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MEANS FOR CONSTANT PRESSURIZATION OF INFLATABLE AND OTHER ENCLOSURES

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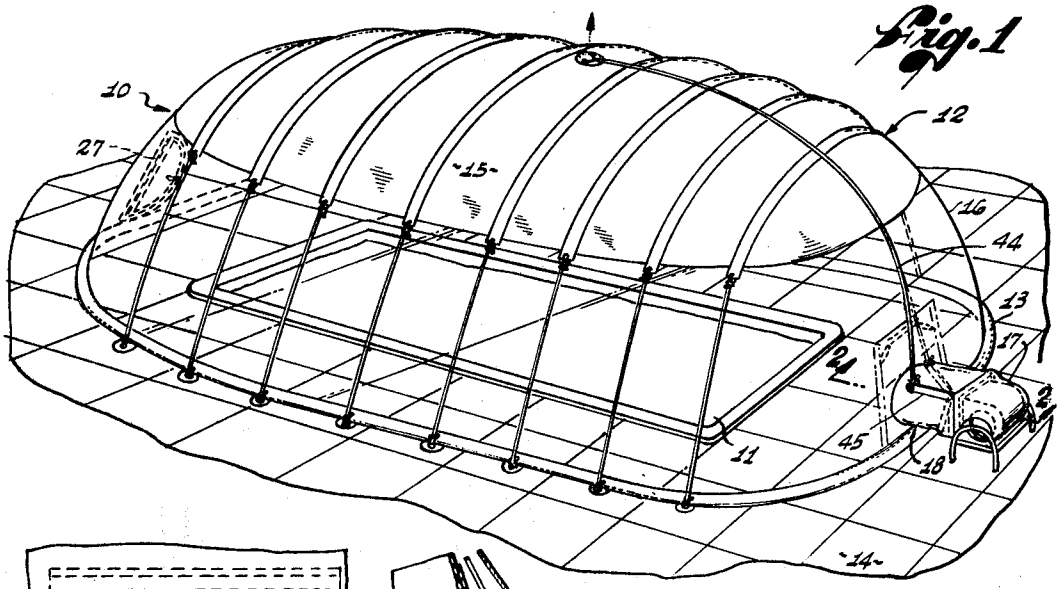
Fig. 1



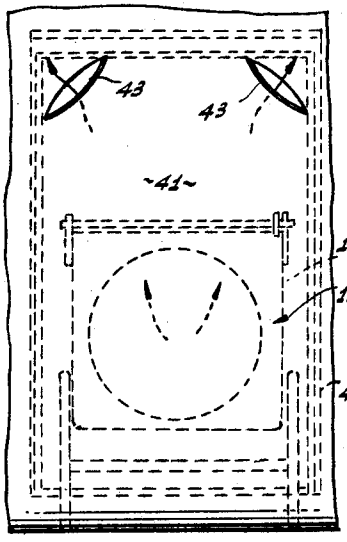




Fig. 2

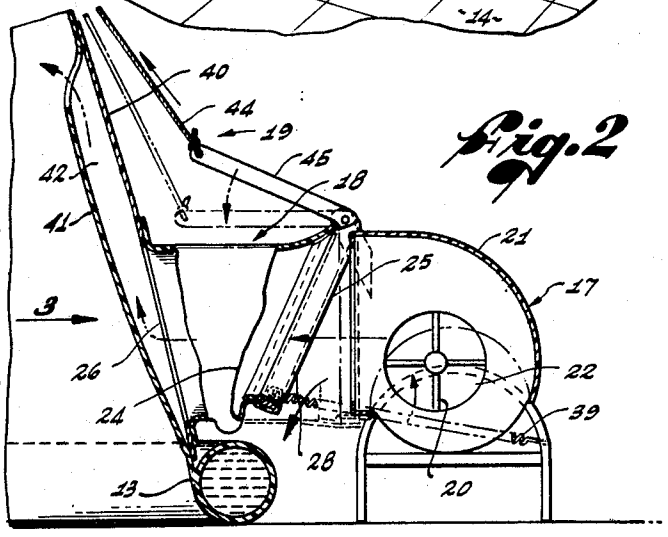



Fig. 3

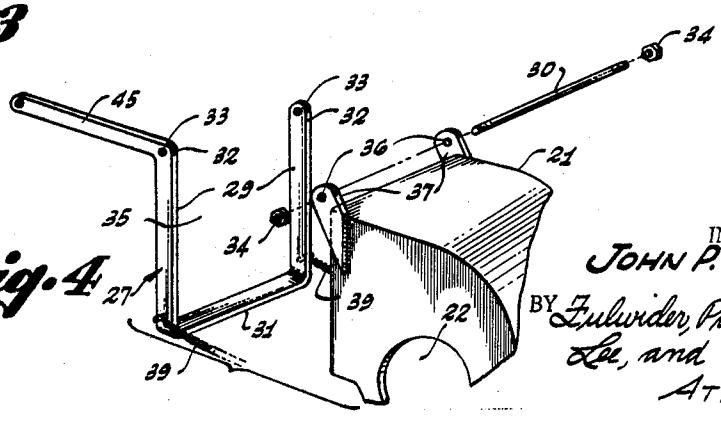



Fig. 4

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# MEANS FOR CONSTANT PRESSURIZATION OF INFLATABLE AND OTHER ENCLOSURES

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U.S. Cl. 52—1 9 Claims

## ABSTRACT OF THE DISCLOSURE

An air conduit communicating with the exhaust of a continuously-operating blower and with the interior of an enclosure, at least a portion of the conduit capable of being opened in response to changes in pressure within the enclosure to thereby vary the air flow into the enclosure in response to said pressure changes within the enclosure.

## BACKGROUND OF THE INVENTION

This invention relates to pressurized enclosures and more particularly, to methods and means for pressurizing inflatable enclosures.

Because inflatable enclosures are generally not made air-tight, air escapes slowly but continuously through leaks in the enclosure and intermittently but relatively rapidly when doors in such enclosures are opened. Therefore, provision must be made for flowing air into inflatable enclosures to make up for these losses. Heretofore, air has been passed into inflatable enclosures by using a blower, a switch means for stopping and starting the blower, and a control means for transmitting changes in the internal pressure to the switch means which either turned off or turned on the blower. Examples of such devices are described in Turner Patent Number 2,948,286, issued August 1960, and in John P. Kwake application Serial No. 458,609 entitled "Inflatable Structure," now abandoned.

The predominant characteristic of most presently-used pressurizing methods is that they operate intermittently, that is, the blower blows either no air into the inflatable enclosure or it blows air at its full capacity into the enclosure. When the blower is not in operation, the walls of the inflatable enclosure can sag slightly as air leaks out of the enclosure. During part of this period, then, the walls are not firmly supported by internal air pressure. If atmospheric conditions are calm, the blower will ultimately commence operation to raise the inflatable enclosure back to its normal position without damage to the enclosure. However, if a strong wind rises at this time, tearing of the inflatable enclosure may occur due to flapping of the walls of the enclosure.

When a door is opened in an inflatable enclosure there is often a rapid decrease in internal air pressure. The presently-available pressurizing devices with their off-on operation are not able to react quickly to such rapid changes. That is, there is a time lag before the blower can effectively begin to restore air pressure to normal. During this period tearing of the enclosure fabric may also occur.

One method of overcoming the problems associated with off-on methods of inflating air-supported enclosures is also shown by the aforementioned Turner patent. Such method involves continuously passing air into an air-supported enclosure at the rate which is preset, constant and approximates the normal rate of air loss due to leakage from the enclosure. To maintain the enclosure in its normally inflated position when air is lost other than by leakage, for example, when a door is opened, a second blower is employed to pass air into the enclosure only at such times. This method is disadvantageous because of its relatively large equipment requirement since two parallel



blower assemblages are required and because the continuously operating blower has to be readjusted as the leak rate changes.

## SUMMARY

The herein-described invention employs a control means which senses changes in the internal pressure of inflatable enclosures and transmits such changes to a partially retractable air conduit which accepts varying proportions of the air exhausted by a blower, which operates continuously, in response to the internal air pressure. Because the blower continuously exhausts at least some air into the inflatable enclosure, the enclosure remains firmly supported by the internal air pressure. Even when a door is opened and the internal air pressure decreases rapidly, the continuously-operating device of this invention is able to restore the internal air pressure to normal before any damage can be caused to the enclosure by, for example, strong winds.

## DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of an inflatable enclosure in inflated position over a swimming pool together with the continuous inflating means of this invention.

FIGURE 2 is a sectional view taken along the line **2—2** of FIGURE 1 showing the arrangement of the component parts of the inflating means of this invention and showing the inflating means in both open and closed positions.

FIGURE 3 is an end sectional view taken in the direction **3** of FIGURE 2 showing the air flow pattern from the inflating means of this invention into the inflatable enclosure.

FIGURE 4 is an exploded view showing the means associating the air conduit (without cover material) to the blower of this invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In general, this invention comprises a method and means for continuously blowing air into an inflatable enclosure in response to the air pressure within the inflatable enclosure to thereby provide a substantially constant pressure within the inflatable enclosure. More particularly, this invention comprises, in combination, a blower which is continuously "on," a partially collapsible or retractable air conduit positioned to pass from the blower into an enclosure, and a control means which alters the amount of air accepted from the blower by the air conduit in response to changes in the air pressure within the inflatable enclosure. Because the forced air means of this invention is sensitive to the air pressure within an inflatable enclosure and because such means employs a continuously operating blower, the amount of air entering the inflatable enclosure is varied so that a substantially constant air pressure is maintained in the inflatable enclosure. The substantially constant internal air pressure improves the stability of inflatable enclosures in high winds and prevents tears from developing in the inflatable enclosure fabric due to such high winds.

This invention will be further described with reference to the drawings. In FIGURE 1, the numeral **10** designates an inflatable enclosure in the fully inflated position over a swimming pool **11**. The inflatable enclosure **10** comprises a cover **12** and a circumferential tube **13** depending therefrom and resting on the pool area decking **14**. The cover **12**, in turn, consists of a roof section **15** and a wall section **16** having a door **27** located therein. The roof **15** and wall **16** sections may be made from a single, continuous sheet or they may be made from separate sheets fused together at the roof-wall interface. The circumferential tube **13** is filled with water to anchor the inflatable enclosure **10** to the decking **14**. The inflatable enclosure **10** may be made from any suitable weather-resistant material. For example,

I have employed various vinyl plastics, such as polyvinylacetate and polyvinylchloride.

An inflataable enclosure such as is shown in FIGURE 1 and with which the herein-described invention has utility is fully described in my co-pending application Inflatable Structure, Serial No. 458,609, filed May 25, 1965, (hereafter referred to as "my said co-pending application") which is incorporated herein by reference. It will be understood, however, that the foregoing inflatable enclosure is used only by way of example and that this invention may be employed in connection with any enclosure requiring air pressure for support.

The air pressurizing or forced air means comprises, in operable combination, a blower **17**, a partially retractable air conduit **18** for conducting air into the inflatable enclosure **10** and a control assembly **19** capable of relating the air pressure within the inflatable enclosure to the amount of air passing from the blower through the air conduit. The blower **17** is of standard construction having a motor-driven impeller **20** carried within a housing **21** adjacent an aperture or inlet port **22**. Another aperture or outlet port **23** is located in the housing **21** such that air passing in the inlet port **22** passes through the impeller **20** before exiting from the outlet port.

The air conduit **18** comprises a cover portion **24**, having a first end **25** (hereafter described as "the enclosure-remote end") in communication with and preferably larger than the exit port **23** of the blower **17** and having a second end **26** (hereafter described as "the enclosure-adjacent end") communicating with the interior of the inflatable enclosure. The cover portion **24** may be formed from any strong, flexible material such as reinforced nylon. The enclosure-remote end **25** is positioned relative to the exit port **23** of the blower **17** such that when the maximum amount of air is required to be flowed into the inflatable enclosure **10**, the enclosure-remote end abuts the blower about the exit port. This is preferably accomplished by mounting a portion of the enclosure-remote end **25** to the blower **17** so that the enclosure-remote end can be partially retracted from the blower.

Although the flexible cover portion **24** could be mounted to the blower **17** without reinforcement it is preferable to provide the enclosure-remote end **25** of the air conduit **18** with a reinforcing frame **27** which is mounted on the blower. To this end, the enclosure-remote end **25** of the air conduit **18** is provided with a plurality of open-ended sleeves **28** which are adapted to receive the component members of the frame **27**.

The frame **27** comprises two side members **29**, a top member **30** and a bottom member **31**. The two side members **29** and the bottom member **31** are rigidly interconnected in the general form of a "U" such that the rigidly interconnected members function as a unit. The upper, unattached ends **32** of the side members **29** of the frame **27** are pivotally mounted on the top member **30** which is a rod sized to be received by aligned openings **33** in the side members **29**. The top member **30** is sufficiently long to extend through and beyond the openings **33** in the side members **29** and is threaded at both ends to receive nuts **34** which, when threaded onto the top member, pivotally retain the side members **29** on the top member **30**.

In the preferred form of this invention, the top member **30** of the frame **27** is fixedly attached to and supported by the blower housing **21**. This is accomplished by passing the top member **30** through aligned openings **36** in a pair of ears **37** projecting from and fixedly attached to the blower housing **21**. Nuts (not shown) lock the top member **30** of the frame **27** to the ears **37** on the blower housing **21**.

When constructed as described, the U-shaped portion of the frame **27** is capable of being rotated about the stationary top member either into or away from contact with the blower housing **21**. The top member **30** of the frame **27** of the air conduit **18** is positioned with respect to the blower housing **21** such that the remote end **25** of the conduit can move into substantially sealing engagement with the blower housing. To aid the remote end **25** of the air conduit **18** to move into sealing engagement with the blower housing **21** a biasing means such as a pair of springs **39** is connected between the bottom member **31** of the frame **27** and the blower housing.



The same result, that is, rotation of the frame **27** away from the blower **17** may be alternatively accomplished by pivotally mounting the top member **30** between the ears **37** extending from the blower and by fixedly attaching the side members **29** to the top member. When mounted in this manner the frame **27** rotates as a unit about the longitudinal axis of the top member **30** which is retained in fixed position relative to the blower **17**.

The other or enclosure-adjacent end section **26** of the air conduit **18** flares into a plastic panel **40** which is bonded, for example, by heat sealing, to a section **41** of the wall **16** of the inflatable enclosure **10**. The section **41** of the wall **16** and the panel **40** of the air conduit **18** define a passageway **42** having a pair of exit ports **43** opening into the interior of the inflatable enclosure.

The control assembly **19** for relating the volume of air flowing into the inflatable enclosure **10** through the air conduit **18** to the air pressure within the inflatable enclosure, comprises a flexible but substantially nonstretchable cord **44** one end of which is attached to the roof **15** of the inflatable enclosure such as is described in my said co-pending application and a lever **45** one end of which is fixedly attached to a side member **29** of the frame **27**. The cord **44** and lever **45** are interconnected at their free ends.

In operation, air is pulled into the blower **17** through the entry port **22** in the blower housing **21** and is expelled through the exit port **23**. The blower **17**, which is operated continuously, produces a substantially constant volume flow rate of air at the exit port **23** of the blower housing. Substantially all or only a fraction of this air volume exiting from the blower **17** passes into the air conduit **18** depending upon the air pressure within the inflatable enclosure **10**.

When there is less air pressure within the inflatable enclosure **10** than is required to provide a sufficiently stable enclosure, the frame **27** of the air conduit **18** is in abutting engagement with the exhaust end of the blower **17**. When the air conduit **18** and the blower **17** are in this position, substantially all the air exiting from the exit port **23** of the blower passes into and through the air conduit and flows into the inflatable enclosure **10**.

As the air pressure within the inflatable enclosure increases, the roof **15** of the enclosure rises causing the cord **44** to move upwardly. Upward movement of the cord **44** causes the lever **45** to rotate upwardly about its pivot point on the longitudinal axis of the upper member **30** of the conduit frame **27**. Since the lever **45** is rigidly connected to the U-shaped unitary portion of the frame **27** which is pivotally carried by the upper member **30** of the frame, the U-shaped portion of the frame rotates upwardly about the upper member. This causes the lower portion of the enclosure-remote end **25** of the air conduit **18** to move away from the blower **17** which, in turn, causes the cover **24** adjacent the U-shaped portion of the frame **27** to retract in accordion fashion, thereby permitting some air to escape into the atmosphere without passing through the air conduit. That is, a portion of the air from the blower **17** is diverted from the enclosure **10**.

The amount of air diverted to the atmosphere will depend up the size of the opening between the air conduit **18** and the blower **17**. That is, as this opening increases, a larger percentage of the air exiting from the blower **17** will pass into the atmosphere and a smaller percentage of this air will pass through the air conduit into the inflatable enclosure **10**. As the roof **15** of the inflatable enclosure **10** rises to its normal position, the space between the air conduit **18** and the blower **17** gradually

increases thereby gradually decreasing the rate of ascent of the roof because of the decreasing amount of air entering the enclosure, and this, in turn, gradually decreases the rate of movement of the bottom portion of the air conduit **18** away from the blower. Thus, it will be understood that the air pressure within the inflatable enclosure **10** and the air exhausted by the blower **17** are interrelated by the control means **19** so that the inflatable enclosure is gradually returned to its normal position thereby eliminating rapid movement of the inflatable enclosure and thereby extending the useful life of the enclosure.

When the inflatable enclosure **10** has been inflated to its normal position, the space between the air conduit **18** and the blower **17** will be at a maximum and the air flowing into the enclosure will be substantially constant and will be equal to the normal leakage of air from the inflatable enclosure.

If air in excess of the normal leakage escapes from the inflatable enclosure **10**, the roof **15** of the enclosure lowers thereby lowering the cord **44** which permits the lever **45** and the U-shaped portion of the frame **27** to rotate downwardly about their pivot points on the upper member **30** of the frame. This tends to reduce the space between the air conduit **18** and the blower **17** thereby increasing the air flowing into the inflatable enclosure **10**. Thus, as soon as the roof **15** begins to fall, the amount of air passing into the inflatable enclosure **10** immediately increases. Air is continuously introduced into the inflatable enclosure **10** even as the roof lowers to thereby maintain a substantially constant pressure within the enclosure. Therefore, the inflatable enclosure **10** will always be highly stable even in strong winds.

A particular air pressure sensing and transmitting means has ben described. However, it will be understood that other means could be employed to sense pressure changes in an enclosure and to divert air from the blower in accordance with such changes. For example, a weighted flap (not shown) can be cut from the top of the conduit **18** so that three sides of the flap are free and a fourth side, acting as a hinge, remains attached to the conduit. The cord **44** can be attached to a stiffened end of the flap farthest from the hinge end. This combination would operate substantially as previously described. That is, as the inflatable enclosure **10** inflates to maximum pressure, the cord **44** lifts the stiffened end of the flap so that the flap rotates out of contact with the conduit **18** thereby diverting a portion of that amount of air coming from the blower away from the enclosure. A decrease in pressure within the inflatable enclosure is accompanied by a lowering of the cord **44** and a consequent return of the weighted flap to a sealing relation with the conduit **18**.

The continuously pressurizing means of this invention may also be used to provide a substantially constant air pressure in non-inflatable buildings, that is, in conventional enclosures. Employed in this way, this invention is the same as described except for the connection means connecting the air conduit **18** to the conventional enclosure and except for the pressure sensing means sensing the pressure within the enclosure. As described, the connection means connecting the air conduit **18** to the inflatable enclosure **10** comprises a panel **40** flaring outwardly from the exit end of the air conduit which is bonded to a section **41** of the wall **16** of the inflatable enclosure **10** to define an airway **42** leading from the air conduit into the interior of the inflatable enclosure. This connecting means is preferably replaced when this invention is employed in conjunction with a conventional enclosure. In its place, it is preferable to provide sleeves in the enclosure-adjacent end **26** of the air conduit **18** similar to the sleeves **28** in the enclosure-remote end **25** of the air conduit and to insert a frame into these sleeves to form a substantially rigid enclosure-adjacent end in the air conduit. This rigid enclosure-adjacent end is then inserted into an aperture in a conventional structure, which aperture substantially conforms in shape and size to the enclosure-adjacent end of the air conduit.

Operation of this invention in conjunction with a conventional enclosure will also vary somewhat from the described operation. In place of the cord **44** which transmits changes in internal air pressure manifested in elevation changes in the roof **15** of the inflated enclosure **10**, another means of sensing air pressure and transmitting changes in air pressure to the lever **45** must be used. Conventional pressure sensing and transmitting methods such as the combination of a diaphragm valve, pressure magnification means and hydraulic linkage may be used.

I have thus described a method and means for providing an enclosure and, particularly an inflatable enclosure, with a substantially constant air pressure. As described, this is accomplished by employing, in combination, a blower which is continuously operated, a retractable conduit and an air pressure sensing and transmitting means which controls the air conduit so that the air conduit accepts varying amounts of air from the blower in response to the air pressure within the enclosure.

Modifications may be made of the herein-described invention by those skilled in the art without departing from the spirit of the invention. Therefore, my invention is to be limited only by the scope of the appended claims.

I claim:

**1.** A pressurizing device for use in conjunction with inflatable enclosures comprising:

a continuously operating blower having an inlet and an exit port;

an air conduit having a first end communicating with said exit port of said blower and having a second end communicating with the interior of said inflatable enclosure, said first end being at least partially retractable from said exit port of said blower to vary the air volume passing from said blower into said air conduit;

control means for retracting said first end of said air conduit from said exit port of said blower in relation to the air pressure within said inflatable enclosure comprising

(a) retracting means for retracting said first end of said air conduit from said exit port of said blower in response to signals received from

(b) pressure transmitting means for sensing and transmitting changes in said air pressure in said inflatable enclosure to said retraction means whereby a substantially constant pressure is maintained in said inflatable enclosure.

**2.** The device of claim **1** wherein a portion of said first end of said air conduit is mounted on said blower, the remainder of said first end being free to rotate away from said blower.

**3.** The device of claim **1** wherein said retraction means comprises a lever fixedly attached to said first end of said air conduit.

**4.** The device of claim **1** wherein said transmitting means comprises a line attached at one end to a portion of the roof of said inflatable enclosure and attached at the other end to said retraction means, said line being flexible but substantially non-stretchable.

**5.** The device of claim **1** including, in addition, a biasing means for urging said first end of said air conduit into abutting relation with said exit port of said blower.

**6.** A pressurizing device for use in conjunction with inflatable enclosures comprising:

a blower having an exit port and an inlet port;

a retractable air conduit having a first end communicating with said exit port of said blower and having a second end communicating with the interior of said inflatable enclosure, a portion of said first end mounted on said blower in fixed position relative to said blower and the remaining portion of said first end pivotally mounted on said blower for rotation away from said exit port of said blower;

a lever fixedly attached to said first end of said air conduit for rotating said remaining portion of said first end of said air conduit away from said blower;

a flexible, substantially non-stretchable line affixed at one end to a portion of the roof of said inflatable enclosure and affixed at the other end thereof to said lever, said line moving said lever in relation to the air pressure within said inflatable enclosure to control the volume of air passing from said exit port of said blower into said air conduit.

7. The device of claim 6 wherein said device includes biasing means urging said remainder portion of said first end of said air conduit into abutting position with said blower.

8. A pressurizing device for use in conjunction with an inflatable enclosure comprising:

a continuously operating blower having an inlet and an exit port;

an air conduit having a first end communicating with said exit port of said blower and having a second end communicating with the interior of said inflatable enclosure;

diversion means operatively engaged with said air conduit to vary the volume of air passing from said blower into said enclosure in response to changes in pressure within said enclosure; and

pressure sensing means for sensing changes in pressure within said enclosure comprising:

(a) detection means affixed to the surface of said enclosure for detecting changes in the movement of the surface of said enclosure and



(b) means operatively engaged with said diversion means whereby as the surface of said enclosure moves said diversion means is caused to move to maintain a substantially constant air pressure in said inflatable enclosure.

9. A pressurizing device for use in conjunction with an inflatable enclosure comprising:

a continuously operating blower having an inlet and an exit port;

an air conduit having a first end communicating with said exit port of said blower and having a second end communicating with the interior of said inflatable enclosure, said first end being at least partially retractable from said exit port of said blower to vary the air volume passing from said blower into said air conduit; and

control means for retracting said first end of said air conduit from said exit port of said blower in response to air pressure within said inflatable enclosure.

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U.S. Cl. X.R.

52—2; 98—15