J. B. ALLFREE.

STEAM ENGINE OR THE LIKE.

APPLICATION FILED NOV. 28, 1908.

1,038,261.

Patented Sept. 10, 1912.

2 SHEETS—SHEET 1.

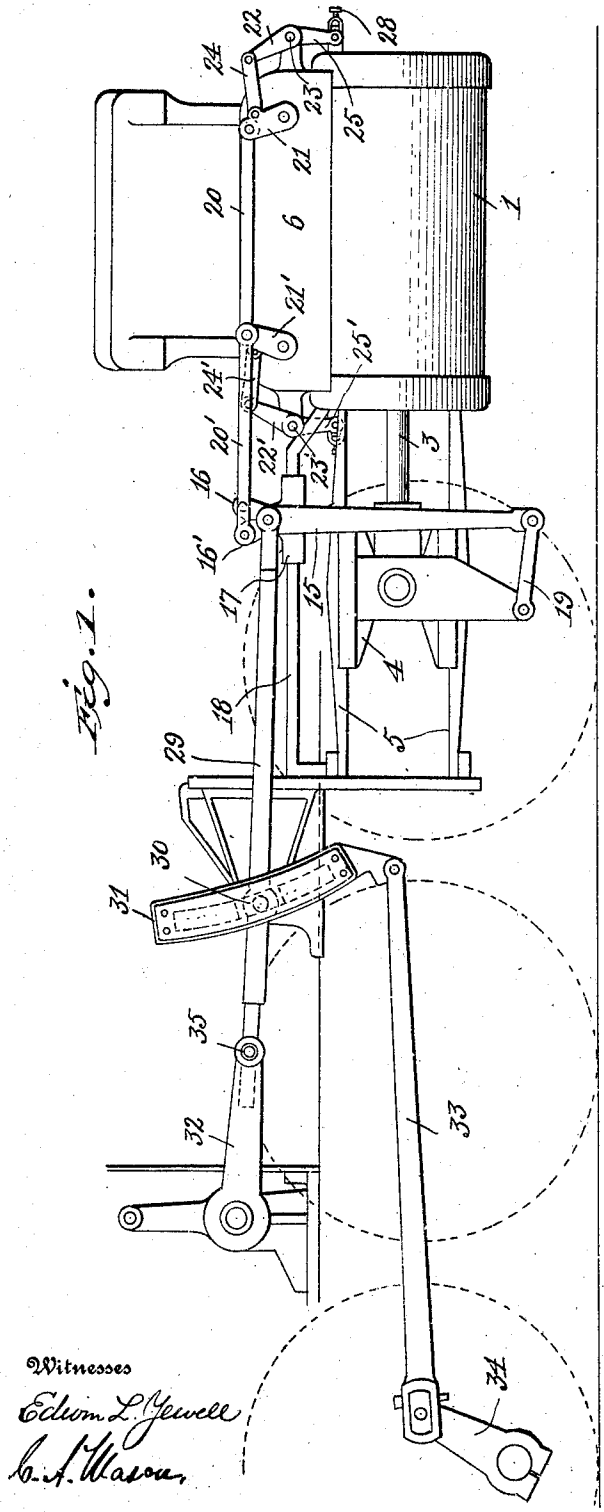

Fig. 1.

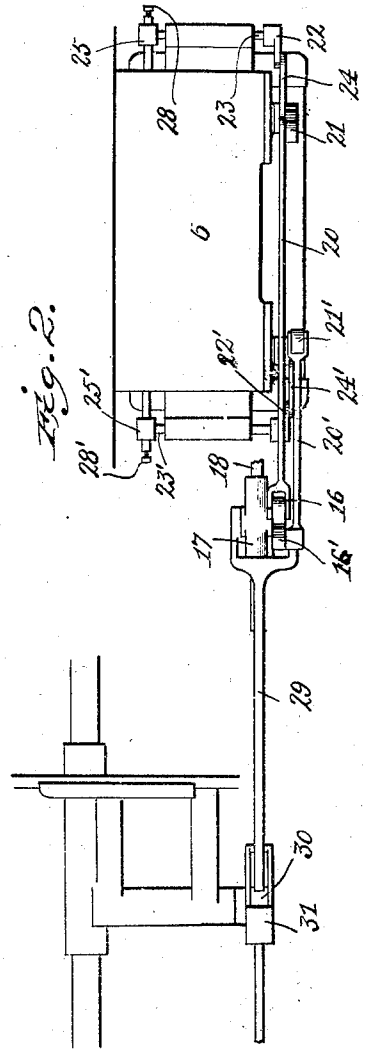

Fig. 2.

