SPEED CONTROL FOR ENGINE DRIVEN FLUID COMPRESSOR

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ABSTRACT

A speed control arrangement is disclosed for an engine driven fluid compressor. The engine includes a throttle valve by which the engine speed and accordingly the compressor speed is variably regulated. A pressure sensitive device is connected to the compressor to sense compressor output pressure and includes a component having a mechanical displacement proportional to compressor output pressure. Displacement of the component is imparted to the throttle valve through an improved actuator arrangement which permits the pressure sensing device to be selectively mounted relative to the throttle valve and other than directly on the engine or in precise alignment with the throttle valve actuating arm.

8 Claims, 5 Drawing Figures
SPEED CONTROL FOR ENGINE DRIVEN FLUID COMPRESSOR

This invention relates to engine driven fluid compressors and, more particularly, to an improved arrangement for controlling the speed of the engine and thus the speed of the compressor in accordance with compressor output pressure. Such compressors Engine driven fluid compressors are, of course, well known. Such compressors are adapted to be coupled to an output shaft of an internal combustion engine so that the compressor is driven in response to rotation of the output shaft for the compressor to deliver fluid, such as air, under pressure to fluid pressure operated equipment such as hammer jacks, for example. Often, such compressor units are mounted on a vehicle such as a truck and the engine of the truck is provided with a power take-off unit adapted to be selectively coupled with the compressor to drive the latter. Arrangements of this character advantageously provide portable compressor units which by means of the truck can be driven to a point of use. By employing the vehicle engine as a source of drive for the compressor, the expense and space required to provide a separate engine to drive for the compressor is avoided.

In the operation of engine driven compressors it is, of course, necessary to control the speed at which the compressor is operated in order to maintain the compressor speed within the operating output limitations thereof. Such control of compressor speed is achieved by controlling the speed of the drive engine. The speed of the drive engine, as is well known, is variably controlled by regulating a speed control thereof such as a throttle valve or fuel injection pump. Accordingly, in order to control the engine speed to achieve a desired range of compressor speeds it becomes necessary to provide for the speed control component of the engine to be positionally controlled in accordance with an operating characteristic of the compressor.

One such operating characteristic of the compressor which is employed to control the position of the engine speed control component is the output pressure from the compressor. More particularly, the output pressure of the compressor is sensed and the sensed pressure is converted to mechanical movement of a component having a displacement proportional to the output pressure. The latter component is interconnected with the engine speed control component so that the speed control component is displaced in accordance with displacements of the mechanical movement component. Thus, the engine speed is varied in accordance with variations in compressor output pressure to provide for the engine to drive the compressor at variable speeds dependent on the output demands on the compressor resulting from use of the equipment supplied with fluid under pressure by the compressor.

Whether engine speed control is achieved by fuel injection pump means or a throttle valve associated with the engine carburetor, it will be appreciated that these components are directly mounted on the engine and accordingly are subject to the engine resulting from operation thereof. Therefore, the mechanical movement component of the sensing device has been interconnected with the throttle valve or fuel injection pump by rigid, substantially straight rod elements. The use of such rod elements requires precise alignment of the mechanical displacement component of the sensing device with existing linkage on the engine. Such precise alignment is required in order to avoid frictional engagement between the several components which not only results in excessive wear but may also cause poor response and consequent hunting of the engine in controlling the compressor speed. Further, the use of such rigid rod components requires that the sensing device be mounted on the engine, whereby the sensing device is undesirably subjected to the vibrational movements of the engine. It will be appreciated that the relative vibrational movements which would be imparted to the sensing device, rods and linkages if the sensing device was not mounted on the engine would both adversely affect the operation of these components and result in excessive wear and possible breakage thereof. Moreover, if the sensing device was not mounted on the engine, alignment would still be required, undesirably long rods would have to be employed, and such mounting might well be impossible for a given engine having parts which would interfere with proper alignment. The latter problem is sometimes encountered even though the sensing device is mounted on the engine. Heretofore, in such situations, bell cranks have been resorted to transfer the mechanical movement of the sensing device component to the throttle valve or fuel injection pump. The use of bell cranks and the like introduces further difficulty with regard to proper operation of the control components whereby excessive friction and poor response and hunting results. It will be further appreciated that installation errors are attendant to any assembly operation involving mechanical elements which must be properly aligned and structurally interrelated in order to achieve proper functioning thereof. Thus, even when the utmost of care is taken, at the expense of increased installation time, the assembly of components may not function in the most desirable manner. It should be noted too that the vibration imparted to the sensing device as a result of its being mounted directly on the engine may adversely affect the operation thereof and may as well result in excessive wear of the operating parts thereof which reduces the life of the sensing device.

