No. 626,028. Patented May 30, 1899.

E. LISTER.

MILL FOR GRINDING BONE CARBON, &c.

(Application filed Mar. 6, 1897.)

(No Model.) 3 Sheets—Sheet 1.

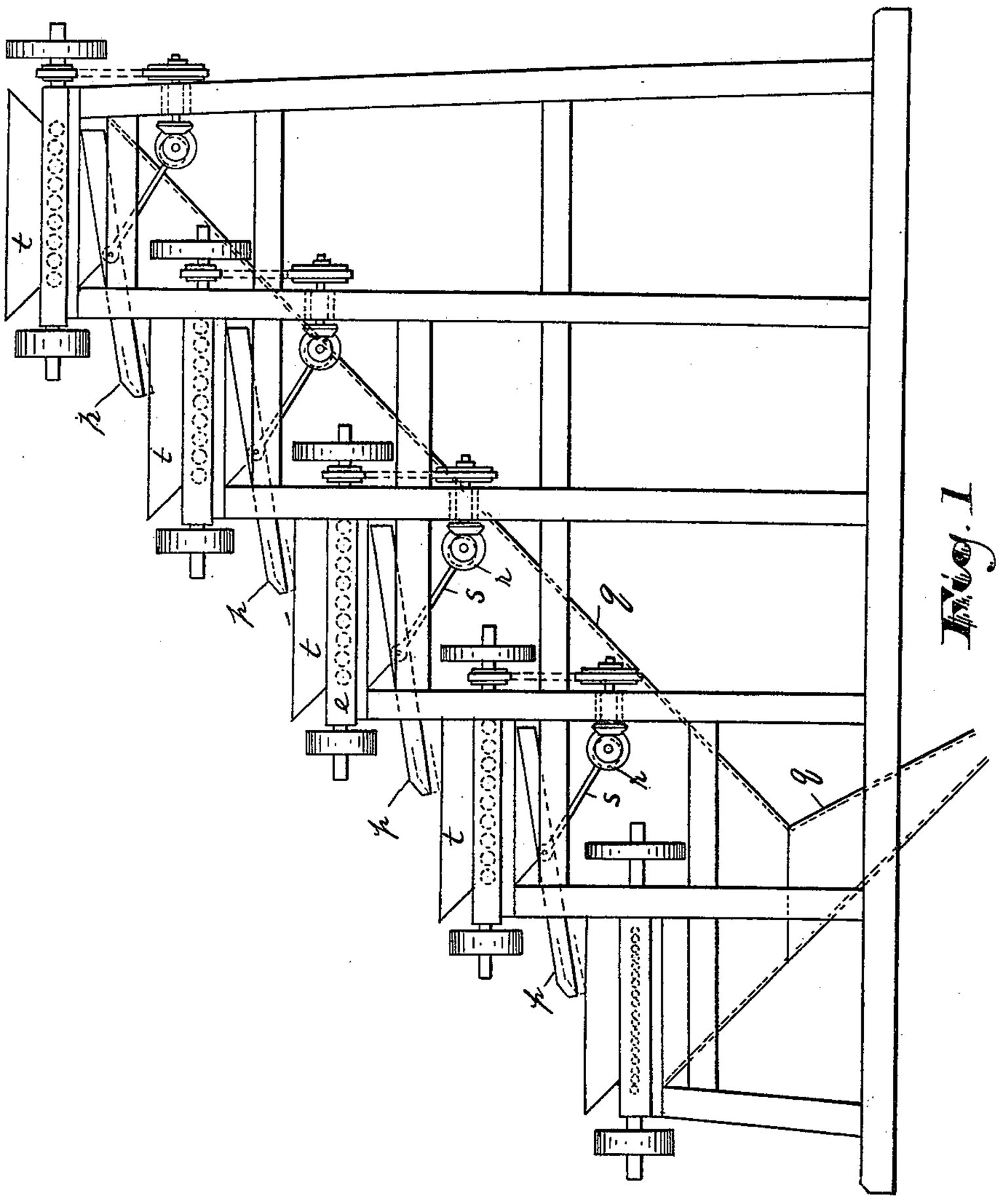

Fig. 1.

WITNESSES:
R. B. Blowmeke
C. B. Peirce.

