

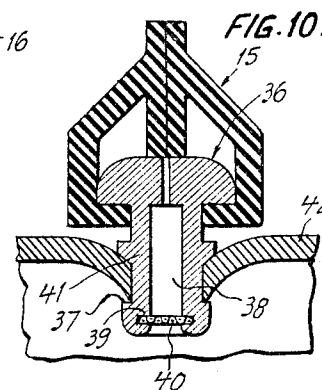
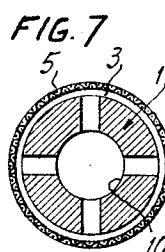
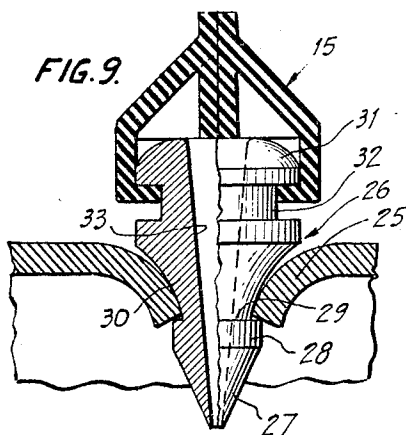
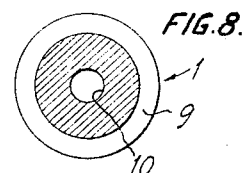
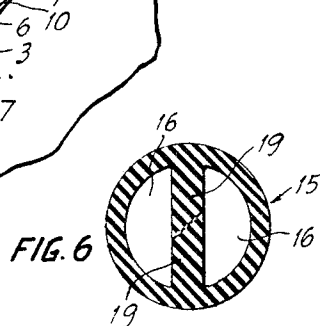
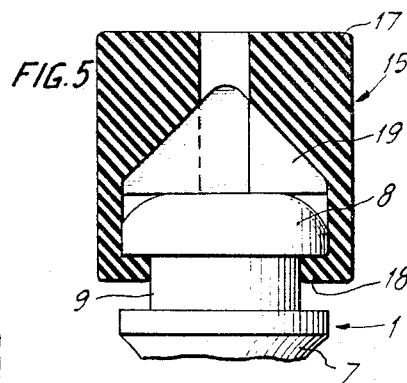
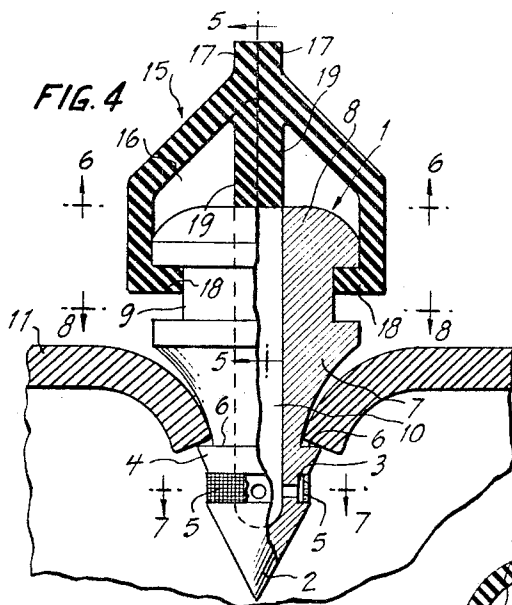
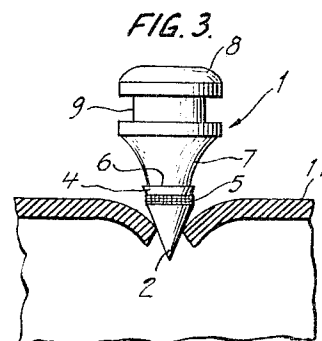
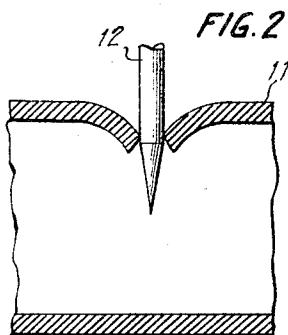
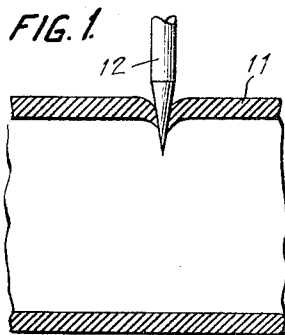
Aug. 30, 1966

C. M. LAMB ET AL

3,269,664

AIR DISCHARGE NOZZLE

Filed Nov. 13, 1962



INVENTORS.
CHARLES M. LAMB
HOMER B. MEYER

BY

James T. Birch
ATTORNEY

1

3,269,664

AIR DISCHARGE NOZZLE

Charles M. Lamb, 511 Glenbrook Road, and Homer B. Meyer, Diamond Crest Lane, both of Stamford, Conn.

