

mm/t-c-009
Burgoyne

PATENT SPECIFICATION

(11)

1432621

1432621

- (21) Application No. 19189/73 (22) Filed 19 April 1973
(31) Convention Application No. 248264 (32) Filed 27 April 1972 in
(33) United States of America (US)
(44) Complete Specification published 22 April 1976
(51) INT CL² F23Q 13/00
(52) Index at acceptance
F4F 11 9A 9D3 9DX 9EY



(54) CHEMICAL IGNITION SYSTEM

(71) We, RONSON CORPORATION, a corporation organised under the laws of the State of New Jersey, United States of America, of 1 Ronson Road, Woodbridge, New Jersey, United States of America, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Aluminum borohydride $\text{Al}(\text{BH}_4)_3$ is a strong reducing agent and is extremely reactive with many materials. It inflames spontaneously in air over a very wide range of conditions, and it reacts with water with explosive violence. The spontaneous ignition of $\text{Al}(\text{BH}_4)_3$ in air is a property which can be advantageously used to ignite a fuel such as liquefied petroleum gas (butane, propane, etc.).

It has been suggested that aluminum borohydride be used to ignite fuels in cigarette lighters. In such lighters, the aluminum borohydride is contained in a compartment separate from the liquefied petroleum gas. The butane is emitted from a reservoir thereof through a burner valve, and the $\text{Al}(\text{BH}_4)_3$ is introduced at the mouth of the burner valve into the path of the gas. The aluminum borohydride then ignites spontaneously and the butane gas is ignited. Such a lighter is depicted in U.S. Patent No. 3,360,965 entitled, "Gas Lighter" which issued on January 2, 1968.

It has been found that lighters using aluminum borohydride do not operate when the relative humidity falls below 25% at approximately 70°F and below 65% at approximately 50°F. When the temperature is as low as 40°F, they do not operate even at 100% relative humidity. It is believed that the reason for the failure of these units at low temperatures is the decreased reaction rate between aluminum borohydride and oxygen in the air. Ignition of aluminum borohydride in air depends on a rapid release of energy generated by chemical reactions; this raises the temperature of the reactant mass to a value at which flame results. The more

rapid the reaction and the greater the quantity of energy released per unit time, the more intense the flame. It should be noted, however, that the rate of chemical reaction depends on the specific rate constant and the concentration of the reacting species, and both of these decrease with decreasing temperature.

Another effect of low temperature is to decrease the absolute concentration of water vapor in the air, even though the relative humidity may be high. It has been found that aluminum borohydride will not ignite spontaneously in absolutely dry air. This is believed to be due to the fact that in order for it to ignite in air, it must first undergo a rapid reaction with another specie, such as the hydroxyl group present in water. Whether this reaction introduces reactive species, such as free radicals, that accelerate the subsequent reaction with air, or whether the reaction merely serves to heat up the $\text{Al}(\text{BH}_4)_3$ to a higher temperature and, therefore, increases its reaction rate with oxygen in the air, is not known at this time.

A method of achieving spontaneous ignition at low temperatures and low humidity is to eject aluminum borohydride from its container in the form of liquid droplets rather than vapor. This can be achieved by filling a cartridge with liquid aluminum borohydride and omitting the absorbent, such as Kaowool, that is normally used in vapor cartridges. Such designs suffer from four significant disadvantages. Masses of glowing material are discharged which constitute a significant hazard to persons and property as they are extremely hot and can cause ignition of such material as cloth and paper. The valve that is used to regulate flow of liquid aluminum borohydride becomes blocked due to formation of a crust of partially oxidized aluminum borohydride.

After a brief period of use, the valve is rendered inoperative. The valve frequently leaks due to entrapment of solid material which interferes with the closing mechanism. Finally a very unpleasant odour is created whenever the unit is actuated because of the

50

55

60

65

70

75

80

85

90

95

relatively high concentration of aluminium borohydride. In vapour form the material is at a lower concentration and the odour is hardly noticeable.

5 The invention seeks to provide a method of ignition, an ignition apparatus and a lighter which alleviate the foregoing difficulties.

10 According to one aspect of the invention there is provided apparatus for igniting a gas to produce a flame, said system comprising a sealed reservoir containing aluminium borohydride, a sealed reservoir containing an ignition aid which is either methanol or acetaldehyde, and means for releasing a quantity of each of said aluminium borohydride and said ignition aid into an ignition space to form a reactive mixture and ignite a combustible gaseous substance contained therein.

