

June 24, 1947.

E. F. SMALL

2,422,933

GEAR DRIVE

Filed Aug. 25, 1944

3 Sheets-Sheet 1

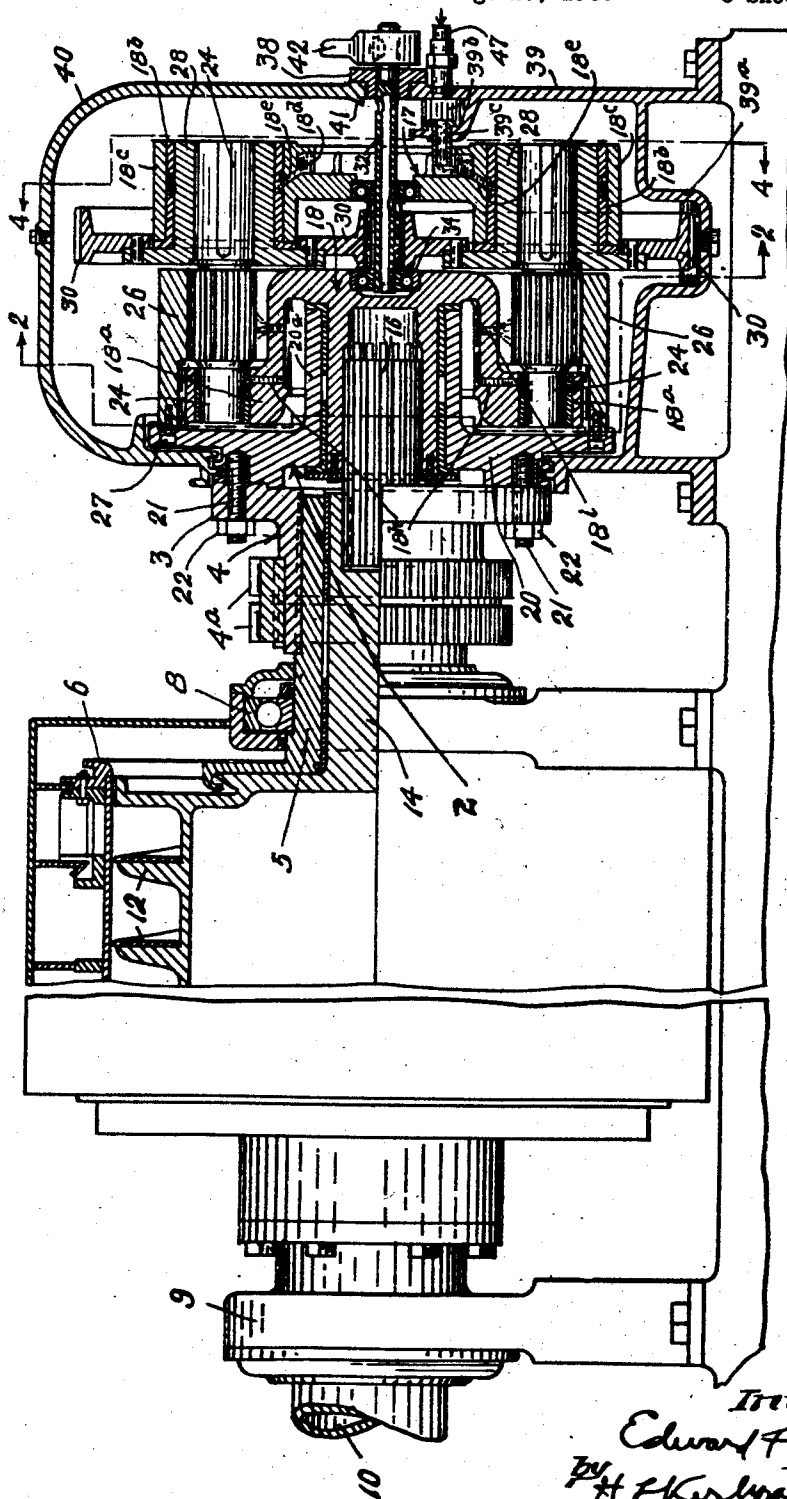


Fig. 1.

