Dec. 29, 1925

1,567,608

N. W. LYON

OIL BURNER

Filed Dec. 10, 1924

2 Sheets-Sheet 1

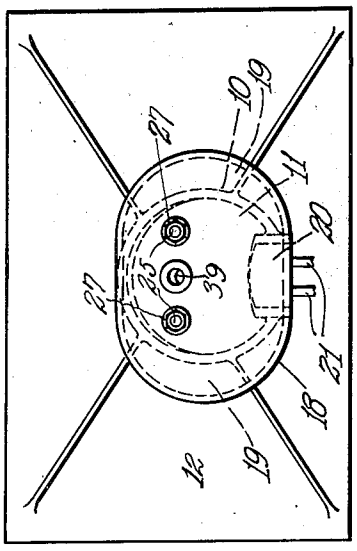


Fig. 2.

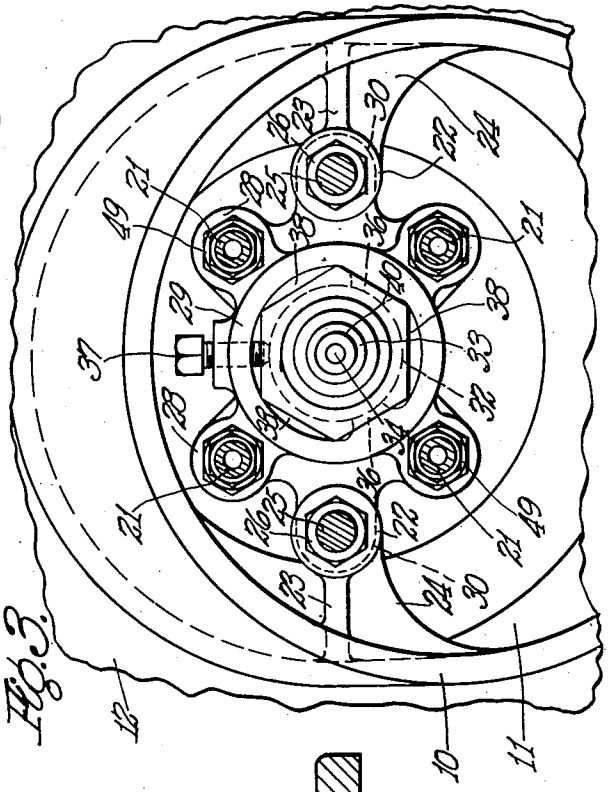


Fig. 3.

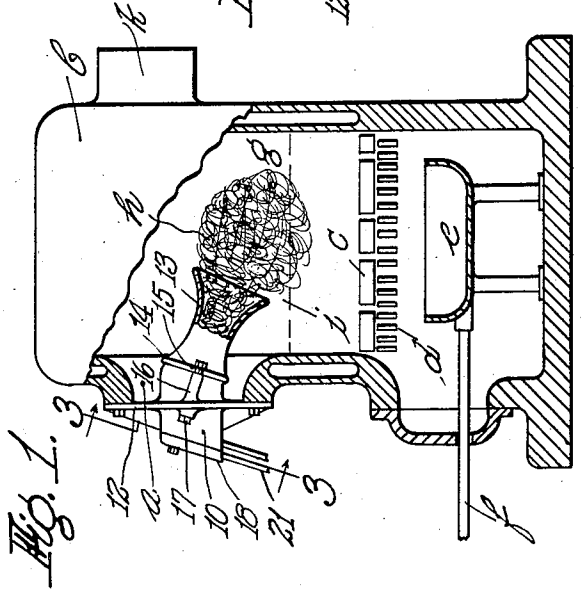


Fig. 1.

INVENTOR.

