May 8, 1962 W. B. BURKETT 3,033,185

AUTOMATIC CHOKE FOR OUTBOARD MOTORS

Filed Nov. 16, 1959 2 Sheets-Sheet 1

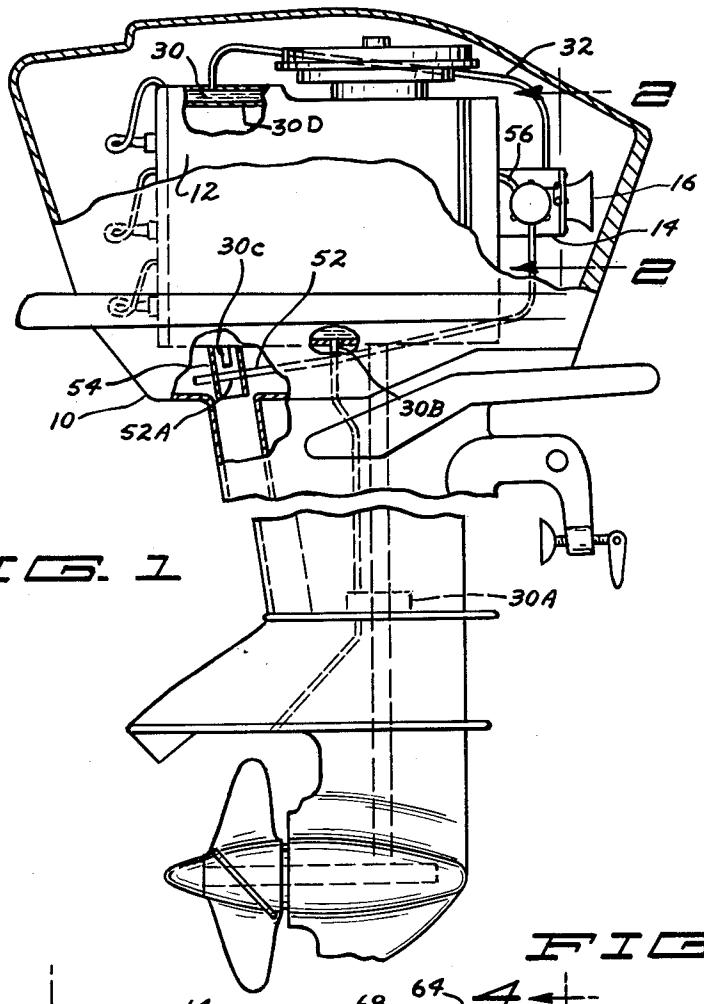
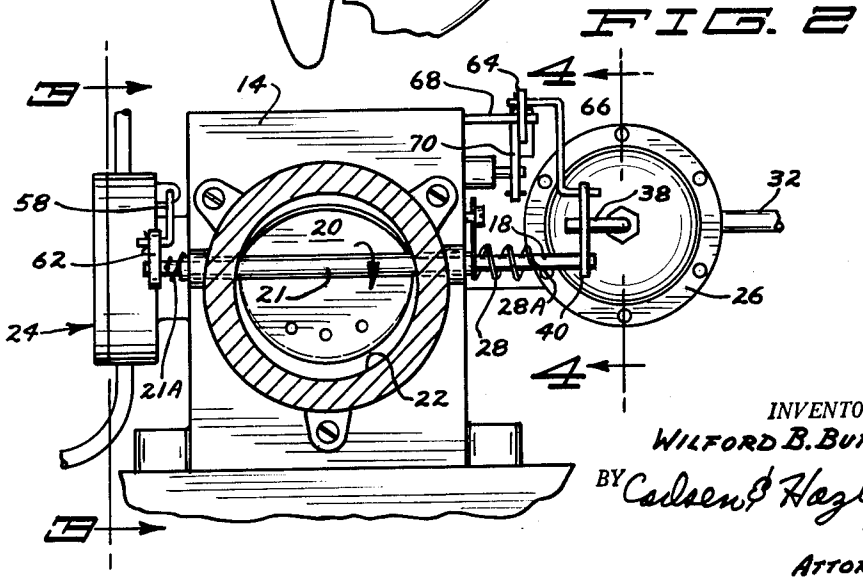