In accordance with the present invention, the disadvantages of control arrangements heretofore known, including those pointed out specifically above, are advantageously overcome by providing a control arrangement in which alignment of the mechanical displacement component of the sensing device and the actuator component of the throttle valve or fuel injection pump of the engine is not required and wherein the necessity of mounting the sensing device on the engine is advantageously avoided. More particularly, in accordance with the present invention the mechanical displacement component of the sensing device is operatively interconnected with the actuator of the speed control component of the engine by an actuator assembly including a longitudinally flexible actuator cable. Thus, the sensing device can be mounted in a wide variety of positional relationships relative to the speed control component of the engine and advantageously can be mounted on a support surface separate from the engine so that it is not subjected to the magnitude of vibration encountered when mounted on the engine. Moreover, the flexible actuator assembly provides for the sensing device to be more readily installed than heretofore possible since alignment is not required, whereby the cost of installation is advantageously reduced. Still further, the flexible actuator arrangement eliminates the free
play which results from the interconnection of a train of links and rods, whereby hunting of the engine is advantageously reduced or eliminated and better response to varying compressor output characteristics is achieved. A further advantage realized is a reduction in parts cost since thinner metal brackets can be employed to mount the sensing device than would be required if it was mounted on the engine.

Accordingly, it is an outstanding object of the present invention to provide an improved speed control mechanism for the engine of an engine driven compressor, which mechanism facilitates selective positional installation of a compressor output pressure sensing device relative to a speed control component of the engine which is mechanically interconnected therewith for actuation thereby.

Another object of the present invention is the provision of an engine speed control arrangement of the foregoing character in which installation of the components of the system can be achieved more readily than heretofore possible.

A further object of the present invention is the provision of a speed control mechanism of the foregoing character in which there is less frictional interference between the components thereof and thus an increased cooperative functioning of the components over mechanisms heretofore known.

Yet another object of the present invention is the provision of a speed control mechanism of the foregoing character in which the components provide for better engine response and less engine hunting than heretofore possible.

The foregoing objects and others will in part be obvious and in part more fully pointed out hereinafter in conjunction with the description of the drawing of preferred embodiments of the invention and in which:

FIG. 1 is a side elevation view illustrating a vehicle mounted compressor adapted to be driven by the vehicle engine and schematically illustrating the engine speed control arrangement of the invention;

FIG. 2 is a side elevation view of the components of the engine speed control arrangement illustrated in FIG. 1;

FIG. 3 is an enlarged side elevation view of a portion of the components illustrated in FIG. 2;

FIG. 4 is a top elevation view of the components illustrated in FIG. 3; and

FIG. 5 is a side elevation view illustrating a modified arrangement of the components of an engine speed control mechanism of the present invention.

Referring now to the drawings in greater detail wherein the showings are for the purpose of illustrating preferred embodiments of the invention only and not for the purpose of limiting the same, FIG. 1 is illustrative of a truck mounted compressor adapted to be driven by an engine which, as illustrated, is the truck engine. It will be appreciated, however, that the compressor does not have to be mounted on a truck or other engine driven vehicle so as to be driven by the vehicle engine. In this respect, the compressor could be mounted on a truck or on a trailer or the like together with an independent engine suitably coupled with the compressor to drive the latter. Further, it will be appreciated that the compressor does not have to be of a portable nature, but rather could be permanently installed on a suitable support and driven by an engine which is either fixed with respect to the compressor or portable and adapted to be drivingly coupled to the compressor.

