F. P. REED AND C. NELSON.

DRYING MACHINE.

APPLICATION FILED JUNE 14, 1921.

1,432,732.

Patented Oct. 17, 1922.

2 SHEETS—SHEET 1.

Fig. 1.

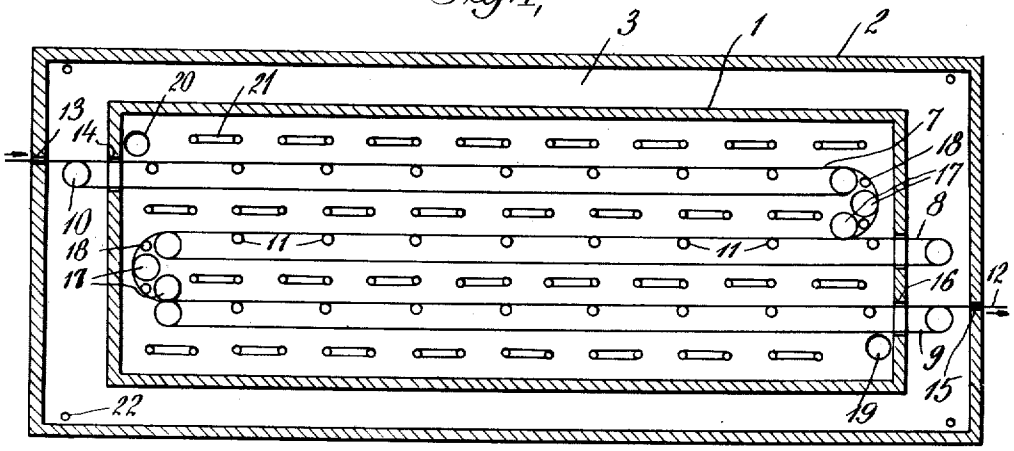
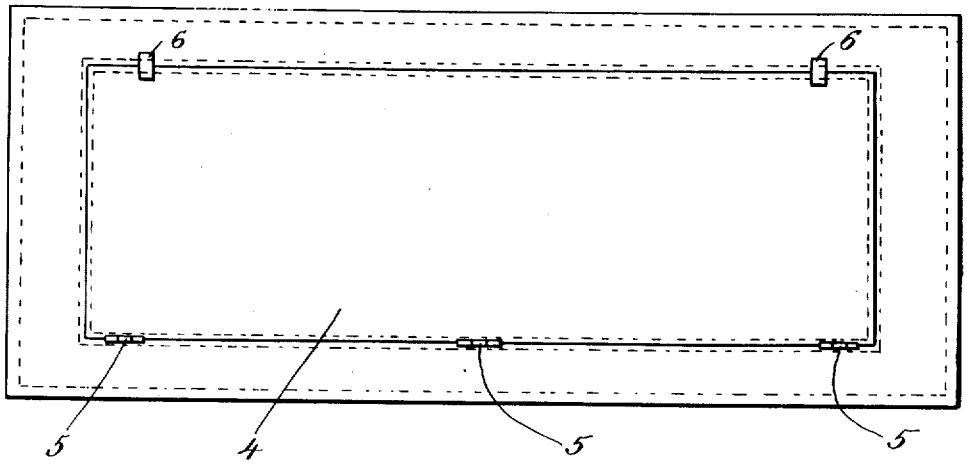


Fig. 2.



Inventor

Clare Nelson

Frederic P. Reed

By their Attorneys

Penn Davis Morris & Edmonds

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2 SHEETS—SHEET 2.

