

Aug. 10, 1943.

R. M. SCHAEFER ET AL

2,326,570

HYDRAULIC TRANSMISSION

Filed Aug. 6, 1941

2 Sheets-Sheet 1

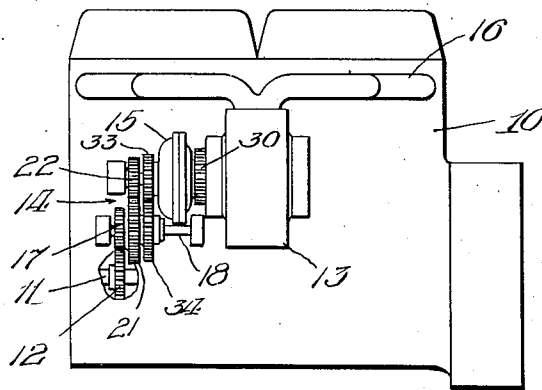


Fig. 1.

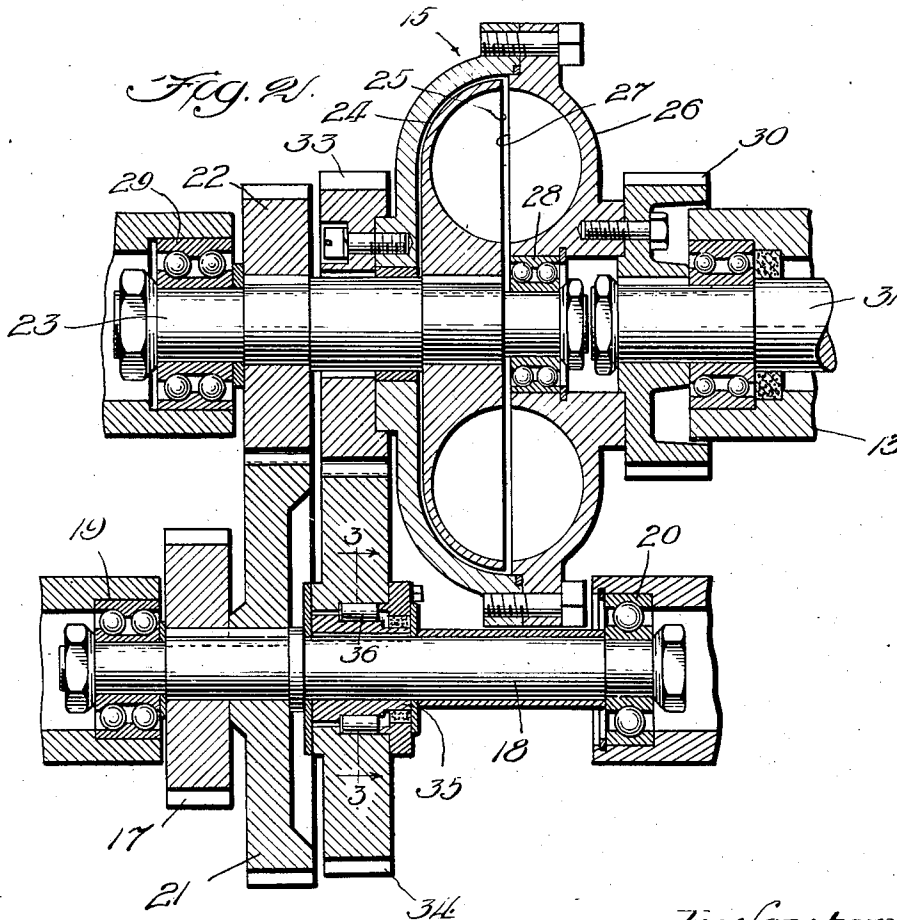


Fig. 2.

Inventors:
Robert M. Schaefer and
Milburn L. Shurts
by *John Starley* atty.