With further regard to the arrangement illustrated in FIG. 1, a compressor 10 is suitably mounted on the bed of a truck 12 having an engine 14. It will be appreciated that engine 14 is of a character adapted to run on gasoline, diesel fuel or other suitable liquid or gaseous fuel which is fed to the cylinders thereof for combustion therein to impart rotation to a drive shaft by which the rear, front or both sets of wheels of the vehicle are driven. It is only necessary in accordance with the present invention that the engine be of the character in which the speed thereof is controllable by controlling the quantity of fuel or the quantity of fuel mixture or fuel-air mixture to the cylinders for combustion therein. In the embodiment illustrated, engine 14 has a carburetor 16 mounted thereon which includes a speed control component defined for example by a butterfly valve 18 disposed within the carburetor throat and having an operating arm 20 disposed outside the carburetor for imparting pivotal movement to the butterfly valve to control the quantity of fuel delivered to the engine cylinders in a manner well known. While the speed control component is illustrated in this instance as being a throttle or butterfly valve associated with the carburetor, it will be appreciated that the fuel feeding system could be of the fuel injection type having a fuel injection pump which is operated to deliver fuel to the engine cylinders and the operation of which is controlled to control the quantity of fuel delivered.

As is further well known, truck 12 is provided with an accelerator and accelerator linkage assembly 22 suitably interconnected with throttle valve arm 20 to provide for driver operation of the engine speed during driver operation of the truck. Details of the interconnection between accelerator linkage assembly 22 and valve arm 20 is set forth in more detail hereinafter.

Compressor 10 may be any one of a variety of fluid compressor devices the details of construction and operation of which are not pertinent to the present invention. For example, the compressor could be a rotary, sliding vein type compressor, a screw or any other type of compressor having a rotary input drive. In the arrangement illustrated, compressor 10 has a rotary input shaft 24 which is adapted to be driven by engine 14 through an auxiliary output shaft 26 rotatably driven by the engine. Shaft 26 is drivingly interconnected with shaft 24 by pulleys 28 and 30 mounted on the adjacent ends of shafts 24 and 26, respectively, and a drive belt 32 which encircles pulleys 28 and 30. While a pulley and belt arrangement is illustrated, it will be appreciated that the driving interconnection could be otherwise achieved, such as by meshing gears on the ends of shafts 24 and 26. Compressor 10 has an outlet 34 adapted to be interconnected with hose means or the like and through which fluid compressed, such as air, is adapted to be delivered under pressure. The outlet of the compressor further includes a fluid line 36 through which fluid at compressor output pressure is delivered to a pressure sensing device 38 mounted adjacent engine 14 in the engine compartment. Sensing device 38 includes a mechanical displacement component 40 adapted to move in opposite directions between first and second positions in response to fluctuations of compressor output pressure during operation of the compressor. Mechanical displacement component 40 is interconnected with arm 20 of the speed control component by a flexible actua-
The flexible actuator assembly provides for mechanical displacements of component 40 to be imparted to throttle valve 18 through arm 20, whereby the engine speed is controlled by the position of component 40 and thus in accordance with the magnitude of the output pressure of compressor 10. The specific structure of pressure responsive device 38 is not pertinent to the present invention and accordingly will not be discussed in detail. It is only necessary that the device have a mechanical displacement component the position of which at any given time during compressor operation corresponds to the output pressure of the compressor at that time, and by which movement is imparted to the engine speed control component to position the latter in accordance with the compressor output pressure at that time to control the engine speed in accordance with the compressor output pressure. Further, while mechanical displacement component 40 is described hereinafter as being a pivotal component, it will be appreciated that the component can have a linear, rotational or other movement rather than pivotal.

The structure and operation of the components of the speed control arrangement will be best understood with reference to FIGS. 2, 3 and 4 of the drawing. In FIG. 2, the solid line positions of the components illustrate the positions thereof when engine 14 is idling and before compressor drive is initiated, and the broken line positions of the components illustrate certain of the positions thereof during compressor operation. Compressor output pressure sensing device 38 is illustrated as being mounted such as by a bracket 44 to a suitable support surface 46 separate from engine 14 and which may be defined, for example, by a fender panel or frame component within the engine compartment. Line 36 from compressor 10 is connected to sensing device 38, and mechanical displacement component 40 is a lever or arm pivotally mounted on the sensing device such as by a pin 48 to pivot in the directions indicated by arrow A in response to variations in the pressure of fluid delivered to the sensing device through line 36.

