March 27, 1951 D. F. PRZYBYLSKI 2,546,869

VARIABLE-SPEED REDUCTION UNIT

Filed Oct. 13, 1948 6 Sheets-Sheet 1

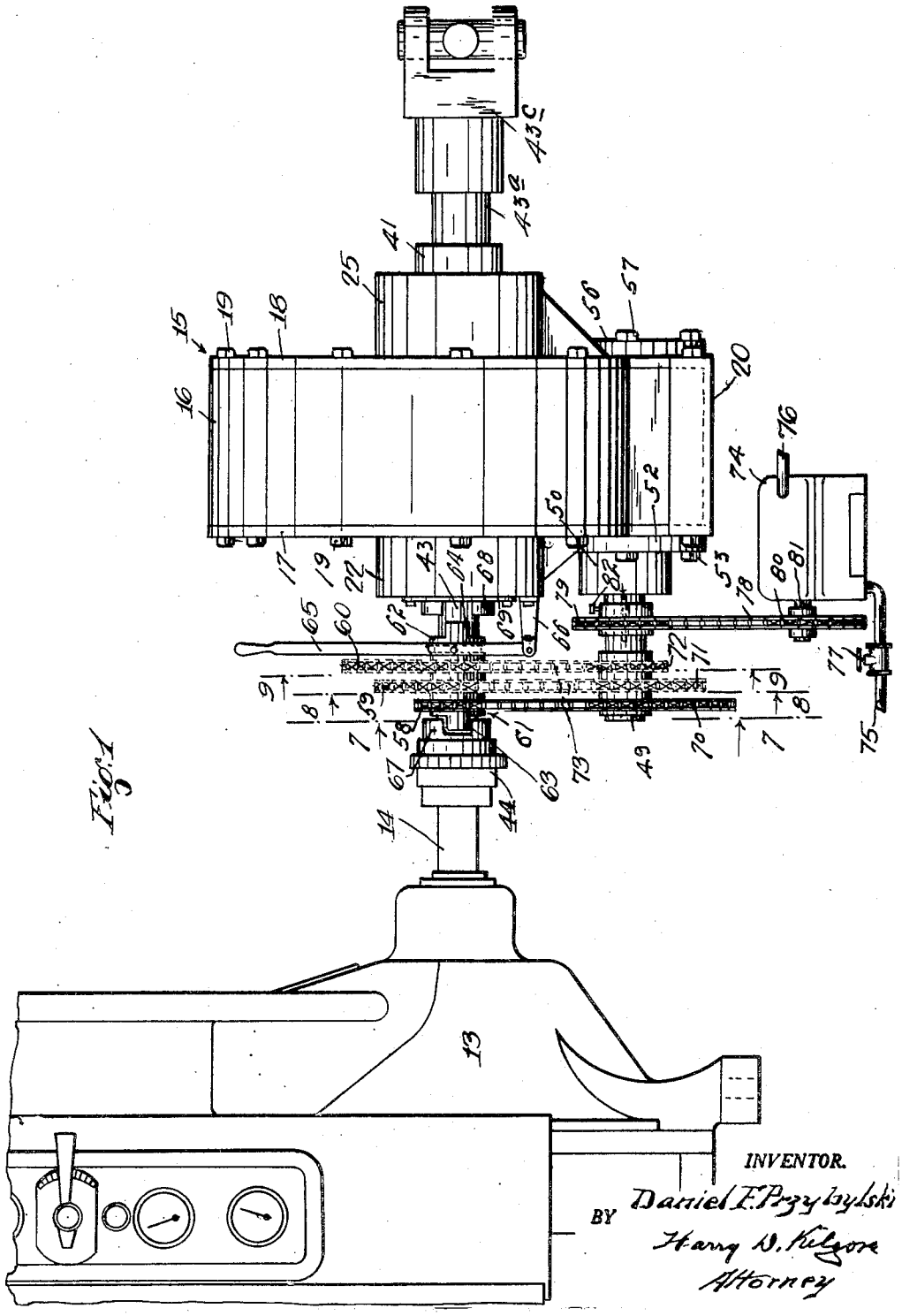


Fig. 1

INVENTOR.

