April 8, 1952 P. R. LAGUILHARRE 2,592,297

ARRANGEMENT FOR ATOMIZING LIQUIDS

Filed April 5, 1949 2 SHEETS—SHEET 1

FIG. 1

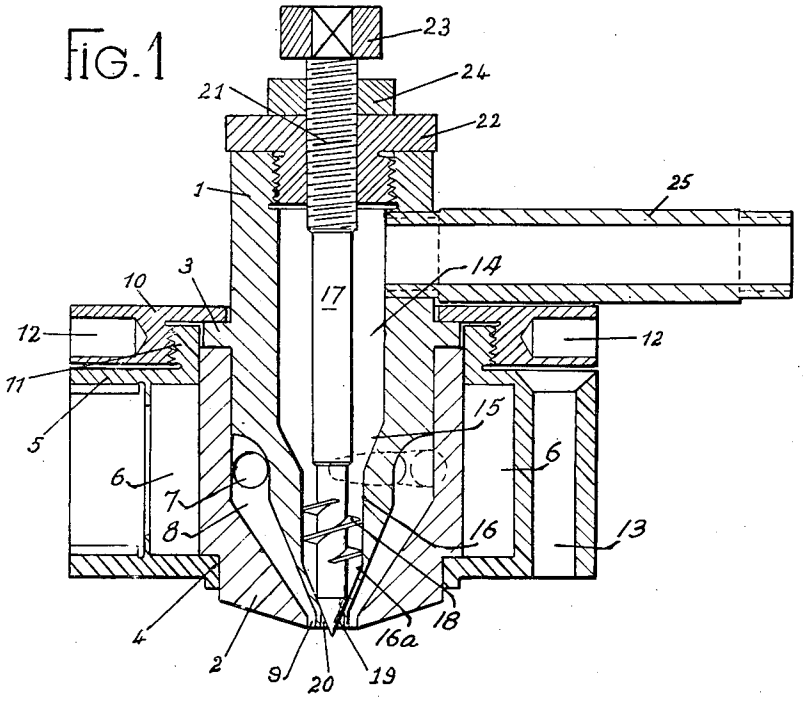


FIG. 2

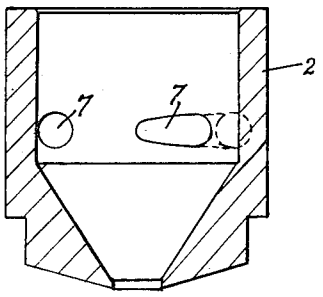
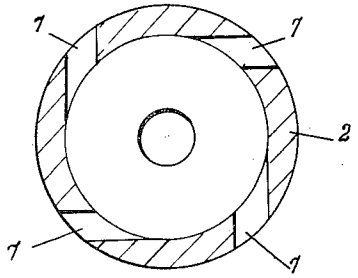


