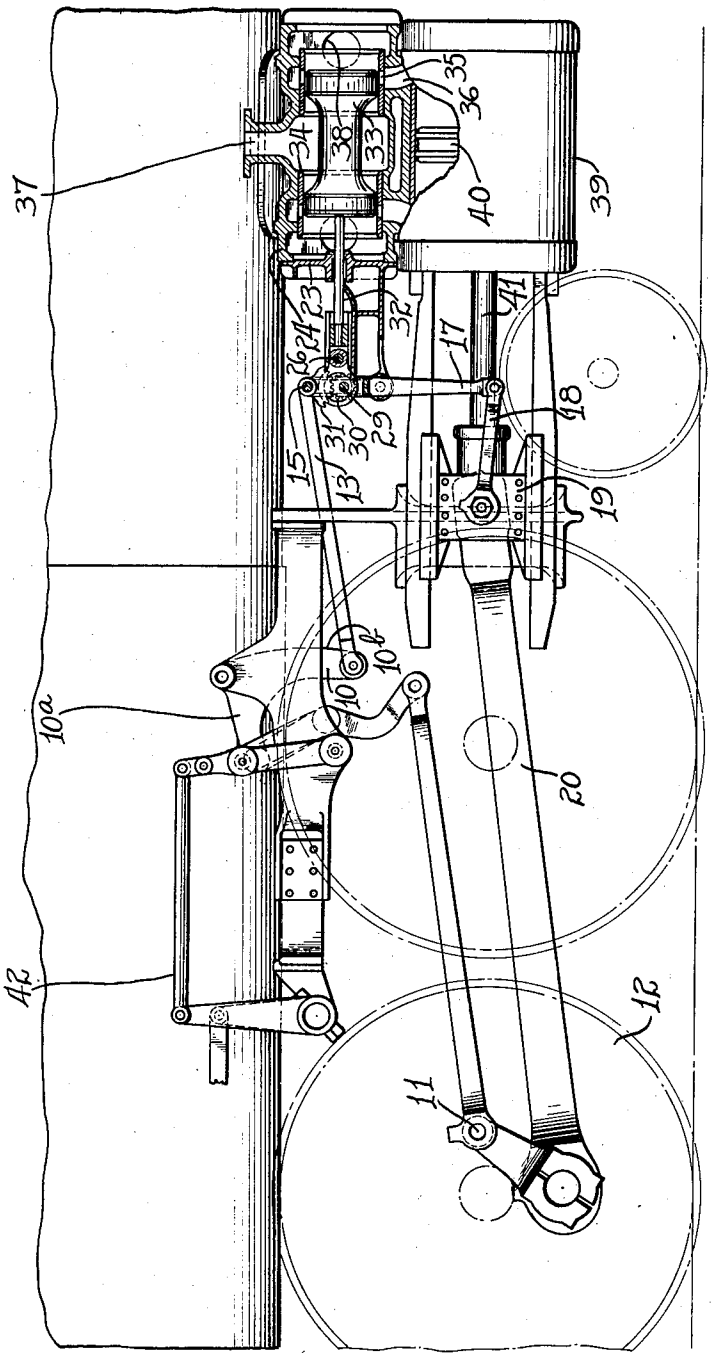
June 1, 1937. A. D. BAKER 2,082,092

AUXILIARY GEAR MECHANISM

Filed March 14, 1935 3 Sheets-Sheet 1

FIG. 1



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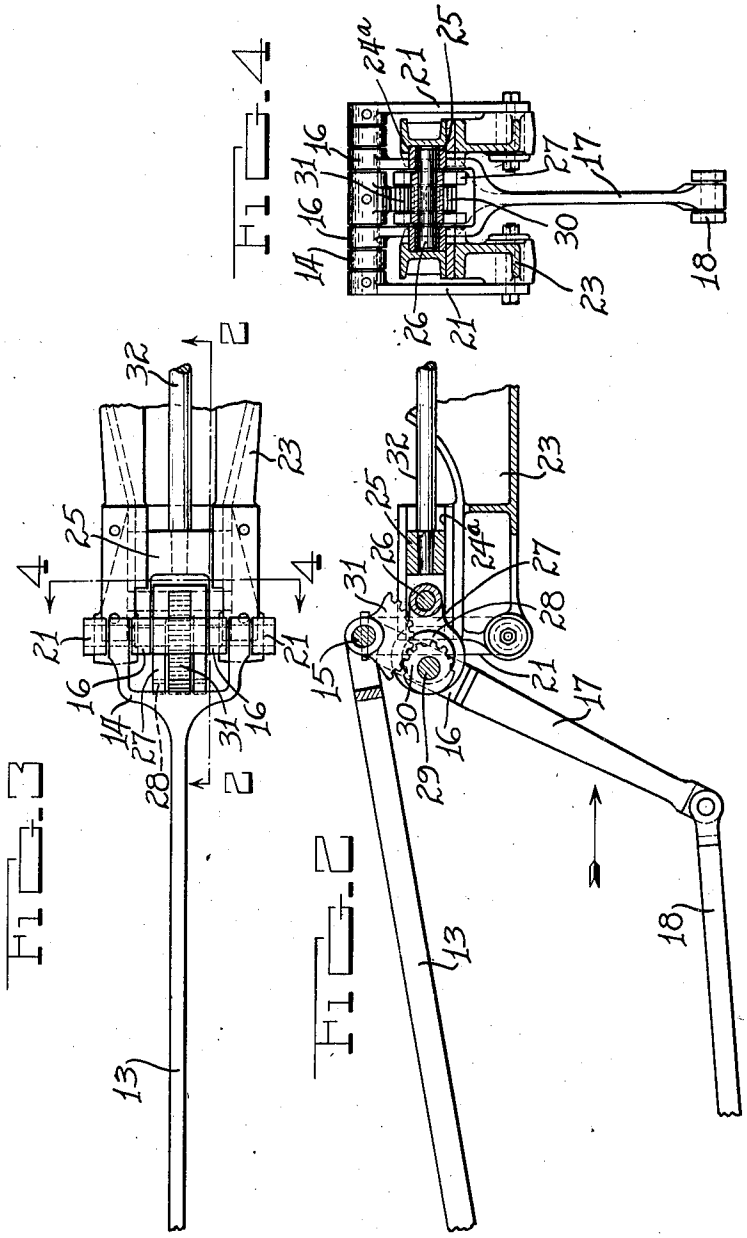
Filed March 14, 1935 3 Sheets-Sheet 2