Actuator assembly 42 includes a longitudinally flexible cable and guide assembly 50 which, preferably, is comprised of a flexible tubular casing 52 having a flexible metal wire or cable component 54 extending therefrom and projecting from the opposite ends thereof. Cable 54 is longitudinally slidable relative to casing 52 and may be of stranded or solid construction. End 52a of casing 52 is loosely received in a recess 55 provided in a threaded bushing 56 which is rotatable relative to casing 52 and threadedly engages an internally threaded aperture 58 extending through a rigid support arm 60 integral with or fixedly attached to sensing device 38. The corresponding end 54a of cable 54 is attached to arm 40 so that the cable will move longitudinally relative to casing 52 in response to pivotal movement of arm 40. The position of bushing 56 is adapted to be longitudinally adjusted relative to aperture 58 in arm 60 after cable end 54a is attached to arm 40 to finely adjust the position of arm 40 in the initially adjusting the engine speed control assembly. The interconnection of cable end 54a and arm 40 may be achieved in any suitable manner. For example, arm 40 may be provided with a sleeve 62 having a transverse aperture through which the cable end extends and a set screw 64 adapted to engage the cable and secure the cable in place relative to the sleeve. The opposite end of tubular casing 52 is loosely received in a recess provided in one end of a retainer component 66. More particularly, retainer 66 as illustrated in FIGS. 2, 3 and 4 includes an elongated body portion 68 having integral upstanding walls 70 and 72 at opposite ends thereof. Wall 72 is provided with an axially extending recess 74 adapted to loosely receive end 52b of casing 52. The inner or bottom wall of recess 74 includes an aperture 76 through which end 54b of cable 54 extends. Retainer component 66 is mounted on a rod element 78 and for this purpose walls 70 and 72 at opposite ends of the retainer are provided with aligned openings 80 and 82, respectively, through which the rod extends. A set screw or the like 84 is provided in wall 72 to secure the retainer on rod 78 against longitudinal movement relative thereto. As set forth more fully hereinafter, rod 78 has its opposite end pivotally interconnected with accelerator linkage 22 of the truck.

End 54b of cable 54 is operatively interconnected with throttle valve arm 20 by means of a sleeve 86 which is apertured to receive rod 78 and which is freely slidable longitudinally on the rod. A coil spring 88 surrounds rod 78 between wall 72 and sleeve 86 and biases the sleeve toward wall 70 for the purpose set forth more fully hereinafter. A threaded stud 90 extends laterally from sleeve 86 toward the carburetor. The stud may be integral with or suitably attached to sleeve 86 such as by brazing. Stud 90 is adapted to receive throttle valve arm 20 which is suitably apertured for this purpose, and a lock nut 92 is disposed on the free end of stud 90 to retain throttle valve arm 20 thereon. A washer 94 may be interposed between nut 92 and arm 20, and it will be appreciated that the nut is threaded onto the stud in a manner whereby arm 20 is retained on the stud and is freely pivotal relative thereto. Sleeve 86 is further provided with a projection 96 having a passageway 98 therethrough adapted to receive end 54b of cable 54. A screw 100 extends downwardly through projection 96 to engage the cable in place with respect to sleeve 86. In view of the foregoing description it will be appreciated that longitudinal reciprocating movement of cable 54 results in reciprocating movement of sleeve 86 and pivotal movement of throttle valve arm 20. In the embodiment illustrated, clockwise pivotal movement of throttle valve arm 20 opens the throttle valve to increase engine speed and counterclockwise pivotal movement of the arm accordingly closes the valve to decrease engine speed. As mentioned hereinabove, when the components are in the solid line positions thereof illustrated in FIG. 2 the engine is idling. When it is desired to operate the compressor, retainer component 66 is displaced to the right in FIG. 2 to the broken line position thereof and during compressor operation the retainer is maintained in this position and thus is in a substantially fixed position relative to the throttle valve. Wall 70 of retainer 66 defines a stop wall against which sleeve 86 is adapted to be biased by coil spring 88. When the retainer is in the broken line position thereof illustrated in FIG. 2 the position of sleeve 86 along rod 78 and relative to stop wall 70 will depend upon the speed of the engine at any given time during compressor operation, as described more fully hereinafter. It will be noted, however, that since retainer 66 is supported in a substantially fixed position relative to the throttle valve, stop wall 70 limits the extent to which sleeve 86 can
move in the direction to open the throttle valve and accordingly the maximum speed at which the engine can run during compressor operation.