FIG. 3



INVENTOR

PIERRE ROBERT LAGUILHARRE

By Linton and Linton

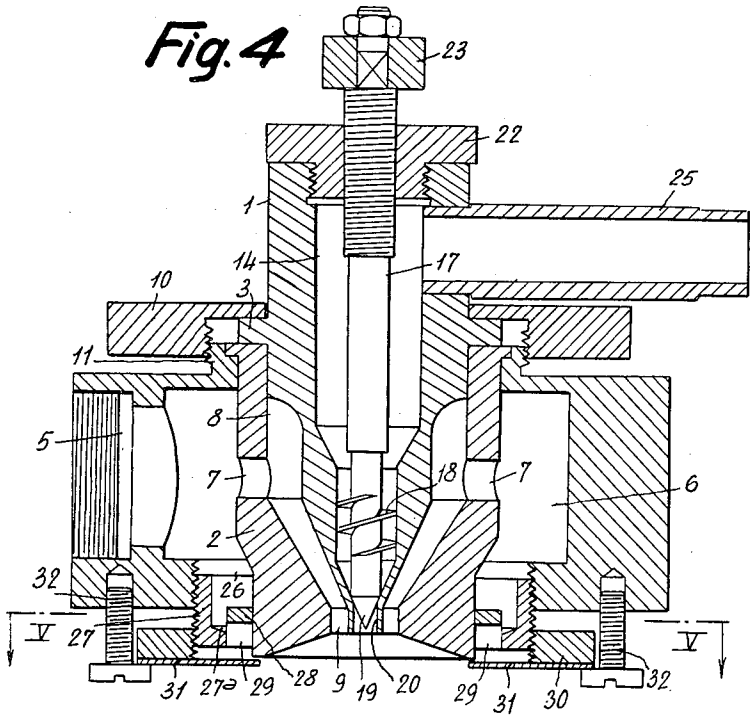
ATTORNEYS

April 8, 1952 P. R. LAGUILHARRE 2,592,297

ARRANGEMENT FOR ATOMIZING LIQUIDS

Filed April 5, 1949 2 SHEETS—SHEET 2

Fig. 4



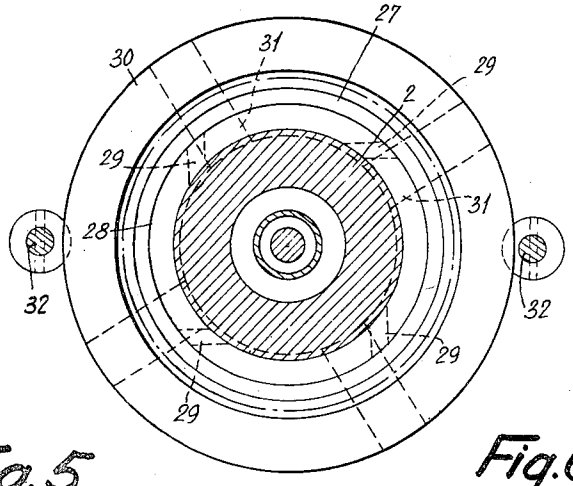


Fig. 5

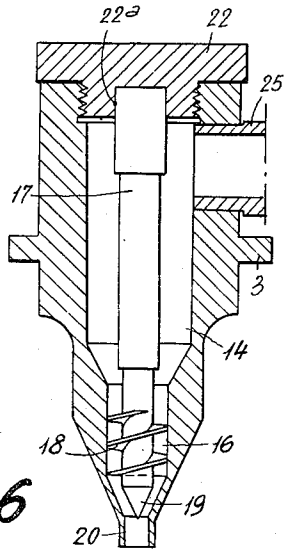


Fig. 6

INVENTOR

PIERRE ROBERT LAGUILHARRE

By Linton and Linton

ATTORNEYS

Patented Apr. 8, 1952

2,592,297

UNITED STATES PATENT OFFICE

2,592,297

ARRANGEMENT FOR ATOMIZING LIQUIDS

Pierre Robert Laguilharre, Enghien-les-Bains, France

Application April 5, 1949, Serial No. 85,514
In France April 9, 1948

7 Claims. (Cl. 299—115)

1

My invention has for its object improvements to liquid atomizing nozzles of the type disclosed in my French Patent No. 926,438 filed on April 21, 1946, in other words to those nozzles that include chiefly two coaxial elongated containers preferably of a cylindro-conical shape, which containers are closed at their upper ends and are provided at their lower ends of a smaller diameter with coaxial openings located substantially in a common plane so as to define between them an annular gap, the inner container being provided at its upper end with a tangential connection through which the liquid to be atomized is introduced substantially without any pressure while the outer container is provided also at its upper end with a tangential connection through which the atomizing gas is fed under a reduced pressure, the input connections for the liquid and gas being preferably directed so as to communicate to the fluid eddying movements of opposite directions.

The improvements according to my invention have for their object to provide for an atomization of the liquid under the form of droplets as fine as possible. In addition to the particular applications disclosed in my prior above-mentioned patent, the improved nozzle according to my invention is applicable advantageously to burners operating with atomized fuel and generally speaking to the atomization of any liquid. As a matter of fact and as will readily appear from the reading of the following disclosure, the nozzle according to my invention shows among other advantages possibilities of adjusting the output in accordance with the viscosity of the liquid to be atomized and of the possibilities of adjusting within a wide range the apex angle and the length of the cone formed by the atomized liquid.

A further object of my invention consists in that it allows, if required, a feeding of the apparatus with the product to be atomized under a more or less high pressure, in particular when it is desired to atomize thick substances or substances showing a substantial viscosity.

