

Nov. 20, 1945.

J. U. SIGNER ET AL

2,389,557

GEARING

Filed Aug. 25, 1943

2 Sheets-Sheet 1

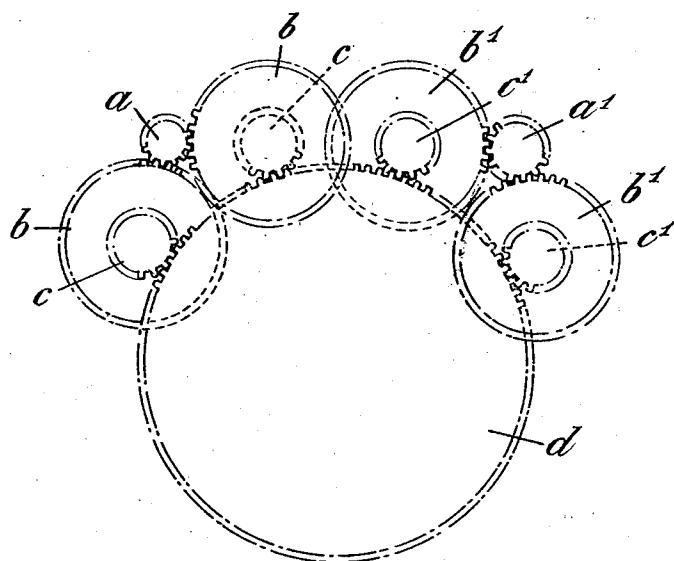


Fig. 1.

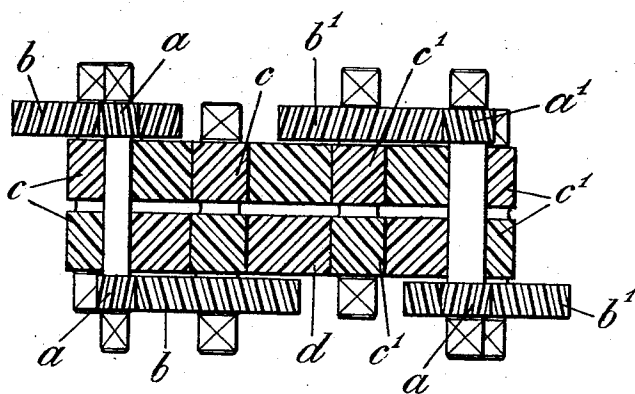


Fig. 2.

INVENTORS
JOHAN ULRICH SIGNER
LOUIS MORTIMER DOUGLAS

By *Clou J. Sawyer*
ATTORNEY

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2 Sheets-Sheet 2

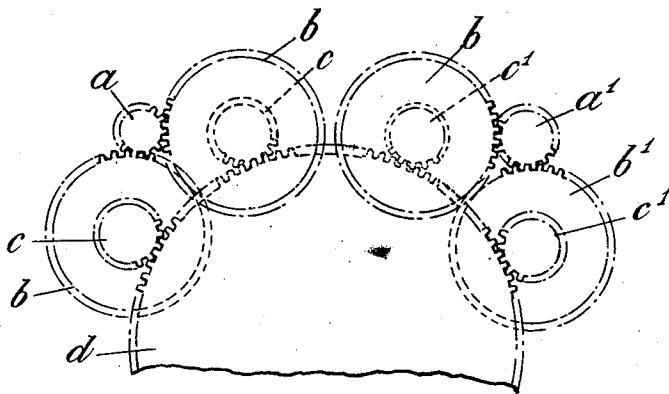


Fig. 3.

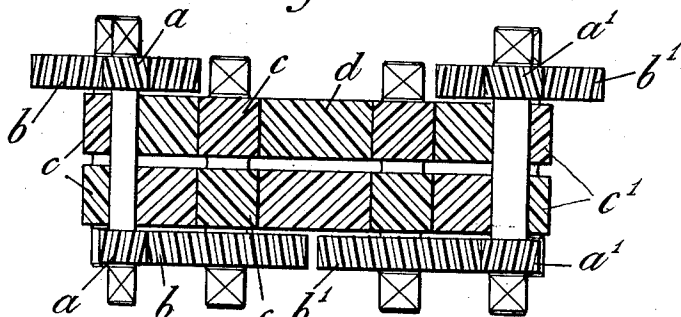


Fig. 4

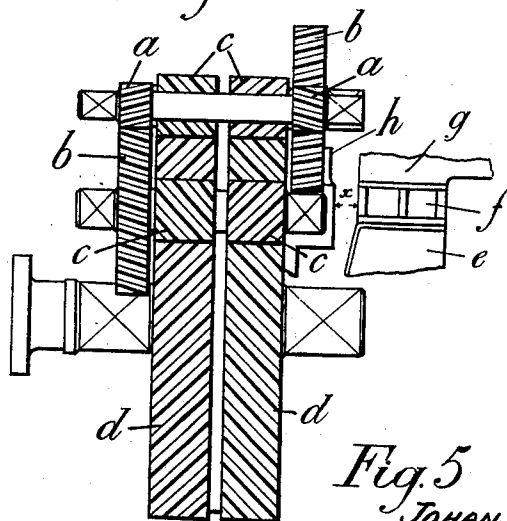


Fig. 5

INVENTORS

JOHAN ULRICH SIGNER

LOUIS MORTIMER DOUGLAS

By *Levon J. Dawzen*
ATTORNEY

UNITED STATES PATENT OFFICE

2,389,557

GEARING

Johan Ulrich Signer, West Hartlepool, and Louis Mortimer Douglas, Wallsend-on-Tyne, England, assignors to Richardsons, Westgarth & Company Limited, Wallsend-on-Tyne, England, and The Parsons Marine Steam Turbine Company Limited, Wallsend-on-Tyne, England

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In Great Britain August 19, 1942

7 Claims. (Cl. 74—410)

This invention relates to gearing and more particularly to gearing of the type known as double reduction gearing.

The state of the art is wholly or in part represented by British Patent Specifications Numbered 111,329, 116,531, 117,840, 120,257, 120,203 and 146,641.

In the usual type of double reduction gear, each primary pinion drives the secondary wheel through a single primary gear and secondary pinion. For example, in Figures 1 and 3 of British Patent No. 116,531 the primary pinion *b* drives the primary wheel *c* which is mounted on the same shaft as the secondary pinion *e* which drives the secondary wheel *f*.

With the object of reducing the weight and size of the gears, particularly of the large heavy secondary gear wheel, proposals have been made in which the primary pinion drives through two primary wheels each of which is associated with a secondary pinion so that the power transmitted per secondary pinion is only one half of that transmitted per secondary pinion of the usual design.

With such constructions, in order to ensure that the primary pinion is in proper contact with the teeth of, and drives equally through, each intermediate shaft and secondary pinion, it is necessary to have a very exact relative circumferential and longitudinal disposition of the teeth of the various interengaging members of the train and in order to maintain the equality of the drives despite inaccuracies in the gears, it is necessary to provide means for automatically accommodating such inaccuracies.

In British Patent No. 146,641, in addition to permanent adjustment in order to bring the teeth of both drives into contact initially, the primary pinion shaft is mounted in bearings which are free to move in such direction as to permit the primary pinion to move into position to drive the two primary gears equally.

The object of the present invention is to provide in gearing of the above described dual secondary drive type improved means for automatically accommodating inaccuracies of the gear teeth, not only those inherent in the gear but also those of a transient nature such as may be caused, for example, by differential thermal expansion.

The invention consists briefly in double reduction gearing of the general character indicated above wherein a primary driving shaft carrying two single helical driving pinions with their teeth oppositely inclined, thus forming a double helical primary driving pinion which drives a pair of single helical primary wheels on separate shafts individually engaged each by one of the helical portions of said pinion, and a secondary driving

pinion rigid with each of said primary wheels engages a common secondary wheel, said primary driving pinion preferably having axial freedom relatively to its associated primary wheels, and in various more specific features of the same.

Referring to the accompanying diagrammatic drawings:

Figure 1 is a front view of a turbine installation gearing;

Figure 2 is a plan thereof;

Figure 3 is a front view of a modified arrangement;

Figure 4 is a plan view thereof, and

Figure 5 is a side elevational view thereof.

In carrying the invention into effect in one form as illustrated by way of example in Figures 1 and 2 as applied to a turbine installation having an H. P. and L. P. turbine shaft coupled respectively to two primary shafts each carrying two single helical primary driving pinions with their teeth oppositely inclined, each primary single helical pinion driving one of two single helical driving wheels *b*, *b₁* on separate shafts. The shafts of these two primary wheels *b* *b₁* and *b₁* *b₁*. The shafts of these wheels carry secondary pinions *c*, *c₁* engaging a common secondary wheel *d*. Each primary wheel *b* *b₁* is single helical and is driven by one helix only of the double primary pinion *a* or *a₁* which is double helical.

The secondary gears are preferably double helical as shown but they may be straight spur or single helical. The double pinions *a* *a₁* have axial freedom, this being preferably attained by connecting them to their driving shafts through couplings which permits relative axial freedom.

With this construction, if the teeth of the two parts composing the double pinions have equal and opposite inclination, the axial forces on them must be equal, the pinion moving endwise if necessary to maintain axial equilibrium, and since the tangential forces must be proportional to the axial forces on the teeth the power transmission through each of the two drives of each double pinion must be equal.

The secondary gears *c*, *c₁*, *d* are disposed axially within the primary gears *a*, *a₁* and the secondary wheel *d* is preferably double helical with each secondary pinion *c*, *c₁* axially free. All the axial forces on a secondary pinion thus balance, and since the primary pinions *a*, *a₁* set up axial forces on the secondary pinions *c*, *c₁*, the axial forces on the secondary wheel must be to this extent unequal, with the result that the circumferential forces are also unequal and more power is transmitted through one helix of each of the secondary pinions *c*, *c₁* than through the other. In order to make this difference as small as possible, it is preferred to make the helical angle of the pri-

mary pinions a a_1 small and the angle of the secondary gears c c_1 d large so that the axial force set up by the primary gears is small in relation to the axial forces produced by the secondary gear engagement.

The invention is not limited to the above example. For instance, the two primary gear wheels associated with a primary pinion may be disposed axially at the same side of the secondary wheels.

An example of such an arrangement is illustrated in Figures 3-5 in which as regards each pair of primary wheels b b and b_1 b_1 , one is disposed in front and the other at the rear of the common secondary wheel d , the turbine being disposed in front and having its H. P. turbine shaft connected to primary pinion a a and L. P. turbine shaft connected to primary pinion a_1 a_1 .

This arrangement allows the primary wheels of each pair b b and b_1 b_1 to overlap one another in axial view and in addition enables the turbines to be brought close to the secondary wheel d . This is illustrated by a reference to Figure 5 in which one of the turbine seats e , packing block f , turbine cylinder foot g and gearcase h are shown, the dimension x indicating the clearance between the turbine cylinder foot and its seat and the nearest part of the gearcase, namely, the keep of the bearing for the secondary shafts carrying the lower primary wheels b b_1 .

If these primary wheels were disposed between the turbine and the gearing, the turbine would have to be moved considerably further away from the gearcase in order to avoid fouling and give a reasonable clearance such as x .

In both the examples described above, the centres of the primary pinions a a_1 and the secondary pinion c c_1 are disposed in the same horizontal plane. This simplifies the construction of the gearcase considerably in that it permits the portion forming the cover to these elements including wheels b and b_1 to have a plane horizontal joint in this plane, which also contains the joint of the bearings of pinions a a_1 c and c_1 .

In the above examples the helical angles of the primary and secondary gears are 15° and 45° respectively.

The invention provides a dual secondary drive with automatic accommodation not only for any inherent inaccuracies of the gear but also for those of a transient nature such as may be caused, for example, by differential thermal expansion, and the maintenance of the equality of the drives by the foregoing means of axial adjustment permits a simpler construction than those in which angular adjustment is employed.

We claim:

1. Double reduction gearing comprising a primary driving shaft carrying two single helical primary driving pinions with their teeth oppositely inclined, two separate shafts each carrying only a single primary wheel engaged by one of the respective single helical driving pinions, a secondary driving pinion rigid with each of said primary wheels, and a common secondary shaft carrying a secondary wheel engaging both of said secondary pinions, whereby self adjustment and axial equilibrium of said gearing is provided, said secondary driving pinions and common secondary wheel being arranged between the helical primary wheels with the primary driving shaft out of line with the secondary wheel.

2. Double reduction gearing as claimed in claim 1, in which the secondary pinions and secondary wheel are double helical.

3. Double reduction gearing as claimed in claim 1, in which the secondary pinions and secondary wheel are double helical and in which the helical angle of the primary pinions and primary wheels is made small relatively to that of the secondary pinions and secondary wheel to reduce the inequality in the power transmission through the secondary pinions to the secondary wheel.

4. Gearing as claimed in claim 1, with a plurality of sets of said primary shafts and separate shafts each carrying a primary wheel and said secondary pinions acting on the same secondary wheel.

5. Double reduction gearing comprising two primary driving shafts each carrying two single helical primary driving pinions with their teeth oppositely inclined, four separate shafts each only carrying a single primary wheel engaged by one of the respective single helical driving pinions, a secondary driving pinion rigid with each of said primary wheels, and a common secondary shaft carrying a secondary wheel engaging all of said secondary pinions, whereby self adjustment and axial equilibrium of said gearing is provided, said secondary driving pinions and common secondary wheel being arranged between the helical primary wheels with the primary driving shafts out of line with the secondary wheels, and in which the secondary pinions and secondary wheel are double helical and the helical angles of the primary pinions and primary wheels is made small relatively to that of the secondary pinions and common secondary wheel to reduce the inequality in the power transmission through the secondary pinions to the secondary wheel.

6. Double reduction gearing of the character indicated comprising two primary driving shafts each carrying two single helical primary driving pinions, four shafts carrying single helical primary wheels individually engaged each by one of the single helical primary driving pinions, a secondary driving pinion on each of the four shafts carrying said primary wheels and rigid with the primary wheels on said shaft, and a common secondary wheel engaged by all said secondary pinions, said secondary driving pinions and common secondary wheel being arranged between the helical primary wheels with the primary driving shaft out of line with the secondary wheel and the centers of all the primary pinions and one of each pair of the associated secondary pinions being disposed in the same plane.

7. Double reduction gearing of the character indicated comprising two primary driving shafts each carrying two single helical primary driving pinions, four shafts carrying single helical primary wheels individually engaged each by one of the single helical primary driving pinions, a secondary driving pinion on each of the shafts carrying said primary wheels and rigid with the primary wheels on said shaft, and a common secondary wheel engaged by all said secondary pinions, said secondary driving pinions and common secondary wheel being arranged between the helical primary wheels with the primary driving shaft out of line with the secondary wheel and the centers of all the primary pinions and associated secondary pinions being above the horizontal center line of the secondary wheel and the centers of all the primary pinions and one of each pair of the associated secondary pinions being disposed in the same horizontal plane.

JOHAN ULRICH SIGNER.
LOUIS MORTIMER DOUGLAS.