

Feb. 27, 1951

G. D. ANGLE

2,543,541

RADIAL ENGINE WITH GENERATOR

Filed June 13, 1947

3 Sheets-Sheet 1

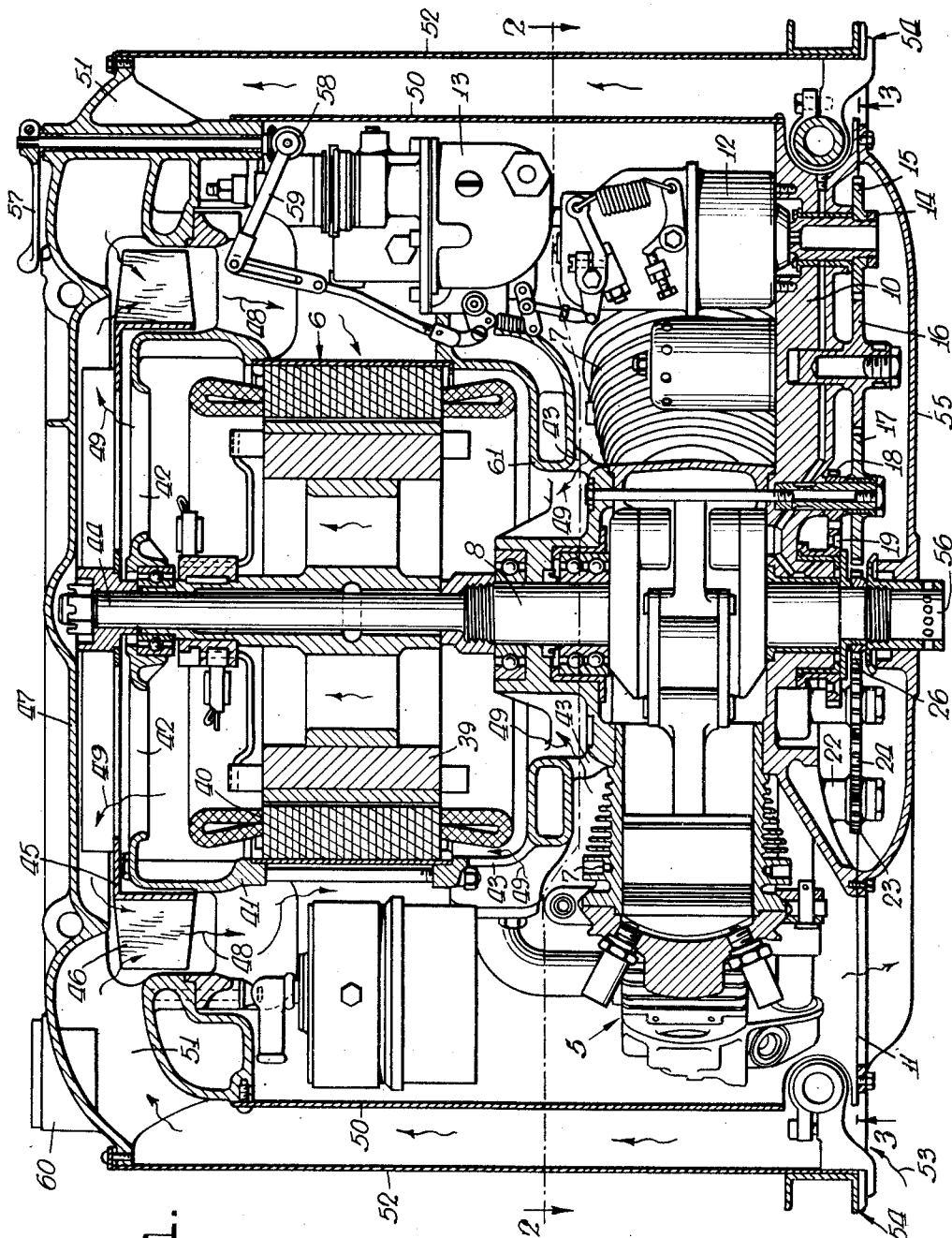


FIG. 1.

INVENTOR
Glenn D. Angle
BY
Mitchell Baker
ATTORNEYS

Feb. 27, 1951

G. D. ANGLE

2,543,541

RADIAL ENGINE WITH GENERATOR

Filed June 13, 1947

3 Sheets-Sheet 2

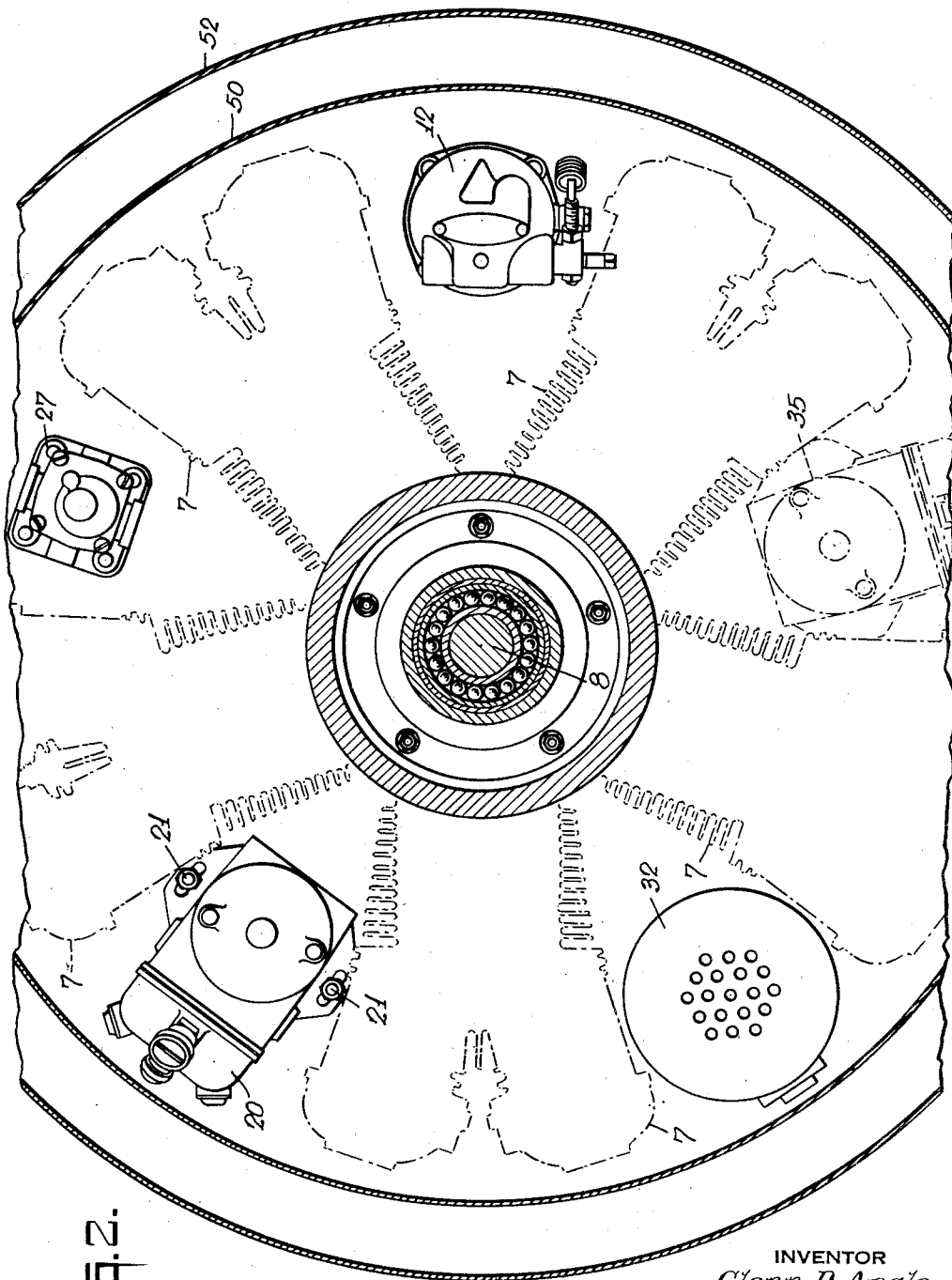


Fig. 2.

INVENTOR
Glenn D. Angle
BY
Mitchell B. Burt
ATTORNEYS

Feb. 27, 1951

G. D. ANGLE

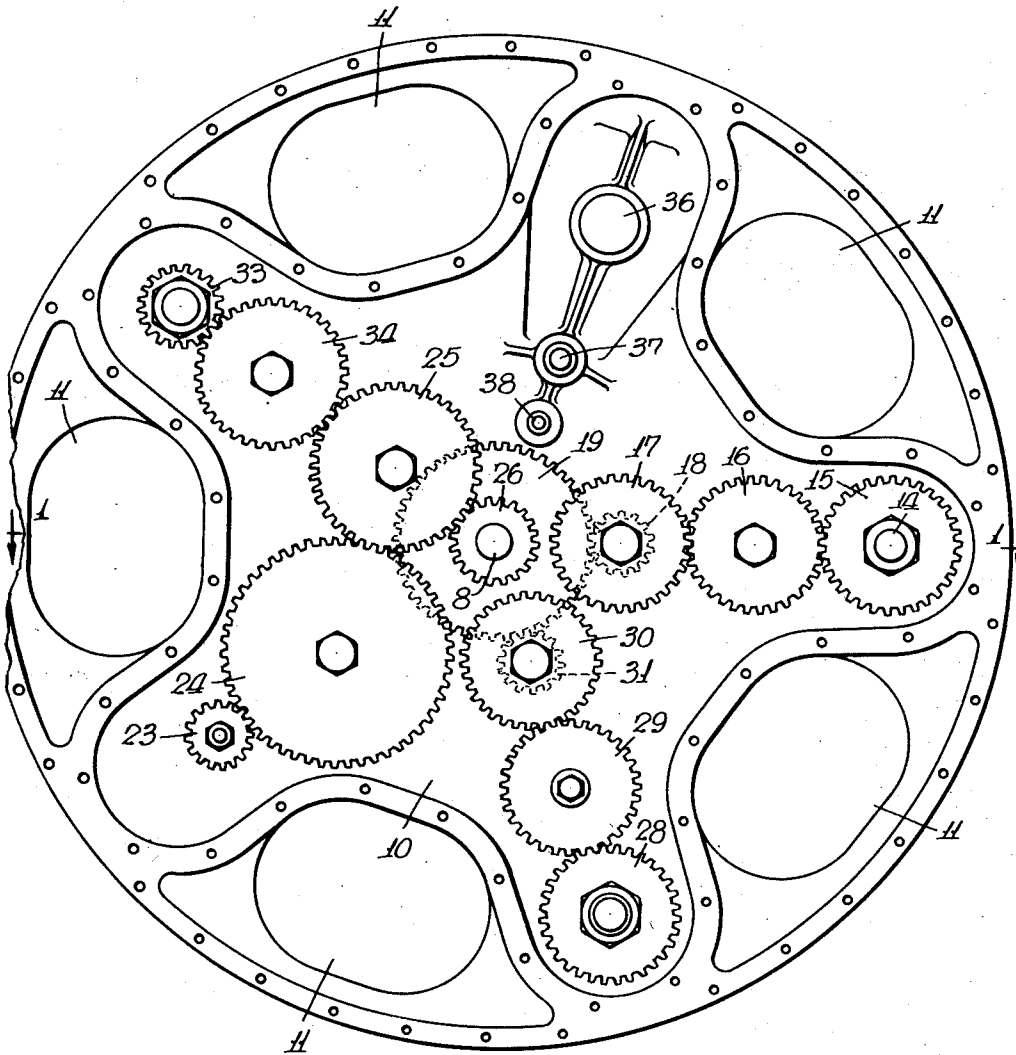
2,543,541

RADIAL ENGINE WITH GENERATOR

Filed June 13, 1947

3 Sheets-Sheet 3

FIG. 3.



INVENTOR
Glenn D. Angle
BY
Mitchell Burkett
ATTORNEYS

UNITED STATES PATENT OFFICE

2,543,541

RADIAL ENGINE WITH GENERATOR

Glenn D. Angle, Thomaston, Conn., assignor to
The New Britain Machine Company, New Britain,
Conn., a corporation of Connecticut

Application June 13, 1947, Serial No. 754,555

5 Claims. (Cl. 290—1)

1

2

My invention relates to motor-generator assemblies and in particular to a generator driven by an internal-combustion engine.

It is an object of my invention to provide an improved and more compact motor-generator of the character indicated.

It is a specific object to provide improved lightweight and compact means for generating current and suitable for use as an auxiliary electric power plant in an aircraft.

It is a further object to provide an improved cooling means for a device of the character indicated.

Still another object is to provide a more compact radial internal-combustion engine.

Other objects and various further features of the invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings:

Fig. 1 is a vertical sectional view of an engine-alternator assembly incorporating features of the invention;

Fig. 2 is a sectional view taken substantially in the plane 2—2 of Fig. 1 and showing a generally plan view of the engine in the Fig. 1 assembly; and

Fig. 3 is a view taken substantially in the plane 3—3 of Fig. 1.

Briefly stated, my invention contemplates an engine-generator assembly in which many of the internal-combustion-engine accessories such as ignition means, fuel-pump means, governor means and the like, may be located in the spaces between cylinders and in which the electric generator may, therefore, be mounted immediately adjacent the main engine assembly. In the specific form to be described, driving means for the various engine accessories and for an exciter or polarizing generator (also located in a space between cylinders) are provided at the end of the engine opposite from the end on which the electric generator is mounted, and a novel arrangement of cooling ducts cooperates with a fan to supply an efficient distribution of cooling air to the engine, to the alternator, and to the various accessories.

Referring now to the drawings, my invention is shown in application to an electric power plant comprising a radial-type internal-combustion engine 5 and an electric alternator 6. In the form shown, the engine 5 comprises five air-cooled cylinders 7 radially directed and angularly spaced about a drive shaft 8, which may be the crankshaft for the engine. The drive or crank-

shaft 8 may be partly journaled as at 9 in a base or frame member 10, so as to support the engine and its drive shaft on a vertical axis. For reasons which will later be clear, the base member 10 preferably includes a plurality of openings 11 of substantial size, in general angular alignment with the cylinders 7 of the engine. In the form shown, therefore, there are preferably five openings 11 in the base member 10.

In accordance with a feature of the invention, the end-to-end dimensions of the engine may be very substantially reduced, as compared with conventional engines, by suitably locating various of the engine accessories in the angular spaces between cylinders 7 of the engine. For example, a governor 12 for a carburetor 13 may be mounted on the base member 10 between two adjacent cylinders, and the drive means for the governor 12 may be journaled as at 14 in the base member 10. Preferably, the governor drive means 14 is directly driven from the crankshaft 9 by means of a train of gears 15—16—17—18—19—all located at one side or end of the engine 5, that end being opposite from the side on which the alternator 6 is mounted.

Ignition means such as a magneto 20 may be mounted in the space between two other adjacent cylinders 7 and secured as by bolts 21 to the base member 10, with a drive connection 22 journaled in the base member 10. Again, the drive for the magneto 20 may be by means of a gear train 23—24—25—26 directly coupled to the crankshaft 8, the gear train 23—24—25—26 being located on the side of engine 5 opposite from the side on which the alternator 6 is supported.

In a similar manner, another fuel-regulating accessory, such as a pump 27, may be mounted in another space between cylinders and supported on and journaled in the base member 10. Drive means including a train of gears 28—29—30—31 may directly couple the fuel pump to the gear 19, which in turn is carried by the crankshaft 8.

In the form shown, an exciter or polarizing generator 32 for supplying field current to the alternator 6 may also be located in a space between adjacent cylinders 7. The generator 32 may be mounted on the base member 10 and include a drive shaft journaled therein and geared as by a train 33—34—35—36 to the crankshaft 8.