It has been found that in the atomizing nozzles of the type disclosed, the arrangement of a tangential input of liquid into the internal chamber and the eddying movement produced thereby for the liquid have for their result a rough preliminary subdivision of said liquid before it arrives into contact with the final atomizing gases. Consequently the pressure of the gas arriving into the arrangement requires a much lesser value than that necessary for atomizing a homogeneous

2

compact liquid vein. It is therefore of advantage to attempt through any suitable means to increase the eddying movement of the liquid in order to obtain at the output of the inner chamber a conical sheet of liquid that is already subdivided in order to further atomization. Similarly, if losses of head are produced artificially, it is possible to allow at the output of the apparatus large cross-sectional areas for the liquid so that the machine is capable of atomizing liquid containing even solid particles in suspension. Moreover it may be of advantage to use means for adjusting the speeds of the liquid at the output and also the thicknesses of the conical sheets in order to obtain favorable conditions for atomizing according to the output required and/or to the viscosity of the different liquids to be atomized.

The improved nozzle according to my invention allows obtaining such results.

According to a further feature of my invention, said nozzle includes to this purpose and along the axis of the internal chamber through which the liquid flows an Archimedean worm housed inside a cyindrical throttled part located in proximity with the output of said chamber, so as to increase the eddying movement of the liquid to be atomized.

According to a further feature of my invention, the spindle carrying the Archimedean screw ends with a needle valve adapted to close to a variable extent the output nozzle for the inner chamber of the arrangement, means being provided for adjusting the position of the needle valve with reference to the nozzle which allows for a given output an adjustment of the output speed of the liquid to be atomized. The liquid passes out of the nozzle in a subdivided form as a conical jet having a variable apex angle and energy, according to the location given to the needle valve against which the cone of air escaping from the output port of the outer chamber impinges.

In order to allow an adjustment of the position of the needle valve, the spindle carrying it may pass through the inner chamber and engage the wall of said chamber opposed to the output port, the corresponding end of the spindle carrying a thread engaging a tapping in said wall.

According to a still further feature of my invention, there may be provided around the outer cylindro-conical capacity a further annular chamber provided with an admission for the atomizing gas and communicating with said outer cylindro-conical capacity through a number of channels provided tangentially with reference to the latter and distributed regularly

throughout its periphery. The ratio between the total cross-sectional area of the channels feeding the gas into the outer chamber and the cross sectional area of the gas at its output from the apparatus may thus be selected according to the application considered as a function of the apex angle to be obtained for the atomizing cone.

A still further arrangement according to my invention consists in providing at the lower end of the annular chamber surrounding the outer cylindro-conical chamber or capacity receiving the atomizing gases a number of channels directed tangentially with reference to said capacity and distributed at uniform intervals round its periphery so as to provide round the annular output port of the apparatus a secondary eddying stream of gases that is substantially at the same pressure as the stream of primary gases serving for atomization. This eddying current meeting the jet of atomized liquid passing out of the apparatus increases the fineness of atomization and ensures a spreading of the jet through a more or less open angle that varies according to the axial location of the above mentioned tangential passages with reference to the output port of the apparatus.

Means are advantageously provided for modifying the axial position of said tangential passages and consequently the opening angle of the jet. To this purpose, said passage may for instance be formed inside a movable annular member screwed into the lower part of the annular chamber surrounding the outer cylindro-conical capacity.

My invention also has for its object the provision underneath the above mentioned tangential passages of substantially flat blades the number of which corresponds to that of said tangential passages, said blades being mounted in a manner such that it may be possible to modify their angular position with reference to said passages in order to direct to a variable extent the secondary eddying current of gases towards the base of the apparatus, which increases the amount of spreading of the jet.

The above improvements allow modifying the angle of the jet between a very small value of the magnitude of a few degrees up to a value of about 180°.

My invention has still further for its object to allow feeding the apparatus with liquid under pressure in the case of particularly thick substances, in which case the Archimedean screw housed axially of the inner chamber through which the liquid flows may be mounted in a stationary manner so that the needle valve provided at the end of said screw may be held at a certain distance away from the output port of the machine. In this case, the modifications in the output of the apparatus may be obtained through suitable variations in the feed pressure of the product to be atomized.

Further advantageous features of my invention will appear in the reading of the following disclosure, reference being made to accompanying drawings given out by way of example and by no means in a binding sense. In said drawings:

Fig. 1 is a vertical cross-section of an embodiment of the improved atomizing nozzle according to my invention.