The positioning of retainer components 66 to set the maximum engine speed will depend on the maximum engine speed desired which in turn will be determined by the operating characteristics of the compressor being driven by the engine. Further, positioning of retainer 66 in substantially fixed relationship with respect to the throttle valve can be achieved in any one of a number of various ways to provide for the components of the actuator arrangement to cooperate in accordance with the present invention. In the embodiment illustrated in FIG. 2, rod 78 on which the retainer is mounted is operatively interconnected with the accelerator components of the truck and is displaced to the right in FIG. 2 when the compressor is to be operated to move the retainer from the solid line to the broken line position thereof. This arrangement advantageously provides for the engine speed control actuator assembly to be mounted on a vehicle in conjunction with the existing accelerator linkage and in a manner whereby both normal driving operation of the vehicle and driving of the compressor by the vehicle engine can be achieved without disturbing the assembled relationship of the speed control actuator linkage components.

In the embodiment illustrated, rod 78 has one end thereof pivotally interconnected with one end of lever 102 of the accelerator linkage of the truck. Lever 102 has an opening end 104 extending through fire wall 106 of the vehicle for engagement with pivotal accelerator pedal 108. Lever 102 is pivotally mounted at 110 to fire wall 106 in a manner whereby depression of accelerator pedal 108 imparts clockwise pivotal movement to lever 102 to displace rod 78 to the right in FIG. 2. Since the opposite end of rod 78 is fixedly attached to retainer 66, it will be appreciated that movement of rod 78 to the right carries retainer 66 and flexible actuator cable 50 therewith, whereby the throttle valve is opened to increase engine speed. An accelerator return spring 112 biases accelerator components, rod 78 and the throttle valve to the engine idle positions thereof upon release of accelerator pedal 108. It will be appreciated therefore that the vehicle may be operated as a road vehicle and that the flexible actuator cable 50 provides for the retainer and its associated components to move as a unit with rod 78 so that these components are not subjected to wear during operation of the vehicle on the road and do not impose a load against foot operation of the accelerator linkage system by the truck driver.

As mentioned hereinabove, retainer 66 is displaced to the broken line position thereof and is retained in this position during compressor operation to limit the extent to which the throttle valve can open and accordingly the maximum speed of the engine in driving the compressor. In the embodiment illustrated, such displacement and positional retention of retainer 66 is achieved by suitable motor means such as, for example, an air cylinder 114 having a fluid actuated longitudinally reciprocable output shaft 116 aligned with accelerator lever 102 so as to engage and pivotally displace lever 102 when in the projected disposition thereof. Projection of output shaft 116 is achieved by delivering fluid under pressure to fluid cylinder 114 through line 118 connected to a suitable source of pressurized fluid, which source may be the compressor. When the compressor is being operated, fluid under pressure is delivered to cylinder 114 causing output shaft 116 to be displaced from the solid line position thereof in FIG. 2 to the broken line position, whereby lever 102 is pivoted clockwise and retainer 66 is displaced to the broken line position thereof illustrated in FIG. 2. Cylinder 114 is suitably supported relative to lever 102 such as by bracket means 120 to which the cylinder is attached and which in turn is attached to the fire wall 106. The extent to which retainer 66 is displaced to define the maximum engine speed setting position can be adjusted such as, for example, by providing for the extent of protrusion of output shaft 116, to be adjustable, providing for the position of cylinder 114 to be adjustable relative to bracket 120, providing for the bracket to be adjustable, or in any other suitable manner. Fluid under pressure is delivered to cylinder 114 at all times during compressor operation whereby output shaft 116 remains in its extending disposition and retainer 66 is maintained in the broken line position thereof. When the compressor is shut down and unloaded, the fluid pressure to cylinder 114 is relieved, whereby accelerator return spring 112 biases the accelerator lever, rod 78 and retainer 66 to the engine idling or solid line positions thereof.

