

(No Model.)

2 Sheets—Sheet 1.

H. RICHARDSON,

MACHINERY FOR GRINDING SPHERICAL BALLS.

No. 365,407.

Patented June 28, 1887.

Fig. 1.

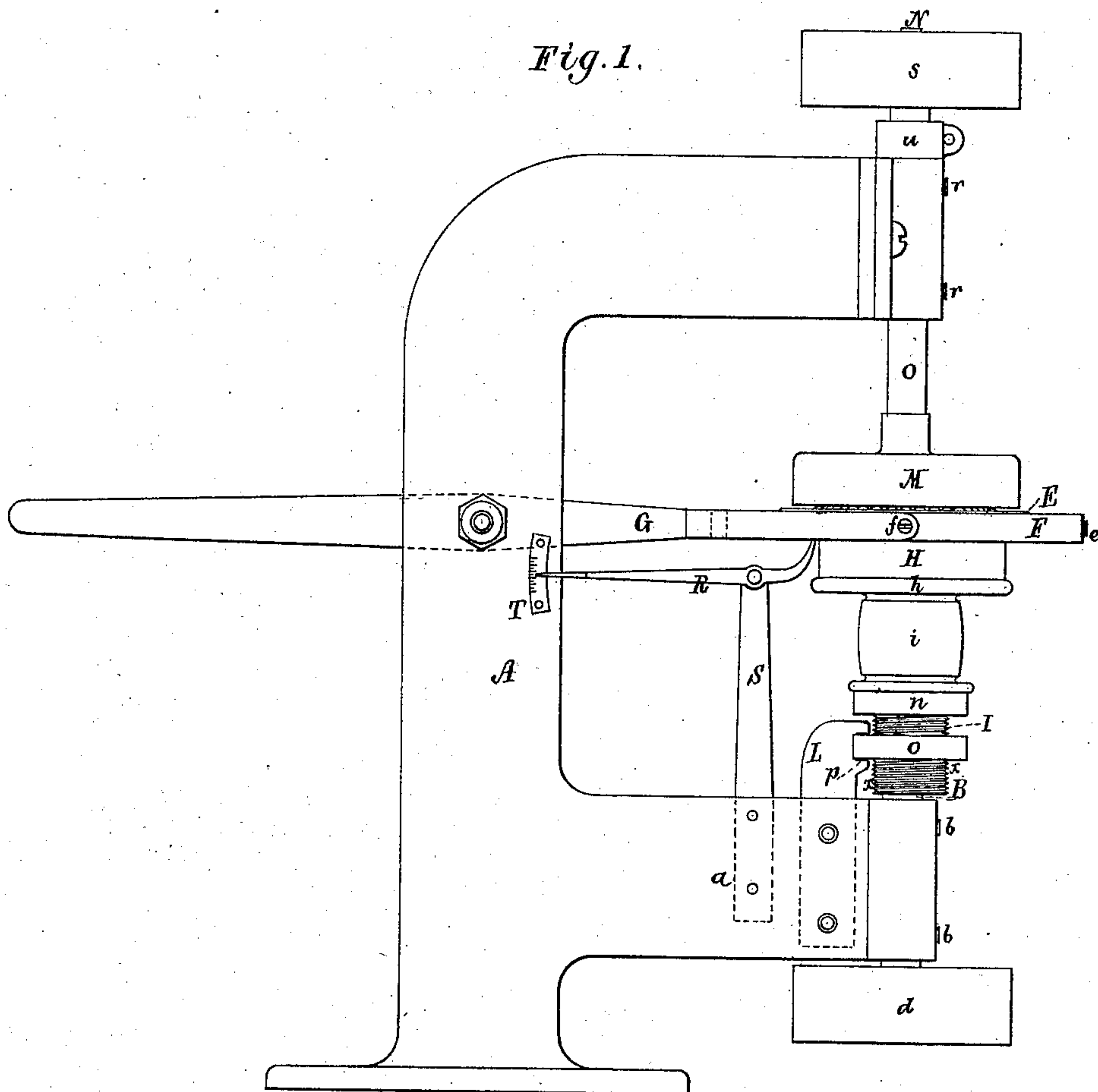
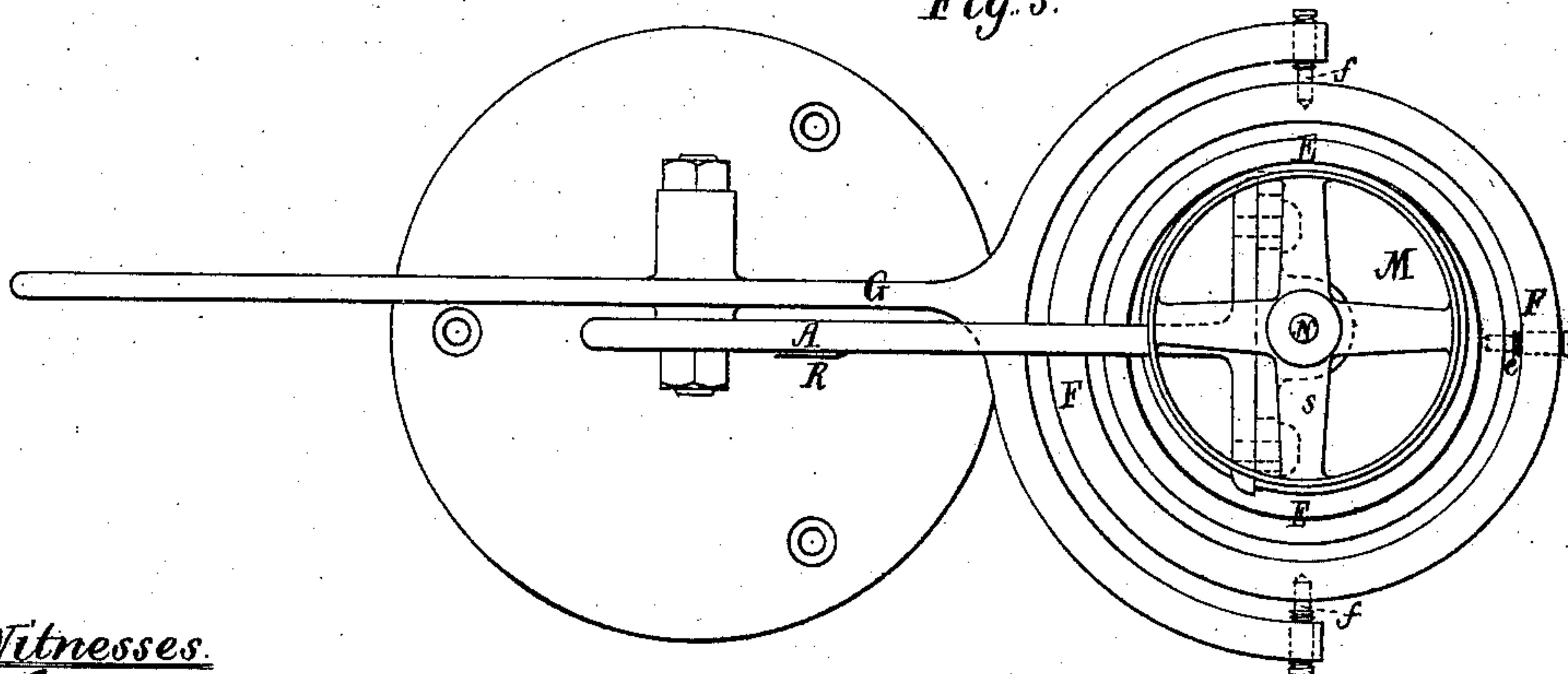


