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PATENTED DEC. 18, 1906.

C. A. PARSONS, H. HALL & J. TURNBULL.

STEAM TURBINE SHAFT.

APPLICATION FILED FEB. 5, 1906.

4 SHEETS—SHEET 1.

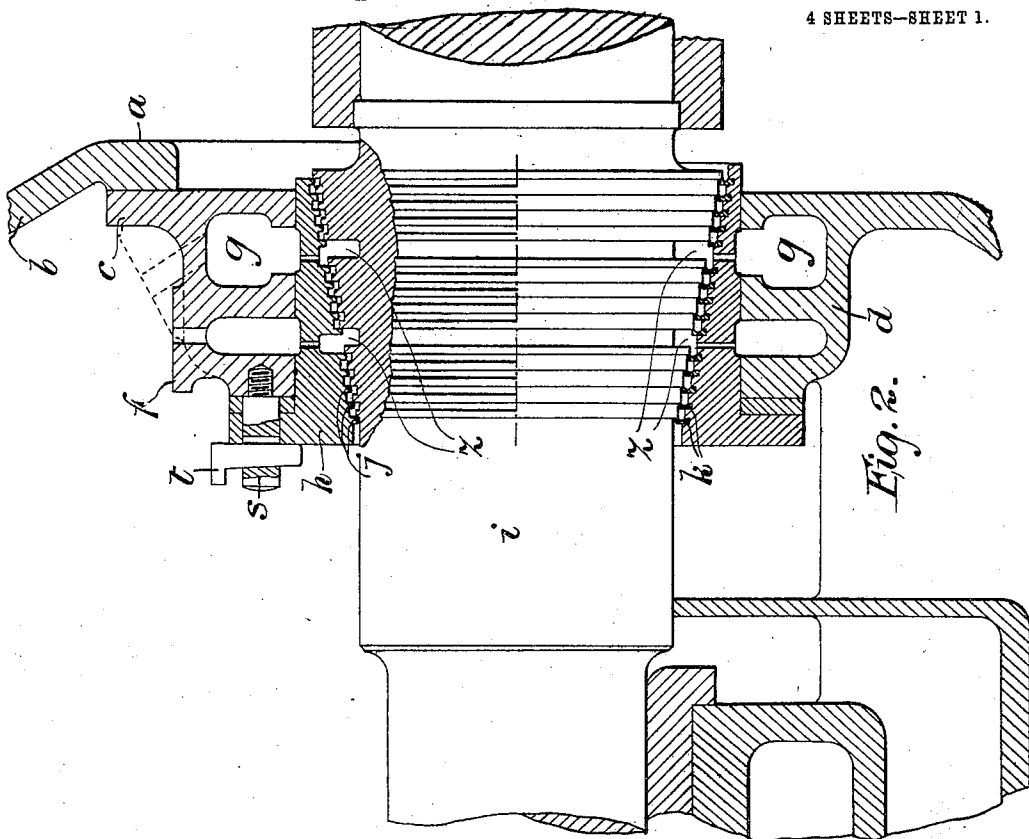


Fig. 2.

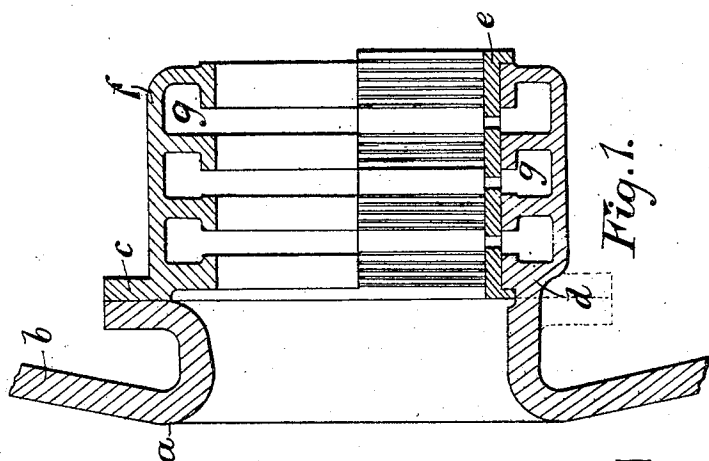


Fig. 1.