Fig. 3,

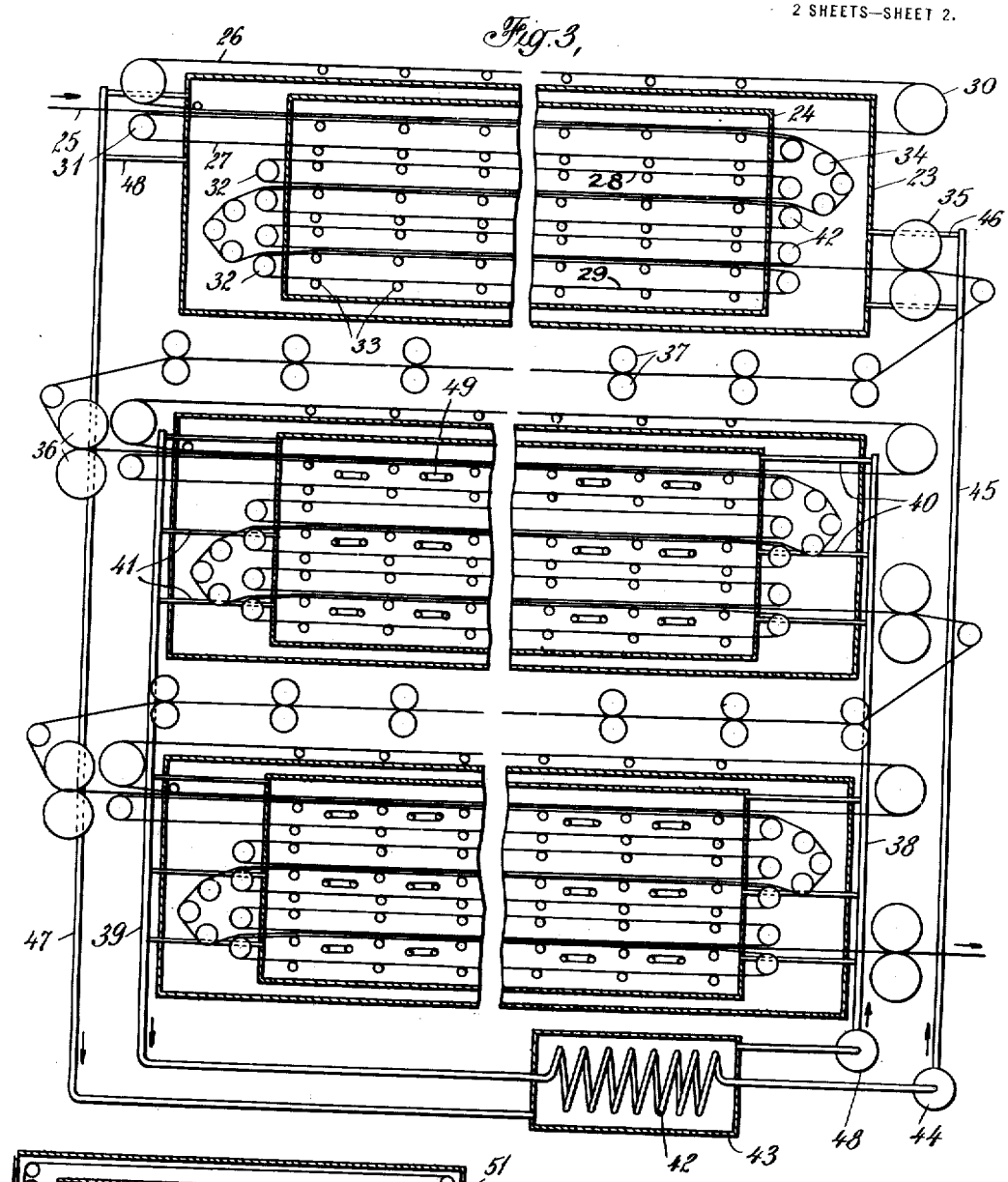
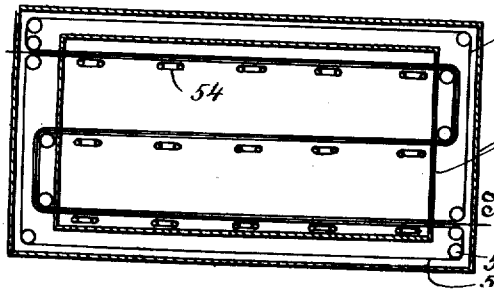


Fig. 4,



Inventor
Clare Nelson
Frederic P. Reed
By their Attorneys
Pennie Davis Marvin & Edmonds

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UNITED STATES PATENT OFFICE.

FREDERIC PAYSON REED, OF EAST ORANGE, NEW JERSEY, AND CLARE NELSON, OF BROOKLYN, NEW YORK, ASSIGNORS, BY MESNE ASSIGNMENTS, TO CHARLES C. ORCUTT.