Witnesses

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2 SHEETS—SHEET 2.

Fig. 4.

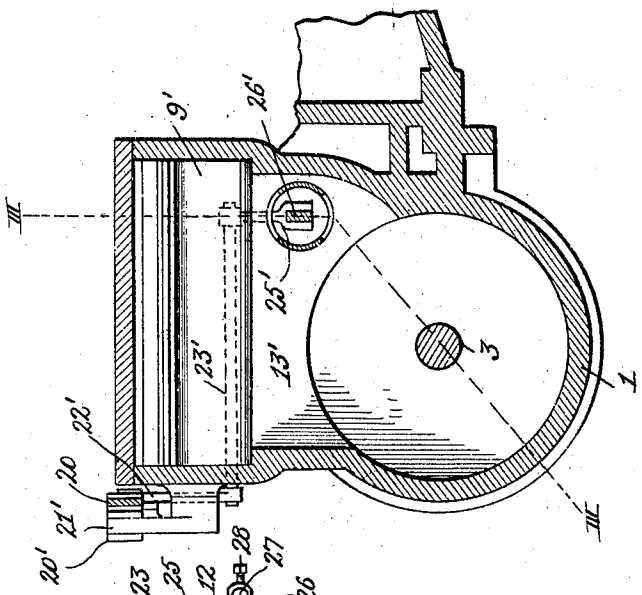
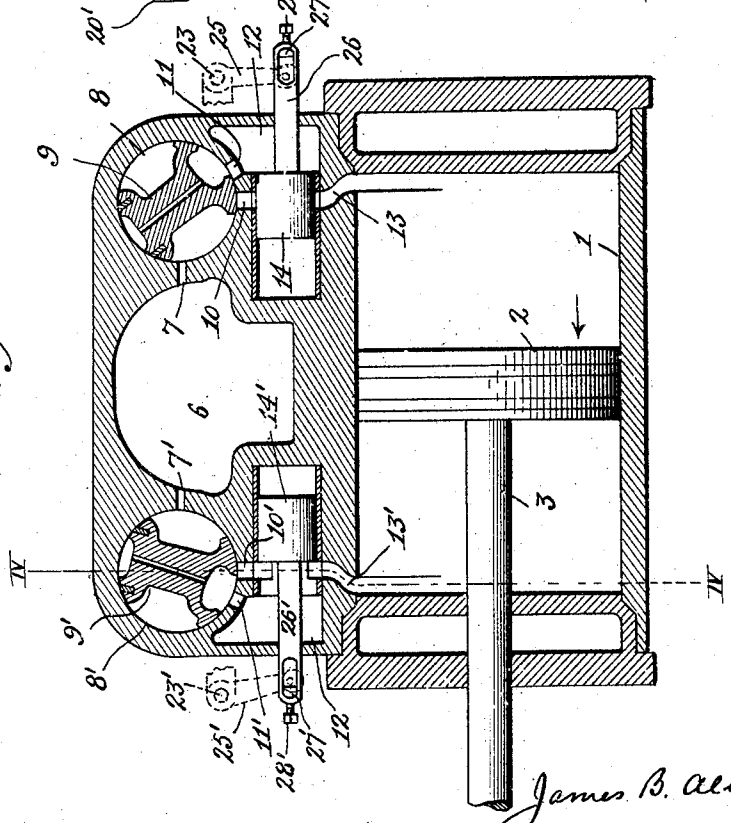


Fig. 3.