In the present case, wherein a five-cylinder engine 5 is employed, there is one remaining or additional space between cylinders, and I prefer to employ this space for the accommodation of a spare magneto 35. The magneto 35 is not shown mounted, but it will be understood that

bearing means 36—37—38 may be provided in the base member 10 to provide suitable support for gearing a magneto drive directly to the crankshaft 8.

As indicated generally above, the alternator 6 is preferably mounted adjacent the engine 5 and on the side opposite that on which the gear drives for the various accessories are located. The alternator 6 may comprise a rotor 39, a stator 40, and a housing 41 extending generally circumferentially of the alternator and preferably having openings 42—43 at both ends of the alternator assembly.

In the form shown, the shaft 44 supporting the rotor 39 carries a fan 45 at the upper end thereof. The fan 45 includes blade elements having surfaces 48 which are preferably at least partially effective circumferentially outside of the alternator housing 41. A cover member 47 is longitudinally spaced from fan 45 and radially over-stands preferably at least a part of the fan blades 46. It will be seen that the fan blades 46 may be effective to direct blasts of cooling air generally in the direction of the heavy arrows shown in Fig. 1, that is, generally coaxial with the alternator axis and in a first direction external of the alternator housing 41. It will be understood that the pressure drop in the cooling blast from end to end of the alternator on the outside thereof may be sufficient to induce a reverse flow of coolant air within the alternator, that is, the main draft may be downwardly directed as indicated by arrows 48, and the reverse draft may be upwardly directed as indicated by arrows 49.

In accordance with a further feature of the invention, the cooling system for the entire alternator assembly may be rendered further effective, and the blasts of cooling air may be so confined as not to inconvenience any one operating the machine from the top side. In the form shown, a first housing member 50 extends circumferentially of the engine 5 and of the alternator 6. The housing member 50 may be attached circumferentially to the base member 10 and to a part of the upper cover casting 47. The cover casting 47 may include generally radially directed duct means 51 so as to extend the effective circumferential coverage of the member 50 to include the fan 45. There is thus formed a generally annular cooling duct between the circumferential housing 50 and the alternator 6 of the engine 5. The inlet to the duct means 51 will be understood to be at the fan blades 46, and the outlet may exhaust through the openings 11 in the base 10.

With the structure described, it will be appreciated that inlet cooling air may be entrained external of the ducts 51 and downwardly blasted by means of the fan blades 46. The main blast will be directed past the cylinders 7 and their cooling fins, for exhaust through the openings 11 at the bottom of the machine. A small fraction of this downward blast will be entrained in the ports 43 for a reversal of cooling flow upward through the alternator 6.

The convenience and effectiveness of my engine alternator may be still further improved by provision of a second external housing member 52 radially spaced from the housing member 50 and circumferentially overlapping the same. It will then be appreciated that inlet cooling air will be entrained in the annular space between members 52—50 at the bottom of the machine (as indicated schematically by the arrow 53). The entrained air will be drawn upwardly through the annular passage between the members 50—52

and then directed through the ducts 51 to the fan blades 46—after which circulation may be as generally described above.

To complete the over-all assembly which has been described suitable mounting brackets 54 may be provided at the bottom of the assembly, and a cover plate 55 may encase the gears driving the accessories 12, 21, 27, 32, 35, which are located between cylinders.

To operate my alternator assembly, starting torques may be applied through conventional starter attachments (not shown) at the bottom and projecting end 56 of the crankshaft 8. Once started, the field generator 32 may supply polarizing current to the field of the alternator 6, and the electrical output may be distributed by conventional methods. Engine speed may be regulated to provide a desired output, as by means of adjustment of a regulating lever 57. In the form shown, the lever 57 cranks a bevel-gear train 58 to raise or lower a crank 33 for controlling the governor 12, so that the latter may appropriately regulate the adjustment of carburetor 13. Electrical output of the alternator 6 and of the field generator 32, together with various pressure magnitudes indicative of engine performance, may all be monitored by observance of meters, such as the meter 60, mounted in the top cover member 47 of the assembly.

