Sept. 13, 1966 D. H. H. BOLTON ETAL 3,272,084

ROOF SUPPORT ASSEMBLIES SUITABLE FOR USE IN MINES

Filed May 13, 1965 2 Sheets-Sheet 1

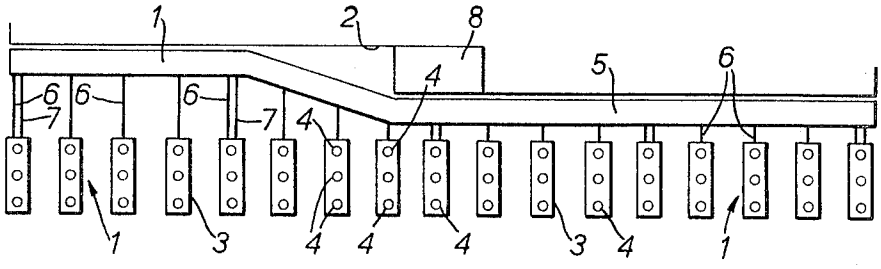

FIG. 1.

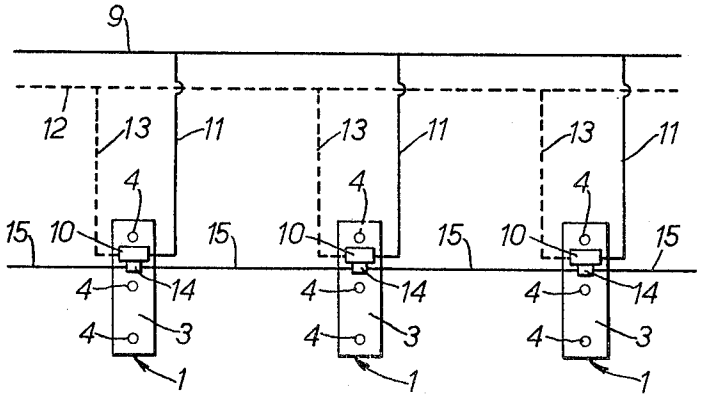

FIG. 2.