Presuming that compressor operation has been initiated and fluid under pressure is being delivered to cylinder 114 to displace lever 102 rod 78 and retainer 66 to the broken line positions thereof illustrated in FIG. 2, fluid at output pressure from the compressor is delivered through line 36 to pressure responsive sensing device 38. It will be appreciated that as the compressor operates the output pressure thereof will vary, whereby a variable pressure signal is delivered to sensing device 38 causing pivotal mechanical displacement component 40 to be pivoted in opposite directions about its pivot axis. It will be further appreciated, that in response to a decrease in compressor output pressure an increase in engine speed is required to increase the speed at which the compressor is driven, thus to raise the output pressure. Likewise, when the compressor is delivering its maximum output pressure a decrease in engine speed is required to prevent overdriving the compressor. In the embodiment illustrated, an increase in the compressor output pressure results in an increase in the pressure signal delivered to sensing device 38 causing a pressure responsive component 38a thereof in exert a force against end 40a of arm 40 to bias arm 40 to pivot about pin 48, whereby outer end 40b thereof moves away from support arm 60 and pulls cable 54 to displace sleeve 86 to the left in FIG. 2 against the bias of spring 88. Movement of sleeve 86 to the left pivots throttle valve arm 20 and thus throttle valve 18 counterclockwise to reduce the engine speed. A decrease in the compressor output pressure results in a decrease in the pressure signal delivered to sensing device 38, whereby the force of component 38a is removed from end 40a of arm 40s forcing arm 40 to pivot about pin 48 in the direction to move arm end 40b toward support arm 60. Pivotal movement of arm 40 in the latter manner results from the bias of spring 88 on retainer 66 against sleeve 86 to which cable 54 is attached. Moreover, the bias of spring 88 moves sleeve 86 to the right in FIG. 2 from its solid line position toward wall 70 of the retainer whereby throttle valve arm 29 is pivoted clockwise to open the throttle valve and increase the engine speed. The spring bias against
sleeve 86 pulls cable 54 within casing 52 to pivot arm 40 in the manner mentioned above. As mentioned hereinabove, the maximum speed at which the engine can run is limited by engagement of sleeve 86 with stop wall 70. It will be appreciated that during compressor operation the output pressure of the compressor will vary up and down and that the flexible actuator cable will be pulled longitudinally back and forth in casing 52 to impart pivotal movement to throttle valve arm 20 and thus the throttle valve to control the engine speed in accordance with the compressor output pressure. It will be noted that in the preferred embodiment the opposite ends of cable 54 are always pulled either by arm 40 or spring 88 and are never pushed.

In the embodiment hereinabove described, the flexible actuator assembly including retainer 66 is interconnected with the vehicle accelerator linkage through rod 78, and the accelerator linkage is employed in the positioning and retention of retainer 66 in the maximum engine speed setting thereof during compressor operation. It will be appreciated, however, that the flexible actuator assembly does not have to be so interrelated with the accelerator linkage. In this respect, end 78a of rod 78 could be extended to project through an opening therefor in fire wall 106 and could be provided on the end thereof projecting through the fire wall with an operating knob, or the like, manually actuable to position the retainer in the maximum engine speed setting thereof. Suitable means would be provided, of course, to releasably hold the rod in the set position. For example, a notch or the like could be provided in the side of rod 78 to engage the peripheral edge of the opening therefor in wall 106 to retain the rod and thus retainer 66 in the desired position during compressor operation. Upon release of the rod from the set position the rod would be free to reciprocate relative to the fire wall during road operation of the truck. A separate accelerator rod would extend between accelerator lever 102 and throttle valve arm 20 to provide for operation of the throttle valve during road operation of the vehicle.

As a further example, the end of rod 78 could be provided with a laterally projecting plate or the like supported in alignment with the output shaft of the attached cylinder so that displacement of the output shaft of its extended disposition would impart the required longitudinal movement of rod 78 to position retainer 66. In this instance too a separate accelerator rod would be interconnected between accelerator lever 102 and throttle valve arm 20. As yet a further example, retainer 66 could be provided with a short rod extending there-through to guide sleeve 86 and spring 88, or other suitable guide and spring biasing arrangements could be provided for the retainer. The retainer could then be releasably attached to the carburetor or engine by a bracket or the like which would position the retainer in the maximum engine speed position thereof. With the latter arrangement an elongated support rod such as rod 78 and manually or fluid cylinder operated positioning means would not be required. Such an arrangement would require that the retainer be released from the carburetor or engine or disconnected from the throttle valve arm when the engine is to be operated to drive the vehicle but it remains that the flexible actuator components would function to provide engine speed control in accordance with the present invention with such an arrangement. It will be further appreciated that while it is preferred to bias sleeve 86 and throttle arm 20 in a direction to open the throttle by means of a coil spring associated with retainer 66, such bias could be achieved by spring means associated with mechanical displacement arm 40 of sensing device 38. In this respect, suitable spring means could be provided on either side of end 40b of the arm to bias the arm to pivot about its axis in the direction to move arm end 40b away from support arm 60. Such bias for arm 40 could also be provided in association with end 40a thereof. It is to be noted further that the fluid motor associated with accelerator lever 102 in the above embodiment or with a rod separate from the accelerator as described above could be cooperatively associated with the lever or rod to exert a pulling force thereon as opposed to a pushing force.

Versatility provided for by the flexible actuator arrangement of the present invention is further demonstrated by the embodiment illustrated in FIG. 5 of the drawing wherein components corresponding to those of the foregoing embodiment are designated by like numerals. In this embodiment an engine 130 is provided with a carburetor 132 having a throttle valve 134 connected to a pivotal throttle arm 136 disposed externally of the carburetor. In this instance, the throttle arm and valve arrangement is such that counterclockwise pivotal movement thereof is required to open the throttle. Further, the accelerator linkage in this embodiment includes an accelerator lever 138 mounted by means such as a pin 140 for pivotal movement counterclockwise about the pin in response to depression of accelerator pedal 142. Retainer component 66 is mounted on a rod 78 in a manner described hereinabove and the other end of rod 78 is interconnected with accelerator lever 138. An accelerator return spring 144 biases lever 138 to pivot counterclockwise about pin 140. Sleeve 86 is associated with retainer 66 and rod 78 is interconnected with throttle valve arm 136 in a manner similar to that described hereinabove with regard to throttle arm 20. Rod 78 must be displaced to the left to set the retainer for maximum engine speed and the throttle valve arm must be pivoted counterclockwise to open throttle valve 134. Preferably, flexible actuator cable 54 is interconnected with sleeve 86 and arm 40 of the sensing device in a manner whereby displacements of arm 40 of the sensing device 38 and the bias of spring 88 against sleeve 86 pull cable 54 in longitudinally opposite directions to impart the proper directional movement of the throttle valve arm during compressor operation. To achieve the desired operational relationship in the present embodiment, sensing device 38 and flexible cable assembly 50 are positioned on the same side of carburetor 132 as the accelerator linkage. The flexible actuator cable advantageously provides for this to be readily achieved in that the sensing device 38 can be selectively positioned relative to the carburetor to suit the circumstances since operating alignment between arm 40 and throttle valve arm 136 is not required. Accordingly, in this embodiment sensing device 38 is suitably mounted on a support separate from the engine such as might be defined by fire wall 146 of the vehicle. In a manner similar to that described hereinabove with regard to the embodiment illustrated in FIG. 2, pivotal movement of end 40b of arm 40 by sensing device 38 in the direction away from support arm 60 pulls cable 54 to displace sleeve 86 along rod 78 against the bias of spring 88 to impart clockwise pivotal movement to throttle valve arm 136 to close the throttle valve and
reduce engine speed. When the force exerted on arm 40 by sensing device 38 is relieved, the bias of spring 88 displaces sleeve 86 toward retainer wall 70, whereby cable 54 is pulled to move outer end 40b of arm 40 toward support arm 60 and to cause counterclockwise pivotal movement of throttle valve arm 136 to open the throttle valve and increase engine speed.

Displacement of retainer 66 to the maximum engine speed setting therefor and retention of the retainer in this position is provided for by fluid motor 114 which, in the present embodiment, operates when output shaft 116 is extended to pivot accelerator lever 138 counterclockwise about pin 140 to position lever 138 and retainer 66 in the broken line positions thereof illustrated in FIG. 5. Operation of the air cylinder to set the retainer of the actuator assembly during compressor operation is similar to that described hereinabove with regard to the embodiment illustrated in FIG. 2. Further, the modifications pointed out hereinabove in conjunction with the earlier described embodiment are applicable to the embodiment illustrated in FIG. 5. It will be appreciated that road operation of the vehicle can be achieved without disturbing the actuator assembly and without interference therefrom in that the flexible cable will readily flex back and forth in response to movements of the accelerator linkage of the vehicle.

