

May 30, 1961

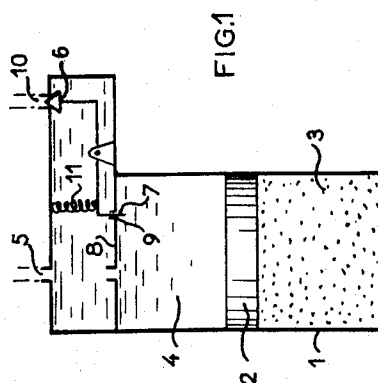
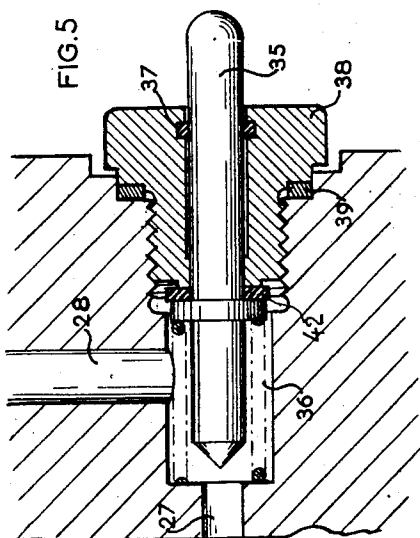
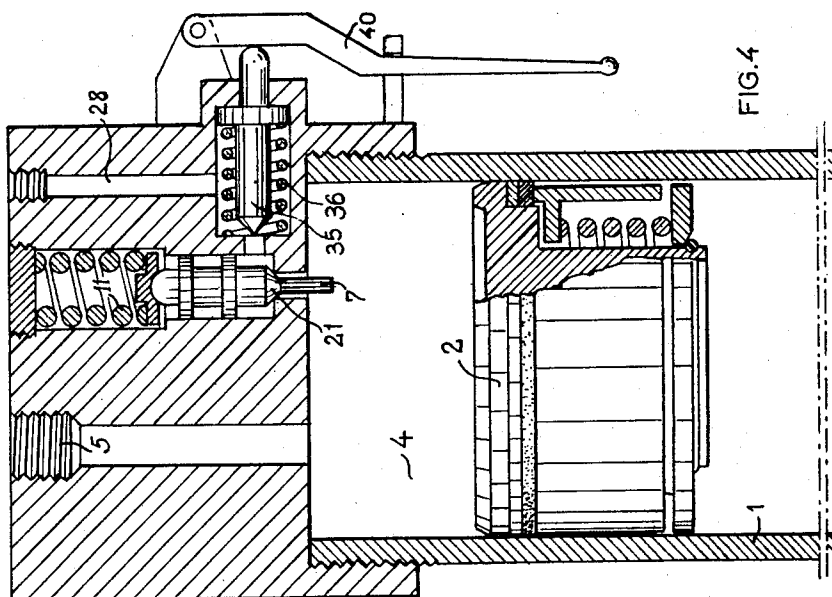
J. L. GRATZMULLER

2,986,158

SELF-DRAINING HYDRAULIC ENERGY ACCUMULATOR

Filed Aug. 27, 1956

2 Sheets-Sheet 1



Inventor
J. L. Gratzmiller
By Pleasant Downing Trebble
Attys.

