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SEARCH ROOM

March 10, 1959 H. MOORE 2,876,859

PULSE SUPPRESSING APPARATUS IN PIPES

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Fig. 1.

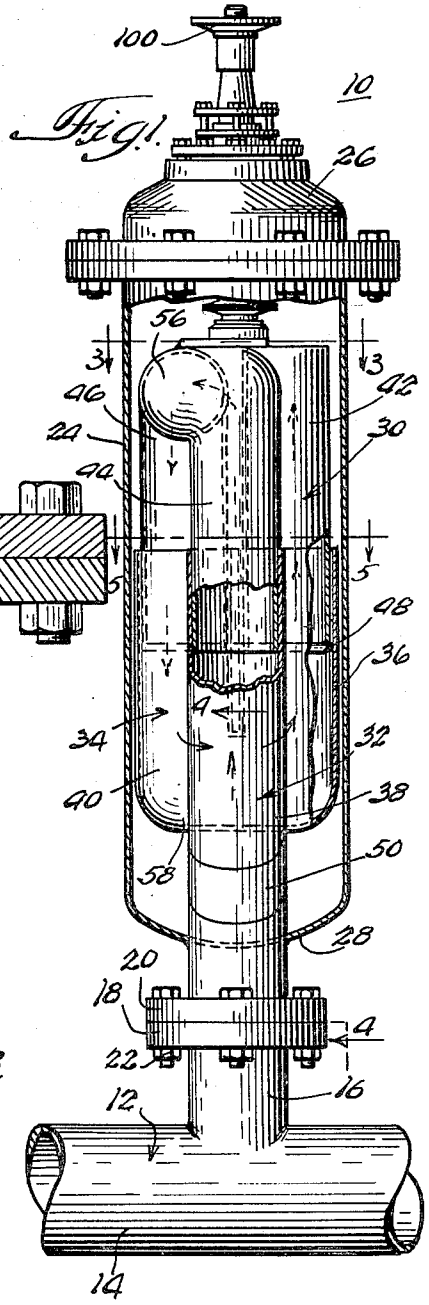


Fig. 2.

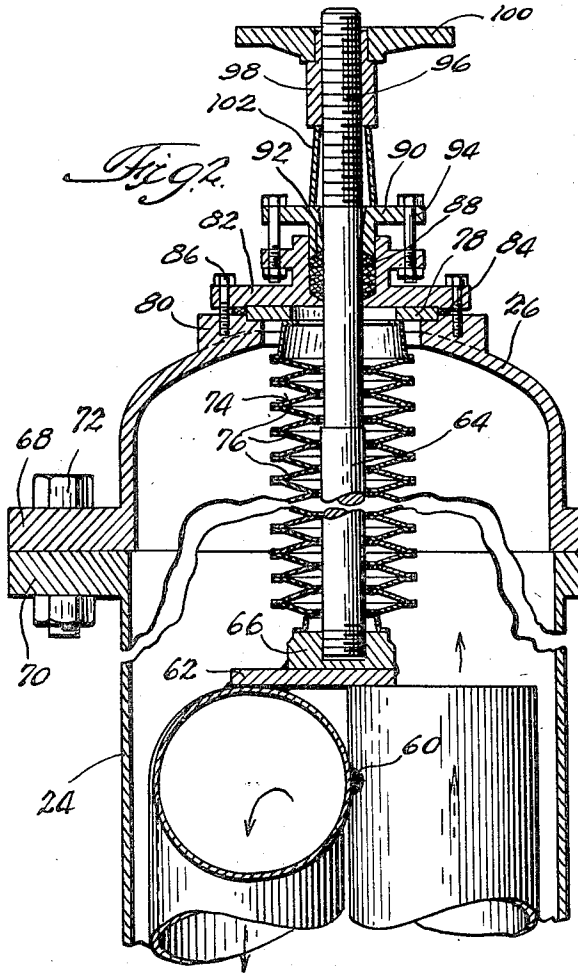
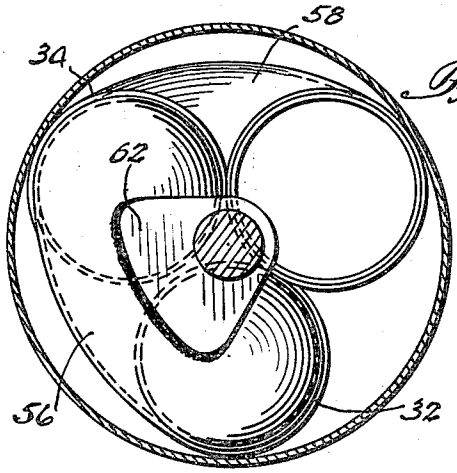


