Dec. 28, 1954 W. E. BRILL ET AL 2,698,013

ENGINE ACCESSORY DRIVE

Filed July 1, 1950 3 Sheets-Sheet 1

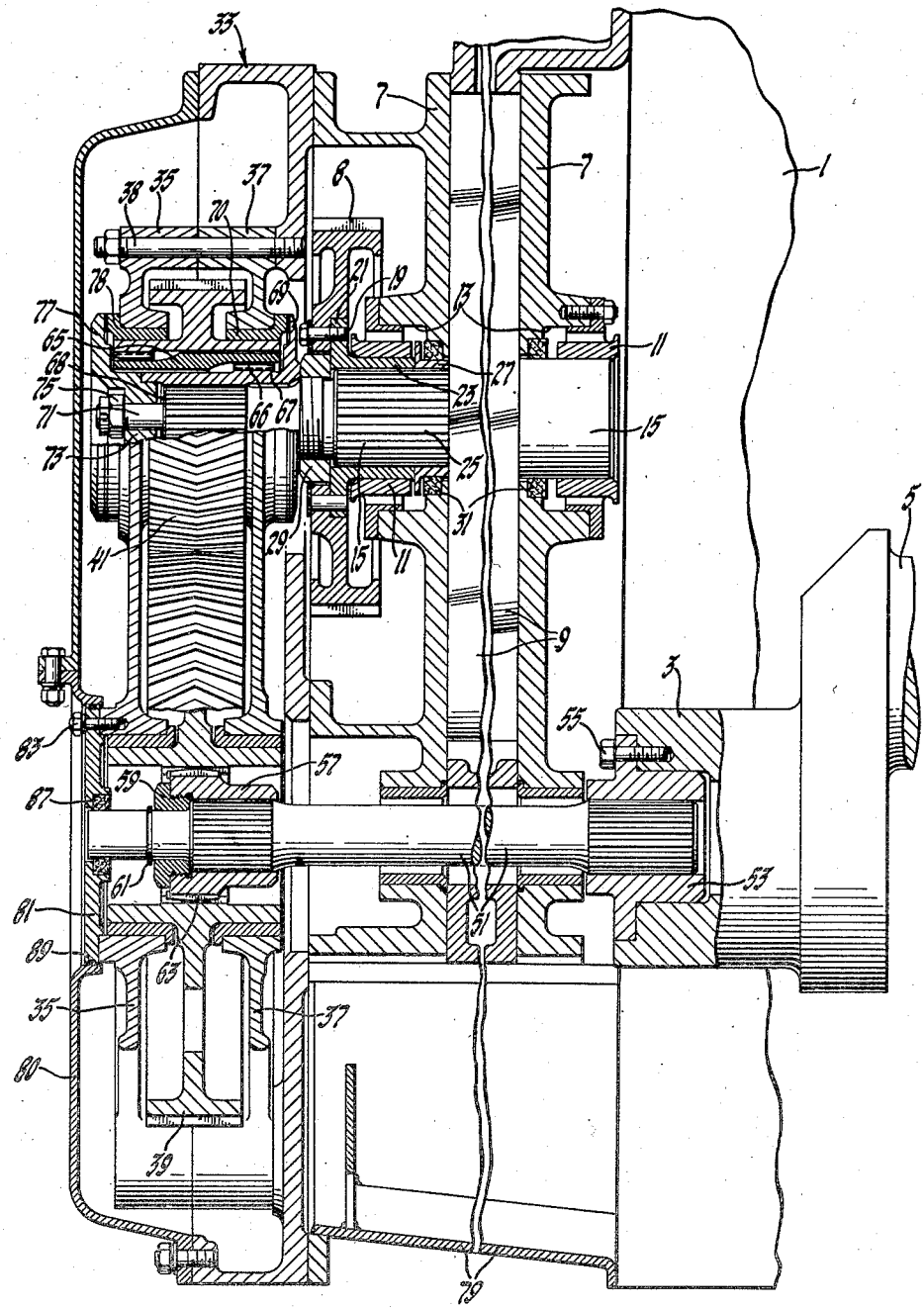


Fig. 1

Inventors
William E. Brill,
Allen H. Glasenapp &
David J. Watt

By
William Helwig & Baillio
Attorneys

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ENGINE ACCESSORY DRIVE

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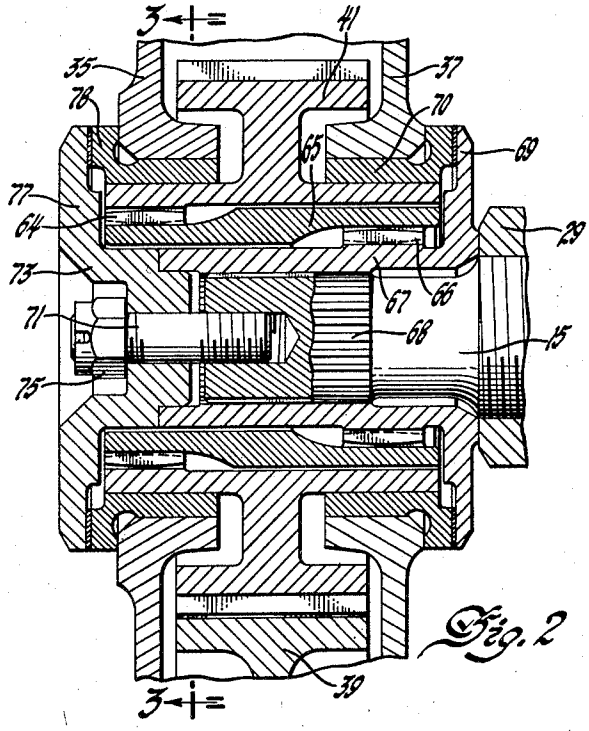


Fig. 2

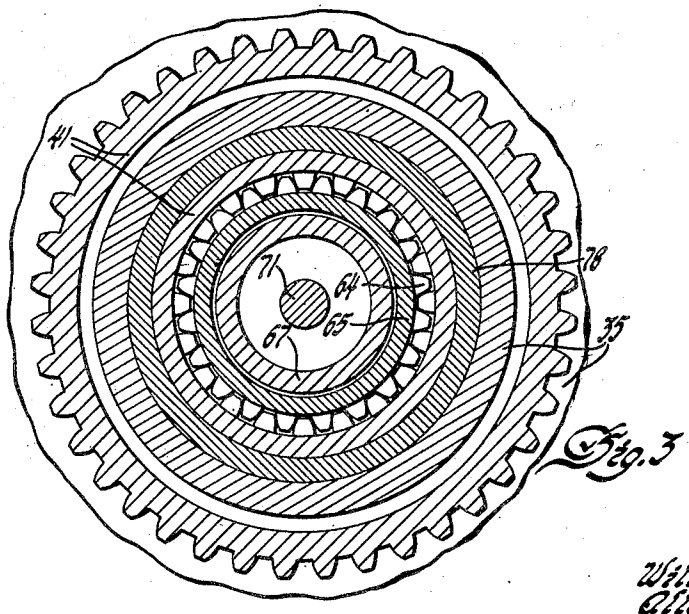


Fig. 3

Inventor
William E. Brill,
Allan H. Glasenapp &
David J. Watt

By Willits, Helwig & Baillie
Attorney

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ENGINE ACCESSORY DRIVE

Filed July 1, 1950 3 Sheets-Sheet 3

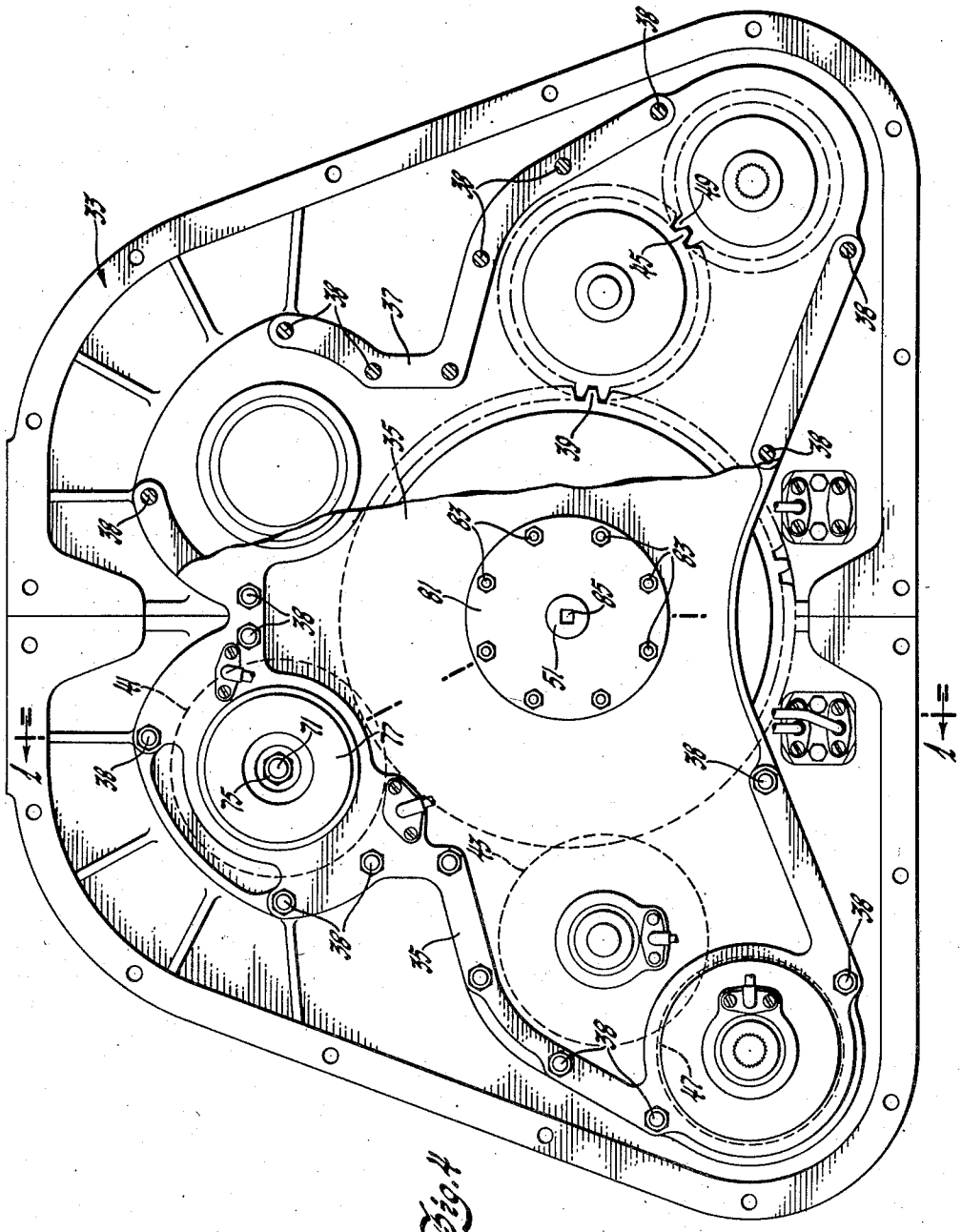


Fig. 4

Inventors
William E. Brill,
Allen H. Glasenapp &
David J. Watt

By
Williston, Hellwig & Baillio
Attorneys

United States Patent Office

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ENGINE ACCESSORY DRIVE

William E. Brill and Alien H. Glasenapp, Cleveland, Ohio, and David J. Watt, Kenmore, N. Y., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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15 Claims. (Cl. 123—195)

This invention generally relates to heavy duty internal combustion engines and more particularly to heavy duty accessory drives for these engines.

In order to obtain high output from internal combustion engines, scavenging and charging blowers driven by the engines are provided. These blowers require more power for operation thereof than do the other engine accessories such as the valve gears, fuel coolant pumps, etc. These blowers also operate at high temperature and the blower housings are subject to expansion and distortion causing misalignment of the bearings and shafts of the blowers supported in these housings which in turn are supported on the engine. The above-mentioned difficulties are greatly magnified when it becomes necessary to increase the speed and capacity of the engine blower and the pressure of the scavenging and charging air supplied to the engine as this causes greater heating and distortion of the blower and greatly increased power from the engine to drive the blower in order to obtain increased engine output.

The object of the present invention is to provide a compact heavy duty engine accessory drive assembly including torsionally flexible driving shafts, thrust members and coupling means permitting axial movement and angular misalignment between the driving and driven members of the assembly.

The combination of means by which the above object is accomplished will become apparent by reference to the following detailed description and drawings illustrating this combination.

Figure 1 of the drawings is a longitudinal sectional elevation view taken on line 1—1 of Figure 4 with parts broken away and in section.

Figure 2 is an enlarged view of a portion of Figure 1.

Figure 3 is a view taken on line 3—3 of Figure 2.

Figure 4 is a vertical end elevation view of the engine accessory drive housing with the cover removed and parts broken away and in section.

One end portion 1 of the frame of the internal combustion engine and the engine crankshaft main journal 3 and crankpin 5 are shown in Figure 1 of the drawings.

The engine blower shown is of the Roots type having an enclosure or housing 7 secured to the end face of the engine frame 1. Blower driving and driven shafts having intermeshing timing gears 8 and rotors 9 of the helical three-lobe type secured thereon are rotatable in side-by-side relation with the housing 7 in bearing sleeves 11 shown secured in aligned openings 13 in the ends of the blower housing. The blower driving and driven shafts are similar, the driving shaft 15 differing only from the driven shaft, not shown, by having a stud 71 threaded in the outer end, as best shown in Figure 1. Each of the timing gears 8 are secured by cap screws 19 to a flange 21 of an internally splined sleeve 23 rotatable in the outer bearing sleeve 11 and engaged with the externally splined portion 25 of each of the blower shafts. An internally splined spacer collar 27 is also positioned on the splined portion 25 of each shaft between the blower rotors 9 and the internally splined sleeve and spacer collar are clamped between each blower rotor and a thrust nut 29 threaded on the shaft. An oil seal member 31 is shown located between each spacer collar and a recess in the blower housing.

A longitudinally split accessory driving gear housing is best shown in Figures 1 and 4 secured to the outer end face of the blower housing. This split accessory driving gear housing is generally indicated by character reference 33. A transversely split gear case comprising

members 35 and 37 is secured by means of bolts 38 to the interior vertical face of the gear housing 33. Longitudinally aligned bearing openings are provided in the gear case members 35 and 37 for supporting the peripheral end surfaces of the hubs of intermeshing accessory driving gears for rotation and for limited axial movement therein, as best shown in Figures 1 and 4. These intermeshing gears include a main crankshaft driving gear 39, a blower driving gear 41, idler gears 43 and 45 and coolant pump driving gears 47 and 49. It will be noted that all of these intermeshing gears are of the double helical or herringbone type and the opposite ends of the hubs of each of these gears are shown supported in bushings located in the separate bearing openings of the split gear case members 35 and 37.

The main driving gear 39 is driven from the engine crankshaft by a torsionally flexible drive shaft 51. The inner end of the shaft 51 is externally splined and is slidably engaged in an internally splined fitting 53 secured in an axial recess located in the end of the main journal 3 of the engine crankshaft by means of a cap screw 55. The outer end of the torsionally flexible shaft 51 is also externally splined and a hollow coupling member 57 having internal splines is engaged with the outer splined end of the shaft 51. A nut 59 on the outer end of the shaft 51 is threaded into the coupling member 57 and a snap ring 61 is placed on the shaft outside this nut. The coupling 57 and nut 59 may accordingly slide axially relative to the shaft 51 between the snap ring 61 and the outer face of the splined end portion of the shaft.

The coupling 57 is provided with external involute splines 63 in engagement with internal involute splines in the main driving gear 39. The involute splines 63 terminate radially in curved peripheral surfaces of longitudinally convex form and engage the internal involute splines of the main accessory driving gear 39 to permit relative axial movement and angular misalignment between the coupling 57 and the main driving gear 39.

The blower driving gear 41 is provided with internal involute splines adjacent the outer end of the hub portion, as best seen in Figure 2. These internal involute splines of the gear 41 are shown in engagement with external involute splines 64 on the outer end of a hollow cylindrical coupling member 65 and this member is provided with internal involute splines adjacent its inner end shown in engagement with external involute splines 66 of a thrust sleeve 67. Like the splines 63, the peripheral surfaces of all of these involute splines are longitudinally convex to permit relative axial movement and angular misalignment between the blower drive gear 41, coupling member 65 and the thrust sleeve 67. The thrust sleeve 67 is internally splined intermediate its ends and engages the outer splined end 68 of the blower driving shaft 15. The thrust sleeve 67 is provided with an abutment in the form of an external thrust flange 69 the outer face of which is shown adjacent the inner face of the inner support bushing 70 and the inner face of the thrust sleeve 67 is shown in contact with the outer face of the thrust nut 29 on the blower driving shaft 15. A stud 71 is threaded in the outer end of the blower driving shaft 15 and an outer thrust sleeve 73 is placed over this stud. A nut 75 threaded on the stud 71 serves to draw the outer thrust sleeve 73 into endwise abutting relation with the inner thrust sleeve 67 and holds it in tight contact with the thrust nut 29. The outer thrust sleeve 73 is also provided with an abutment in the form of an external thrust flange 77 the inner face of which is shown adjacent the outer face of the outer support bushing 78 for the blower driving gear 41.

With the thrust sleeves 67 and 73 secured on the blower driving shaft 15 slight axial or endwise clearance is provided between the inwardly facing thrust surfaces of the flanges 69 and 77 of the thrust sleeves 67 and 73 and the outwardly facing surfaces of the bushings 70 and 78 supporting the driving gear 41, and greater endwise or axial clearance is provided between the inner faces of the flanges 69 and 77 and outer end faces of the hub of the gear 41, and the blower driving shaft 15 and blower driving gear 41 may move axially relative to each other by reason of the coupling member 65 therebetween and engaging involute splines thereof. The blower driving gear

41 is limited in axial movement by endwise contact with either of the flanges 69 and 77, and all of the other herringbone gears 39, 43, 45, 47 and 49 meshing therewith will accordingly be limited to the same amount of axial movement and line up with the center plane of the gear 41.

It will be noted that the lower outer face of the engine frame 1 and the inner face of the lower portion of the accessory driving gear housing 33 are interconnected by a lower blower housing member 79. An outer end cover 80 is provided for the accessory driving gear housing 33. An opening is provided in the cover 80, and an accessory mounting member 81 is located therein and secured by bolts 83 to the outer member 35 of the split accessory gear case. The outer end of the main driving shaft 51 is shown extending into an opening in the accessory mounting member 81 for abutting driving relation with another engine accessory, not shown, adapted to be mounted thereon in order to limit outward axial movement of the shaft 51.

As best seen in Figure 4 a square socket 85 is provided in the outer end face of the driving shaft 51 for entry of a projection of similar form of the driving shaft of an accessory for driving engagement with the shaft 51 and slight axial movement with respect thereto. The hubs of the coolant pump driving gears 47 and 49 are shown internally splined for insertion of the respective splined ends of pump driving shafts for drive thereby and for axial movement of the shafts therein. An oil seal 87 is provided between the outer end of the driving shaft 51 and accessory mounting member 81 and another oil seal 89 is provided between the accessory mounting member 81 and the cover 80 for the accessory gear housing 33.

The above-described engine accessory driving gear arrangement provides intermeshing heavy duty herringbone gears with thrust means to control the axial movement of a blower driving gear and thereby causes the other gears to move axially therewith to take care of expansion and distortion of the engine frame and blower housing. The longitudinally convex involute splined connections between the blower driving gear 41 and blower driving shaft 15 and also between the torsionally resilient main driving shaft 51 and main driving gear 39 take care of any angular misalignment between these shafts and gears due to this expansion and distortion of the engine frame 1 and blower housing 5. The accessory driving gear housing 33 including the gear case and gears and housing cover enables the speed, air pressure and output of the blower to be materially increased without increasing the space necessary for this accessory driving gear assembly over a conventional helical driving gear assembly.

We claim:

1. In an accessory drive gear for an engine, the combination of a gear case, intermeshing driving and driven gears supported for rotation and unitary axial movement therein, said gears having involute splined portions, coupling means also having involute splined portions intermeshing therewith for angular misalignment and axial movement between said gears and said couplings, and a shaft drivably connected to the coupling means intermeshing with one of said gears, said shaft having abutments operatively engageable with said gear case and said one gear to limit axial movement of said shaft and one gear and thereby limit axial movement of the other of said gears.

2. In an accessory drive gear for an engine the combination of a gear case, intermeshing gears supported for rotation and unitary axial movement therein, one of said gears serving as a main driving gear, a torsionally resilient main driving shaft operably connected to the engine, another of said gears serving as an accessory driving gear, an accessory driving shaft, said main and accessory driving gears and shafts having interengaging involute splined portions permitting relative misalignment and axial movement between said gears and shafts, said accessory driving shaft having abutments operatively engageable with said gear case and said accessory driving gear to limit axial movement of said shaft and said accessory driving gear and thereby limit axial movement of said main driving gear.

3. In an accessory drive gear for an engine the combination of a gear case, intermeshing herringbone gears supported for relative rotation and unitary axial movement therein, one of said gears serving as a main driving gear, another of said gears serving as an accessory driving gear, a main driving coupling operated by the engine, an accessory driving coupling, an accessory driving shaft directly connected to said accessory driving coupling, thrust members fixedly secured to said shaft and operatively engageable by the accessory driving gear and the gear case to limit axial movement of said shaft and accessory driving coupling and thereby limit axial movement of all of said herringbone gears, said main and accessory driving gears and couplings having engaging involute splined portions with curved peripheries for misalignment of said couplings and axial movement between said gears and couplings.

4. In an accessory drive gear for an engine having a frame and an engine driven shaft rotatable in the frame, the combination of an accessory having a housing secured on the engine frame, an accessory driving shaft rotatable in said housing, a gear case secured on the accessory housing having a plurality of support bearing means, a plurality of herringbone gears having the peripheral hub portions supported for relative rotation and unitary axial movement in said bearing support means, one of said gears serving as an accessory driving gear, thrust bearing means secured on the accessory driving shaft cooperating with the accessory driving gear bearing support means of the gear case to limit axial movement of the accessory driving shaft and engageable with the accessory driving gear to limit its axial movement and thereby limit unitary axial movement of all said gears, another of said gears serving as a main driving gear, a main driving shaft operatively connected to the engine driven shaft, said accessory and main driving gear hubs and shafts having engageable involute splined coupling means accommodating misalignment of the coupling means relative to said gears and accessory driving shaft and unitary axial movement of the gears.