Filed Nov. 13, 1962, Ser. No. 237,277

1 Claim. (Cl. 239-272)

This invention relates to an air discharge nozzle construction and mounting in a flexible conduit for use in connection with apparatus used in maintaining the surface of water free of ice during freezing weather in boat basins, harbors, waterways, ponds and the like, as disclosed in applicant's co-pending application filed on even date herewith Serial No. 237,278 and now abandoned and applicant's prior application Serial No. 95,114 filed March 13, 1961, now Patent No. 3,193,260.

The present invention provides an air discharge nozzle construction that may be made of any suitable material such as metal or plastic and formed with a nozzle body having a pointed inner end and a retaining flange or shoulder constructed so that the nozzle body may have the inner end forced through a small aperture formed in a flexible pipe or casing wall structure so as to enlarge the aperture sufficient for the inner end of the nozzle body to extend through the wall of the conduit or casing and have the portion forming the aperture engage the shoulder for locking the nozzle body in the conduit member. This provides a convenient nozzle body for air discharge pipes or conduits, casings and the like, having a flexible wall portion, because the nozzle body can have the inner end forced into the conduit or flexible wall from the outside surface by first piercing an aperture through the wall and then forcing the inner end of the nozzle body through the aperture to enlarge the aperture and interlock the nozzle body with the flexible wall structure for a firm fluid-tight connection with the flexible wall structure without other means of attachment.

The air nozzle provided by the invention has a reduced inner end portion formed with a tapered substantially pointed terminal section at the inner extremity and a locking flange or shoulder formed on the inner end of the nozzle body adjacent the tapered terminal section with a central section having a smaller size adjacent the locking shoulder or flange which flares outwardly toward the outer end of the nozzle body into an outer end portion of larger size. This provides an inner end structure constructed so the substantially pointed inner extremity of the nozzle body may be inserted in a small aperture formed in a flexible conduit casing wall and forced through this aperture. In forcing the inner end of the nozzle body through the aperture in the casing wall the tapered end will enlarge the aperture and cause the flexible wall to bend inwardly under the tension while the inner end extends through the aperture until the edge of the conduit or casing wall about the aperture engages and interlocks with the flange or locking shoulder on the nozzle body. Then, the flexible wall and nozzle body will inter-engage in locked relation with the inwardly curved portion of the flexible wall lying adjacent the surface of the outwardly flaring central portion of the nozzle body and provide a sealed interlocked connection between the nozzle body and flexible wall for firmly retaining the nozzle body mounted in the wall structure. The nozzle body is formed with an air passage extending from the inner end to the outer end in order that compressed air flowing through the flexible conduit or casing may be discharged through the air passage of the nozzle body and outwardly from the conduit or casing.

The nozzle body according to the invention, also has the inner end inwardly of the locking shoulder formed with an annular air passage in a section of reduced diam-

2

eter between the tapered or conical terminal section and the locking flange providing a pair of spaced shoulders facing one another adapted to receive and retain a band of screen mesh about the section of reduced diameter between the shoulders. When the inner end of the nozzle body is forced through the aperture in the flexible wall structure, this section having the annular air inlet and screen structure will extend through the aperture into the inside of the conduit or casing when the edge of the casing about the aperture is interlocked with the flange or locking shoulder construction. The air passage through the nozzle body will open into this annular recess forming an air inlet chamber at the inner end of the body. This screen covered annular air duct or recess in the inner end of the nozzle body provides a means of having foreign matter in the air conduit prevented from entering the passage in the nozzle body and clogging it against the passage of air. Any dirt or other foreign matter will be stopped by the surface of the screen and in view of the screen band extending about the inner end of the nozzle body, a considerable amount of dirt can be stopped by the screen without preventing entrance of air through other portions of the screen.