DRYING MACHINE.

Application filed June 14, 1921. Serial No. 477,422.

To all whom it may concern:

Be it known that we, FREDERIC PAYSON REED and CLARE NELSON, both citizens of the United States, residing at East Orange, county of Essex, State of New Jersey, and Brooklyn, county of Kings, State of New York, respectively, and whose post-office addresses are 338 Springdale Avenue, East Orange, New Jersey, and 45 So. Elliott Place, Brooklyn, New York, respectively, have invented certain new and useful Improvements in Drying Machines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention is an improvement in drying machines and relates particularly to a new and improved construction of dryer unit, for machines of the character shown and described in application, Serial No. 470,667, filed May 18, 1921.

Machines of the character in question are composed of a plurality of dryer units, through which, in succession, the web is passed. Each unit comprises a casing having means for supporting and guiding the web through the same, and heating means is arranged in the casing, above and below the web. Dry air is circulated continuously through the casing, at both faces of the web, and the vapor is withdrawn as it forms, so that there is no recondensation of the moisture on any part of the web. Hence the drying action on the web is progressive, uniform, and rapid, and but a relatively small quantity of hot gases, or electric current, is required for any one unit. In such machines, the web is so supported, that the hot air may circulate freely about both faces, the supporting means being either in the form of a foraminous endless belt, traveling with the web, or in the form of rollers, fixed with respect to each other, but moved by the web to continuously present fresh engaging surfaces to the web. For convenience in construction, the units have heretofore been made relatively short, and the web has been passed directly through the unit, and through a succession of such units, arranged one above the other.

When used in connection with web forming mechanism, as for instance paper making machines, the web must travel through the drying machine at the same rate of speed that it travels through the forming mechanism. While the web dries rapidly in the units, yet there must be a number of units, or units of relatively great length, in order that the web be thoroughly dried before it passes to the calendering mechanism. Either arrangement has economic objections, and one purpose of the present invention, is to provide a construction of unit, such that while the web may travel to and from the unit at the same rate of speed it travels in the web forming mechanism, its stay within the unit may be prolonged to any desired degree, in order to insure a sufficient drying action of the web in the unit.

In practice it has been found that in machines of this character, it is desirable that the temperature of the web be raised gradually. When the wet web is passed directly into the highly heated atmosphere of a unit, the intense heat causes a surface drying of the web with the formation of a large amount of vapor. Such surface drying retards to some extent the drying of the interior of the web, so that there is not the uniform drying action desired. Furthermore to satisfactorily remove the vapor from the initial unit as it forms, requires that the air be circulated through said unit at a higher speed than is conducive to the most economic utilization of the heat produced in the unit.

Another purpose of the invention is to provide an arrangement of units in series, such that the temperature of the web is raised gradually, at the commencement of the drying operation, to eliminate surface drying, and to permit the removal of the vapor as it forms, and wherein the heating of the said initial unit is provided for by the waste heat from the succeeding units.

In the drawings;

Figure 1 is a vertical section somewhat diagrammatic of an embodiment of the invention,

Figure 2 is a front view of the same,

Figure 3 is a vertical section showing an arrangement of units in series,

Figure 4 is a view similar to Figure 1 showing a modified form of unit.

