No. 686,844. Patented Nov. 19, 1901.

C. L. DAVIS.

AIR MOTOR.

(Application filed Jan. 26, 1900.)

(No Model.)

Fig. 2

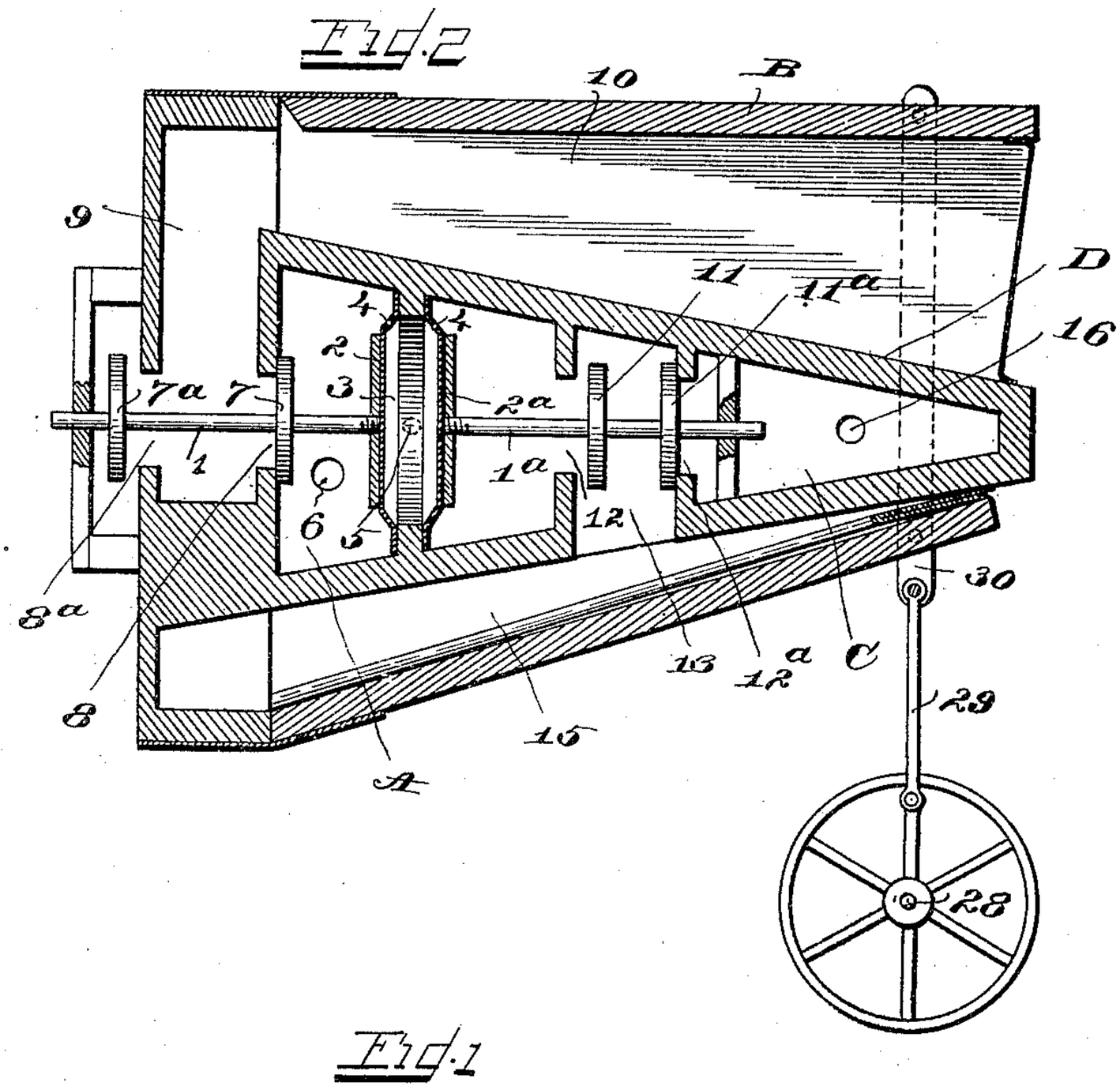
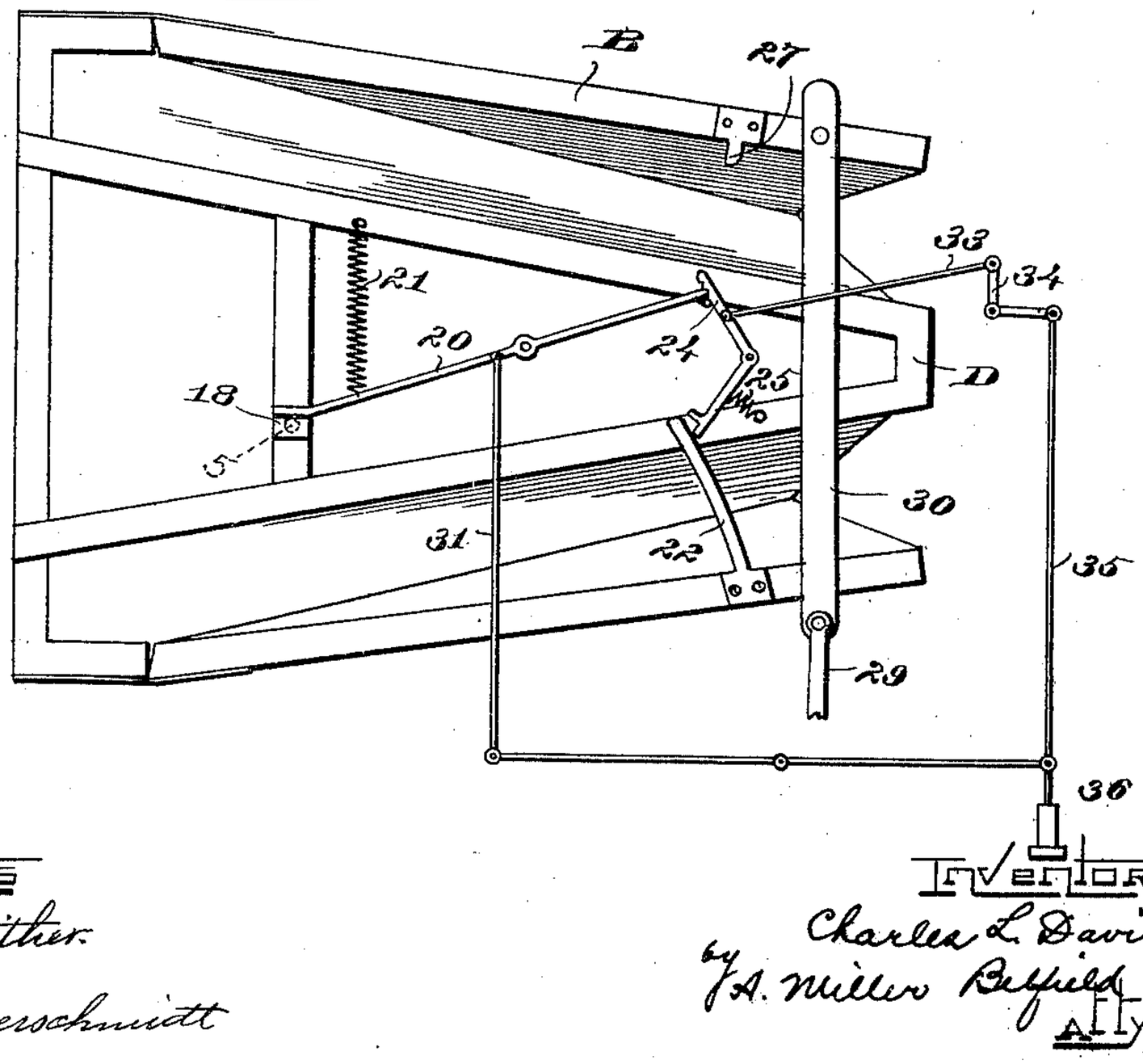


