April 12, 1938. A. G. KERSHAW ET AL 2,113,621

ELECTROPNEUMATIC BRAKE

Filed Dec. 12, 1936 2 Sheets-Sheet 1

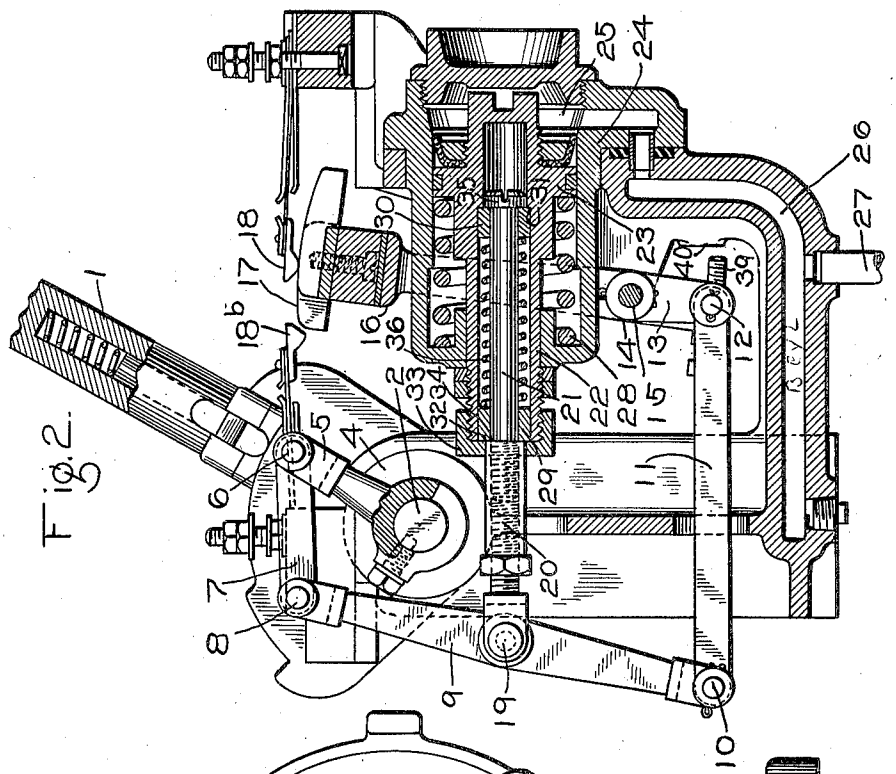


Fig. 2.

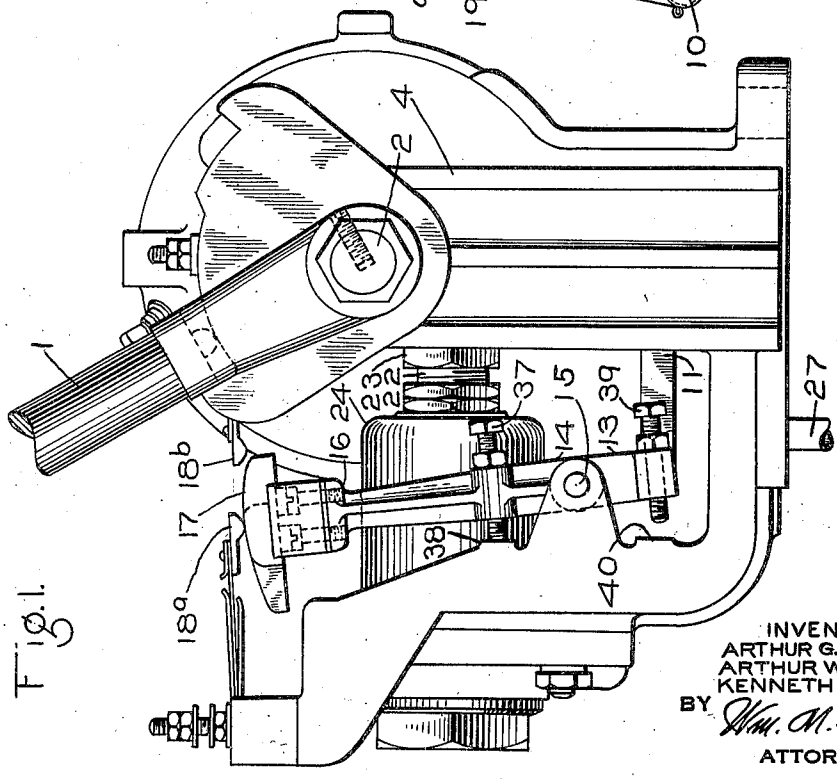


Fig. 1.