In the present embodiment of the invention, the unit comprises a casing 1, which

is jacketed, the casing 1 being enclosed by another casing 2, and an air space 3 being provided between the inner and outer walls. A door opening is provided at the front of the casing co-extensive with the limits of the inner casing, and a door 4 is provided for closing the opening, the door being hinged at 5 at the bottom of the opening, and having any suitable latch mechanism, indicated at 6, for holding it closed. Within the inner casing is arranged a series of endless carriers, three in the present instance, said carriers being arranged one above the other in spaced relation, and with their upper runs horizontal. Each carrier consists of an endless belt, 7, 8 and 9 respectively, which may be of foraminous material of the character shown and described in application, Serial No. 434,231, filed May 13, 1921, and supporting rollers 10 and 11 are provided for supporting the belts, the rollers 10 are at the ends of the belts, while the rollers 11 are intermediate the ends of the upper run, and support such upper run in a horizontal plane. These endless belts support the web indicated at 12, the web entering the unit through passages 13 and 14 in the outer and inner walls respectively, and leaving the unit through passages 15 and 16 in the outer and inner wall respectively, and at the opposite end of the unit. The passages 13 and 14 are near the top of the unit, and in alinement with the upper run of the belt 7, while the passages 15 and 16 are near the bottom of the unit, and in alinement with the upper run of the endless belt 9. The web entering the unit, passes onto the upper run of the belt 7, and travels the full length of the unit. The web then passes around guide rollers 17 and 18 to the upper run of the belt 8, changing the direction of its travel, and now moving toward the inlet end of the unit. At the inlet end the web passes around through guide rollers 17 and 18, onto the upper run of the belt 9, again changing the direction of its travel, and moving toward the outlet end of the unit, eventually passing from the unit through the passages 15 and 16. The guide rollers 17 are of relatively large diameter, being in the present instance of the same diameter as the rollers, 10, while the rollers 18 are of relatively small diameter, being of the same diameter as the rollers 11. It will be obvious that instead of the endless, foraminous belts, the web might be supported by rollers of the character shown and described in application Serial No. 509,632, filed Oct. 22, 1921, the said form of support being especially adapted for use with heavy webs, as for instance, cardboard, felt and the like.

Dry air is circulated through the unit, by means of a suitable pump or fan, not shown, which is connected to the inner casing of the unit, by an inlet pipe 19, and an outlet pipe 20. The inlet pipe 19 is at the outlet end of the unit, and near the bottom, while the outlet pipe 20 is at the inlet end of the unit and near the top. Thus the air which circulates through the unit travels for the greater part of the length of the web in the opposite direction to the travel of the web, and it will be obvious that a number of inlets might be provided if desired, the said inlets being arranged between the runs of the belts, and between the belts, so that every part of the web is exposed to the free circulation of the dry air. Suitable heating means is provided for heating the air within the casing. The said means in the present instance comprises a series of electrically controlled heating units 21. A series of such units is arranged above the upper run of the belt 7, and another series is arranged below the lower run of the belt 9. Other series are arranged between the belts 7 and 8 and 8 and 9, so that the opposite faces of each run of the web are heated. With this arrangement all the air circulated through the unit will be uniformly heated, and there will be a uniform, progressive and rapid drying action on the web. The jacket, that is the space 3 between the casings, insulates the inner casing, and there is some circulation of hot air through this space by way of the passages 14 and 16. If desired, hot air may also be circulated through the space by means of the pump above-mentioned, and openings 22 are provided for this purpose. The roller 10 which supports that end of the endless belt 7 adjacent to the passage 13 is arranged within the space 3, and both runs of the belt 7 pass through the passage 14. The rollers which support the ends of the belts 8 and 9 adjacent to the outlet for the web are also arranged in such space 3, as clearly shown in Figure 1. This arrangement of the belts provides for the easy threading of the web through the unit, access being had to the casing 1 by way of the door 4. It will be obvious that the units might be made of any desired height, providing for more than three layers of web, and they may be of any desired length, so that with a single unit the web may be in condition to pass directly to the calendering mechanism from the unit. With this arrangement of unit, while the web enters the unit, and leaves the unit, traveling at the same speed as it travels from the web forming mechanism, its stay in the unit may be prolonged to any desired extent, so that the web will be completely dried when it leaves the unit.

In Figure 3 there is shown an arrangement of units in series, such that the temperature of the web is raised gradually, to eliminate surface drying of the web. In this arrangement, each unit of the series, in