Fig. 1



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UNITED STATES PATENT OFFICE.

CHARLES L. DAVIS, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE HALF TO AUGUST HEUER, JR., CHARLES A. BROWN, GEORGE L. CRAGG, AND A. MILLER BELFIELD, OF CHICAGO, ILLINOIS.

AIR-MOTOR.

SPECIFICATION forming part of Letters Patent No. 686,844, dated November 19, 1901.

Application filed January 26, 1900. Serial No. 2,928. (No model.)

To all whom it may concern:

Be it known that I, CHARLES L. DAVIS, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Air-Motors, of which the following is a specification.

My invention relates to air-motors, such as are commonly employed in mechanical piano-players and other musical instruments to produce a rotary motion from a reciprocating motion of a bellows induced by pneumatic action.

In an application filed by me, Serial No. 734,169, filed October 20, 1899, for mechanical piano-player, I have illustrated and described a new and useful arrangement of valve mechanism for properly controlling the admission of air into the bellows for causing the operation of the latter.

In this application I have shown the bellows employed in the mechanical piano-player for two purposes—first, to operate key-levers for striking keys of the piano, and, second, for operating a rotary shaft, which is connected with a roll, so as to turn the same and cause a proper feeding action of a perforated sheet of music.

In said other application I have claimed the valve mechanism as an entirety and also the same in combination with the mechanism whereby the bellows actuates the piano-key.

In the present application I propose to claim the valve-and-bellows arrangement in combination with the mechanism by which it produces a continuous rotary motion to continuously turn the roll carrying sheet-music.

In this present application also I have shown a novel and useful arrangement of the chamber containing the valve mechanism with respect to the bellows, and this arrangement I propose to claim also in this application.

In the accompanying drawings, Figure 1 is a side elevation of an air-motor embodying my invention, and Fig. 2 is a vertical section of the same.

The valve mechanism shown in my said other application involves a couple of valve-stems 1 and 1^a, which are arranged for longitudinal movement along the same axial line. The inner or adjacent ends of these valve-stems are attached to flexible diaphragms 2 and 2^a, which are situated alongside of one another with a small space 3 between them. The diaphragms 2 and 2^a are each provided with small perforations 4 4, and an air-port 5 opens from the outside into the space 3. The diaphragms 2 and 2^a are arranged within a chamber A, in which a vacuum is always maintained—as, for instance, suitable vacuum-ports 6 6, understood to be connected with an exhaust-bellows or the like. By such arrangement when air is admitted to the port 5 it will press the diaphragms 2 and 2^a outwardly, as shown in Fig. 2, and thereby move the valve-spindles 1 and 1^a away from one another; but when it is shut off from the port 5 it is slowly exhausted from the space 3 by the ports 4 4, whereupon the diaphragms collapse or move toward one another, and the valve-spindles 1 and 1^a therefore move simultaneously toward one another. The port 5 is larger than the combined area of the ports 4 4, in which way the amount of air admitted between the diaphragms will always be greater than that withdrawn from said diaphragms through the ports 4 4.

The valve-spindle 1 is provided with a couple of valves 7 and 7^a, respectively, controlling the two openings 8 and 8^a to a port 9, which leads to one side or chamber 10 of the bellows B. The port 7 communicates with the vacuum-chamber A, and the port 7^a communicates with the outside atmosphere. The valve-spindle 1^a is provided with a couple of valves 11 and 11^a, respectively, controlling the openings 12 and 12^a of a port 13, leading to the other side or chamber 15 of the bellows B. The opening 12 establishes communication between the port 13 and the vacuum-chamber A, and the opening 12^a establishes communication between the same and an air-chamber C, having an air-port 16, which is understood to always communicate with the outside atmosphere. By such arrangement when the valve-spindles 1 and 1^a are simultaneously projected outwardly the valve 7 will close the port 8 and the valve 7^a will close the port 8^a, while the valve 11^a will close the port 12^a and the valve 11 will open the opening 12. As a result the upper chamber

of the bellows will be connected with the outside atmosphere and shut off from the vacuum-chamber A and the lower chamber 15 will be connected with the vacuum-chamber A and shut off from the air-chamber C. Consequently the bellows will rise to an upper position, as indicated in Fig. 2. When the valve-spindles 1 and 1ª are moved toward one another by the shutting off of air from the port 5 and the consequent collapse of the diaphragms 2 and 2ª, the valve 7 will open the opening 8 and the valve 7ª will close the opening 8ª, while at the same time the valve 11 will close the opening 12 and the valve 11ª will open the opening 12ª. As a result the upper chamber 10 of the bellows B will be connected with the vacuum-chamber A and shut off from the atmosphere, while the lower chamber 15 will be connected with the air-chamber C and cut off from the vacuum-chamber A. Consequently the bellows will move downwardly.