Edwin Lister, INVENTOR.
BY Drake & Co.,
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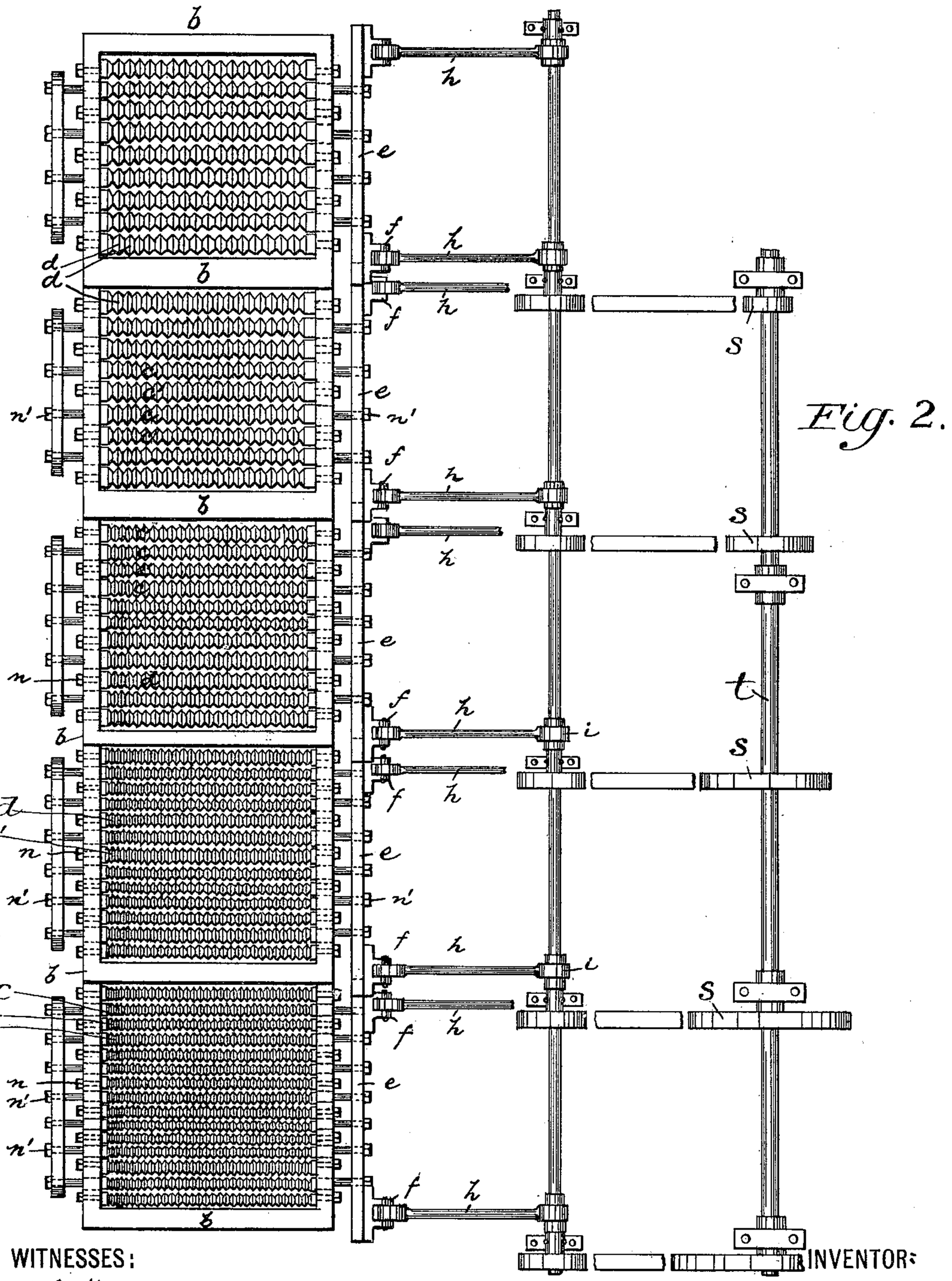

Fig. 2.

WITNESSES:

A. R. Krousse.

C. B. Sitney.

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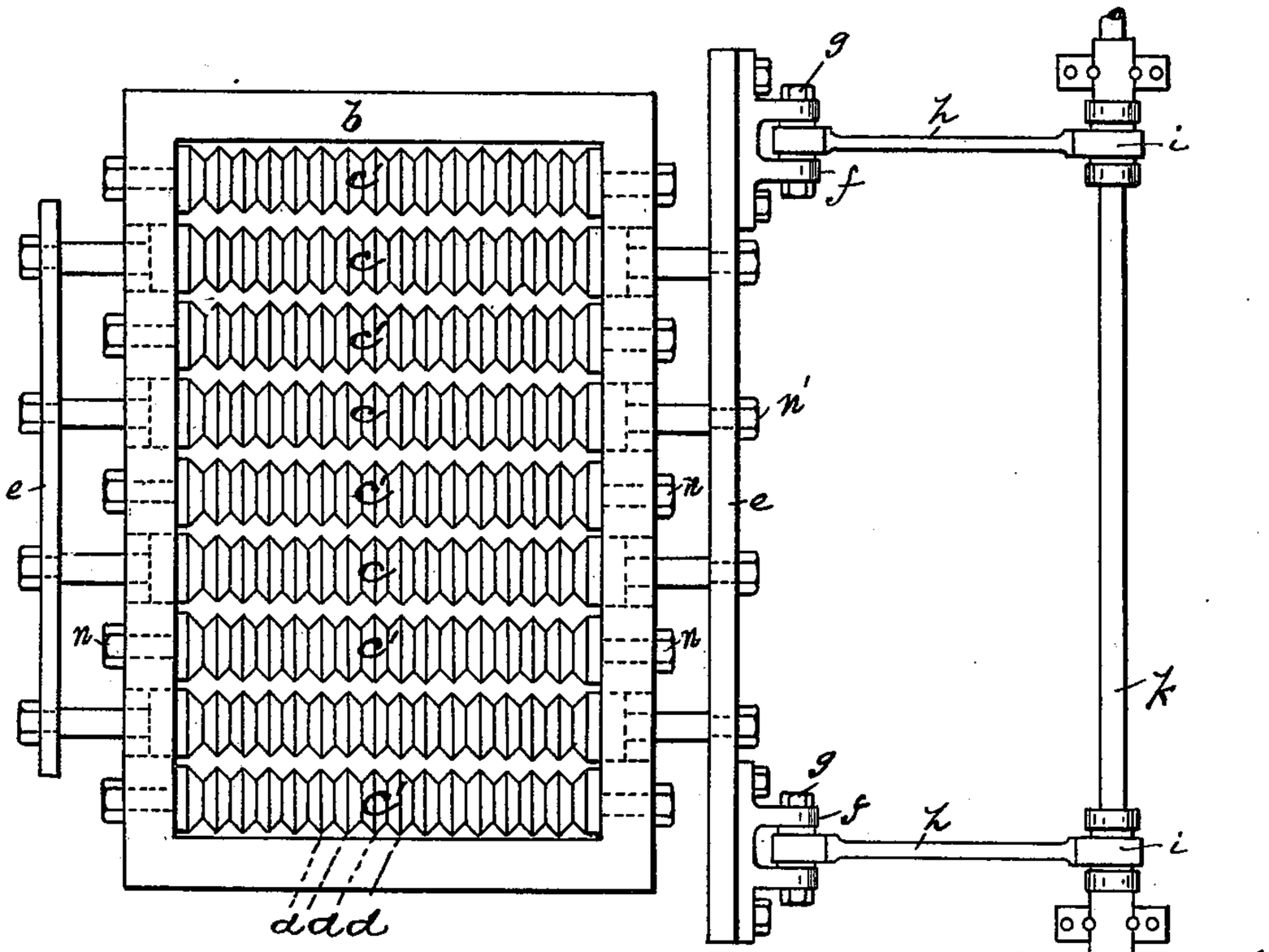

Fig. 3.

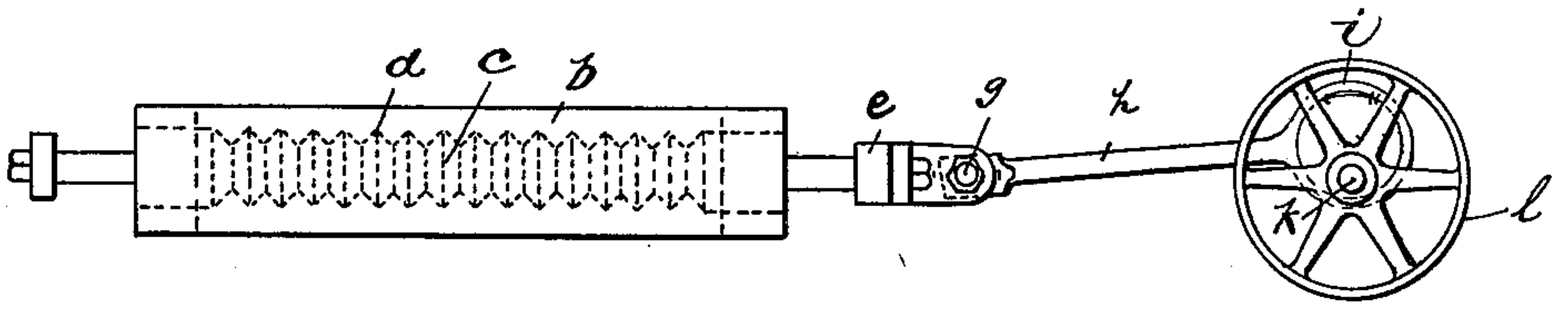

Fig. 4.