Witnesses

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STEAM-ENGINE OR THE LIKE.

1,038,261. Specification of Letters Patent. Patented Sept. 10, 1912.

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To all whom it may concern:

Be it known that I, JAMES B. ALLFREE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Engines or the Like, of which the following is a specification.

My invention relates to improvements in valves and valve gears for steam engines and is especially adapted for high speed and locomotive types.

The objects of my invention are:—first, to so construct and arrange a cylinder, steam chest, short live steam and exhaust ports with independent oscillating distribution valves and auxiliary exhaust ports with independent exhaust valves, in order to insure a most economical distribution and use of the live steam in the cylinder by having the "events" of the valves, or admission, cut-off, release, exhaust, and compression, give the greatest and most uniform mean effective pressure with relatively low terminal or back pressure for a given cut-off and with a minimum of clearance: second, to provide independent compression controlling or regulating valves which may be adjusted to open and exhaust simultaneously with or a little later than the oscillating valves, but made to close for compression much later than the oscillating or live steam distribution valves: third, to provide a steam distribution primarily for locomotives that will accomplish the above stated objects with the least number of parts and of such a construction and arrangement which practice has proven will best resist the hardships incident to locomotive service; while at the same time obtaining the greatest economy and increasing the tonnage capacity and speed of the locomotive: fourth, to provide an arrangement of valve gear in connection with the above referred to valves, in order to obtain the greatest degree of economy by reducing the clearance to a minimum, and a steam distribution that will not increase the slipping tendency of the driving wheels when used in connection with locomotives: fifth, to provide an arrangement of valves and valve gear which will give the piston the least retarded movement in its cylinder by cutting down the compression and delaying, as far as possible, the time of exhaust, or, in other words, to apply the power in such a way as to obtain the nearest approach to a continuous and uniform torque or turning movement: sixth, to insure against the irregular or jerking motion imparted to the driving wheels of a locomotive by providing against a too early release of the expanding steam and a too early compression of the expanded steam: seventh, to provide a construction of main valves, auxiliary exhaust or compression regulating valves, ports, and valve gear to permit the use of a minimum of clearance, thus avoiding one of the greatest sources of waste in steam engines, and at the same time obtain higher piston speed if desired: eighth, to provide a construction and arrangement which is cheaper to build, easier of access to repair, less expensive to maintain, and having all the strains on the valve gear in a straight line: ninth, other evident functions and advantages of the specific constructions and arrangement of the parts, which will hereinafter appear from the detailed description of the invention and the manner of applying the same.

My invention comprises novel features of construction and relative arrangements of the parts, which will be hereinafter described in the detailed description, and particularly pointed out in the appended claims.

Reference is had to the accompanying two sheets of drawings, forming a part of this specification, in which similar reference characters indicate corresponding parts throughout the several figures.

Figure 1 is a side elevation of my invention. Fig. 2 is a plan view omitting some of the common and well known elements shown in Fig. 1. Fig. 3 is a section and development taken on line III—III of Fig. 4. Fig. 4 is a section taken on line IV—IV of Fig. 3.

To accomplish the objects above mentioned, I provide a gear of the Walschaert type adapted to operate independent oscillating valves, one located at each end of the cylinder for the distribution of the live steam and main exhaust and a similar arrangement of independent and preferably reciprocating piston valves for controlling and regulating the compression after the main exhaust has been closed. The valve gear and its connection with the oscillating valves is such that a rapid travel is imparted to said valves at the time of opening and closing the ports to the live steam and there-

by preventing wire drawing, and a retarded or delayed movement during the period of expansion and exhaust.