Fig. 3.



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Fig. 4.

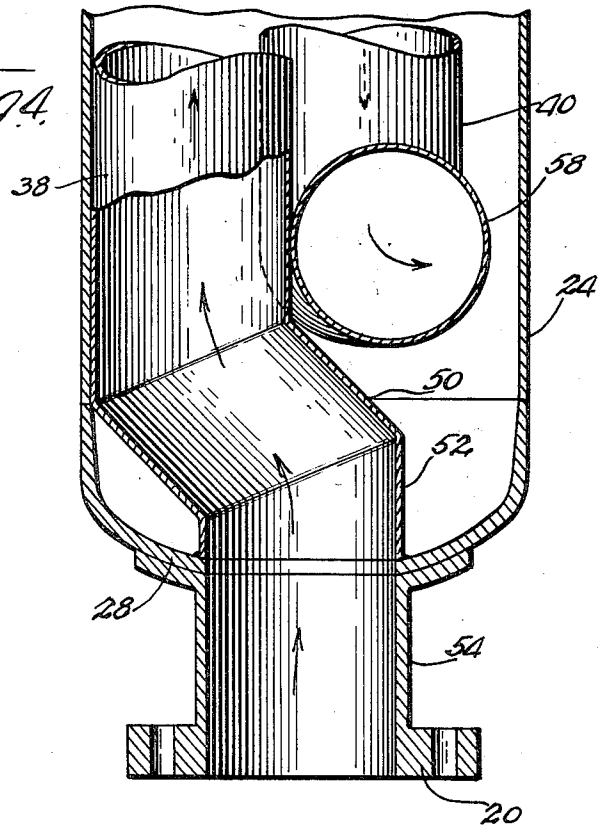
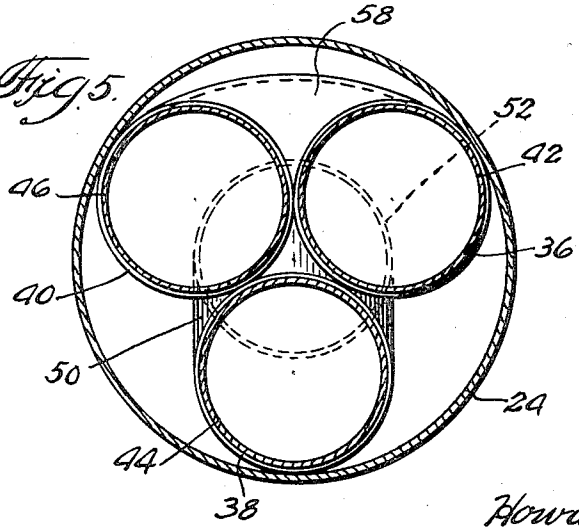


Fig. 5.



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PULSE SUPPRESSING APPARATUS

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Application August 27, 1956, Serial No. 606,483

11 Claims. (Cl. 181—48)

This application relates to pulse suppressing apparatus and more particularly to improved tunable apparatus for suppressing fluid impulses in fluid pipe lines and the like.