In accordance with my present invention the chambers A and C and the valve-supporting structure are provided by a box D, conveniently made in substantially triangular form and inclosed centrally within the bellows B, so as to form the dividing-wall between the chambers 10 and 15 thereof. In such case the port 13 opens from one side of the box D to the lower chamber 15 and the port 9 opens from the other side thereof to the upper port 10. As a result of this arrangement it will be seen that the bellows-controlling valve mechanisms are exceedingly compact and occupy a minimum amount of space. This is well known to be a highly-desirable characteristic in machines of this kind, where it is necessary to economize space to the greatest possible extent.

In accordance with my present invention also the port 5, admitting air into the diaphragm-chamber 3, is automatically controlled by suitable valve mechanism, whereby air is alternately admitted to and shut off from said port, so as to cause a continuous reciprocating motion of the bellows. As a simple arrangement I have shown a simple slide-valve 18, carried by a pivoted lever 20, which is pivoted to the box D and moves the valve back and forth in front of and away from the port 5. This lever 20 is subjected to a spring 21, which normally tends to spring it, so as to withdraw the valve 18 from in front of the port 5, and thereby admit air into the latter. When air is so admitted, it will be remembered that the bellows will move in an upward direction. During this rise of the bellows-flaps a long arm 22, secured to the lower flap of the bellows, acts against the outer end of the lever 20, so as to raise the same, and thereby lower the valve 18 into position in front of the port 5. When the bellows has reached the uppermost point in its movement, the valve will be swung an extent to entirely close the port 5. At such time the outer end of the lever 20 will be engaged by notches in the pivoted catch 24, pivoted to the box D and subject to a spring 25, tending to always hold it in engagement with the lever 20. The port 5 being now closed, the valve-spindles 1 and 1ª are retracted and the bellows B swings downwardly, as previously explained. Upon reaching the end of its downward stroke a projection 27 on its upper flap slides against the upper end of the pivoted catch 24 and swings such catch outwardly to an extent to release the lever 20, whereupon the spring 21 swings the lever 20 and withdraws the valve 18 away from in front of the port 5. As a result air is again admitted to the port 5 and the bellows again moves upwardly. This upward and downward movement of the bellows will obviously be continued as long as a vacuum is maintained in the vacuum-chamber A.

The bellows D can be connected with a rotary shaft 28, as by a link 29 and a rod 30, on the bellows, so that the reciprocating motion of the bellows will be transmitted into rotary motion and in turn can be transmitted to the music-rolls of the mechanical piano-player or to any other mechanism of any musical instrument by any suitable or well-known mechanical connection.

In accordance with my invention also I desirably provide means for allowing the motor to be reversed and operated in either direction. As a simple arrangement I have shown a link 31 pivotally connected to the lever 20 and a pivoted lever 32 pivotally connected with the link 31, and also a link 33 pivotally connected to the pivoted catch 24 and also to a bell-crank 34, which latter is pivotally connected to a long push-rod 35. The rod 35 is understood to be extended to the side of the keyboard of the musical instrument, in which the motor is used, and is provided with a stop 36, which can be engaged by the hand to operate the reversing mechanism. By this arrangement when the stop 36 is pushed in the valve-lever 20 will be swung so that its valve will close the port 5 and the pivoted catch 24 will also be swung so that it will engage the valve-lever 20, both as shown in Fig. 1. In such case the motor will operate in the manner above described.

When the stop 36 is pulled out, the pivoted catch 24 will be swung so as to release the valve-lever 20, and the latter will be swung so as to open the port 5. This will obviously admit air to the port 5 when it had previously been shut off therefrom, and thereby will cause a reversal of movement of the bellows and a consequent reversal in direction of rotation of the shaft 28. The upper movement of the bellows will swing the valve-lever 20 so as to close the valve, and thereby move the stop 36 inwardly and restore the rod 24 to its normal position, so that the mechanism will work as before, with the direction of rotation of its driving-shaft changed.