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AUXILIARY GEAR MECHANISM

Filed March 14, 1935 3 Sheets-Sheet 3

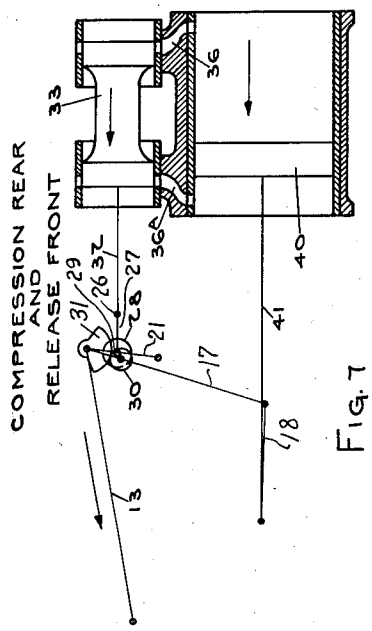

FIG. 7

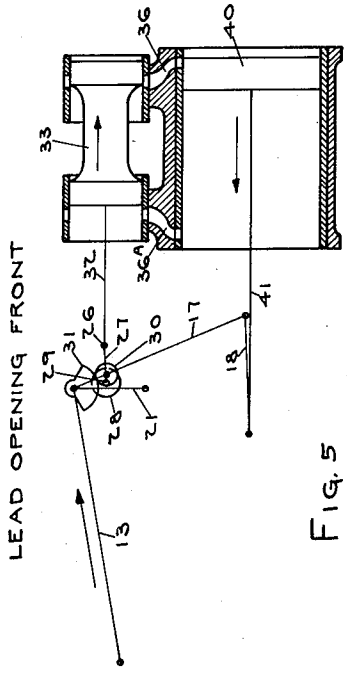

FIG. 5

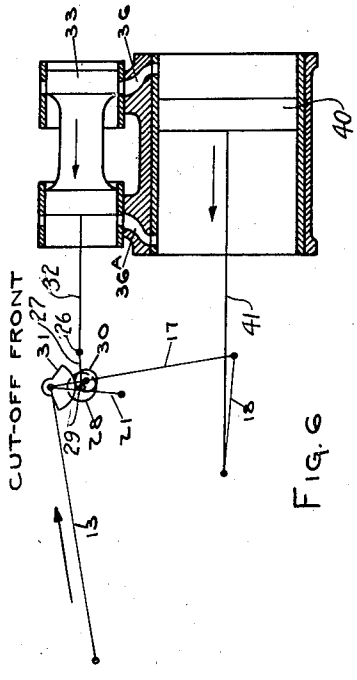

FIG. 6

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UNITED STATES PATENT OFFICE

2,082,092

AUXILIARY GEAR MECHANISM

Abner D. Baker, Swanton, Ohio

Application March 14, 1935, Serial No. 11,102

8 Claims. (Cl. 121—163)

This invention relates to reciprocable piston engines of the expansible fluid type, such as steam driven locomotives, but more particularly to valve gear mechanisms for engines of this character, and an object is to produce a simple and improved auxiliary valve gear mechanism which operates to retard movement of the steam valve as soon as a volume of steam is supplied to the main cylinder sufficient to drive the piston by its expansive properties in one direction or the other, and accelerate the movement of the steam valve at the opposite ends of its movement during the movement of the valve from lead position to full steam port opening before reaching the cut-off position and also during movement of the valve from the point of release to the end of the stroke.

Other objects are to produce an actuating mechanism having the novel features of construction, arrangement and operation hereinafter described, and, for purposes of illustration, an embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a side elevation partly in vertical section of a valve gear arrangement, valve chest and associated parts, showing the valve gear in neutral position with the piston at mid-stroke;

Figure 2 is an enlarged vertical sectional elevation of the auxiliary valve gear mechanism taken substantially on the line 2—2 of Figure 3 showing the parts in the positions assumed when the piston is in rear dead center position;

Figure 3 is a top plan view of the parts shown in Figure 2;

Figure 4 is a transverse sectional view on the line 4—4 of Figure 3;

Figures 5, 6 and 7 are diagrammatic views showing the position of the parts at the points of lead, cut-off, release and compression respectively, with the valve gear adjusted to approximately 25 percent forward motion cut-off.

In the illustrated embodiment of the invention a valve gear is shown for imparting reciprocatory movements to the steam admission and exhaust valve of an engine, and only sufficient illustration is given to enable those skilled in this art readily to understand the invention. Although the auxiliary valve gear mechanism hereinafter described can be used in conjunction with any well known mechanism, the Baker valve gear is shown having a bell crank 10, provided with a horizontal arm 10^a, which derives its oscillatory movement through a system of links and levers from an eccentric pin 11 on a driven wheel 12 of the locomotive.

