J. J. GREENOUGH.

Gearings.

No. 145,499. Patented Dec. 16, 1873.

Fig. 1.

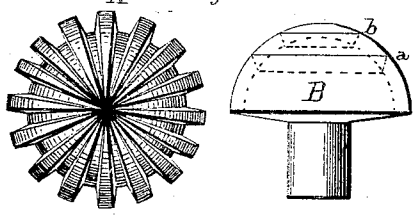


Fig. 2.

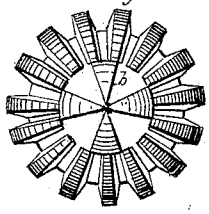


Fig. 3.

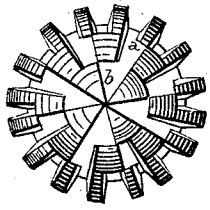


Fig. 4.

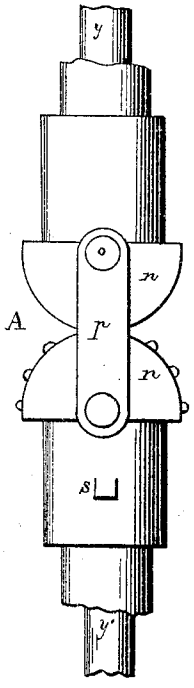
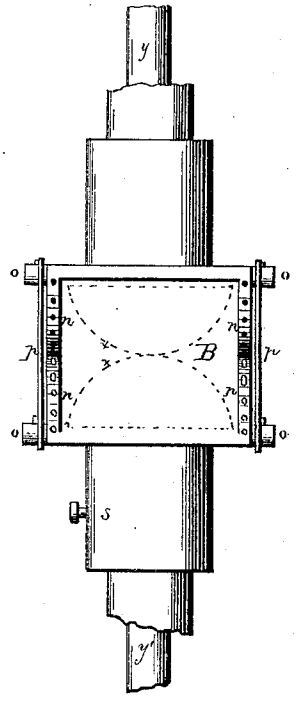


Fig. 5.



Witnesses.

F. A. Lehmann

J. H. Clements

Inventor.

J. J. Greenough

UNITED STATES PATENT OFFICE.

JOHN JAMES GREENOUGH, OF SYRACUSE, NEW YORK.

IMPROVEMENT IN GEARINGS.

Specification forming part of Letters Patent No. **145,499**, dated December 16, 1873; application filed July 15, 1872.

To all whom it may concern:

Be it known that I, JOHN JAMES GREENOUGH, of Syracuse, New York, have invented certain Improvements in Machine-Gearing, by which I form a universal joint, of which the following is a specification:

This invention consists in a gearing that will give two shafts a varying angle with one pair of gears only, so as to allow the shafts a movement from a right line to a position parallel to each other, giving to line-shafts thus geared a motion in any direction through one hundred and eighty degrees. This gearing is composed of two semi-spheres, on the convex surface of which the teeth are cut radially. These teeth, to produce their best effect, are formed so that at every point between their base and apex the cross-section of the tooth is of a proper form and curve, which varies from the base where the outline of the cross-section of the tooth should have the form of a spur-gear up to the apex where the face of the tooth would be theoretically a straight line.

To properly form these teeth has heretofore been deemed impracticable by any known means; but I have succeeded in devising machinery therefor, which I propose hereafter to patent, which perfects the construction, and renders my device valuable.

It is obvious that if all the teeth, as hereinabove named, were formed of the proper size at the base, and run all the way up to the apex, where they vanish at the center, they would be very light, and too thin for practical purposes. To avoid this practical difficulty, I propose, when necessary, to use the center against much resistance, to diminish the number of teeth one or more times between the base and the apex, so as to keep the teeth of sufficient size for the strength required Thus, suppose there are sixteen teeth at the base, as in Fig. 2, up to the line *b*, and from thence to the apex four teeth; or, as in Fig. 3, from the base up to *a* sixteen teeth, from *a* to *b* eight teeth, and from *b* to the apex four teeth.

A greater number of changes may be made, and the number of teeth in each circle or section may be different from those named. The semi-sphere may be made whole or in sections at the junction of the several sets of teeth.

In the drawing, Figure 1 shows A, the plan, B the elevation, of one of the semi-spheres. In this plan all the teeth run from the base to the apex nearly. Fig. 2 shows a plan of the gear with two sets of teeth. Fig. 3 shows a plan of gear with three sets of teeth. Fig. 4 is a side view, and Fig. 5 a front view, of the coupling-joint.

Two semi-spherical gears, constructed as above described, and each affixed to the end of separate shaft, are coupled as follows: Two segment-pieces, *n*, Fig. 4, inclose the gear on two sides. The curved edges of these segments are furnished with pin-gear, as shown in the drawing, or are cut into spur-teeth, the purpose of which is to hold the semi-spherical gear in place, and prevent their binding. At the center of the segments, on each side, there is a projecting stud, *o*, and the two studs are connected by links *p* extending from one center to the other. This arrangement will allow the segments to make a half-revolution on each other, so as to bring every part of the semi-spherical gear into contact. The dotted lines *x* represent the gear within the coupling-joint, and *y y* are the shafts connected by them. One of the joint-pieces *s* has a swivel motion around the shaft, by which a universal movement is obtained for the shaft.

A modification in constructing the semi-spherical gear would be to drill into the surface of a semi-sphere a properly-increasing series of holes from apex to base, and insert pin-gear, a second semi-sphere being made with holes in it to correspond therewith, to receive the pins, as in ordinary pin-gear, which, being well known to the mechanist, needs no further description.

In coupling this gear, the segments above named may be omitted in the joint-coupling, if desired.

I claim, in the above-described universal-movement gear—

1. The teeth of the gear formed on the surface of the segment of a sphere, so as to radiate from the axis of revolution to the base, and the curve of the teeth made to conform at their pitch-line to the segment of a circle concentric with a point on the axis, substantially as shown and set forth.

2. The segmental gear having the number

of its teeth diminished, and their thickness increased as they approach the apex of the gear, substantially as shown and described.

3. The segmental gears coupled by links, which are pivoted on a radial line in the plane of their axes coincident with the center of the pitch-line of the teeth, enabling the gears thereby to sweep through an arc, substantially as shown and described.

4. The segment-joint piece, constructed with a swivel, to enable the gears to sweep around the entire circle on the axis of the gear, substantially as shown and described.

5. The semi-spherical gears, in combination with the swivel-link, substantially as and for the purpose described.

In witness whereof I have hereto set my my hand this 1st day of July, 1872.

JOHN JAMES GREENOUGH.

Witnesses:

GEORGE WEST,

JOHN YOUNG.