The invention provides a nozzle body adapted to be mounted on an air outlet conduit or casing of suitable form having an outer end extending outwardly from the outer side of the casing or wall structure and formed with the open outer end of an air passage through the nozzle body for discharging air from the outlet conduit outwardly therefrom. A bubble cap is mounted on the outer end of the nozzle body and has a passage for air from the passage in the nozzle body extending with a pair of lip portions on the outer end of the bubble cap resiliently engaged with each other for normally closing the passage through the nozzle cap for air from the nozzle body by means of the resilience of the material of which the cap is formed, or in any other suitable manner. The flexible lips are formed to normally engage one another and maintain the air passage therebetween in closed relation so as to prevent water or fluid outside of the bubble cap from entering through the passage therein into the nozzle body. The bubble cap is formed on the inner side at the end of the air passage in the nozzle body so that compressed air with sufficient force applied through the passage in the nozzle body will operate the lip portions to separate them and cause them to vibrate back and forth out of closed position. This vibration of the lip portions during discharge of air through the nozzle body will break the air discharged between the lip portions into fine bubbles particularly when they are discharged into water or similar fluids.

Where the invention is used with submerged air conduits and casings for maintaining the surface of water free of ice in a marina, harbor or the like, the present invention provides a simple and inexpensive means for providing air discharge nozzles at spaced intervals in the air outlet conduits and casings. The air discharge nozzles according to the invention are easily inserted at any point along the length of an air conduit and casing structure. Should any nozzle become stuffed up with dirt or foreign matter so that it does not effectively discharge air therethrough, it is very easily replaced by a new nozzle being inserted into the conduit wall adjacent the clogged nozzle and at a minimum of expense because of the simple manner by which the flexible conduit wall can be pierced to provide a small opening and the nozzle body then forcibly inserted into fluid-tight relation through the flexible wall of the conduit to operate in place of the clogged nozzle. Nozzles made according to the invention may be inserted into the flexible outlet conduits without removing the conduits from their assembled relation in the air discharge system.

In the drawing:

FIG. 1 shows how an air discharge conduit having a flexible wall is pierced with a pointed instrument to form a small aperture therein.

FIG. 2 shows how the pointed instrument shown in FIG. 1 is extended through the flexible wall of the conduit to bend it slightly inward and complete the formation of a small aperture in the conduit wall.

FIG. 3 illustrates an air discharge nozzle with the inner end having the pointed terminal portion engaged with the pointed end in the aperture formed in the flexible wall of the air outlet conduit preparatory to forcing it into assembled relation with the conduit wall.

FIG. 4 shows an enlarged cross-section through a flexible air outlet conduit illustrating an air discharge nozzle forced through the aperture in the flexible conduit wall and interlocked therewith in fluid-tight and assembled relation.

FIG. 5 is a vertical cross-section taken on line 5—5 of FIG. 4 showing the outer end of the nozzle body in elevation and the bubble cap in cross section to illustrate details of construction.

FIG. 6 is a cross-section on a reduced scale taken on line 6—6 of FIG. 4.

FIG. 7 is a cross-section on a reduced scale taken on line 7—7 of FIG. 4.

FIG. 8 is a cross-section on a reduced scale taken on line 8—8 of FIG. 4.

FIG. 9 is a cross-section of a modified form of discharge nozzle mounted in a flexible conduit wall which omits the screen and annular air passage.

FIG. 10 is a vertical cross-section showing a modified form of nozzle and screen mounting.

The air discharge nozzle has a nozzle body generally indicated at 1 formed of an elongated circular shape in cross-section with a plurality of sections between opposite ends of different size and shape. The inner end portion is formed with a terminal section 2 of small size which has outer wall surfaces at opposite sides lying in planes which intersect at the inner extremity of the nozzle body as clearly shown in FIG. 4. Terminal section 2 is preferably of conical shape with the inner extremity substantially pointed. Adjacent terminal section 2, the nozzle body is formed with an annular air channel 3 extending between the inner end of terminal section 2 and annular locking flange 4. Air channel 3 is formed by an inner end section of smaller diameter than the inner end of conical section 2 and flange 4, as illustrated in FIGS. 4 and 5, with oppositely facing shoulders formed on the inner end of terminal section 2 and the outer side of annular locking flange 4. This provides an annular air channel about the inner end of the nozzle body for receiving a band of filter screen mesh 5 having opposite ends engaging between the inwardly facing shoulders defining air channel 3. Screen mesh or filter 5 will engage the shoulders in spaced relation about the surface of the body portion of reduced diameter forming the air channel.

