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CHAIN SAW

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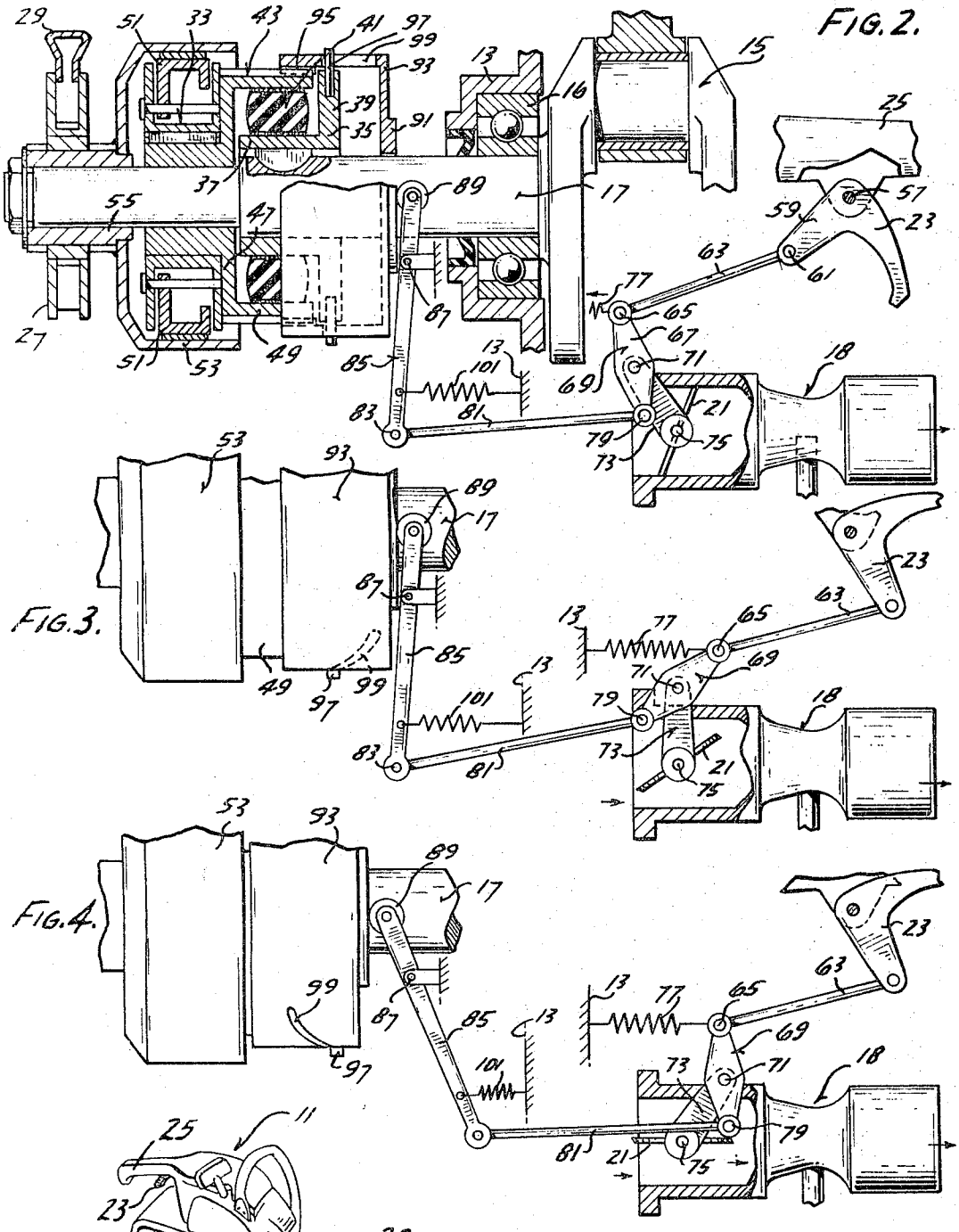

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 1.

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CHAIN SAW

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The invention relates generally to throttle controls. More particularly, the invention relates to throttle controls for power operated devices such as chain saws and the like.