From the foregoing it will be seen that the invention provides a neat and compact ar-

rangement of valve mechanism and also an effective and practical construction of air-motor especially adapted for musical instruments.

What I claim as my invention is—

1. The combination with the bellows having ports leading thereto; of reciprocating valve-spindles, each attached to a flexible diaphragm in a vacuum-chamber, and each provided with valves controlling the ports leading to the bellows; an air-port communicating with the space between said diaphragms; a valve controlling the admission of air to said port; and means for operating said valve from the operation of the bellows, so as to produce a continuous reciprocation of the latter.

2. The combination with the bellows, having ports leading to its opposite sides; of valve mechanism controlling said ports; a vacuum-chamber, in which said valve mechanism is arranged; an air-port communicating with said vacuum-chamber so as to actuate the valve mechanism; a valve controlling said air-port, a swinging lever carrying said valve; a spring tending normally to swing said lever so as to withdraw its valve away from in front of the air-port; a spring-controlled pivoted catch for engaging said lever when it is swung so that its valve uncovers the air-port; and projections on the opposite flaps of the bellows, one adapted to actuate said catch so as to release the lever, and the other adapted to engage and act upon the lever, so as to restore it into engagement with the catch.

3. The combination with the bellows having a pair of swinging flaps and also having a port 5; of a swinging lever carrying a valve controlling said port; a spring tending to draw said lever in one direction; a pivoted catch adapted to engage the lever and hold it against the tension of the spring; a projection on one of the flaps of the bellows adapted to actuate said catch so as to release the pivoted lever, and a projection on the other flap of the bellows, adapted to act against said lever, and restore it into engagement with the catch, against the tension of the spring.

4. The combination of a bellows provided with valve mechanism whereby air can be admitted to and exhausted from the interior of the bellows, the said valve mechanism being adapted for operation by pneumatic pressure, a valve mechanism for controlling the pneumatic pressure for operating the bellows, the said pneumatic pressure-valve mechanism being reversible, and mechanism for reversing the said pneumatic pressure-valve mechanism at any point in its stroke.

5. The combination with the bellows having an air-port 5; of a pivoted lever carrying a valve controlling said air-port; a spring tending to draw said lever in one direction; a pivoted catch arranged to engage the lever and hold it against the tension of the spring; a projection upon one side of the bellows for actuating said catch, so as to cause it to release the lever; a projection on the other side of the bellows for engaging and acting upon said lever, so as to restore it in engagement with the catch; a link connected with said lever, and in turn connected with another pivoted lever; a second link connected with the pivoted catch, and also connected with a bell-crank, which is in turn connected with a push-rod to which the second pivoted lever is also connected.

6. The combination with a bellows, of a valve-casing arranged between the swinging sides of the bellows, the valve-casing providing the inner walls of the bellows-chambers and having its sides converging, and the swinging sides of the bellows being pivoted or hinged at the diverging ends of the casing, substantially as set forth.

7. The combination with the bellows, having ports leading to its opposite chambers; of a box or casing arranged within the bellows so as to form a wall separating said chambers; an air-chamber arranged at one end of said box or casing; and a vacuum-chamber arranged near the middle thereof; ports connecting one of the bellows-chambers with said air-chamber, and also with the vacuum-chamber, and connecting the other bellows-chamber with the vacuum-chamber and with the outside atmosphere; a couple of valve-spindles having valves controlling the openings of said ports, and extending into said vacuum-chamber; a couple of flexible diaphragms arranged opposite one another, with a space between them, and attached to the inner ends of said valve-spindles, said diaphragms being provided with small apertures; and an air-port in the box or casing, admitting air into the space between the diaphragms, said air-port having an area greater than the total area of all the apertures in the diaphragms.

Signed by me at Chicago, Illinois, this 17th day of January, 1900.

CHARLES L. DAVIS.

Witnesses:

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A. MILLER BELFIELD.