To all whom it may concern:

Be it known that I, WILLIAM E. HOKE, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Methods of Making Gears, of which the following is a specification.

My invention relates to a method of making gears and has for its object the provision of a method by which may be made accurately shaped gears internal or external, of hardened or unhardened metal, all the gears being of identical configuration within any desired degree of accuracy.

The method employed is based on the principles described in my application 252,073 filed Aug. 30, 1918.

The method will be understood from the accompanying description and drawings in which Figs. 1 is a sectional elevation showing a lapping spur gear in mesh with the internal gear which is being lapped.

Fig. 2 is a sectional elevation on a plane at right angles to the plane of Fig. 1 and on a smaller scale.

As is well understood an external gear will mesh properly with an internal gear provided it has a number of teeth less by two or more than the number of teeth on the internal gear.

Accordingly if it is desired to accurately shape the teeth of an internal gear, particularly such as are made of hardened steel or iron, I assemble a number of such hardened internal gear blanks A in contact side by side and preferably contained in a holder, B, in the form of a sleeve or other device that insures their being held in concentric relation.

I also provide a long external gear C of cast iron or other suitable metal, having accurately formed tooth surfaces of the same pitch as those to be formed on the internal gear teeth.

Except for mathematically accurate work, the lapping gear need not be of high accuracy, as the system of symmetrical distribution of errors, as herein described, produces gear teeth of equal spacing and correct curves, more than sufficient for commercial purposes.

This lapping gear is, by any of the usual methods, charged with a suitable abrasive, and is of less diameter and has a smaller number of teeth than the internal gear. The lapping gear is then inserted into and its teeth brought into mesh with the teeth of the internal gears and held in contact therewith by any suitable pressure means. The containing sleeve or other device having been locked by any appropriate means, the lapping is effected, a suitable lubricant being used, by reciprocating the stack of internal gears endwise and at the same time slowly revolving them about the lapping gear, which is also mounted to rotate. The intermeshed gears are kept in lapping engagement by the application of suitable pressure, either by gravity or by spring pressure. After a suitable period of grinding in this first relation, the container is unlocked and the internal gears may then be turned into a relatively different position to each other, so that other teeth are matched. The operation is then repeated as often as may be necessary. From time to time the relative positions of the internal gears in the stack or row are also changed and they are also reversed side for side.

By this repeated turning, interchanging of position and side-for-side reversal in combination with the lapping action due to the longitudinal reciprocation and relative rotation of the intermeshed gears, the teeth of the internal gears are provided with surfaces which are of accurate curvature, which are accurately spaced, concentric with the axis of the gear and perpendicular to the faces of the disks and adapted to mesh properly with any external gear having a less number of teeth of the same pitch. And each gear is exactly identical with every other gear of the series.

It is obvious that this method might be reversed by using an internal gear having precisely shaped tooth surfaces as the lapping means for producing accurate teeth on a hardened steel external gear, and either method is included within the scope of my claims.

It is also apparent that the stack or row of blanks might be held stationary and the lapping gear be reciprocated, or that both might be reciprocated, during the rotation.

Nor is my invention limited to the production of precision gear teeth, as other forms of symmetrical corrugations either external or internal may be produced by application of the same principle of operation.

As the gears, whether internal or external, have hardened teeth of precise shape, they
are available not only for use as gears, but
as punches or dies for forming gears either.

The same principle of operation may also
be applied to spiral or helical gears, either
external or internal.

The terms “lap” and “lapping” are in-
tended to include not only abrading with
surfaces charged with abrasive, but also.
other abrading action.

I claim:
1. The method of making gears which
consists in lapping a series of gear blanks
by means of an intermeshed gear shaped lap,
the lapping operation comprising repeated
change in the position of the blanks relative
to each other and to the lapping gear, and
also relative longitudinal and rotative move-
ments of the blanks and lapping gear.

2. The method of making gears which
consists in lapping a series of gear blanks
by means of an intermeshed gear shaped lap,
the lapping operation comprising repeated
inter-changing of the blanks of the series,
reversal of the blanks side for side, and also
relative longitudinal and rotative move-
ments of the blanks and lapping gear.

3. The method of making gears which
consists in lapping a series of gear blanks by
means of an intermeshed gear shaped lap,
the lapping operation comprising repeated
inter-changing of the position of the blanks
in the series, and turning of the blanks into
different relative positions.

4. The method as claimed in claim 1, in
which the blanks are internal gears and the
lapping gear is a spur gear.

5. The method as claimed in claim 2 in
which the blanks are internal gears and the
lapping gear is an external gear.

6. The method as claimed in claim 3 in
which the blanks are internal gears and the
lapping gear is an external gear.

7. The method of making an internal gear
of hard metal which consists in lapping the
tooth surfaces thereof into accurate config-
uration by means of an external gear lap
having accurately formed teeth and charged
with abrasive, held in yielding engagement
with the internal gear, and imparting to
said gear and lap relative rotative and longi-
tudinal movement.

8. The method of finishing gears which
consists in intermeshing a number of gears
to be finished with a gear of accurate form,
one gear or set of gears having internal
teeth and the other set of gears or gear hav-
ing external teeth, and imparting to said
intermeshed gears while in yielding engage-
ment and under abrading conditions, rela-
tive rotative and longitudinal movement.

In testimony whereof I affix my signa-
ture.

WILLIAM E. HOKE.