To the lower end of the vertical arm 10^b of the bell crank 10 is pivoted a valve rod 13, which inclines forwardly and upwardly, the forward end being bifurcated, as indicated at 14, and pivotally mounted on a pin 15. Pivoted to the forward end 14 of the valve rod on the pin 15 is the bifurcated upper end 16 of a vertically disposed combination lever 17. Pivotally connected to the lower end of the combination lever 17 is a union link 18, which is connected in the usual manner to the main crosshead 19 of the engine. The main crosshead is connected to the driven wheel 12 of the locomotive by the usual connecting rod 20.

The pin 15 is securely mounted to opposite ends in the upper ends of vertically disposed hangers 21. The lower ends of the hangers 21 are pivoted to opposite sides of a rear valve chamber head 23, which is secured in any suitable manner to the valve chest 24.

Formed in the head 23 is a valve stem crosshead guide 24^a, in which a valve stem crosshead 25 is reciprocable horizontally. Pivotally mounted on a pin 26 at the rear end portion of the valve stem crosshead 25 are a pair of straps 27, each apertured to receive an eccentric cam 28. The eccentric cams 28 are fixed to a pin 29, which is pivotally mounted at its opposite ends in the bifurcated upper end portion 16 of the combination lever. Fixed to central portions of the pin 29 and arranged between the eccentric cams 28 is a gear toothed sector 30. Secured to the pin 15 is a larger gear toothed sector 31, the teeth of which mesh with the teeth of the gear sector 30.

Secured to the valve stem crosshead 25 is a valve stem 32, which is connected at its forward end to a steam admission valve 33 of the spool type, which reciprocates in bushings 34 disposed within the valve chest 24. The bushings 34 are provided with steam ports 35, and the valve chest has the usual cylinder ports 36 at opposite ends thereof. Steam is admitted in the usual manner through a central admission passage 37 to the valve chest, and the exhaust steam passes through ports 38 in the opposite ends of the valve chest. Beneath the valve chest 24 is the main piston cylinder 39 in which a piston 40 is reciprocable. The piston 40 is connected by a piston rod 41 to the main crosshead 19.

The main valve gear mechanism of which the bell crank 10 forms a part imparts the port opening travel in the usual manner to the steam valve 33 through the above described connections, and the operation of this mechanism is controlled in the usual manner, through a system of links and

levers 42 leading to the cab for enabling the percentage of cut-off to be increased or diminished and the direction of movement of the locomotive to be controlled. Since this mechanism is old in the art, detail description thereof and of the operation is not considered necessary here.