5. In an accessory drive for an engine having a frame and a crankshaft rotatable therein, the combination of an engine blower housing securable to the frame and a blower driving shaft rotatable in the housing, a gear housing secured to the blower housing having a plurality of aligned sets of openings serving as support bearing means, a plurality of intermeshing herringbone gears having hub portions rotatable and axially movable in said support bearing means, said blower driving shaft extending axially through one gear hub and the support bearing means therefor and having thrust bearing means on said shaft cooperating with the support bearing means to limit axial movement of said shaft and said gear, said gear hub having internal involute splines, said blower driving shaft having external involute splines, a driving coupling having involute splined portions engageable with the splines of the gear hub and shaft, another of said gears serving as a main driving gear and having internal involute splines, and a main driving shaft operably connectible at one end to the crankshaft and having external involute splines on the other end in engagement with internal involute splines of said other of said gears.

6. An accessory drive for an engine having a frame and a crankshaft rotatable therein, comprising the combination of a blower housing having a blower driving shaft rotatable in the housing, said housing being securable to one end of the frame for rotation of said blower shaft about an axis parallel to the crankshaft, a gear case secured to the blower housing and having bearing openings aligned with the blower driving shaft and other parallel aligned bearing openings located for alignment with the crankshaft, a plurality of intermeshing herringbone gears having splined hubs and projecting end hub portions rotatable and axially movable in the bearing openings of the gear case, a resilient main driving shaft operably connectible to the crankshaft at one end and having splines at the other end engaging the hub splines of one of said gears serving as a main driving gear, one end of said blower driving shaft extending through the hub of another gear serving as a blower driving gear, said blower driving shaft having thrust bearing means thereon engageable with the gear case and the projecting end hub portions of the blower driving gear adjacent each of the bearing openings for the blower driving gear and having splines thereon intermediate the thrust bearing means, and a coupling having splines engageable with the splines of the blower driving gear and shaft.

7. In an accessory drive gear for an engine having a frame and a crankshaft therein, the combination of an

accessory driving shaft, an enclosure therefor mountable on one end of the engine frame for rotation of said driving shaft parallel to the crankshaft, an accessory gear housing mounted on the enclosure, a two part gear case mounted in the gear housing having separate sets of aligned bearing openings located on parallel axes located for each part of the gear case, one set of bearing openings being in alignment with the crankshaft and another set of bearing openings being in alignment with the accessory driving shaft, intermeshing herringbone gears, each having hubs with internal involute splines and opposite end hub portions rotatable and axially movable in one set of bearing openings in the gear case, a torsionally resilient main driving shaft operably connectible to the crankshaft and having external involute splines engaged in the internal involute splines of one gear serving as a main driving gear, said accessory driving shaft extending through the hub of another gear serving as an accessory driving gear, thrust bearing means located on the accessory driving shaft adjacent opposite ends of said blower driving gear and the bearing openings therefor and engageable therewith to limit axial movement of accessory driving shaft and gear, said accessory driving shaft having external involute splines located within the accessory driving gear hub and coupling means having involute splines engaging the involute splines of both the accessory driving shaft and gear, all of said engaging involute splines being longitudinally convex for angular misalignment as well as axial movement.

8. In a drive mechanism, the combination of rotatable driving and driven members, each having a splined portion, a torsionally flexible shaft having splined end portions, the splined portion of one member slidably engaging one splined end portion of the shaft, and a coupling member axially slidable on the shaft and having separate splined portions engaging the other splined end portion of said shaft and the splined portion of said other member respectively, the splines of one splined portion of said coupling being longitudinally convex.

9. In a drive mechanism, the combination of rotatable driving and driven members, each having a splined portion, a torsionally flexible shaft having splined end portions, and a coupling member slidably splined on one of said end portions and having other longitudinally convex splines, one splined end portion being longitudinally convex and slidably engaging the splined portion of one member, the other splined end portion engaging the splined portion of said other member.