FIG. 1

FIG. 2



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FIG. 3

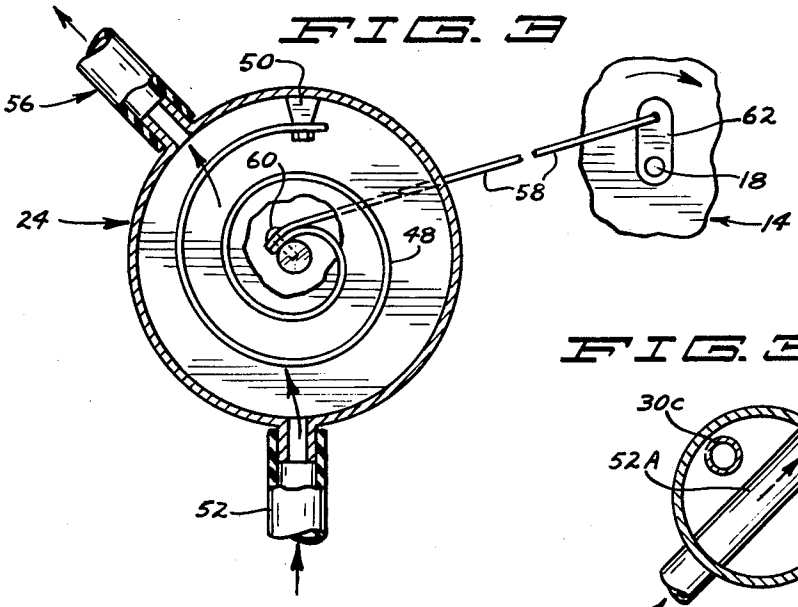
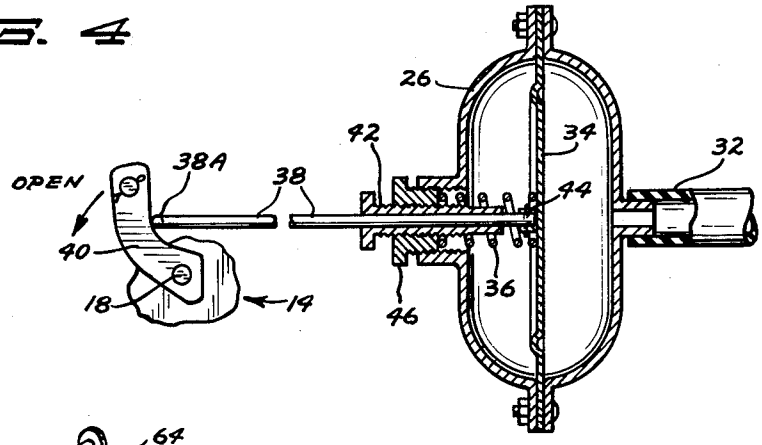


FIG. 3A

FIG. 4



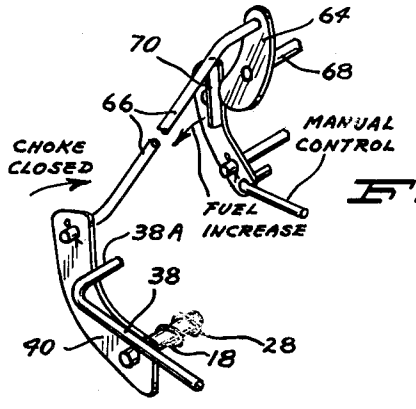


FIG. 5

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AUTOMATIC CHOKE FOR OUTBOARD MOTORS

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This invention relates generally to outboard motors and more specifically to an outboard motor having a fully progressive automatic choke with a coolant system operated choke unloader.

Previous automatic chokes often included an induction manifold vacuum operated piston to unload the choke during engine warmup periods for preventing flooding the carburetor and subsequently stopping the engine. Manifold vacuum, while somewhat related to engine speed, is not directly indicative thereof and thus the engine may be choked differently at one engine speed.

This invention provides an automatic choke in an outboard motor in which during warmup the engine choke unloading is proportioned to true engine speed or r.p.m. A closed water pressure line is connected between a pressure responsive choke unloading diaphragm and the engine cooling system having water or coolant pressures related to true engine speed. The coolant pressure overrides a calibrated spring yieldably urging to flex the diaphragm which is suitably limited in flexing for determining the maximum the choke may be unloaded. A thermal bimetallic motor is also connected to the choke valve for opening same as the engine temperature approaches normal. Since the pressure diaphragm provides only limited choke valve opening, the motor disengages the valve from the diaphragm as the engine temperature nears normal operating temperature.

With a fast idle attachment on the carburetor, the spring load diaphragm may be utilized to determine and adjust the maximum fast idle speed directly from actual engine speed.

Accordingly it is an object of the present invention to provide an automatic choke on an outboard motor having an engine warmup control responsive to engine speed to unload the choke in a predetermined proportion to engine speed.

It is another object of this invention to provide an engine speed controlled fast idle attachment to an automatic choke in an outboard motor.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

FIG. 1 is a side elevational view of an outboard motor unit embodying the present invention.

FIG. 2 is a vertical sectional and enlarged view taken along line 2—2 in FIG. 1.

FIG. 3 is an enlarged vertical sectional view of an exemplary thermostat spring motor as taken along line 3—3 in FIG. 2.

FIG. 3A is an enlarged horizontal sectional view of an exhaust stove section for use with the present invention as viewed looking down from the FIG. 1 engine.

FIG. 4 shows an exemplary coolant pressure responsive unit in an enlarged vertical sectional view taken along line 4—4 of FIG. 2.

FIG. 5 is a perspective view of an exemplary fast idle linkage for use in the present invention.

With more particular reference now to the drawings like numbers denote like parts and structure features in the various views. An outboard motor **10** has an internal combustion engine with the usual intake or induction manifold **12** having a carburetor **14** mounted thereon and being in communicative relation therewith. An air intake assembly **16** for cleaning the combustion air before entering the carburetor is provided, the details of which are unimportant to this invention. A choke valve shaft **18** is rotatably mounted through opposing sides of carburetor **14** in a rotatable sleeve **21** which eccentrically mounts a choke valve **20**. A spring linkage **21A** yieldably urges the sleeve **21** and thus the valve **20** to rotate with the shaft **18**. The valve **20** is rotatable between a closed position in which the valve is perpendicular to the air intake passageway **22** axis and an open position in which the valve is parallel to the axis.

The position of choke valve **20** is controlled through spring linkage **21A** by the thermal bimetallic motor **24**, coolant pressure responsive diaphragm unit **26** and a spring **28**. The spring **28** is fixedly attached at one end to the carburetor **14**, such as by a screw, and the other end being inserted into a slot **28A** in the shaft **18** while under tension for urging the shaft **18** to close valve **20**.

When initially starting the outboard motor engine the bimetallic spring motor **24** and the spring **28** completely close the choke valve **20**. When the engine is started the air drawn through the passageway **22** tends to override the biasing of spring linkage **21A** to allow limited opening of the choke valve. As the engine fires, more air is required to sustain combustion requiring that valve **20** be further opened. As the engine begins to operate the coolant system **30** rotary impeller engine shaft driven pump **30A** provides water under pressure from outside the outboard motor unit. The cooling system fluid circuit further includes engine intake tube **30B**, engine water jacket **30D** and discharge tube **30C** for returning the water to outside the unit. Water under pressure is provided from jacket **30D** through closed tube **32** to the unit **26**. The unit **26** responds to the coolant or water pressure by the flexure diaphragm **34** against the calibrated spring **36** to move the L-shaped rod **38** against non-rotatably mounted choke valve lever **40** to tend to open valve **20** in proportion to engine speed. The spring **28**, in addition to urging the valve **20** toward the closed position, also urges the lever **40** against the transversely bent end, **38A**, of rod **38**, thereby removing lost motion therebetween.

Pressure unit **26** preferably has a diaphragm travel limiting stop bearing **42** which axially slidably supports the rod **38** and limits the diaphragm flexing, and thus the valve opening, by its inner end engaging the diaphragm-rod connection as at **44**. The bearing **42** is screwed into retaining bushing **46** which in turn is screwed into the unit **26** housing. Alternately the rod **38** may be slidably supported in the unit **26** housing with the diaphragm flexing limiting and the spring retaining being accomplished by housing itself.

While the pressure unit **26** may be constructed to fully open the valve **20** at a predetermined engine speed, it is preferred that the thermal bimetallic spring motor **24** be utilized to keep the valve **20** completely open after the engine is at normal operating temperature. The motor **24** consists of a spiral bimetallic thermostat spring **48** fixedly attached at its radially outer end to stationary mounting member **50**. Fresh air is drawn by manifold **12** vacuum through the air inlet tube **52** which includes a heater section **52A** extending through the engine exhaust housing **54** for heating the air in proportion to the engine operating temperature. The air passes over the spring **48** heating it in proportion to the engine exhaust temperature, thence through the tube **56** into the induction manifold **12**. As the spring **48** is heated the bimetallic thermostatic action causes the spring tension to relax, moving the inner end outwardly and to the right as viewed in FIG. 3. The inner end of spring **48** is pivotally connected, by connecting means **60**, to choke

operating rod 58 which in turn is connected to choke lever 62 on shaft 18 for opening and closing valve 20 in proportion to engine temperature.