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3 Sheets-Sheet 2

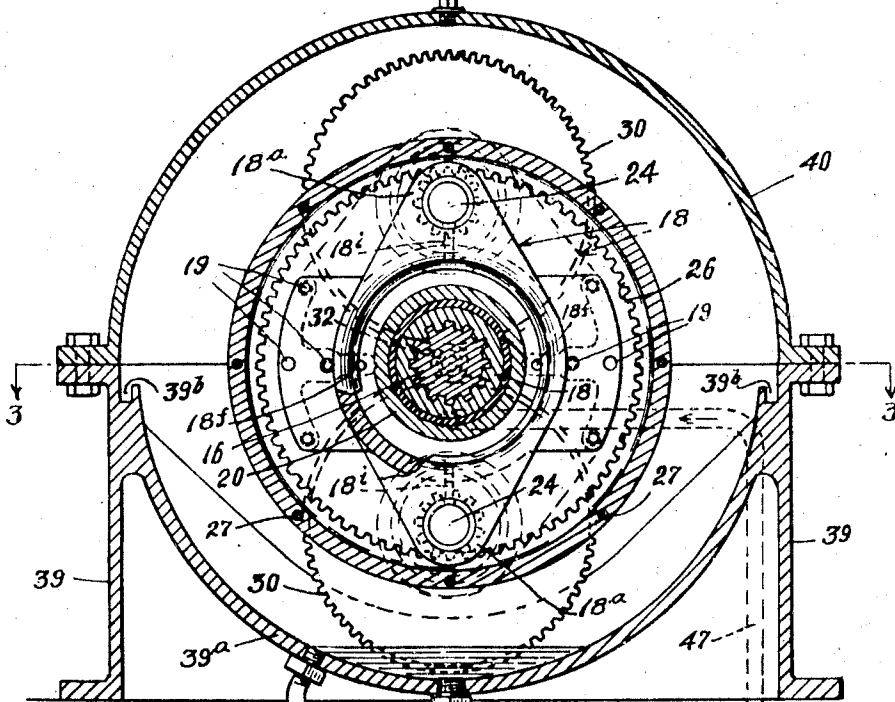


Fig. 2.