20 According to another aspect of the invention there is provided a method of igniting a gas in an ignition space, the method consisting of releasing into the gas in the ignition space a quantity of aluminium borohydride and a quantity of an ignition aid which is either methanol or acetaldehyde to form a reactive mixture which ignites the gas.

30 The ignition apparatus may be used as an igniter for gas appliances and is not necessarily permanently associated with the source of gas to be ignited. However, in a preferred embodiment of the invention a lighter is provided which comprises an ignition apparatus as described above, in combination with a reservoir for liquefied petroleum gas and a valved conduit extending from the reservoir to the ignition space.

40 Preferably the ignition aid and aluminium borohydride are contained in respective sealed cartridges each having an outlet port therein, said outlet ports being normally closed but openable by respective inertially operated valves for releasing of small quantities of their contents into a confined ignition space.

45 Although attempts have been made to improve the ignition properties of aluminum borohydride, by bringing it into contact with

50 other reactive materials, such as chloropropane, methylacetate, propylamine and various alcohols, it has now been found that of these several reactants, only methanol and acetaldehyde, as shown below, are suitable for use in ignition systems used in gas lighters. In fact, these appear to be superior to water 55 as ignition aids. Chloropropane, methyl acetate and propylamine all have about the same volatility as methanol and are all reactive with $\text{Al}(\text{BH}_4)_3$ and a hydroxyl group is an important intermediate in further rapid 60 reactions that lead to spontaneous ignition in air.

The reaction of $\text{Al}(\text{BH}_4)_3$ with water is believed to proceed stepwise as shown below:



With methanol the reaction would be expected to proceed as follows:



The BH_3 radical has frequently been proposed as the active intermediate in the oxidation of boron hydrides. Its presence logically could influence the rate of oxidation of $\text{Al}(\text{BH}_4)_3$. 75

One additional advantage that methanol and acetaldehyde may have as ignition aids, compared to water, is that they can generate more energy per molecule than water in the overall reaction that occurs. 80

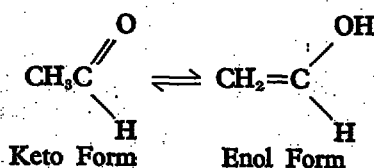
The reaction of $\text{Al}(\text{BH}_4)_3$ with water or, for example, methanol leads to incompletely oxidized products, including hydrogen (see above). However, since the reaction in the cigarette lighter involves both a reaction with ignition aid and a subsequent combustion 85 with oxygen in the air, the overall reactions of importance in determining the release of energy are:



95 Additional water and carbon dioxide are generated per molecule of $\text{Al}(\text{BH}_4)_3$ reacted with methanol, since there is one extra carbon and two extra hydrogen atoms present in the methanol. The combustion reaction is accompanied by considerable generation of heat, which increases the temperature of the spark generated.

100 It has also been found that acetaldehyde is a useful ignition aid for aluminum borohydride. It is believed that acetaldehyde reacts with aluminum borohydride because it con-

tains a hydroxyl group. It is known that acetaldehyde can exist in two tautomeric 105 forms in dynamic equilibrium, i.e.



and the enol form contains a hydroxyl group.

In order that the invention may be better understood, two embodiments thereof will now be described by way of example only and with reference to the accompanying drawings in which:—

Figure 1 is a partial cross section view of an embodiment of an inertial ignition system for a lighter;

Figure 2 is a partial cross section view of a cigarette lighter, in rest position, having a second embodiment of an ignition system in accordance with the invention;

Figure 3 is the lighter of Figure 2 in a partially actuated (compressed) position;

Figure 4 is the lighter of Figure 2 in the sudden release position;

Figure 5 is the lighter of Figure 2 in the fingerpiece-return position;

Figure 6 is a part-sectional view along the lines 6—6 of Figure 3 showing the side-by-side cartridges; and

Figure 7 is a detailed section view of the lighter of Figure 2 showing the arrangement of the cartridges with respect to a baffle plate.