It will be understood that the lap and lead movements for the steam valve 33 are obtained from movements imparted through the combination lever 17. The combination lever 17 and the main valve gear mechanism operate conjointly to impart the desired movement to the valve 33, but it is important in order to secure the greatest efficiency in the use of steam, that the movement of the valve 33 be accelerated at certain points in its travel as well as retarded at other points. Retardation of the valve movement is desired as soon as cut-off position is reached, or, in other words, as soon as the volume of steam supplied to the main cylinder 39 is sufficient to drive the piston by its expansive properties in one direction. Acceleration of the movement of the steam valve is desired during the ends of its travel, or, in other words, during movement of the valve from lead position to full steam port opening position before reaching the cut-off position and also during the movement of the valve from the point of release to the end of the stroke. It will also be understood by those skilled in this art that by slowing down the movement of the valve during the central portion of its stroke, the expansion period between the events of cut-off and release is lengthened. It also causes the event of compression to occur later in the stroke, inasmuch as it enables the piston 40 to travel a greater distance before the valve 33 operates to cover or uncover the cylinder ports 35.

In other words, it is desired that the movement of the steam valve be accelerated at the opposite ends of its travel and retarded during the intermediate portion of its travel. It will be seen from Figure 2 that when the combination lever 17 is in its back dead center position with the steam valve in its rear position, the eccentric cams 28 are in their reverse dead center so that turning movements thereof with respect to their respective straps 27 impart no appreciable movement to the latter. Consequently, as the combination lever swings forwardly the steam valve moves abruptly or speedily until the eccentric cams are swung by the sectors 31 and 30 in a counterclockwise direction sufficiently to hold back the valve 33, thereby to some extent compensating for the swinging movement of the combination lever 17.

Thus, the operation of the eccentric cams rocking in a direction opposite to the swinging movement of the combination lever, retards the movement of the valve. Retardation of the valve movement continues until the valve 33 approaches mid-position on its travel and from there to the end the movement is accelerated, whereupon the eccentric cams are on reverse dead center. At that point the full movement of the combination lever 17 is imparted to the valve 33, thereby accelerating its travel at the proper time. During swinging movement of the combination lever in each direction, it will be apparent that the valve 33 is first accelerated and then during the major portion of its travel is retarded.

Attention is also directed to the fact that speeding up or retarding the movement of the valve is aided by moving the axis of the eccentric cams 28, thereby shifting the fulcrum for the combination lever farther away from or closer to the pin 15. By moving the cam axis farther away from the pin 15 the leverage of the combination lever is reduced, thereby accelerating the valve movement toward either of its extreme positions from mid-position. It is further to be noted that as the cams 28 are rocked upwardly bringing their centers closer to the pins 15, the leverage of the combination lever 17 is increased so as to retard the movement of the valve 33 during the major portion of its travel. To that end, gradual changing of the position of the combination lever fulcrum cooperates with the action of the cams either to retard or accelerate the valve movement.

The operation of the above described mechanism will be more readily understood from an examination of Figures 5 to 7, which show the position of the parts at the points of lead, cutoff, release and compression respectively. In Figure 5 the parts are in lead position, steam being admitted to the forward end portion of the cylinder to drive the piston 40 to the left, the port 36 being uncovered to admit steam and the port 36a at the rear end of the cylinder being open to exhaust. It will be understood that the valve 33 travels a short distance forwardly in the direction of the arrow as the piston 40 starts its movement in the opposite direction. At this point it is desired to accelerate the movement of the valve 33 in order that the maximum amount of steam may be introduced to the cylinder by providing as full an opening as possible. Such acceleration is effected by the operation of the eccentric cam 28, which is swung by movement of the hangers 21 with which the gear sector 31 moves. It will be apparent that such movement of the gear sector 31 imparts clockwise movement to the smaller gear 30 with which the eccentric cam 28 moves. Because of the clockwise movement of the eccentric cam 28 it accelerates the movement of the valve 33 at this point.

After a sufficient amount of steam is admitted to the cylinder, the valve 33 operates to cut off further steam admission and, assuming that the main gear has been set for a 25 percent forward motion cut-off, such event will take place substantially as illustrated in Figure 6, in which the forward end of the valve 33 has completely closed the port 36, the port 36a serving as an exhaust port to release steam from the rear end of the cylinder. At this point it is desired that the movement of the valve 33 be retarded so that the full expansive properties of the steam, trapped in the front end of the cylinder, can be utilized. Such retardation of the valve movement is effected by the continued movement of the eccentric cam 28 in a clockwise direction, imposing a retrograde movement to the valve 33 which is being drawn to the left of Figure 6 or rearwardly of the engine. Such further clockwise movement of the eccentric cam 28 is caused by the more rapid swinging movement to the left of the figure of the combination lever 17 as compared to the movement of the valve rod 13 to the right as indicated by the arrow on Figure 6, so that the smaller gear 30 travels rearwardly relative to the sector 31.