Norman W. Lyon

BY Chapin & Neal

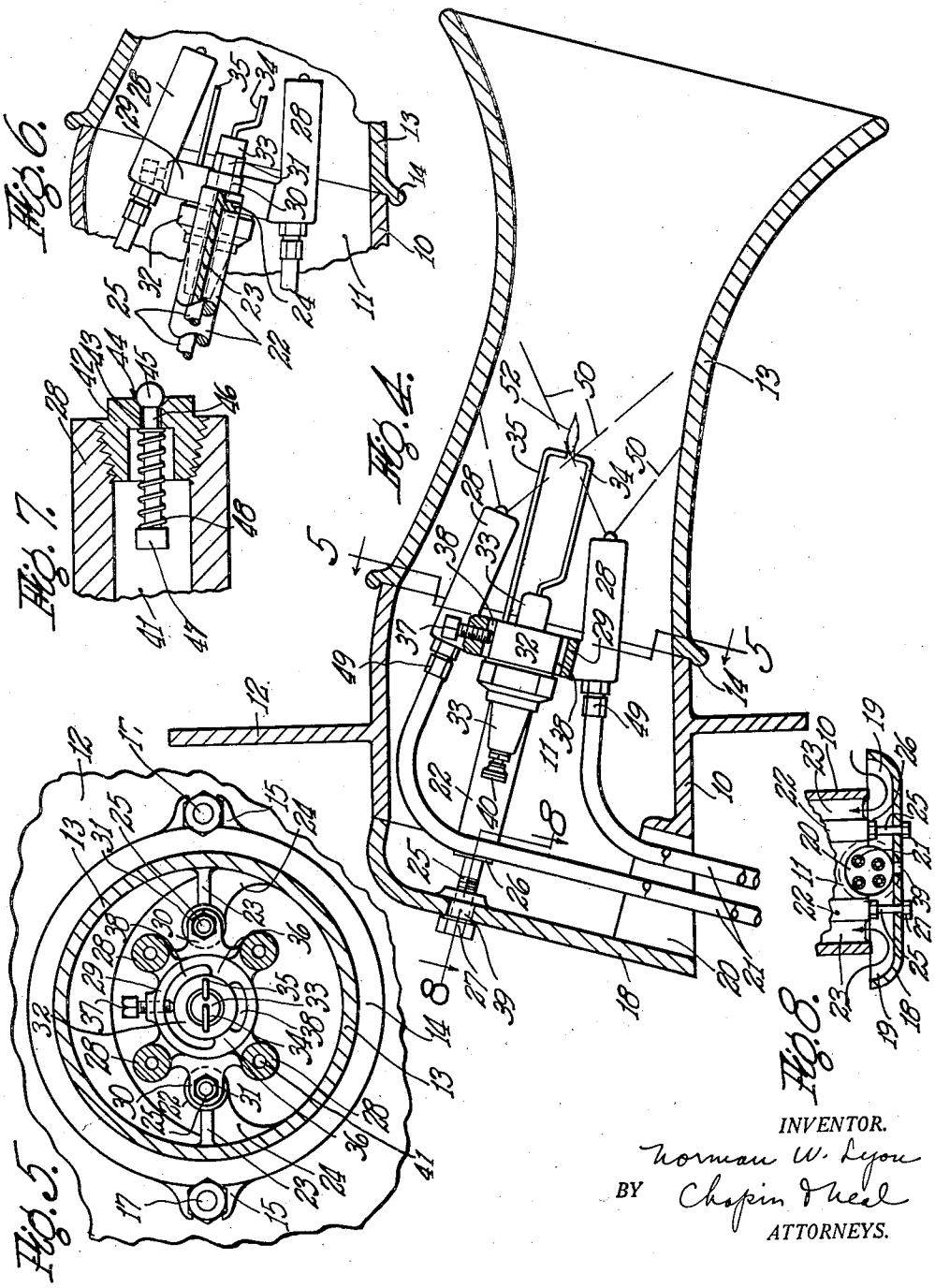
ATTORNEYS.

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Patented Dec. 29, 1925. 1,567,608

UNITED STATES PATENT OFFICE.

NORMAN W. LYON, OF SPRINGFIELD, MASSACHUSETTS, ASSIGNOR TO EDWARD O. SUTTON, OF SPRINGFIELD, MASSACHUSETTS.

OIL BURNER.

Application filed December 10, 1924. Serial No. 755,030.

To all whom it may concern:

Be it known that I, NORMAN W. LYON, a citizen of the United States, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improverents in Oil Burners, of which the following is a specification.

This invention relates to an improved oil burner which, while capable of other applications, is especially suitable for household heating service.