Fig. 2 is a vertical cross-section of the member forming the outer wall of the chamber allowing the passage of air.

Fig. 3 is a horizontal cross-section of the member illustrated in Fig. 2, said section registering with the openings allowing the inlet of air into said member.

Fig. 4 is a vertical cross-section of a further embodiment of the atomizing nozzle, said section passing through the channels provided at the lower end of the annular chamber distributing the atomizing gas and through the axis of the blades located underneath said passages.

Fig. 5 is a horizontal cross-section through line V—V of Fig. 4.

Fig. 6 is a vertical partial cross-section of an embodiment including an Archimedean screw that is held in a stationary position.

In the following description, the atomizing gas is supposed to be air. Obviously the gas might be a gas different from air.

In the example illustrated in Fig. 1, 1 designates the central body of the arrangement that is axially recessed so as to form the internal chamber 14 for the admission of liquid to be atomized, while its upper part is connected to the pipe 25 feeding said liquid, which pipe does not need, in the case illustrated, to enter the chamber tangentially. A member 2 arranged coaxially with said body 1 is also recessed axially to form the chamber 8 for the circulation of the atomizing air while the annular passage 9 provided at the lower end of said chamber allows the output of air. On said member 2 is fitted a further hollow member 4 provided with a lateral input channel 5 for the air, said member 4 forms round the chamber 2 an annular chamber for distributing the air and communicates with the chamber 8 through passages 7 opening tangentially into the latter. The members 1—2—4 are rigidly connected together through the agency of an annular flange 10 bearing on the flange 3 of the body 1 and screwed over the sleeve 11 formed on the member 4 while the member 2 has at its lower end a reduced diameter part engaging exactly inside the annular flange formed at the inner periphery of the member 4. The flange 10 may include along its edge radial openings 12 that are regularly distributed at its periphery and wherein may be inserted suitable tools for fastening said flange over the upper edge of the collar 3. Vertical bores 13 the number of which is suitably selected may be provided along the periphery of the member 4 for allowing the passage of bolts therethrough in order to secure the whole arrangement on to a suitable support that is not illustrated.

According to my invention, the inner chamber 14 is cylindrical in its upper part and it includes a lower conical portion 15 connected at its lower end with a cylindrical part of reduced diameter 16 ending with a further conical or tapering part 16a. Axially of the chamber 14 there is provided a spindle 17 carrying at its lower end an Archimedean screw 18 housed inside the cylindrical part 16 of reduced diameter. This spindle ends with a conical needle valve 19 adapted to close to a varying extent the output port 20 of said inner chamber. The adjustment of the needle valve as to position is ensured through a rotation of the threaded part 21 of the spindle 17 inside a corresponding part of the closing plug 22 that is screwed in its turn inside the upper part of the body 1. A knurled head 23 rigid with the spindle 17 controls the rotation of the spindle and a knurled safety nut 24 bearing against the plug 22 allows holding the spindle 17 at the desired height without risking any misadjustment.

The tangential ports 7 are arranged preferably in a manner such that the eddying movement given to the atomizing air may be directed against the movement given to the liquid by the Archimedean screw 18. On the other hand, the height of the cylindrical part 16 of a reduced diameter is such that for the extreme retracted position of the needle valve 19 with reference to the opening 20, the Archimedean screw 18 remains always at least partly engaged inside said cylindrical part of reduced diameter.

It should be noticed that this arrangement allows modifying either the importance of the eddying movement or the loss of head produced in the helical channel thus provided.

By reason of the eddying movement of the liquid, there is thus produced on one hand a preliminary subdivision of the liquid to be atomized and, on the other hand, losses of head that vary according to the shape and length of the Archimedean screw. The speed of flow and the centrifugal force to which is submitted the liquid as it passes through the helical channel have for their result a friction and loss of head that lead to the adoption, for a given output of cross-sectional areas for the passage of the liquid at the outlet of the apparatus that are much larger than those adopted in any prior apparatuses.