May 30, 1961

J. L. GRATZMULLER

2,986,158

SELF-DRAINING HYDRAULIC ENERGY ACCUMULATOR

Filed Aug. 27, 1956

2 Sheets-Sheet 2

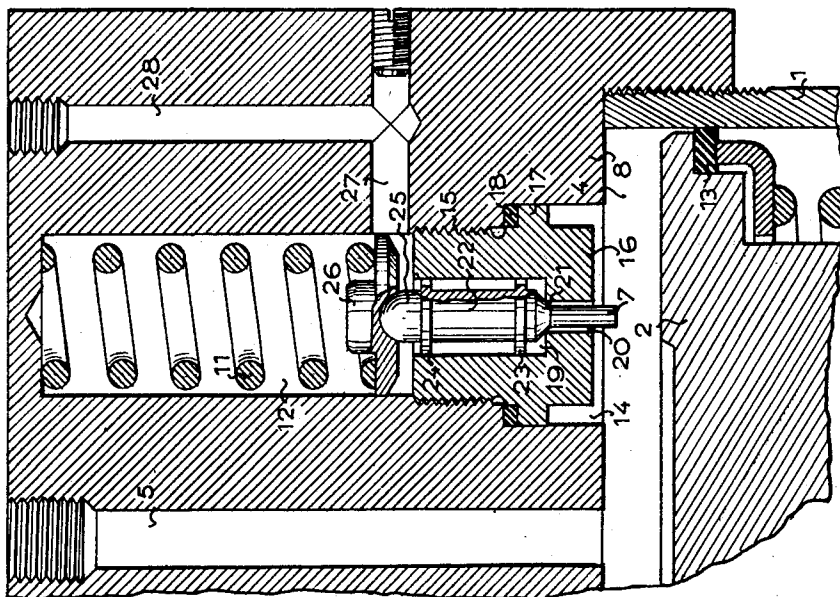


FIG 2

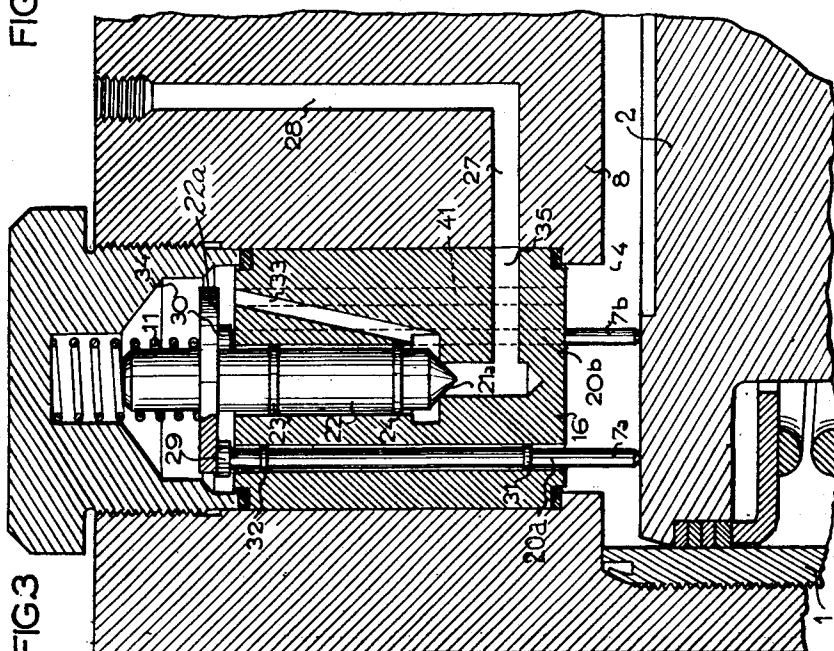


FIG 3

Inventor
J. L. Gratzmuller
By *Glascock Downing Reebolt*
Attys

1

2,986,158

SELF-DRAINING HYDRAULIC ENERGY ACCUMULATOR

Jean Louis Gratzmuller, 30 Ave. Georges Mandel,
Paris 16, France

Filed Aug. 27, 1956, Ser. No. 606,482

Claims priority, application France Sept. 3, 1955

7 Claims. (Cl. 137-467)

The present invention relates to hydraulic accumulators of the type comprising a movable partition such as a free piston, one face of which is subjected to the action of energy storing means such as a weight, a spring or a pneumatic cushion, and whose other face is in contact with and transmits pressure to a mass of liquid, such as oil, and hereinafter referred to as such for convenience, said mass being in communication with a service line or to a hydraulic utilization circuit.

In what follows, by way of simplification, the case of an hydraulic-pneumatic accumulator of free-piston type will be considered, it being understood of course that the invention is in no way limited to this specific form of construction, and that it applies equally to all hydraulic accumulators as hereinbefore defined. In a conventional free-piston hydraulic-pneumatic accumulator, the movement of the piston is limited by a fixed abutment on the oil side. In these conditions, after the free piston has met the abutment, if there is any leakage whatsoever in the hydraulic utilization circuit, the oil therein contained can escape gradually, and will escape more slowly the smaller is the said leak.

Now, in a great number of fields of use for such an accumulator, it is essential to be able at any instant to have available at least a predetermined minimum pressure, or at least, as soon as this minimum pressure is no longer ensured, to obtain a complete release of the pressure in as short a time as possible.