The use of aluminium borohydride alone in a cartridge as an igniter for another fuel has been shown in Patent No. 1,249,101. In Figure 1, there is shown an ignition system comprising two sealed reservoirs, 11 and 12, for aluminium borohydride and ignition aid, respectively. Both reservoirs are located within an outer cartridge 13, which is preferably cylindrical in shape. A tapered port 14 is bored into one end wall of the outer cartridge 13. An inner cartridge 15 is reciprocally positioned and coaxially spaced within the outer cartridge 13 such that a clearance space 16 of approximately two-thousandths (.002) of an inch is maintained. This inner cartridge is closed at its inner extremity by an end cap 17. A seal retainer 18 which can be integral with end cap 17, if desired, retains thereon a seal 19, in the form of an O-ring. Seal 19 precludes any fluid from leaking into or out of inner cartridge 15. The seal is rolled into the metal wall of the cartridge.

A coil spring 20 has one end bearing against seal retainer 18 and the opposite end bearing on a plunger 21. The plunger has an enlarged outer portion and a smaller diameter inner portion thereby forming a shoulder 22 on which the end of spring 20 bears. The plunger is hollow and contains an absorbent material 23 therein which may be Kaowool. The absorbent material is saturated with liquid aluminum borohydride. A cap 24 closes the outer portion of the plunger 21. The cap 24 has a socket 26 therein, into which is press-fitted a tapered seal tip 27. The tapered tip 27 mates with tapered orifice, 13a, in inner cartridge 15 to seal orifice 13a. A thin gasket, 34 prevents flow through channel 16 and out through the orifice 14 of outer cartridge 13.

The reservoir 12 of outer cartridge 13 is closed by an end cap 28 and an O-ring 29 in the same manner as described with respect to inner cartridge 15. A longitudinal rod 30 is secured to a seal retainer 31. An absorbent cylinder 32, which can be packed with Kaowool, for example, is saturated with an ignition aid (methanol or acetaldehyde). A coil spring 33 has one end secured to seal retainer 31; the opposite end thereof bears against the end cap 17 of inner cartridge 15.

In operation, a sharp blow on the end face of outer cartridge 13, adjacent to orifice 14, or a sharp rearward acceleration/deceleration of cartridge 13 will force plunger 21 and inner cartridge 15 rearwardly. The relative strength of the springs 20 and 33 is adjusted so that, upon impact, the spring 33 compresses first, thus causing cartridge 15 to move against the bias of spring 33 until the end cap 17 strikes rod 30 which limits further movement of inner cartridge 15. The movement of inner cartridge 15 opens a space between inner cartridge 15 and sealing gasket 34. The ignition aid vapour passes from saturated pad 32 into the clearance space 16 and enters port 14. When the inner cartridge 15 has reached the limit of its travel, plunger 21, because of its inertia, continues to move toward the now stationary end cap 17. The tapered seal pin 27, which is fixed to plunger 21, is thereby withdrawn slightly from port 13a thus opening port 13a and releasing a small amount of aluminum borohydride into port 14 via apertures (not shown) in the cap 24. Thus the port 14 forms an ignition zone in which the aluminum borohydride reacts with the ignition aid substantially improving the spontaneous combustion of the aluminum borohydride.

It will be appreciated that, if the above described system is to be used in a lighter, it will be necessary to further provide a reservoir for liquified petroleum gas and a valved conduit extending from the reservoir to the ignition space.

In Figures 2—7 is shown a lighter having a pair of cartridges disposed in side-by-side relationship rather than in coaxial alignment as in Figure 1. This igniter design is referred to hereafter as the dual stream ignition unit. The lighter includes a housing 35 which can be made of metal or other suitable material. A fingerpiece 36 is pivotally mounted on the housing about pin 37 and is freely movable on said housing. A return spring 38, which can be a coiled spring, is secured at one end within cavity 39. A plunger 40 is secured to the other end of spring 38 and lies in the path of movement of fingerpiece 36. A striker plate 41 is pivotally secured about a pin 42 within a recess 43 on the fingerpiece. A stop 44 is secured to the fingerpiece 36 across the

recess 43. The stop limits the clockwise rotation of the striker plate 41 about pin 42 caused by the bias of spring 45. Spring 45 is held by a protuberance on striker plate 41. The top surface 46 of striker plate 41 is sloped in configuration from front to rear.