As illustrated, the motor 24 is operative to fully open the valve 20, thereby freeing the lever 40 from the pressure unit linking choke rod end 38A to make the unit 26 ineffective for operating the choke. During warm-up at high engine speeds pressure unit 26, in opening the valve overrides the urging of spring 28 and motor 24. Either pressure unit 26 or the motor 24 may open the valve 20. When the diaphragm 34 flexing is limited to partially open the valve 20, although not necessary, it is highly desirable that linkage to the lever 40 be made unidirectionally operative, as shown, permitting the motor 24 to independently open the valve for efficient engine operation at normal operating temperatures. Further, with the diaphragm being limited in flexing the spring tension of the motor element 48, the spring 28 and pressure unit 26 may be calibrated together and the spring 36 eliminated; the calibrated bias against the diaphragm 34 then being transmitted through the choke valve linkages.

As aforementioned, a fast idle is preferred when an automatic choke is provided. Particularly referring now to FIG. 5 it is seen that choke lever 40 is operatively connected to the fast idle cam 64 by a pivotally connected rod 66. As the valve 20 is closed the lever 40 urges cam 64 to rotate in the direction of the illustrated arrow about the pivot pin 68 which is stationarily secured to the carburetor. The cam 64 engages the throttle valve control lever 70 to increase engine speed as the choke valve is moved toward the closed position. It is understood that the lever 70 is non-rotatably secured to the usual carburetor throttle valve such as illustrated in FIG. 241 on page 312 of James V. Frost's book "Pre-service Course in Automotive Mechanics," John Wiley & Sons, New York, 1943.

During engine warmup the valve 20 tends to open as the engine speed increases through the action of pressure unit 26. The fast idle speed is determined by the combined forces of calibrated spring 36, spring motor 24 and spring 28 as balanced by the force of the engine speed indicating pressure flexing of the diaphragm 34 plus the slight force from the valve 20 due to air passing thereby. The fast idle speed may be varied by adjusting any of the above listed items or any of the linking rods with the fast idle speed being governed in part by true engine speed. As the engine warms up, the motor 24 begins to open the choke valve to progressively decrease the fast idle speed in proportion to increasing engine temperature. Note that the maximum fast idle speed is always determined by engine speed responsive unit 26.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described by invention, what I claim to be new and desire to protect by Letters Patent is:

1. In an outboard motor having an internal combustion engine with a carburetor having an air intake passageway, a choke valve mounted in the passageway and being rotatable between open and closed positions, engine cooling means providing liquid coolant and operatively connected to the engine for developing coolant pressures related to engine speed, pressure responsive linkage means communicatively associated with the cooling means and operatively connected to the valve for rotating it toward the open position as the coolant pressure increases, and means yieldably urging the valve toward the closed position.

2. In an outboard motor having an internal combustion engine with a carburetor having an air intake passageway, a choke valve mounted in the passageway and being rotatable between open and closed positions, engine cooling means providing liquid coolant and operatively associated with the engine for developing pressures proportional to engine speed, a pressure flexible diaphragm communicatively associated with the cooling means for being flexed in a first direction, resilient means operatively connected to the diaphragm for yieldably urging the diaphragm to flex oppositely to the first direction, and the diaphragm being operatively connected to the valve for rotating same toward the open position as the pressure increases in proportion to engine speed.

3. In an outboard motor having an engine with a carburetor with an air intake passageway, a choke valve mounted in the passageway and rotatable between open and closed positions by a choke valve lever non-rotatably associated therewith, spring means on the engine and being operatively connected to the valve for yieldably urging same toward the closed position, engine cooling means operatively associated with the engine for developing coolant pressures proportional to engine speed, travel limited pressure responsive means communicatively associated with the cooling means and operatively engaged with the valve lever for overriding the yieldable spring means to limitedly rotate the valve toward the open position in proportion to the coolant pressures and being disengageable from the valve lever when the valve is moved toward the open position irrespective of coolant pressures.

