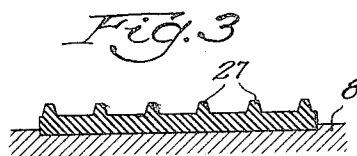
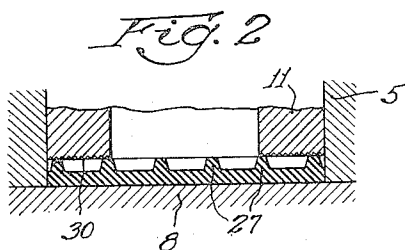
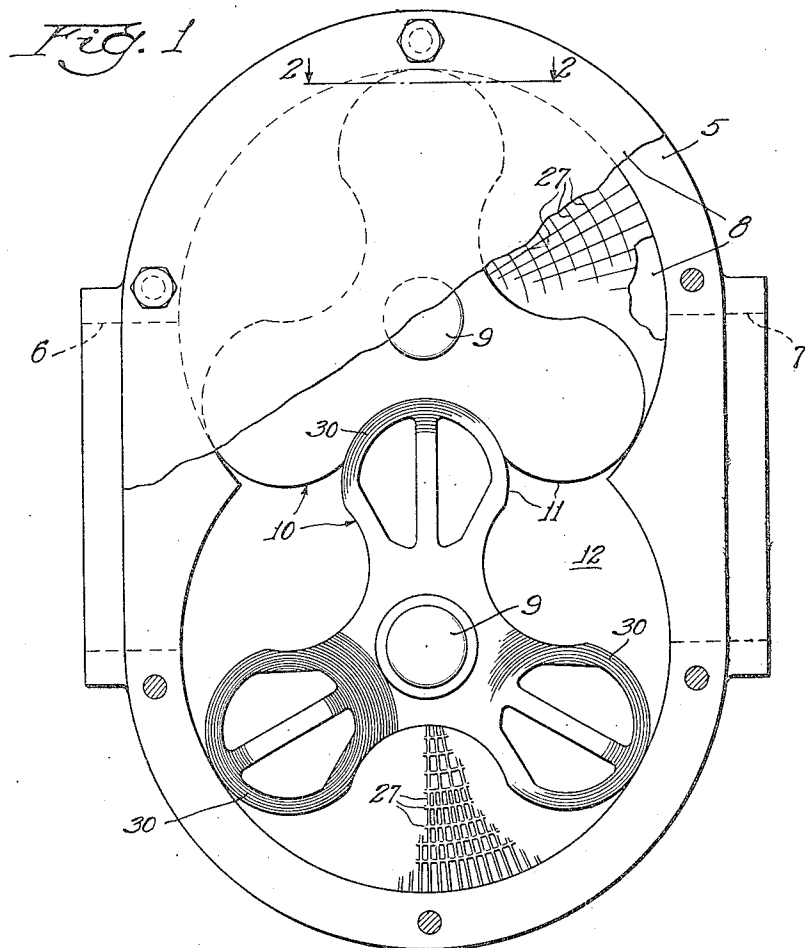


Dec. 27, 1949

R. P. McCULLOCH ET AL
ROTARY BLOWER WITH ABRADING ROTOR ENDS AND
ABRADABLE CASING SEALING RIDGES
Filed Nov. 22, 1943

2,492,935



Inventors:
Robert P. McCutlock
John L. Ryde

By: Edward C. Gitzbaugh atty.

UNITED STATES PATENT OFFICE

2,492,935

ROTARY BLOWER WITH ABRADING ROTOR ENDS AND ABRADABLE CASING SEALING RIDGES

Robert P. McCulloch, Fox Point, and John L. Ryde, Milwaukee, Wis., assignors, by mesne assignments, to Borg-Warner Corporation, Chicago, Ill., a corporation of Illinois

Application November 22, 1943, Serial No. 511,250

25 Claims. (Cl. 230—141)

1

This application is a continuation-in-part of the co-pending original application of Robert P. McCulloch and John L. Ryde, for a Rotary blower, filed March 20, 1942, Serial No. 435,506, now issued as Patent No. 2,393,116, dated January 15, 1946.