The sealed reservoirs for aluminium borohydride and ignition aid take the form of respective cartridges 47 and 48 (see Figure 6). The cartridges are movably positioned in side-by-side relationship within a pair of longitudinal openings 49 and 50 in housing 35. Coiled springs 51 and 52 surround each cartridge; one end of each spring bears on the housing and the other end bears on the respective end cap flanges 53 and 54 on cartridges 47 and 48. Springs 51 and 52 urge the cartridges against an impact pin 55 which is secured to housing 35 and extends transversely of said longitudinal openings 49 and 50.

By pushing fingerpiece 36 inwardly against the bias of spring 38, striker plate 41 will bear against cartridges 47 and 48 and drive them in a direction away from pin 55. The cartridges pivot the striker plate in a clockwise direction about pin 42 until lower leg 56 of striker plate 41 is prevented from moving further by stop member 44. As the cartridges are moved inwardly by plate 41, a point is reached where springs 51 and 52 are compressed and end cap flanges 53 and 54 slip past the pointed end of the plate. The cartridges are then forced outwardly and about violently against impact pin 55.

Cartridges 47 and 48 are designed according to the principles set forth in Patent No. 1,249,101. Each cartridge has a port therein which is directed towards the ignition space, which port is sealed by an inertially movable means (not shown). They simultaneously discharge a minute amount of their contents toward a mixing baffle 57. Baffle 57 is a V-shaped plate (see Figure 7), the line forming the apex of which is slightly offset from the centre line between the two cartridges in order to create a turbulent flow. The offset is desirably between 0.070" and 0.085".

Particularly good optimum performance is achieved by making one arm of the V slightly

smaller than the other, shown by arms 57a and 57b. The center line between the cartridges extends through larger arm 57b; the cartridge containing aluminum borohydride is in axial alignment with smaller arm 57a. For example, the dimensions of that face of smaller arm 57a which faces the cartridges are approximately 0.20×0.20 inches, and the dimensions of the equivalent face on the larger arm 57b are approximately 0.275×0.20 inches. Mixing baffle 57 is held by a support wire 58 secured to housing 35 by fastener 59. It concentrates the aluminum borohydride and ignition aid in the ignition zone where spontaneous combustion takes place. Baffle 57 can be moved with respect to the nozzles of the cartridges 47 and 48 for optimum location.

A fuel reservoir 60 is secured to housing 35 or made integral therewith. It is sealed and is designed to receive a liquefied petroleum gas, such as butane, which is a liquid under pressure but vaporizes readily under atmospheric pressure. An inlet valve 61 such as that shown in U.S. Patent No. 3,085,601 is mounted on the reservoir to permit the latter to be refueled. Gas is supplied to the ignition zone by means of a conduit 63 which leads from the fuel reservoir 60 to a burner valve 62, such as that shown in British Patent No. 683734, (U.S. Patent No. 2,620,643). Burner valve 62 can also be of the forklift variety such as that depicted in British Patent No. 692789, (U.S. Patent No. 2,571,435), where the valve is opened by fingerpiece 36. When the aluminum borohydride ignites spontaneously in the reaction zone, it ignites the gas emanating from burner valve 62.

Examples of the performance obtained with various ignition aids are set forth below.

Example 1

Methanol as an Ignition Aid

Five coaxial inertial cartridges were tested under different conditions of temperature and relative humidity (R.H.) using methanol as the ignition aid. The results are summarized in Table I.

TABLE I

Ignition Performance Using Methanol						
Cartridge Number	Conditions		No. of Attempts	No. of Ignitions	Efficiency (%)	
	Temp (°F)	R.H. %				
1	38—39	16—33	150	136		91
2	41	23	180	158		87
3	36—38	24—54	300	281		94
4	34—37	15—50	440	415		94
5	36—38	52—65	110	71		64

In comparison with the foregoing results, a cartridge containing no ignition aid does not ignite at temperatures below 40°F, or below 50°F, when the relative humidity is less than 65%.

Example 2

Chloropropane as an Ignition Aid

Cartridge No. 1 (see Table I) was used. The rear compartment was filled with chloropropane rather than methanol. The results are summarized in Table II:

5

TABLE II

Ignition Performance Using Chloropropane					
Conditions		No. of	No. of		
Temp (°F)	R.H. (%)	Attempts	Ignitions	Efficiency (%)	
39	18	50	0	0	
41	24	20	0	0	
41	25	40	0	0	

Methanol was then put into cartridge No. 1 in place of chloropropane. An 87% ignition efficiency at 41°F and 23% relative humidity was obtained.