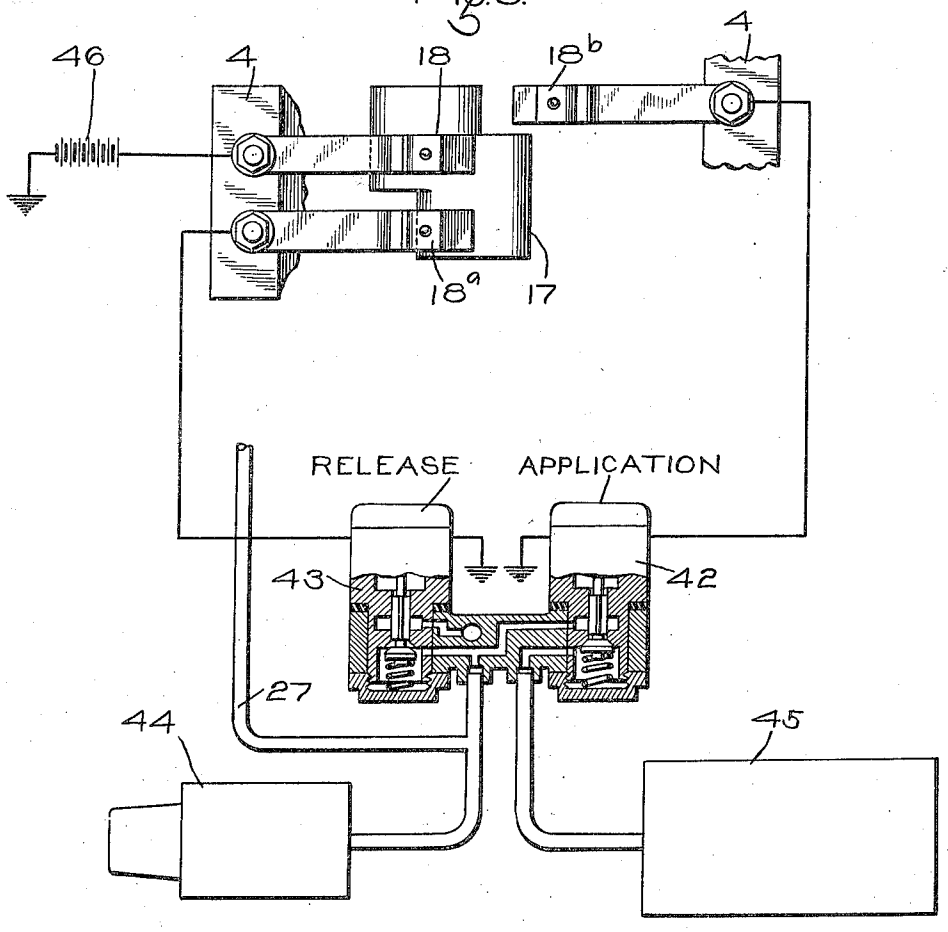
INVENTORS
ARTHUR G. KERSHAW
ARTHUR W. SIMMONS
KENNETH H. LEECH
BY Wm. M. Cady
ATTORNEY

April 12, 1938. A. G. KERSHAW ET AL 2,113,621

ELECTROPNEUMATIC BRAKE

Filed Dec. 12, 1936 2 Sheets-Sheet 2

Fig. 3.



INVENTORS
ARTHUR G. KERSHAW
ARTHUR W. SIMMONS
KENNETH H. LEECH
BY Wm. M. Cady
ATTORNEY

Patented Apr. 12, 1938 2,113,621

UNITED STATES PATENT OFFICE

2,113,621

ELECTROPNEUMATIC BRAKE

Arthur G. Kershaw, Arthur W. Simmons, and Kenneth H. Leech, King's Cross, London, England, assignors to The Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application December 12, 1936, Serial No. 115,572
In Great Britain December 14, 1935

20 Claims. (Cl. 303—54)

This invention relates to engineer's brake control devices for electropneumatically controlled fluid pressure braking apparatus and more particularly to a brake control switch device of the self-lapping type having electric contacts arranged to control the operation of electropneumatic valves in such a manner as to effect the automatic adjustment of the brake cylinder pressure in accordance with the setting of the control device.