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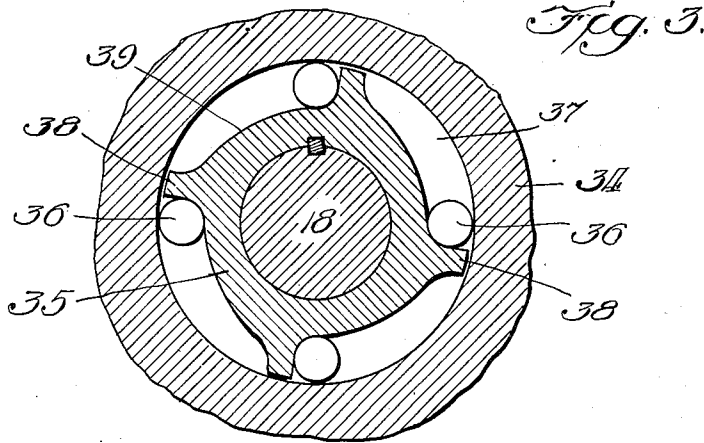
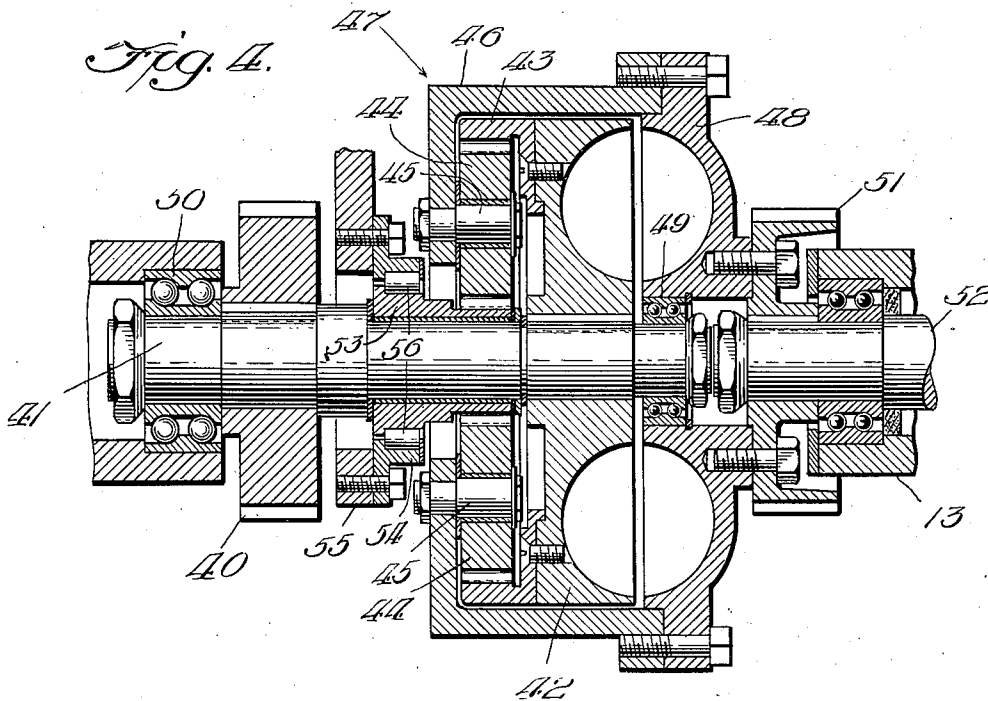
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HYDRAULIC TRANSMISSION.

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2 Sheets-Sheet 2



Inventors:
Robert M. Schaefer and
Melbur T. Shurts.
by John H. Darley

UNITED STATES PATENT OFFICE

2,326,570

HYDRAULIC TRANSMISSION

Robert M. Schaefer and Wilbur F. Shurts, Racine,
Wis., assignors to Twin Disc Clutch Company,
Racine, Wis., a corporation of Wisconsin

Application August 6, 1941, Serial No. 405,690

8 Claims. (Cl. 74-189.5)

Our invention relates to hydraulic transmissions and more particularly to one that is specially designed for use with supercharging blowers for internal combustion engines.

Considerable difficulty has been encountered heretofore with straight gear transmissions between the engine and supercharger because of their rigid and inelastic nature, the involved shafting being twisted to such an extent during sudden increases or decreases in the engine speed that it is frequently sheared.

We have ascertained that a hydraulic coupling will serve as an efficient and elastic connection under the foregoing circumstances provided that some means are employed to by-pass the drive around the coupling at speeds considerably lower than the most effective transmitting speed of the coupling, such as when the engine is being cranked. Under these conditions, the speed of the engine is only a fraction of its normal speed so that if a hydraulic coupling provided the connection to the supercharger, the slip in the coupling would be so great that the supercharger would be rendered ineffective for its primary purpose.

It is therefore the principal object of our invention to devise a supercharger driving mechanism which embodies a hydraulic coupling through which the drive is effected over one predetermined range of speed of the engine and a gear train which transmits the drive directly to the supercharger over a lower range of engine speed.

A further object is to devise a transmission of the character indicated wherein the drive through the gear train is automatically thrown into or out of operation at a predetermined engine speed.

These and further objects of our invention will be set forth in the following specification, reference being had to the accompanying drawings, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawings:

Fig. 1 is an elevation of a supercharger equipped, internal combustion engine showing our improved hydraulic transmission applied thereto.

Fig. 2 is an enlarged, sectional elevation of the transmission as viewed in Fig. 1.

Fig. 3 is an enlarged, section along the line 3-3 in Fig. 2 showing a free wheeling or over-running clutch connection that forms an important part of our invention.

Fig. 4 is a sectional elevation showing a modified form of our transmission which utilizes a planetary system of gearing.

Referring to Fig. 1, the numeral 10 designates an internal combustion engine which may be of the gasoline or Diesel type and which is provided with the usual cam shaft 11 having attached thereto a pinion 12. This pinion, as hereinafter described, is drivably connected to the supercharger 13 by means of a system of gearing indicated by the numeral 14 and a hydraulic coupling 15, the gearing and coupling combination more particularly constituting our invention. For purpose of illustration, the supercharger 13 is indicated as being of the Roots blower or positive displacement type and the transmission referred to is connected to one of the rotors of the supercharger. Air delivered by the supercharger passes into an intake pipe 16, in the case of a Diesel engine, while for gasoline engines air may be delivered to the engine cylinders in any of the ways now commonly employed in the art. Our invention is not restricted to the type of supercharger stated, but may be just as easily applied to a centrifugal blower. Moreover, our transmission may be driven directly by the engine crank shaft instead of the cam shaft.

The form of our invention which is shown more or less diagrammatically in Fig. 1 is more particularly illustrated in Figs. 2 and 3 to which reference will now be made. The cam shaft pinion 12 meshes with a gear 17 that is keyed to a countershaft 18, whose opposite ends are journaled in bearings 19 and 20 that may be supported by any convenient portion of the engine bloc. Also keyed to the shaft 18 is a pinion 21 that meshes with a gear 22 secured to a shaft 23 and keyed to this shaft is an impeller 24 having the usual radial blades 25. The impeller is located in operative relation to a runner 26 having blades 27 that are similar to the blades 25. The impeller and runner together constitute the hydraulic coupling element of our improved transmission, and the latter is generally indicative of any fluid turbine transmission circuit. Since devices of this character are well known in the art, they are not specifically illustrated or described. The runner 26 is coaxially bored to receive a bearing 28 in which one end of the shaft 23 is journaled while the opposite end of this shaft is journaled in a bearing 29 carried by a convenient part of the engine. A pinion 30 is secured to the runner 26 and is also keyed to a shaft 31 which is axially aligned with the shaft 23 and connected to one of the supercharger

rotors (not shown). The pinion 30 is drivably connected through a gear (not shown) to the other rotor. Since the internal construction of this supercharger is well known it has not been illustrated in the drawings.