It will be appreciated that I have described an efficient and compact arrangement of a radial engine to drive an electric generator. The compacting of parts is made possible largely through a novel arrangement of the accessory devices associated with the internal-combustion engine and also by preferably locating the drives for these accessories on one side of the engine. The other side of the engine is then relatively clear for the accommodation of the alternator 6, and, by judicious design, even the manifolds for the engine 5 may be formed integral with the lower part or casting 61 of the alternator housing.

While I have described my invention in detail for the preferred form shown, it will be understood that modifications may be made within the scope of the invention as defined in the appended claims.

I claim:

1. In an electric generator, a radial internal-combustion engine, an electric generator coupled to said engine and coaxial therewith, said generator comprising a stator coaxial with a rotor and a housing open at both ends and extending circumferentially of said rotor and said stator, an assembly housing including a member extending circumferentially of said engine and of said first housing and radially spaced therefrom, a fan driven by said engine and axially aligned with said engine and generator to produce a flow generally parallel to the axis of said engine and generator, said flow being directed substantially in the annular space between said housings, and a cover longitudinally spaced from an end of the first-mentioned housing and radially overlapping a part of said fan, whereby a direct draft may be circulated past said engine and may cause an indirect draft of cooling air through said generator.

2. In an engine-and-generator assembly of the character indicated, a radial internal-combustion engine having a drive shaft, a generator having a rotor directly coupled to said drive shaft, said generator having a circumferentially extending housing open at both ends, a fan driven by said engine and having blades sweeping externally of said generator housing so as to produce a flow

5

directed generally coaxially of said generator, a second housing member extending circumferentially of said engine and of said fan and generator, a third housing member extending circumferentially of said second housing member, and a cover effectively closing one end of said third housing member and spaced from said second housing member and from said generator; whereby a coaxial flow of cooling air may be circulated by said fan in one direction in the annular space between said second and said third housing members, in a reverse direction in the annular space between said generator and said second housing member, and in said one direction within said generator.

3. In an engine-and-generator assembly of the character indicated, an internal-combustion engine including a plurality of radially directed cylinders and a drive shaft normal to the radial plane of said cylinders, a generator coupled to said drive shaft and including a housing with cooling openings, a further housing member circumferentially spanning and radially spaced from said engine and from said generator, and a fan coupled to said drive shaft and including blades overstanding the annular space between said housing and said generator, whereby said fan may force a direct blast of cooling air past said cylinders, and whereby such direct blast may through said openings indirectly cool said generator.

4. An engine-and-generator assembly according to claim 3, in which engine-driven accessories for said engine are disposed between said cylinders, whereby the constriction presented by said cylinders and by said accessories may effectively force accelerated flow of cooling air past said cylinders and said accessories.

5. In a device of the character indicated, a radial internal-combustion engine, a base in which the crankshaft of said engine is partly journaled, said base having openings in general

6

alignment with the cylinders of said engine, a generator on the other side of said engine, a fan on the other side of said generator, a housing member circumferentially spanning said base and said engine and said generator and said fan, whereby said fan may direct cooling air in the annular space between said generator and said housing past the cylinders of said engine and through the openings of said base, said generator being substantially completely enclosed except for an opening at each end, and a cover member longitudinally spaced from and overstanding a part of said fan, whereby the pressure drop in the flow of cooling air along the outside of said generator will cause a reversed flow of cooling air within said generator.

GLENN D. ANGLE.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
25 1,573,883	Vining -----	Feb. 23, 1926
1,751,958	Treiber -----	Mar. 25, 1930
1,848,511	Adamcik et al. ----	Mar. 8, 1932
1,913,199	Gossiau -----	June 6, 1933
1,924,462	Scofield -----	Aug. 29, 1933
30 2,209,363	Sutherland -----	July 30, 1940
2,240,664	Moore -----	May 6, 1941
2,260,042	McMahan -----	Oct. 21, 1941
2,288,017	Neuland -----	June 30, 1942
2,366,852	Goodman -----	Jan. 9, 1945
35 2,383,996	Stucke -----	Sept. 4, 1945
2,410,471	Warner -----	Nov. 5, 1946

FOREIGN PATENTS

Number	Country	Date
40 149,875	Great Britain -----	Aug. 26, 1920
545,035	Germany -----	Feb. 24, 1932