Annular locking flange 4 is formed on the side facing the outer end of the nozzle body with a locking face or seat 6 formed by the central portion 7 of the nozzle body having the part extending outwardly from annular flange 4 of reduced diameter in comparison with flange 4. Central portion 7 of the nozzle body extends from flange 4 toward the outer end of the nozzle body and flares outwardly to provide an annular curved outwardly flaring wall terminating at its outer end opposite flange 4 in a portion substantially enlarged in size from the inner end portion. Central portion 7 merges into enlarged outer end portion 8 of the nozzle body formed with a retaining groove 9. The nozzle body is formed with a longitudinally extending air passage 10 opening through outer end portion 8 at the outer end of the nozzle body and having openings at the inner end opening into annular air channel 3, as shown in FIGS. 4 and 7.

Locking flange 4, central portion 7 and outer end portion 8 are all constructed of circular form in cross-section for convenience in manufacture although other shapes which are not substantially circular may be found convenient for use in carrying out the invention as herein disclosed.

With the nozzle body constructed as above described, it is formed for convenient insertion into a flexible conduit or flexible wall structure of an air outlet system. FIGS. 1 to 4 inclusive illustrate an air outlet conduit 11 preferably formed of flexible tubing or the like, there being forms of piping or tubing made from synthetic plastic material and other types of materials well known in the art which provide a flexible wall structure of a character desirable for use with the outlet nozzle construction of the present invention.

The nozzle herein above described may be readily applied to the flexible wall 11 into interlocked relation as shown in FIG. 4 by following a method of first piercing the wall of conduit 11 with a pointed piercing tool 12. Piercing tool 12 has the pointed end engaged with the outer surface of conduit 11 and then forcibly pressed or forced through the wall transversely as indicated in FIGS. 1 and 2 until the tapered end portion on the tool is moved entirely through the flexible wall structure, as illustrated in FIG. 2. Piercing tool 12 is then removed leaving a small aperture in the wall of outlet conduit 11. Then, a nozzle body 11 has the pointed end of terminal section 2 inserted into the aperture in the outlet conduit, as indicated in FIG. 3. Nozzle body 11 is then forced transversely into the aperture so as to bend and stretch the wall structure of the conduit about the aperture inwardly and cause terminal section 2 to enlarge the aperture until it provides for movement of terminal portion 2 through the aperture and movement of the surrounding portion of the flexible conduit wall over the terminal section at the inner end of the nozzle body, then over screen mesh 5 and annular locking flange 4 until the edge of the flexible wall of the conduit 11 passes inwardly beyond locking flange 4.

By reason of the resiliency and flexibility of the material of conduit 11, the marginal portion about the aperture therein will resiliently snap into engagement about central portion 7 as soon as the edge about the aperture slides off the inner edge of annular locking flange 4. This will provide for the inner edge of the flexible wall engaging the locking face or seat 6 on the inner side of locking flange 4. The marginal portion of the flexible wall of conduit 11 about the aperture will curve outwardly along the surface of central portion 7, as shown in FIG. 4, and firmly interlock the flexible wall structure under tension against the outer surface of central section 7 and locking face or seat 6 on flange 4 to firmly lock the nozzle body in the conduit wall structure. The wall structure of the conduit 11 is sufficiently flexible to firmly grip the central section 7 of the nozzle body and seal the nozzle in fluid-tight relation therein.

The interlocking relation between the wall of conduit 11 and locking face or seat 6 on locking flange 4 will firmly hold nozzle body 1 in transversely extending relation with the outer end projecting outwardly beyond the outer wall surface of the conduit or wall structure. The nozzle body is inserted from the outer side of the air outlet conduit in which the shape of the inner end of the body facilitates its insertion through the aperture in the outlet conduit in a convenient manner into interlocked relation merely by forcing it transversely into the conduit. This provides a most economical method of applying outlet nozzles to air outlet conduits for de-icing systems of the character disclosed in the aforementioned depending applications. The connection between the nozzle body and the outlet conduit wall is substantially rigid and firm in addition to being fluid-tight so that the usual pressures used in air conduits of the character employed in de-icing systems of the character herein mentioned

and described in the co-pending applications, will withstand the highest air pressures and exterior water pressures without leakage of fluid through the connection between the conduit wall structure and the nozzle body.

The nozzle body may be made of any suitable materials such as metal or plastic, and constructed so it may be molded or turned in a convenient manner and produced in large numbers at an economical cost.