BY Daniel F. Przybylski

Harry D. Kilgore

Attorney

March 27, 1951 D. F. PRZYBYLSKI 2,546,869

VARIABLE-SPEED REDUCTION UNIT

Filed Oct. 13, 1948 6 Sheets-Sheet 2

Fig. 2

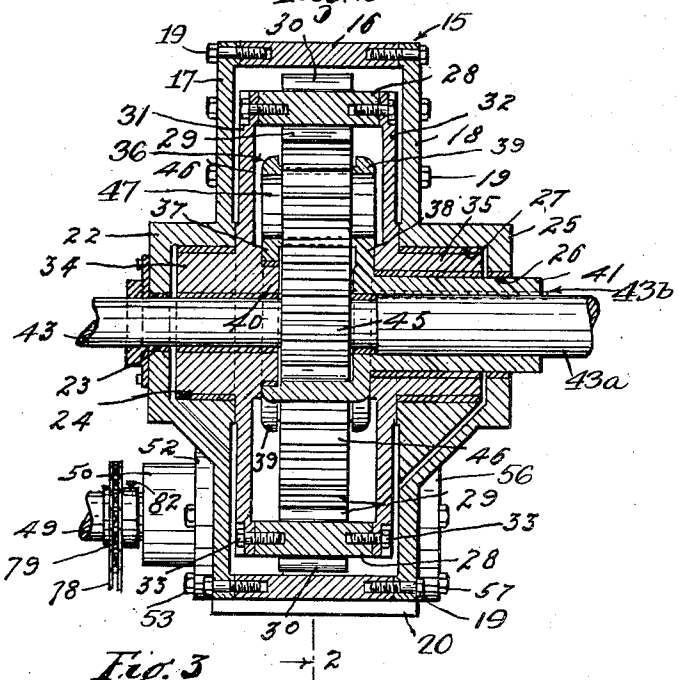
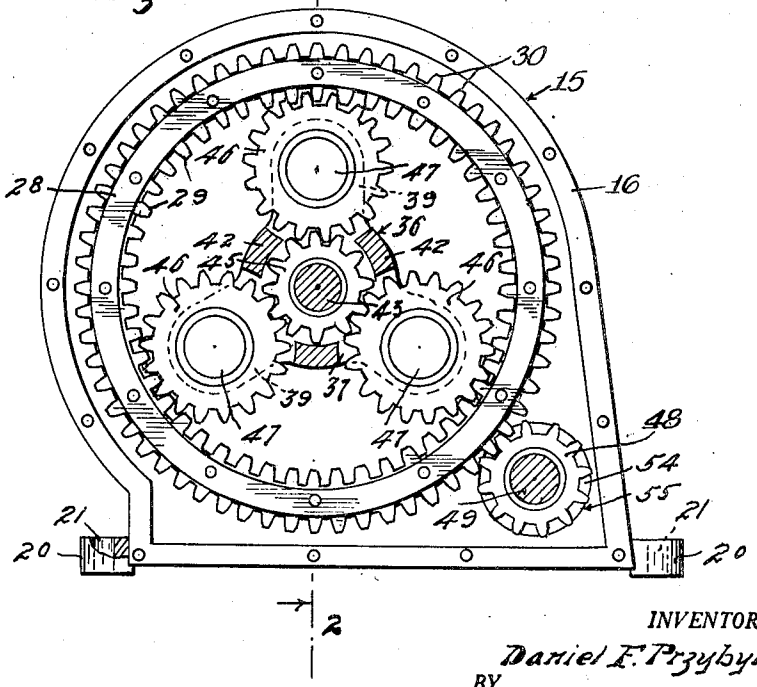


Fig. 3



INVENTOR.
Daniel F. Przybylski
BY
Harry D. Kilgore
Attorney

March 27, 1951 D. F. PRZYBYLSKI 2,546,869

VARIABLE-SPEED REDUCTION UNIT

Filed Oct. 13, 1948 6 Sheets-Sheet 3

Fig. 9

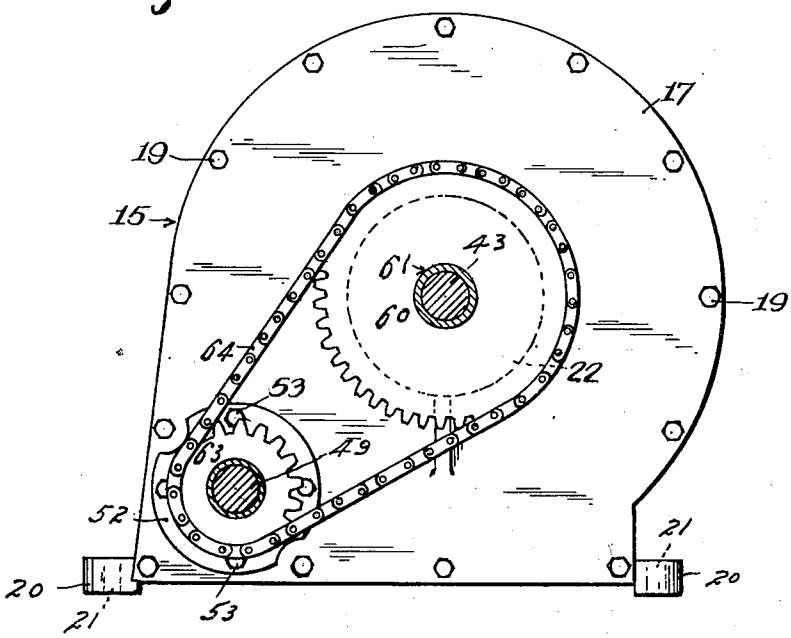


Fig. 4.