which there are three in the present instance, comprises an outer casing 23, and an inner casing 24, the outer casing 24, forming a jacket for the inner casing, in the same manner as in the construction of Figure 1. The web indicated at 25 enters at the top and left of the unit, through registering passages in the inner and outer walls, and it leaves the unit at the right and bottom, through similar registering passages in the walls. The web is supported in the unit by pairs of endless belts 26—27 and 28—29. Each of these belts, which may be of foraminous material as above mentioned, is supported by rollers, the belt 26 being supported by end rollers 30, while the belt 27 is supported by end rollers 31, and the belts 28 and 29 by end rollers 32. The upper runs of the belts 26, 27, 28, and 29, are supported by small rollers 33, and the web is supported between the adjacent runs of the belts 26—27 and 28—29. Between the pairs of endless belts, the web passes around guide rollers 34, the said rollers being so arranged that the web is not bent abruptly at any point, but passes on a broad curve from one carrier to the other. With this arrangement of unit, the web is supported between belts, which may be either of foraminous material, or of the character shown in application, Serial No. 470,667, filed May 18, 1921. As the web leaves each unit, it passes between a pair of press rollers 35, and as the web enters the second and succeeding units, it passes between similar press rollers 36. Between the units, that is between the pressing rollers 35 and 36, the web is supported by pairs of rollers 37, which act also to press and iron the same, and it will be obvious that the rollers 35, 36, and 37 might be heated if desired.

The initial unit, in which the web is gradually brought to near the temperature of the succeeding units, is heated by the waste heat from the succeeding units. Air is circulated through the second and succeeding units by means of header pipes 38 and 39, the pipes 38 and 39 being connected to the inner casings of the units by means of branch pipes 40 and 41. The vapor laden hot air withdrawn from the second and succeeding units passes through a heating coil 42 arranged within a casing 43, and from thence is delivered by a pump 44 to a header pipe 45, which is connected by branches 46 with the space between the walls of the first or initial unit. Air is withdrawn from this space by means of a pipe 47, connected by branches 48 to the space, and delivering to the interior of the casing 43 before mentioned. This air is withdrawn from the casing 43 by means of a pump 48, and delivered to the header pipe 38 before mentioned. The operation of the machine is as follows:

The web entering the initial unit, is gradually heated to a temperature something near that of the second unit during its passage through the initial unit, and the drying action is completed in the succeeding units, while at the same time the web is semi-finished by the ironing and pressing rollers 35, 36, and 37. No heating means is arranged within the initial unit, and the other units may be supplied with any desired form of heating means, as for instance electrically controlled units 49, shown and particularly described in application, Serial No. 434,231, filed May 13, 1921. The air withdrawn from the initial unit by the pump 48 passes through the casing 43, and is heated by the coil 42. This air, preheated, is delivered to the inner casings of the second and succeeding units, where it is thoroughly heated by the heaters. The vapor laden and partially cooled air is withdrawn from the second and succeeding units by the pump 44, through the header pipe 39, and through the coil 42, and this air is delivered to the initial unit, being delivered into the space between the walls of the unit. Thus the initial unit is heated by the waste from the other units, to a degree just sufficient to raise the temperature of the web to near that of the interior of the second unit, before the web passes into the said unit. With this arrangement there can be no surface drying of the web, and the drying action thereof is uniform and progressive.

In the embodiment of the invention shown in Figure 3, each of the supporting belts has the ends of its runs in the space between the casings of the unit. This arrangement corrects any tendency of the belts to overheat, since they are being continuously moved through the somewhat cooler atmosphere outside of the inner casing. At the same time they do not cool to an extent that would be prejudicial to the drying of the web.

In Figure 4 there is shown an arrangement wherein a pair of belts is provided for supporting the web in three runs. The unit 50 is composed of inner and outer casings, and the endless belts 51 and 52 are supported by rollers 53 in such manner that the web is supported in three runs in the unit, and is supported between adjacent runs of the two belts. In this arrangement it will be noted that the belt 51 engages the upper face of the first run of the web, the lower face of the second run and the upper face of the third run, while the belt 52 engages the lower face of the first run, the upper face of the second run, and the lower face of the third run. The unit is heated by electrically controlled units 54 of the same character as those shown in Figures 1 and 3. The rollers 53 are also all arranged outside the inner casing, and in the space between the inner and outer casings. On each run of

the web, it passes out of the inner casing. It will be understood that air may be circulated through the unit just described, in the same manner as in the construction of Figure 3, and either this unit, or that shown in Figure 1, may be substituted for those shown in Figure 3.

I claim:

1. In a drying machine, a dryer unit comprising a casing, a series of substantially horizontal carriers for the web, arranged one above the other and in substantially parallel relation, each carrier presenting a supporting surface for the web of paper or the like to be dried freely movable with the web, and each carrier delivering to the next lower carrier, the casing having means for circulating air therethrough, and means within the casing for heating the air.