The runner 26 surrounds the impeller 24 and so constitutes a housing for the coupling and secured to the runner adjacent the gear 22 is a gear 33 which is coaxial with the shaft 23 that is journaled freely thereon or in spaced relation thereto. The gear 33 meshes with a pinion 34 which surrounds a clutch sleeve 35 that is secured to the shaft 18. Interposed between the adjacent surfaces of the pinion 34 and sleeve 35 is a plurality of rollers 36 which are circumferentially spaced around the sleeve 35 and which operate in channels or slots 37 defined by the mentioned surfaces. Movement of these rollers in a clockwise direction relative to the sleeve 35, as viewed in Fig. 3, is prevented by means of shoulders 38 formed on the sleeve. When this sleeve is rotated in a clockwise direction, as viewed in Fig. 3, the rollers 36 are moved outwardly along the surfaces 39 to establish a clutching connection with the internal surface of the pinion 34. The arrangement thus described, therefore, constitutes a free wheeling or overrunning clutch connection between the pinion 34 and sleeve 35 for a purpose presently discussed. This clutch is only diagrammatically illustrated in the drawings and it will be understood that any of the usual spring arrangements may be employed to insure positive engagement of all the rollers.

In describing the operation of our improved transmission, it will be assumed that the cam shaft 11 rotates counterclockwise when viewed in the direction of the arrow 5 in Fig. 1. When the engine is operating over its normal working range, the drive of the supercharger 13 is accomplished through the gear 17, pinion 21, gear 22, shaft 23 and the hydraulic coupling 25 to the pinion 30. Under these circumstances, the clutch rollers 36 will occupy the positions generally shown in Fig. 3, or in other words, the pinion 34 overrides the rollers 36, so that direct gear drive to the runner 26 is interrupted.

However, at relatively lower speeds, than those indicated, such as when the engine is being cranked, the slip in the coupling is so great that it is necessary to provide a direct gear driving connection to the supercharger in order to insure an adequate output of air. Under these conditions, the rotation of the sleeve 35 relative to the pinion 34, i. e., in a clockwise direction, as viewed in Fig. 3, causes the rollers 36 to move outwardly along the surface 39 to establish a clutching engagement with the pinion 34 and hence a direct gear connection to the runner 26 and thence to the pinion 30.

The change from coupling to gear drive and vice versa is accomplished automatically in response to changes in speed of the power source. The free wheeling connection can be designed to provide for any per cent of slip in the coupling before the free wheeling connection again engages. This feature is a matter of design that will vary with operating conditions and hence it is unnecessary to establish any definite limits in this respect. In one particular instance, the free wheeling connection was designed to accommodate a 15 per cent slip.

In Fig. 4 is illustrated a modified arrangement of our improved transmission which embodies a

planetary system of gearing. In this modification, the cam shaft pinion 12 meshes with a gear 40 which is keyed to a shaft 41 and secured thereto is an impeller 42. An internal gear 43 is secured to one side of the impeller and meshing with this gear is one or more planet pinions 44, each of which is rotatably mounted upon a stub shaft 45 that is secured to an annular cover 46 forming a part of a hydraulic coupling 47. The cover 46 is attached to a runner 48 which is located in cooperative relation to the impeller 42 and is coaxially bored to receive a bearing 49 in which is journaled one end of the shaft 41 while the opposite end is journaled in a bearing 50 that may be carried by any convenient portion of the engine. A pinion 51 is secured to the runner 48 and is also keyed to a shaft 52 that is axially aligned with the shaft 41 and is connected to one of the supercharger rotors (not shown). The pinion 51 corresponds to the pinion 30 in Figs. 1 and 2 and it will be understood that the former is drivably connected to the other rotor of the supercharger.

Freely journaled on the shaft 41 is a brake sleeve 53 formed at one end as a sun gear which meshes with the pinions 44 and at the opposite end is encircled by a ring 54 fast on a part 55 which may be a bracket or other support secured to the engine block. Disposed between the periphery of the last noted portion of the sleeve 53 and the inner surface of the ring 54 is a plurality of brake rollers 56, it being understood that the sleeve 53, ring 54 and roller 56 constitute a one-way brake that may be arranged in a manner similar to that illustrated in Fig. 3 with the sleeve 53 corresponding to the sleeve 35.

