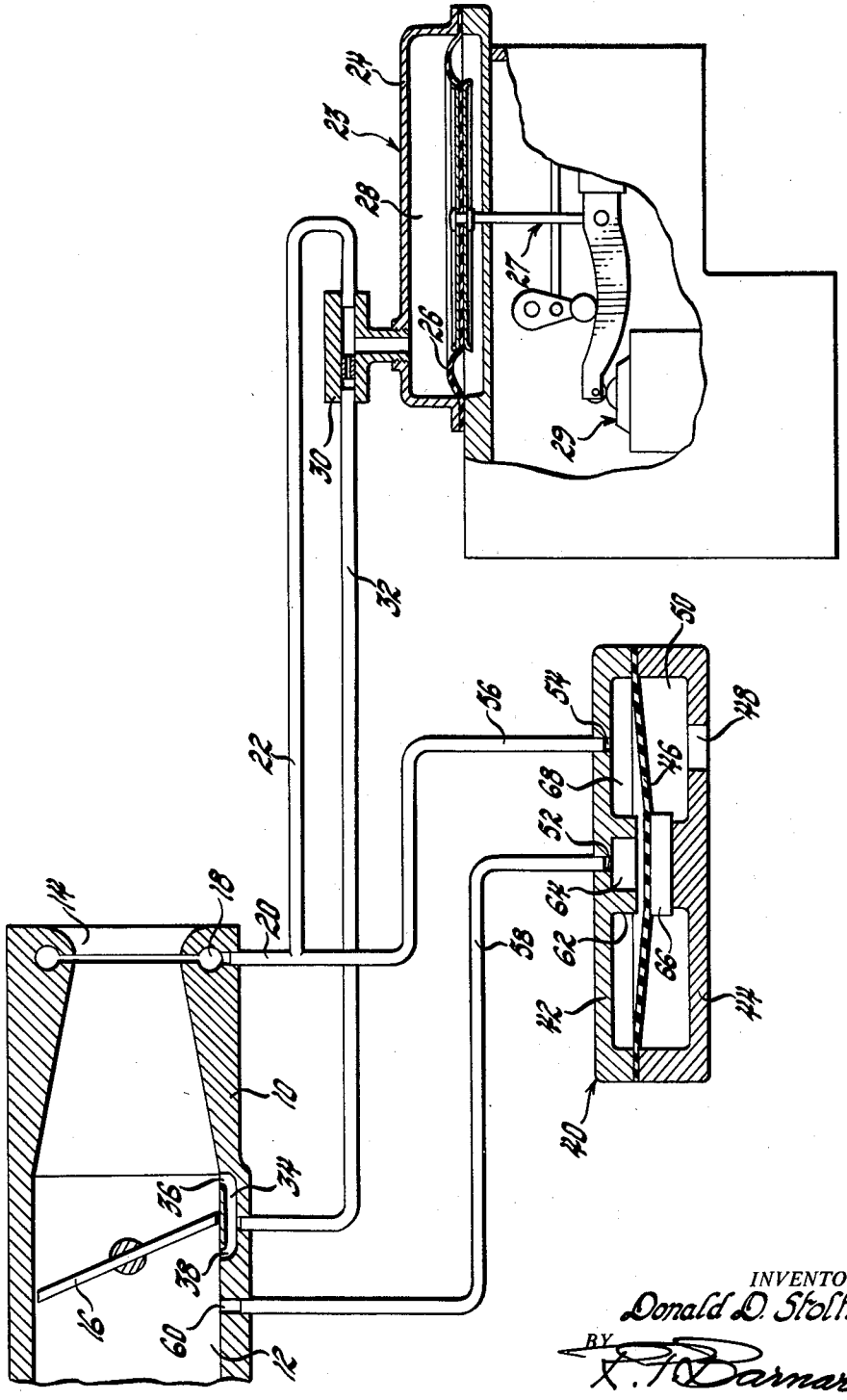
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FUEL INJECTION CRANKING SIGNAL MODIFYING DEVICE

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FUEL INJECTION CRANKING SIGNAL MODIFYING DEVICE

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6 Claims. (Cl. 261—69)

The present invention relates to a device for creating or supplementing the vacuum control force for a mass air flow type fuel injection system under engine cranking. More specifically, the present device is an improvement over the cranking enrichment mechanism shown in copending application Serial No. 591,889, Dolza, filed June 18, 1956.