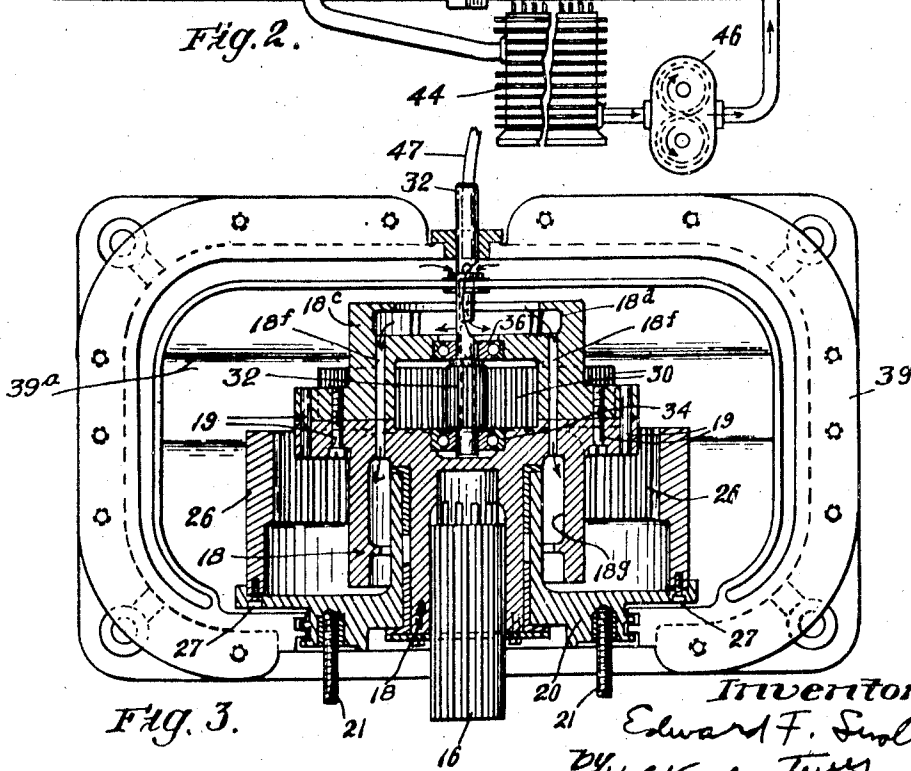


Fig. 3.

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3 Sheets-Sheet 3

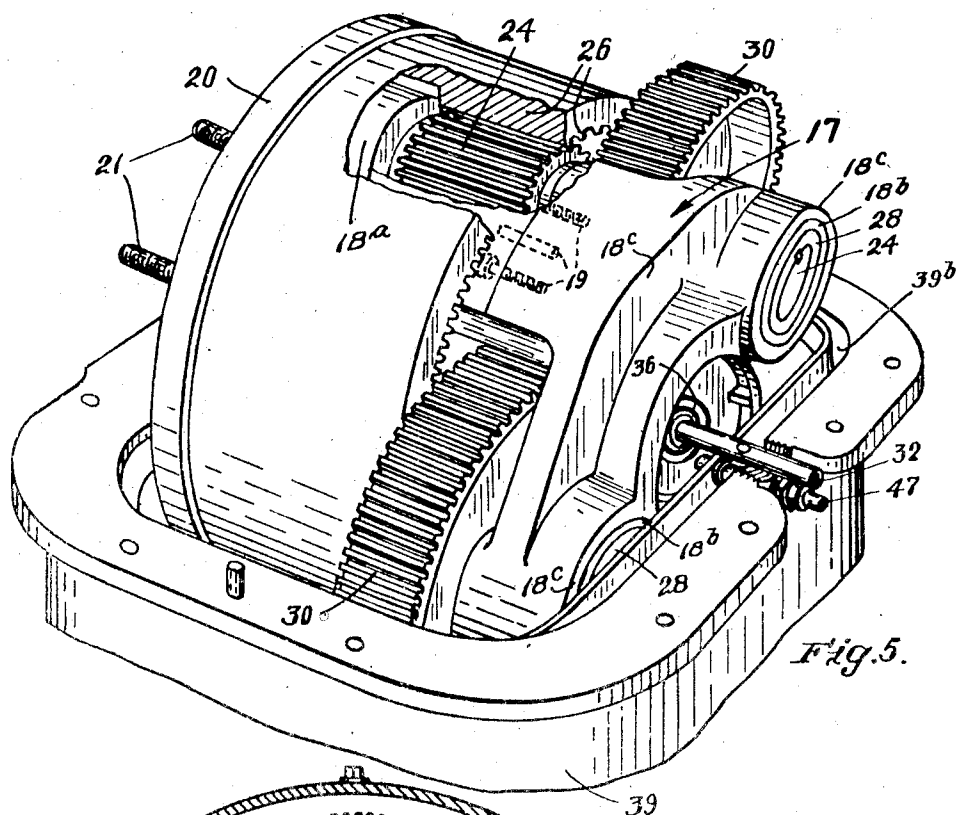


Fig. 5.