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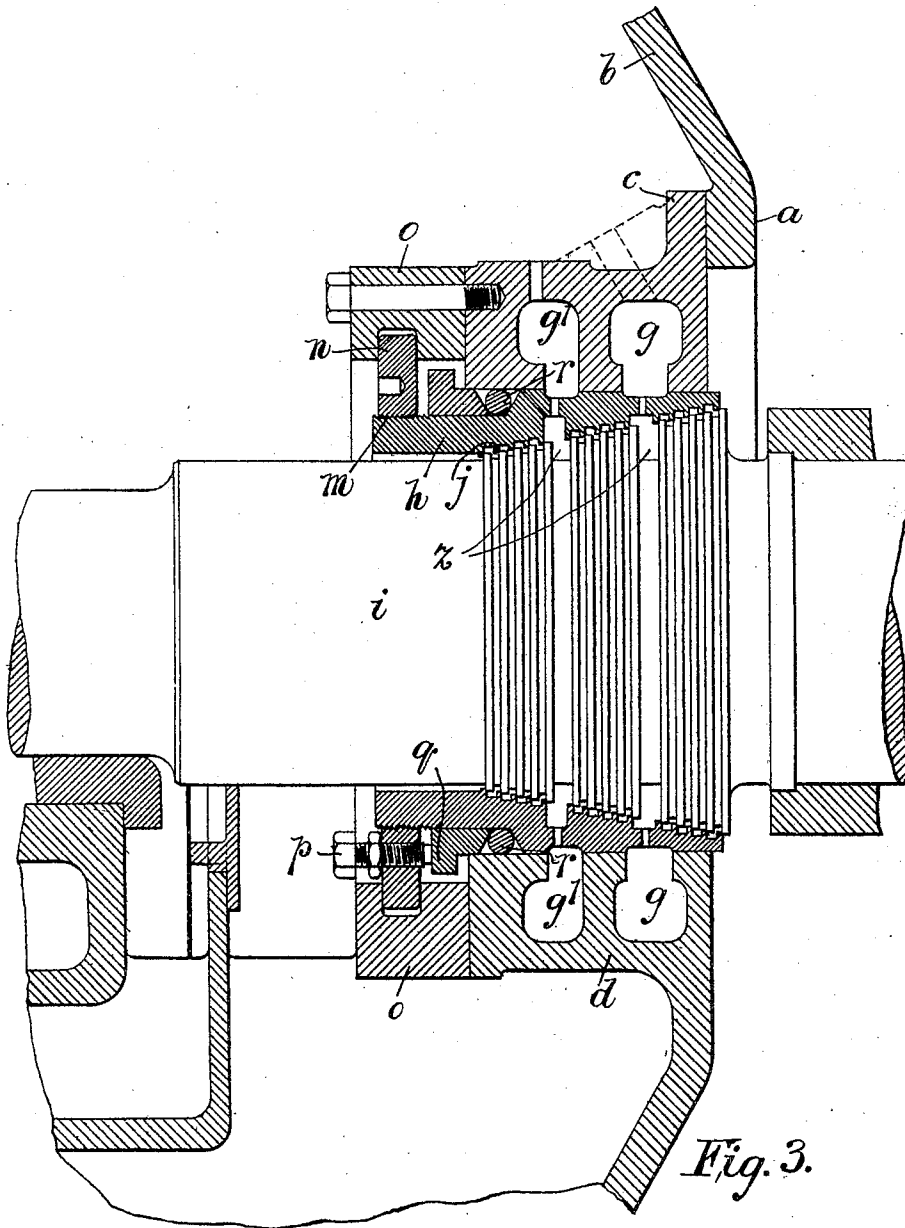
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4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.