The domestic oil burners, with which I am familiar, are largely adaptations from the oil burners used in the furnaces of large boilers in power plants. That is, the oil is injected into the fire box by a spray from either a fixed nozzle or a rotary atomizer and in either case with considerable velocity. Such methods, while suitable for power plant use, are not so well adapted for the domestic furnace which has a much smaller fire box. The use of such methods in the domestic furnace is liable to work injury to the walls thereof by direct contact with a much more intense flame than results from the coal fire for which it was designed. Also, the high velocity of oil propagation is apt to result in incomplete combustion. The fuel, if carried at high velocity, is not retained in the fire box long enough to be converted into carbon dioxide and some of it escapes into the flue as carbon monoxide, thus resulting in a lower efficiency of fuel consumption than should be the case. The high velocities of fuel have been employed to secure atomization of a fuel which is difficult to atomize.

This invention has for one object the provision of an oil burner which will reproduce, with the use of oil fuel in a domestic furnace, substantially the same conditions as obtain when a coal fire is used.

In carrying out this object the fuel is atomized by subjecting it to high pressure whereby it is emitted from the nozzle or nozzles in a fine mist or spray suitable to be readily and thoroughly mixed with the combustion supporting air. However, although high pressure is used for securing adequate atomization, the flame propagation is controlled so as to produce in the fire box a ball of flame, largely in suspension and located at substantially the same place as the ordinary coal fire. That is, the flame is not allowed to impinge upon the walls of the fire box to any considerable degree and its velocity is lowered as it passes into the fire box so that it will not be likely to escape into the flue before complete combustion has taken place.

Another object of the invention is to provide in an oil burner an improved arrangement and association of the essential burner elements with respect to the ignition means, such as a spark plug, characterized by a resulting effectiveness and reliability of the ignition and by the marked decrease in carbon deposits, and as a practical matter, the substantial elimination of troubles from carbon.

This object is attained in two principal ways, viz., by keeping the electrodes cool and by keeping them out of direct contact with the spark or flame. The electrodes are kept cool by provision for air circulation all around them and all other parts of the ignition device as well as the burner parts, and by the production of an air circulation,—the combustion supporting air being caused to flow by and around all parts of the burner and ignition device for a cooling effect. The electrodes are also kept cool by so arranging them with respect to the burner nozzle or nozzles, that they are sprayed with oil and kept wet and cool. The air flow is so arranged with respect to the spark plug as to draw the flame ahead of the electrodes and the fuel is largely ignited at a location ahead of the electrodes so that the latter are kept out of direct contact with the flame. In this manner, the oil, which is purposely sprayed on the electrodes to keep them cool, is prevented from being burnt on the electrodes to carbonize them. The latter ar-

rangement also contributes to the desired result of keeping the electrodes cool.

Other objects and advantages will appear in the following description and in the illustrative embodiment of the invention in the accompanying drawings, in which:—

Fig. 1 is a small scale sectional elevational view showing the burner as applied to a furnace of the household type;

Fig. 2 is an enlarged front elevational view of the burner, apart from the furnace;

Fig. 3 is a cross sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a view, in vertical section, through the entire oil burner assembly;

Fig. 5 is a cross sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is a fragmentary view taken somewhat similarly to Fig. 4, but showing only the casing in section,—the nozzle support not being in section to illustrate the manner of attaching it to the casing;

Fig. 7 is a detail sectional view of the tip of one of the nozzles; and

Fig. 8 is a fragmentary sectional plan view taken on the line 8—8 of Fig. 4.

Referring to these drawings:—the oil burner includes a cylindrical casing 10, which is hollow to form a passage 11 for the flow of combustion supporting air. This casing is an integral part of a flat, rectangular plate 12, disposed at right angles to the axis of passage 11 and of such shape and size as to form a closure for the fire box opening *a* of the furnace *b*. The plate 12 is designed to be substituted for the usual door provided for opening *a* and is secured to the furnace *b* in any suitable manner.