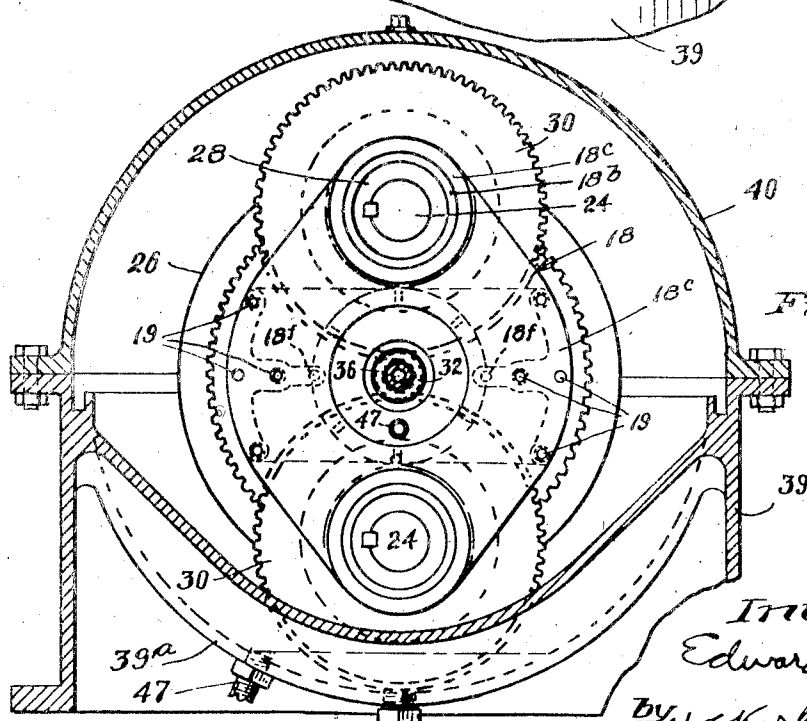


Fig. 4.

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UNITED STATES PATENT OFFICE

2,422,933

GEAR DRIVE

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10 Claims. (Cl. 74—305)

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This invention relates to an improved positive-gear drive for rotating two different elements of the same machine in the same direction but at a differential speed of said two elements. The invention is particularly useful in connection with various types of apparatus for treatment of materials, for example, centrifugal and grinding apparatus. The invention is described in connection with a centrifuge having a high-speed rotating centrifugal drum and a rotating conveyer therein between which elements there are potential power and energy losses dependent upon the difference in relative speeds, and the character and load of material being treated by the machine. The object of the present invention is to minimize such losses by the improved device, as hereinafter described, and which also presents various other substantial mechanical and operational advantages including reduced overhung weight, fewer working parts, and improved support, balance, and reduced weight of rotating parts, including in combination with said device a novel lubrication system—all directed to more efficient performance and easier operation and maintenance of the machine.

A preferred embodiment of the invention is illustrated in the drawings wherein—

Fig. 1 is a view, partly in side elevation and partly in longitudinal cross-section, showing the drive as applied to a typical centrifuge;

Fig. 2 is a transverse cross-section taken on line 2—2 of Fig. 1 with certain additional parts of the lubrication system being shown therebelow in elevation;

Fig. 3 is a horizontal cross-section of the drive taken on line 3—3 of Fig. 2;

Fig. 4 is a further vertical transverse cross-section taken on line 4—4 of Fig. 1, and

Fig. 5 is an isometric view of the drive (with top portion of the gear housing removed) having certain parts broken away for clarity.

Referring to the drawings, in which like numerals represent like parts, and particularly to Fig. 1 thereof, the drive, generally designated 2, is connected to and supported by the flange 3 of a hollow driving shaft 4 and drum shaft 5, connected to a rotatable centrifuge drum 6 mounted in supporting bearings 8 and 9 through the latter of which projects a hollow shaft 10 by which the centrifuge is internally supplied with fluid material to be treated therein (the material exits not being shown). In effect, the members 3, 4 and 5 function as though in one piece. Within the drum 6 is a conveyer member 12, carried within and mounted for rotation with respect thereto, as shown in Fig. 1.

The internal shaft 14, by which the conveyer 12 is rotated, extends to the right where it is connected by a short, externally-splined stub-shaft 16 to a gear cage 18 rotatably mounted

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within the central bearing portion 20a of the flanged member 20, which is, in turn, affixed as by studs 21 and nuts 22 to the supporting and driving flange 3 of the hollow driving shaft 4, as shown. It will be seen from Fig. 1 that the flanged member 20 thus carries (through the members 3, 4 and 5), cantilever fashion, all moving parts of the drive beginning with the cage 18 and its wing portions 18a, which carry, rotatably mounted therein, the two pinion-gear shafts 24, the gear pinions of which mesh with the internal gear 26 affixed to the radially extending flanged member 20, as by cap screws 27 (shown in Figs. 1 and 3). To the right-hand end of each pinion-gear shaft 24 is keyed (as shown) for rotation therewith a flanged gear-carrying member 28 rotatably mounted within bearing shells 18b of the two wings 18c carried by the gear cage extension 17 (Figs. 1 and 5) which is affixed by dowels and cap screws 19 to and rotated by the cage 18 as if said cage extension 17 were an integral part of the cage 18. Affixed to the flange of each rotatably mounted member 28 is a gear 30, each gear 30 meshing with a normally fixed central pinion-gear and shaft 32 carried in roller bearings 34 and 36, respectively, the shaft 32 extending to the right (Fig. 1) through a stuffing-box bearing 38 mounted in the horizontally, longitudinally-split stationary gear housing made up of a lower half 39 and an upper half 40, both provided with a labyrinth (as shown in Figs. 1 and 3) to prevent the escape of oil and the ingress of foreign matter from around the rotating periphery of the flanged member 20.

The right-hand end of the shaft 32 (Fig. 1) is normally held in fixed (non-rotating) position to the housing or elsewhere, by any suitable means, for example, by an externally held locking member 42 (not fully shown) with a suitable, easily sheared key or pin connection with the shaft 32 as a safety feature. From the foregoing, it will be seen that the cage 18 and flanged member 20 carrying its internal gear member 26 rotate about the common axis so as to provide a gear reduction between the drum-driving shaft 4 and the conveyer-driving shaft 14, power being applied to the shaft 4 by silent chain or belt drive means (not shown) through toothed sprocket members or sheaves 4a keyed to the shaft 4 (Fig. 1).

It will also be seen from the foregoing that the rotating parts in size and number have been cut to the minimum by way of reducing loads in both driving and accelerating the same, and that the rotating parts are all such as to be readily susceptible of accurate manufacture and balancing, all conducive to smooth running with minimum amount of vibration and power absorbed.

The lubrication of the drive may be accomplished by a built-in combined splash and circu-

latory system as shown so that all rotating parts of the drive receive oil through said system which embodies a sump 39a (Fig. 2) in which a quantity of oil is maintained at a suitable minimum level, being drawn from the sump through a combined oil storage tank (of substantial capacity) and oil cooler unit 44 by a conventional gear-oil-pump 46 from which the oil is forced through the feed pipe 47, as shown in Fig. 2, and fed to a channel 38b within and near the upper portion of the housing 39. The channel 38b thus receives oil from the pipe 47 and also catches and conducts oil splashed onto the inside walls of the upper half 40 of the gear drive housing and thus, with or without the oil fed through the feed line 47, supplies oil through the short pipe 39c leading from the channel 38b into the rotating right-hand end of the cage 18 where it is retained at a suitable level in an annular channel 18d by an annular lip with short transverse members dividing the channel into separate compartments, as shown in Figs. 1 and 3, the oil being held therein by centrifugal force due to the rotation of the cage 18. An oil-pressure head, for example, of the order of 15-20/p. s. i., may be provided in the device as shown when rotated say at 1400 R. P. M., affording ample oil pressure for lubrication. Oil under such suitable pressure is thus separately supplied from one of said compartments to each one of the two channels 18e and, in turn, to the bearings 18b at the right-hand end of the cage 18 (Fig. 1) and is fed to the bearings of the two pinion-gear shafts 24 at the opposite end of the cage 18 through separate channels 18f extending from the respective compartments of the annular channel 18d (see Fig. 3) to a second annular channel 18g wherein the oil is likewise held at a suitable level by a lip, as shown, the oil being fed from said channel 18g through radially extending oil passages 18h to the respective left-hand ends or bearings (Fig. 1) of the shafts 24. The separate compartments and oil passages leading therefrom, respectively, thus insure a more nearly uniform feed of oil to the respective bearings and gears. Oil is also directly supplied to the pinion-gears of the shaft 24 from the channel 18g through the passages 18i, as shown in Fig. 1.

In addition, oil may be supplied to the roller bearings 34 and 36 mounted to the shaft 32 through the hollow bore of shaft 32 with radial holes opposite the respective bearings 34 and 36 into which bore the oil is fed by gravity from an overhanging lip 41 (Fig. 1) on the upper half of the stationary housing, the oil being fed from said lip to the hollow bore through a radial hole in the normally fixed shaft 32.

It will be seen from the foregoing that the device will function by splash (due to gears 30 swinging through the oil sump 39a) to adequately lubricate all bearings of the drive with or without the operation of the pump 46, thus providing a safety factor for possible oil pump failure. Also, the oil pressure is the same at the normal operating speed whether or not the oil pump functions due to the centrifugal oil-pressure feature of the rotating gear cage.

It will also be evident from the structure of the drawings that the overhung, i. e. cantilever-supported, weight of the drive is much reduced by the provision of the horizontally-split stationary gear housing and that there is no difficulty in oil retention since the housing itself is not under oil pressure, but, instead, simply serves to contain oil thrown from the gearing and return it to the centrifugal oil-pressure system. Furthermore,

the split housing facilitates inspection, cleaning, and proper mechanical maintenance of the gearing by simply removal of the top half thereof, as well as providing a guard for the moving parts preventing contact with and/or possible failure and escape of parts or fragments due to centrifugal force at high speed rotation, commonly of the order of 1000 to 2000 R. P. M.

In accordance with the above description, it will be appreciated by those skilled in the art that I have provided a novel, improved, though simple, drive for rotating apparatus, for example, centrifuges, and that said drive when properly dynamically balanced, will afford highly efficient and trouble-free operation for the purpose intended.

Having described my invention, I claim:

1. A device of the class described, having in combination two concentric shaft elements one outside the other adapted and connected to be driven at different speeds from a single source of power directly applied to the outer one only of said elements, a gear cage wholly supported by and rotatably mounted upon one of said elements but connected to rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit, and gearing means connecting said stub shafts and the other of said elements, each of said stub shafts being geared to a central fixed shaft.

2. A device of the class described, having in combination two concentric shaft elements, one outside the other adapted and connected to be driven at different speeds from a common source of power directly applied to the outer one only of said elements, a gear cage wholly supported from and geared to one of said elements but directly connected to rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit and provide the gearing connection with said element supporting said cage, and gears affixed to and carried by said stub shafts, a central normally fixed shaft having a pinion-gear meshing with each of said gears carried by said stub shafts.

3. A device of the class described, having in combination two concentric shaft elements, one outside the other adapted and connected to be driven at different speeds from a single source of power directly applied to the outer one only of said elements, a gear cage supported from and positively geared to an internal gear carried by one of said elements but directly connected to rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit with each of said pinion-gears meshing with said internal gear, a central normally fixed shaft, and gearing means connecting said stub shafts and said normally fixed shaft.

4. A device of the class described, having in combination two concentric shaft elements one outside the other adapted and connected to be driven at different speeds from a single source of power directly applied to the outer one only of said elements, a gear cage directly connected to rotate directly one of said elements but wholly supported by the other of said elements, pinion-gear stub shafts carried by said gear cage in

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parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit, gearing means connecting said stub shafts and the other of said elements, each of said stub shafts being geared to a central fixed shaft axially aligned with said concentric shaft elements, and an oil-tight independently supported stationary housing for said gear cage, stub shafts and gearing means.

5. A device of the class described, having in combination two concentric shaft elements one outside the other adapted and connected to be driven at different speeds from a single source of power directly applied to the outer one only of said elements, a gear cage wholly supported by one of said elements but connected to rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit, gearing means connecting said stub shafts and the other of said elements, each of said stub shafts being geared to a central fixed shaft, and an oil-tight stationary housing for said gear cage, stub shafts and gearing means.

6. A device of the class described, having in combination two concentric shaft elements one outside the other adapted and connected to be driven at different speeds from a common source of power directly applied to the outer one only of said elements, a gear cage supported from and geared to one of said elements but directly connected to rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit and provide the gearing connection with said element supporting said cage, gears affixed to and carried by said stub shafts, a central normally fixed shaft having a pinion-gear meshing with each of said gears carried by said stub shafts, and an oil-tight independently supported stationary housing for said gear cage, stub shafts and gearing means.

7. A device of the class described, having in combination two concentric shaft elements one outside the other adapted and connected to be driven at different speeds from a single source of power directly applied to the outer one only of said elements, a gear cage positively geared to an internal gear carried by one of said elements but directly connected to rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit with each of said pinion-gears meshing with said internal gear, a central normally fixed shaft, gearing means connecting said stub shaft and said normally fixed shaft, and an oil-tight independently supported stationary housing for said gear cage, stub shafts and gearing means.

8. A device of the class described, having in combination two concentric shaft elements one outside the other adapted and connected to be driven at different speeds from a single source of power directly applied to the outer one only of said elements, a gear cage supported from and positively geared to an internal gear carried by one of said elements but directly connected to

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rotate directly the other of said elements, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit with each of said pinion-gears meshing with said internal gear, a central normally fixed shaft, gearing means connecting said stub shafts and said normally fixed shaft, and an oil-tight independently supported stationary housing for said gear cage, stub shafts and gearing means.

9. A device of the class described, having in combination two concentric shaft elements adapted and connected to be driven at different speeds from a single source of power directly applied to one only of said elements, a gear cage directly connected to rotate with one of said elements, said gear cage having an internal channel for receiving oil and holding oil therein by centrifugal force and means to supply oil to said channel, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit, gearing means connecting said stub shafts and the other of said elements, each of said stub shafts being geared to a central fixed shaft axially aligned with said concentric shaft elements, an oil-tight stationary housing for said gear cage, stub shafts and gearing means, and conduits supplying oil under pressure from said channel to said stub shafts and gearing means.

10. A device of the class described, having in combination two concentric shaft elements adapted and connected to be driven at different speeds from a single source of power directly applied to one only of said elements, a gear cage supported by one of said elements but connected to rotate with the other of said elements, said gear cage having an internal channel for receiving oil and holding oil therein by centrifugal force and means to supply oil to said channel, pinion-gear stub shafts carried by said gear cage in parallel relation to but spaced from the common axis of said concentric shaft elements so as to rotate bodily in an orbit, gearing means connecting said stub shafts and the other of said elements, each of said stub shafts being geared to a central fixed shaft, an oil-tight stationary housing for said gear cage, stub shafts and gearing means, and conduits supplying oil under pressure from said channel to said stub shafts and gearing means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,217,427	Fast	Feb. 27, 1917
1,225,360	Royce	May 8, 1917
1,350,522	Royce	Aug. 24, 1920
1,470,947	Tyler	Oct. 16, 1923
1,963,461	Piper	June 12, 1934
2,190,254	Caproni	Feb. 13, 1940

FOREIGN PATENTS

Number	Country	Date
411,965	Great Britain	June 21, 1934