May 12, 1970 R. H. BRANDES 3,511,102

VARIABLE STROKE SWASH PLATE MECHANISM AND ADJUSTING MEANS THEREFOR

Filed July 9, 1968

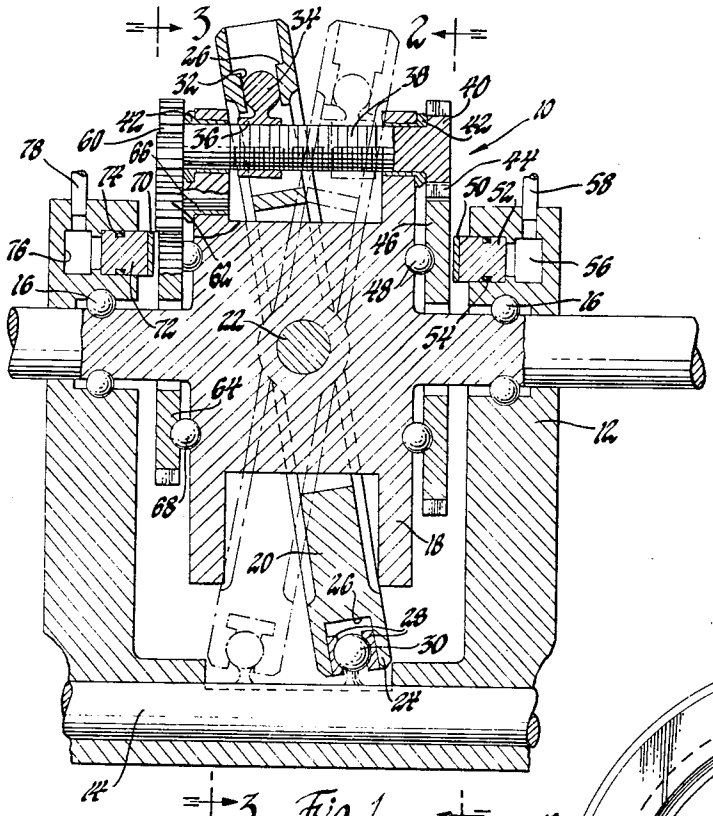


Fig. 1

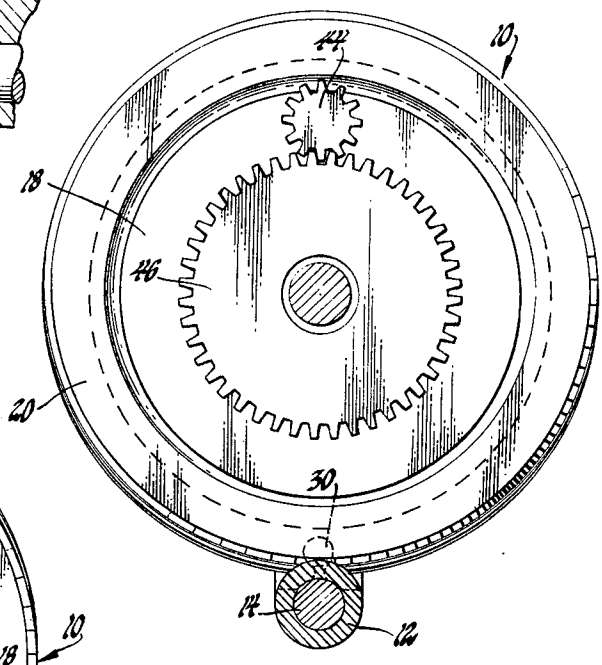


Fig. 2

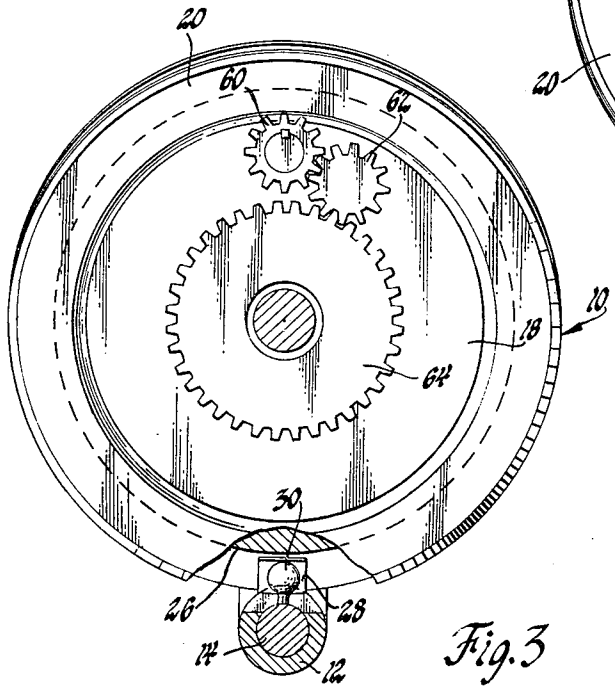


Fig. 3

INVENTOR.
Roy H. Brandes

BY
Robert J. Outland
ATTORNEY

United States Patent Office

3,511,102

Patented May 12, 1970

3,511,102

VARIABLE STROKE SWASH PLATE MECHANISM AND ADJUSTING MEANS THEREFOR

Roy H. Brandes, Utica, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed July 9, 1968, Ser. No. 743,480
Int. Cl. F16b *33/10*; F02b *75/04*; F01b *13/04*
U.S. Cl. 74—60 3 Claims

ABSTRACT OF THE DISCLOSURE

In a preferred embodiment, a hot gas engine includes a swash plate mechanism which is adjustable for varying the stroke of the engine pistons. Adjustment of the swash plate is accomplished by an adjusting screw actuated by gear means which are engaged by one of two hydraulic clutches to rotate the adjusting screw in a stroke lengthening or stroke shortening direction, as desired.

FIELD OF THE INVENTION

This invention relates to adjustable swash plate mechanisms especially for use as a variable stroke drive for a reciprocating piston machine. In its more particular aspects, the invention relates to the combination of such mechanisms in a hot gas engine of the Stirling cycle type so as to provide means for controlling the speed and power of the engine by varying the stroke lengths of the pistons.

DESCRIPTION OF THE PRIOR ART

The use of swash plate mechanisms, sometimes called wobble plate mechanisms, is well known in the art relating to reciprocating piston machines including engines, pumps and the like. It is also known to vary the angular position of such a swash plate in order to vary the stroke of the pistons and thus change the operating characteristics of the machine. It is further known in the prior art to construct a hot gas engine having a plurality of cylinders reciprocating on parallel axes and delivering power to a crankshaft through a fixed angle wobble plate mechanism. One such arrangement is disclosed in FIGS. 4 and 5 of U.S. Pat. No. 2,480,525—Van Weenen.

SUMMARY OF THE INVENTION