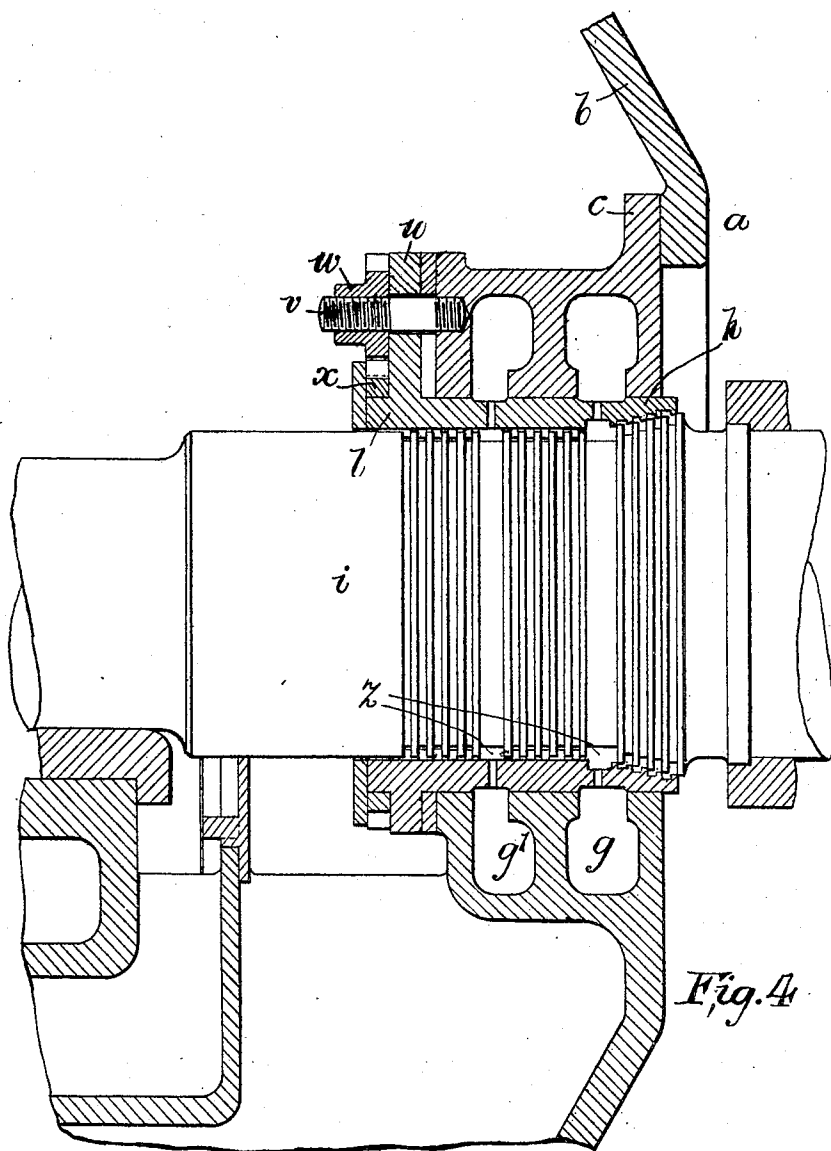


Fig. 4

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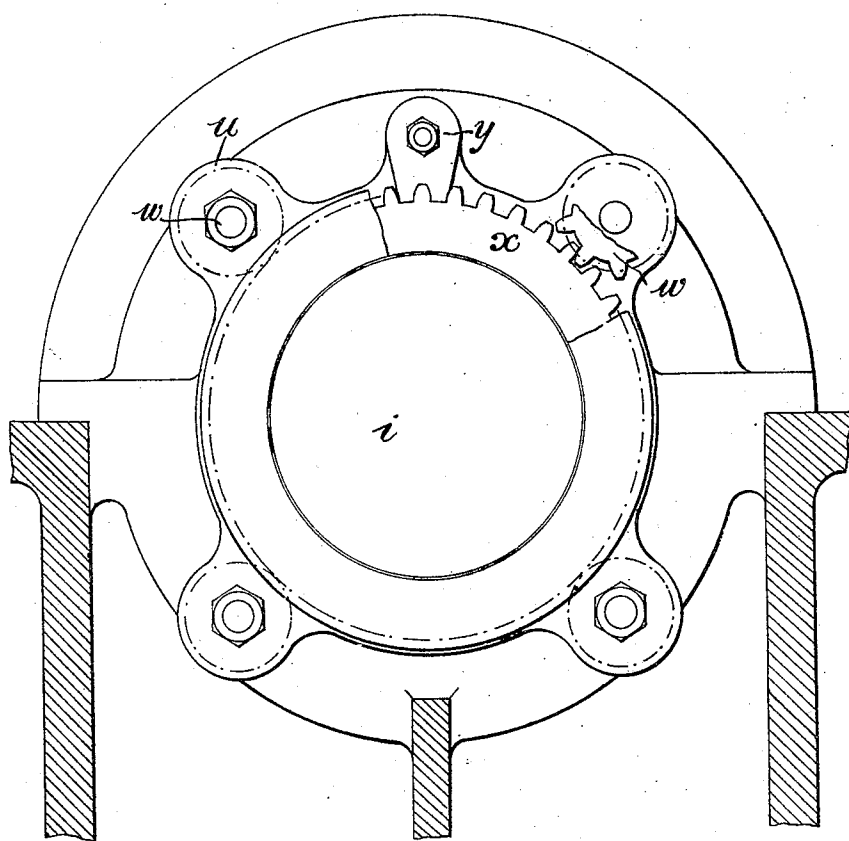


Fig. 5.

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# UNITED STATES PATENT OFFICE.

CHARLES ALGERNON PARSONS, OF NEWCASTLE-UPON-TYNE, AND HEWITSON HALL AND JOHN TURNBULL, OF WALLSEND, ENGLAND; SAID HALL AND TURNBULL ASSIGNORS TO SAID PARSONS.

## STEAM-TURBINE SHAFT.

No. 838,744.

Specification of Letters Patent.

Patented Dec. 18, 1906.

Application filed February 5, 1906. Serial No. 299,539.

*To all whom it may concern:*

Be it known that we, CHARLES ALGERNON PARSONS, C. B., residing at Heaton Works, Newcastle-upon-Tyne, and HEWITSON HALL and JOHN TURNBULL, residing at Turbinia Works, Wallsend, in the county of Northumberland, England, subjects of the King of Great Britain and Ireland, have invented new and useful Improvements in Packing Devices for the Shafts of Steam-Turbines and other Rotary Motors, of which the following is a specification.

The invention relates to improvements in packing devices for the shafts of rotary motors, and is especially applicable in steam-turbines.

Hitherto it has been usual to construct the packing-glands of steam-turbines in such a manner that they cannot be examined or adjusted without removing the cover of the turbine.

The object of the present invention is to provide an improved packing-gland in which the gland may be examined, removed, or adjusted without removing the cover or casing of the turbine or other motor.