The invention provides a drive for delivering power from an engine to a driven member, which drive includes a member subject to resilient flexure or deflection in accordance with the loading on the driven member, thereby absorbing shock imposed on the driven member. The drive constitutes a part of means controlling the supply of energy to the engine in accordance with the load imposed on the driven member.

In the disclosed construction, the drive is specifically applied to a chain saw and the rate of energy supplied to the engine is increased and decreased in accordance with the state of flexure of the resilient member.

The invention also makes provision for cooperative control of the rate of energy supplied to the engine in response to the operation of a manual or other control and in response to the load imposed on the driven member. Specifically, in the disclosed construction, there is provided a manual control operable to vary the setting of a carburetor throttle valve between a closed position and a partially open position. In addition, there is provided a linkage operable in response to flexure of a resilient drive member to increase and decrease the setting of the throttle above the setting provided by the manual control. The resulting structure performs better than an air governor, is simpler than a centrifugal governor, and is operable without regard to the attitude or spacial orientation of the structure.

Other objects and advantages of the invention will become known by reference to the following description and the accompanying drawings in which:

FIGURE 1 is a perspective view of one embodiment of a chain saw incorporating various of the features of the invention;

FIGURE 2 is a partially diagrammatic view, partially broken away in section of various components of the saw shown in FIGURE 1, the components being shown with the driving member under no load and with the manual control in its closed setting;

FIGURE 3 is a view similar to FIGURE 2 showing the components when the driven member is not under load and the manual control is in position partially opening the throttle; and

FIGURE 4 is a view similar to FIGURES 2 and 3 showing the components when the driven sprocket is under load and the manual control is in its position partially opening the throttle.

The drawings are illustrative of a single embodiment of the invention. Shown therein is a chain saw **11** including a frame **13** supporting a prime mover which is in the form of an internal combustion engine **15** (shown fragmentarily in FIGURE 2) including bearing means **16** rotatably mounting an output or drive shaft or member **17**. Also shown is an energy supply control means in the form of a carburetor **18** having a pivotally mounted throttle valve **21**. The chain saw **11** also includes a throttle control in the form of a manually operated actuator or trigger **23** which is pivotally carried on a handle **25** supported by the chain saw frame **13** and which is movable between a closed throttle position and an open throttle position (as will be explained hereinafter, the open throttle position of the trigger **23** is only effective to partially open the throttle valve **21**).

While the invention is not so limited, in the disclosed construction, the engine powers a drive member which is in the form of a chain sprocket **27** and which is rotatably mounted by suitable means carried coaxially on the crankshaft **17**. The sprocket **27** could, however, be rotatably mounted independent of the crankshaft. Trained around the chain sprocket **27** is a saw chain **29**.

In accordance with the invention, means are provided for drivingly connecting the driven member or chain sprocket **29** with the driving member or crankshaft **17**. Such means includes a resiliently flexible connecting member which transmits power between the crankshaft **17** and the sprocket **29**, and which can take various forms. In the specifically disclosed construction, such means also includes a centrifugal clutch **33**.

More specifically, keyed to the crankshaft **17** is a ring or member **35** having a hub **37** and a flange **39**. Bonded to the hub **37** is the inner surface of an annular member or ring **41** of resiliently flexible rubber or rubber-like material. Bonded to the outer surface of the flexible ring **41** is the driving part **43** of the centrifugal clutch **33**.

More specifically, the driving part **43** is rotatably mounted on the crankshaft **17** and includes a flange **47** and an annular collar **49** which extends from the flange **47** and is bonded to the outer surface of the flexible ring **41**. The clutch **33** also conventionally includes a pair of weights **51** which are carried by the driving part **43** for engagement with a drum part **53** in response to attainment by the driving part **43** of a predetermined rotational speed. In the disclosed construction, the drum part **53** includes a hub **55** which is rotatably mounted on the crankshaft **17** and which non-rotatably supports the chain sprocket **27**.

Accordingly, when the crankshaft **17** is driven by the engine **15**, the clutch driving part **43** will be driven through the flexible ring **41**. Consequent to rotation of the driving part **43**, the drum part **53** will be engaged by the weights **51** to effect driving of the chain sprocket **27**. When the chain **29** carried by the sprocket is placed under a cutting load, the resilient ring **41** will deflect to afford absorption of any shocks encountered by the chain **29** and to afford angular displacement of the driven part **43** relative to the ring member **35** in the direction opposite to the direction of crankshaft rotation.