The present invention relates to variable angle (adjustable) swash plate mechanisms for use in reciprocating piston machines. A particular arrangement encompassed by the invention provides rotatable adjusting means which are actuated through the engagement of clutch means so as to use the rotation of the swash plate in its housing as a source of power for adjusting the plate angle. Although the proposed arrangement is particularly intended for use in a hot gas engine of the Stirling cycle type, its use is not so limited and might be appropriately extended to other reciprocating piston machines.

When used in a Stirling engine, the arrangement has the advantage that hydraulic or other fluid pressure controlled by a governor or throttle may be used to actuate the clutches so as to increase or decrease the swash plate angle. This, in turn, controls the piston stroke which determines the power output of the engine and thus a simple means of controlling engine speed of power is provided. Other objects and advantages of the invention will be apparent from the following description of a preferred embodiment taken in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a cross-sectional view, schematically representing a Stirling cycle hot gas engine having an adjustable swash plate variable stroke mechanism according to the invention;

FIG. 2 is a cross-sectional view taken in the plane generally indicated by the line 2—2 of FIG. 1 and showing one of the gear adjusting means; and

FIG. 3 is a cross-sectional view taken in the plane generally indicated by the line 3—3 of FIG. 1 and illustrating the other gear adjusting means.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, numeral **10** generally indicates a hot gas engine of the Stirling cycle type having a housing **12** in which are reciprocably disposed a plurality of pistons (not shown) connected to a reciprocable shaft **14**. Although only one shaft **14** is illustrated, it should be understood that numerous such shafts could be spaced on parallel axes around the periphery of the engine housing and that reciprocating pistons could be disposed on either or both ends of such shafts.

Housing **12** also supports on bearings **16** a rotor **18** on which is pivotally supported a swash plate or wobble plate **20**. Swash plate **20** is arranged to pivot on a laterally extending shaft **22** and has a circular periphery **24** having an outwardly opening groove **26** extending therearound. A pair of slide bearings **28** are received within groove **26** and connect therein with a spherical ball **30** which is secured to shaft **14** for reciprocation therewith.