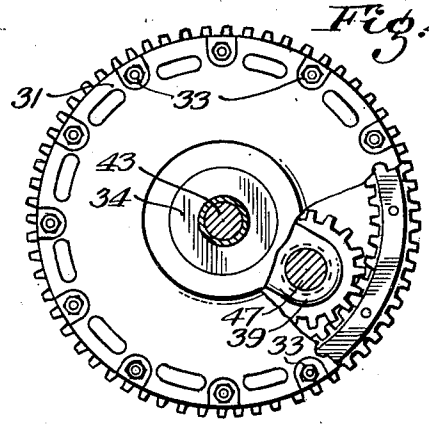


Fig. 5.

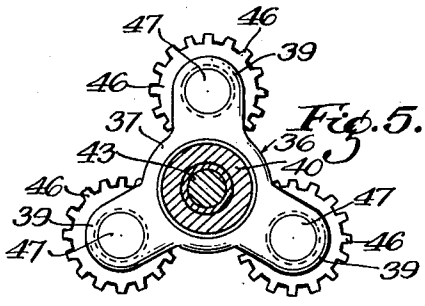
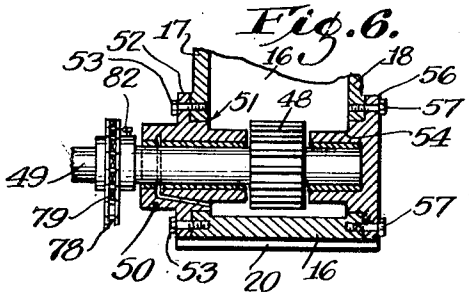


Fig. 6.



INVENTOR.
Daniel F. Przybylski
BY
Harry V. Kilgore
Attorney

March 27, 1951 D. F. PRZYBYLSKI 2,546,869

VARIABLE-SPEED REDUCTION UNIT

Filed Oct. 13, 1948 6 Sheets-Sheet 4

Fig. 7

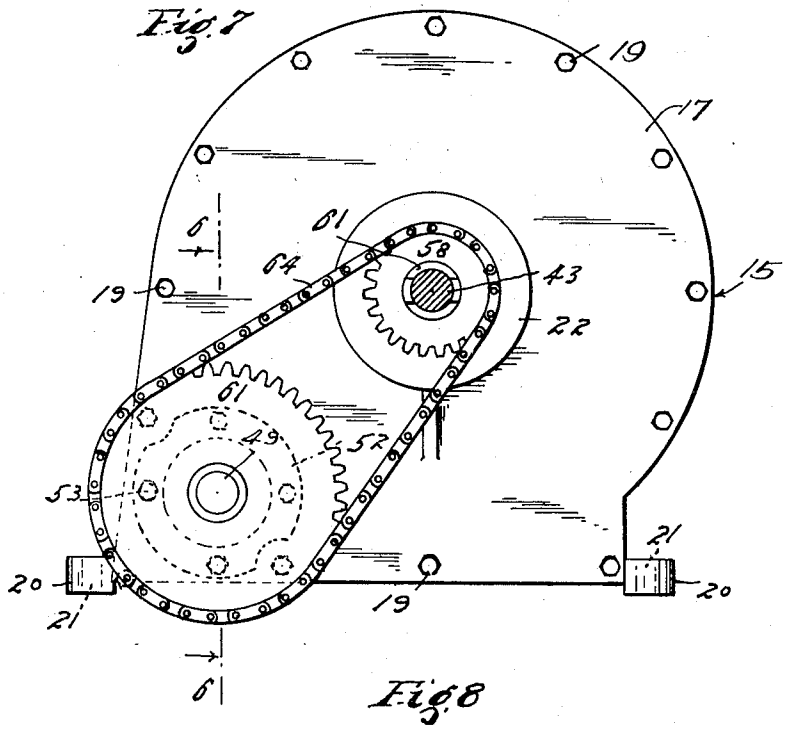
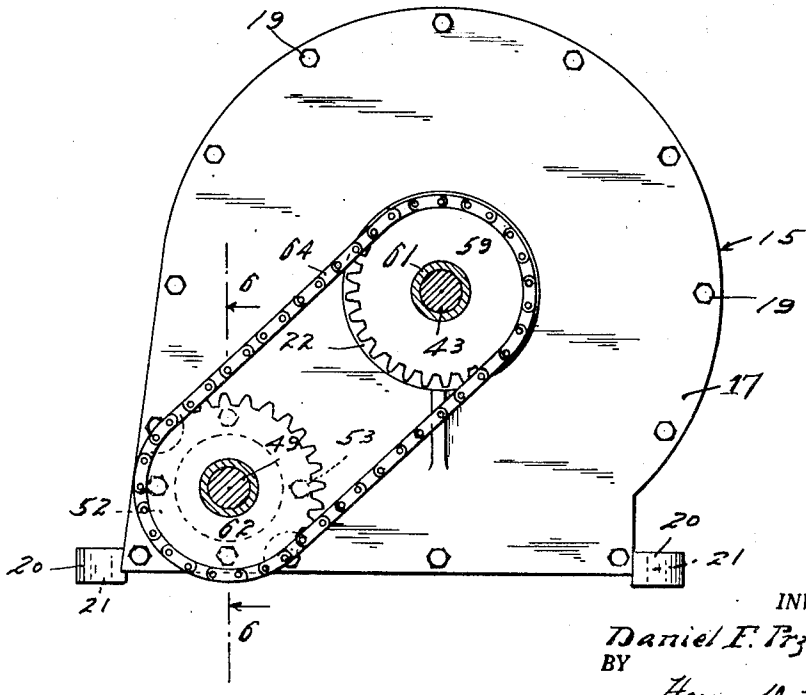