4. In an automatic choke for an outboard motor internal combustion engine, a choke valve having control linkage and being operable between open and closed positions, an engine temperature responsive motor operatively associated with the linkage for opening and closing the valve as engine temperature respectively increases and decreases, an engine cooling system operatively associated with the engine for developing coolant pressures related to engine speed, a travel-limited pressure responsive means communicatively connected to said coolant means and being operatively engaged with the choke valve linkage at least when the motor is somewhat urging the valve toward the closed position, the pressure responsive means being responsive to increasing coolant pressures to override the motor urging for opening the valve in proportion to engine speed, and the pressure means being operatively disengageable from the linkage as the motor urges the valve toward the open position.

5. In an outboard motor having an internal combustion engine, a combustion air control valve means communicatively associated with the engine and having open and closed positions, a spring connected to the valve means for yieldably urging it closed, an engine temperature responsive motor operatively associated with the valve means to open same in proportion to engine temperatures, an engine cooling system operatively associated with the engine for developing coolant pressures proportional to engine speed, a pressure responsive diaphragm unit having a pressure responsive diaphragm and being communicatively associated with the cooling system for flexing the pressure responsive diaphragm in one direction, stop means in the unit for limiting the diaphragm flexing in the one direction, resilient means in the unit engaging the diaphragm for yieldably urging it opposite to the one direction, and the unit being operatively engaged with the valve means for opening same only when the diaphragm is flexed to provide a valve means opening exceeding or equaling a valve means opening being provided by the temperature motor.

6. In an outboard motor internal combustion engine having combustion air intake means with a choke valve operable between open and closed positions, the valve being offset mounted on a shaft journaled through the intake means such that air drawn in through the means will partially open the valve, lever means on the shaft for operating the valve, exhaust means on the engine, a thermostatic spring motor operatively connected to the lever means and being in fluid communication with outside the engine through the exhaust means for receiving

air heated thereby and being responsive to the heated air for opening the valve in proportion to the heated air temperature, engine cooling means providing water under pressure to the engine in proportion to the engine speed, a pressure responsive unit communicatively associated with the cooling means and having a diaphragm exposed and being responsive to the cooling means pressures for flexing in one direction, diaphragm flexing limiting and disengageable means connecting the diaphragm to the lever means for communicating diaphragm pressure flexing to the lever means to partially open the valve proportionately to engine speed, and the connecting means disengaging and freeing the lever means from the pressure unit when the spring motor has operated the valve toward the open position more than said partial opening.

7. In a fast idle for an internal combustion engine in an outboard motor, a choke valve, a throttle control, fast idle means connecting the valve to the control for increasing the engine speed up to a predetermined rate as the valve is closed, an engine cooling system drawing water from outside the engine and providing same to the engine under pressures related to engine speed, a pressure responsive device communicatively associated with the cooling system and being operatively engaged with the choke valve for opening same as the pressures increase, means yieldably urging the valve to be closed, and means for varying the maximum fast idle engine speed as a function of the actual engine speed.

8. Apparatus as in the claim 7 wherein the yieldable urging means includes a thermostatic spring motor for yieldably urging the valve to vary between being open and closed as a function of engine temperature whereby at a predetermined engine temperature the valve is sufficiently operated toward the open position whereby the pressure device is operatively disengaged from the valve.

9. In an outboard motor having an internal combustion engine with a carburetor having an air intake passageway, a choke valve mounted in the passageway and being rotatable between open and closed positions, engine cooling means providing liquid coolant and operatively connected to the engine for developing coolant pressures related to engine speed, pressure responsive linkage means communicatively associated with the cooling means and operatively connected to the valve for proportionately rotating it toward the open position in accordance with increases of pressure and means yieldably urging the valve toward the closed position.

10. In an outboard motor having an internal combustion engine with a carburetor having an air intake passageway, a choke valve mounted in the passageway and being rotatable between open and closed positions, engine cooling means operatively associated with the engine for developing pressures proportional to engine speed, a pressure flexible diaphragm communicatively associated with the cooling means for being flexed in a first direction, resilient means operatively connected to the diaphragm for yieldably urging the diaphragm to flex oppositely to the first direction, said diaphragm being operatively connected to the valve for proportionately rotating same toward the open position as the pressure increases in proportion to engine speed.

11. In an internal combustion engine; an air inlet to an air-fuel mixing device; a moveable choke valve mechanism positioned in said air inlet; liquid engine cooling means including means operatively connected to an engine for developing liquid coolant circulation pressures proportional to engine speed; means biasing said choke valve to a position tending to reduce the flow of air through said air inlet and means responsive to said proportional pressure and connected to said choke valve mechanism in a manner to overcome said biasing means so as to tend to move said choke valve mechanism proportionately toward a position tending to increase the flow of air through said inlet.

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