In pumping fluids through pipe lines and the like, violent surges frequently appear in the fluid as a result of periodic pulsations of the pumping apparatus, the sudden opening and closing of various controls, irregular periodic consumption of fluid in the line and the like. Such impulses are frequently violent and destructive in nature and thus it has been found necessary to suppress the mechanical effects thereof. Various devices, such as expansion loops, headers and sealed chambers have been provided for this purpose. All such devices, however, have proven unsatisfactory in that devices of large size and mass have been required. Furthermore, it has been found that these impulses, whether repeated or of a single transient type, are periodic in nature, similar to conventional acoustical impulses.

It is therefore one particular object of this invention to provide an improved suppressor for acoustical impulses adapted for use with conduits containing fluid under pressure.

It is another object of this invention to provide improved apparatus for suppression of acoustical impulses present in conduits carrying fluid under pressure wherein the apparatus is resonant at the frequency of the acoustical impulses.

It is still another object of this invention to provide improved suppression apparatus for acoustical impulses in fluid under pressure including means for adjusting the resonant character of the suppression apparatus to correspond to the wavelength of the acoustical pulses.

It is a further object of this invention to provide improved apparatus for acoustical pulse suppression for use with fluid under pressure wherein limited linear adjustment provides extended variations in the resonance frequency of the apparatus.

It is a still further object of this invention to provide an improved acoustical pulse suppressor which is simple in theory and construction, requires a minimum space and is readily adjustable to produce resonance over an extended range of pulse wavelengths.

Further and additional objects of this invention will become manifest from a consideration of this specification, the accompanying drawings, and the appended claims.

In one form of this invention a sealed cylindrical housing having end closures is provided wherein a variable tortuous internal fluid path is provided within the sealed housing, and means further provided for connecting said tortuous fluid path to a fluid line requiring impulse suppression.

More particularly, the tortuous fluid path described above includes an assembly of a plurality of side by side parallel tubular members, each including two telescoping tubular sections whereby adjustment of the relative positions of the two assemblies of tubular sections produces variations in the overall length of the fluid path.

For a more complete understanding of this invention, reference will now be made to the accompanying drawings wherein:

Fig. 1 is an elevational view, partially in section, of one embodiment of this invention;

Fig. 2 is an enlarged sectional view of the upper portion of the embodiment of Fig. 1;

Fig. 3 is a transverse sectional view of the embodiment of Fig. 1, taken on the line 3—3 thereof;

Fig. 4 is a partial sectional view of the lower portion of the embodiment of Fig. 1, taken on the line 4—4 thereof; and

Fig. 5 is a transverse sectional view of the embodiment of Fig. 1, taken on the line 5—5 thereof.

Referring now to the drawings and more particularly to Fig. 1, an acoustical pulse suppressor **10** is illustrated as connected to a conduit section **12**, said conduit section including a cylindrical portion **14** and a transverse connection **16**. The transverse connection **16** is provided with a flange **18** which cooperates with a corresponding flange **20** of the pulse suppressor **10**. A plurality of bolts and associated nuts **22** are utilized to securely clamp and seal the pulse suppressor **10** onto the transverse vertical connector **16**.

The pulse suppressor **10** comprises a cylindrical housing **24** having a centrally apertured upper end portion **26** and a centrally apertured lower end portion **28**. A plurality of substantially parallel tubular members **30**, **32** and **34** are disposed in side by side relationship within the housing **24** and substantially parallel to the axis thereof. Each of the tubular members **30**, **32** and **34** is composed of a lower fixed tubular section **36**, **38** and **40**, respectively, and an upper tubular section **42**, **44** and **46** respectively. The upper tubular sections slide against the inner wall of the associated lower tubular sections, whereby a variable sealed fluid path is formed.

Each of the upper tubular sections is provided with an outwardly formed bead or flange **48** which forms an effective seal against the inner wall of the corresponding lower section. Thus, engagement of the telescoping sections over substantially their entire coextensive portions is avoided and a freer, lower friction, though substantially fluid-tight, seal is formed. The lower tubular section **38** includes an offset portion **50**, most clearly seen in Fig. 4. This offset portion terminates at its lower end in the center of housing **24** and a vertical tubular element **52** is in sealed engagement therewith. Element **52** is sealed to the lower end portion **28** of housing **24** and completely encloses the aperture therein. An outer connecting tubular element **54** is coaxial with element **52** and encloses the aperture in the end portion **28** about its outer periphery. Element **54** is integrally formed with the connecting flange **20**, already described. Thus, tubular elements **54**, **52**, **50** and **32** are in seriatim fluid communication with fluid conduit **12**.