INVENTORS
DOUGLAS H. H. BOLTON
BY FRANK PAWLING
MICHAEL C. POTTS

Orland M. Christensen
ATTORNEY

Sept. 13, 1966 D. H. H. BOLTON ETAL 3,272,084

ROOF SUPPORT ASSEMBLIES SUITABLE FOR USE IN MINES

Filed May 13, 1965 2 Sheets-Sheet 2

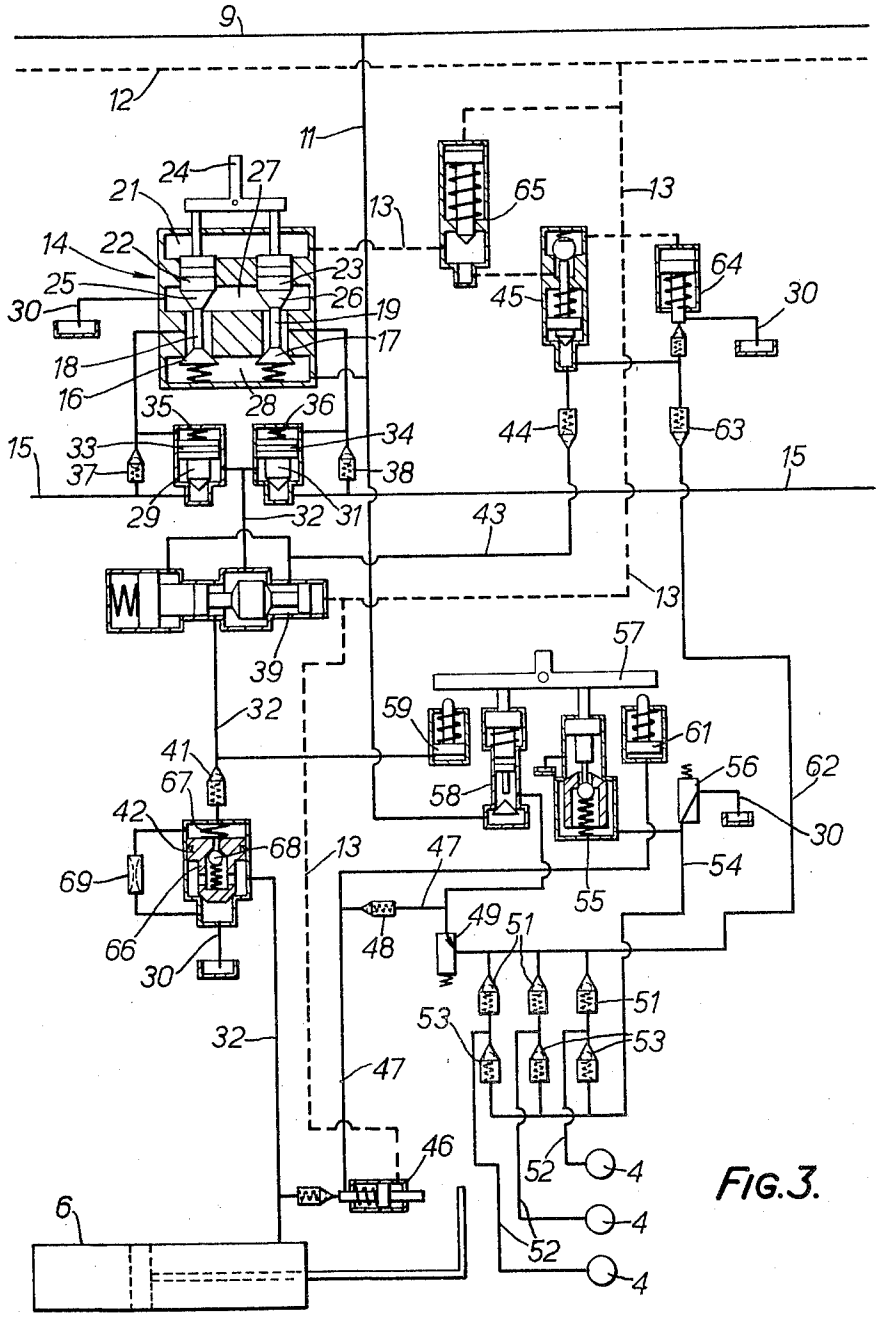

FIG. 3.

INVENTORS
DOUGLAS H.H. BOLTON
BY FRANK PAWLING
MICHAEL C. POTTS

Arland M. Christenson
ATTORNEY

United States Patent Office

3,272,084

Patented Sept. 13, 1966

3,272,084

ROOF SUPPORT ASSEMBLIES SUITABLE FOR USE IN MINES

Douglas Herbert Hewlett Bolton, Winchcombe, Frank Pawling, Charlton Kings, and Michael Charles Potts, Prestbury, England, assignors to Dowty Mining Equipment Limited

Filed May 13, 1965, Ser. No. 455,541
Claims priority, application Great Britain, May 15, 1964, 20,382/64
7 Claims. (Cl. 91—414)

This invention relates to roof support assemblies suitable for use in mines.

The present invention provides a roof support assembly including a series of advanceable roof supports, each roof support having at least one fluid-pressure-operated prop operable to set the support against a roof and a fluid-pressure-operated jack operable to advance the support, each roof support also having a valve assembly controlling the operation of the prop and the jack, the valve assembly being operated by the receipt of a signal from the preceding roof support in the series to cause its roof support to undergo an advancing operation, and the valve assembly being responsive to the satisfactory completion of the advancing operation of its roof support to send a signal to the next roof support in the series, and by-passing means operable from a position remote from the roof supports to cause the signal to be sent from one roof support to the next roof support in the event of failure of the roof support to satisfactorily complete an advancing operation.

Each valve assembly may include a first valve associated with a line which remains unpressurised until its roof support receives the signal from the preceding roof support, and operation of the by-passing means actuating the first valve of every valve assembly, each valve assembly being so arranged that a first valve actuated by the by-passing means causes the signal to be sent to the next roof support if the line associated with the first valve is pressurised.

Each valve assembly may include a second valve operated by a satisfactory roof-supporting fluid pressure in the prop of its roof support, after the roof support has undergone an advancing operation, to cause the signal to be sent to the next roof support, and the actuation of the first valve of a valve assembly when the line associated with the first valve is pressurised causing the operation of the second valve of the valve assembly.

The signal may be a fluid-pressure signal which supplies the fluid pressure for the line.

