Nov. 18, 1924. 1,516,477

J. K. SCHOFIELD

LOST MOTION COMPENSATING MEANS FOR GEAR HOBBING MACHINES

Filed Oct. 14, 1922

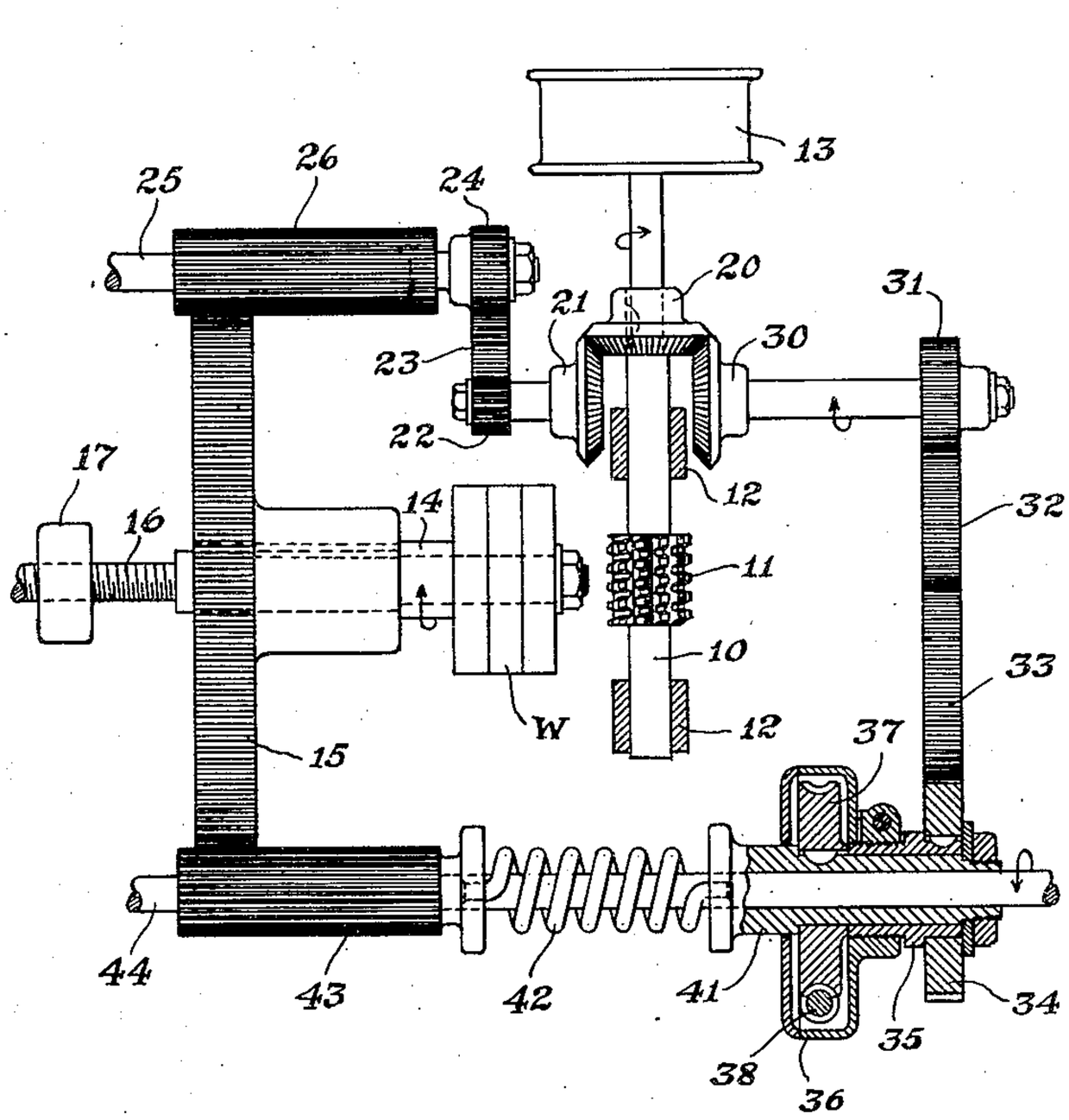
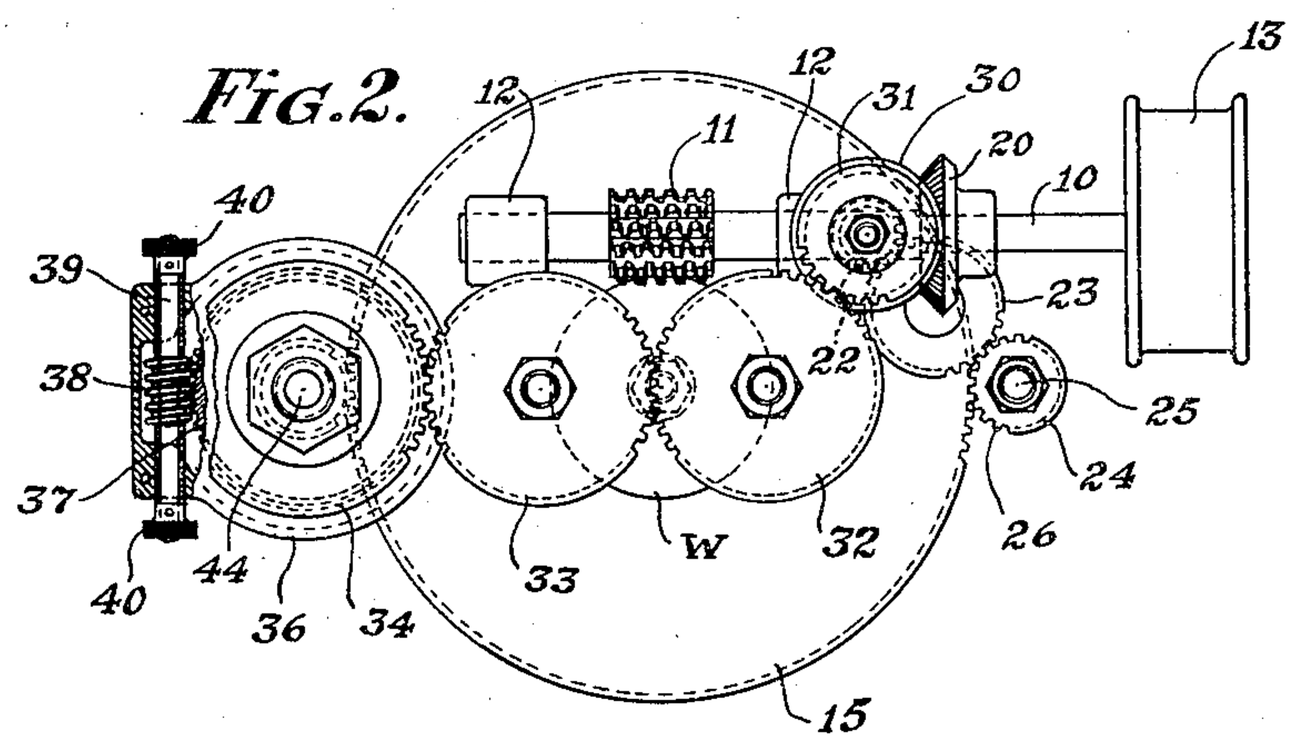