While the two oscillating or main distribution valves accomplish perfectly for all cut-offs, the functions of admission, cut-off and release; the closure and beginning of compression with them alone would be too early and in order to correct this "event" I have provided in conjunction with the auxiliary exhaust ports a compression controlling or regulating valve, with a movement so timed as to remain open after the main exhaust has been closed and the closure of the auxiliary exhaust ports takes place at such a period of the stroke of the engine as to take care of the lost motion in the rapidly reciprocating and rotary parts and prevent pounding. With this end in view and in order to obtain the greatest efficiency and expansion of the admitted live steam with a free and unrestricted exhaust, I have devised the hereinafter described construction. The means employed by my invention to overcome these difficulties and effect the objects stated above will now be specifically described as used in connection with a locomotive, and while so described I wish it to be distinctly understood I do not care to limit myself to this specific use, as will be readily understood by those skilled in the art. It may be applied to other forms of engines—as, for example, stationary or marine type.

Referring to the drawings 1, is a cylinder which is provided with the usual heads, stuffing boxes, threaded openings for drain valves and other essentials which need no description to be fully understood; 2, is a piston provided with a piston rod 3, connected to the cross-head 4, which is supported and guided by suitable rods 5, 5, in the well known manner.

6, is a live steam chest, preferably located above the cylinder and 7, 7^1, are steam ports leading from the steam chest 6, to the oscillating distribution valve chambers 8, 8^1.

9, 9^1, are any suitable form of oscillating balanced piston valves controlling the live steam admission to the cylinder 1, through the ports 10, 10^1, and the exhaust through the main exhaust ports 11, 11^1, to the final exhaust passage 12, leading to the stack. 13, 13^1, are the auxiliary exhaust ports leading from the ends of the cylinder 1, to the main exhaust passage and which are controlled by any suitable and preferably piston form of compression regulating or auxiliary exhaust valves 14, 14^1, reciprocating in suitable cylindrical seats. The means for properly operating the said oscillating or main distribution valves 9, 9^1, as above explained, consists of a combination lever 15, which is bifurcated at its upper end with forks or branches 16, 16^1, and pivotally connected to a guide block 17, sliding on guide rod 18. The lower end of the combination lever 15, is pivotally connected to the cross-head 4, by any suitable link 19. The fork or branch 16, is suitably connected by a link 20, to a crank arm 21, attached to the oscillating valve 9, while the fork or branch 16^1, is connected by link 20^1 to crank arm 21^1, operating the other oscillating valve 9^1.

22, and 22^1, are arms connected respectively at one end of rocker shafts 23, and 23^1, suitably supported on the exterior and end of the steam chest 6, while the other ends of said arms are pivotally connected by short links 24, and 24^1, to the crank arms 21, and 21^1, operating the oscillating valves 9, 9^1. The opposite ends of the rocker shafts 23, and 23^1, by means of the arms 25, and 25^1, are connected by variable slotted connections 27, 27^1, with the exterior of the valve rods 26, 26^1, operating the auxiliary exhaust valves 14, and 14^1, said slot connections being varied by adjustable bolts 28, 28^1, as shown.

29 is a radius bar, one end of which is pivotally connected to the guide block 17, and the other end is supported by the slide block 30, guided in the link 31, which is pivotally supported by the engine frame in the usual manner. The rear end of the radius bar 29, is so arranged and constructed as to have a sliding and adjustable connection 35, with the cut-off or reversing lever 32, while the link 31, is rocked by the well known expedient of connecting rod 33, and crank 34, on a driving wheel as indicated.

As will be seen from the foregoing disclosure of the construction and arrangement of the various parts and reference to Fig. 1, the forks or branches or points of connection of the oscillating or distribution valves are arranged at such an angle as to vary the movements of translation at certain periods of the stroke between the rods 20, and 20^1, connecting the said valves, while the angular arrangement or connections of the crank arms 21, and 21^1, operating the valves with the said rods 20, 20^1, will, furthermore, quicken the movement of the distribution valves over their seats at the beginning of the stroke or admission and cut-off and retard their travel during the end of the stroke or point of release. This will be more clearly understood when it is observed that while the effective arm of a fork or branch of the combination lever is being lengthened due to its oscillation, the crank effective arm of the corresponding valve is being shortened, and vice versa, thus imparting to the distribution valve a highly accelerated movement at one portion or commencement of its travel, and a retarded or slower motion at another portion or end of its travel, and is accomplished with the least