The upper end of element **32** is connected to a transverse connecting tube **56** which is also in sealing engagement with tubular member **34**. This is best seen in Fig. 3. Thus, tubular member **34** is in fluid communication with the other series described above to form a continuous fluid path. Moreover, the lower end of tubular member **34** is in communication with tubular member **30** through a transverse connecting tube **58**. This connection is best seen in Figs. 3 and 5. Thus, tubular member **36** also forms a part of the continuous fluid path described above and this member is open at its upper end whereby it is in fluid communication with the entire remaining cavity of housing **24**.

Means is provided by this invention for vertically reciprocating the upper tubular sections 42, 44 and 46. These sections are integrally formed as an assembly by interconnecting brackets 60, one of which is clearly shown in Fig. 2 and by top plate 62 welded or otherwise secured to the upper ends to the tubular sections. A central shaft 64 is threadedly secured in a support 66 mounted on plate 62. The shaft 64 extends upwardly through a central aperture in end portion 26. This construction is best illustrated in Fig. 2. The end portion 26 is removably secured to the cylindrical housing 24 by an apertured flange 68 integral with the lower periphery of end portion 26 and a correspondingly apertured flange 70 extending outwardly from the periphery of housing 24. The apertures in flanges 68 and 70 are aligned and bolts 72 passed therethrough, whereby the flanges are maintained in sealing engagement.

A bellows assembly 74 having a plurality of bellows sections 76 surrounds the shaft 64. Bellows 74 is sealed at its lower end to support 66 and at its upper end to an annular ring 78. Bellows 76 tends to expand and thus urge the lower end support 66 downwardly. Ring 78 is secured against a mounting disk 80 which is integrally formed with the end portion 26. Ring 78 is held against disk 80 by a clamping ring 82. A gasket 84 is disposed between ring 82 and disk 80 and is held therebetween by a plurality of mounting bolts 86. Ring 82 has a central recess therein providing clearance between shaft 64 and the inner periphery of the recess. This space is filled with sealing gasket material 88 and a compression cylinder 90 having a tapered lower surface 92 fitting within the recess. The tapered lower surface 92 engages the upper surface of gasket material 88 to compress the material and form a seal against shaft 64. Cylinder 90 is forced downwardly to compress gasket material 88 by adjustment of a plurality of bolts 94 which extend through corresponding apertures in cylinder 90 and ring 82. The upper end 96 of shaft 64 is threaded to receive a correspondingly threaded sleeve 98. Sleeve 98 is preferably provided with an outwardly extending wheel-like flange 100. As shaft 64 is restrained against rotation, rotation of wheel 100 will, it is obvious, produce axial motion of shaft 64. Thus the position of the upper tubular sections 42, 44 and 46 may be varied over a substantial range by rotation of wheel 100. A cylindrical spacer 102 is provided between wheel 100 and cylinder 90 to provide easier manipulation of the wheel 100, while bellows 76 tends to expand downwardly against support 66 to urge downwardly the upper assembly thus described.

It will be apparent that by this invention a relatively long fluid path is provided within a small volume. Thus, it is possible to provide a fluid path which is in resonance with acoustical pulses in a fluid conduit where the pulses have relatively long wavelengths. Furthermore, it will be apparent that the total fluid path is adjustable over a substantial range, the variations in the fluid path being approximately three times the actual linear variations in the position of shaft 64. It has been found that by adjusting the position of shaft 64, optimum pulse suppression is provided by adjusting the effective fluid path length to a value approximately one-fourth of the length of the pulses to be suppressed. Thereby the reflected pulse returning to the fluid conduit over the effective fluid path will be 180° out of phase with the succeeding impulse and will thus produce effective cancellation of the deleterious impulses.

