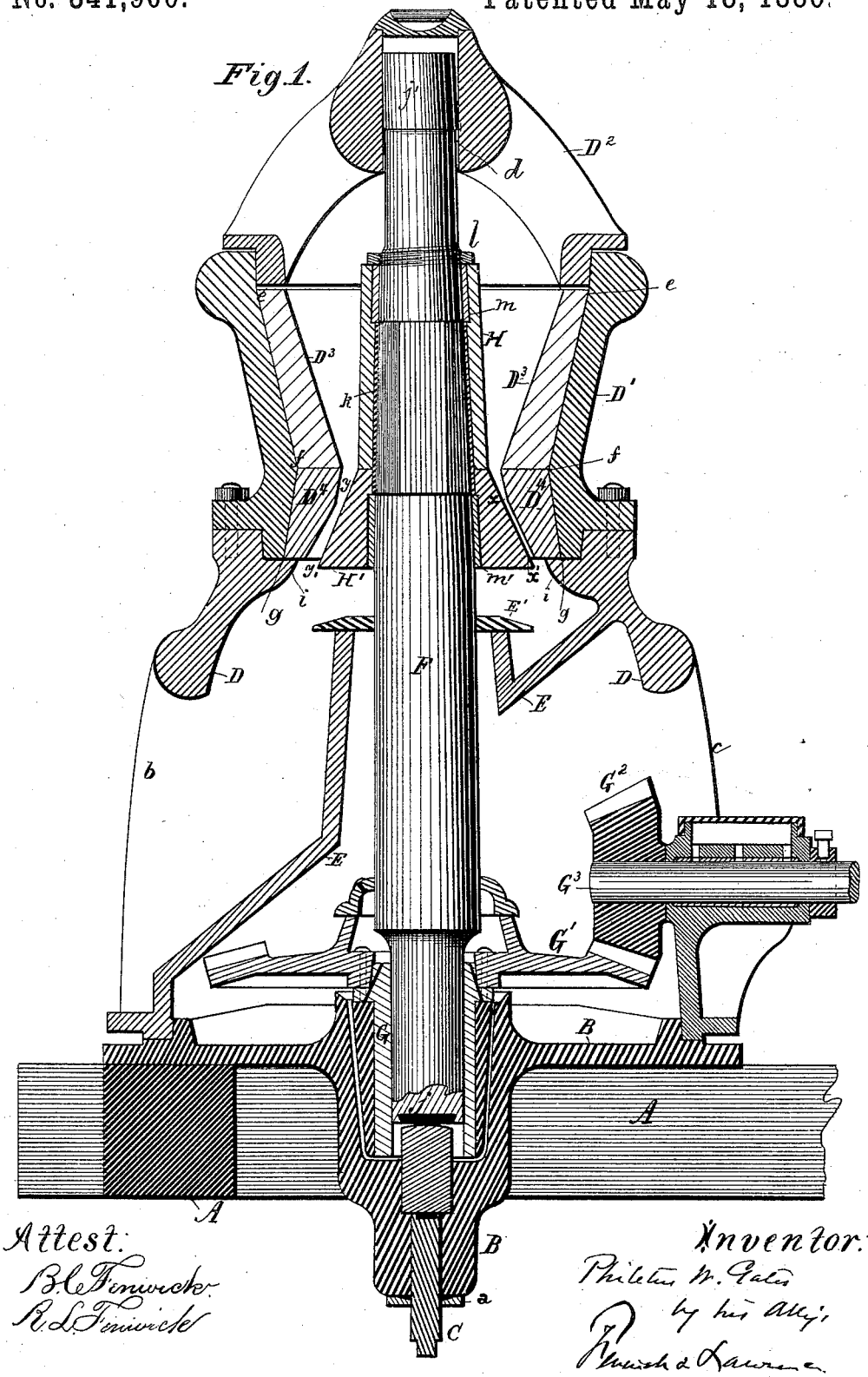
(No Model.) 2 Sheets—Sheet 1.

P. W. GATES.

STONE BREAKER AND ORE CRUSHER.

No. 341,900. Patented May 18, 1886.

Fig. 1.



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B. C. Fenwicke
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Inventor:
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by his Attys
Church & Lawrence

(No Model.) 2 Sheets—Sheet 2.