Fig. 3.



Witnesses.

S. N. Piper

A. G. Eddy

Inventor.

Henry Richardson

by R. H. Eddy atty

(No Model.)

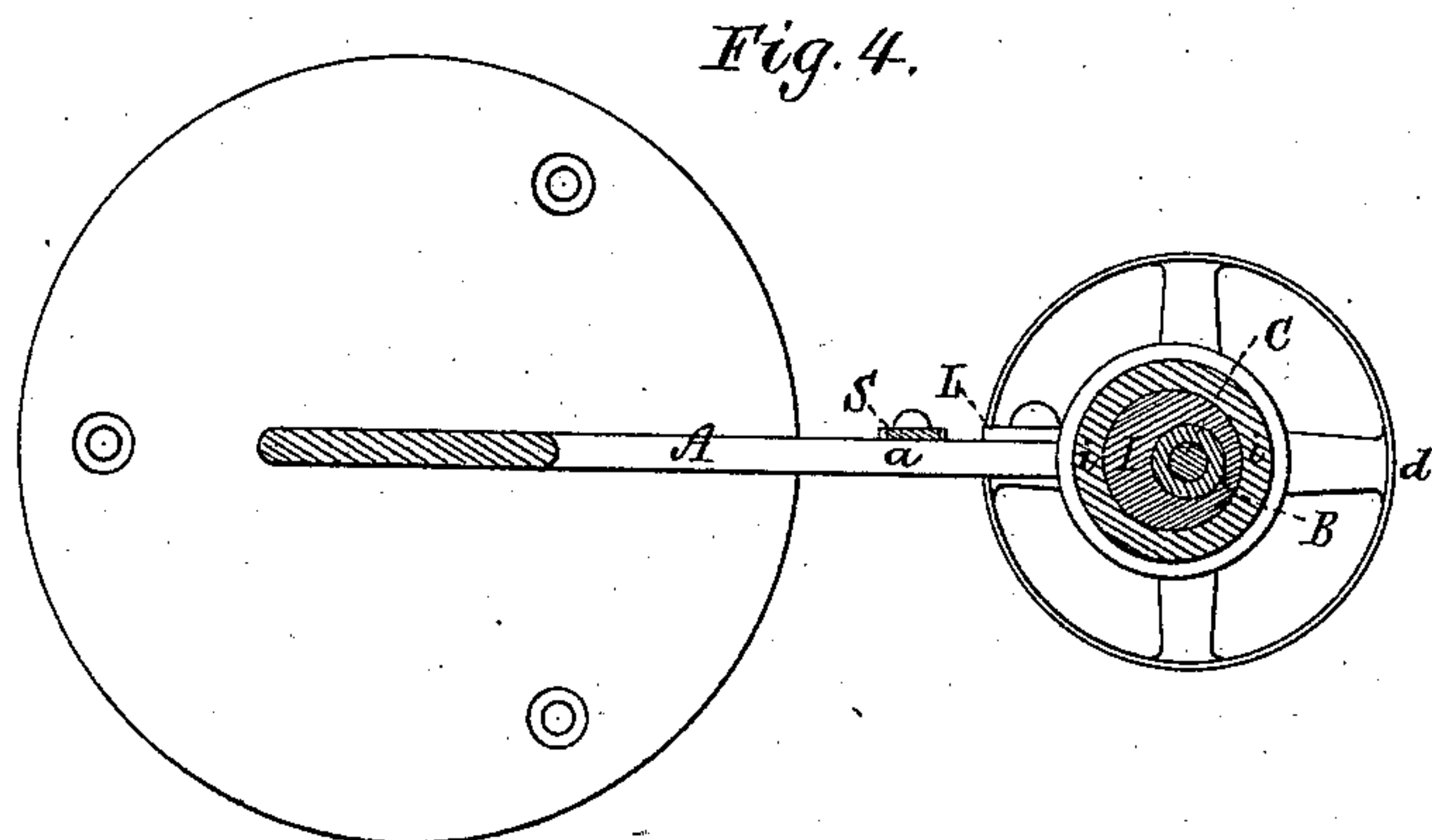
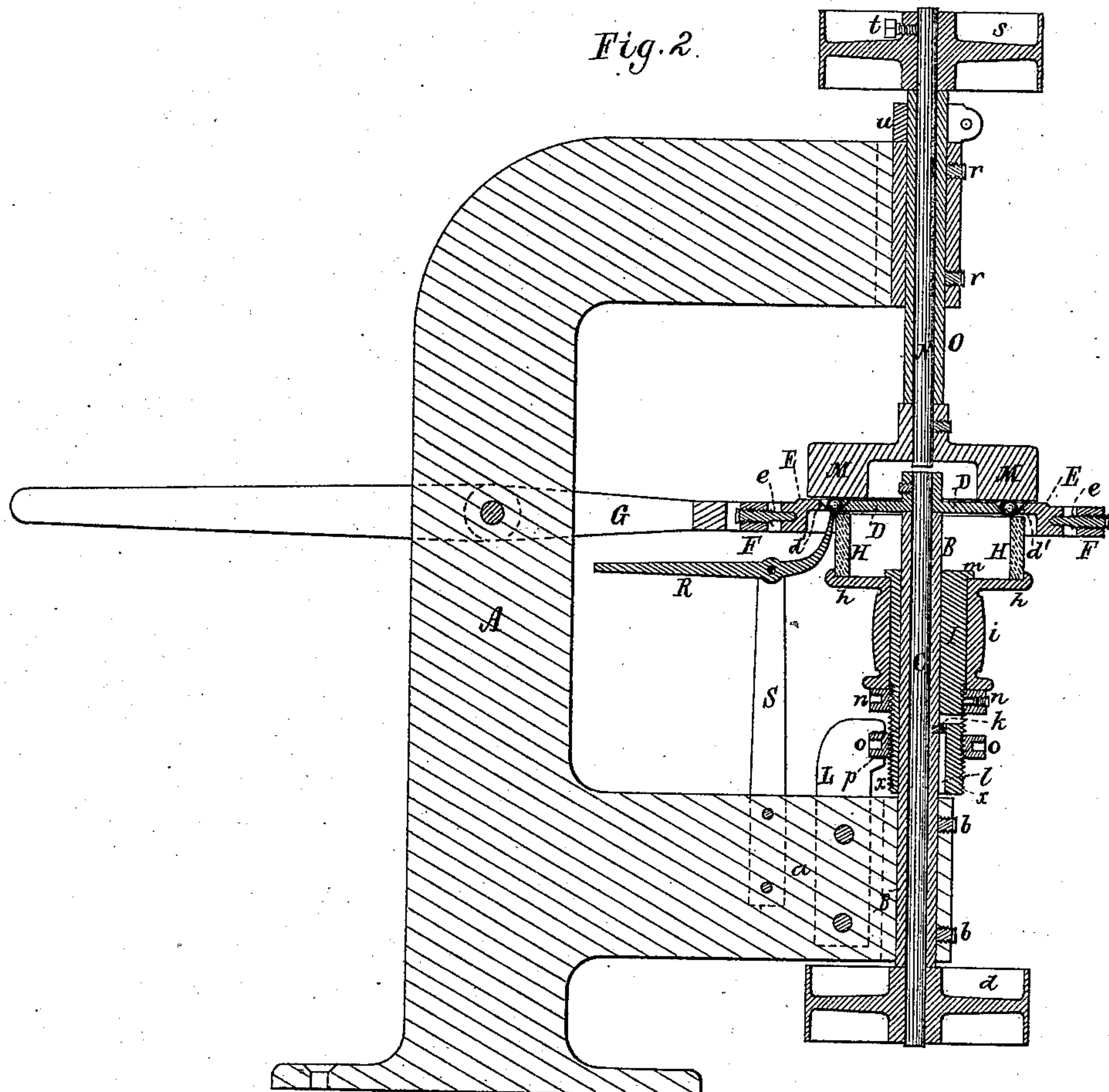
2 Sheets—Sheet 2.