In order to make it easier to understand the necessity for providing the conditions which have just been stated, there will now be considered more especially the case, which moreover constitutes a most important application of an hydraulic accumulator according to the invention, where such an accumulator is intended to feed an hydraulic jack for engaging a circuit-breaker against the action of elastic disengaging means which are intended to carry out the said disengagement in conjunction with, and in response to, the voluntary draining of the said jack. It is known that in a circuit-breaker it is essential that the disengaging stroke be carried out completely and in a time which never exceeds a predetermined duration, that is to say, the movable contact must move at at least a predetermined speed and must never remain stationary in an intermediate position between the position of total engagement and a position known as the disengagement position, in which the said movable contact is separated from the associated fixed contact by a distance greater than the spark-gap, through which an arc is established between the two contacts.

Now in the case where the movable contact of the circuit-breaker is controlled by an hydraulic jack fed by a free-piston hydraulic-pneumatic accumulator, it will be realized that the least leakage in the supply circuit for the said jack will cause the gradual emptying of the accumulator, and then, after the accumulator piston has made contact with its fixed abutment, there will be a slow draining of the jack under the action of the elastic disengaging means, and consequently a movement of the movable

2

contact towards the position of disengagement at a speed lower than the limiting value imposed, and the movable contact may even stop unintentionally between its two extreme positions.

In order to eliminate all risk of such defective operation of a circuit-breaker the most varied devices have been conceived for ensuring that the movable contact is maintained in the engaged position, whatever the conditions of pressure in the hydraulic control system, or else, to ensure, once the disengaging stroke is started, that the said stroke is carried out completely and within the desired time. But the majority of these devices are complicated, expensive, and themselves introduce new risks, so that the safety which they offer is often illusory.

The invention has as its object to achieve perfectly the desired safety conditions by completely putting out of action the hydraulic control after complete and rapid disengagement of the circuit-breaker, by a particular arrangement of the feed accumulator itself, that is to say, without any modification of the hydraulic control system properly so-called.

The invention comprises an hydraulic energy accumulator of the type described, wherein the movable partition when moved beyond the end of its normal operative stroke brings about, by direct mechanical initiation, the draining of its oil compartment.

More specifically, an hydraulic accumulator according to this invention may be characterized in that it comprises a normally closed valve for draining its oil compartment, of which valve the closure member is fast with means adapted to be actuated in the sense for opening the valve by the free piston of the accumulator when moved beyond the end of its normal operative stroke and before it can be arrested by a fixed abutment, at a point of the stroke of the said piston which is sufficiently distant from the said abutment for the remainder of the stroke of the piston to effect the complete opening of the valve.

In a preferred embodiment of the invention, the aforesaid valve is of the safety valve type, which enables the piston to act directly on the movable means of the valve without it being necessary to provide a stuffing box.

The accumulator according to the invention is also preferably provided with a device by means of which it is possible to close temporarily the drainage orifice when the accumulator is to be charged with oil in readiness for use.

According to a preferred form of construction, the last-named device is constituted by a valve which is normally open and can only be shut and kept shut by a sustained action on a control member (for example of the push-button type), so that there is no risk of failure to re-open the drainage orifice, after charging of the accumulator, through forgetfulness of the operator.

The invention will be better understood from reading the detailed description which follows and studying the accompanying drawings which illustrate by way of non-limitative example some embodiments of the invention.

In the drawings:

Figure 1 is a diagrammatic view of an hydraulic energy accumulator according to the invention;

Figure 2 is a longitudinal axial sectional view of one form of construction of the draining valve of such an accumulator;

Figure 3 illustrates a modified form of construction of the valve of Figure 2;

Figure 4 is an axial sectional view of an accumulator according to the invention, comprising a priming device; and

Figure 5 is a partial axial sectional view, in more detail, of the said priming device.

3

In the different figures, corresponding elements have been designated by the same reference numerals.

In Figure 1, 1 is the cylinder of the hydraulic-pneumatic accumulator, whose free piston 2 partitions the said cylinder into an air compartment 3 and an oil compartment 4 which is intended to feed an hydraulic utilization circuit (not shown) through a conduit 5 and also communicates with a normally closed drain valve controlling the flow through a draining conduit 10. The valve body or closure member 6 for this valve is fast with a lever mounted for pivotal movement about an axis transverse to the accumulator axis and having an offset or angled free end 7. A spring means 11 acts upon the lever on the side of its axis opposite the valve body so as to normally urge the valve body to closed position and to project the free end 7 of the lever through a drain orifice 9 and into the oil containing compartment of the accumulator a distance below the head 8 of the accumulator sufficient to ensure that the upwardly moving piston 2 engages the free end 7 of the lever before the piston reaches the head 8, whereby the remainder of the stroke of the piston 2 ensures that the drain valve is completely opened when the piston has reached the head 8.