This invention relates to rotary or positive displacement blowers or superchargers of the type used on Diesel engines to provide forced air induction and scavenging.

Such blowers comprise a pair of rotors having intermeshing lobes rotating in an appropriate housing or casing. The air or other fluid being pumped is trapped in the pockets between the lobes and the side walls of the casing and advanced from the inlet to the outlet. Consequently a pressure differential obtains between the inlet and outlet.

This pressure differential tends to cause leakage around the ends of the rotors, and notwithstanding the various refinements which have been incorporated in the design of these blowers, the leakage past the ends of the rotors constituted a serious limitation to their efficiency.

Heretofore this leakage was accepted as inherent and inevitable, for although the machining of the parts was conducted with the greatest accuracy, production tolerances had to be maintained. In addition, expansion clearance had to be provided. This follows from the fact that while the rotors and casings may be made of metal having the same coefficients of expansion and contraction, a load suddenly applied on a cold blower would result in rapid expansion of the rotors well in advance of any equivalent expansion on the part of the casing or housing.

Thus, unless adequate clearance existed between the ends of the rotors and the adjacent end walls of the casing or housing the rotors would bind and ruin the machine.

Prior to this invention, nothing was done to reduce this clearance for as stated hereinbefore, its presence was regarded as an inherent and inevitable characteristic of this type of machine. The present invention, however, does contemplate the provision of means to reduce the leakage past the ends of the rotors to an inappreciable minimum.

To this end, it is an object of this invention to provide sealing means so designed and constructed that it may be incorporated in blowers of this type without danger of having the rotors bind and without danger of pitting or scoring the surfaces of the end walls or the ends of the rotors.

Another object of this invention resides in the

2

provision of novel sealing means carried by the end plates or walls and so designed and constructed as to accommodate itself to the particular installation and automatically maintain a minimum clearance between the ends of the rotors and the adjacent end walls.

Another object of this invention is to provide sealing means for the purpose described which may be quickly and easily replaced.

10 A further object of this invention is to provide sealing means for the purpose described which is carried by the end walls or closure plates of the housing and which presents a multiplicity of projections or thin edges to the adjacent ends of the rotors to automatically accommodate the seal to the installation without danger of scoring, pitting or otherwise injuring the rotors or any part of the blower. In this connection one portion of the sealing means embodies a plurality of arcuate or circular spaced ridges on the housing end walls, the radii of the circles defining these annular ridges being at the axes of the rotor shafts to provide concentric elements. Another portion of the sealing means comprises a plu-
25 rality of radially disposed ridges that intersect or cross the concentric ridges and provide therewith a multiplicity of uniformly disposed flat bottomed depressions or recesses, such arrangement presenting a gridiron or waffle pattern that is co-extensive with the area on the end walls that is traversed or swept by the ends of the rotors when the blower is in operation.

30 It is another object to provide a combination in which the rotor ends, sweeping across the sealing element, are deliberately roughened or provided with abrading means or serrations whereby any rotating contact of the end of the rotor with said sealing means causes an abrading action on said sealing means whereby portions of the latter are removed or worn away and an optimum working clearance is maintained.

40 With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

50 The accompanying drawing illustrates a complete example of a physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Fig. 1 is an end view of a blower embodying this invention, the end wall or cover plate thereof being broken away;

Fig. 2 is an enlarged sectional view taken through part of Fig. 1 on the plane of line 2—2 thereon; and

Fig. 3 is a view similar to Fig. 2 showing a modification thereof.

Referring now particularly to the accompanying drawings, in which like numerals indicate like parts, the numeral 5 designates the casing or housing of a rotary or positive displacement type blower, the opposite side walls of which have an inlet 6 and an outlet 7 therein. The ends of the casing are closed by flat end walls 8 bolted or otherwise secured thereto. These end walls carry bearings not shown in which the shafts 9 of rotors 10 rotate.

The rotors 10 are geared together by suitable gears (not shown) fixed to their shafts, and have intermeshing lobes 11 which sweep across the inner surfaces of the casing side walls and coast therewith to form pockets 12 in which the air or other fluid being pumped is entrapped and carried from the inlet to the outlet. Obviously, therefore, during the operation of the blower a pressure differential obtains between the inlet and outlet.