The first part of our invention consists in providing the packing-glands of rotating shafts with means for withdrawing the packing for inspection, comprising a removable top cover and a semicylindrical extension on the turbine-casing, which together form a box for a split bushing carrying the packing rings or collars.

The second part of our invention consists in a conical formation of the packing collars or rings, which are stepped so that the bush may be entirely withdrawn longitudinally. Any form of baffle may be employed with this form of gland, either those depending upon radial clearance or longitudinal adjustment for their steam tightness.

A third feature of our invention resides in means for effecting the independent longitudinal adjustment of the gland-packings, whereby when the turbine has been warmed up the packing collars or rings may be set to a fine degree of clearance for the prevention of leakage.

In a modification we employ in combination a group of conical packings, as described above, and one or more groups of piston-ring packings as ordinarily used in steam-turbine glands.

Referring now to the accompanying drawings, which form part of our specification, Figure 1 illustrates a form of removable packing for rotating shafts in which the packing collars or rings are cylindrical in form. Fig. 2 is a sectional elevation similar to that shown in Fig. 1 of a conical arrangement of the packing-collars. Fig. 3 is another sectional elevation of a form of the invention in which provision is made for the longitudinal adjustment of the split bushing. Figs. 4 and 5 are sectional side and front elevations of a combined piston-ring and conical packing-gland according to one modification of this invention.

In carrying out the invention according to the form shown in Fig. 1 the cover *b* of the turbine-cylinder or in some cases where no separate cover is used the turbine-cylinder itself is provided with a semicylindrical portion *d*, which forms the lower half of the packing-box. The upper half of the packing-box is formed by the semicircular cover *f*, fixed to the turbine-cover *b* by the flanges *c*, and the usual lantern-spaces *g* are provided in the packing-box so formed. The packing-collars are carried on a split bushing *e*, only the lower half of which is shown in position in Fig. 1. In some cases we also make the lower half *d* of the packing-box detachable, as shown by dotted lines in Fig. 1. In this form the entire box is detachable.

The packing which we employ may be either of the radial clearance type or the piston-ring type or a combination of these two types. The lantern-spaces are connected to the turbine-casing at suitable points in the expansion of the steam for the purpose of reducing leakage through the packing-rings. Thus by connecting the lantern-spaces *g* to various parts of the expansion of the steam the drop of pressure between, and in consequence the leakage in, the various groups is minimized. This has also the effect of preserving the life of the rings or collars.

It will be seen that by removing the cover *f* of the gland-box the top bushing may be readily removed and inspected, while the lower packing-bushing may be slid round the shaft till it too may be readily removed. In

this way the repairing of the gland or packing is much facilitated and does not render it necessary to remove the whole top of the turbine cylinder or cover. The side of the turbine-casing marked *a* represents the interior.

In the form of our invention illustrated in Fig. 2 and in the upper half of that figure, in addition to the removable cover *f*, we provide a conical packing-bushing *h*, having stepped collars *j*. The shaft *i* has also stepped collars formed on it, the collars on the shafts being so proportioned that the split bushing *h* may be readily withdrawn to the left in Fig. 2, where it will be noticed the step of smallest diameter is arranged toward the outside, the diameter of the steps increasing inwardly. In the lower half of this figure separate packing rings *k* are shown as the form of packing employed. As shown, these rings are arranged in groups, and, as in the case of collars *j*, the rings *k* are proportioned so as to permit of the longitudinal withdrawal of the bushing. For the purpose of longitudinally adjusting the packing after the turbine has been heated up we provide bolts *s*, having slots formed in the heads thereof. Cotters *t*, passing through these slots, bear against the conical bushing *h*, so that by hammering down the cotter *t* the bush *h* may be adjusted longitudinally.

In Fig. 3 the gland is shown with other means for longitudinally adjusting the packing. The split packing-bushing *h* is provided with a screwed portion *m*, which engages a nut *n*. This nut rests in a recess formed in a ring *o*, fixed to the removable cover *f* and to the part *d* of the turbine cylinder or cover. Passing through the ring *o* there are a number of set-pins *p*, adapted to bear against a short plain gland *q*, adapted to force a packing-ring *r* outward against the inner cylindrical surface of the gland-box, thereby preventing leakage from the lantern-space *g'* to the atmosphere. By screwing the nut *n* in Fig. 3 the bushing *h* is adjusted longitudinally, while by tightening up the set-pins *p* leakage from the lantern-space *g'* is effectually prevented.

In Figs. 4 and 5 a modification of our invention is shown in which a combination of conical and piston packing is used and in which the longitudinal adjustment of the packing-bushings is effected by means of nuts operated simultaneously by means of a rack in the manner well known as applied to the packing-glands of piston-rods. The bushing *b* is provided with lugs through which pass studs *v*, having nuts *w*, provided with toothed rims, these toothed rims being adapted to engage with a circular rack *x*. A locking device *y* is also provided. In this case no special provision is made for the prevention of leakage of steam from the lantern-space *g'*, as we find that this leakage in some cases is practically negligible.

In most cases we prefer to form between groups of steps or groups of parallel collars lantern-spaces *z*, communicating with the lantern-spaces *g g'* in the gland-box in order to prevent a great difference of pressure between the sets of rings nearest the turbine-drum and the set most remote therefrom. These lantern-spaces are shown in the packings hereinbefore described with reference to Figs. 2 to 5. Several groups of conical steps, such as in the form shown in Fig. 4, may be employed, or we may use one or more conical groups in conjunction with one or more parallel groups of baffles with or without the intermediate lantern-spaces *z*.