Supposing S designates the total cross-sectional area of the air input nozzle in the chamber 8 and *s* the cross-sectional area for the passage of air at the output end of the apparatus, *s* defines the flow of air for a given pressure at the input end of the nozzles and the ratio S/*s* defines the speed of rotation of the air in the chamber 8. Without this leading to any limitation for the value of the ratio S/*s*, it is however of advantage to keep it above 1. The air enters tangentially the chamber 8 and assumes consequently an eddying motion, the speed of which is all the higher when the value of the ratio S/*s* is nearer 1. The importance of the eddying motion has for its immediate consequence an action on the shape of the jet and in particular on the apex angle of the atomizing cone. When the ratio S/*s* is near 1, the angle of the cone flares out to a maximum. For applications other than atomization, it is probably advantageous to approximate an apex angle value that is near 15 degrees which leads to adopting a ratio S/*s* substantially equal to 5. The value of this ratio will be defined in accordance with the application considered.

The arrangement according to my invention will allow therefore providing, through air under a low pressure and with large adjustable cross-sectional areas for the liquid, a driving action on the liquid through a suction effect and its subdivision into very fine droplets, even for large outputs and liquids of a considerable viscosity. It should be noticed that this arrangement allows producing not only a driving action on the liquid to be atomized but also a suction effect equal to several meters of water.

In the embodiment illustrated in Figs. 4 and 5, the chamber 6 ensuring the distribution of the air is provided at its lower end with an annular opening 26 forming a passage round the lower end of the member 2. Said annular passage 26 is provided with a tapping inside which is screwed a ring-shaped member 27 inside which is fitted under friction or secured in any other manner a ring 28 the bore of which is fitted with slight friction over the member 2. In the lower surface of the ring 28 are provided notches 29,

say four notches as illustrated in Fig. 5, that are distributed regularly along the periphery of the ring and are directed in a substantially tangential location with reference to the periphery of the member 2. The depth of these notches in an axial direction is such that they provide above the bevelled flange 27*a* of the ring 27 passages through which a part of the air admitted into the annular chamber 6 may flow outwardly. There is thus formed at the lower part of the apparatus a secondary current of air that is substantially at the same pressure as the primary atomizing air and that assumes by reason of the tangential arrangement of the notches 29 the form of an eddying current. Said current when it meets the jet of liquid passing out of the port 20 of the apparatus increases the fineness of atomization and produces a spreading out of the jet, which spreading varies when the ring 27 is screwed more or less inside the opening 26.

To the ring 27 is furthermore screwed an outer flat ring 30 carrying radial blades 31 the number and the angular distribution of which correspond to those of the notches 29 in the ring 28. Through an angular shifting of the ring 30, it is possible to bring the blades 31 into more or less exact register with the notches 29. The blades direct then all or part of the eddying current of air toward the output end of the apparatus which produces thus a depression that tends to increase the spreading out of the jet of atomized liquid.

According to the position given to the blades 31, said spreading may reach an angle as high as 180°. Screws 42 screwed into the wall of the chamber 6 allow holding the ring 30 in a predetermined angular position and consequently the blades 31 and the ring 27 in the selected position of adjustment.

In principle and as disclosed hereinabove, the apparatus is adapted to produce of its own a sufficient depression for ensuring a suction of the liquid fed without any pressure through the pipe 25. However in the case where the product to be atomized shows a high viscosity, it may be useful to provide a feed under pressure of said product, the atomization of the latter being reliably produced through the actual suction of the nozzle in accordance with the above procedure. In this case, as apparent from the modification illustrated partly in Fig. 6, the Archimedean screw 18 is mounted in an internal chamber 14 so as to occupy an axial stationary position for which the needle valve 19 is no longer in engagement with the port 20. To this purpose, for instance, the screw 18 rests at the lower end of the cylindrical part 16 of reduced diameter and the spindle 17 carrying it simply engages a blind hole 22*a* provided in the plug 22 closing the chamber 14 at its upper end.

Obviously and as apparent from the preceding disclosure, the embodiments illustrated and described are given out by way of a mere exemplification and it is possible to bring various modifications thereto without unduly widening the scope of the invention as defined in accompanying claims.

In particular, it is possible for the Archimedean screw 18 to be no longer rigid with the needle valve 19 so that these two parts may be individually adjusted. It is also possible to replace the Archimedean screw by a cylindrical member provided with a helical channel or by a screw of similar shape formed directly inside the wall of the body 1.

On the other hand, in the embodiments illus-

trated in Figs. 4 and 5, the tangential passageways 29 provided for the output of secondary air may be replaced by radial passages or mere vertical openings, the blades 31 being then sloping so as to allow impressing the desired eddying movement to the secondary current of air with a view to spreading the jet of atomized liquid.