In the swash plate inwardly of groove **26**, a recessed portion **32** receives the spherical end **34** of a traveling nut **36**. Nut **36** is carried for longitudinal movement on the threaded portion **38** of a positioning or adjusting screw **40** which is rotatably supported in bearings **42** mounted in the rotor **18**. At one end, adjusting screw **40** has a gear wheel **44** which is engaged with a first adjusting gear **46** carried for rotation on the rotor by bearings **48**. The gear **46** is arranged to be engaged by the friction surface **50** of reciprocable clutch piston **52** for a purpose to be subsequently described. Piston **52** includes a suitable seal such as O ring **54** to prevent leakage of fluid from a chamber **56** behind the piston which connects through conduit **58** with a source of pressure fluid such as a governor or throttle device.

At the end opposite gear **44**, adjusting screw **40** has a second gear wheel **60**. Gear wheel **60** engages an idler gear **62** which, in turn, engages a second adjusting gear **64**. Gears **62** and **64** are rotatably mounted on the housing on bearings **66** and **68** respectively. Adjusting gear **64** is adapted to be engaged by the friction surface **70** of a second reciprocable clutch piston **72** which, like piston **52**, includes seal means **74** and is open to a fluid chamber **76** that connects through a conduit **78** with a source of fluid pressure.

The operation of the construction is as follows. Reciprocating action of the shaft **14** in response to gas forces applied to the engine pistons causes the swash plate **20** to be rotated in a desired direction, depending on the construction and operation of the engine. The housing **12**, with its reciprocating shaft **14**, of course, remains stationary.

If it is desired to change the stroke of the pistons so as to alter the speed or power of the engine, a hydraulic or other fluid pressure is applied to the appropriate one of the pistons **52**, **72**. Assuming the pressure is applied to piston **52**, friction surface **50** contacts adjusting gear **46**, the rotation of which is thus slowed down or stopped.

This causes rotation of the gear train and adjusting screw **40** in the rotor, traversing the nut **36** and changing the angular position of the swash plate **20** accordingly. The change in position reduces or increases the power of the engine as the stroke of the pistons is reduced or increased by the previously described action which, of course, depens on the original position of the swash plate, direction of lead on the adjusting screw and the direction of rotation of the rotor.

If then, it is desired to make a change in power in the engine, opposite to that made by the previously described method, it is only necessary to apply fluid pressure through conduit **78** to actuate piston **72** with its friction surface **70** into engagement with its adjusting gear **64**. Through the engagement of gear **64** with idler gear **62** and gear wheel **60**, this action rotates the adjusting screw **40** in the opposite direction to the previously described action, returning the nut **36** toward its previous position and adjusting the piston stroke and accordingly the engine power in the desired manner.

While the invention has been described by reference to a particular embodiment, schematically represented by the drawing, it should be apparent that numerous changes might be made in the details of the mechanism and its components without departing from the spirit and scope of the invention.

I claim:

1. Variable stroke mechanism for a reciprocating piston machine having a housing and at least one piston reciprocable in said housing, said mechanism comprising

a rotor rotatably supported by said housing,

a swash plate pivotally supported on said rotor for rotation therewith and connected with said piston to correlate rotation of said rotor with reciprocation of said piston,

movable adjustment means carried on said rotor and arranged to pivotally adjust said swash plate so as to vary the stroke of said piston, and

clutch means in said housing and arranged to upon engagement, connect said adjustment means to said housing to move said adjustment means in response to rotation of said rotor and thereby pivotally adjust said swash plate.

2. The mechanism of claim **1** wherein said movable adjustment means includes

a rotatable adjustment member connected with said swash plate for pivotal adjustment thereof,

first gear means connected with said adjustment member and

second gear means connected with said adjustment member and said clutch means comprises

first friction means having a surface engageable with said first gear means to move said adjustment member in one direction upon rotation of said rotor in a predetermined direction, and

second friction means having a surface engageable with said second gear means to move said adjustment member in the other direction upon rotation of said rotor in said predetermined direction.

3. The combination of claim **2** and further including first and second clutch actuating means carried by said housing and connected with said first and second friction means, respectively, so as to engage one of said friction means with its respective gear means upon application of a suitable fluid pressure to the associated one of said actuating means.

References Cited

UNITED STATES PATENTS

225,651	3/1880	Silver	103—162
511,044	12/1883	Cooper et al.	
1,241,624	10/1917	Guy	74—60
1,407,047	2/1922	Trowbridge.	
1,763,397	6/1930	Hutchinson.	
2,465,638	3/1949	Eckert	74—60
3,139,006	6/1964	Budzich	91—199
3,319,874	5/1967	Welsh et al.	

WENDELL E. BURNS, Primary Examiner

U.S. Cl. X.R.

91—199; 103—162; 123—48, 58, 78; 230—178