The present invention also provides a roof support assembly including a series of advanceable roof supports, each roof support having at least one fluid-pressure-operated prop operable to set the support against a roof and a fluid-pressure-operated jack operable to advance the support, each roof support also having a valve assembly controlling operation of the prop and the jack, each valve assembly including an operating line whose pressurisation by fluid under pressure causes operation of the prop and of the jack, and a secondary valve assembly connected by a first signal line to the secondary valve assembly of the adjacent roof support in one direction along the series and by a second signal line to the secondary valve assembly of the adjacent roof support in the opposite direction along the series, each secondary valve assembly including a first one-way valve which allows

pressurisation of the operating line from the first signal line when the first signal line is pressurised from the relevant adjacent roof support and a second one-way valve which allows pressurisation of the operating line from the second signal line when the second signal line is pressurised from the other adjacent roof support, and valve means responsive to the satisfactory completion of the advancing operation of its roof support to hold the first and second one-way valves in a closed position to prevent pressurisation of the operating line from either signal line and to connect a source of fluid pressure to the first and second signal lines.

The valve means may include two valves which can be manually alternatively operated to pressurise either signal line and hold the associated one-way valve in a closed position.

The pressure in the operating line may drain away when there is no pressure in either signal line and when both one-way valves are held in the closed position.

One embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings of which,

FIGURE 1 is a diagrammatic view of a series of advanceable roof support arranged along the working face of a coal-mine,

FIGURE 2 is a diagrammatic view of three roof supports of the series, showing the hydraulic connections to each roof support and,

FIGURE 3 is a diagrammatic view of the hydraulic circuit of one of the roof supports.

With reference to the accompanying drawings, a series of roof supports 1 are arranged along the working face 2 of a coal-mine. Each roof support 1 includes a floor-engaging member 3 which carries three hydraulically-operated props 4, and the three props 4 carry a roof-engageable member (not shown). Each roof support 1 is connected to a snakeable conveyor 5 by a hydraulically-operated jack 6 operable to advance the roof support 1 toward the conveyor 5. Some roof supports, for example every fourth roof support as shown, have a second hydraulically-operated jack 7 which is operable to apply an advancing force to the conveyor 5 when its roof support is set against the roof. However, this invention is not concerned with the advance of the conveyor 5, and the operation of the jacks 7 will not be further described here. The jacks 7 may operate in the manner described in U.K. patent application No. 34,818/63. FIGURE 1 also shows a cutting machine 8 which is moving from left to right along the working face 2.

A main hydraulic pressure line 9 extends along the series of roof supports and is connected to a valve assembly 10 of each roof support by a branch line 11. A control line 12, which can be pressurised to various hydraulic pressures for purposes which will be described later, also extends along the series of roof supports, and is connected to the valve assembly 10 of each roof support by a branch control line 13.

Each valve assembly 10 includes a secondary valve assembly 14 which is connected to the secondary valve assembly 14 of the adjacent roof support by a signal line 15. Each secondary valve assembly 14 includes two valves 16, 17 which can be opened by linear movement of push-rods 18, 19. The push-rods 18, 19 can be moved to open valves 16, 17 by hydraulic pressure in a chamber 21 acting on pistons 22, 23 carried by push-rods 18, 19, in which case both valves 16, 17 are opened together. The push-rods 18, 19 can also be moved by manual

operation of a pivotally-mounted lever 23, in which case the valves 16, 17 can be opened alternatively, depending upon the direction of movement of the lever 24. The push-rods 18, 19 also carry valves 25, 26 respectively. Each signal line 15 is connected to a position between the valves 16, 25 or 17, 26 as the case may be.

The secondary valve assembly 14 also includes two valves 29, 31 to one of which one signal line 15 is connected and to the other of which the other signal line 15 is connected. When open, the valves 29, 31 bring the respective lines 15 into communication with a line 32 leading to the jack 6. Each valve 29, 31 carries a piston 33, 34 respectively, upon which acts a spring 35, 36 respectively, in the valve-closing sense. Each signal line 15 also includes a non-return valve 37, 38 respectively. The valve 29 is connected to its signal line 15 on the side of the non-return valve 37 remote from the secondary valve assembly 14, and the portion of the signal line 15 on the side of the non-return valve 37 adjacent the secondary valve assembly 14 is connected to the piston 33 so that pressure in this portion of the signal line 15 acts on the piston 33 in the same sense as the spring 35. The valve 31 is similarly connected to its signal line 15.