FIG. 1.

FIG. 2.



INVENTOR

Joseph K. Schofield

Patented Nov. 18, 1924. 1,516,477

UNITED STATES PATENT OFFICE.

JOSEPH K. SCHOFIELD, OF HARTFORD, CONNECTICUT, ASSIGNOR TO PRATT & WHITNEY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

LOST-MOTION-COMPENSATING MEANS FOR GEAR-HOBBING MACHINES.

Application filed October 14, 1922. Serial No. 594,566.

To all whom it may concern:

Be it known that I, JOSEPH K. SCHOFIELD, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Lost-Motion-Compensating Means for Gear-Hobbing Machines, of which the following is a specification.

This invention relates generally to gear hobbing machines and in particular to mechanism adapted to be applied to machines of this type whereby all lost motion or back lash between the members of the driving connections extending from the hob spindle to the work carrying spindle is entirely eliminated.

It is an object of the invention to provide a simple and inexpensive mechanism which will eliminate all inaccuracies in the hobbing operation due to lost motion or back lash between parts of the machine and provide a mechanism for this purpose which will not place a drag upon the work spindle.

One feature which enables me to accomplish the above named object is that I provide two driving connections from the hob spindle to the work supporting and rotating spindle, both of these connections comprising positive gear connections. One of these gear connections extends directly to the indexing mechanism on the work spindle while the other connection rotates one end of a torsional spring. The opposite end of the torsional spring is connected to a pinion also in mesh with the indexing mechanism. By these means timing of the work spindle is controlled entirely by the positive gear connections and the second gear connection, that is, the one including the torsional spring, tends by the resiliency of the torsional spring to force the work spindle as far advanced as possible. In this way, all of the lost motion or back lash of the parts in the positive driving connection is constantly held on the same side of the gear teeth. All possibility of lost motion in this gear connection causing inaccuracies in the work is eliminated.

More particularly, it is an object of the present invention to provide substitute means for the form of lost motion compensating means described and claimed in the copending applications filed by E. Buckingham, Serial No. 593,309 filed October 9, 1922, and Serial No. 594,150 filed October 12, 1922.