2. In a drying machine, a dryer unit, comprising a jacketed casing, a series of carriers arranged in the casing one above the other, each carrier having a supporting surface for the web moving freely with the web of paper or the like to be dried, and delivering to the next lower carrier, the casing having an entrance and an exit for the web, means for circulating air through the casing, and means within the casing for heating the air.

3. In a drying machine, a dryer including a casing, means for supporting and guiding a web of paper or the like to be dried through the unit in a plurality of runs, whereby to protract the stay of the web in the unit without retarding the travel of the web to and from the unit, means for circulating air through the unit, means in the casing for heating the air, the supporting and guiding means for the web moving freely with the web comprising foraminous belts.

4. In a drying machine, a dryer including a casing, means for supporting and guiding a web of paper or the like to be dried through the unit in a plurality of runs, whereby to protract the stay of the web in the unit without retarding the travel of the web to and from the unit, means for circulating air through the unit, means in the casing for heating the air, the supporting and guiding means for the web comprising foraminous belts, engaging the opposite faces of the web and moving freely with the web.

5. In a drying machine, a series of dryer units through which, in succession, the web of paper or the like to be dried is passed, means for circulating air through the initial unit, means for circulating air through the other units, heating means within the other units, and means for delivering the heated air withdrawn from the said other units to the circulating means of the initial unit.

6. In a drying machine, a series of dryer units through which, in succession, the web of paper or the like to be dried is passed, means for circulating air through the initial unit, means for circulating air through the other units, heating means within the other units, means for delivering the heated air withdrawn from the said other units to the circulating means of the initial unit, and means controlled by the heated air passing from the initial unit for preheating the air delivered to the other units.

7. In a drying machine, a series of dryer units, each comprising a casing through which the web of paper or the like to be dried is passed, means for supporting and guiding the web through the casings in succession, means for circulating air through the initial unit, means for circulating air through the succeeding units and delivering to the circulating means of the initial unit, and means in the succeeding units for heating the air.

8. In a drying machine, a series of dryer units, each comprising a casing through which the web of paper or the like to be dried is passed, means for supporting and guiding the web through the casings in succession, means for circulating air through the initial unit, means for circulating air through the succeeding units and delivering to the circulating means of the initial unit, means in the succeeding units for heating the air, and means controlled by the air circulating from the initial unit for preheating the air circulating to the succeeding units.

9. In a drying machine, a series of dryer units, through which, in succession, the web of paper or the like to be dried is passed, means for supporting and guiding the web through each unit in a plurality of runs, whereby to protract the stay of the web in the unit without retarding the movement of the web to and from the unit, means for circulating air through the initial unit, means for circulating air through the succeeding units, heating means in the said succeeding units for heating the air, the circulating means of the succeeding units delivering to the circulating means of the initial unit.

10. In a drying machine, a series of dryer units, through which, in succession, the web of paper or the like to be dried is passed, means for supporting and guiding the web through each unit in a plurality of runs, whereby to protract the stay of the web in the unit without retarding the movement of the web to and from the unit, means for circulating air through the initial unit, means for circulating air through the succeeding units, heating means in the said succeeding units for heating the air, the circulating means of the succeeding units delivering to the circulating means of the initial unit, and means controlled by the

circulating means of the initial unit for preheating the air delivered to the succeeding units by the circulating means therefor.

11. In a drying machine, a series of dryer units, each comprising a casing through which the web of paper or the like to be dried is passed, means for circulating air through the units, means within the units for heating the air, and an initial dryer unit through which the web passes, and through which the air from the first named units is circulated to preliminarily heat the web.

In testimony whereof we affix our signatures.

FREDERIC PAYSON REED.
CLARE NELSON.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,432,732, granted October 17, 1922, upon the application of Frederic Payson Reed, of East Orange, New Jersey, and Clare Nelson, of Brooklyn, New York, for an improvement in "Drying Machines," an error appears in the printed specification requiring correction as follows: Page 4, lines 39–41, claim 3, strike out the words "moving freely with the web comprising foraminous belts," and insert the words *comprising foraminous belts moving freely with the web;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of November, A. D., 1922.

[SEAL.] KARL FENNING,

Acting Commissioner of Patents.