If, from this instant when the piston comes into contact with the free end 7 of the lever, the quantity of oil contained in the compartment 4 and in the hydraulic utilization circuit diminishes, even very slightly, for any accidental reason whatsoever, such as a leakage, then in continuing its stroke, the piston 2 will actuate the closure member 6 of the drain valve and bring the compartment 4 by way of the drain orifice 9 into communication with the drain conduit 10, which brings about the complete and rapid drainage of the rest of the compartment 4 and of the hydraulic utilization circuit.

Once the piston has made contact with the lever end 7 and initiated the draining of the compartment 4, the escape of oil will allow the piston to move more rapidly and as the drain valve opens progressively the escape of oil and likewise the movement of the piston will be accelerated progressively until the piston abuts on head 8 when the drain valve 6 attains its maximum opening. The progressive acceleration of flow through the drain valve promotes very rapid emptying of the accumulator and service line. To utilize the maximum opening of the drain valve to the best advantage the capacity of the drain 10 itself should be great enough to accommodate easily the maximum rate of flow through the drain valve. The capacities of the drain and drain valve will be selected to obtain the required maximum drainage rate and if large enough, a substantially instantaneous drop of pressure in the accumulator and service line to that subsisting in the drainage system may be obtained.

It will be realized that the diagram in Figure 1 is purely theoretical. In fact, the drain valve according to the invention is preferably constructed as illustrated in Figure 2 or Figure 3.

In the embodiment according to Figure 2, the drain valve and the spring 11 which normally closes the said valve are housed in a blind cavity 12 in the head 8 of the accumulator, part of whose cylinder and free piston are shown, again designated as 1 and 2 respectively, fluid-tightness between the piston and cylinder being ensured by appropriate seals 13.

In the example illustrated, the cavity 12 comprises a portion of wider diameter 14 which communicates directly with the oil compartment 4, and a portion of reduced diameter whose end nearest the compartment 4 is tapped to receive the screwhead 15 of a valve body 16 provided with a collar 17 which bears, with an interposed appropriate sealing ring 18, against the annular shoulder connecting the two portions of the cavity 12. The valve body 16 is formed with an axial bore 19 the end of which communicates by an axial port 20, of smaller diameter than the bore 19, with the compartment 4; the annular shoulder which connects the port 20 to the bore 19, constitutes a seating for the frusto-conical head 21 of a movable valve.

4

closure member 22, which is guided by lands 23, 24 in the bore 19, such lands being slotted or perforated to allow oil to pass them freely. In the example illustrated, the end opposite to the head 21 of the movable valve member 22 has a spherically rounded portion 25 which forms a ball joint with a corresponding recess in a slider 26 on which bears one end of the spring 11, whose other end bears against the blind end of the cavity 12. Finally, the latter communicates, at a position clear of the tapping into which is screwed the valve body 16, with a drain (not shown) by way of a radial port 27 and a longitudinal passage 28.

In the form of construction of Figure 2, the initiation of draining by the piston 2 is ensured by means of a single rod 7 which is integral with the movable member 22 of the drain valve and extends through the axial port in the valve body so as to project into the interior of the oil compartment 4. It must be understood that the spring 11 will have to be so calibrated as not to permit the valve 21 to be unseated merely by the action of the maximum fluid pressure that can subsist in the compartment 4.

In the variant according to Figure 3, the single rod (such as 7 of Figure 2) is replaced by three rods in a triangular arrangement (that is to say, spaced at 120° around a common circumference of contact), only two of which, 7a and 7b, are illustrated in the figures; these rods extend through longitudinal guideways 20a, 20b, and another (not shown) respectively, which are formed in the valve body 16 and in which the rods are guided, for example by lands such as 31, 32; and their mushroom-shaped upper ends 29, 30 bear against a bearing plate 22a which is fast with the movable closure member 22 of the draining valve. The latter member is guided by lands 23, 24 in a blind cavity in the valve body 16, one of whose compartments, of larger diameter, communicates through an oblique port 33 with a compartment 34 in which is housed the bearing plate 22a and the spring 11, compartment 34 communicating in turn with the oil compartment 4 of the accumulator by way of one or more longitudinal ducts such as 41. Finally, the second portion, of smaller diameter, of the said blind cavity, whose annular edge constitutes the valve seating cooperating with the conical head 21a of the movable member 22, communicates by way of the radial port 27 and the axial passage 28 in the head 8 of the accumulator with the drain (not shown). With this arrangement, the pressure prevailing in the oil compartment 4 no longer tends to unseat the movable valve member directly as in the case of the constructional form of Figure 2; and this makes it possible to reduce considerably the strength of the spring 11, which has now only to bring the valve into the closed position in which it is maintained by the fluid pressure acting on the movable member 22.

It will be appreciated that with a drain valve according to the invention, once draining is initiated the accumulator is rendered completely inoperative. In order to enable it to be brought back into operation, and also for bringing it into operation initially, the apparatus as so far described is preferably supplemented by priming means arranged, for example, as illustrated in Figure 4 and in a more detailed way in Figure 5.

In the example illustrated, the priming device is essentially constituted by a valve whose movable closure member 35 is normally held unseated by a spring 36, while by means of a lever 40 it can be temporarily seated to interrupt communication between the drain valve 21 and the drain 28, to allow the accumulator to be filled with oil, for example, through the hydraulic utilization duct 5. In the form of construction illustrated in Figure 5, the movable member 35 of the priming valve is mounted to slide, in a fluid-tight manner ensured by means of an appropriate packing ring 37, in a screw-threaded plug 38 which is also screwed in fluid-tight manner, by means of a packing 39, into a tapped hole in the head 8 of the accumulator, which communicates by way of an internal extension on the one hand with the radial port 27 and on

the other hand with the longitudinal duct 28. Fluid-tightness during operation of the accumulator is ensured by a packing ring 42 which is compressed by the spring 36.

It is therefore clear that the present invention provides a hydraulic accumulator for use in an hydraulic system or utilization circuit with the accumulator comprising a cylinder, a closure means or cylinder head at one end of the piston and a movable partition within the cylinder so as to define a liquid compartment between one face of the partition and the closure means and a gas compartment between the other face of the partition and the closure means. Thus, with liquid in the liquid compartment and the gas compressed in the space on the other side of the partition, a source of fluid under pressure is available. The cylinder head is provided with a conduit therethrough for establishing communication between the liquid compartment and the exterior of the accumulator. In addition, a drain passage means is provided in the closure or cylinder head that is in communication with the liquid compartment. A movable valve means is operably associated with the drain passage so as to control liquid flow therethrough. Elastic means such as a spring normally urges the valve means in the drain passage to closed position so as to prevent liquid flow out of the compartment through the drain passage. Additionally, means are operably associated with said valve means to extend into the compartment so as to be engaged by the partition when the same approaches the cylinder head or closure means. This engagement occurring before the partition reaches the cylinder head ensures that the valve is completely opened during the remainder of the stroke of movement of the partition or free piston in the accumulator.

In one form of the invention the valve body of the closure valve means has an extension that projects into the liquid compartment below the cylinder head. In another form of the invention the valve body is provided with a flange that engages pin means that project into the liquid compartment so that movement of the pin means imparts opening movement to the valve body. In this latter form of the invention, a part of the drain passage is incorporated in an insert mounted in the cylinder head. This insert is provided with a bore communicating with a cavity that accommodates the upper end of the valve body. This cavity is formed in a closure plug that also houses a spring that applies a certain amount of closing force on the valve body. However, liquid under pressure is accommodated in this cavity so that the liquid under pressure at least assists in holding the valve body closed.

What is claimed is:

1. An hydraulic accumulator for use in an hydraulic utilization circuit, said accumulator comprising a cylinder, a closure means at one end of said cylinder, a movable partition within the cylinder and defining a liquid compartment between one face of the partition and said closure means, liquid within said compartment, conduit means providing communication with the exterior of said compartment, elastic means within the cylinder on the side of the partition opposite said closure means and operative to urge said partition toward said closure means to apply pressure to the liquid in said compartment and in said conduit means, said closure means having a drain passage means therein also in communication with said compartment, a movable valve means operably associated with said drain passage means for controlling liquid flow therethrough, elastic means acting on said movable valve means to hold the same in closed position, said elastic means having sufficient strength to overcome the pressure existing in said compartment so as to prevent liquid flow out of said compartment through said drain passage, and means operably associated with said movable valve means, extending into said compartment into the path of movement of and spaced from said partition but engageable by said partition only when the same approaches said closure means in response to diminution in fluid volume

in said compartment to impart valve opening movement to said movable valve means.