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UNITED STATES PATENT OFFICE.

HENRY RICHARDSON, OF WALTHAM, MASSACHUSETTS.

MACHINERY FOR GRINDING SPHERICAL BALLS.

SPECIFICATION forming part of Letters Patent No. 365,407, dated June 28, 1887.

Application filed March 31, 1887. Serial No. 233,141. (No model.) Patented in Canada April 16, 1887, No. 26,460.

To all whom it may concern:

Be it known that I, HENRY RICHARDSON, of Waltham, in the county of Middlesex, of the Commonwealth of Massachusetts, have invented a new and useful Improvement in Machinery for Grinding Spherical Balls; and I do hereby declare the same to be described in the following specification, and represented in the accompanying drawings, of which—

Figure 1 is a side elevation, and Fig. 2 a vertical, longitudinal, and median section; and Fig. 3 is a top view of a machine embodying my invention, the nature of which is defined in the claims hereinafter presented. Fig. 4 is a horizontal section taken through the grinding-wheel pulley and the eccentric sleeve on which such pulley revolves when the machine is in operation.

The said machine is to reduce to a true spherical form each of a series of balls.

In the drawings, A denotes a standard for supporting the principal operative parts of the machine. There extends down through the lower arm or part, *a*, of the said standard a tube, B, which also projects above the said part *a*, the tube being fastened in the part *a* by set-screws *b*, screwed into the part *a* and against the tube.

A spindle or shaft, C, going upward through the bore of the tube, has fixed on the part of it extending below the tube a driving-pulley, *d*. On the portion of the spindle projecting above the tube there is fastened concentrically a conic frustum, D, which is arranged within and concentrically with an aperture or race, *d'*, in a horizontal annulus, E, the said aperture being in the form of an inverted conic frustum. The annulus E is surrounded by another annulus or ring, F, to which it is pivoted diametrically thereof, as shown at *e e*, and this latter annulus is arranged within the prongs of a furcated lever, G, fulcrumed to the standard A. The annulus F is pivoted to the prongs of the lever, as shown at *f f*, a line through such pivots being at right angles to one through the pivots *e e*. Thus it will be seen that the lever is connected to the ring E by what are termed "gimbals."