Example 3

Methyl Acetate as an Ignition Aid

Cartridge No. 1 (see Table I) was again used. The rear compartment was filled with methyl acetate rather than methanol. The results are summarized in Table III:

15

TABLE III

20	Ignition Performance Using Methyl Acetate				
	Conditions		No. of	No. of	
	Temp (°F)	R.H. (%)	Attempts	Ignitions	Efficiency (%)
	34—38	28	40	0	0

Methanol was then put into cartridge No. 1 in place of methyl acetate. A 65% ignition efficiency at 34°F and 50% relative humidity was obtained.

25

Example 4

Acetaldehyde as an Ignition Aid

In a sustained test with a set of acetaldehyde and aluminum borohydride cartridges in a dual stream ignition unit the data shown in the Table IV below were obtained:

TABLE IV

30	Ignition Performance Using Acetaldehyde				
	Conditions		No. of	No. of	
	Temp (°F)	R.H. (%)	Attempts	Ignitions	Efficiency (%)
	35—43	26—65	1310	1230	94

It can be concluded from the foregoing examples that methanol and acetaldehyde are responsible for the successful ignition of aluminum borohydride under conditions of low humidity and temperature.

It will be understood by those skilled in the art that modifications and variations of the present invention may be made. In particular, the orientation of the cartridges with respect to one another may be varied. It may be preferable, for example, to arrange the cartridges in a vertical plane.

WHAT WE CLAIM IS:—

1. Apparatus for igniting a gas to produce a flame, said apparatus comprising a sealed reservoir containing aluminium borohydride, a sealed reservoir containing an ignition aid which is either methanol or acetaldehyde, and means for releasing a

quantity of each of said aluminium borohydride and said ignition aid into an ignition space to form a reactive mixture and ignite a combustible gaseous substance contained therein.

2. The apparatus of claim 1 wherein said sealed reservoirs each take the form of a cartridge having an outlet port, each outlet port being normally closed but openable by a respective inertially operated valve for release of their contents into said ignition space.

3. A method of igniting a gas in an ignition space, the method consisting in releasing into the gas in the ignition space a quantity of aluminium borohydride and a quantity of an ignition aid which is either methanol or acetaldehyde to form a reactive mixture which ignites the gas.

4. The apparatus or method of Claim 1 or

55

60

65

70



Example 2

Chloropropane as an Ignition Aid

Cartridge No. 1 (see Table I) was used. The rear compartment was filled with chloropropane rather than methanol. The results are summarized in Table II:

TABLE II

	Ignition Performance Using Chloropropane				
	Conditions	No. of	No. of		
	Temp (°F)	R.H. (%)	Attempts	Ignitions	Efficiency (%)
10	39	18	50	0	0
	41	24	20	0	0
	41	25	40	0	0

Methanol was then put into cartridge No. 1 in place of chloropropane. An 87% ignition efficiency at 41°F and 23% relative humidity was obtained.

Example 3

Methyl Acetate as an Ignition Aid

Cartridge No. 1 (see Table I) was again used. The rear compartment was filled with methyl acetate rather than methanol. The results are summarized in Table III:

TABLE III

	Ignition Performance Using Methyl Acetate				
	Conditions	No. of	No. of		
	Temp (°F)	R.H. (%)	Attempts	Ignitions	Efficiency (%)
20	34-38	28	40	0	0

Methanol was then put into cartridge No. 1 in place of methyl acetate. A 65% ignition efficiency at 34°F and 50% relative humidity was obtained.

Example 4

Acetaldehyde as an Ignition Aid

In a sustained test with a set of acetaldehyde and aluminum borohydride cartridges in a dual stream ignition unit the data shown in the Table IV below were obtained:

TABLE IV

	Ignition Performance Using Acetaldehyde				
	Conditions	No. of	No. of		
	Temp (°F)	R.H. (%)	Attempts	Ignitions	Efficiency (%)
30	35-43	26-65	1310	1230	94

It can be concluded from the foregoing examples that methanol and acetaldehyde are responsible for the successful ignition of aluminum borohydride under conditions of low humidity and temperature.

It will be understood by those skilled in the art that modifications and variations of the present invention may be made. In particular, the orientation of the cartridges with respect to one another may be varied. It may be preferable, for example, to arrange the cartridges in a vertical plane.