One object of the invention is to provide an improved brake control switch of this character in which the operation of the contacts controlling the electropneumatic valves is arranged to be directly effected by the movement of the operating handle or lever of the switch device, the reverse or lapping operation of the contacts being effected by an abutment subject to the fluid pressure obtaining in the brake cylinder or its equivalent without effecting any movement of the handle or lever from the position to which it was initially adjusted which determines the pressure acting upon the abutment necessary for effecting its operation to cause the reverse operation of the contacts.

According to a further feature of the invention the initial movement of the handle or lever from one position to another is arranged to effect a rapid operation of the contacts, the continued movement of the handle effecting the compression or extension of a suitable spring without having any action upon the contacts, the reverse operation of these contacts under the action of the brake cylinder pressure being similarly rapidly effected only when the spring has been restored to its original condition.

In the accompanying drawings;

Fig. 1 is a view in front elevation of a preferred construction of an engineer's control device embodying one form of the invention,

Fig. 2 is a view thereof in sectional, rear elevation, and

Fig. 3 is a plan view of a portion of the control device shown in Fig. 1, associated with one form of brake equipment for illustrating an application thereof.

As shown in the drawings, the engineer's control device comprises an operating handle or lever 1 which is rigidly secured to a horizontal shaft 2 mounted in suitable bearings in a casing 4. The shaft 2 carries an arm 5 rigidly secured at one end thereto while the outer end is pivotally connected at 6 to one end of a short link 7 the other end of which is pivotally connected at 8 to the upper end of a substantially vertical floating lever 9. The opposite or lower end of the lever 9 is pivotally connected at 10 to one end of a link 11 the other end of which is pivotally connected at 12 to the shorter arm 13 of a substantially vertical contact lever 14 having its fulcrum 15 at a fixed point in the casing 4. The longer arm 16 of the contact lever carries an insulated contact member or segment 17 adapted to engage with fixed flexible contacts 18, 18a and 18b which are secured to and insulated from the casing 4. The contact 18 is in constant contact with segment 17 for supplying thereto electric current from any suitable source such as a battery 46. The contact 18a is connected to an application magnet valve device 42 for controlling the operation thereof, and the contact 18b is connected to a release magnet valve device 43 for controlling its operation, as most clearly shown in Fig. 3. The segment 17 is step-cut on either side to disengage the contact finger 18a at one time and 18b at another time. The magnet valve devices 42 and 43 are of usual construction adapted to control the supply and release of fluid under pressure to and from a brake cylinder 44 for controlling the application and the release of the brakes; the magnet valve device 42 when energized being adapted to supply fluid under pressure from a main reservoir 45 to said brake cylinder and when deenergized to cut off said supply; the magnet valve device 43 being adapted when energized to release fluid under pressure from said brake cylinder and when deenergized to close the brake cylinder release communication. When both magnets 42 and 43 are deenergized the fluid under pressure is bottled in the brake cylinder to effect holding of the brakes in the usual manner.

An intermediate point 19 in the floating lever 9 is pivotally connected through an adjustable member 20 to a horizontal rod or stem 21 adapted to slide within the tubular piston rod 22 of an operating piston 23 contained in a cylinder 24 mounted in the casing 4. The outer end 25 of the cylinder 24 beyond the piston 23 is in communication through passage 26 and pipe 27 with the brake cylinder 44 the pressure in which acts upon the piston 23 in opposition to the action of a control spring 28 interposed between the opposite side of the piston 23 and the corresponding end of the cylinder 24.

The tubular piston rod 22 is provided at each end with an internal collar 29, 30 adapted to slide within the piston rod, the collar 30 adjacent to the piston 23 abutting against a suitable shoulder 31 formed in the piston rod while the

collar 29 at the opposite end abuts against a similar shoulder 32 formed on a cap 33 secured to the end of the tubular piston rod 22. The rod 21 coupled to the floating lever 9 passes loosely through the cap 33 and the sliding collars 29, 30 and is provided with a shoulder 34 adapted to engage with the outer side of the collar 29 and with a head 35 adapted to engage with the outer side of the other collar 30, a light compression spring 36 surrounding the rod 21 being interposed between the two collars 29 and 30.

The operation of the control device is as follows:—

Under release conditions, the operating handle or lever 1 is at one end (assumed to be the right-hand end as seen in Fig. 2) of its stroke or travel and the floating lever 9 is consequently in a corresponding position so that the contact lever 14 is at the right-hand end of its stroke in which the contact member 17 carried thereby is in engagement with fixed contact 18*a* to which electric current is supplied from battery 45 by way of contact 18 for effecting the energization of the release magnet valve device 43 so as to establish communication between the brake cylinder 44 and the atmosphere for effecting a release of the brakes. In this position of the contact lever 14 an adjustable stop bolt 37 engages with a boss 38 on the casing 4 so as to define the position of the contact lever.

When it is desired to effect an application of the brakes the handle or lever 1 is rocked towards the left, as viewed in Fig. 2 of the drawings, to an extent depending upon the degree of braking required. The initial part of this movement rocks the floating lever 9 about its intermediate pivot 19 as a fulcrum so as to effect a corresponding rocking movement of the contact lever 14 about its fixed fulcrum 15. Since the shorter arm 13 of the contact lever 14 is coupled to the floating lever 9 and its longer arm 16 carries the contact member 17, a relatively small initial movement of the handle 1 will effect the rapid and full movement of the contact lever 14 to its extreme left or application position. During this movement the contact member 17 first moves out of engagement with finger 18*a* and then into engagement with finger 18*b* effecting deenergization of the release magnet valve device 43 and energization of the application magnet valve device 42, thereby cutting off communication between the brake cylinder 44 and the atmosphere and effecting the supply of fluid under pressure from the main reservoir 45 to the brake cylinder. An adjustable stop bolt 39 on the contact lever 14 in this extreme position engages with a boss 40 on the casing 4 so that further movement of the contact lever 14 is prevented after which the continued movement of the operating handle 1 causes the floating lever 9 to rock about its pivotal connection 10 to the link 11 coupling this end of the floating lever 9 to the contact lever 14 which is now stationary.

This rocking movement of the floating lever 9 causes the rod 21 to move towards the left, as viewed in Fig. 2 of the drawings, within and relative to the tubular piston rod 22, the head 35 of the rod 21 carrying with it the adjacent sliding collar 30 which accordingly compresses the spring 36 between the collar 30 and the other collar 29 which remains stationary abutting against the shoulder 32 on the cap 33. The extent of this movement of the rod 21 will evidently depend upon the extent of movement of the operating handle 1 which in turn determines the brake cylinder pressure ultimately established in the following manner:

The energization of the application magnet valve device 42 causes fluid under pressure to be supplied to the brake cylinder 44 as above described and the pressure thus obtained in said brake cylinder is transmitted through pipe 27 and passage 26 to the end 25 of the cylinder 24 wherein said pressure acts upon the piston 23 and moves the latter towards the left, as viewed in Fig. 2, against the opposing action of the control spring 28. This movement of the piston 23 is relative to the rod 21 and will evidently continue as the brake cylinder pressure increases until the shoulder 31 on the piston rod 22 engages with the stationary sliding collar 30 so that the rod 21 and the two collars 29, 30 are again in their original positions relative to the piston rod 22. After this occurs the continued movement towards the left of the piston 23 and piston rod 22 causes the rod 21 to move in the same direction and rocks the floating lever 9 about its pivotal connection 8 to the link 7 as a fulcrum so that the lower pivotal connection 10 of the floating lever 9 is moved towards the left and turns the contact lever 14 in a clockwise direction away from its application position. This movement of the contact lever 14 disengages the contact segment 17 from the contact finger 18*b* and effects the deenergization of the application magnet valve device 42 which then operates to cut off the further supply of fluid to the brake cylinder. The increase in brake cylinder pressure in the end 25 of the cylinder 24 acting upon the piston 23 thereupon ceases and the movement of the contact lever 14 is arrested in an intermediate or holding position in which the application magnet valve device 42 is deenergized while the release magnet valve device 43 remains deenergized. It is desired to more particularly point out here that the segment 17 is so formed as to provide the holding or lap position in which it engages neither of the fixed contacts 18*a* or 18*b*. Regardless of the direction of movement of the contact member 17 it always disengages one of the fixed contacts 18*a* or 18*b* before it engages the other.

If the operating handle or lever 1 is moved further towards the full application position the floating lever 9 and the contact lever 14 are again operated in a similar manner to that above described so as to cause the pressure of fluid in the brake cylinder 44 to be correspondingly increased to a higher value and maintained at this value.

If on the contrary the operating handle 1 is moved towards the release position, i. e., turned toward the right hand, as viewed in Fig. 2 of the drawings, the initial portion of this movement causes the floating lever 9 to be rocked about its intermediate pivotal connection 19 as a fulcrum thereby causing the contact lever 14 to move to its release position in which the segment 17 is moved out of engagement with contact 18*b* and into engagement with contact 18*a* thereby deenergizing the application magnet valve device 42 and energizing the release magnet valve device 43 thus permitting the release of fluid from the brake cylinder 44. The continued movement of the operating handle 1 effects the rocking of the floating lever 9 about its pivotal connection 10 to the link 11 as a fulcrum and thus moves the rod 21 connected

to the floating lever 9 towards the right hand, as viewed in Fig. 2, within the tubular piston rod 22 carrying with it the left-hand collar 29 and compressing the spring 36.

As the brake cylinder pressure decreases, the piston 23 and piston rod 22 are permitted to move towards the right under the action of the control spring 28 until the collar 29 is restored to its original position within the tubular piston rod 22 after which the continued movement of the piston 23 towards the right rocks the floating lever 9 about its pivotal connection 8 to the link 7 as a fulcrum and moves the contact lever 14 and thereby contact 17 to its intermediate or holding position, thereby cutting off the release of fluid from the brake cylinder 44 and maintaining the brake cylinder pressure at the desired reduced value.

From the above description it will be evident that whenever the operating handle 1 is adjusted from one position to another from or towards its release or full application position, a small initial movement of the handle effects through the shorter and longer arms 13, 16 respectively of the contact lever 14 a rapid and relatively considerable movement of the contact member 17 as is required to effect the proper change in the control circuit connections. On the other hand the range of subsequent movement of the handle 1 (compressing the light spring 36 in the tubular piston rod 22) is of considerable extent thereby enabling the automatic adjustment of the brake cylinder pressure in accordance with the setting of the handle 1 and under the action of the piston 23 to be accurately effected.

The invention is evidently not limited to the particular construction and arrangement of the control device above described and illustrated by way of example which may be varied in many respects without exceeding the scope of the invention.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a brake control apparatus, in combination, a brake control member, means operable upon movement of said member to one position to effect an application of the brakes and to another position to effect the release of the brakes, manually operable means, a lever operatively connecting said manually operable means with said member, a movable fulcrum element for said lever, and yielding resistance means operative to hold said fulcrum element stationary during movement of said member to either of its positions by said manually operable means and then yieldable to permit movement of said fulcrum element by said manually operable means.

2. In a brake control apparatus, in combination, a brake control member, means operable upon movement of said member to one position to effect an application of the brakes and to another position to effect the release of the brakes, manually operable means, a lever operatively connecting said manually operable means with said member, a movable fulcrum element for said lever, and yielding resistance means acting on said fulcrum element to prevent movement thereof during movement of said member to either one or the other of its positions by said manually operable means and then yieldable to permit further movement of said manually operable means relative to said member and means operative upon effecting a predetermined application of the brakes for moving said element and thereby said lever and brake control member from the brake application position.

3. In a brake control apparatus, in combination, a brake control member, means operable upon movement of said member to one position to effect an application of the brakes and to another position to effect the release of the brakes, manually operable means, lever means operatively connecting said manually operative means with said member, and yielding resistance means cooperative with said manually operative means to effect movement of said member to one or the other of said positions upon movement of said manually operative means and then yieldable to permit movement of said manually operable means relative to said member.

4. In a brake control apparatus, in combination, a brake control member, means operable upon movement of said member to one position to effect an application of the brakes and to another position to effect the release of the brakes, manually operable means, lever means operatively connecting said manually operative means with said member, and yielding resistance means cooperative with said lever means upon operation of said manually operative means to effect movement of said member to one or the other of said positions and then yieldable to permit further movement of said manually operable means, and means operative upon effecting a predetermined variation in the degree of application of brakes to move said brake control member to still another position.

5. In a brake control apparatus, in combination, a brake control member, means operable upon movement of said member to one position to effect an application of the brakes and to another position to effect the release of the brakes, manually operable means for moving said member to either one or the other of said positions, yielding resistance means cooperative with said manually operable means to effect movement of said member to said positions and then yieldable to manual pressure on said manually operable means whereby said manually operable means is movable relative to said member, and means controlled by a predetermined force acting in opposition to a force proportioned to the degree of application of brakes operative after a movement proportional to the movement of said manually operable means relative to said member to move said member to still another position.

6. In a brake control apparatus, in combination, a brake control member, means operable upon movement of said member to one position to effect an application of the brakes and to another position to effect the release of the brakes, stops for preventing movement of said member past said positions, manually operable means for effecting the movement of said brake control member, an element subject to a predetermined force acting in opposition to a force which varies with the degree of brake application for also effecting operation of said brake control member, and yielding resistance means in the connection of said manually operable means and said element to said member operable upon operation of said manually operable means to effect movement of said member to one or the other of said positions and then yieldable to permit further movement of said manually operable means, and operative by said ele-

ment to effect movement of said member to a position intermediate said positions after movement of said element a distance proportional to said further movement of said manually operable means.

7. In a brake control apparatus, in combination, brake control means operative to effect an application of the brakes and to supply to a chamber fluid at a pressure proportional to the degree of brake application, manually operable means connected to said brake control means for effecting the operation thereof, a lever in the connection between said manually operable means and said brake control means, a movable fulcrum member for said lever, a spring, a movable abutment subject to the opposing pressure of said chamber and said spring, and yielding resistance means between said fulcrum member and abutment, said abutment being operative after a predetermined increase in fluid pressure in said chamber to operate said fulcrum member and thereby said lever and brake control means.

8. In a brake control apparatus, in combination, brake control means operative to effect a release of the brakes and to vary the pressure of fluid in a chamber in accordance with the degree of brake application, manually operable means for controlling the operation of said brake control means, a floating lever operatively connecting said manually operable means with said brake control means, a movable fulcrum member for said lever, means for yieldingly opposing movement of said fulcrum member, a spring, and a movable abutment subject to the opposing pressures of said chamber and said spring and operative upon a predetermined reduction in fluid pressure in said chamber to operate said fulcrum member and thereby said brake control means.

9. In a brake control apparatus, in combination, brake control means operative to effect an application and a release of the brakes and to vary the pressure of fluid in a chamber in accordance with the degree thereof, a brake control member movable to one position for effecting the operation of said control means to supply fluid under pressure to said chamber and movable to another position for effecting the operation of said control means to release fluid under pressure from said chamber, manually operable means for moving said brake control member to either one or the other of said positions, a spring, a movable abutment subject to the opposing pressures of said spring and chamber for moving said brake control member out of said positions, and yielding resistance means in the operating connection of said manually operable means and movable abutment to said brake control member for opposing movement of said brake control member to said positions by the operation of said manually operable means and for moving said brake control member out of said positions by the operation of said movable abutment.

10. In a brake control apparatus, in combination, brake control means operative to effect an application and a release of the brakes and to vary the pressure of fluid in a chamber in accordance with the degree thereof, a brake control member movable to one position for effecting the operation of said control means to supply fluid under pressure to said chamber and movable to another position for effecting the operation of said control means to release fluid under pressure from said chamber and movable to a third or intermediate position for preventing either the release of fluid under pressure from or the supply of fluid under pressure to said chamber, stop means for preventing movement of said brake control member past its extreme positions, manually operable means connected to said brake control member for moving said brake control member to either one or the other of its extreme positions, yielding resistance means in the connection of said manually operable means with said brake control member cooperative with said manually operable means for moving said brake control member to its extreme positions and then yieldable to permit further movement of said manually operable means relative to said brake control member, a spring, a movable abutment subject to the opposing pressures of said spring and chamber, and means including said yielding resistance means forming an operating connection for said movable abutment to said brake control member whereby said movable abutment is operative to move said brake control member to said intermediate position after movement of said abutment proportional to said further movement of said manually operable means.

11. In a brake control apparatus, in combination, brake control means operative to effect an application and a release of the brakes and to vary the pressure of fluid in a chamber in accordance with the degree thereof, a brake control member movable to one position for effecting the operation of said control means to supply fluid under pressure to said chamber and movable to another position for effecting the operation of said control means to release fluid under pressure from said chamber, and movable to a third or intermediate position for preventing either the release of fluid under pressure from or the supply of fluid under pressure to said chamber, stop means for preventing movement of said brake control member past its extreme positions, a manually operable member, a spring, a movable abutment subject to the opposing pressures of said spring and chamber, and lever means including a yielding resistance forming an operating connection of said manually operable member and movable abutment with said brake control member whereby said manually operable member is operative to first move said brake control element to either one or the other of its extreme positions and is then movable relative to said brake control element, and said abutment is operative to move said brake control means relative to said manually operable member to said intermediate position.

12. In a brake control apparatus, in combination, brake control means operative to effect an application and a release of the brakes and to vary the pressure of fluid in a chamber in accordance with the degree thereof, a brake control member movable to one position for effecting the operation of said control means to supply fluid under pressure to said chamber and movable to another position for effecting the operation of said control means to release fluid under pressure from said chamber, and movable to a third or intermediate position for preventing either the release of fluid under pressure from or the supply of fluid under pressure to said chamber, stop means for preventing movement of said brake control member past its extreme positions, a lever for moving said brake control member to its different positions, a manually operable member connected to said lever, a floating fulcrum member connected to said lever, a spring, a movable abutment subject to the opposing pressures of said spring and chamber, yielding resistance

means interposed between said abutment and floating fulcrum member for opposing movement of said fulcrum member upon operation of said manually operable member and thereby said lever to move said brake control member to its extreme positions and operative to oppose operation of said movable abutment upon a variation in fluid pressure in said chamber to move said lever and thereby said brake control member to its intermediate position.

13. In a brake control apparatus, in combination, brake control means operative to effect an application and a release of the brakes and to vary the pressure of fluid in a chamber in accordance with the degree thereof, a brake control member movable to one position for effecting the operation of said control means to supply fluid under pressure to said chamber and movable to another position for effecting the operation of said control means to release fluid under pressure from said chamber, and movable to a third or intermediate position for preventing either the release of fluid under pressure from or the supply of fluid under pressure to said chamber, stop means for preventing movement of said brake control member past its extreme positions, a lever for moving said brake control member to its different positions, a manually operable member connected to said lever, a floating fulcrum member connected to said lever, a spring, a movable abutment subject to the opposing pressures of said spring and chamber, an element connected to said floating fulcrum member and associated with said abutment and movable relatively to said abutment longitudinally thereof in either direction from a neutral position, spring means associated with said abutment for opposing movement of the element from its neutral position, said spring means being operative to prevent movement of said fulcrum member relative to said abutment until after said brake control member is moved to one or the other of its extreme positions by the operation of said manually operable means and then yieldable to permit further movement of said manually operable member, said abutment being operative through said spring means to move said fulcrum member and thereby said lever and brake control member to said intermediate position.

14. In an electro-pneumatic brake, in combination, a brake cylinder, electro-responsive means, a brake control switch means movable to an application position for effecting the operation of said electro-responsive means to supply fluid under pressure to said brake cylinder, and movable to a release position to effect the release of fluid under pressure from said brake cylinder, and movable to a lap position intermediate said application and release positions for holding fluid under pressure in said brake cylinder, stop means engageable by said switch means in the application and release positions for preventing further movement of said switch means, a lever having one end connected to said brake control switch means for effecting operation thereof, a manually operable member connected to the opposite end of said lever, a floating fulcrum member connected to said lever intermediate said ends, a spring, a movable abutment subject to the opposing pressures of said spring and a chamber in which the pressure of fluid varies with that in said brake cylinder, and yielding resistance means connecting said floating fulcrum member to said abutment and operative to prevent movement of said fulcrum member relative to said abutment upon operation of said manually operable member until after said switch means engages said stop means in one or the other position of said switch means, and operative by said abutment after a predetermined degree of movement thereof to move said fulcrum member and thereby said lever and said switch means to said lap position.

15. In a brake control apparatus, in combination, a brake control member movable a fixed distance in one direction to an application position for effecting an application of the brakes and movable a fixed distance in the opposite direction to a lap position for holding the brakes applied, manual means having a predetermined zone of movement and operative during an initial relatively small movement in said zone to move said member to said application position, yielding means cooperative with said manual means to move said member to said application position and then yieldable to permit further movement of said manual means in said zone relative to said member, and means controlled by the degree of brake application and operative to move said member to lap position when the degree of brake application corresponds to the position of said manual means in said zone.

16. In a brake control apparatus, in combination, a brake control member movable a fixed distance in one direction to a release position for effecting a release of the brakes and movable a fixed distance in the opposite direction to a lap position for holding the brakes applied, manual means having a predetermined zone of movement and operative during an initial relatively small movement in said zone to move said member to said release position, yielding means cooperative with said manual means to move said member to said release position and then yieldable to permit further movement of said manual means in said zone relative to said member, and means controlled by the degree of brake application operative to move said member to lap position when the brake application is released to a degree corresponding to the position of said manual means in said zone.

17. In a brake control apparatus, in combination, a brake control member having a neutral or lap position and movable therefrom in one direction a fixed distance to an application position for effecting an application of brakes and in the opposite direction a fixed distance to a release position for effecting a release of brakes, manual means having a predetermined zone of movement for controlling said brake control member and operative during an initial, relatively small movement in one direction in said zone to move said member to said application position and in the opposite direction to move said member to said release position, yielding means cooperative with said manual means to effect movement of said member to either said application position or to said release position and then yieldable to permit movement of said manual means relative to said member, and means controlled by the degree of brake application operative to move said member to lap position when the degree of brake application corresponds to the position of said manual means in said zone.

18. In a brake control apparatus, in combination, a brake control member having a neutral or lap position and movable therefrom in one direction a fixed distance to an application position for effecting an application of brakes and in the opposite direction a fixed distance to a release position for effecting a release of brakes, manual

means having a predetermined zone of movement for controlling said brake control member and operative during an initial, relatively small movement in one direction in said zone to move said member to said application position and in the opposite direction to move said member to said release position, yielding means cooperative with said manual means to effect movement of said member to either said application position or to said release position and then yieldable to permit movement of said manual means relative to said member, and mechanism set in motion upon initiating an application of the brakes and upon initiating a release of the brakes to move said brake control member to said lap position after a movement of said mechanism proportional to the movement of said manual means relative to said member.

19. In a brake control apparatus, in combination, a brake control member having a neutral or lap position and movable therefrom in one direction a fixed distance to an application position for effecting an application of brakes and in the opposite direction a fixed distance to a release position for effecting a release of brakes, manual means having a predetermined zone of movement for controlling said brake control member and operative during an initial, relatively small movement in one direction in said zone to move said member to said application position and in the opposite direction to move said member to said release position, yielding means cooperative with said manual means to effect movement of said member to either said application position or to said release position and then yieldable to permit movement of said manual means relative to said member, mechanism controlled by the application and release of brakes and movable to a position corresponding to the degree of brake application, and means including said yielding means operative by said mechanism to move said brake control member to said lap position after a movement of said mechanism proportional to the movement of said manual means relative to said member.

20. In a brake control apparatus, in combination, a brake cylinder, a brake control member having a lap position for holding fluid under pressure in said brake cylinder, and movable therefrom in one direction a fixed distance to an application position for supplying fluid under pressure to said brake cylinder, and movable from said lap position in the opposite direction a fixed distance to a release position for releasing fluid under pressure from said brake cylinder, manual means having a predetermined zone of movement for controlling the operation of said brake control member to effect the application and release of brakes and operative during an initial, relatively small movement in said zone in one direction to move said brake control member to said application position and in the opposite direction to move said brake control member to said release position, a spring, a movable abutment subject to the pressure of said spring and the opposing pressure of fluid in a chamber, in which the fluid pressure varies with that in said brake cylinder, movable to a position corresponding to the pressure of fluid in said brake cylinder for moving said brake control member to said lap position, and resilient means in the connection of said manual means and movable abutment to said brake control member for moving said brake control member upon operation of either said manual means or said movable abutment and yieldable after said brake control member attains either the application or the release position to permit movement of said manual means relative to said brake control member, and operative to delay operation of said brake control member by said abutment until after a movement thereof which is proportional to the movement of said manual means relative to brake control member.

ARTHUR G. KERSHAW.
ARTHUR W. SIMMONS.
KENNETH H. LEECH.