

Sept. 1, 1936.

F. H. CHEYNE

2,053,130

SPEED TRANSFORMER

Filed July 11, 1934

4 Sheets-Sheet 1

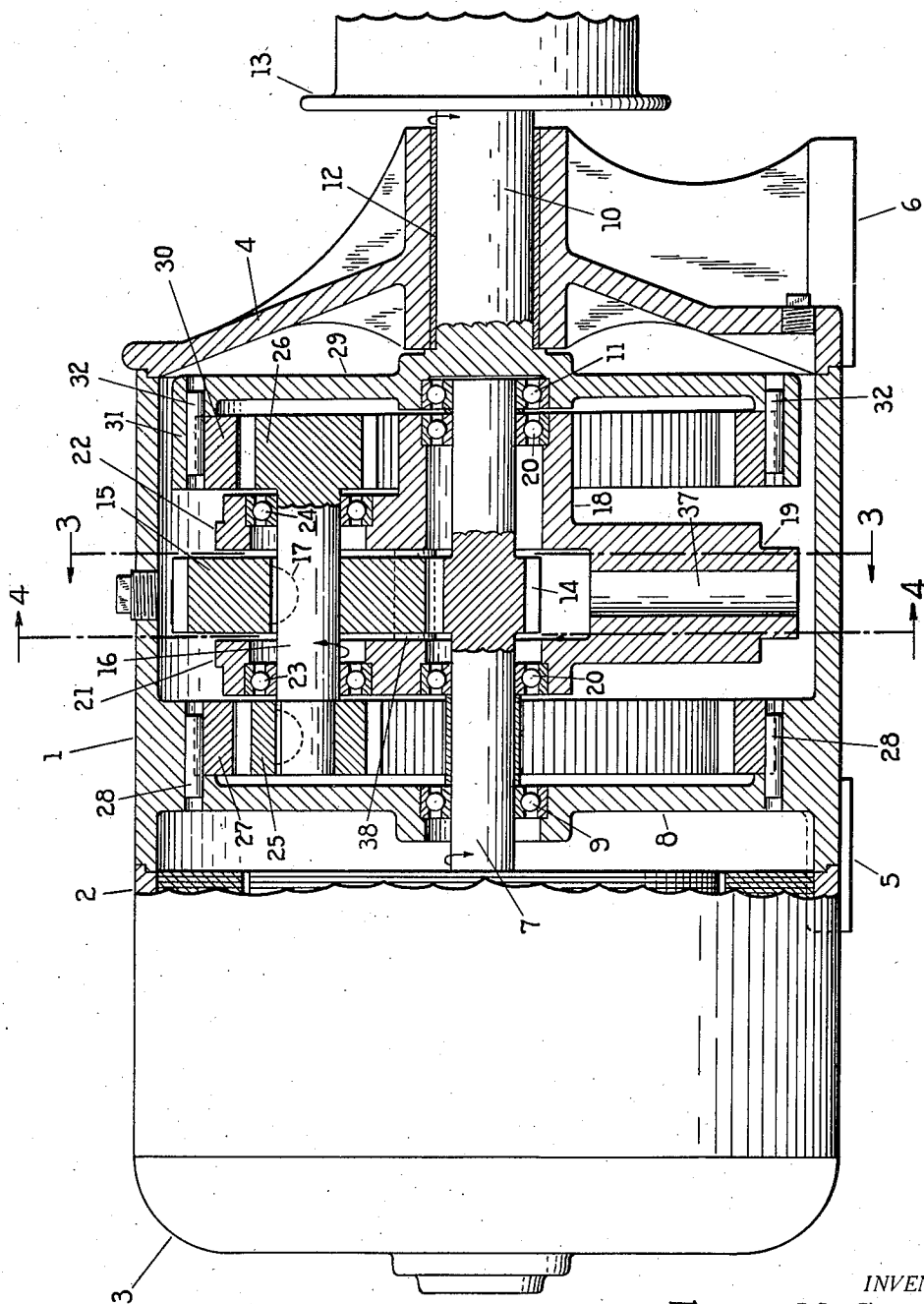


FIG. 1

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4 Sheets-Sheet 2

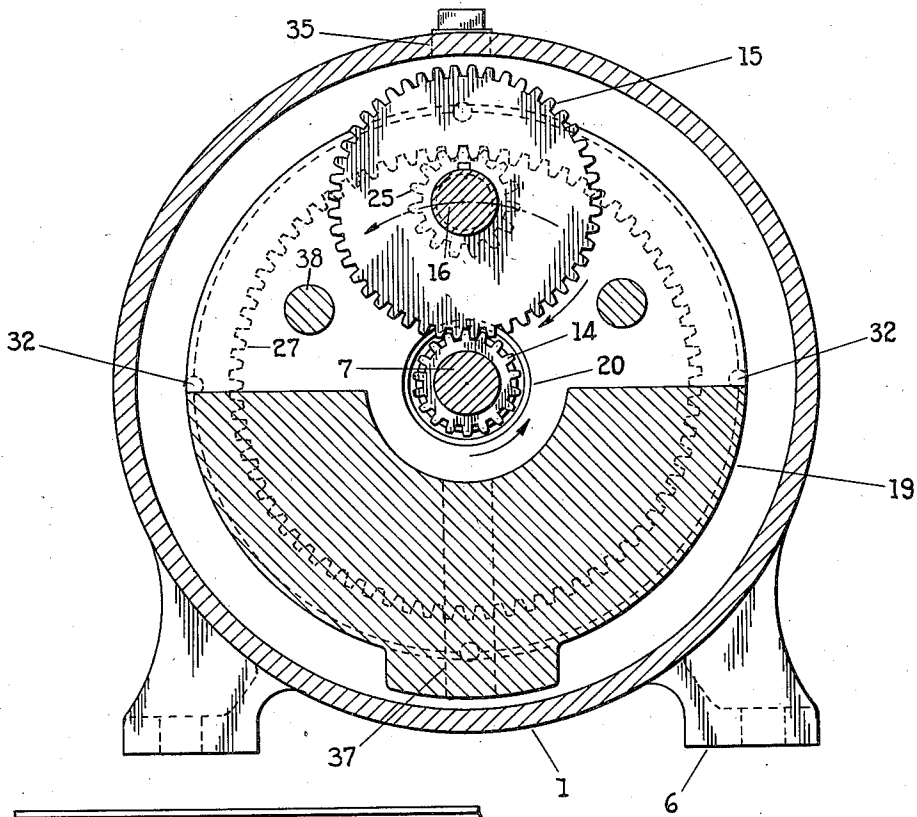


FIG. 2

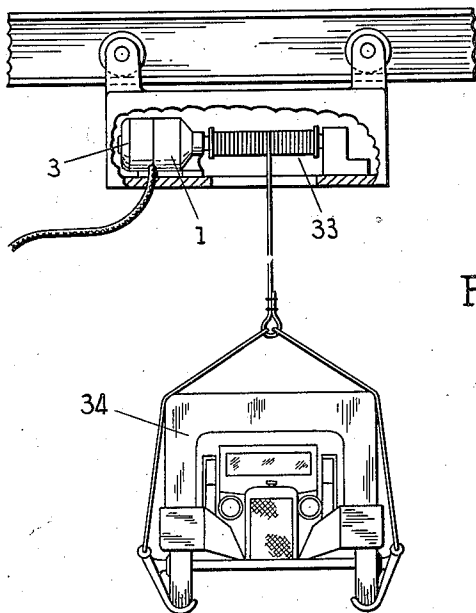


FIG. 4

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4 Sheets-Sheet 3

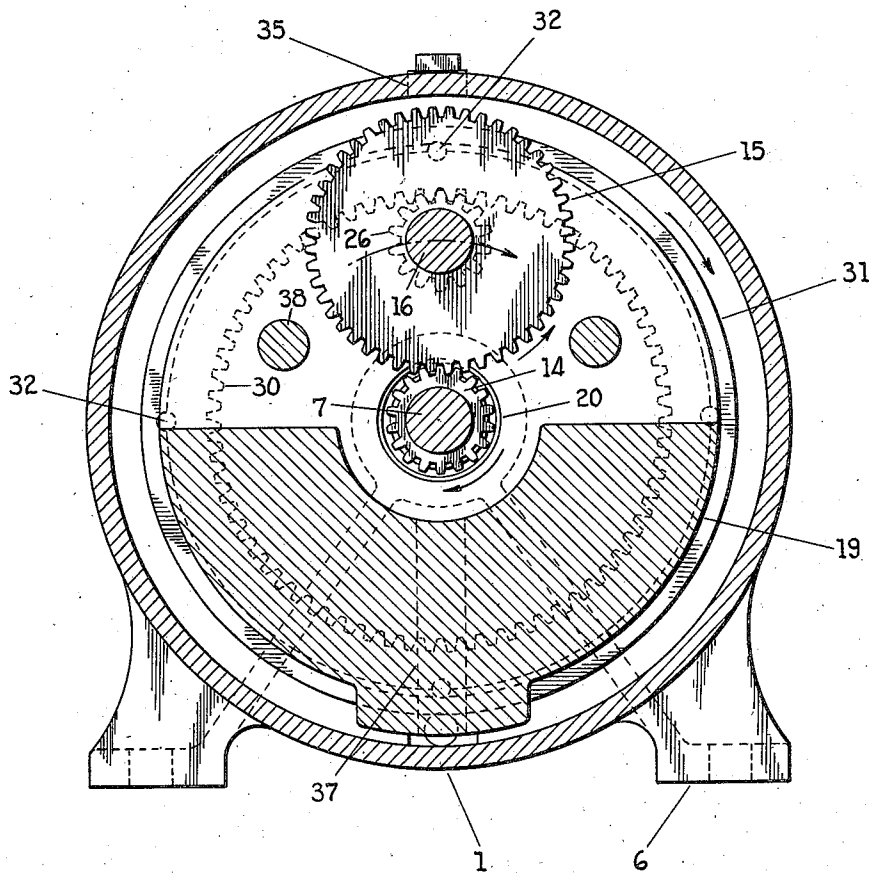


FIG. 3

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4 Sheets-Sheet 4

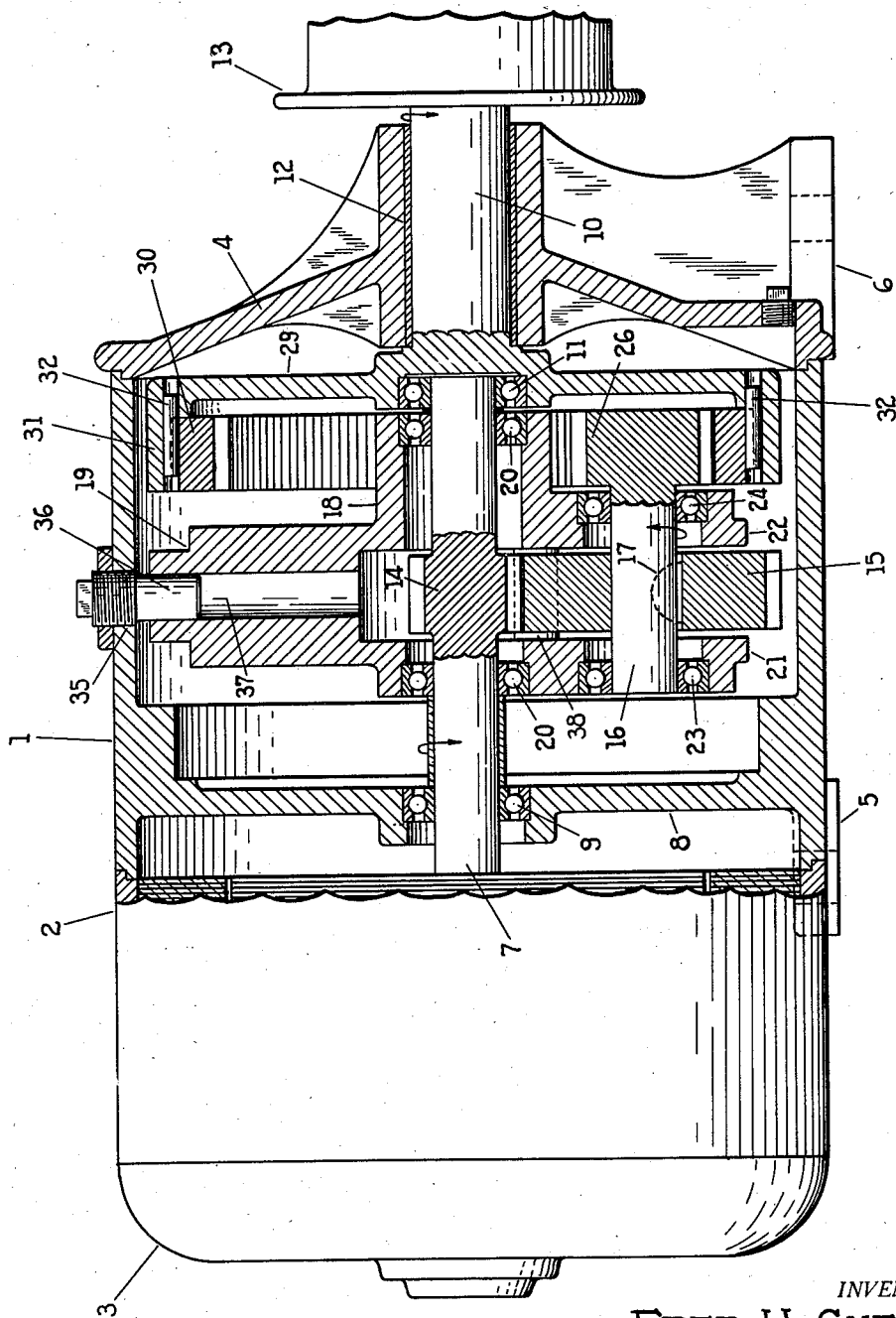


FIG. 5

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UNITED STATES PATENT OFFICE

2,053,130

SPEED TRANSFORMER

Fred H. Cheyne, Indianapolis, Ind.

Application July 11, 1934, Serial No. 734,601

2 Claims. (Cl. 74-305)

The invention is a speed transformer especially adapted to the extreme gearing down of rotary motion; and the invention resides substantially in the construction, combination and arrangement of elements hereinafter pointed out and recited more particularly in the claims.