The above description has been placed herein on the fact that the compressor output pressure responsive device receives fluid at output pressure from the compressor, it will be appreciated that the fluid signal to the sensing device could be at a pressure directly proportional to output pressure. Further, it will be appreciated that the mechanical displacement output of the sensing device could be other than through a pivotal component, and that in the embodiments described the pivotal arm could be actuated in a manner whereby pivotal movement of the outer end thereof toward the support arm for the cable assembly would close the throttle valve rather than open the valve.

As many possible embodiments of the present invention may be made and as many possible changes may be made in the embodiments herein described, it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the present invention and not as a limitation.

I claim:

1. In a fluid compressor drive system including a fluid compressor and an engine coupled therewith for driving the compressor, the engine having a variably positionable throttle valve and an actuating arm by which said valve is displaceable in engine speed increasing and decreasing directions, and control means between the compressor and throttle valve for varying the position of the valve and thus the engine speed in accordance with compressor output pressure, said control means including means to sense a compressor pressure, a variably positionable component the position of which is determined by the sensed pressure, and means coupling said component with said actuating arm of said valve for said valve to assume a position determined by the position of said component, the improvement comprising: said coupling means including longitudinally flexible actuator means having opposite ends, one of said ends being connected to said component, a coupling element interconnecting the other of said ends to said actuating arm, stop means, means for selectively positioning and supporting said stop means in fixed position relative to said throttle valve for engagement by said coupling element to limit displacement of said throttle valve in said direction which increases engine speed.

2. The improvement according to claim 1, wherein said means supporting said stop means includes a rod having opposite ends, one of said opposite ends of said rod being connected to said stop means, and means supporting the other of said opposite ends of said rod for longitudinal movement of said rod relative to said throttle valve to selectively position said stop means relative to said throttle valve.

3. The improvement according to claim 2, wherein said stop means is a stop wall at one end of a flexible actuator element having spaced apart opposite ends, said coupling element being movable between said opposite ends of said retainer element, spring means between said coupling element and the other of said opposite ends of said retainer element biasing said coupling element toward said stop wall.

4. The improvement according to claim 2, and fluid pressure actuated motor means adjacent the other of said ends of said rod operable to longitudinally displace said rod to position said stop means relative to said throttle valve.

5. The improvement according to claim 3, and fluid pressure actuated motor means adjacent the other of said ends of said rod operable to longitudinally displace said rod to position said stop means relative to said throttle valve.

6. The improvement according to claim 5, and means providing for the extent of longitudinal displacement of said rod by said motor means to be adjustable.

7. In a fluid compressor drive system including a fluid compressor and an engine coupled therewith for driving the compressor, the engine having variably positionable speed control means displaceable in engine speed increasing and decreasing directions, and control means between the compressor and engine speed control means for varying the engine speed in accordance with compressor output pressure, said control means including means to sense a compressor pressure, a variably positionable component the position of which is determined by the sensed pressure, and means coupling said component with said engine speed control means for said engine speed control means to assume a position determined by the position of said component, the improvement comprising: said coupling means including longitudinally flexible actuator means having opposite ends connected one to said component and the other to said speed control means, means for limiting the displacement of said speed control means in the direction thereof which increases engine speed, said speed control means being a throttle valve having a pivotal actuating arm, means including sleeve means interconnecting the other of said ends of said flexible actuator means with said arm, said limiting means including stop means, means supporting said stop means in substantially fixed position relative to said throttle valve, and said stop means being engageable by said sleeve means to limit displacement of said throttle valve in said direction which increases engine speed, said means supporting said stop means including a rod having opposite ends, one of said opposite ends of said rod being connected to said stop means, and means supporting the other of said opposite ends of said rod for longitudinal movement of said rod relative to said throttle valve, said stop means being a stop wall at one end of a re-
tainer element having spaced apart opposite ends, said sleeve means being movable between said opposite ends of said retainer element, spring means between said sleeve means and the other of said opposite ends of said retainer element biasing said sleeve means toward said stop wall, and said retainer element having a wall at said other end thereof, said wall and stop wall being apertured to receive said one end of said rod, said sleeve means being apertured to receive said rod and being slidable therealong between said wall and stop wall, and said spring means being a coil spring sur-rounding said rod and between said wall and sleeve means.

8. The improvement according to claim 7, and fluid pressure actuated motor means adjacent the other of said ends of said rod operable to longitudinally displace said rod to position said retainer element relative to said throttle valve, and means providing for the extent of longitudinal displacement of said rod by said motor means to be adjustable.