The inner end of casing 10 is turned downwardly at an inclination to the horizontal and has secured thereto a Venturi tube 13, the interior of which forms a prolongation of the passage 11 and a continuation of the casing 10,—the latter being made in two parts for convenience. The Venturi tube 13 is preferably provided with a circular rim 14 to fit over the inner end of casing 10 and from this rim project two oppositely disposed lugs 15. On plate 12 are formed two laterally spaced and downwardly inclined bosses 16 (Fig. 1) and bolts 17, which extend therethrough, are engaged in notches in lugs 15 to hold the Venturi tube in place.

The outer end of casing 10 is supplied with a substantially elliptical cover 18 (Fig. 2) which, when associated with the circular opening 11 in the casing 10, affords air passages 19 at each side thereof (Fig. 8). In the lower central part of cover 18 is a semicircular opening which registers with a corresponding opening in the adjacent part of casing 10,—the two openings cooperating to form a cylindrical and downwardly directed passage 20, through which the fuel tube, or tubes 21, may pass from the exterior of the furnace into casing 10. The passage 20 also provides for the entrance of some of the combustion supporting air.

Within the casing 10 are two laterally spaced bosses 22 which are disposed in parallel relation and which incline downwardly as they extend inwardly,—the common plane which includes the axes of these bosses also including the axis of the Venturi tube 13. These bosses 22 are formed as integral parts of the casing 10 and are connected thereto by longitudinally and transversely disposed webs 23 and 24, respectively. A stud 25 extends through each of these bosses and is provided with an integral head 26 which engages the outer end face thereof. Each stud 25 extends outwardly beyond head 26 and passes through the cover 18 to receive nuts 27, whereby the cover may be drawn inwardly until its upper and lower rims seat against corresponding portions of casing 10.

The nozzles of the oil burner, shown at 28, are four in number and they are arranged in a circular series with their axes converging toward a common point located well in advance of their inner end faces and in the axis of the Venturi tube 13 beyond its throat. These nozzles are formed integrally with a supporting ring 29 to the outer periphery of which they are secured in equally and angularly spaced relation. Also projecting from the periphery of ring 29, at diametrically opposite points, are two lugs 30 which abut the inner end faces of the bosses 22, receive the inner ends of studs 24, and are secured in place by nuts 31.

The ring 29 also serves to support the ignition device, herein shown as a spark plug, comprising a metallic shell 32, a porcelain 33, a central electrode 34 insulated from the shell by the porcelain, and an electrode 35 connected to the shell. The shell 32 extends through the hole in ring 29 and is held against two seats 36 (Figs. 3 and 5), which project inwardly from the inner periphery of the ring, by a set screw 37, whereby air passages 38 are left through the ring and between it and the shell of the spark plug. A hole 39 is provided in cover 18 to permit the passage of a wire to the terminal 40 of the spark plug, such wire being connected to any suitable source of electricity. The electrodes 34 and 35 are made longer than usual and extend inwardly well into the Venturi tube 13 and a considerable distance in advance of the tips of the nozzles but behind the throat of the venturi.

The nozzles 28 have passages 41 therethrough and the inner end of each receives a threaded plug 42, having an axial passage 43, terminating with a valve seat 44, with which a ball valve 45 cooperates. The valve 45 is fixed to a stem 46, carrying a collar 47, and a spring 48, interposed between the plug and collar 47, normally holds valve 45 to its

seat to close the exit of passage 43. The other ends of the passages 41 are connected to the oil supply tubes 21, heretofore described,—the connection being made by common fittings 49 usually used for connecting tubing to a pipe. The tubes 21 extend to a suitable source of fuel supply.

As an example of one suitable means of forcing fuel to and through the nozzles 28, reference is made to U. S. Letters Patent No. 1,418,566, granted June 6, 1922 to Stephen A. Hasbrouck, for a fuel injector. A fuel injecting apparatus, constructed according to the principles disclosed in said patent, is the mechanism now contemplated for use in connection with the oil burner of this invention. Such fuel injecting apparatus may be operated, as by an electric motor, under thermostat control, so that fuel is supplied only when needed to maintain the desired temperature, and the usual safety devices in common use with outer types of burners may be employed. The fuel injector, its driving means and controlling devices, however, form no part of the present invention.