WITNESSES:
R. B. Blowmeke
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Edwin Lister, INVENTOR.

BY Drake & Co.

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UNITED STATES PATENT OFFICE.

EDWIN LISTER, OF NEWARK, NEW JERSEY.

MILL FOR GRINDING BONE CARBON, &c.

SPECIFICATION forming part of Letters Patent No. 626,028, dated May 30, 1899.

Application filed March 6, 1897. Serial No. 626,698. (No model.)

To all whom it may concern:

Be it known that I, EDWIN LISTER, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Mills for Grinding Bone Carbon, &c.; and I do hereby 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 letters of reference marked thereon, which form a part of this specification.

The object of this invention is to reduce the loss sustained in the process of granulating bone carbon because of the production of dust when subjecting the bones to the reducing devices.

The bones used in the manufacture of bone carbon are by reason of the heat applied to them exceedingly friable, so that merely a slight friction will rapidly wear off the outer surfaces, forming a dust or powder. This powder is of little value in the market and is largely used for fertilizing purposes. The coarser particles of bone, however, are useful in sugar refining, and in this form the carbon brings a higher price.

If the bones are reduced between two surfaces by a grinding movement or if after being broken the pieces are allowed to remain in contact with the reducing parts of the mill or are given a motion against each other, the fine dust spoken of will be formed in considerable quantities to the loss of the larger particles.

By the machines heretofore employed in the production of granulated bone carbon a large percentage of dust or flour-like particles too fine for service in sugar refining has been produced due to the peculiar crushing operations and trituration to which the bone has been subjected. Because of its fineness and unsuitability for refining purposes it is sold at a largely-reduced price for agricultural fertilizing purposes, thus entailing considerable loss. By my improvements this loss is greatly reduced.

The invention consists in the improved reducing-mill for granulating bone carbon, &c., and in the arrangements and combinations of parts, all substantially as will be hereinafter set forth and finally embraced in the clauses of the claim.

Referring to the accompanying drawings, in which like letters of reference indicate corresponding parts in each of the views, Figure 1 is a side elevation showing the relations of the parts of the mill. Fig. 2 is a plan view of a series of reducing-sections of the mill having reducing-bars of different sizes and means for longitudinally reciprocating certain of said bars. Fig. 3 is a plan of one of the reducing-sections on an enlarged scale, and Fig. 4 is a side view of the same.

In said drawings, *a* indicates a suitable framework of considerable height and of sufficient strength and firmness to sustain the heavy working parts. Said framework at the top is stepped or graduated to receive a series of reducing-sections and hold them so that a part of the product of one section will pass automatically to the next in the series, as will be readily understood upon reference to Figs. 1 and 2. Upon each of the steps is arranged a metallic framework *b*, Fig. 4, preferably in sections and providing boxes or bearings for a series of granulating-bars *c c'*, which are arranged in said bearings parallel to and a little apart from one another. Said granulating-bars are round in cross-section and are peripherally threaded or grooved, so as to form on each a longitudinal series of circumferential teeth *d*.

The cylindrical bars are preferably as small in diameter as is consistent with the strength required, and the circumferential teeth *d* have sharp edges.

In practice I prefer the teeth on the bars of the first or uppermost series of bars receiving the unreduced bone of the size of one to the inch, the teeth on the bars of the second series of two to the inch, on the bars of the third series three and four to the inch alternately, on the fourth six to the inch, and on the fifth and last eight and twelve teeth to the inch alternately, this last series serving to reduce the bone to the fineness particularly desirable in sugar-refining operations. Said bars or the alternate bars *c c c* are given a lengthwise-sliding movement in their bearings by suitable means, the means preferred being shown more clearly in Figs. 3 and 4,

where *e e* are perforated connecting-rods joining the ends of the movable bars *c c*, so that said bars will move in unison when fastened in the perforations. Said connecting rods or pieces are provided at or near their opposite ends with ears *f* to receive the pivotal bolts *g*, and on the said bolts are arranged rods *h h*, having eccentric-straps *i* to receive the eccentric *j* of the counter-shaft *k*, driven by pulley *l*, which last, with the several other pulleys and counter-shafts driving the other series of toothed bars, receives its power from a main power-shaft *t*, having pulleys *s* of various sizes to secure the different speeds required. By means of the eccentrics *j* it is evident that the alternate toothed bars will be given longitudinal reciprocating movements in their end bearings of the frames *b*, and the pieces of bone will be caught between the teeth of any two adjacent bars where they more closely approach one another. The teeth being moving toward each other in slightly-separated parallel lines and being sharp-edged, said edges cut into the opposite sides of any piece of bone, whereby a rotary motion is imparted to the particles of bone and a leverage secured by which the teeth are forced deeper into the bone, which is thus split apart because of its highly brittle character.