Fig. 8



INVENTOR.
Daniel F. Przybylski
BY
Harry D. Kilgore
Attorney

March 27, 1951 D. F. PRZYBYLSKI 2,546,869

VARIABLE-SPEED REDUCTION UNIT

Filed Oct. 13, 1948 6 Sheets-Sheet 5

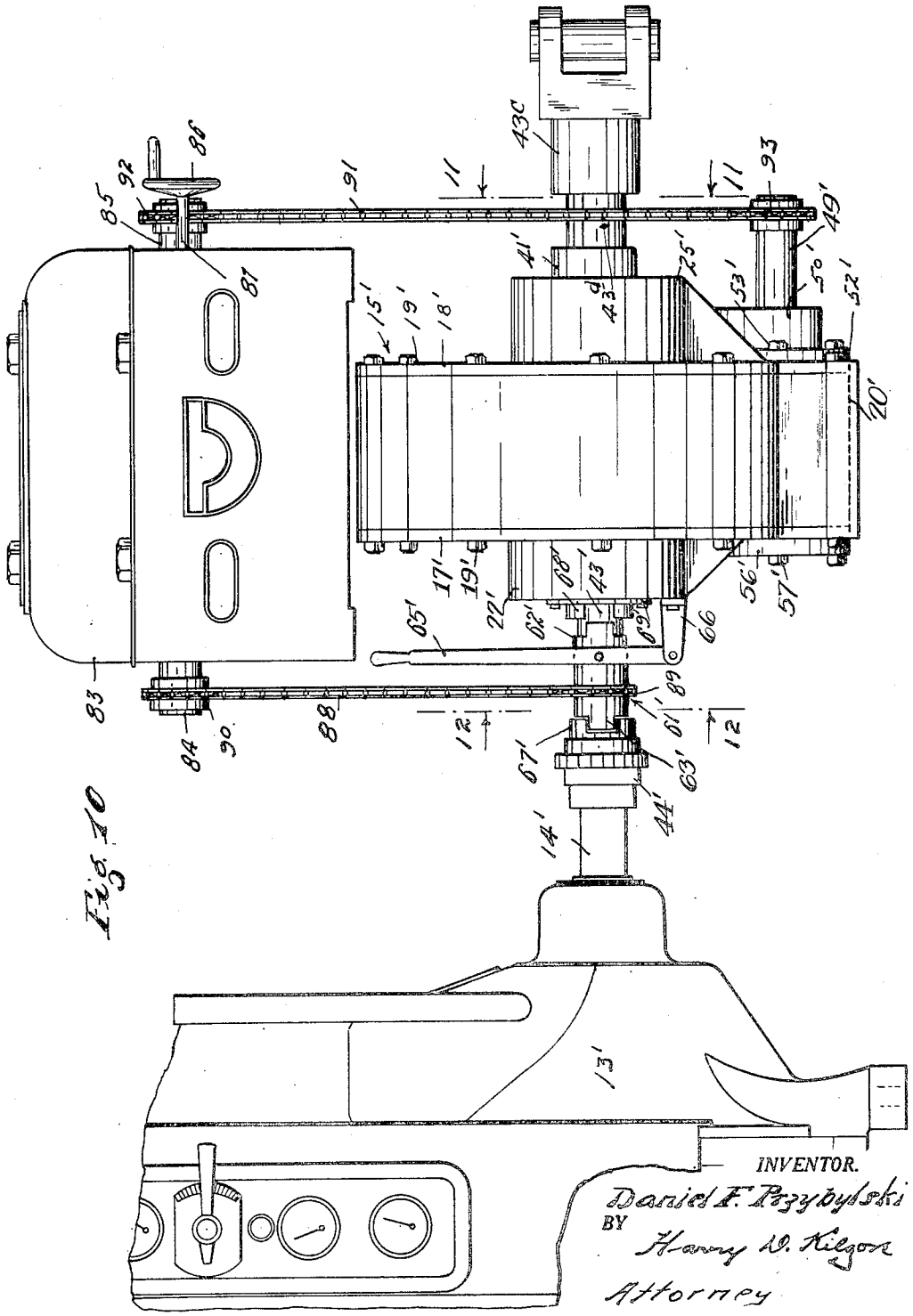


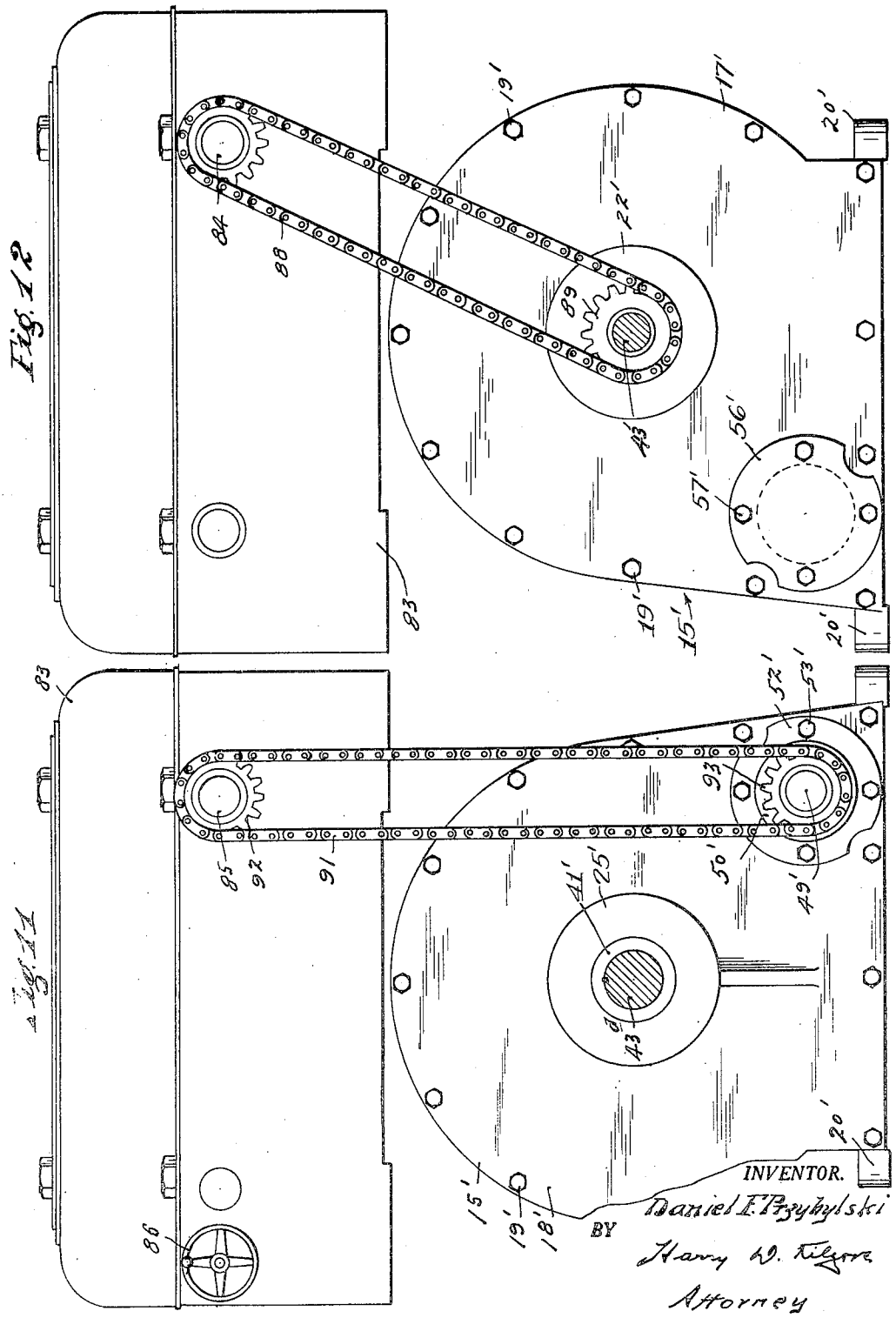
Fig. 10

INVENTOR.
Daniel F. Przybylski
BY
Harry D. Kilgore
Attorney

March 27, 1951 D. F. PRZYBYLSKI 2,546,869

VARIABLE-SPEED REDUCTION UNIT

Filed Oct. 13, 1948 6 Sheets-Sheet 6



INVENTOR.
Daniel F. Przybylski
BY
Harry D. Kilgore
Attorney

Patented Mar. 27, 1951 2,546,869

UNITED STATES PATENT OFFICE

2,546,869

VARIABLE-SPEED REDUCTION UNIT

Daniel F. Przybylski, Winona, Minn.

Application October 13, 1948, Serial No. 54,291

3 Claims. (Cl. 74—689)

1

My present invention relates to improvements in variable speed reduction mechanisms.

The principal object of this invention is to provide a variable speed reduction unit that will give an unlimited number of input speeds and a wide range of selective predetermined output speeds as it will give variable speeds of infinitesimal variations.

A further object of this invention is to provide a variable speed reduction unit in which it is never necessary to change any of the internal parts of the unit for different speeds.

These and other objects of the invention will be apparent from the following description and accompanying drawings.

To the above end, generally stated, the invention consists of the novel devices and combination of devices hereinafter described and defined in the claims.

In the accompanying drawings, which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is an elevational view of the variable speed reduction unit connected to the crank shaft of an internal combustion engine, fragmentarily shown, by an input shaft and having an output shaft that may be connected to a device to be driven;

Fig. 2 is a view of the variable speed reduction unit principally in central vertical section taken on the line 2—2 of Fig. 3;

Fig. 3 is an elevational view of the variable speed reduction unit with its front cover member removed to expose the mechanism in the housing of said unit, parts of which are shown in section;

Fig. 4 is an elevational view of the ring gear and parts associated therewith removed from the housing, with a portion of the ring gear mount broken away to expose one of the traveler gears and the cage therefor, some parts being sectioned;

Fig. 5 is an elevational view of the traveler gears and cage therefor removed from the ring gear mount, some parts being sectioned;

Fig. 6 is a fragmentary detail view partly in elevation and partly in section taken on the line 6—6 of Fig. 8;

Figs. 7, 8 and 9 are elevational views with the output shaft sectioned on the lines 7—7, 8—8 and 9—9 of Fig. 1, respectively;

Fig. 10 is an elevational view corresponding to Fig. 1, with the exception that the auxiliary shaft is driven through a variable speed transmission in place of the hydraulic motor;

Fig. 11 is a right side elevational view of the invention as shown in Fig. 10, with the output shaft sectioned on the line 11—11 of Fig. 10; and

Fig. 12 is a left side elevational view of the

2

invention shown in Fig. 10, with the input shaft sectioned on the line 12—12 of Fig. 10.

Referring first in detail to the invention shown in Figs. 1 to 9, inclusive, there is illustrated in the drawings, fragmentarily, a motor in the form of an internal combustion engine indicated as an entirety by the numeral 13 with the exception of its crank shaft 14.

The variable speed reduction unit, which is the subject-matter of this application, has a housing 15 that includes a round body member 16 on a flat base portion and front and rear displaceable side members 17 and 18, respectively. These side members 17 and 18 are detachably secured to the body member 16 and its base portion by machine screws 19. Integral with the base portion of the body member 16 are foot members 20 having bores 21 to receive anchor bolts, not shown, for securing the housing 15 to a suitable support.

Formed with the front side member 17 is a large outwardly projecting boss 22 having an axial bearing 23 of relatively small diameter and an internal bearing 24 of relatively large diameter. On the rear side member 18 is an outstanding large boss 25 having a large axial bearing 26 and an internal bearing 27 of a still larger diameter. All of the bearings 23, 24, 26 and 27 are in axial alignment with the axis of the housing 15.

Within the housing 15 is a large ring gear 28 having internal teeth 29 and external teeth 30. The body of the ring gear 28 extends materially outwardly of the ends of the teeth 29 and 30 and has detachably secured thereto a front side plate 31 and a rear side plate 32 by means of machine screws 33. Formed as a part of the front side plate 31 is a large external hub 34 journaled in the bearing 24. A large external hub 35 is formed as a part of the rear side plate 32 and journaled in the bearing 27.

The ring gear 28 and its side plates 31 and 32 afford a housing for a gear carrier 36 comprising a pair of laterally spaced side members 37 and 38 having three pairs of short arms 39 circumferentially spaced equi-distantly apart and provided with bearings 39 at their ends. The carrier side member 37 is journaled on an inwardly projecting hub 40 integral with the front side plate 31 in axial alignment with the hub 34 and of a reduced diameter. Integral with the carrier side member 38 is a long sleeve 41 journaled in the bearing 26 and the hub 35 and projects outwardly of the boss 25. The two carrier side members 37 and 38 are rigidly connected by three circumferentially spaced cross-tie members 42 that are integral therewith.

An input shaft 43 is attached at its outer end to the engine crank shaft 14 by a flexible coupling 44. The inner end portion of the input shaft 43

is journaled in the bearing 23, the hubs 34 and 40, and the rear carrier side plate 32. A spur pinion 45 in the carrier 36 is secured to the input shaft 43 for rotation therewith. This pinion 45 meshes with three planet spur gears 46 having short shafts 47 journaled in the carrier bearings 39. These planet gears 46 mesh with the internal teeth 29 on the ring gear 28. The inner end portion of an output shaft 43a is fitted in the sleeve 41 and secured for rotation therewith by a key 43b. On the outer end of the output shaft is a coupling member 43c for attaching said output shaft to any member or device to be driven thereby.

An auxiliary pinion 48 on an auxiliary shaft 49 is intermediately journaled in a bearing 50 removably mounted in a round hole 51 in the front side member 17. This bearing 50 has an annular flange 52 that overlaps the face of the side member 17 and is detachably secured thereto by machine screws 53. The auxiliary shaft 49, at its rear end portion, is journaled in a socket bearing 54 removably mounted in a hole 55 in the rear side member 18, of the same diameter as the hole 51 and in axial alignment therewith. This socket bearing 54 has an annular flange 56 that overlaps the outer face of the rear side member 18 and is detachably secured thereto by machine screws 57. The bearing 54 and its flange 56 afford a closure for the hole 55. The bearings 50 and 54 are interchangeable to permit the auxiliary shaft 49 to be turned end for end and projected outwardly from either side member 17—18.

A small sprocket wheel 58, an intermediate sprocket wheel 59 and a large sprocket wheel 60 are secured to a clutch 61 in the form of a sleeve 62, having on one end square teeth 63 and on its other end similar teeth 64. The clutch sleeve 62 is mounted on the input shaft 43 for axial sliding movement between the boss 22 and the flexible coupling 44. A shipper lever 65 fulcrumed on a bearing 66 secured to the boss 22 is provided for shifting the clutch 61 and the parts thereon. When the clutch 61 is moved to the left, in respect to Fig. 1, its teeth 63 mesh with square teeth 67 on the coupling 44 and hold the clutch 61 and the sprocket wheels 58, 59 and 60 thereon for rotation with the input shaft 43. When the clutch 61 is moved to the right, its teeth 63 are moved out of mesh with the teeth 67 on the coupling 44 and its teeth 64 are moved into mesh with square teeth 68 on a face plate 69 secured to the boss 22 and hold the clutch 61 from rotating with the input shaft 43. Sprocket wheels 70, 71 and 72 are mounted on a common hub 49' secured on the auxiliary shaft 49 for rotating the same. These sprocket wheels 70, 71 and 72 are of the same diameters as the sprocket wheels 58, 59 and 60 with which they are aligned but in reverse order. A sprocket chain 73, shown in Fig. 1, by full lines, is arranged to run over the sprocket wheels 58 and 70 and drive the auxiliary shaft 49 from the input shaft 43 at a slower speed than that of said input shaft. By means of broken lines in Fig. 1, the sprocket chain 73 is applied to the sprocket wheels 59 and 71 to drive the auxiliary shaft 49 at the same speed as the input shaft 43 and also applied to the sprocket wheels 60 and 72 to drive the auxiliary shaft at a faster speed than that of the input shaft 43.

When the clutch 61 is in neutral position, the auxiliary shaft 49 may be driven independently of the input shaft 43 at a variable speed by a hydraulic motor 74, as shown, or a variable speed electric motor, not shown. Oil under pressure for operating the motor 74 is delivered thereto through a pipe 75 leading from any suitable source of supply, not shown. This oil is bypassed in the motor 74 and returned to its source of supply through a pipe 76. A regulator valve 77 is interposed in the oil pipe 75. The auxiliary shaft 49 is driven from the motor 74 by a sprocket chain 78 that runs over a sprocket wheel 80 on the shaft 81 of said motor. The sprocket wheel 79 is secured to the auxiliary shaft 49 for rotation therewith by a key and a set screw 82 having threaded engagement with the hub of said sprocket wheel and impinges the auxiliary shaft 43.

Operation of the variable speed reduction unit may be described as follows: When the clutch 61 is in neutral position and the motor 74 stopped, the auxiliary pinion 48 will hold the ring gear 28 from turning. It may be assumed that the input shaft 43 is being driven from the engine 13 and turning clockwise and, in turn, turns the planet gears 46 counterclockwise. The meshing of the planet gears 46 with the internal teeth 29 of the stopped ring gear 28 will cause said planet gears to be moved bodily clockwise while being rotated counterclockwise by the pinion 45. This clockwise bodily movement of the travel gears 46 will rotate the cage 36 and hence the output shaft 43a clockwise and in the same direction of rotation as the input shaft 43, see Fig. 3.

In case it is desirable to rotate the output shaft 43a at a slower predetermined speed than that just described, it will be necessary to turn the ring gear 28 counterclockwise and thus reduce the speed of the carrier 36 to which the output shaft 43a is secured. It may be here stated that the faster the auxiliary pinion 48 is rotated, the slower will be the rotation of the output shaft 43a. It is possible to rotate the auxiliary pinion 48 at a speed that will reverse the direction of rotation of the output shaft 43a.

To drive the auxiliary pinion 48 at a predetermined speed, the sprocket chain 73 is arranged to run over any one aligned pair of sprocket wheels 58—70, 59—71 or 60—72, depending on the speed desired. The clutch 61 is next shifted on the input shaft 43 to bring its teeth 63 into mesh with the clutch teeth 67 on the coupling 44 to turn the clutch 61 and hence all of the sprocket wheels 58, 59 and 60 thereon with the input shaft 43. It will, of course, be understood that other sprocket wheels of different diameters may be substituted for the sprocket wheels 58, 59, 60 and 70, 71 and 72 to obtain any desired peredetermined speed for the auxiliary pinion 48. When driving the auxiliary pinion 48 from the input shaft 43, the hydraulic motor 74 will be stopped and the set-screw 82 loosened to permit the auxiliary shaft 49 to turn freely in the hub of the sprocket wheel 79.

To drive the output shaft 43a at variable speeds of infinitesimal variations, the auxiliary pinion 48 is driven independently of the engine 13, as shown in Fig. 1, by the hydraulic motor 74 to turn the ring gear 28 clockwise and progressively decrease the speed of the output shaft 43a. When driving the auxiliary pinion 45 from the hydraulic motor 74, the clutch 61 will, of course, be in neutral position and the set-screw 82 tightened to secure the sprocket wheel 79 to the auxiliary shaft 49 and drive said shaft from said motor. Preferably, when driving the auxiliary pinion 48 from the hydraulic motor 74, the sprocket chain 73 will be removed from the sprocket wheels over which it is arranged to run.

Referring now in detail to the modification

shown in Figs. 10, 11 and 12, wherein parts that correspond to like parts in Figs. 1 to 9, inclusive, are given the same reference numerals followed by a prime, with the exception of the output shaft and its coupling which are designated by 43d and 43e, respectively. The internal mechanism of the variable speed reduction unit shown in Figs. 10, 11 and 12 is identical with that in the unit heretofore described in detail.

The auxiliary shaft 49', which is reversed end for end from the showing in Fig. 1, is driven from the input shaft 43' through a mechanical variable speed transmission unit of any conventional type, indicated as an entirety by the numeral 83, with the exception of its input shaft 84, its output shaft 85 and the handle-equipped wheel 86 on the shaft 87 for changing the speed of said transmission unit. For the purpose of this case, it is not thought necessary to show and describe the internal mechanism of the transmission unit 83, as the same is so well understood.

The driving connections from the input shaft 43' to transmission unit 83 and from said unit to the auxiliary shaft 49' are as follows: A sprocket chain 88 runs over a sprocket wheel 89 on the clutch 51' and an aligned sprocket wheel 90 on the input shaft 84 of the transmission unit 83, and a sprocket chain 91 runs over aligned sprocket wheels 92 and 93 on the output shaft 85 of said transmission unit and the auxiliary shaft 49', respectively.

It may be here stated that it is never necessary to change any of the parts inside of the variable speed reduction unit to obtain any desired speed for the output shaft.

The drawings illustrate a commercial form of the invention, but it will be understood that the same is capable of certain modifications as to details of construction and arrangement within the scope of the invention herein described.

What I claim is:

1. In a variable speed unit, a housing having side members, at least one of which is displaceable, said side members having bosses provided with internal bearings, a ring gear having internal and external teeth in the housing and provided with side plates, at least one of which is displaceable, said side plates having hubs journaled in the internal bearings of the bosses, a carrier within the ring gear and journaled on a hub on one of said hubs and provided with a sleeve bearing journaled in the other hub, idler gears journaled in the carrier and meshing with the internal teeth of the ring gear, an input shaft journaled in the hub opposite the sleeve bearing, a pinion on the input shaft and meshing with the idler gears, an output shaft secured in the sleeve bearing, an auxiliary shaft journaled in the housing side members and having an auxiliary pinion meshing with the external teeth of the ring gear, and means for driving the auxiliary shaft.

2. In a variable speed unit, a motor, a housing having side members, at least one of which is displaceable, said side members having bosses provided with internal bearings, a ring gear having internal and external teeth in the housing and provided with side plates, at least one of

which is displaceable, said side plates having hubs journaled in the internal bearings of the bosses, a carrier within the ring gear and journaled on a hub on one of the said hubs and provided with a sleeve bearing journaled in the other hub, idler gears journaled in the carrier and meshing with the internal teeth of the ring gear, and input shaft journaled in the hub opposite the sleeve bearing, a pinion on the input shaft and meshing with the idler gears, an output shaft secured in the sleeve bearing, an auxiliary shaft journaled in the housing side members and having an auxiliary pinion meshing with the external teeth of the ring gear, a coupling interconnecting the motor and the input shaft, a sleeve slidable on the input shaft, said coupling and sleeve having co-operating clutch members for connecting the sleeve to the input shaft for rotation therewith, and driving connections from the sleeve to the auxiliary shaft.

3. In a variable speed unit, a motor, a housing having side members, at least one of which is displaceable, said side members having bosses provided with internal bearings, a ring gear having internal and external teeth in the housing and provided with side plates, at least one of which is displaceable, said side plates having hubs journaled in the internal bearings of the bosses, a carrier within the ring gear and journaled on a hub on one of said hubs and provided with a sleeve bearing journaled in the other hub, idler gears journaled in the carrier and meshing with the internal teeth of the ring gear, an input shaft journaled in the hub opposite the sleeve bearing, a pinion on the input shaft and meshing with the idler gears, an output shaft secured in the sleeve bearing, an auxiliary shaft journaled in the housing side members and having an auxiliary pinion meshing with the external teeth of the ring gear, a coupling interconnecting the motor and the input shaft, a sleeve slidable on the input shaft, said coupling and sleeve having co-operating clutch members for connecting the sleeve to the input shaft for rotation therewith, pairs of sprocket wheels on the sleeve and the auxiliary shaft, and a sprocket chain shiftable from one pair of sprocket wheels to another, said sprocket wheels being of diameters to drive the auxiliary shaft at different predetermined speeds.

DANIEL F. PRZYBYLSKI.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
782,262	Morse	Feb. 14, 1905
1,263,125	Sawyer	Apr. 16, 1918
1,530,967	Williams	Mar. 24, 1925
1,708,270	Henderson	Apr. 9, 1929
2,245,392	Drill	June 10, 1941
2,259,823	Locke	Oct. 21, 1941

FOREIGN PATENTS

Number	Country	Date
319,522	Italy	July 12, 1934