A bubble cap 15 is formed of flexible plastic or rubber and has a recess 16 opening at the inner end of a size for receiving the outer end portion 8 on the nozzle body, as shown in FIGS. 4 and 5. Recess 16 has the inner wall projecting beyond the outer end 8 of the nozzle body extending outwardly in inclined relation toward the lip portions 17. The outer wall of cap 15 is also inclined beyond the end of the nozzle body to form a wall section of substantially uniform thickness. The inner end of bubble cap 15 has an inwardly extending flange 18 extending into the open end of recess 16 for engagement in retaining groove 9 in the outer end portion 8 of the nozzle body. This flange 18 retains bubble cap member 15 in fluid-tight detachable engagement on the outer end of nozzle body 1, as shown in FIGS. 4 and 5. Bubble cap member 15 is formed of a suitable highly resilient plastic or rubber material which will normally maintain a passage between lips 17 closed by the resiliency of the material of the cap maintaining lips 17 engaged with one another as shown in FIGS. 4 and 5.

When fluid pressure within conduit 11 is built up to sufficient pressure it will operate on inclined portions of the inner walls of bubble cap 15 in recess 16 beyond the end of the nozzle body and flex the lip portions 17 outwardly and apart from each other to open a small passage between them according to the volume of air and its pressure for discharging air outwardly from between the lip portions. The resiliency of the material forming the lip portions will cause them to vibrate back and forth and break up the air being discharged under pressure into small bubbles. Where conduits 11 and nozzle body 1 with bubble cap 15 are submerged in water in a de-icing system of the character above mentioned, the pressure within the bubble cap will have to be sufficiently greater than the water pressure on the outside of the bubble cap to secure operation of lip members 17 which will vibrate back and forth in discharging air in small bubbles in the surrounding water and normally maintain the passage there-between closed against the entrance of water. The outer ends of lip portions 17 may have flexible supporting flanges 19 formed on the inner walls, as shown in FIGS. 4 and 5, with the inner ends engaged with the end surface of outer end portion 8 for co-operation with flanges 18 for supporting bubble cap 15 in assembled relation on the nozzle body. New bubble caps may be applied to any nozzle body in its location in a conduit wherever and whenever it becomes necessary by merely pulling the old cap off and applying a new one with flange 18 engaged in retaining groove 9.

Where it is found unnecessary to use nozzles having filter screen band 5 and annular air channel 3 the nozzle body will be constructed as shown in FIG. 9. The flexible wall 25 will be pierced to provide a small aperture as hereinabove described. Nozzle body 26 is made like nozzle body 1 with the section providing air channel 3 omitted. Nozzle body 26 will accordingly be formed with the terminal section 27 of tapered form. Terminal section 27 will be substantially conical in shape having the extremity terminating in substantially pointed shape and the inner end terminating in an annular locking flange 28. Annular locking flange 28 is formed with a locking face or seat 29 facing toward the outer end of body 26.

Nozzle body 26 has a central section 30 extending from locking flange 28 outwardly. Section 30 has a smaller diameter or size at the portion adjacent flange 28 for cooperation in forming locking face 29. Section 30 has an outwardly curved and flared surface extending

from flange 28 toward the outer end of the nozzle body and terminates in a substantially cylindrical outer end portion 31 of substantially larger size than the inner end of the body. Outer end portion 31 of the nozzle body is formed with a retaining groove 32 for detachably mounting a bubble cap 15 thereon. Outer end portion 31, central section 30 and terminal section 27 will have the same size and shape as the corresponding portions of nozzle body 1.

Terminal section 27 is inserted through an aperture in wall portion 25 in the same manner as terminal section 2, until the wall portion about the aperture engages about the inner end of central section 30 and locking face or seat 29 on locking flange 28 when the nozzle body will be firmly retained in assembled position in wall 25.

The central portion of nozzle body 26 is formed with an air passage 33 extending axially through the body and opening at opposite ends. Air within the conduit or casing having wall portion 25 will flow through this passage 33 in the nozzle body outwardly to the inside of cap 15 for operation of the lip portions in a manner as hereinabove described.

It will be understood that lip portions 17 will be connected at opposite edges of cap 15 and that the central portions will have wall portions which are separate and normally engaged so that air pressure separates the intermediate portions of the lip portions in releasing the air. These lip portions will vibrate at a relatively high frequency in discharging air and forming many small bubbles below the surface of water. These small bubbles spread out in the water in their upward travel and move a volume of water in a boat harbor, marina, channel or the like upwardly. Since the water near the bottom of an open body of water is warmer than the water at the surface, the upward circulation of the warmer water and air will spread out under an ice coating on the surface and melt the ice for a considerable distance away from the position at which a nozzle body is located. The water will be circulated by and with the air for keeping an area above the nozzle free of ice during freezing weather.