In accordance with the invention, there is also provided means or linkage which is sensitive to the state of flexure of the ring **41** and which is operative to afford regulation of energy supplied to the engine by controlling the throttle valve **21**. Moreover, and also in accordance with the invention, there is provided means, including the manually operable trigger **23**, for affording regulation of energy supplied to the engine in cooperation with the throttle valve control afforded by said load responsive linkage.

More specifically, in accordance with the invention, the trigger **23** is operable to displace the throttle valve **21** between a closed and a partially opened position. Also in accordance with the invention, the throttle valve **21** can be advanced in response to deflection or flexure of the ring **41** from the setting afforded by the trigger **23**. In the event the throttle valve is set as far open as possible by the trigger **23**, about one-half full throttle in the disclosed construction, the throttle valve **21** can be advanced to a fully opened position in response to deflection of the annular ring **41**.

While various arrangements can be employed in the disclosed construction, the means for controlling the throttle valve **21** comprises an operating linkage which is connected to the trigger **23** and to both the collar **49** and to the flange **39**. Specifically, the trigger **23** comprises a bellcrank lever which is mounted intermediate its legs for rotation about a pivot **57**. Connected to one end of the

bellcrank lever leg 59 about a pivot 61 is a rod or link 63. At its other end, the rod or link is connected about a pivot 65 to one end 67 of a double ended arm 69. Intermediate its ends, the arm 69 is rotatably mounted on a pivot 71 connected to one end of a lever 73. At its other end, the lever 73 is fixed to a rock-shaft 75 which carries the throttle valve 21.

Means are provided for urging the trigger 23 to its closed position which is effective to displace the throttle valve 21 toward its closed position. In the disclosed construction, such means is in the form of a spring 77 which is anchored, at one end, to the frame 13 and which, at its other end, is connected to the end 67 of the arm 69.

Connected to the other end of the arm 69 about a pivot 79 is an actuating link 81. At its other end, the link 81 is connected about a pivot 83 to a double lever 85 which is supported, intermediate its ends, about a pivot 87 mounted by the frame 13. At its other end, the lever 85 carries a roller 89 which is engageable with an end face 91 of a drum or sleeve 93 which is non-rotatably engaged on and telescopically related to, the collar 49. Specifically, the sleeve 93 and the collar 49 include one or more mating grooves or splined connections 95 affording displacement of the sleeve axially of the crankshaft 17 while affording rotation of the sleeve 93 with the collar 49.

Means are provided for axially displacing the sleeve 93 in accordance with relative angular displacement between the ring or member 35 and the driving part 43 of the clutch 33 accompanying deflection of the flexible ring 41. Such means is in the form of one or more pins 97 extending radially from the flange 39 of the member 35, which pins are in engagement with associated spiral slots 99 in the sleeve 93.

Means are provided for the dual purpose of maintaining engagement of the roller 89 with the face 91 of the sleeve 93 and for thereby releasably locating the pivot 79 so as to act as a flucrum for swinging movement of the arm 69 in response to movement of the trigger 23. In the disclosed construction, such means is in the form of a spring 101 which is connected at one end to the frame 13 and which, at its other end, is connected to the lower end of the lever 85 to urge the lever in the counter-clockwise direction as seen in the drawings.

In operation, assuming the absence of any load on the chain sprocket 27, movement of the trigger 23 in the counter-clockwise direction from its closed position shifts the link 63 to the right as seen in the drawings and against the action of the spring 77, thereby rocking the arm 69 in the clockwise direction about the pivot 79 and thereby also rocking the lever 73 in the clockwise direction to displace the throttle valve 21 from a closed position (FIGURE 2) to a partially open position (FIGURE 3). Release of the trigger 23 causes return of the components to the position shown in FIGURE 2 in response to the action of the spring 77.