When the valve 16 is shut and valve 25 is open, as shown in FIGURE 3, the non-return valve 37 connected to the left hand side of the secondary valve assembly 14 is put into communication with a chamber 27 connected to a fluid return line 30 and fluid does not flow through the non-return valve 37 into the signal line 15. When valve 16 is open and valve 25 is shut, the non-return valve 37 connected to the left hand side of the secondary valve assembly 14 is put into communication with a chamber 28 connected to the branch supply line 11, and fluid from this branch supply line flows through the non-return valve 37 into the signal line 15. In practice, valves 16 and 25 will be so arranged that valve 25 can never be partly open when valve 16 is partly open so that chamber 28 can never be in communication with chamber 27. The signal line 15 and non-return valve 38 connected to the right hand side of secondary valve assembly 14 is connected to valves 17, 26 which operate in a similar manner to valves 16, 25 respectively.

The line 32 passes through a self-latching by-pass valve 39, a non-return valve 41 and a drain valve 42. The by-pass valve 39 is a two position valve which opens a line 32 in one position and, in its other position, shuts off the valves 29, 31 from the non-return valve 41 and connects valves 29, 31 through line 43 and non-return valve 44 to a sequence valve 45. The by-pass valve 39 is spring-biased to the first position, shown in the drawing, and can be moved to its second position by a predetermined pressure in the branch control line 13, to which it is connected.

Line 32 is also connected through a prop re-setting valve 46 to a line 47 including a non-return valve 48 and a pressure reducing valve or restrictor 49. Line 47 is connected to the props 4 through non-return valves 51 and lines 52. Prop re-setting valve 46 can be opened by contraction of the jack 6 to almost its minimum length, or by a predetermined pressure in branch control line 13.

Lines 52 are also connected through non-return valves 53 to a line 54 leading to a prop-release valve 55 and a pressure relief valve 56. Prop-release valve 55 is operable by a pivotally-mounted lever 57, as is also a manual prop-setting valve 58, connected to branch supply line 11 and line 47. The lever 57 is operable by a piston 59 actuated by pressure in line 32, and by a piston 61 actuated by pressure in line 47.

A line 62 connected to the portion of line 47 between valve 49 and non-return valves 51 includes a non-return valve 63 and is connected to the sequence valve 45. A locking valve 64 connected to line 62 between sequence valve 45 and non-return valve 63 can be opened by a predetermined pressure in branch control line 13. A portion of branch control line 13 connected to chamber 21 of secondary valve assembly 14 includes the sequence valve 45 and a safety valve 65 which can be closed by a predetermined pressure in branch control line 13.

The drain valve 42 includes a piston valve 66 urged by a spring 67 to a position in which the portion of line 32 between the drain valve 42 and the jack 6 is isolated from the return line 30. The piston valve 66 contains a non-return valve 68 through which fluid can pass from the by-pass valve 39 to the jack 6. A restrictor 69 is connected to the portion of line 32 between the non-return valve 41 and the drain valve 42 and to the fluid return line 30.

The various elements in each valve assembly 10 which are operated by predetermined pressures in the control line 12 and branch control line 13 are arranged to be operated by different predetermined pressures. In this embodiment, the pistons 22, 23 of secondary valve assembly 14 require a pressure of 400 lbs./sq. in. in chamber 21 to cause the pistons 22, 23 to shut valves 25, 26 and open valves 16, 17. The safety valve 65 shuts when the pressure reaches 800 lbs./sq. in. The prop re-setting valve 46 opens at a pressure of 1,200 lbs./sq. in., and the locking valve 64 is opened by a pressure of 2,800 lbs./sq. in.

When the conveyor 5 has been advanced, the roof supports 1 can be caused to undergo advancing operations either automatically one after the other, or each roof support 1 can be caused to undergo an advancing operation by manual operation of the lever 24 of the secondary valve assembly 14 of the roof support 1 on either side of the roof support 1 to be advanced, as will be described later.

Firstly, the operation of the roof supports 1 advancing automatically one after the other will be described. Although the advancing sequence can be started at either end of the series, according to whether it is desired to have the advance sequence proceed from left to right or from right to left along the series, only a left to right sequence will be described. Before an advance sequence commences, each roof support 1 will be set against the roof and the various elements of its valve assembly 10 will be as shown in the drawing.

