Oct. 6, 1936. J. F. GELNAW 2,056,719

ELECTRIC MOTOR

Filed Dec. 29, 1933 2 Sheets-Sheet 1

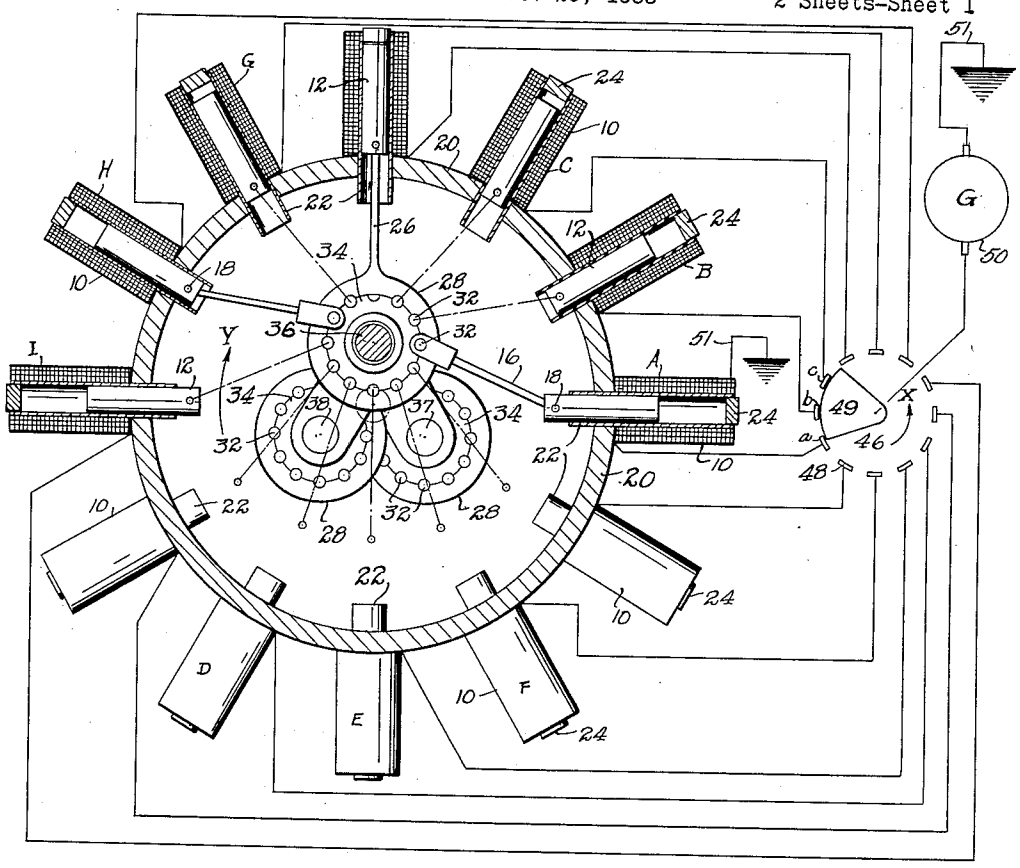

Fig.1

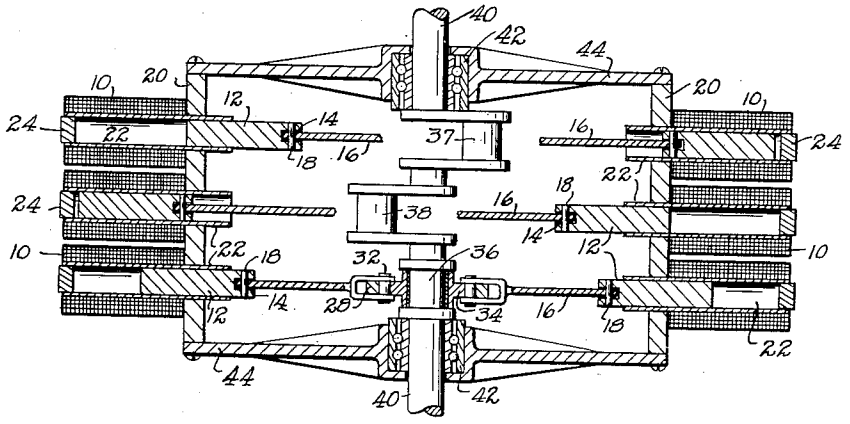

Fig.2

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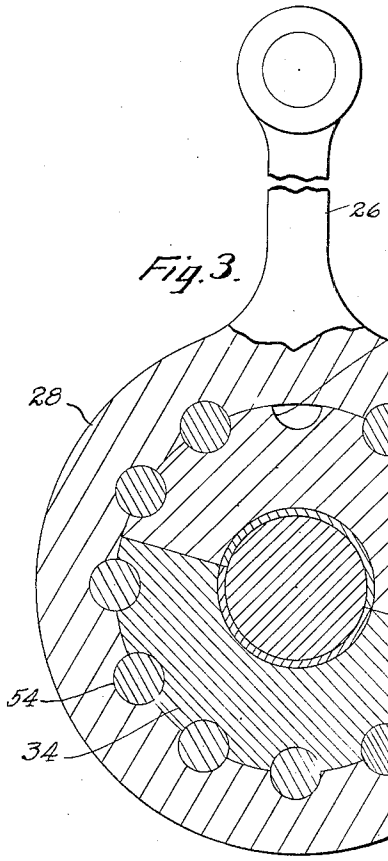

Fig. 3.

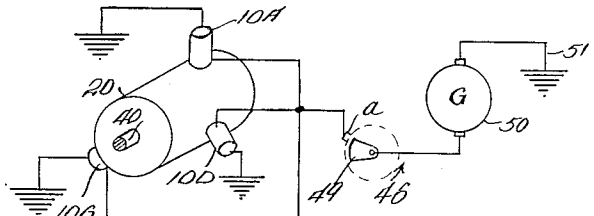

Fig. 6.

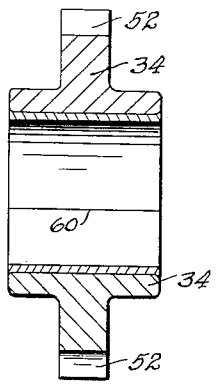

Fig. 5

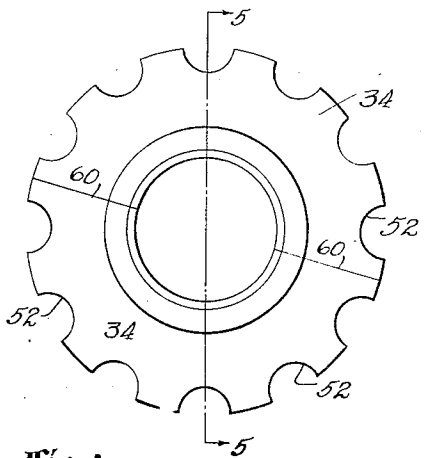

Fig. 4

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ELECTRIC MOTOR

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2 Claims. (Cl. 172—126)

This invention relates to an electric motor, and in particular to a reciprocating piston, radial type, electric motor.

A general object of the invention is to provide an electric motor having reciprocating pistons in solenoids radially arranged and adapted to deliver a smooth flow of energy to a drive shaft.

Another object is to provide an electric motor having reciprocating pistons in solenoids radially arranged in different planes in which power strokes of the pistons in one plane are delivered to a drive shaft simultaneously with the power strokes of pistons in other planes but at a predetermined relative angular relation.

Another object is to provide a radial type motor having reciprocating pistons actuated by cooperating solenoids in which the solenoids are only intermittently in use during each revolution of the motor, thereby making possible a more economical design and one having relatively low winding losses.

Among other objects my invention contemplates a radial type electric motor of rugged and simple construction, and one adapted to be manufactured economically. Other and more specific objects will be apparent from the following description taken in connection with the attached drawings, in which

Fig. 1 is an elevation partly in section, and somewhat diagrammatical, illustrating an embodiment of my invention.

Fig. 2 is a transverse sectional view of that in Fig. 1.

Fig. 3 is an enlarged detail view, partly in section, of a portion of the connecting rod mechanism.

Figs. 4 and 5 are further detail views of this same mechanism.

Fig. 6 is a diagrammatic view illustrating a wiring arrangement used in an embodiment of my invention.

Referring now to Figs. 1 and 2, there is shown a plurality of solenoids **10** having cooperatively associated therewith magnetic pistons **12**, which are slotted at **14** to receive the ends of connecting rods **16** secured thereto as by pins **18**. The solenoids **10** may be supported on the periphery of a supporting annulus **20**, as shown. Within each solenoid is a liner member **22** in which the pistons **12** reciprocate. Each solenoid may have a stop or cap member **24** located in one end. This member may be apertured to prevent compression of air between it and the end of the pistons. The solenoids may be arranged radially in different axial planes or rows, as shown in Fig. 2, and for a purpose which will more fully hereinafter appear.