A modified form of nozzle construction is shown in FIG. 10. The nozzle body 36 is of cylindrical construction and has an annular locking flange 37 at the inner end. The nozzle body 36 has an enlarged air chamber 38 opening through the inner end. A shoulder 39 is formed near the inner end of the nozzle body about the air chamber 38 to receive and support a screen 40. After the screen 40 is inserted in the inner end of chamber 38, the end of body 36 is formed inwardly about the margin of the screen for retaining it against shoulder 39. The central portion 41 of the outer surface of the body 36 has the marginal portion of an aperture formed in conduit 42 engaged therewith and annular locking flange 37 for retaining the nozzle body in the conduit. The outer end portion of the nozzle body 36 is constructed in a manner similar to the previous constructions and carries a bubble cap for closing the air passage at the outer end of the body. The nozzle body 36 has an aperture at the outer end of the air chamber 38 of reduced size as shown in FIG. 10. The type of nozzle body construction provides a more economical construction for mounting the screen and a larger section of screen for passage of air directly into the air chamber. Otherwise, operation of the nozzle and bubble cap is substantially the same as above described.

The invention claimed is:

A discharge nozzle for water de-icing apparatus comprising a nozzle body for insertion in a flexible conduit wall structure having an inner end portion formed with a substantially conical terminal section with the inner extremity substantially pointed, the portion of said inner end adjacent said terminal section having an air filter section of reduced diameter extending therefrom and co-operating to form a shoulder, the opposite end of said air filter section terminating in an annular retaining flange

7

of larger diameter than said reduced diameter of said filter section, a band of screen wire mounted between said shoulder and retaining flange in spaced relation to said section of reduced diameter, said nozzle body being formed with a longitudinal air passage having the inner opening in said air filter section of reduced diameter within said band of screen wire for preventing foreign matter from entering said passage, said nozzle body having an intermediate section extending outwardly from said retaining flange and having a smaller size than said retaining flange adjacent thereto to form an outwardly facing locking shoulder, said intermediate section having an annular curved surface extending outwardly from said retaining flange and locking shoulder in substantially frusto-conical relation and terminating in an outer head portion of larger diameter than the inner end portion of said body, said head portion being formed with an inwardly extending annular groove, and a bubble cap formed of resilient material having a recess in the inner end receiving the outer end of said head portion and an inwardly extending annular flange engaged in said inwardly extending annular groove in said head portion for retaining said bubble cap mounted on said nozzle body in fluid-tight relation, and a pair of lip portions formed at the outer end of said bubble cap resiliently engaging each other to maintain a passage through said bubble cap communicating with said nozzle body passage closed against passage of fluid, and said lip portions being movable apart by predetermined pressure applied through said nozzle body passage which will cause said lips to vibrate and divide compressed fluid into fine bubbles upon leaving said lip portions, said

8

nozzle body having said inner end portion insertable, through a smaller aperture in said flexible conduit wall structure for enlarging said aperture bending said wall structure inwardly and movement through said conduit wall structure until the edge of said wall structure engages said outwardly facing locking shoulder on said retaining flange for retaining said nozzle body interlocked in fluid-tight relation in said wall structure with the inwardly bent portion of said wall structure engaging said annular curved surface for holding said nozzle body in transverse position in said wall structure.

References Cited by the Examiner

UNITED STATES PATENTS

15	135,320	1/1873	Camp	137—525.1
	428,307	5/1890	Leland	55—256
	1,348,966	8/1920	Smith	55—303
	2,013,361	9/1935	Reynolds	222—90
	2,563,300	8/1951	Aker	239—272
20	2,667,992	2/1954	Hammond et al.	222—92
	2,716,574	8/1955	Chase	239—547
	2,894,530	7/1959	Stevens et al.	137—525.1

FOREIGN PATENTS

25	597,951	5/1960	Canada.
	1,256,893	2/1961	France.
	720,728	12/1954	Great Britain.

HARRY B. THORNTON, *Primary Examiner*.30 ROLAND R. WEAVER, *Examiner*.D. M. REISS, *Assistant Examiner*.