10. In a drive mechanism, the combination of coaxial rotatable driving and driven members, a flexible shaft connected at one end to the driving member and having a splined portion adjacent the opposite end, and a coupling member slidably splined on said portion and having other longitudinally convex splines, the driven member having a splined portion in slidable and angular driving engagement with the convex splines of the coupling.

11. In a drive mechanism, the combination of driving and driven members rotatable about parallel axes, a plurality of intermeshing gears mounted for rotary and unitary axial movement on said axes, one serving as a driving gear and another serving as a driven gear, said driving and driven gears having internal splines, a flexible shaft connected to the driving member and having a longitudinally convex splined portion engaging the internal splines of the driving gear, said driven member having a splined portion and thrust means thereon, thrust means on the driven gear engageable by the thrust means on the driven shaft, stationary thrust means engageable by the thrust means on the driven shaft to limit axial movement of the driven shaft and thereby limit axial movement of the gears, and a coupling member having separate longitudinally convex splined portions respectively engaging the splined portions of the driven shaft and driven member.

12. In a drive mechanism, driving and driven shafts having internal and external splines, respectively, and rotatable about parallel axes, the peripheral portions of the splines of the driven shaft being curved, a plurality of intermeshing herringbone gears mounted for rotary and unitary axial movement about said parallel axes, one gear serving as a driving gear and having internal splines, a torsionally flexible shaft operably connected at one end to the driving shaft and having external splines at its other end provided with curved peripheral portions in engagement with the internal splines of the driving gear, another of said gears serving as a driven gear and having internal splines with curved peripheral portions, a coupling member having axially spaced internal and external splined portions provided with curved peripheral portions respectively engaging the external splines of the driven shaft and the internal splines of the driven gear, mutually engageable thrust surfaces on the driven gear and driven shaft and fixed thrust surfaces engageable by certain of the first mentioned thrust surfaces to limit axial movement of the driven gear and driven shaft and thereby limit axial movement of the driving gear.

13. In a drive mechanism the combination of a rotatable driven shaft having axially spaced thrust surfaces thereon and longitudinally convex splines thereon intermediate said thrust surfaces, support bearings spaced axially apart and in concentric relation with the driven shaft and engageable by the thrust surfaces thereon, a driving gear located between and rotatable in the support bearings and having internal longitudinally convex splines axially spaced from the splines of the driven shaft and a coupling having axially spaced splined portions, one splined portion of the coupling engaging the splines of the driving shaft and the other splined portion engaging the splines of the driven shaft.

14. In a drive mechanism the combination of a frame, a driven shaft rotatable in the frame and having external longitudinally convex splines on a projecting end portion of the driven shaft and spaced thrust surfaces facing the respective ends of the splines, axially spaced bearings removably secured on the frame in concentric relation with the shaft intermediate the thrust surfaces thereon and engageable thereby, a driving gear having spaced hub portions rotatable in the bearings and engageable with the thrust surfaces of the driven shaft and internal longitudinal convex splines in one hub portion, and a misalignment coupling member having external longitudinally convex splines at one end slidably engaging the gear hub splines and internal longitudinally convex splines at the other end slidably engaging the splines of the driven shaft.

15. In a drive mechanism the combination of a frame, a driven shaft rotatable in the frame and having a projecting end portion, thrust members removably secured in spaced axial relation on the projecting end of the driven shaft, one of said thrust members having a portion with longitudinally convex external splines extending toward the other thrust member, axially spaced bearings removably secured on the frame in concentric relation with the projecting end of the shaft and engageable endwise by the thrust members, a driving gear having opposite end hub portions rotatable in the support bearings and engageable endwise with the thrust members, one of said gear hub portions having internal longitudinally convex splines, and a hollow misalignment coupling having an external longitudinally convex splined portion slidably engaging the internal splined portion of the gear and an internal longitudinally convex splined portion slidably engaging the splined portion of the driven shaft.

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