Cooperating with one solenoid in each plane or row is a master connecting rod **26** having a ring portion **28** integral therewith. Individual or separate connecting rods **16** to each piston are pivotally connected with the master connecting rod **26** by pins **32**. Bearing members **34** are rotatably disposed on crank pins **36**, **37** and **38** rigid with the drive shaft **40**. The drive shaft may be supported in suitable bearings such as those shown at **42** and supported in hub or end members **44** secured to the supporting annulus **20**.

Rigid with the drive shaft **40** and insulated therefrom is a commutator, diagrammatically illustrated at **46**. Each solenoid **10** has one terminal thereof suitably connected to a corresponding segment **48** on the commutator **46** in a manner to be indicated later, and rotating brush member **49** slidably contacts with these segments. The commutator diagrammatically illustrated in Fig. 1 is shown as being disposed on the end of shaft **40** at the top in Fig. 2, so that if the drive shaft **40** rotates in the direction indicated by the arrow Y the commutator will rotate in a direction indicated by the arrow X.

As shown in Fig. 2, the solenoids **10** may be arranged axially in rows corresponding to the number of crank pins associated with the drive shaft **40**. As shown, there are three rows or planes axially, each row having solenoids actuating pistons connected to ring portions **28** on the crank pins **36**, **37** and **38**, respectively.

The solenoids **10** may be connected to the commutator **46** in various ways. One preferred method is to parallel certain solenoids in different planes at a proper angular relation. For example, referring to Fig. 1 and Fig. 6, I may connect the solenoids in one plane at positions indicated at A, B, and C to commutator segments *a*, *b*, and *c*, respectively. Also solenoids in another plane at positions indicated at D, E, and F, and in still another plane at positions indicated at G, H, and I may be paralleled with the solenoids at A, B, and C, respectively, by connecting to the segments *a*, *b*, and *c*, respectively.

The operation of the embodiment illustrated is as follows: Assuming the brush member **49** to be connected to a suitable source of supply, as the generator indicated diagrammatically at **50**, and each solenoid having a common connection therewith, as indicated at **51**, when the brush member is contacting with the segments *a*, *b*, and *c*, solenoids at A, B and C in one row or plane and solenoids in another row corresponding to

positions D, E and F, and solenoids in a third row at positions indicated at G, H and I will be simultaneously energized to exert a pull on the pistons therein. It will thus be clear that each of the crank pins **36**, **37** and **38** will have a pull exerted thereon continuously throughout rotation of the shaft **40**, and that the pull will be angularly disposed, so that the drive shaft **40** has imparted thereto a substantially smooth flow of power.

Instead of using one commutator and paralleling coils in different planes of solenoids, I may use a separate commutator for each plane and control the solenoids in a manner like or similar to that just described.

While in Figs. 1 and 2 there have been shown three axial rows or planes of solenoids, it will be obvious that by providing fewer or additional crank pins associated with the drive shaft a lesser or greater number, respectively, of axial rows may be provided; the greater the number of rows the smoother will be the flow of energy and the greater the power delivered to the drive shaft. However, I have found that with the arrangement illustrated in these two figures, for all practical purposes a continuously smooth flow of power is produced.

In Figs. 3, 4, and 5 I have illustrated details of one form that my connecting rod mechanism may take. As there shown, the master connecting rod **26** has integral therewith a ring portion **28** concentric with and having disposed inside thereof a bearing member **34**. The bearing member **34** has equi-distantly spaced therearound a series of recesses **52** adapted to register with similar recesses **54** in the ring portion **28**, to receive and support connecting rod retaining pins **32**. The connecting rods **16** may have bifurcated heads **58** adapted to embrace the pins **32**, as shown. The bearing member **34** may be split as indicated as **60** to facilitate assembly of the mechanism.

Various other and further modifications of my invention can obviously be made, and I do not desire to be limited to the exact details of construction shown, but include such other and further modifications as are within the spirit and scope of the appended claims.

I claim:

1. A radial type electric motor comprising a plurality of solenoids annularly disposed in a plurality of planes, there being corresponding solenoids in each plane, pistons in the solenoids, a crank shaft, means connecting said pistons to said crank shaft, a commutator, and connections from said solenoids to said commutator paralleling solenoids in one plane with solenoids in other planes disposed at an angular relation to said first solenoid.

2. In a radial type electric motor, the combination of a plurality of solenoids angularly disposed in different planes, the solenoids in each plane having corresponding solenoids in the other planes, pistons in said solenoids, a crank shaft having angularly disposed crank pins, means connecting the pistons in each plane to one of said pins, and means for successively and intermittently energizing adjacent groups comprising less than all of said solenoids in each plane to cause a substantially constant pull to be exerted on said crank pins.

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