2. An hydraulic accumulator as claimed in claim 1 and further including means conducting liquid under pressure from the compartment to said movable valve means to hold the same in closed position.

3. An hydraulic accumulator as claimed in claim 1 in which said movable valve means includes a valve body, said drain passage means having a portion accommodating a part of said valve body and terminating in a valve seat engageable by said part of said valve body, said closure means having a cavity therein accommodating another portion of said valve body and extending beyond said first-mentioned portion of the drain passage means and said drain passage means including another portion providing constant communication between said compartment and said cavity and a further portion providing communication between said cavity and said first-mentioned portion of the drain passage means so that liquid under pressure can be applied against said another portion of said valve body in holding said part of said valve body in engaged position on said valve seat.

4. An hydraulic accumulator as claimed in claim 3 and said closure means having at least one bore there-through providing communication between said cavity and the liquid compartment, pin means in said bore, and a flange on the portion of the valve body in the cavity and overlying said pin means whereby movement of said pin means in response to movement of the partition moves said valve body to open position.

5. An hydraulic accumulator as claimed in claim 1 and an additional movable valve means operably associated with said drain passage downstream of said first-mentioned movable valve means, spring means operably associated with said additional valve means to bias the same to open position and manually operated means operably associated with said additional valve means for moving the same to closed position against the action of said spring means.

6. An hydraulic accumulator comprising a cylinder, a cylinder head closing one end of the cylinder, a free piston in said cylinder defining a liquid compartment between one face of the piston and the cylinder head, elastic means within the cylinder on the side of the piston opposite the liquid compartment for urging said free piston toward the cylinder head, said cylinder head having a first passage therethrough communicating with the exterior of the compartment, said cylinder head having a cavity therein, a valve accommodating body within said cavity, said body having a valve body accommodating cavity therein in communication with the first mentioned cavity, said cylinder head having a drain passage therein, port means providing communication between said valve body accommodating cavity and said drain passage and between said valve body accommodating cavity and said liquid compartment, said valve body accommodating cavity having a valve seat, a movable valve body within the valve accommodating cavity and cooperable with said valve seat, elastic means urging said valve body to closed position, said elastic means having sufficient strength to overcome pressure existing in said compartment so as to hold said valve body in closed position, push rod means operably associated with said valve body and extending into the liquid compartment beyond the cylinder head so as to be engageable by the piston only when the piston approaches the cylinder head in response to diminution in fluid pressure in said first passage and said push rod means having an axial extent within the liquid compartment sufficient to ensure that said valve body is moved to fully open position in response to piston movement when the piston has engaged the cylinder head.

7. An hydraulic accumulator as claimed in claim 6 in which said cylinder head has a chamber therein downstream of said valve body accommodating cavity and constituting an enlargement of the drain passage, said

chamber having a surface defining a valve seat, a movable valve body within said chamber and cooperable with said seat for also controlling flow through the drain passage, spring means urging said last-mentioned movable valve body away from the valve seat in the chamber, said last-mentioned valve body having an extension thereon opposite the valve seat, a fluid-tight gland means operably associated with the cylinder and accommodating said extension and said extension having a terminal end disposed exteriorly of the cylinder head whereby with said piston against said cylinder head and said first valve body in open position, valve closing movement can be imparted to said second mentioned valve body to block liquid flow

5

10

through said drain passage so that said cylinder can be charged with liquid through said first passage.

References Cited in the file of this patent

UNITED STATES PATENTS

1,166,358	Grant	Dec. 28, 1915
1,763,777	Hamilton	June 17, 1930
2,257,204	Temple	Sept. 30, 1941
2,301,031	Ferguson	Nov. 3, 1942
2,331,084	Sorenson	Oct. 5, 1943
2,538,133	Tratzik	Jan. 16, 1957
2,781,776	Gratzmuller	Feb. 19, 1957