This pressure differential in previous constructions causes leakage around the ends of the rotors, that is, between the ends of the rotors and the adjacent flat inner surfaces of the end walls 8.

It is desirable that a minimum clearance or substantial seal exist between the ends of the rotor lobes 11 and the housing end walls 8, for the purpose of materially reducing the leakage, and for this reason the construction contemplated herein may be used to advantage.

A substantial seal is effected by means of the instrumentalities shown herein. In this construction the lobes of the rotors may be hollow and preferably the end surfaces thereof are provided with serrations or substantially sharp cutting projections or abrading means 30, as will be clearly apparent in Figs. 1 and 2. As illustrated, each lobe 11 presents a substantially cylindrical portion to the rotor housing, and the end surfaces of the lobes are circularly grooved to provide a plurality of sharp arcuate ridges or projections disposed substantially concentric with the axis of the cylindrical portions of the lobes. Any abrading surface such as a grit-blasted surface is feasible, the purpose of said abrading surface on the ends of said rotors being apparent from later description herein.

The sealing means herein disclosed consists of a multiplicity of projections or tiny ridges 27 formed on the end walls 8 and covering the areas thereof that are presented to the sweeps of the rotors. These tiny ridges 27 are formed of rubber or synthetic rubber that is vulcanized or bonded as a thin sheet or liner to the inner surfaces of the end walls as shown in Fig. 2, or imbedded in shallow recesses in the surfaces of said end walls as shown in Fig. 3, the said ridges projecting a slight distance out from the surface of the sheet proper. These sealing areas, as shown in Fig. 1 comprise a plurality of concentric arcuate or circular ridges that are spaced from each other, the curves thereof being struck from radii at the axes of the rotor shafts 9. The liner, of course, has openings (not shown) through which the shafts 9 extend. Intersecting these arcuate ridges there is a plurality of radially disposed ridges. This disposition provides a multiplicity of uni-

formly disposed shallow depressions or recesses of substantially frusto-sectoral configuration bounded by the intersecting circular and radial ridges, said depressions or recesses serving as static air pockets to increase the sealing effect. The arrangement disclosed presents a gridiron or waffle pattern having the general configuration of the numeral 8 and coextensive with the areas on the end walls that are traversed by the ends of the rotors during rotation of the latter.

It is desirable that the radial dimension of the metal forming the wall at the edges of the rotor ends be such that the wall will at all times span the space between any two adjacent ridges 27, whereby air is prevented from by-passing the end of the rotor as it swings past one ridge toward another.

In actual practice on one size of device the liner sheet of rubber, or synthetic rubber or other suitable resilient, pliable materials such as plastics, has a thickness of approximately ten thousandths (.010) of an inch and the ridges project upwardly or perpendicularly therefrom twenty to twenty-five-thousandths (.020 to .025) of an inch, and the edges or summits of the ridges 27 presented to the ends of the rotors are but one sixty-fourth ($\frac{1}{64}$) of an inch wide. The ridges 27, as shown in Fig. 2, are spaced apart with a flat portion of the liner exposed therebetween, and decrease in width in a direction from the end wall 8 toward the adjacent end of the rotor, so that the ridges 27, being of substantial height, can flex slightly as the rotor initially engages the same and rotates relatively thereto. As will be readily apparent, this arrangement will produce an exceptionally effective seal without danger of injury to the rotors or any other portion of the machine.

In operation, the rotors 10 are fitted into the housing 5 with not more than a bare minimum clearance from the end sealing means. As the device is "run in" through any operation or any process of manufacture, heat due to the operation of the rotors 10 will expand them longitudinally to where they may contact the end seal means. When this occurs, the resilient ridges 27 are initially deformed as the expanded rotors 10 rotate, and upon additional longitudinal expansion of the rotors 10 and pressural contact with the ridges 27, the ends of the rotors abrade away a sufficient amount of the ridges 27 to allow the rotor to pass thereover without substantial binding action. This creates, after a short period of operation, the minimum clearance for normal operating conditions. Should the device be operated at abnormal speeds, causing the rotors to expand still more, further abrading action will occur and the rotor will automatically provide the clearance required and will continue to operate instead of seizing or sticking in the housing. The advantage of this is obvious.