Theoretical determinations indicate that the anticipated range of wavelengths will be of the order of several feet. As the suppressor herein described functions best when tuned to one-fourth of the surge wavelength and the fluid path variations are three times the physical extension, motion of the shaft 64 in the order of several inches will be adequate for use in a given system.

It has further been discovered that as a result of variations in temperature, input and load characteristics, and the like, the wavelength of the surges and impulses in a given system may vary substantially over a period of time. Thus, by periodic adjustment of the hand wheel 100, optimum pulse suppression may be provided at all times. In the particular embodiment described, the tubular members 30, 32 and 34 are galvanized steel tubes having a diameter of 6 inches and the housing 24 is a 14 inch steel cylinder. The sections of the tubular members overlap, when fully extended, by about 4 inches.

While one particular embodiment of this invention is herein described employing a particular fluid seal and adjusting technique, it will be apparent that the purposes of this invention may be accomplished using various components and details and that all such variations will fall within the spirit and scope of this invention. For example, while the suppressor is particularly designed for use with fluids in the gaseous state, the desired advantages of the herein described structure may be attained with liquids provided a sufficient compressible gaseous volume is maintained in the suppressor.

Without further elaboration, the foregoing will so fully explain the character of my invention that others may, by applying current knowledge, readily adapt the same for use under varying conditions of service, while retaining certain features which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims.

I claim:

1. Apparatus for pulse suppression comprising a sealed cylindrical housing having end closures, a plurality of substantially parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, one end of said fluid path opening into and terminating within said housing, and a connecting tubular element extending through one end closure of said housing and sealed thereto, said tubular element being in fluid communication with the other end of said path.

2. Apparatus for pulse suppression comprising a sealed cylindrical housing having end closures, a plurality of substantially parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, extension means in engagement with said tubular members and extending through an aperture in one of said end closures, one end of said fluid path opening into and terminating within said housing, and a connecting tubular element extending through the second end closure of said housing and sealed thereto, said tubular element being in fluid communication with the other end of said path.

3. Apparatus for pulse suppression comprising a sealed cylindrical housing having end closures, a plurality of substantially parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, extension means in engagement with said tubular members and extending through an aperture in one of said end closures, means surrounding said aperture providing a seal between said housing and said extension means, one end of said fluid path opening into and terminating within said housing, and a connecting tubular element extending through the second end closure of said housing and sealed thereto, said tubular element being in fluid communication with the other end of said path.

4. Apparatus for pulse suppression comprising a sealed

cylindrical housing having apertured end closures, a plurality of substantially parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, one end of said fluid path opening into said housing, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, respective tubular sections of said plurality of tubular members being secured together, one assembly of said sections including said open end being movable within said housing, a connecting tubular element extending through and sealed to the apertured portion of one of said end closures and in sealed fluid communication with the other end of said fluid path, and adjusting means extending through the apertured portion of the other of said end closures and secured to said assembly to determine the position thereof within said housing.

5. Apparatus for pulse suppression comprising a sealed cylindrical housing having apertured end closures, a plurality of substantially parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, one end of said fluid path opening into said housing, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, respective tubular sections of said plurality of tubular members being secured together, one assembly of said sections including said open end being movable within said housing, a connecting tubular element extending through and sealed to the apertured portion of one of said end closures and in sealed fluid communication with the other end of said fluid path, adjusting means extending through the apertured portion of the other of said end closures and secured to said assembly to determine the position thereof within said housing, and means providing a seal between said adjusting means and said other end closure permitting relative movement therebetween.