It is a primary object of the invention to provide a means for transmitting motion from the rotary shaft of a prime mover to a co-axially aligned shaft, at any desired lower speed than the speed of the prime mover.

It is a further primary object to provide a device of this class which is self-locking, and which cannot rotate or be rotated except by motion transmitted from the power receiving end of the device.

It is a further object to provide a device of this class which may be readily converted to an ordinary speed reduction mechanism as desired.

The above and other objects are attained by the mechanisms illustrated in the accompanying drawings in which:

Figure 1 is a fragmentary elevation and partly a longitudinal section of the device embodied unitarily with an electric motor;

Fig. 2 is a cross-section taken in the proximity of line 3-3 of Figure 1;

Fig. 3 is a cross-section taken in the proximity of line 4-4 of Figure 1;

Fig. 4 is a fragmentary view of the device, drawn to a considerably smaller scale, and is shown in use as a traveling self-locking hoist; and

Fig. 5 is a fragmentary section similar to Figure 1, and illustrates a converted form of the invention.

Similar characters of reference designate similar parts throughout the different views.

The numeral 1 designates a cylindrical enclosure for the gearing, one end of said enclosure co-joining the housing 2 of the electric motor 3 and the other end being closed by the journaling head 4; the apparatus as an entirety being supported by feet 5 formed on the motor end of the enclosure 1 and corresponding feet 6 formed on said journaling head. The gear end of the drive shaft 7 of said motor is journaled through the web 8 which is formed across the motor end of the enclosure 1, the bearing 9 being provided to receive said shaft. Said shaft extends through said enclosure almost to the head 4, the extreme gear end of said shaft being journaled to the inner end of the output shaft 10 by the bearing 11; said output shaft being journaled through the head 4 by the bearing 12 which is embodied in said

head. Said output shaft extends beyond the journal 12, exteriorly of the device as an entirety, the exposed end thereof being conveniently provided with the driving pulley 13.

The sun gear 14 is a spur gear concentrically mounted on the shaft 7 at a substantially central position of the case 1, and in this example of the invention is integral with shaft. Said sun gear meshes with the planetary gear 15 which is mounted on the planetary shaft 16 and which is conveniently locked from independent rotation by the key 17.

The hub 18 of the carrier wheel 19, is journaled at each end on the shaft 7, through the bearings 20, which are disposed on said shaft on opposite sides of the gear 14, the inner or motor end of said hub being spaced from the web 8. Said carrier wheel is dually formed from one side of said hub and provides the two parallel half-discs 21 and 22, between which the planetary spur gear 15 is disposed in meshed relation with the sun gear 14, said planetary gear being mounted upon the planetary shaft 16 which is journaled through the half-discs 21 and 22 by the bearings 23 and 24, respectively, by which arrangement it will be understood that said planetary gear is rotatable by the motor 3, through the motor shaft 7 and sun gear 14.