What I claim is:

1. A liquid atomizing device comprising a first chamber the lower end of which is conical, a second chamber arranged coaxially within said first chamber and having near its lower end a substantially cylindrical throttled part connected to the discharge opening of said second chamber through a tapering part, both chambers being closed at their upper ends and provided at their lower ends with coaxial openings lying substantially in the same plane, a pipe connected with the upper part of said second chamber and adapted to feed into the latter the liquid to be atomized, at least one pipe connected tangentially with the first chamber and adapted to feed a gas under pressure into said chamber, a spindle movable axially in the second chamber, an Archimedean screw arranged within the throttled part of said second chamber and carried by said spindle, the diameter of said Archimedean screw being substantially equal to that of said throttled part and its pitch being directed so as to impress the liquid to be atomized with a swirling movement in a sense opposed to that of the movement of the gas entering the first chamber through the tangential pipe, a needle valve ending said spindle and adapted to close to a varying extent the discharge opening of said second chamber and means for adjusting the location of said spindle with respect to said second chamber.

2. An atomizing device according to claim 1 in which the upper part of the spindle is threaded and screwed in the wall of the second chamber.

3. An atomizing device according to claim 1 in which the height of the cylindrical throttling part is such that in the extreme retracted position assumed by the needle valve with reference to the discharge opening of the second chamber, the Archimedean screw may always remain engaged at least partly in said cylindrical throttling part.

4. A liquid atomizing device comprising a first chamber the lower end of which is conical, a second chamber arranged coaxially within said first chamber and having near its lower end a substantially cylindrical throttled part, both chambers being closed at their upper ends and provided at their lower ends with coaxial openings lying substantially in the same plane, a third chamber around said first chamber and communicating with the latter through a number of channels provided in the separating wall, opening tangentially in said first chamber and regularly distributed over the periphery of said wall, a pipe connected with the upper part of said second chamber adapted to feed into the latter the liquid to be atomized, a pipe connected with said third chamber and adapted to feed a gas under pressure into said third chamber, and an Archimedean screw arranged within the throttled part of said second chamber, the diameter of said Archimedean screw being substantially equal to that of said throttled part and its pitch being directed so as to impress the liquid to be atomized with a swirling movement in a sense opposed to that of the movement of the gas entering the first chamber through the tangential channels.

5. An atomizing device according to claim 4 in which the ratio between the total cross-sectional area to said channels at their entrance in said first chamber and the cross-sectional area for the passage of the gas at the output of said first chamber is higher than 1.

6. An atomizing device according to claim 4 in which the ratio between the total cross-sectional area of said channels at their entrance in said first chamber and the cross-sectional area for the passage of the gas at the output of said first chamber is substantially equal to 5.

7. A liquid atomizing device comprising a first chamber the lower end of which is conical, a second chamber arranged coaxially within said first chamber and having near its lower end a substantially cylindrical throttled part connected to the discharge opening of said second chamber through a tapering part, both chambers being closed at their upper ends and provided at their lower ends with coaxial openings lying substantially in the same plane, a third chamber around said first chamber and communicating with the latter through a number of channels provided in the separating wall, opening tangentially in said first chamber and regularly distributed over the periphery of said wall, a pipe connected with the upper part of said second chamber adapted to feed into the latter the liquid to be atomized, a pipe connected with said third chamber and adapted to feed a gas under pressure into said third chamber, a spindle movable axially in said second chamber, an Archimedean screw arranged within the throttled part of said second chamber and carried by said spindle, the diameter of said Archimedean screw being substantially equal to that of said throttled part and its pitch being directed so as to impress the liquid to be atomized with a swirling movement in a sense opposed to that of the movement of the gas entering the first chamber through the tangential channels, a needle valve ending said spindle and adapted to close to a varying extent the discharge opening of said second chamber and means for adjusting the location of said spindle with respect to said second chamber.

PIERRE ROBERT LAGUILHARRE.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,000,227	Bennett et al.	Aug. 8, 1911
1,066,161	Stilz	July 1, 1913
2,022,513	Macchi	Nov. 26, 1935

FOREIGN PATENTS

Number	Country	Date
10,710	France	July 29, 1909
816,143	France	Apr. 26, 1937