It is to be understood that throughout the claims the term "collar" includes a ring fixed to the shaft or bushing.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A packing-gland for a rotating shaft, having in combination, a semicylindrical extension in the pressure-casing, a removable top cover, a split bushing carrying the packing-collars, packing-collars on the shafts and registering with the packing-bushing, substantially as described.

2. A packing-gland for rotating shafts having in combination, a fixed semicylindrical extension on the pressure-casing, a removable top cover, a split bushing having groups of packing rings or collars, packing rings or collars fixed to the shaft and registering with the packing rings or collars on the bushing, substantially as described.

3. A packing-gland for rotating shafts having in combination, conically-arranged collars on the shaft, a split bushing carrying packing-collars adapted to said conically-arranged collars, an inclosing box having a removable top thereto, substantially as and for the purpose described.

4. A packing for rotating shafts having in combination, groups of collars arranged in steps on the shaft, a split bushing carrying packing-collars, an inclosing box having a removable top thereto.

5. A packing-gland for rotating shafts having in combination, packing-collars arranged in groups, partly cylindrical in form and partly conical, a split bushing adapted to the collars on the shaft, a box inclosing the bushing and having a removable cover thereto, substantially as described.

6. A packing-gland for rotating shafts having in combination, a packing-gland box with a removable top cover, a split bushing within the box said split bushing having packing-collars thereon, packing-collars on the shaft, and means for longitudinally adjusting position of the split bushing, substantially as described.

7. A packing-gland for rotating shafts having in combination, a packing-gland box with

a removable cover, a split bushing within said box, groups of packing-collars arranged in steps, collars on the shaft adapted to the collars in said bushing, means for longitudinally adjusting the position of the bushing, the step of smallest diameter being toward the outer side of the gland and the other steps being progressively of larger diameter toward the inner side of the gland, substantially as described.

8. A packing-gland for rotating shafts having in combination, a packing-gland box with a removable cover, a split bushing carrying groups of packing-collars, groups of packing-collars on the shaft adapted to the packing-collars on the bushing, spaces between said groups, lantern-spaces *g* in the packing-gland box, holes in the split bushing at the spaces between the groups of packing, said holes communicating with the lantern-spaces.

9. A packing-gland for rotating shafts having in combination, a packing-gland box with removable cover, a split bushing, packing-collars on said bushing, packing-collars on the shafts, lantern-spaces *g* in the packing-gland box, a packing-gland *q* adapted to prevent leakage from said lantern-spaces, substantially as described.

10. A packing-gland for rotating shafts having in combination, a packing-gland box with removable cover, a split bushing, packing-collars on said bushing, packing-collars on the shafts, lantern-spaces *g* in the packing-gland box, a packing-gland *q* adapted to prevent leakage from said lantern-spaces, means

for longitudinally adjusting the split bushing.

11. A packing-gland for rotating shafts having in combination, a packing-gland box with removable cover, a split bushing, packing-collars on said bushing, packing-collars on the shafts, lantern-spaces *g* in the packing-gland box, a packing-gland *q* adapted to prevent leakage from said lantern-spaces, a ring externally fixed to the gland-box, a screwed ring engaging with a screw on the split bushing and working in a recess in the externally-fixed ring.

12. A packing-gland for rotating shafts having in combination, a packing-gland box with removable cover, a split bushing, packing-collars on said bushing, packing-collars on the shafts, lantern-spaces *g* in the packing-gland box, a packing-gland *q* adapted to prevent leakage from said lantern-spaces, a ring externally fixed to the gland-box, a screwed ring engaging with a screw on the split bushing and working in a recess in the externally-fixed ring, screws in the screwed ring adapted to exert an end pressure on the packing-gland *q*.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

CHARLES ALGERNON PARSONS.

HEWITSON HALL.

JOHN TURNBULL.

Witnesses:

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