If the chain saw 11, now operated at partial throttle, is applied to the cutting of wood, thereby applying a load on the chain sprocket 27, the driving part 43 of the clutch 33 and the telescopically engaged sleevve 93 are rotated relative to the member 35 in the direction counter to the direction of crankshaft movement, due to the flexibility of the ring 41. Such relative movement between the flange 39 and the sleeve 93 causes displacement of the sleeve to the left as seen in the drawings due to interaction of the pins 97 and spiral slots 99.

Such movement of the sleeve 93 to the left affords rocking movably the lever 85 in the counter-clockwise direction under the influence of the spring 101, thereby shifting the rod 81 to the right, so as to rock the arm 69 in the counter-clockwise direction about the pivot 65, and thereby rocking the lever 73 further in the clockwise direction to displace the throttle valve 21 toward its fully open position. Removal of the load on the sprocket 27 will result in return of the throttle valve 21 to the position afforded by operation of the trigger 23. The amount of throttle advancement beyond the setting afforded by the trigger 23 is proportional to the load encountered by the sprocket 27.

Various of the features of the invention are set forth in the following claims.

What is claimed is:

1. The combination of an engine having energy supply control means, a first member rotatably driven by said engine, a second member mounted for rotation, a resilient member drivingly connecting said first and second members for transmission of power between said first and second members, and subject to flexure in response to said transmission, and means connected to said energy supply control means and sensitive to flexure of said resilient member to operate said energy supply control means in response to flexure of said resilient member.

2. The combination of an engine having energy supply control means, a first member rotatably driven by said engine, a second member mounted for rotation, a resilient member drivingly connecting said first and second members for transmission of power between said first and second members, and subject to flexure in response to said transmission, and means connected to said energy supply control means and sensitive to the flexure of said resilient member to increase and decrease the rate of energy supply afforded to said engine by said control means in respective accordance with flexure of said resilient member occurring in response to increasing and decreasing load on said driven member.

3. The combination of an engine having energy supply control means and a manually operable actuator, a first member rotatably driven by said engine, a second member mounted for rotation, a resilient member drivingly connecting said first and second members for transmission of power between said first and second members, said resilient member being subject to flexure in response to said transmission, and means connected to said resilient member, to said actuator, to said energy supply control means, and sensitive to flexure of said resilient member and to operation of said actuator for operating said energy supply control means in response to the flexure of said resilient member and the operation of said actuator.

4. The combination of a chain saw engine having a crankshaft and energy suppply control means, a chain sprocket, means on said engine rotatably mounting said chain sprocket, means drivingly connecting said crankshaft and said chain sprocket including a resilient member subject to flexure, and means connected to said energy supply control means and sensitive to flexure of said resilient member to increase and decrease the rate of energy supply afforded to said engine by said control means in accordance with flexure of said resilient member occurring in response to increasing and decreasing load on said chain sprocket.

5. The combination of a chain saw engine having a crankshaft and a carburetor having a throttle valve movable between open and closed positions, a manual control connected to said throttle valve for displacing said throttle valve between said closed position and a partially opened position, a chain sprocket, means on said engine rotatably mounting said chain sprocket, means drivingly connecting said crankshaft and said chain sprocket including a resiliently flexible member, and means operable by said flexible member and connected to said throttle valve for opening said throttle valve in response to the flexible of said flexible member.

6. The combination of a chain saw engine having a crankshaft and a carburetor having a throttle valve movable between open and closed positions, a manual control connected to said throttle valve for displacing said throttle valve between said closed position and a partially opened position, a chain sprocket rotatably mounted on said crankshaft, means drivingly connecting said crankshaft and said chain sprocket including a centrifugal clutch having driving and driven parts, a member keyed to said

crankshaft, and a resiliently flexible ring fixed to said member and said driving clutch part, and means operable by said flexible ring and connected to said throttle valve for displacing said throttle valve between said partially open position and said open position in response to flexure of said resiliently flexible ring, said valve displacing means including a sleeve, means telescopically connecting said sleeve and said driving clutch part to afford displacement therebetween axially of said crankshaft and common rotation, and interacting means connecting said sleeve and said member for displacing said sleeve axially of said crankshaft in response to angular displacement between said driving clutch part and said member accompanying flexure of said resiliently flexible ring.

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