number of parts, which are in a straight line to avoid strains and acquire certainty of operation and on the outside where they are easily accessible. For the operation of the compression controlling or auxiliary exhaust valves the same general plan is followed, setting the respective arms at such angles as will delay the closing of the compression valve at a period later than that of the main valve and as will be readily seen to still further adjust or regulate the operation of the compression valve, a slot is provided permitting any desired amount of lost motion, whereby a perfect and accurate means is at hand for bringing the compression into perfect accord or harmony with the invariable clearance, which is the greatest care in engine building and will vary as between different sized cylinders and ratios of stroke and cylinder diameter, but with this means for variation, a perfect adjustment may be quickly made.

It is well known that two engines built from the same drawings will oft times vary materially in operation. One operating perfectly and the other very imperfectly even though the valve events for admission, cut-off, and release are known to be the same; as no means heretofore has been provided for readily controlling the compression which is always the principal difficulty or the cause of trouble and in many cases remains more or less a mystery; and with the present invention a little adjustment will soon bring the operation of a bad working engine up to a high standard.

The operation of the invention is as follows:—Assuming the piston and valves in the position indicated in Fig. 3, the live steam in the chest 6, has been admitted through the ports 7, and 10, to the cylinder 1, and cut-off by the oscillating or distribution valve 9, and the piston 2, is moving in the direction indicated by the arrow, and the auxiliary exhaust passage is closed and the admitted live steam is expanding. At the other end of the cylinder the expanded steam is exhausting and the main exhaust passage 11^1, is about to be closed by the valve 9^1, and the auxiliary exhaust passage 13^1, is still open for the remainder of the stroke except for entrapping sufficient expanded stem for proper cushioning. As above described the link motion properly oscillates the distribution valves 9, and 9^1, so that the movements and "events" of the valves are correct and the auxiliary exhaust valves are so adjusted as to open simultaneously with or a little later than the main or oscillating valves, but are made to close for compression much later than the main valves and effect a highly efficient distribution of the steam by avoiding unnecessary back pressure due to too early closing of the exhaust and at the same time having under absolute control independently at each end of cylinder the compression separate from the oscillating or main valves, whereby the clearance of the ports and cylinder may be reduced, and consequently effect a great saving of live steam. While I have shown and described my invention as applied to steam it can be used with the same efficiency and manner, with any other expansible fluid.

Various changes may be made in the specific details of my engine and in the means for operating or adjusting the valves, and while I have in the foregoing specification described one form to accomplish the results aimed at, yet it will be obvious to those skilled in the art that the same may be modified in many ways without changing in any way the operation of the mechanism or varying the invention.

From the detailed description and the mode of operation of my invention it will be clearly seen that I have devised an engine in which the objects set out in the statement of invention are fully and efficiently carried out.

Having fully described my invention what I claim as new and desire to secure by Letters Patent is as follows:—

1. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, oscillating valves controlling the main admission and exhaust ports, and separate compression regulating valves controlling the auxiliary exhaust ports, and valve gear for simultaneously operating the oscillating and compression regulating valves, so that the compression regulating valves have a shorter stroke than the oscillating valves in the short or earlier cut-offs, and a longer stroke than the oscillating valves in the long or later cut-offs.

2. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, independent oscillating valves controlling the main admission and exhaust ports, and independent and adjustable compression regulating valves controlling the auxiliary exhaust ports, and valve gear for simultaneously operating the oscillating and compression regulating valves, so that the compression regulating valves have a shorter stroke than the oscillating valves in the short or earlier cut-offs, and a longer stroke than the oscillating valves in the long or later cut-offs.

3. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, independent oscillating valves

controlling the main admission and exhaust ports, independent and adjustable compression regulating valves controlling the auxiliary exhaust ports and means for operating the compression regulating valves and closing the auxiliary exhaust ports after the oscillating valves close the exhaust through the main exhaust ports.

4. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, independent oscillating valves controlling the main admission and exhaust ports, a compression regulating valve connected to each of the oscillating valves and controlling the auxiliary exhaust ports, and means for adjusting the connections between the oscillating valves and compression regulating valves for varying the closing of the auxiliary exhaust ports.

5. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, separate and independent oscillating valves controlling the main admission and exhaust ports, means for operating said oscillating valves for quick admission and cut-off of the live steam and late release of the expanded steam, separate and independent compression regulating valves controlling the auxiliary exhaust ports and adjustable means connected with the compression regulating valves for varying and controlling the closing of the auxiliary exhaust ports.

6. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, separate and independent oscillating valves controlling the main admission and exhaust ports, valve gear for operating said oscillating valves for quick admission and cut-off of the live steam and late release of the expanded steam, and an adjustable compression regulating valve connected to each of the oscillating valves and controlling the auxiliary exhaust ports.

7. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, oscillating valves controlling the main admission and exhaust ports, means for operating said oscillating valves for quick admission and cut-off of the live steam through the admission ports, auxiliary exhaust ports connecting the cylinder with the exhaust, independent compression regulating valves adjustable with respect to the oscillating valves and controlling the auxiliary exhaust ports and means for operating said compression regulating valves to close said auxiliary exhaust ports after the main exhaust ports.

8. A steam engine comprising a cylinder, a steam chest, main admission and exhaust ports connected with the cylinder, oscillating valves controlling the main admission and exhaust ports, means for operating said oscillating valves for quick admission and cut-off of the live steam through the admission ports, and late release of the expanded steam, auxiliary exhaust ports connecting the cylinder with the exhaust, independently adjustable compression regulating valves controlling the auxiliary exhaust ports and means for operating said compression regulating valves to close said auxiliary exhaust ports after the main exhaust ports.

9. A steam engine comprising a cylinder, piston, piston rod, cross-head, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the exhaust, independent oscillating valves controlling the main admission and exhaust ports, means for operating said oscillating valves consisting of a combined reciprocating and oscillating combination lever having at one end two forks or branches and having its other end connected with the cross-head, a radius bar connected at one end with and reciprocating the combination lever, means for reciprocating the radius bar, means for connecting an oscillating valve to each one of the forks or branches, auxiliary exhaust or compression regulating valves controlling the auxiliary exhaust ports and means for connecting a compression regulating valve to each of the oscillating valves.

10. A steam engine comprising a cylinder, piston, piston rod, cross-head, a steam chest, main admission and exhaust ports connected with the cylinder, auxiliary exhaust ports connecting the cylinder with the main exhaust, independent oscillating valves controlling the admission and exhaust ports, means for operating said oscillating valves consisting of a combined reciprocating and oscillating combination lever having at one end two forks or branches and having its other end connected with the cross-head, a radius bar connected at one end with and reciprocating the combination lever, means for reciprocating the radius bar, means for connecting an oscillating valve to each one of the forks or branches, auxiliary exhaust ports, independent auxiliary exhaust or compression regulating valves controlling the auxiliary exhaust ports, means for connecting a compression regulating valve to each of the oscillating valves and means for adjusting the connection between the oscillating valves and the compression regulating valves.

11. A steam engine comprising a cylinder, piston, piston rod, cross-head, a steam chest, main admission and exhaust ports connected with the cylinder, independent oscil-

lating valves controlling the main admission and exhaust ports, a combined reciprocating and oscillating combination lever connected with the oscillating valves, means for oscillating said combination lever and independent means for reciprocating said combination lever, auxiliary exhaust ports, and independently adjustable compression regulating valves controlling the auxiliary exhaust ports.

12. A steam engine comprising a cylinder, piston, piston rod, cross-head, a steam chest, main admission and exhaust ports connected with the cylinder, independent oscillating valves controlling the admission and exhaust ports, a combined reciprocating and oscillating combination lever connected with the oscillating valves, means for oscillating said combination lever, independent means for reciprocating said combination lever, auxiliary exhaust ports, and compression regulating valves adjustably connected with the oscillating valves and controlling the auxiliary exhaust ports.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES B. ALLFREE.

Witnesses:
W. E. SCHOENBORN,
CHARLES LOWELL HOWARD.