With these and other objects in view, my invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawing.

In the accompanying drawing annexed hereto and forming a part of this specification, I show diagrammatically a form of the cooperative mechanism of a gear hobbing machine provided with the present invention. It will be understood, however, that the invention can be otherwise embodied and that the drawing is not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawing:

Figure 1 is a diagrammatic plan view of the mechanism forming the present invention, and

Fig. 2 is a front elevation of the mechanism also shown diagrammatically.

In the above mentioned drawing, I have shown but one modification of the invention which is now deemed preferable but it is to be understood that changes and modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

Briefly, my invention in its broadest aspect comprises the following principal parts: first, a hob supporting and rotating spindle preferably provided with suitable driving means directly in alignment therewith; second, a work spindle adapted to rotate the work in timed relation to the rotation of the hob spindle and adapted simultaneously to advance the work axially past the hob; third, a geared driving connection extending from the hob spindle directly to the work supporting and rotating spindle; fourth, another set of gearing between the hob spindle and the work spindle which includes a torsional spring therein, the tension of which may be adjusted; and fifth, pinions, preferably elongated, forming the final driving elements of both gear connections and adapted to directly engage the indexing gear fastened directly to and moving axially with the work spindle.

Referring more in detail to the figures

of the drawing, at 10 is shown a hob spindle having a hob 11 of suitable form thereon. This hob spindle 10 is adapted to be rotated in bearings provided in the base or other part of the machine shown diagrammatically at 12, and be provided with a driving pulley as at 13. Disposed at right angles to the axis of the hob spindle is a work spindle 14 which also may be suitably supported in the base or other part of the machine so that it may be rotated and simultaneously advanced axially. In the preferred embodiment of the invention the axes of the hob and also the work spindle are fixed in predetermined angular relation. On this spindle 14 I provide an indexing gear 15 directly attached thereto. By any suitable fastening means, I mount gear blanks W which are adapted to have teeth cut therein by the hob 11, these gears W being mounted coaxially with the work spindle 14 in the usual way. In alignment with the work spindle 14 is a screw 16 engaging a threaded member 17 attached to or forming a part of the base of the machine. It will be seen from this construction that as the work spindle 14 is rotated, it will be simultaneously advanced in an axial direction by engagement of the screw 16 within the nut 17.

In order to rotate the work spindle 14 in timed relation to the rotation of the hob spindle 10 during the hobbing operation, I provide a positive geared driving connection between these two spindles. Preferably, a bevel gear 20 fixed to the hob spindle 10 is in mesh with another bevel gear 21 on a short intermediate shaft having a pinion or gear 22. In mesh with the gear 22 is an idler gear 23 which in turn engages with another gear 24. Preferably, gears 22 and 24 are arranged so that they may be conveniently removed and the idler 23 adjustably positioned so that it may be placed in engagement with both of them. The gear 24 is fixed to and drives a shaft 25 having an elongated pinion 26 thereon. This pinion 26 is adapted to engage directly with the teeth of the indexing gear 15 in all axial positions of the work spindle 14 and gear 15 during operation.

A second driving connection is provided between the hob spindle 10 and work spindle 14 which also may be driven from the bevel gear 20 directly mounted upon the hob spindle 10. This connection comprises a bevel gear 30 on a shaft having a gear 31 thereon which is in mesh with an intermediate gear 32. The gear 32 is in mesh with another intermediate gear 33 which engages a gear 34. The ratio of gears 31 and 34 is identical with the ratio of gears 22 and 24 respectively so that the gear 34 is rotated at exactly the same speed as the gear 24 and, as there are two intermediate gears between the gears 31 and 34 instead of but one as between the gears 22 and 24, the gear 34 rotates in the opposite direction as compared with gear 24. The gear 34 is mounted on a sleeve 35 which is provided with a small housing 36 enclosing a worm wheel 37 having a worm 38 in engagement therewith. The worm 38 is mounted upon a short transverse shaft 39 rotatably mounted in bearings provided in the housing 36. Knurled heads 40 on opposite ends of this worm shaft 39 provide means for rotating the worm 38 and the worm wheel 37 therewith. The worm wheel 37 is mounted upon an inner sleeve 41 coaxial with and extending through the first sleeve 35 and at one end of this sleeve 41, the end of a torsional spring 42 is permanently secured. A pinion 43, preferably in the form of a sleeve is mounted so as to engage the indexing wheel 15 above mentioned, and, at one end of this pinion gear 43, the opposite end of the torsional spring 42 is permanently secured. In order to keep the sleeves 35 and 41 in alignment with each other and with the pinion 43, I preferably provide a shaft 44 extending through the sleeve 41 and the pinion 43. It will be seen from the above description therefore that rotation of the gear 34 will rotate the second pinion 43 and, as the ratio between gears 31 and 34 is the same as between gears 22 and 24, the second pinion 43 is driven at exactly the same speed as the first pinion 26.

The above described means comprising the sleeve 35, the housing 36 and contained parts constitute means for varying the torsion applied to the spring 42. If desired, however, these parts may be omitted and the torsion of the spring 42 may be applied by slightly rotating one of the gears in the driving connection therefor while the other connections are held stationary.

The purpose for which the torsional spring 42 is inserted in the driving connections for the second pinion 43 is to resiliently force this pinion 43 rotatably as far as possible in order to firmly hold the indexing gear 15 in advanced position. I accomplish this by providing an initial torque between the gear 34 and pinion 43. This is accomplished by rotating the worm wheel 37 relative to its housing 36. By relative rotation of the housing 36 and worm wheel 37, any desired amount of torsion can be applied to this torsional spring 42. In operation it will be understood that the housing 36 and worm wheel 37 within this housing rotate simultaneously without relative movement so that the torsion of the spring 42 is not varied during operation except by variations in the back lash between the members of the driving connections 21 to 26.

It will be seen from the above described construction that the timed relation between rotation of the hob spindle 10 and the work spindle 14 is governed entirely by the first

driving connections including the gears 20 to 26 and that this ratio may be varied within wide limits by substituting gears of different numbers of teeth for the gears 22 and 24 shown. This change of ratio is, of course, necessary to accommodate the machine for hobbing gears of different numbers of teeth. The driving connection provided between gears 32 and 35 by reason of the interposition of the torsional spring 42, tends to rotate the pinion 43 and then the gear 15 as far as permitted by rotation of the pinion 26. The positive connections prevent the torsional spring 42 from unwinding and thus advancing the indexing wheel 15 beyond its proper position. The indexing gear 15, however, is always held as far advanced as permitted by this positively driven pinion and thus all lost motion or back lash between the members of the positive driving train is continuously held on the same side of the teeth. In this way all lost motion or back lash between these members during operation does not in any way affect the precision of operation of the mechanism.

What I claim is:

1. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob spindle and work spindle, two driving connections between said spindles, the ratio of said driving connections being the same, and means to force one of said driving connections in advance of the other to eliminate the effects of lost motion between members of the driving connections.

2. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob spindle and work spindle, two driving connections between said spindles, the ratio of said driving connections being the same, and a torsional spring inserted in one of said connections.

3. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob spindle and work spindle, two driving connections between said spindles, the ratio of said driving connections being the same, a torsional spring inserted in one of said connections, and means to vary the torsion of said spring.

4. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob spindle and work spindle, two geared driving connections between said spindles, the ratio of said driving connections being the same, and a torsional spring inserted in one of said connections.

5. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob spindle and work spindle, two driving connections between said spindles, the ratio of said driving connections being the same, and resilient means inserted in one of said connections to advance one of the driving connections as far as permitted by the other connection.

6. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means for comprising a second spindle, a hob thereon, driving means for said hob spindle and work spindle, two driving connections between said spindles, the ratio of said driving connections being the same, and a torsional spring inserted in one of said connections to advance one of the driving connections as far as permitted by the other connection.

7. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob disposed in alignment therewith, and two driving connections from said hob driving means to said work spindle whereby said hob and spindle may be rotated in timed relation to each other, one of said connections being positive throughout and the other adapted to be forced in advance of the other to eliminate the effects of lost motion between members of the driving connections.

8. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob disposed in alignment therewith, and two driving connections from said hob driving means to said work spindle whereby said hob and spindle may be rotated in timed relation to each other, one of said connections being positive throughout and the other including a resilient element adapted to force said spindle as far advanced as permitted by said first connection.

9. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob disposed in alignment therewith, and two driving connections from said hob driving means to said work spindle whereby

said hob and spindle may be rotated in timed relation to each other, one of said connections being positive throughout, and the other including a resilient element adapted to force said spindle as far advanced as permitted by said first connection, and means to vary the torsion of said resilient element.

10. A gear hobbing machine having cooperating mechanism comprising, a work supporting and rotating spindle, a rotatable hob supporting means comprising a second spindle, a hob thereon, driving means for said hob disposed in alignment therewith, and two driving connections from said hob driving means to said work spindle whereby said hob and spindle may be rotated in timed relation to each other, one of said connections being positive throughout and the other including a torsional spring adapted to force said spindle as far advanced as permitted by said first connection, and worm and worm wheel mechanism to vary the torsion of said spring.

In testimony whereof, I hereto affix my signature.

JOSEPH K. SCHOFIELD.