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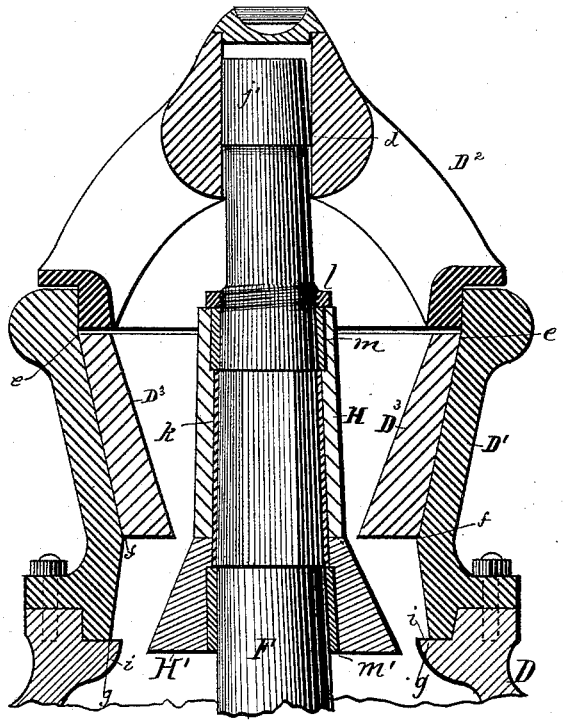
Fig. 2.



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UNITED STATES PATENT OFFICE.

PHILETUS W. GATES, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE GATES IRON WORKS, OF SAME PLACE.

STONE-BREAKER AND ORE-CRUSHER.

SPECIFICATION forming part of Letters Patent No. 341,900, dated May 18, 1886.

Application filed January 30, 1885. Serial No. 154,431. (No model.)

To all whom it may concern:

Be it known that I, PHILETUS W. GATES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Stone-Breakers and Ore-Crushers, of which the following is a specification.

This invention relates to that class of stone-breakers and ore-crushers which have a flaring hopper or conical concave and an upright shaft carrying a conical crusher-head near its upper or fulcrum end, said shaft and crusher being gyrated and revolved by means of a revolving eccentric, to which the shaft is connected loosely by its lower end, motion being imparted to the eccentric by gearing, one wheel of which is rigidly fastened to it below the crusher-head and concave, and isolated by a dust-collar and an inclined diaphragm or laterally-discharging partition of the frame of the stone-breaker.

My invention consists in the combination, with the ordinary gyrating crusher-shaft, crusher-head, flaring main hopper or concave, gearing and frame, of an auxiliary tapered crusher-head, and an auxiliary inverted concave crushing-surface at the bottom of the main concave or hopper, whereby the machine can, when desirable, be quickly adjusted so as to be adapted for cracking or crushing quite fine—say to the size of grains of Indian corn or a little less—adapted for use in making asphalt pavements, or the machine can be adjusted for cracking stone to a size suitable for being ground or pulverized in mills usually employed for reducing substances to a powdered condition, as required in mining operations, or for breaking or crushing stone or ore to sizes adapted for Macadam roads. Thus is furnished a combined machine, which on one day can be used for fine cracking or crushing and on another day for coarser breaking, as required for Macadam roads or other purposes.

My invention also consists in certain constructions and combinations, as hereinafter described and specifically claimed.

After several years' practical experience with stone-breaking and ore-crushing machines, I have found that there is a demand for a breaker or crusher which will break stone or crush ore, at once, the size of either grains of Indian corn or hickory-nuts.

Machines with either reciprocating jaw and a stationary jaw, or a flaring concave and a crusher-head with a revolving gyratory motion, as heretofore constructed, have not been found to answer the twofold object sought, because in cracking or crushing fine the material "packs" and causes the machine to break itself, and no matter how strong the machine may be this has been found to be the case. There have been several jaw crusher-machines devised that would crush fine—say three-eighths to one-fourth of an inch—and this was accomplished by giving the movable jaws a sliding or downward motion as well as a to-and-fro movement, thereby producing a rubbing or grinding action; but experience has proved that this style of crusher would wear out fast and its use has not been generally adopted; and so, when establishments require fine cracking or crushing, the roller, burr, or other pulverizer has been adopted, while for coarser breaking or crushing either the jaw or gyratory crushers are used. This creates extra expense.

The machine which I have invented and shall now proceed to describe is intended to meet the demands above mentioned, while it belongs to that class of stone-breakers which work with a gyratory motion.

In the accompanying drawings, Figure 1 is a vertical central section of the machine, its driving-shaft and gyratory shaft being shown in elevation, except where the latter is broken out to expose the steel or hard-metal wearing-plate at its lower end; and Fig. 2 is a detail vertical section of the upper part of the machine, showing the inverted auxiliary working portion of the concave or hopper removed from its place on the frame.

In the drawings, A is the foundation sill-work of the stone breaker or crusher; B, the base-plate and oil step-box mounted upon the sill-work, and C is an adjustable step-rod with step-block resting on it, passed up from the outside into a passage in the step-box and packed oil-tight by a removable gland or collar, *a*. The step-rod usually rests on an ad-

justing bridge-tree, and is raised and lowered thereby in a well-known manner whenever the step-block is to be adjusted up or down.

D designates the main portion of the circular upright frame of the breaker or crusher, and D′ the upper or hopper-like portion of the same bolted to portion D. The portion D has an opening, *b*, at its front and an opening, *c*, at its rear, as usual.

E is a diaphragm or partition formed diagonally from rear to front within the portion D, so as to cut off access from the front side of the portion D with the rear side and leave the opening *b* fully open. This diaphragm has a central passage through it, and around this passage a raised circular flange is formed, and upon the same an ordinary loose dust-excluding collar, E′, is placed and allowed to slide laterally as it is gyrated with the shaft, around which it is placed when the said shaft is set in position. On the top of the portion D′ a strong open bearing-support, D^2, is fitted like a cap or cover, and this bearing-support has a strong fulcrum-box, *d*, at its center, of cylindrical bore, and in which the tapered end of the shaft plays, but always finds a firm bearing while its lower end is being moved.

The hopper-like portion D′ of the frame is made from the point *e* to the point *f* similar to ordinary hoppers or concaves, and is lined with a correspondingly-shaped hard-metal lining, D^3, as usual; but from the point *f* to the point *g* this portion D′ is differently constructed from the ordinary mode, it being extended downwardly a considerable distance, and this extended portion made similar to an inverted hopper, as shown, and in this flared extended portion a hard-metal lining, D^4, having a downward flare on a suitable angle—say of from thirty to forty-five degrees—is applied upon a supporting-ledge, *i*, of the frame portion, D, as shown, or in any other substantial and proper manner. The line of flare of the lining may be continuous from top to bottom, or it may be on different angles, as represented, so as to give a more ready passage of substances to the crushing-surfaces.

The gyratory shaft F is fitted by its lower end in an eccentric bearing, G, and rests with its steel-faced end *j* upon the step-block, and it has its upper end, *j′*, made of taper form and fitted in the cylindrical fulcrum-bearing *d*. The eccentric bearing G is flanged, and rests, as usual, upon the oil step-box, being bolted to the gear-wheel G′, which is driven by the gear-wheel G^2 of the shaft G^3, and it and the shaft are supplied with lubricating material in the usual manner. On the shaft at a point within the hopper the ordinary conical crusher-head, H, is fitted upon tapered flat surfaces of the shaft in the manner represented, or in any other approved manner, so that it shall not turn and slip independently of the shaft, it being truly centered on said shaft by a bored tapering ring, *m*, cast within the head. The crusher-head is rendered firm and solid and confined in position by means of zinc backing or filling *k* and a nut and screw fastening, *l*, or other suitable means.

Below the crusher-head H an auxiliary crusher-head, H′, is applied on the shaft and confined from turning, and is truly centered on the shaft by the tapered ring *m′* and flat portions of the shaft, or by means such as are used in confining and centering the cone H. This auxiliary cone adjoins by its upper end the base of the cone H, but it is formed with a less inclination than the cone H, its inclination corresponding very nearly with that of the line of flare of the auxiliary or extended portion of the concave or hopper.

It is intended that the surfaces of the auxiliary cone and auxiliary portion of the hopper shall stand parallel from *x* to *x′* when the action of crushing is being performed, and that the surfaces not crushing shall stand as indicated at *y y′*.

When the auxiliary cone is not to be used for crushing to the size of Indian corn, or thereabout, and the main cone is required for crushing to the size of hickory-nuts, or thereabout, the shaft is lowered down to the bottom of the oil step-box by lowering the step rod and block, and by this adjustment the discharging-space between the auxiliary crushing-surfaces will be increased, so as to allow a free escape of the cracked pieces of the size stated; but if the substances are to be cracked or crushed to the size of Indian corn the crusher head and shaft are used in about the position represented in the drawings, Fig. 1.

It is estimated that the discharging-space for the auxiliary cone on the side where the crushing is going on may be about one-fourth of an inch, while the opening at the point where the crushing is not being performed may be about one-half an inch, which is about as close as it can be set and have the machine work without packing or clogging. The cones may be in two separate pieces, as shown; but it is thought it will be best to have both in one solid piece. So, too, the parts of the concave lining may be in one piece instead of two; but it is believed it will be best to make the concave lining in two pieces, as shown.

The principle of my invention is this: The stone is crushed at top and passes to the second crusher-head or parallel, or nearly so, opening, and before it can get out of the parallel space it will be subjected probably to two bites on the side where the crushing is being performed, and thus no pieces larger than one-fourth of an inch (if that is the size to which the machine is set to crush) will pass; but if the machine gets only one bite upon the substances passing down, every piece would probably be reduced to one-fourth of an inch. If the machine runs slow, it might not do this, and larger pieces might drop out through the one-half-inch or larger space; but when the head is gyrated, say, one hundred and fifty times per minute, it is quite

sure that before the stone gets out of the parallel surfaces it will be subjected to two bites, or one at least.

I prefer to have the parallel faces on an angle of less than forty-five degrees; but in some cases it might be practicable to put the parallel faces on an angle of forty five degrees. It should, however, be borne in mind that if the angle is too obtuse the stone may be more likely to pack. This can be obviated by making the auxiliary cone shorter and allow for a quicker discharge where the angle is great.

If it is deemed desirable, the auxiliary concave might be made removable, and the machine could then be adapted for crushing coarse without lowering the gyrating shaft by simply taking out said concave, as illustrated in Fig. 2 of the drawings; but this would be very troublesome and expensive, as compared with the operation of raising and lowering the shaft and crusher-heads. I however intend my patent to protect me in either mode of adapting the machine for the special operations set forth.

I do not claim a gyratory cracking or crushing machine for crushing and breaking substances, except when constructed as above described, so that the product can be reduced to a given size by the upper or main set of cracking or crushing surfaces without being still further reduced by the lower or auxiliary set of such surfaces, and so that at the will of the operator the product crushed by the main or upper set of surfaces can be further reduced on its way out of the machine, when desirable, by the lower or auxiliary set of crushing-surfaces being adjusted into operation for the purpose of thus further reducing the product.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination of a gyratory shaft provided with main and auxiliary crushing-surfaces and a hopper provided with reversely-tapered crushing-surfaces, the respective sets of opposing crushing-surfaces being together adapted for breaking stone or other substances into fine pieces, while the lower of said sets is adapted to be moved entirely out of operative relation, and the upper set to be used alone for breaking the stone or other substances into coarser pieces, substantially as and for the purpose described.

2. The combination, with the vertically-adjustable gyratory crusher shaft and heads, of a hopper having main and auxiliary crushing-surfaces, the latter of which is made separate from the former, substantially as described.

3. The vertically-adjustable gyratory shaft provided with main and auxiliary crushing-surfaces of different degrees of taper, the latter of which is constructed separately from the former, in combination with a hopper provided with reversely-tapered breaking or crushing surfaces, substantially as described.

4. The combination of the gyratory crushing-shaft, crusher-head formed of main and auxiliary crushing-surfaces having different degrees of taper, the hopper or concave having reversely-tapered breaking-surfaces, and an adjustable step-block, substantially as and for the purpose described.

5. In a stone breaker or crusher, the combination of the lower substantially parallel breaking or crushing surfaces, adjustable gyratory shaft, and the upper greater and reversely-divergent crushing-surfaces, substantially as described.

PHILETUS W. GATES.

Witnesses:
J. L. FARGO,
RALPH GATES.