WHAT WE CLAIM IS:—

1. Apparatus for igniting a gas to produce a flame, said apparatus comprising a sealed reservoir containing aluminium borohydride, a sealed reservoir containing an ignition aid which is either methanol or acetaldehyde, and means for releasing a

quantity of each of said aluminium borohydride and said ignition aid into an ignition space to form a reactive mixture and ignite a combustible gaseous substance contained therein.

2. The apparatus of claim 1 wherein said sealed reservoirs each take the form of a cartridge having an outlet port, each outlet port being normally closed but openable by a respective inertially operated valve for release of their contents into said ignition space.

3. A method of igniting a gas in an ignition space, the method consisting in releasing into the gas in the ignition space a quantity of aluminium borohydride and a quantity of an ignition aid which is either methanol or acetaldehyde to form a reactive mixture which ignites the gas.

4. The apparatus or method of Claim 1 or



Claim 2 wherein the ignition aid is methanol.

5. The apparatus or method of Claim 1 or Claim 2 wherein the ignition aid is acetaldehyde.

5 6. The apparatus or method of any one of the preceding claims wherein the aluminium borohydride in the ignition space is in the vapor phase.

10 7. The apparatus of claim 2 wherein the cartridge containing ignition aid takes the form of a first closed cylindrical container having its outlet port in one end wall and the cartridge containing the aluminium borohydride takes the form of a second closed cylindrical container coaxially located within the first container and spring-biased against said one end wall thereof, said second container having its outlet port in that end wall adjacent said one end wall of the first container, the outlet port of the second container being closed by a spring-biased plunger forming its inertially operated valve, and wherein the second container is shorter than the first container, thereby defining a compartment within said first container for the ignition aid.

8. The apparatus of claim 7 wherein the spring biasing the second container against said one end wall of the first container is positioned within said compartment and is adapted to compress, under inertial forces, before the spring biasing the plunger of the second container compresses.

9. The apparatus of claim 8 wherein stop means are provided in said chamber to limit movement of the second container within the first container.

10. The apparatus of any one of claims 7 to 9 wherein the second container and the compartment within said first container contains an absorbent medium for said aluminium borohydride and said ignition aid respectively.

11. The ignition system of any one of claims 7 to 10 wherein said plunger is axially positioned within said second container and includes an annular shoulder against which its biasing spring abuts, said spring being positioned at its other end against the inner wall of the second container.

12. The apparatus of claim 2 further including a housing, a spring-loaded ignition actuator pivotally mounted upon said housing and including means to strike each of said

cartridges to thereby simultaneously release a quantity of the contents thereof to the ignition space, the ignition space being fed, in use, with said combustible gaseous substance.

13. The apparatus of claim 12 where said cartridges are arranged side by side in spaced parallel relation.

14. The apparatus of claim 13 wherein a V-shaped, mixing baffle plate is positioned concavely facing the ports in said cartridges, the line forming the apex of the V being laterally offset from the centre line between the spaced cartridges.

15. The apparatus of claim 14 wherein said cartridges are spring-loaded within said housing and said ignition actuator comprises a spring-loaded, pivotally mounted fingerpiece having a spring loaded, pivotally mounted striker plate adapted to move said cartridges against their restraining springs and upon further pivoting to suddenly release said cartridges against an impact member, whereby a quantity of the contents of each of said cartridges is released.

16. The apparatus of claim 12 wherein said cartridges are arranged in a vertical plane.

17. Apparatus for igniting a gas to produce a flame, substantially as hereinbefore described with reference to Figure 1 of the accompanying drawings.

18. A lighter comprising apparatus as claimed in any one of claims 1, 2, or 4 to 6, or 7 to 17 in combination with a reservoir for liquefied petroleum gas and a valved conduit extending from the reservoir to the ignition space.

19. A lighter substantially as hereinbefore described with reference to Figures 2 to 7 of the accompanying drawings.

20. A method of igniting a gas in an ignition space substantially as hereinbefore described.

STEVENS, HEWLETT & PERKINS,
Chartered Patent Agents,
5, Quality Court,
Chancery Lane,
London, W.C.2.

Reference has been directed in pursuance of Section 9, Subsection (1) of the Patents Act 1949, to Patent No. 1249101 and 1107609.