For the present purposes, it will suffice to state that fuel is supplied intermittently and successively to each nozzle of the series by an impact mechanism which drives the oil in passages 41 and 43 against the valve 45 with a very high pressure, sufficient to unseat the valve and at the same time break up the oil into small particles. The atomized oil is in the form of a fine mist and, due to the outwardly flaring valve seat 44, emerges in a conical spray about in the manner indicated by the broken lines 50 in Fig. 4.

In applying the burner to a furnace, such as *b*, the plate 12 is substituted for the usual fire box door and fastened in place, thus supporting all other parts of the burner. The fuel pumping means and the ignition generator are located at a convenient point adjacent the furnace and connected to the nozzles 28 and spark plug by the tubes 21 and a suitable wire, respectively. Firebricks, such as *c*, are laid upon the grate *d*, preferably in slightly spaced relation so that any drip of oil can pass therethrough into a pan *e* from which it may be conducted away by a pipe *f* to any suitable point. It is to be noted that the Venturi tube is located at such an angle and extends into the firebox *g* to such a degree that the flame from the venturi, which flame is largely in suspension and substantially in the form of a ball, as indicated at *h* in Fig. 1, is located substantially the same with respect to the firebox as the flame and hot coals from a coal fire would be. The normal level of the top of a coal fire is indicated by the broken line *i* in Fig. 1.

In operation, the oil is supplied, as previously described, successively to the nozzles 28 and conical sprays of finely atomized oil issue from each in succession. As soon as one spray stops another starts so that there is always one spray in action. Under such conditions the spark plug is preferably arranged to operate continuously. The use of the plurality of nozzles is largely on account of the particular fuel injecting means chosen and is not necessarily essential, according to all features of the invention. That is, with other fuel feeding means, of a continuously operating type, one nozzle would suffice and many of the substantial results of the invention can be obtained with one nozzle, as well as several.

It is to be noted that the tip of each nozzle is located to the rear of the spark gap between the electrodes 34 and 35 and sufficiently so in conjunction with the angle of the emitted spray so that part of the spray is directed upon the adjacent electrode, covering the latter with wet, cool oil at its end portions. The nozzles are so located with respect to the Venturi tube 13 as to induce a flow of combustion supporting air at a velocity considerably greater than would otherwise be had if reliance were placed solely on natural draft. This air enters from opposite sides of the cover 18 and from the bottom thereof, by way of the openings 19 and 20 and flows through the passage 11 into the venturi. This flow of air is caused to divide and pass outside and inside the ring 29 and is caused to flow around and encompass as completely as possible all parts of the spark plug and all parts of the nozzles 28, thereby keeping all these parts cool and particularly keeping the electrodes, near their spark gap forming ends, cool. The effort also has been to avoid any dead pockets in which carbon can collect and the air is caused to sweep by substantially all exposed surfaces inside casing 10. The flow of air at substantial velocity draws the flame, created between the electrodes 34 and 35, ahead of the same in the manner indicated at 52 in Fig. 4, whereby the major portion of the flame is kept out of contact with the electrodes. This contributes to keeping the electrodes cool and prevents the oil, which is purposely sprayed on the electrodes to cool the same, from being burnt on with resulting carbonization. The atomized fuel mixed with combustion supporting air is therefore largely ignited at a point in advance of the electrodes and at a point well in advance of the nozzle tips so that the usual carbonization troubles at the nozzle tips are avoided by keeping the same cool and out of contact with the flame.

The flame as it travels outwardly through the Venturi, from the throat thereof, is rapidly lowered in velocity, due to the outwardly diverging mouth of the venturi, and

the effect is to cause the flame to be pulled together so that the flame is largely in the form of a ball, as indicated at *h* in Fig. 1. The rate of flame propagation is thus controlled and the effort is to keep the flame in suspension, whereby impingement thereof on the walls of the furnace and grate is avoided, and to obtain ample time for the fuel to be completely consumed before it escapes through the smoke pipe *k*. With long fireboxes, such as are used with large boilers in factories, it is well enough to eject the flame at high velocity into the firebox for the walls thereof are adequately constructed to resist the intense heat and many baffles are provided to prevent the escape of the fuel before it is completely consumed. With the small firebox of the average household furnace, which lacks baffles and has a relatively short passage from the firebox to the smoke pipe opening, the same practice used in factory boilers is not satisfactory. Consequently, the effort has been to depart from prior practice and cause the flame to be held largely in suspension and to emit it from the venturi at rapidly decreasing velocity.