In the earlier system of the aforenoted copending application, a solenoid device was utilized which acted directly upon the fuel metering valve to increase the nozzle fuel flow under engine starting conditions. This previous device also recognized the insufficiency of the metering signal during engine cranking conditions. However, the earlier device was considerably more expensive than the present mechanism and further was operative during closed throttle cranking irrespective of the magnitude of the fuel requirement of the engine.

In the present device, a diaphragm actuated valve is provided which is opened by gravity or a spring force in such a way as to communicate the induction passage posteriorly of the throttle valve with a conduit leading from the throat of an induction passage venturi whereby manifold vacuum will supplement the venturi vacuum force when the combined venturi and manifold vacuum forces on the diaphragm is less than a given amount, e.g., two inches of water differential across the diaphragm. At such time as sufficient air flow takes place through the induction passage as to increase the vacuum signal above said given value, the complementary action of venturi and manifold vacuum will close the diaphragm controlled valve thereby blocking further supplemental manifold vacuum from reaching the fuel metering valve controlling diaphragm.

Further objects and advantages of the present device will be apparent from a perusal of the detailed description which follows.

The drawing is a diagrammatic representation of a fuel injection system embodying the present invention.

As already noted, the present invention may be incorporated with a fuel injection system of the type shown in the aforenoted copending Dolza application, therefore, such system will be described only insofar as is necessary to an understanding of the present invention.

An air intake casing is provided at **10** and includes an induction passage **12** having a venturi **14** formed therein. A throttle valve **16** is disposed in passage **12** posteriorly of venturi **14**. An annular chamber **18** is formed about the throat of venturi **14** and radially inwardly communicates with the venturi throat whereby a vacuum force proportional to induction passage air flow is created in said chamber. Chamber **18** in turn communicates through a conduit **20** and a branch conduit **22** with a fuel metering valve control mechanism indicated generally at **23**. Mechanism **23** includes a casing member **24** cooperating with a diaphragm **26** to define a vacuum chamber **28**. A T-plug **30** is mounted on casing **24** and communicates at one side with venturi vacuum conduit

22 and at the other side with a conduit **32**. As set forth in detail in the Dolza application, diaphragm **26** through a linkage mechanism **27** controls a fuel metering valve **29** which controls the metering pressure of fuel to fuel nozzles, not shown.

As described in copending application Serial No. 608,797, Olson, filed September 10, 1956, now Patent No. 2,873,732, dated February 17, 1959, conduit **32** communicates with a U-shaped passage **34** which terminates in induction passage ports **36** and **38** anteriorly and posteriorly of the closed throttle **16**. Passage **34** and conduit **32** are provided for the purpose of reinforcing or increasing the vacuum metering signal in chamber **28** during idle and off-idle conditions when the air flow through venturi **14** is too low to provide a suitable vacuum metering force.

An engine cranking signal valve mechanism is shown generally at **40** and includes a pair of casing members **42** and **44** peripherally clamping a diaphragm member **46** therebetween. Casing **44** includes a port **48** therein which communicates a chamber **50** defined by the casing and diaphragm **46** with the atmosphere. Port **48** is preferably a restricted hole, e.g., .020" diameter for the purpose of dampening diaphragm surging and preventing diaphragm vibration on boss **62** which otherwise generates objectionable noise.

Casing **42** includes ports **52** and **54**. Port **54** communicates with a conduit **56** which branches off of venturi vacuum conduit **20**. Port **52** communicates with a conduit **58** which connects at its other end with a port **60** formed in casing **10** and communicating with induction passage **12** posteriorly of throttle **16** to transmit manifold vacuum to conduit **58**.

Casing **42** includes a downwardly opening boss or valve seat **62** formed about port **54** to define a vacuum chamber **64**. A reinforcing washer-like member **66** is suitably fixed to diaphragm **46** and disposed opposite port **52** and chamber **64**.

Under normal conditions with the engine running, the manifold vacuum in conduit **58** acting through chamber **64** on diaphragm **46** as well as venturi vacuum in chamber **68** acting on the diaphragm will overcome the weight of the member **66** causing the diaphragm to seat against boss **62** to block communication of manifold vacuum with chamber **68**. Under this condition no vacuum from the modifying device will be admitted to metering diaphragm chamber **28** to control actuation of the fuel metering valve **29**.

However, with engine inoperative, the weight of member **66** will cause diaphragm **46** to uncover seat **62** to communicate conduits **56** and **58**. In this condition cranking vacuum posteriorly of throttle **16** will be transmitted to metering diaphragm chamber **28** to supplement the weak venturi signal in controlling diaphragm **26**. In this way a sufficiently strong vacuum control force is imposed on diaphragm **26** to insure an adequate supply of fuel will be metered to the engine by valve **29** for starting purposes.

It is apparent that by suitably selecting the weight of member **66** as well as the areas of diaphragm **46** exposed to venturi and manifold vacuum, the enrichment device **40** can be made to function at any condition desired. As already noted, in the present instance it is only intended to render device **40** operative during cranking conditions. Accordingly, the area of diaphragm **46** and weight of member **66** are calculated to be overcome and block seat **62** when induction air passage air flow reaches a given value. To illustrate, it has been found that a vacuum force equal to two inches of water is the maximum required for cranking fuel flow through the fuel metering valve **29**. Therefore, diaphragm area and mem-

ber **66** weight are of such that when the total vacuum force in chambers **64** and **68** exceed two inches of water the diaphragm will be moved upwardly closing port **52** and thereby blocking manifold vacuum from communication with chamber **68** whereby fuel flow will be controlled solely in accordance with the air flow induced vacuum force in conduits **20** and **32**.

I claim:

1. A charge forming device for an internal combustion engine comprising an air induction passage, a venturi formed in said passage, a throttle valve disposed in said passage posteriorly of said venturi, a fuel metering mechanism including a diaphragm member, conduit means communicating said venturi with said diaphragm permitting a vacuum force proportional to air flow to act on said diaphragm and thereby control the quantity of fuel flow through said mechanism, and a metering vacuum modifying means connected between said air induction passage and said fuel metering mechanism and comprising a pressure responsive valve mechanism, a first port in said metering means adapted to be controlled by said valve mechanism, a second conduit means communicating said port with said induction passage posteriorly of said throttle valve whereby said valve mechanism is exposed to manifold vacuum, a second port in said metering means, said conduit means communicating said venturi with said diaphragm also communicating with said second port, the total vacuum force acting on said valve mechanism during normal engine operation blocking communication between said first and second ports, said valve mechanism being adapted to communicate said ports when said total vacuum force falls below a predetermined value whereby manifold vacuum supplements venturi vacuum to control said fuel metering diaphragm.

2. A charge forming device as set forth in claim 1 in which said metering vacuum modifying device comprises a pair of casing members, a diaphragm peripherally clamped between said members and coacting therewith to define first and second chambers, said first and second ports being formed in one of said casing members and communicating with said first chamber, the second chamber being exposed to atmospheric pressure.

3. A charge forming device as set forth in claim 2 in which said pressure responsive valve mechanism includes a valve seat formed about said first port, a weighted element mounted on the vacuum modifying device diaphragm, said element being aligned with said valve seat and coacting with said latter diaphragm to control flow through said first port.

4. A charge forming device as set forth in claim 3 in which the area of the vacuum modifying device diaphragm exposed to manifold and venturi vacuum forces and the weighted element coact to uncover said valve seat by gravity actuation when air flow through the induction passage falls below a predetermined value.

5. A charge forming device as set forth in claim 3 in which said first port and said weighted element are centrally disposed relative to the associated diaphragm and casing members.

6. A charge forming device as set forth in claim 3 in which said valve seat comprises an open ended cylindrical portion depending from said one casing member and further in which said weighted element is diametrically coextensive with said cylindrical portion.

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