The ends of the planetary shaft 16 extend beyond the bearings 23 and 24, respectively, the crawl gear 25 and the driving pinion gear 26, being mounted on different ends of said shaft beyond the half-discs 21 and 22, respectively; the crawl gear 25 being secured to said shaft similarly to the planetary gear 15, and the gear 26 in the particular example being formed integrally on said shaft. The crawl gear 25 meshes with the stationary internal gear 27 which is fitted in the female gear seat of the enclosure 1, and is secured therein by the pins 28.

On the enclosure end of the output shaft 10, the disc 29 is formed and the crawl gear 26, meshes with the internal gear 30, which is fitted in the female gear seat formed on the rim 31 of said disc and is secured therein by the pins 32.

The stationary internal gear 27, and the rotatable internal gear 30, are concentrically positioned in relation to the motor shaft 7, and said rotatable internal gear is rotatable with the shaft 10 and disc 29.

The total number of teeth on the gear 25 and gear 27, is greater than the total number of teeth on gear 26 and the gear 30, consequently the gear 30 will advance each revolution of the carrier wheel 19 a fraction of one revolution, said frac-

tion being determined by the difference in fractional ratio between the gear 25 and the gear 27 as related to the fractional ratio between the gear 26 and the gear 30.

5 In the example shown the speed of the motor shaft 7 is 1725 revolutions per minute, the sun gear 14 has eighteen teeth and the planetary gear 15 has forty-eight teeth. The crawl gear 25 has fifteen teeth and the fixed internal gear 27 has
10 seventy teeth. The carrier wheel 19 will therefore be pulled around by said crawl gear in its engagement with said fixed internal gear, the fractional number of 1725 revolutions per minute determined by the ratio of the planetary gear 15
15 to the sun gear 14 multiplied by the ratio of the crawl gear 25 to the fixed internal gear 27; being 138.616 times per minute.

During one cycle movement of the carrier wheel 19 through its orbit about the axial center of the
20 shaft the crawl gear 25 is revolved in the fixed internal gear 27, 4.666 times, and the planetary driving gear 26 being revolved a corresponding number of times and having fourteen teeth works 65.24 teeth of the rotatable internal gear 30 which
25 has sixty-nine teeth, therefore leaving 3.76 teeth unworked during each revolution of said carrier wheel, which will cause the internal rotatable gear 30 to advance 3.76 teeth each revolution of the crawl gear 25 through its orbit. The output
30 shaft 10 is therefore revolved 7.366 revolutions per minute.

If the motor 3 is stopped intentionally or otherwise, the output shaft 10 is self locked in any position. For example in embodying the device
35 with a hoisting drum means 33 which is directly driven by the output shaft 10, as in Fig. 5, the motor may stop or be stopped at any stage during the lifting of any weight such as the automobile 34.

40 The device is self-locking as considered at the output end. Assuming that power were applied at the drum or pulley 13 in the reverse direction as considered in Figure 1, it would tend to revolve the rotatable internal gear 30 counter clockwise
45 as considered in Fig. 4. This would tend to revolve the planetary driving gear 26 also in a counter clockwise direction; which would cause the carrier wheel 19 to rotate also in counter clockwise direction about the shaft 7. But since the
50 crawl gear 25 would likewise rotate in a counter clockwise direction about the shaft 16 it would tend to pull the inner end of the shaft 16 in a clockwise orbit or reverse direction from the outer end, due to the fact that the fixed internal gear
55 27 is stationary. It will be obvious that when rotative force is applied to the output shaft 10 in a clockwise direction as considered in Fig. 4, the crawl gear 25, by engagement with the fixed internal gear 27, tends to pull the inner end of the
60 shaft 16 around counter-clockwise in its orbit and opposite to the tended orbit movement of the driving gear 26. Thus it is obvious that the engaging teeth, of the crawl gear 25 and the fixed internal gear 27, and the engaging teeth of the planetary
65 driving gear 26 and the rotatable internal gear 30 act as a key to lock the device in either direction at the output end.

The carrier wheel 19 is centrifugally balanced together with planetary shaft 16, the planetary
70 gear 15, the crawl gear 25, and the driving pinion 26, thus providing an efficient, quiet and steady running mechanism.

