

said shaft removably fitted in the frame of the machine, driving-pulleys on the said shaft, and divided collars keyed and clamped to the shaft, and having pins passing through them and through the bosses of the driving-pulleys in order to secure the latter on the shaft, substantially as set forth, and as illustrated in the accompanying drawings.

Dated this 21st day of October, 1896.

W. E. HUGHES.

IMPROVEMENTS IN PULVERISING-MILLS.

I, Ammi Vining Young, of the Dom Hotel, Köln, in the Empire of Germany, engineer, do hereby declare the nature of my invention for "Improvements in Pulverising-mills," and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to machines for pulverising ores or other hard substances. In the accompanying drawing Figure 1 is a vertical section through the entire mill, Figure 2 a section through the upper part of the machine, and Figure 3 a plan of part of the same.

In the upper part of the mill is arranged a pulley *l*, running horizontally, and driven by a belt by steam or other convenient power. From this pulley is suspended a shaft *h* by means of a universal joint, and to the lower extremity of this shaft is rigidly secured the crushing-roll *c*, which is thus free to swing in any direction.

In the drawing, *a* is the base or pan, containing a ring or die *b*, against which the crushing-roll *c* works, and upon the inner vertical surface of which the pulverising is done. This pan has a number of openings *d* through it downward outside the ring or die, which lead into a pit or receptacle *e* below. Upon the base is secured the screen-frame *f*, which is surrounded with a sheet-iron cover, to the top of which is fastened a conical shield *g*, open at the apex, through which the shaft *h* works.

The pulverising-roll *c* is attached to the lower end of the shaft *h*, and just above the roll is the fan *i*, which is used when the mill is crushing dry, but not when crushing wet. On the underside of the crushing roll *c* are shown stirrers *k*, which are used in both. The shape of these stirrers is varied according to the nature of the work to be done.

The driving-pulley *l* revolves upon the tapered and adjustable bearing *m*, Figure 2, which is in turn supported by the frame composed of standards *n*, Figure 1. Two of these standards are extended above the pulleys to carry an arm *O*, in which is secured the hollow journal-pin *p*.

Within the pulley *l* (the outer part of which is made of wood) is the universal joint from which the shaft *h* is suspended, as shown in Figure 2. This joint is composed of the ball or sphere *v*, with trunnions *s s* attached thereto. These trunnions work in half-boxes, which slide up and down in recesses *t t*, Figure 3, in the pulley-head casting *u*.

The joint in the pulley is enclosed by means of the cover *v*, thus keeping the working-parts away from all dust and grit. The lubricating-oil is supplied for all parts needing it through the hollow pin *p*.

When the mill is started the pulley and the shaft revolve together, the roll *c* hanging free in the centre of the ring *b*; but if the shaft is pushed outward the crushing-roll *c* on its lower end comes in contact with the ring or die *b*, and immediately begins to travel round on its inner surface, pressing against it with a force sufficient to effectually pulverise anything that comes in its way.

When a quantity of the material to be reduced has been fed into the mill sufficient to fill the pan *a* as high as the stirrers *k* on the lower side of the crushing-roll *c* they work in it, stir it up, and throw it against the ring *b*, so that it is acted upon by the crushing-roll *c*, and when fairly in operation the whole body of loose material whirls round rapidly within the pan, and, being brought between the roll and die, is crushed, and all that is sufficiently fine passes at once through the screen *w* above the die, the coarser portion falling down to be acted upon again.

The universal joint by which the shaft is connected with the pulley allows perfect freedom of movement to the roll, so that it can easily pass over obstructions of any kind without damage. It, with its adjoining parts, is constructed as shown in Figure 2.

The ball *V* is carried in a spherical step *x* upon the body *u* of the pulley, the lower part of which is formed with an internal cone *y*, which fits upon a corresponding cone *z* (with the intervention of an anti-friction lining), the latter being formed with a turned-up flange at its lower end, which is screwed inside so as to be screwed upon the externally-screwed cylinder *A*, the upper part of which is screwed into the ring *B* (which is preferably split at one side to give it elasticity), a flange upon the upper end of which is carried by the upper ends of the standards *n* of the machine. The lower end of the inner conical bearing is provided with bosses *C*, into which are screwed set-screws (with lock-nuts) which press against the lower end of the cylinder *A*, and hold the bearing firmly in its place when it has been properly adjusted. Thrust-rings of steel and of anti-friction composition alternately are inserted under the lower end of the hollow revolving internal cone *Y*, to reduce the friction of the latter.

The upper part of the hollow body *U* of the pulley is closed by the cover *V*, and a steel ring *D* is fitted upon the upper part of the ball *V*, and is kept pressed against it by a spring *E* inserted between the ring and the cover.

Upon the upper part of the cover *V* is formed a set of hollow cone speed-pulleys *F*, the central bore of which turns, with the intervention of an anti-friction lining, upon the pin *P*, which is firmly fixed into a strong bracket *G*, carried by a bracket *o* upon a prolongation of the standard *n*. The pin *p* is hollow, and is provided with channels for lubrication. A second light bracket *H*, carried by the bracket *o*, has at its outer end a bearing in which revolves the upper end of a vertical feeding-spindle *l*, which carries cone-pulleys *K*, driven at the required speed by a cord from the pulleys *F* already described. *L* is a hopper, from which the material to be pulverised is fed uniformly into