Under the aperture *d'* is the tubular grinder H, that extends upward from and is supported by a disk or head, *h*, having a driving-pulley,

i, projecting down from it, as represented. The said pulley and disk or head encompass and revolve on an eccentric cylindrical sleeve, I, adapted to surround and slide vertically on the tube B, but not to revolve thereon, a stud, *k*, from the tube being extended into a groove, *l*, made in the sleeve. The circumference of the sleeve I is eccentric relatively to the bore of such sleeve. At its upper part the sleeve has a flange or head, *m*, that rests on the disk *h*.

The sleeve is screw-threaded, as shown at *x*, in the part of it which projects below the pulley *i*, there being screwed on the screw-threaded part two rings, *n* and *o*. The lower of these rings projects into a notch, *p*, in a stationary standard, L, projecting upward from the part *a*.

By revolving the ring *o* one way the grinder may be forced upward, it being correspondingly moved downward by turning the ring the opposite way. By such means the upper edge of the grinder can be properly adjusted for the series of balls placed in the aperture or race *d'*, to rest in contact with the said upper edge. As the grinder-pulley revolves on the eccentric I, the upper or grinding top of the grinder H will be caused to revolve eccentrically relatively to the race, whereby the whole surface of the upper edge of the grinder will be caused to act against the balls, and will thereby be prevented from becoming grooved.

Above the race is the ball-revolver M, which is a disk fixed on the lower part of a vertical shaft, N, that is arranged within the bore of a sleeve, O, fixed in the upper part of the standard A, and held therein by set-screws *r r*, arranged as represented. A pulley, *s*, is fixed on the shaft N above the sleeve O, such pulley being held to the shaft by a set-screw, *t*. Furthermore, there is a clamping-collar, *u*, fixed on the sleeve O and to rest on the top of the standard A.

The balls to be ground are placed in the race *d'*, after which the revolver M is to be lowered to rest on the balls. This revolver is to be revolved by an endless band going about the pulley *s*, fixed on the upper part of the shaft N.

The rear arm of the furcated lever G is to have a weight or spring applied to it to force it downward, in order to press the ring E up-

ward against the balls to keep them in contact with the revolver M. The said ring, by its gimbal attachment with the lever, can automatically adjust itself to the series of balls, 5 which bear not only against the ring E but against the periphery of the conic frustum D, such frustum being at the time revolved so as to aid in turning the balls. While by the disk M each ball of the series of balls is revolved 10 around within the race, so as to bring more or less of such ball in contact with the grinder while the latter is in rapid revolution, such ball, by the frustum D, will be further turned or revolved, whether such frustum be at rest 15 or in revolution. Thus by means of the automatically-adjustable ring E the revolver M, the frustum D, and the eccentrically-revoluble grinder H all the balls will be simultaneously ground, and each will be reduced to, or substantially to, a perfect sphere in shape. 20

The axis of the shaft N is not in line with that of the shaft C, though parallel to such as extended. By having the axis of such shaft N eccentric with that of the shaft C the disk M 25 while in revolution will not be worn or ground unevenly by the balls.

Although I have represented the disk D as a conic frustum, its periphery may be grooved or caused to fit or bear on the balls rather than 30 be strictly frusto-conical. The same may be said relatively to the internal periphery of the annulus E.

If desirable, the axis of the shaft N may be in a straight line with that of the spindle C; 35 but it is preferable to have it a little out of line therewith, as and for the purpose hereinbefore mentioned.

R is a lever fulcrumed to a standard, S. The inner arm of this lever extends upward into

the race and against the series of balls. The 40 longer arm of the lever works against a scale, T, to indicate when the balls are sufficiently reduced. The said arm may operate in connection with a metallic plate arranged in the circuit of an electro-magnet, the whole being so 45 that when the balls are sufficiently ground the arm may, by contact with the plate, close the circuit and cause the magnet to move its armature in a manner to put in operation mechanism for stopping the machine. 50

I claim—

1. The combination of the revolver M and frustum D, provided with means of revolving them, as described, with the ring E, automatically adjustable, as set forth, and the tubular 55 rotary grinder H, arranged with such frustum D and ring E, and having means of revolving it, the said grinder, as explained.

2. The combination of the revoluble tubular grinder H, its pulley i, and the vertically- 60 adjustable eccentric I, having means of adjusting it, as described, with the conic frustum D, the automatically-adjustable annulus E, and the revolver M, having mechanism for revolving it, as explained, the whole being to operate 65 substantially in manner and for the purpose as represented.

3. The combination of the lever R and scale T with the ball-grinding machine, substantially as described, consisting of the revolver 70 M, frustum D, automatically-adjustable ring E, and grinder H, the said grinder and revolver being provided with means of revolving them, as specified.

HENRY RICHARDSON.

Witnesses:

R. H. EDDY,
R. B. TORREY.