In the event the material forming the seal is worn off to an excessive amount due to expansion of the rotor under abnormal operating conditions, the cover plate of the housing may be removed and a new sealing means provided, or a new cover plate having proper sealing means may be substituted without much expense. It is thus seen that the efficiency of the blower may be brought up to a desired amount by a comparatively inexpensive substitution of parts, or by a simple repair job.

While we have described our invention in connection with certain specific embodiments thereof, it is to be understood that this is by way of

5

illustration and not by way of limitation and the scope of our invention is defined solely by the appended claims which should be construed as broadly as the prior art will permit.

We claim:

1. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in said housing and having an end adjacent said end wall, a plurality of ridges of resilient pliable material disposed on the inner side of said end wall of the housing and arranged to present a grid-like surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, said adjacent end of the rotor being provided with substantially sharp, abrading means capable of rapidly abrading the ridges upon rotating contact relative thereto, whereby an optimum working clearance is maintained between said end wall of the housing and said adjacent end of the rotor.

2. A rotary blower according to claim 1, wherein the grid-like surface comprises a first plurality of spaced apart ridges and a second plurality of spaced apart ridges intersecting the first plurality of ridges to define a plurality of depressions, the open ends of which depressions face said adjacent end of the rotor.

3. A rotary blower according to claim 1, wherein the resilient ridges are sufficiently high and have such resilience characteristics as to be deformed upon initial rotating contact by the end of the rotor and have such durability characteristics as to be abraded by the rotor upon increased pressural contact due to longitudinal expansion of the rotor relative to the housing.

4. A rotary blower according to claim 1, wherein the ridge material is of sufficient height and has resilience and durability characteristics such that upon rotating contact of the rotor end surface with the ridges, the ridges are initially distorted to accommodate slight relative expansion of the rotor with respect to the housing, and then upon increased expansion of the rotor the ridges are abraded by the rotor end to reduce their height, the resilience of the ridge material being such that the ridges tend to return to their original nondistorted condition when rotating contact of the rotor therewith ceases, thereby maintaining an optimum sealing condition.

5. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in said housing and having an end adjacent said end wall, a first plurality of concentric spaced apart ridges, and a second plurality of radially extending spaced apart ridges intersecting said concentric ridges, said intersecting ridges being formed of resilient, pliable material and being disposed on the inner side of said end wall of the housing and defining a plurality of depressions of frusto-sectoral configuration with the open ends of the depressions facing said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, said adjacent end of the rotor being provided with substantially sharp, abrading means capable of rapidly abrading the ridges upon rotating contact relative thereto, whereby an optimum working clearance is maintained between said end wall of the housing and said adjacent end of the rotor.

6. In a rotary blower of the type including a housing having an end wall, and a rotor of hard,

6

substantially inflexible material journaled in said housing and having an end adjacent said end wall, a plurality of ridges of resilient, pliable material disposed on the inner side of said end wall of the housing and arranged to present a grid-like surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, said adjacent end of the rotor having the surface thereof grooved to provide a plurality of sharp projections capable of rapidly abrading the ridges upon rotating contact relative thereto, whereby an optimum working clearance is maintained between said end wall of the housing and said adjacent end of the rotor.

7. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in said housing and having an end adjacent said end wall, a plurality of ridges of resilient, pliable material of less hardness than the material of the rotor disposed on the inner side of said end wall of the housing and arranged to present a grid-like surface to said adjacent end of the rotor to provide an efficient seal between said adjacent end of the rotor and said end wall of the housing, said adjacent end of the rotor having a surface deliberately roughened sufficiently with respect to the abrasion susceptibility of the ridge material to provide cutting means such that the maximum rate of thermal expansion of the rotor in use does not exceed the rate at which the roughened end surface of the rotor can remove the ridge material in contact therewith, whereby to maintain adequate working clearance.

8. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in said housing and having an end adjacent said end wall, a plurality of ridges of resilient, pliable material disposed on the inner side of said end wall of the housing and arranged to present a grid-like surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, the rotor comprising a plurality of hollow lobes, the end of each lobe being provided with substantially sharp abrading means capable of rapidly abrading the ridges upon rotating contact therewith, whereby an optimum working clearance is maintained between said end wall of the housing and said adjacent end of the rotor.

9. A rotary blower according to claim 8, wherein the ridges decrease in width in a direction from the housing end wall toward the adjacent end of the rotor.

10. A rotary blower according to claim 8, wherein the grid-like surface is at least coextensive with the area of the end wall traversed by the end of the rotor during rotation of said rotor.

11. A blower according to claim 8, wherein the area of the grid-like surface engageable by the rotor in the course of rotation substantially exceeds the area engaged by the end surface of the rotor at any one instant, thereby permitting cooling of the grid-like surface of the end wall and increasing its useful life.

12. In a rotary blower of the type including a housing having an end wall, and a metallic rotor journaled in said housing and having an end adjacent said end wall, a plurality of spaced apart ridges of material of less hardness than the material of the rotor disposed on the inner side

of said end wall of the housing and arranged to present a grid-like surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, the rotor comprising a plurality of hollow lobes, the end of each lobe being provided with substantially sharp abrading means capable of rapidly abrading the ridges upon rotating contact therewith, the walls of the hollow lobes having a minimum thickness greater than the maximum spacing between any two adjacent ridges on said end wall of the housing, whereby air is substantially prevented from by-passing said adjacent end of the rotor as it sweeps past the ridges.

13. In a rotary blower of the type including a housing having a side wall and an end wall, and a rotor of hard, substantially inflexible material journaled in said housing and having an end adjacent said end wall, a plurality of ridges of material of less hardness than the material of the rotor disposed on the inner side of said end wall of the housing and arranged to present a grid-like surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, the rotor comprising a plurality of hollow lobes each presenting a substantially cylindrical portion to the side wall of the housing, the end face of each lobe being circularly grooved to present substantially sharp projections to the grid-like surface capable of rapidly abrading the ridges comprising said grid-like surface upon rotating contact therewith, whereby an optimum working clearance is maintained between said end wall of the housing and said adjacent end of the rotor.

14. A rotary blower according to claim 13, wherein the grooves are substantially concentric about the axis of the substantially cylindrical portions of the rotor lobes.

15. A rotary blower according to claim 13, wherein the substantially sharp projections comprise a plurality of substantially concentric ridges arranged substantially closer together than the ridges on the end wall of the housing.

16. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in the housing and having an end adjacent said end wall, a liner having a plurality of ridges of resilient, pliable material disposed on the inner side of said end wall of the housing with the ridges intersecting each other to define a plurality of depressions therebetween forming static air chambers, the ridges presenting a grid-like surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, and said adjacent end of the rotor being provided with substantially sharp abrading means capable of rapidly abrading the ridges upon contact therewith and relative rotation with respect thereto to maintain an optimum working clearance between said end wall of the housing and said adjacent end of the rotor.

17. A rotary blower, comprising: a housing having end walls; a pair of meshing, metallic rotors in the housing between the end walls, said rotors having the ends thereof disposed adjacent the end walls of the housing; and a liner having a plurality of ridges of resilient, pliable material disposed on the inner side of each of the end walls of the housing, the ridges on each liner intersecting each other to present a grid-like surface

to the adjacent ends of the rotors to thus form an effective seal between the ends of the rotors and the end walls of the housing, each of the ends of the rotors being provided with serrations capable of rapidly abrading the ridges upon contact therewith and rotation relative thereto, to thereby provide optimum working clearance between the end walls of the housing and the ends of the rotors.

18. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in the housing and having an end adjacent said end wall, a liner of resilient, pliable material mounted on the interior of said end wall of the housing and having a thickness of about .010 of an inch and having flexible ridges on the surface thereof adjacent said end of the rotor arranged in the form of a grid, the height of said ridges being about .020 to .025 of an inch, and the summits of the ridges being approximately $\frac{1}{4}$ of an inch in width, said adjacent end of the rotor having substantially sharp abrading means thereon capable of rapidly abrading the ridges upon rotating contact relative thereto, whereby an optimum working clearance between said end wall of the housing and said adjacent end of the rotor is maintained.