In constructing the invention for a rotary direction reversing device as well as a reduction
75 means the total number of teeth of the rotatable

internal gear 30 and the driving pinion gear 26 is greater than the total number of teeth of the fixed internal gear 27 and the crawl gear 25, under which arrangement all of the teeth of said rotatable gear will be worked and the first worked
5 teeth of said rotatable gear will be again worked by said pinion gear during one revolution of the carrier wheel 19, and said rotatable gear will be revolved the amount of teeth again worked in the direction opposite the rotation of said carrier
10 wheel.

It will be obvious that in substituting slightly different sets of gears for the sets illustrated that widely different ratios of reduction are attained.

The invention is converted to a device of more
15 ordinary speed reduction by constructing same without the fixed internal gear 27 or crawl gear 25, the dowel 35 being threaded through the corresponding hole 36, in the wall structure of enclosure 1, into engagement with the dowel hole
20 37, in the carrier wheel 19, under which usage a simple speed reduction is attained from the motor shaft 7 through the sun gear 14, the planetary gear 15, the pinion gear 26, and the rotatable internal gear 30, the carrier wheel being held from
25 rotation by the dowel 35.

Reenforcing tie rods 38, each engage both the half-discs 21 and 22, adding to the rigidity of the carrier wheel 19, said rods being suitably located in said carrier wheel to clear the sun gear 14 and
30 the planetary gear 15.

In constructing the device the diametrical pitch of the different gears is determined by selecting sets of gears of the same axial spacing. In other words the distance from the axial center of the
35 crawl gear 25 to the axial center of the stationary internal gear 27 is identical with the distance between the axial center of the planetary gear 15 to the axial center of the sun gear 14, as well as the distance from the axial center of the driving pinion 26 to the axial center of the rotatable internal gear 30.
40

It will be obvious that the invention may be constructed with two or more planetary shafts 16, journaled through the half discs 21 and 22, each
45 planetary shaft having a crawl gear 25 meshing with the fixed internal gear 27 and a planetary gear 26 meshing with the rotatable gear 30, all of said planetary shafts operating in unison.

An important feature of the invention resides
50 in the fact that by substituting gears of different ratio for the planetary gear 26 and rotatable gear 30, and/or fixed internal gear 27 and crawl gear 25 the ratio of reduction in speed between the motor shaft 7 and the output shaft 10 may be
55 changed as desired.

With the object in view of providing a quiet and smooth running device the carrier wheel 19 with the planetary gear 15, the shaft 16, crawl gear 25, and planetary pinion 26, are together constructed
60 as a centrifugally operating unit.

While the description and drawings illustrate in a general way a certain manner of carrying the invention into effect, it is obvious that many modifications may be made in the various details
65 without departing from the scope of the appended claims, it being understood that the invention is not restricted to the particular example herein shown.

The invention claimed is:

70 1. A speed transformer comprising a rotary power receiving shaft, a carrier wheel pivoted co-axially with said shaft, a sun gear carried on said shaft in operating position, a planetary shaft pivoted through said carrier wheel parallel to said
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power receiving shaft, a planetary gear mounted on said planetary shaft in meshed relation with said sun gear, a crawl gear mounted on said planetary shaft, a fixed removable gear concentrically mounted with regard to said power receiving shaft, said fixed gear being in meshed relation with said crawl gear, a driving gear on said planetary shaft, a rotatable gear in meshed relation with said other gear, said rotatable gear being connected to a power output means, and a means to lock said carrier wheel against rotation when said fixed gear is removed, said means to lock causing rotation of said rotatable gear through said sun gear, said planetary gear and said driving gear.

2. A speed transformer comprising a rotary power receiving shaft, a carrier wheel pivoted coaxially with said shaft, a sun gear carried on said

shaft in operating position, a planetary shaft pivoted through said carrier wheel parallel to said power receiving shaft, a planetary gear mounted on said planetary shaft in meshed relation with said sun gear, a crawl gear mounted on said planetary shaft, a fixed gear concentrically mounted with regard to said power receiving shaft, said fixed gear being in meshed relation with said crawl gear, a driving gear removably mounted on said planetary shaft, a rotatable gear in meshed relation with said other gear, said rotatable gear being removably connected to a power output means; whereby gears of other size may be substituted for said rotatable gear and said driving gear in changing the reduction ratio of the transformer.

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