In Figure 7 the parts are shown at the point of release in which the steam in front of the piston 40 is about to be released from the cylinder. It will be noted that the valve 33 is continuing its movement to the left of the figure. At this time the eccentric cam 28 is moving in a clockwise direction although, because of the position of the eccentric cam, its effectiveness with respect to the movement of the valve 33 is greatly reduced. The

event of compression is substantially the same as the event of release, it being understood that the further movement of the piston **40** to the left of Figure 7 will be cushioned by the steam which has been trapped therein. Thereafter the movement of the eccentric cam **28** is in counterclockwise direction, first imparting from lead position an abrupt or accelerated movement to the valve to the left of Figure 7 to full port opening position for admitting steam to the rear end of the cylinder in back of the piston **40** to drive it to the right of the figure.

According to this invention, an exceedingly long dwell followed by a very quick cut-off of the valve is effected. This enables the valve to be opened fully quickly and also to close quickly so that the supply and exhaust of steam are not wire-drawn during the period of flow through the ports. In other words, this invention provides for an alternately fast and slow operation of the valve during its stroke so as to accomplish a quick and complete opening of the admission port and maintain it in this fully open position up to a point very near the cut-off.

Changes in details of construction, arrangement and operation may be effected without departing from the spirit of the invention, especially as defined in the appended claims. It is to be noted that the invention is not intended to be confined to locomotives, inasmuch as other engines and mechanisms may be equipped advantageously with the above actuating mechanism.

What I claim as new and desire to secure by Letters Patent is:

1. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, and means including a rockable cam element providing a connection between said crosshead and said combination lever operable to reduce the effective movement of the combination lever during a portion of its travel, and to increase the effective movement thereof during another portion of its travel.

2. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, and means providing an operative connection between said crosshead and the upper end portion of said combination lever, said last means including a fulcrum for said combination lever, and gear means including a pair of gear members, one of which derives motion from the driven reciprocable member, to shift the effective position of said fulcrum at predetermined points during the movement of said combination lever.

3. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, and mechanism joining said crosshead to the upper end portion of said combination lever including means to impose retrograde movement relative to the movement of the crosshead, to the upper end portion of said combination lever thereby partially to compensate the swinging movement of the combination lever for reducing the valve movement.

4. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, and mechanism joining said crosshead to the upper end portion of said combination lever including means to impose retrograde movement relative to the movement of the crosshead, to the upper end portion of said combination lever thereby partially to compensate the swinging movement of the combination lever for reducing the valve movement, said last means providing a shifting fulcrum for said combination lever, and positive means for shifting said fulcrum at predetermined points in the swinging movement of said combination lever.

5. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, means providing a connection between said crosshead and the upper portion of said combination lever, said last means including an eccentric cam, and positive means actuated by said combination lever for rocking said cam in a direction opposite to the swinging movement of said combination lever.

6. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, a strap pivotally mounted at one end on said crosshead and apertured at the opposite end, a rotatable cam eccentrically mounted for rotation in the upper end portion of said combination lever, a pivotal mounting for the upper end of said combination lever, and positive means providing an operative connection between said pivotally mounted end and said eccentric cam for rocking same in a direction opposite to the direction of swinging movement of said combination lever.

7. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, a strap pivotally connected at one end to said crosshead and apertured at its opposite end, a rotatable cam disposed in the apertured end of said strap, a pin mounted on said combination lever and fixed to said cam and disposed eccentrically thereof, a gear member for actuating said pin, and a second gear member meshing with said first gear member and mounted for rocking movement with the

upper end portion of said combination lever thereby to rock said cam in a direction opposite to the swinging movement of said combination lever.

8. A valve gear mechanism for steam engines having a driven rotatable member, a driven reciprocable member, and a steam admission and exhaust valve, comprising a combination lever deriving motion at its lower end portion from said reciprocable member and at its upper end portion from said rotatable member, a reciprocable crosshead for said valve, a strap pivotally connected at one end to said crosshead and apertured at its opposite end, a rotatable cam disposed in the apertured end of said strap, a pin mounted on said combination lever and fixed to said cam and disposed eccentrically thereof, and means for actuating said cam during the swinging movement of the combination lever.

ABNER D. BAKER.