When the engine is operating over its normal working range, the supercharger is driven through the coupling 47, since the drive under these conditions is transmitted by the gear 40, shaft and coupling 47 to the pinion 51. At this time, the rollers 56 occupy positions corresponding to those indicated in Fig. 3 and the pinions 44 rotate freely on their shafts 45 and move around the teeth on the sleeve 53. However, at cranking speeds or at relatively lower speeds than those indicated in the normal working range, the rotation of the impeller 42 causes the pinions 44 to move the brake sleeve 53 to a stationary position and thereafter the pinions 44 roll around the teeth on the sleeve 53 and establish a positive gear drive to the cover 46 and thence to the pinion 51.

It will be understood that the hydraulic coupling portion of our transmission may include any number of working circuits and also that our transmission is not restricted to the particular type of coupling illustrated since the latter is intended to generally denote any type of fluid turbine transmission circuit. Moreover, our invention is not restricted to use with a supercharger since the latter is to be generically regarded as any load, while the engine 10 constitutes any source of power.

We claim:

1. A hydraulic transmission for connecting a source of power and a load comprising a shaft, an impeller secured to the shaft, an internal gear rotatable with the impeller, a runner having a shell surrounding the impeller and gear, the impeller and runner constituting the hydraulic portion of the transmission, planet pinions meshing with the gear and rotatably connected to the shell, a gear freely journaled on the shaft in mesh with the pinions, and a one-way brake con-

nection between the last named gear and a fixed part of the transmission whereby the drive is automatically shifted from the gear to the hydraulic portion at a predetermined speed of the source.

2. A power transmission for connecting driving and driven shafts comprising a hydraulic coupling having an impeller secured to the driving shaft and a runner secured to the driven shaft, planetary gear means between the impeller and runner and having planet pinions carried by the runner, and means coupled to the pinions including a one-way brake for providing a mechanical drive between the impeller and runner.

3. A power transmission for connecting driving and driven shafts comprising a hydraulic coupling having an impeller secured to the driving shaft and a runner secured to the driven shaft, planetary gear means providing a mechanical drive between the impeller and runner and having planet pinions carried by the runner, a sun gear freely mounted on the driving shaft in mesh with the pinions, and a one-way brake coupled to the sun gear.

4. A power transmission for connecting driving and driven shafts comprising a hydraulic coupling having an impeller secured to the driving shaft and a runner secured to the driven shaft, a shell secured to the runner in enclosing relation to the impeller, planetary gear means providing a mechanical drive between the impeller and runner and having planet pinions carried by the shell, a sun gear freely mounted on the driving shaft in mesh with the pinions, and a one-way brake coupled to the sun gear.

5. A power transmission for connecting driving and driven shafts comprising a hydraulic coupling having an impeller secured to the driving shaft and a runner secured to the driven shaft, a gear annulus secured to the impeller, a shell

secured to the runner in enclosing relation to the impeller, planet pinions carried by the shell in mesh with the gear annulus, a sun gear freely mounted on the driving shaft in mesh with the pinions, and a one-way brake coupled to the sun gear.

6. A power transmission for connecting driving and driven shafts comprising a hydraulic coupling having an impeller member secured to the driving shaft and a runner member secured to the driven shaft, planetary gear means between the members and having planet pinions carried by one of the members, and means coupled to the pinions including a one-way brake for providing a mechanical drive between the members.

7. A power transmission for connecting driving and driven shafts comprising a hydraulic coupling having an impeller member secured to the driving shaft and a runner member secured to the driven shaft, planetary gear means between the members having planet pinions carried by one of the members, a sun gear freely mounted on the driving shaft in mesh with the pinions, and a one-way brake coupled to the sun gear.

8. A hydraulic transmission for connecting a source of power and a load comprising a shaft, an impeller element secured to the shaft, an internal gear mounted on the impeller concentric with the shaft, a runner element, the impeller and running elements constituting the hydraulic portion of the transmission, pinions meshing with the gear and rotatably connected to the runner element, a gear freely journaled on the shaft in mesh with the pinions, and a one-way brake connection between the last named gear and a fixed part of the transmission whereby the drive is automatically shifted from the gear to the hydraulic portion at a predetermined speed of the source.

ROBERT M. SCHAEFER.
WILBUR F. SHURTS.