The practical results are a high efficiency in fuel consumption; a reproduction of substantially the same conditions, as far as location of the flame is concerned, as obtain with a coal fire; avoidance of injurious action on the furnace walls and grate; satisfactorily operating and reliable ignition; and the practical elimination of the usual source of trouble, viz, carbonization both of the nozzle tips and electrodes.

The invention has been disclosed, in an embodiment at present preferred, for illustrative purposes but the scope of the invention is defined by the appended claims rather than by the foregoing description.

What I claim is:

1. In an oil burner, a casing adapted to be inserted into the fire box of a furnace and having a single passage for air and an air inlet thereto, a spark plug supported entirely within the passage so as to be protected against the heat of the fire box and so that air can flow along and around substantially all parts thereof, said plug having its axis disposed generally lengthwise of said passage and its body nearer said inlet than the electrodes thereof, and a nozzle supported within said passage for emitting a fuel spray and having its tip located nearer said inlet than the spark gap between the electrodes of the spark plug.

2. In an oil burner, a casing provided with an air passage including a venturi, a circular series of nozzles mounted within said casing with their tips located to the rear of the throat of the venturi, the axes of said nozzles converging to a common point in advance of said throat, and a spark plug, the body of which is located behind the tips of the nozzles and the electrodes of which extend beyond said tips and between them and said throat and provide a spark gap disposed substantially centrally of said venturi.

3. In an oil burner, a casing provided with a passage for the flow of combustion supporting air, a circular series of fuel spraying nozzles each being spaced from the walls of said passage and having its axis disposed substantially longitudinally thereof, a common support for said nozzles disposed substantially transversely of said passage and also spaced from the walls thereof, a longitudinal opening provided in said support, and a spark plug supported from said support and so disposed that air flowing through said opening can circulate around substantially all parts of said plug.

4. In an oil burner, a casing provided with a passage for the flow of combustion supporting air, a circular series of fuel spraying nozzles each being spaced from the walls of said passage and having its axis disposed substantially longitudinally thereof, a common support for said nozzles disposed substantially transversely of said passage and also spaced from the walls thereof, a longitudinal opening provided in said support, and a spark plug supported from said support and substantially concentrically within said opening and with substantial passages between it and the wall of said opening for the passage of air.

5. In an oil burner, a casing provided with a passage for the flow of combustion supporting air, a circular series of fuel spraying nozzles, each being spaced from the walls of said passage and having its axis disposed substantially longitudinally thereof, the axes of said nozzles converging in the direction of air flow, a common support for said nozzles disposed substantially transversely of said passage and also spaced from the walls thereof, a longitudinal opening provided in said support, and a spark plug supported from said support and substantially concentrically within said opening and with substantial passages between it and the wall of said opening for the passage of air.

6. In an oil burner, provided with an air passage, an annular nozzle support mounted within said casing so that air can flow through and around it, a circular series of nozzles projecting forwardly from the periphery of said support and approximately longitudinally of said casing, a spark plug within the opening in said support and having its axis disposed longitudinally thereof and of said casing with its electrodes extending forwardly beyond said nozzles, spaced projections extending inwardly from the interior wall of said annular support for engaging the periphery of the shell of the spark plug, and means for holding said shell

against said projections, whereby air passages are left between the spark plug shell and said interior wall.

7. In an oil burner, a casing adapted to extend into the fire box of a furnace and provided with a single passage for the flow of combustion supporting air, a series of fuel nozzles mounted in said passage in separated relation and with their axes disposed in generally the same direction as the direction of air flow through said passage and converging in the direction of such flow to a common point, whereby the air can flow along and around the nozzles to cool the same, and a spark plug having its electrodes extending into said passage with the spark gap disposed in advance of the tips of said nozzles and in the range of the fuel spray but to the rear of said common point.

In testimony whereof I have affixed my signature.

NORMAN W. LYON.