It will be seen that it is absolutely essential that the circumferential teeth have sharp edges; otherwise there would be a rubbing action on the sides of the pieces of bone, which would make a powder, owing to the friability of the bone. This rubbing would continue until the piece was sufficiently worn down in size to slip through the bars or else be caught and crushed with force enough to break the lump into smaller pieces, much fine dust being further produced by this crushing. By my construction the bone is split into fragments by the sharp teeth, rather than ground or crushed, which obviously decreases the formation of dust or powder, and consequently reduces the waste of bone, as has been described.

The spaces between the bars are flaring both above and below because of the cylindrical form of the bars, and thus the bone is guided directly between the coöperating teeth on the upper side, and as soon as cut or split into smaller pieces is allowed to immediately drop freely from said bars to pass to the next series. Thus there is little chance for frictional abrasion of the particles under pressure against one another or against the reducing-bars after being properly acted upon and reduced.

The fixed bars *c' c'* are held in the boxes or sockets of the frame *b* by nuts *n*. These bars *c' c'* are not necessarily fixed; but if they are made movable the movement must be different from the movement of the bars *c* to secure the desired action upon the bone, as will be evident. However, I prefer to fix the bars *c' c'*, as that construction is conducive to the simplicity and cheapness of the structure. The bars *c* and *c'* are made adjustable in their bearings, so that by simply turning said bars as their cutting edges wear dull at the points of nearest approach in opposite teeth new edges are brought into play. The adjustments are obtained by loosening the nuts *n* and *n'*, turning the bars by hand, and again setting the nuts; but other means or methods of adjustment may be employed.

The driving means for reciprocating the granulating-bars may be constructed in any manner known to mechanics for varying the speed of the different series of reciprocating bars. The uppermost and largest-toothed series are reciprocated at the rate of about one hundred and eighty strokes per minute, the intermediate series at about two hundred and twenty-five strokes per minute, and the bars having the smaller teeth at the rate of about four hundred and fifty strokes per minute. Of course these rates of movement, as well as the sizes of the teeth in graduated series of sizes, may be varied at will to accommodate various grades or kinds of work.

Beneath each of the frames *b* and its series of toothed bars is a sieve *p*, having its wire-cloth of sufficient fineness to allow bone of a size desirable for refining purposes to pass through. This bone, with the dust, passes through said sieve to a chute or guide *q*, down which it slides to an elevator, which raises it to the top of a series of assorting-sieves, where the dust is separated from the larger granules, the latter being conducted to the bags for packing in any ordinary manner, while the dust is conducted elsewhere. The larger reduced bone failing to pass through the sieve is led down the inclined sieve, as will be understood upon examination of Fig. 2, the said sieve being given a sharp vibratory motion by suitable means, such as the eccentric *r* and connecting-rod *s* and means for operating the same, and falls upon the reducing-bars of the sieves next in order, the teeth of which are of a smaller size than those of the section above. The bone is thus brought to a size easy to be wrought upon by the bars prior to passing onto the same, and is free from dust.

Above the frames *b* I prefer to arrange hoppers *t*, of any suitable kind, to collect the pieces of bone and guide them onto the reducing-bars.

Having thus described the invention, what I claim as new is—

1. In a bone-carbon-reducing mill, the combination with a frame *b*, of a series of cylindrical bars arranged near one another, said bars having circumferential cutting-teeth and being adapted to slide longitudinally, and means for reciprocating said bars, substantially as set forth.

2. In a bone-carbon-reducing mill, the combination with a frame *b*, providing bearings, of a series of parallel bars circular in cross-section with sharp-edged circumferential teeth and having their opposite ends resting

in said bearings, a portion of said bars being adapted to slide longitudinally and means for reciprocating said longitudinally-movable bars, substantially as set forth.

3. In a bone-carbon-reducing mill, the combination with a frame *b*, of a series of cylindrical bars placed parallel to each other in the same plane and having sharp-edged circumferential teeth, the alternate bars being adapted to slide longitudinally and means for reciprocating said alternate bars, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 24th day of November, 1896.

EDWIN LISTER.

Witnesses:
CHARLES H. PELL,
R. P. LISTER.