19. A liner, for use in a rotary blower of the type including a housing having an end wall, and a rotor journaled in the housing with one end of said rotor adjacent said end wall, comprising: a substantially flat sheet of resilient, pliable material adapted to be mounted on the interior of an end wall of the housing and to be engaged by and to form a seal with one end of the rotor, said sheet having a thickness of about .010 of an inch and having flexible spaced apart ridges on the surface thereof arranged in the form of a grid, the height of said ridges being about .020 to .025 of an inch, and the summit of the ridges being approximately $\frac{1}{4}$ of an inch in width.

20. A liner, for use in a rotary blower of the type including a housing having an end wall, and a rotor journaled in the housing with one end of said rotor adjacent said end wall, comprising: a substantially flat sheet of resilient, pliable material adapted to be mounted on the interior of an end wall of the housing and to be engaged by and to form a seal with one end of the rotor, said sheet having flexible ridges on the surface thereof arranged in the form of a grid and including a series of spaced apart concentric ridges and a series of spaced apart radial ridges intersecting the concentric ridges.

21. A liner, for use in a rotary blower of the type including a housing having an end wall and a rotor journaled in the housing, comprising: a substantially flat sheet of resilient, pliable material adapted to be mounted on the interior of the end wall of the housing and to be engaged by and to form a seal with one end of the rotor, said sheet having a first plurality of spaced apart ridges on one side thereof and a second plurality of spaced apart ridges on the same side thereof intersecting said first plurality of ridges, with the intersecting ridges extending in a direction substantially perpendicular to the plane of said sheet to present a grid-like surface to the end of the rotor.

22. A liner, for use in a rotary blower of the type including a housing having an end wall and a pair of intermeshing rotors each having a shaft journaled in the end wall, comprising: a substantially flat sheet of resilient, pliable material adapted to be mounted on the interior of the end

wall of the housing and to be engaged by and to form a seal with one end of each of the rotors, said sheet having an opening therein for each rotor shaft and having a first plurality of spaced apart ridges on one side thereof and a second plurality of spaced apart ridges on the same side thereof intersecting said first plurality of ridges to present a grid-like surface to the ends of the rotors.

23. A liner as defined in claim 22, wherein the configuration of the liner sheet has the general appearance of the numeral 8.

24. In a rotary blower of the type including a housing having an end wall, and a rotor of hard, substantially inflexible material journaled in said housing and having an end adjacent said end wall, a plurality of projections of resilient, pliable material disposed on the inner side of said end wall of the housing and arranged to present an abradable surface to said adjacent end of the rotor to provide an effective seal between said adjacent end of the rotor and said end wall of the housing, said adjacent end of the rotor being provided with substantially sharp, abrading means capable of rapidly abrading the projections upon rotating contact relative thereto, whereby an optimum working clearance is maintained between said end wall of the housing and said adjacent end of the rotor.

25. A rotary blower according to claim 24 wherein the projections are of sufficient height and have resilience and durability characteris-

tics such that upon rotating contact of the rotor end surface with the projections, the projections are initially distorted to accommodate slight relative expansion of the rotor with respect to the housing, and then upon increased expansion of the rotor the projections are abraded by the rotor end to reduce their height, the resilience of the projections being such that the projections tend to return to their original non-distorted condition when rotating contact of the rotor therewith ceases, thereby maintaining an optimum sealing condition.

ROBERT P. McCULLOCH.
JOHN L. RYDE.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
930,907	Westinghouse	Aug. 10, 1909
1,631,359	Brown	June 7, 1927
2,028,414	Schneider	Jan. 21, 1936
2,259,432	Falling et al.	Oct. 14, 1941
2,322,867	Meyer	June 29, 1943
2,373,443	Armington	Apr. 10, 1945

FOREIGN PATENTS

Number	Country	Date
1,392	Great Britain	1855
464,475	Great Britain	Apr. 16, 1937