6. Apparatus for pulse suppression comprising a sealed vertical cylindrical housing having apertured end closures, a plurality of substantially vertical parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, one end of said fluid path opening into said housing, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, respective tubular sections of said plurality of tubular members being secured together, the upper assembly of said sections including said open end being movable within said housing, a connecting tubular element extending through and sealed to the apertured portion of one of said end closures and in sealed fluid communication with the other end of said fluid path, adjusting means extending upwardly through the apertured portion of the other of said end closures and secured to said assembly to dedetermine the position thereof within said housing, and means providing a seal between said adjusting means and said other end closure permitting relative movement therebetween.

7. Apparatus for pulse suppression comprising a sealed vertical cylindrical housing having apertured end closures, a plurality of substantially vertical parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, one end of said fluid path opening into said housing, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, respective tubular sections of said plurality of tubular members being secured together, the upper assembly of said sections including said open end being movable within said housing, the lower end of each of the tubular sections of said upper assembly being formed with a flanged portion to form a seal with the lower section of each of said tubular members, a connecting tubular element extending through and sealed to the apertured portion of one of said end closures and in sealed fluid communication with the other end of said fluid path, adjusting means extending upwardly through the apertured portion of the other of said end closures and secured to said assembly to determine the position thereof within said housing, and means providing a seal between said adjusting means and said other end closure permitting relative movement therebetween.

8. Apparatus for pulse suppression comprising a substantially vertical sealed cylindrical housing having apertured end closures, a plurality of substantially vertical parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, one end of said path opening into said housing, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, respective tubular sections of said tubular members being secured together, the upper assembly of said sections being movable within said housing, the lower end of each of the tubular sections of said upper assembly being formed with a flanged portion to form a seal with the corresponding lower section of each of said tubular members, a connecting tubular element extending through and sealed to the apertured portion of the lower one of said end closures and in sealed communication with one end of said fluid path, a threaded shaft extending upwardly through the apertured portion of the upper one of said end closures and secured to said upper assembly, bellows means disposed between said assembly and said upper end portion and surrounding said shaft to seal said housing, and means engageable with the outer portion of said housing and threadedly engaging said shaft whereby the position of said threaded means on said shaft determines the position of said upper assembly and the total length of said fluid path.

9. Apparatus for pulse suppression comprising a substantially vertical sealed cylindrical housing having apertured end closures, a plurality of substantially vertical parallel tubular members disposed within said housing, a plurality of shaped tubular portions interconnecting said parallel members providing a tortuous fluid path, one end of said path opening into said housing, each of said tubular members comprising two telescoping tubular sections whereby the length of said fluid path may be varied, respective tubular sections of said tubular members being secured together, the upper assembly of said sections being movable within said housing, the lower end of each of the tubular sections of said upper assembly being formed with a flanged portion to form a seal with the corresponding lower section of each of said tubular members, a connecting tubular element extending through and sealed to the apertured portion of the lower one of said end closures and in sealed communication with one end of said fluid path, a threaded shaft extending upwardly through the apertured portion of the upper one of said end closures and secured to said upper assembly, bellows means disposed between said assembly and said upper end portion and surrounding said shaft to seal said housing, said bellows being normally partially compressed whereby said upper assembly is urged downwardly, and means engageable with the outer portion of said housing and threadedly engaging said shaft whereby the position of said threaded means on said shaft determines the position of said upper assembly and the total length of said fluid path.

10. The apparatus of claim 9 wherein three tubular members are employed in side-by-side relationship.

11. The apparatus of claim 9 including a tubular section having a connecting transverse tube, said transverse section being adapted for connection into a fluid line carrying fluid under pressure and said connecting tubular

element being in sealed communication with said tubular section.

References Cited in the file of this patent

UNITED STATES PATENTS

806,714	Porter	Dec. 5, 1905
1,622,843	Price et al.	Mar. 29, 1927
1,855,880	Elliott	Apr. 26, 1932
2,070,543	Cary et al.	Feb. 9, 1937
2,382,159	Klemm	Aug. 14, 1945
2,403,699	Wilson	July 9, 1946
2,707,033	Moerke et al.	Apr. 26, 1955

FOREIGN PATENTS

121,212	Great Britain	Dec. 12, 1918
484,771	Great Britain	May 10, 1938