The control line 12 is first pressurized to 400 lbs./sq. in., but this pressure does not reach chamber 21 because sequence valve 45 is closed. The signal line 15 leading to the left hand side of the secondary valve assembly 14 of the first roof support 1 is pressurized by operation of a manually-operated or remotely-controlled valve (not shown). This pressure cannot pass non-return valve 37, but opens valve 29 and pressurises line 32. The pressure passes along line 32 through the by-pass valve 39, non-return valve 41 and drain valve 42 to the jack 6 upon which it acts in a jack-contracting sense. At the same time, the pressure in line 32 actuates piston 59 to pivot lever 57 and open the prop release valve 55 to bring line 54 into communication with the fluid return line 30. Hence the props 4 lose their pressure and the roof support 1 is released from the roof. The jack 6 then advances the roof support 1 up to the conveyor 5.

When the jack 6 is nearly fully contracted, the jack 6 causes prop-resetting valve 46 to pressurise line 47 from line 32. Piston 61 then moves lever 57 to allow prop release valve 55 to close, and the props 4 are reset by pressurisation of line 47 from line 32. When a satisfactory setting pressure in the props 4 is achieved, this pressure which is also present in line 62 opens sequence valve 45 to cause pressurisation of chamber 21 and consequent closure of valves 25, 26 and opening of valves 16, 17. Sequence valve 45 is locked in the open position by fluid trapped in the lines between non-return valves 44, 63 and locking valve 64.

The opening of valve 16 results in closure of valve 29 due to fluid pressure from chamber 28 acting on piston 33 in the same direction as the spring 35. The opening

of valve 17 pressurises the signal line 15 leading to the adjacent roof support 1 on the right of the roof support 1 which has just advanced, and this next roof support 1 then undergoes an advancing operation.

Both valves 29 and 31 are now held in the closed position by fluid pressure from chamber 28 assisting the springs 35, 36 respectively, and line 32 is isolated from the signal lines 15. The pressure in the portion of line 32 between the valves 29, 31 and drain valve 62 and piston 59 drains away through the restrictor 69. Then the pressure in the portion of line 32 between the drain valve 42 and the jack 6, and the pressure in the portion of line 47 between the prop-resetting valve 46 and the piston 61, lifts piston valve 66 and drains to the fluid line 30.

The advance sequence could equally well proceed from right to left along the series, if the signal line 15 leading to the right hand side of the secondary valve assembly 14 of the roof support at the right hand end of the series had been pressurised.

If, during the advance, the roof support 1 met an obstruction and did not complete its advance, the jack 6 would not operate prop-setting valve 46. Hence this valve 46 would have to be opened by pressurisation of the control line 12 to 1,200 lbs./sq. in. Safety valve 65 would close at 800 lbs./sq. in., and prevent any pressurisation of chamber 21 until the pressure in the control line 12 has been reduced back to 400 lbs./sq. in.

If any of the props 4 develop a leak, the desired setting pressure will not be achieved in the props 4 and lines 47 and 62 after the roof support 1 has advanced. Therefore, there will not be sufficient pressure in line 62 to operate the sequence valve 45. If this happens, the control line 12 is pressurised to 2,000 lbs./sq. in. to move by-pass valve 39 to its second position in which signal line 15 and valve 29 are isolated from the jack 6 and props 4 and are brought into communication with line 43 leading to the sequence valve 45 which is thus opened. Safety valve 65, which is shut by the 2,000 lbs./sq. in. pressure in the control line 12, opens when the control line pressure is reduced back to 400 lbs./sq. in. The chamber 21 is then pressurised by the pressure in the control line 12, and the pistons 22, 23 are operated by this pressure, and the signal line 15 leading to the next roof support 1 becomes pressurized. By-pass valve 39 remains in its second position because of its self-latching property, fluid being trapped in line 43 and in the portion of line 32 between halves 29, 31 and by-pass valve 39, and hence isolates the leaking part of the hydraulic circuit of the roof support from the signal line 15 and valve 29, thus preventing further leakage.

When the by-pass valve 39 of a leaking roof support 1 is moved to its second position, the by-pass valves 39 of all the other roof supports 1 will be similarly moved. However, the by-pass valves 39 of the other roof supports will not self-latch, since their lines 32 will not be pressurised.

When all the roof supports have advanced, the locking valves 64 on all the roof supports 1 are opened by pressurising the control line 12 to 2800 lbs./sq. in. This also causes any operated by-pass valve 39 to revert to the position shown in the drawing, since the self-latching pressure drains away through line 43 and the open locking valve 64 to the return line 30.

If it is desired to advance the roof supports 1 by manual operation of their levers 24, no pressure is put into the control line 12. On any roof support, manual operation of the lever 24 in an anti-clockwise manner to operate push-rod 18 causes a signal to be sent along the signal line 15 leading to the adjacent left hand roof support 1, which consequently undergoes an advancing operation. Similarly, manual operation of the lever 24 in a clockwise manner to operate push-rod 19 results in the adjacent right hand roof support 1 undergoing an advancing operation.

The drain valve 42 also allows fluid to be expelled from the piston rod side of the jack 6 when the conveyor 5 is advanced relative to the roof support 1 with consequent extension of the jack 6. When this occurs, fluid from the jack 6 passes up line 32 to the drain valve 42 and moves the piston valve 66 against the spring 67 to open the pathway to the fluid return line 30.

In an emergency, the props 4 may be reset by manual operation of lever 57 and setting valve 58.

We claim:

1. A roof support assembly including a series of advanceable roof supports, each roof support having at least one fluid-pressure-operated prop operable to set the support against a roof and a fluid-pressure-operated jack operable to advance the support, each roof support also having a valve assembly controlling the operation of the prop and the jack, the valve assembly being operated by the receipt of a signal from the preceding roof support in the series to cause its roof support to undergo an advancing operation, and the valve assembly being responsive to the satisfactory completion of the advancing operation of its roof support to send a signal to the next roof support in the series, and by-passing means operable from a position remote from the roof supports to cause the signal to be sent from one roof support to the next roof support in the event of failure of the roof support to satisfactorily complete an advancing operation.

2. A roof support assembly according to claim 1 wherein each valve assembly includes a first valve associated with a line which remains unpressurised until its roof support receives the signal from the preceding roof support, and operation of the by-passing means actuates the first valve of every valve assembly, each valve assembly being so arranged that a first valve actuated by the by-passing means causes the signal to be sent to the next roof support if the line associated with the first valve is pressurised.

3. A roof support assembly according to claim 2 wherein each valve assembly includes a second valve operated by a satisfactory roof-supporting fluid pressure in the prop of its roof support, after the roof support has undergone an advancing operation, to cause the signal to be sent to the next roof support, and the actuation of the first valve of a valve assembly when the line associated with the first valve is pressurised causes the operation of the second valve of the valve assembly.

4. A roof support assembly according to claim 2 wherein the signal is a fluid-pressure signal which supplies the fluid pressure for the line.

5. A roof support assembly including a series of advanceable roof supports, each roof support having at least one fluid-pressure-operated prop operable to set the support against a roof and a fluid-pressure-operated jack operable to advance the support, each roof support also having a valve assembly controlling operation of the prop and the jack, each valve assembly including an operating line whose pressurisation by fluid under pressure causes operation of the prop and of the jack, and a secondary valve assembly connected by a first line to the secondary valve assembly of the adjacent roof support in one direction along the series and by a second signal line to the secondary valve assembly of the adjacent roof support in the opposite direction along the series, each secondary valve assembly including a first one-way valve which allows pressurisation of the operating line from the first signal line when the first signal line is pressurised from the relevant adjacent roof support and a second one-way valve which allows pressurisation of the operating line from the second signal line when the second signal line is pressurised from the other adjacent roof support, and valve means responsive to the satisfactory completion of the advancing operation of its roof support to hold the first and second one-way valves in a closed position to prevent pressurisation of the operating line from either signal line and to connect

a source of fluid pressure to the first and second signal lines.

6. A roof support assembly according to claim 5 wherein the valve means includes two valves which can be manually alternatively operated to pressurise either signal line and hold the associated one-way valve in a closed position.

7. A roof support assembly according to claim 5 wherein pressure in the operating line drains away when there is no pressure in either signal line and when both one-way valves are held in the closed position.

No references cited.

EDGAR W. GEOGHEGAN, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,272,084 September 13, 1966

Douglas Herbert Hewlett Bolton et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 59, after "first" insert -- signal --.

Signed and sealed this 1st day of August 1967.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents