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Henke et al.

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[54] **ELEVATING DEVICE IN PARTICULAR FOR PAINT SPRAYING PLANTS**

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[52] **U.S. Cl.**.........................**91/1,** 91/216 B, 91/306, 91/403

[51] **Int. Cl.**.......................**F01b 31/12,** F15b 13/042

[58] **Field of Search**.......................91/305, 306, 403, 91/1, 304, 461, 277, 278, 216, 216 A, 216 B, 388

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Assistant Examiner—I. C. Cohen
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

An elevating device for paint spraying comprising a base supporting a guide bar having a piston thereon, a hydraulically movable elevating section slidably mounted on said guide bar, a pneumatic stroke control means including a grooved control member having a control groove therein and apneumatic a pneumatic chamber through which said control member slidably moves, and a pneumatic-hydraulic transducer means for controlling the hydraulically movable elevating section by the pneumatic stroke control means.

10 Claims, 6 Drawing Figures

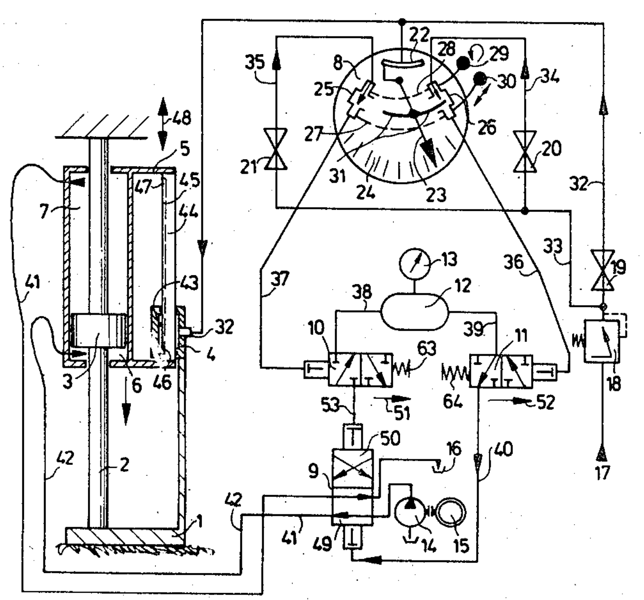
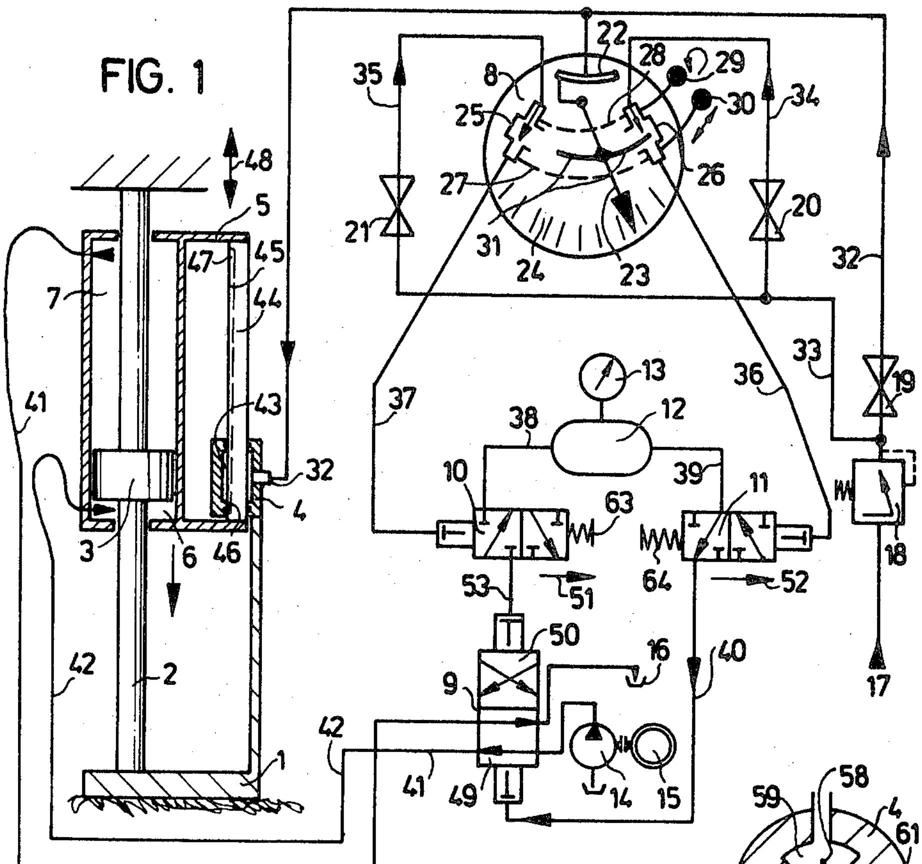


FIG. 1



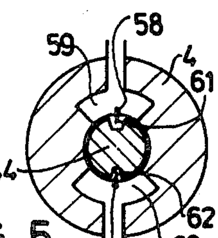


FIG. 5

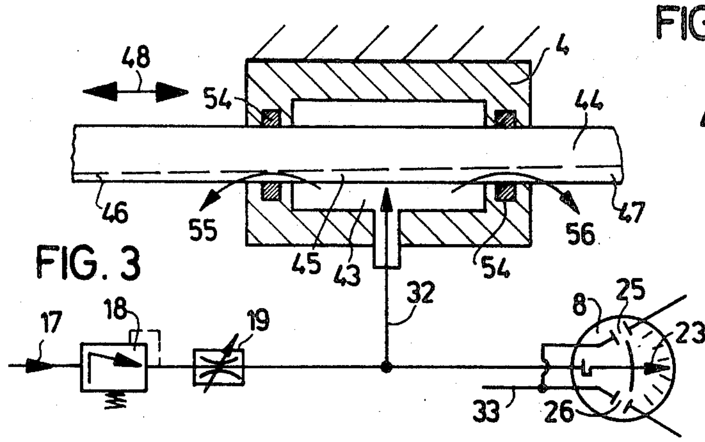


FIG. 3

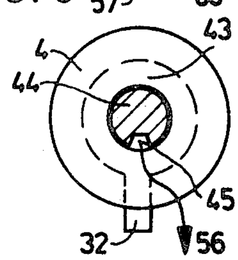


FIG. 4

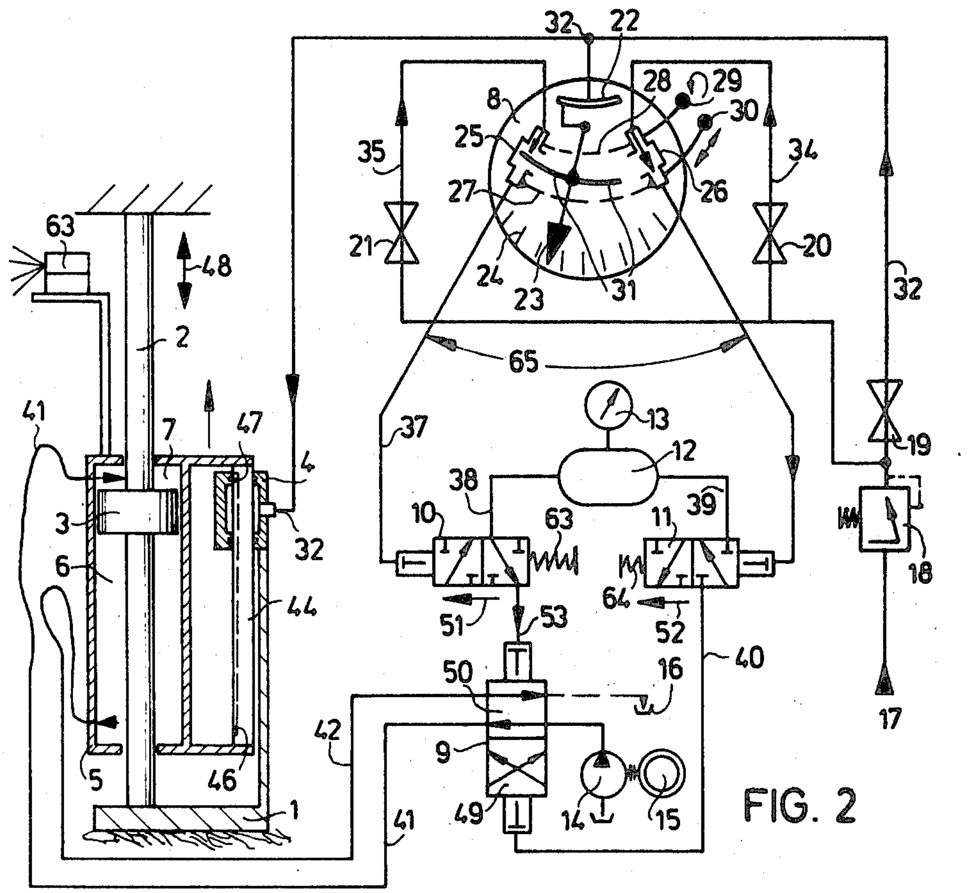

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FIG. 2

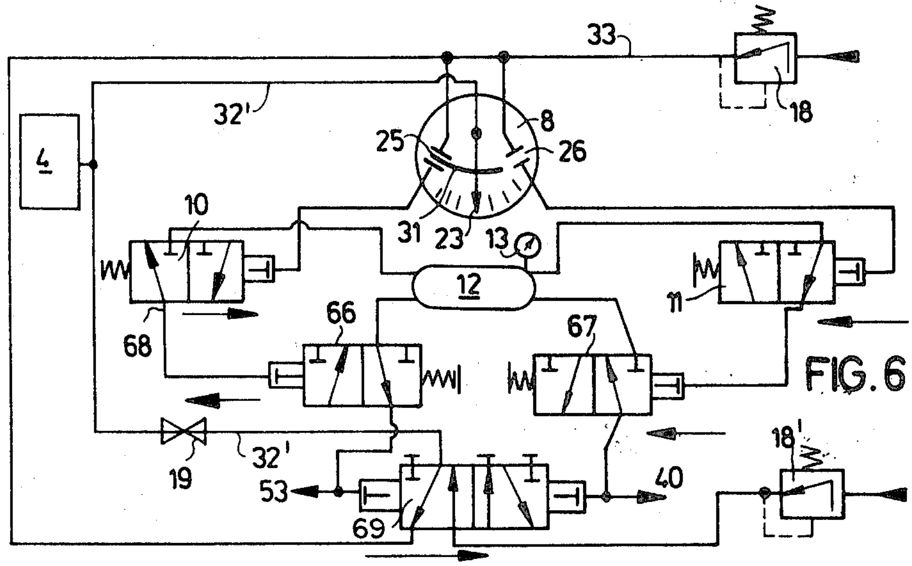
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FIG. 6

ELEVATING DEVICE IN PARTICULAR FOR PAINT SPRAYING PLANTS

The invention relates to an elevating device as it is used, for example, for paint spraying plants for treating larger objects with projecting portions where the spray gun must cover larger areas.

In this connection it is necessary that from a control desk or also from a program control the spray gun and the elevating device covers a fixed elevating range or is alternatively controllable by hand.

Various elevating devices for paint spraying plants have already become know in the art which mostly make use of mechanical means as, for example, the chain drive or the push drill system.

In all these devices known in the art extensive mechanical supplementary means are necessary to make it possible to place the elevating motion into a particular range.

A further disadvantage of the devices known in prior art is that within the range of the elevating device electrical supplementary devices must be arranged which have to comply with the strict explosion protection regulations of electrical engineering.

It is an object of the invention to create an elevating device in particular for paint spraying plants, with an elevating range adjustable at any point of the total lift path and with the elevating stroke alternatively being freely adjustable by hand in the case of special objects.

It is another object of the invention to create a device using as few as possible mechanical means so that the elevating device can be installed easily and at reasonable cost.

Still another object of the invention is to achieve a complete explosion protection by eliminating the need for applying electrical auxiliary means in the range of the elevating device and at the supplementary parts.

The invention also lends itself to covering longer lengths of stroke.

The invention solves the problem in that the device consists of a combination of the following parts:

a. a hydraulically movable elevating section carrying the spray gun slides along a guide bar which is firmly arranged at the base, said guide bar also carrying the working piston. Arranged at the base is

b. a pneumatic stroke control section which responds to a

c. measuring device with pneumatic measurement as setting member for the length of lift and the location of the elevating range,

d. pneumatic-hydraulic converter valves are arranged between measuring devices and a hydraulically movable elevating section and provide the possibility of converting the pneumatic pulses into hydraulic ones, thereby enabling the elevating section to be moved accordingly at the elevating device.

According to the invention an operating piston at a guide bar is fixed to the foundation and the elevating section in the form of a cylinder enclosing the piston on either side is slidable on the guide bar. Connected to the elevating section is a rod-shaped carrying part which can slide up and down in a sleeve-shaped supplementary part which is connected to the foundation.

The pneumatic stroke control section consists of a carrying part which has on the surface in axial extension at least one calibrated passage and a supplementary part, the two parts being movable relative to each other. Between passage and supplementary part there

is a room section which can be loaded with compressed air provided, however, that there are measuring devices by means of which the dynamic pressure forming by the movement of the parts relative to each other can be measured.

The passage is preferably designed as a groove varying in cross-section and extending along the covering length.

According to the invention the measuring devices are so designed that the size of the stroke and the location of the elevating range of the elevating section can be selected with adjustment of the pneumatic measurement through the pneumatic-hydraulic converter valves.

As measuring devices preferably contact manometers are used.

The nozzle valves in the measuring device are preferably seated on a bridge which is adjustable as a whole relative to the pointer with the control vane. At least one nozzle valve can be adjustable relative to the bridge.

In this way the stroke in its full size and also the entire elevating range set can be shifted either by hand of from another transmitter.

Together with other control valves the measuring device can be built into a control desk and can even be accommmodated in an explosion-endangered room as there is no electrical switchgear whatsoever.

The invention is schematically represented in the attached drawings. In the drawings:

FIG. 1 shows a schematic elementary connection diagram with the elevating section in the top-most position right at the point of moving downward,

FIG. 2 shows the same as FIG. 1, except that the elevating section is in the bottom-most position and just at the point of moving upward, a spraying device being arranged at the elevating section,

FIG. 3 shows the stroke control section in FIGS. 1 and 2, drawn separately and with the measuring device in schematically simplified representation,

FIG. 4 shows a side view of the device according to FIG. 3,

FIG. 5 shows a section through a stroke control section and along the lines of FIG. 3 with two room sections and associated passages;

FIG. 6 shows a schematic connection diagram of another modification.

FIG. 1 shows a schematic elementary connection diagram with the elevating section 5 in top-most position and just at the point of moving downward. The elevating section 5 carries a spray gun 63, as shown in FIG. 2.

The device according to FIG. 1 consists of a base 1, to which a guide bar 2 is mounted which also carries the operating piston 3. The operating piston 3 is fixed to the guide bar 2. The elevating section 5 is capable of sliding on the guide bar 2 and on the piston 3 by forming two hydraulic chambers 6 and 7.

Firmly attached to the elevating section 5 is a carrying part 44 which is of rod-shaped design and has a passage 45 on the surface in the form of a groove which has a relatively small cross-section at 46 and reaches its largest cross-section at 47. The carrying part 44 slides in the stroke control section 4 which is firmly connected with the base 1. Between stroke control section 4 and carrying part 44 there are seals 54, as shown in

FIG. 3. The elevating section 5 can move back and forth in the direction of arrow 48.

In the stroke control section 4 a room or pneumatic chamber section 43 is formed, as in particular shown in FIG. 3, which is supplied through a compressed-air line 32 from a compressed-air source 17 through a compressed-air regulating valve 18 and a presetting valve 19. The compressed-air line 32 is connected to the pressure gauge 22 of the measuring device 8. The pressure gauge 22 indicates the pressure in the compressed-air line 32 through a pointer 23 on a scale 24. In the compressed-air line 32 there is a dynamic pressure as in the room section 43, which builds up there by the compressed air flowing out from the holes 55 and 56. This dynamic pressure is indicated in the measuring device at pointer 23. According to the position of FIG. 1 the pressure is relatively high as the passage 45 has a relatively small cross-section at this point.

In the measuring device 8 at least two nozzle valves 25 and 26 are arranged on a carrier 27 which is arranged to slide in the direction of arrow by means of the actuating knob 30. Control vanes 31 mounted to pointer 23 can immerse into the nozzle valves 25 and 26 so that, as shown by the example, the control vane 30 has just shut off the nozzle valve 26. The nozzle valve 26 is supplied with compressed air from the compressed-air regulating valve 18 through line 33 and by interposing an individual valve 20 and the line 34. The nozzle valve 25 arranged at the other side is supplied with compressed air from the compressed-air regulating valve 18 through line 33 and by interposing an individual valve 21 and the line 35.

In the example drawn the compressed air is now pressed through nozzle valve 25 into line 37, but cannot do any work there as the input valve of the fluid amplifier 10 is pressed against 63 in the direction of arrow 51 and thus the line 38 is not connected to line 53.

From a pressure accumulator 12 the fluid amplifier 10 and 11 is supplied with energy which can be read at the manometer 13.

The nozzle valve 26 in the measuring device 8 is locked at the pointer 23 by the control vane 31 so that line 36 connecting the nozzle valve 26 with the fluid amplifier 11 is pressureless and thus the valve is pressed in the direction of arrow 52 by spring 64 so that through line 40, line 39 can supply compressed air to the pneumatic-hydraulic converter valve 49 which brings the bottom part 49 of the pneumatic-hydraulic converter valve 9 into operating position.

The hydraulic pump 14 with its electric drive 15 forces hydraulic fluid through line 41 to the hydraulic chamber 6 so that the elevating section 5 can move down. The hydraulic fluid from the hydraulic chamber 7 is pressed to the return-flow unit 16 through line 41.

When the elevating section 5 has moved into the opposite end position according to FIG. 2, the pressure has dropped at the measuring device 8 as at the carrier part 44 the passage 47 has become effective which is relatively wide.

Pointer 23 has swung to the left with the control vane 31, thereby having shut off the nozzle valve 25 that very moment, so that line 37 has become pressureless and thus the change-over valve of the fluid amplifier could evade in the direction of arrow 51 under the pressure of spring 63, so that from the pressure accumulator 12 compressed air can get into line 53 through line 38 and in the pneumatic-hydraulic converter valve 9 the upper valve group 50 can connect through. The hydraulic pump 14 with its electric drive 15 pumps hydraulic fluid into the hydraulic chamber 7 through the hydraulic line 41 with the result that the elevating section 5 can move upward. The hydraulic fluid from the hydraulic chamber 6 can flow off through line 42 into the return-flow unit 16.

The valve unit of the fluid amplifier 11 is shut off as can be seen from FIG. 2.

The length of lift and the location of the elevating range can be obtained by adjustment of the nozzle valves 25 and 26. In the measuring device 8 the nozzle valve 25 and 26 is arranged on a carrier 27 which, by means of the setting knob 30, can be adjusted in the direction of arrow shown. In this way the stroke length once set can be shifted in its location as desired.

The nozzle valves 25 and 26, however, can be connected to each other by means of a spindle 28, one side being provided with a right-hand thread and the other with a left-hand thread. The angle 65 under which the nozzle valves 25 and 26 are arranged in the measuring device 8 can be adjusted by means of the setting knob 29 resulting in an adjustment of the length of lift.

It can also be proceeded in such a way that each nozzle valve 25, 26 is seated on a separate spindle and is separately adjustable so that a certain angle setting 65 can be obtained.

Adjustment can be made by hand or by another transmitter so that program control is possible.

FIG. 3 is a representation, on an even larger scale, of the stroke control section 4 making evident the manner in which the dynamic pressure is built up in the room or pneumatic chamber section 43 in that compressed air flows out of the holes 55 and 56 of the passage. The numbering is identical with FIGS. 1 and 2.

FIG. 4 is a side view of the device according to FIG. 3 with the same numbers being used as in FIGS. 1 to 3.

FIG. 5 is a sectional view of carrier part 44 with grooves 61 and 62 being provided on the surface forming respective passages. The passages cooperate accordingly with the room sections 59 and 60 which are supplied with compressed air through the compressed air lines 57 and 58. In this way it is possible to derive several control functions from the elevating section 5.

Separate measuring devices can be assigned to the compressed-air lines 57 and 58 or it can be proceeded in such a way that several nozzle valves are then arranged in the measuring device 8.

Another modification is described in FIG. 6 where the inertia of the measuring device 8 is compensated by varying pressure loading.

In the example, nozzle valve 25 and fluid amplifier 10 are closed and thus line 68 is vented through fluid amplifier 10, thereby opening the reversing valve 66 and loading the line 53 with pressure so that the pressure stabilizer 18 loads the room or pneumatic chamber section 4 with a relatively high pressure through impulse valve 69. In this way a higher dynamic pressure is built up in room or pneumatic chamber section 4 causing measuring device 8 to move abruptly in reverse direction through line 32.

When the pointer 23 with control vane 31 gets into the air current of the nozzle valve 26, fluid amplifier 11, reversing valve 67 and impulse valve 69 are reversed, thus connecting the pressure stabilizer 18′ with a relatively low pressure to line 32′ at room or pneumatic chamber section **4**, so that an abrupt drop of the dynamic pressure occurs in the room or pneumatic chamber section **4**. This causes pointer **23** to again move abruptly in the reverse direction.

The setting valves **20, 21** can also be replaced by fixed nozzles in order to fix the air volume flowing through at a definite rate.

According to FIG. **5** it can also be proceeded in such a way that the second passage **62**, for instance, is used for indication only, while passage **61** serves for control.

It is, however, also possible to control with the second passage safety end stops or to change paint or stop paint flow at the spray gun or spray guns **63**.

In the fixed-cycle spraying process, timing impulses can be picked up from passage **62** after or during the spraying process, said impulses permitting transport or movement of the workpiece.

We claim:

1. An elevating device comprising:

a base supporting a guide bar having a piston fixed upon said guide bar;

a hydraulically movable elevating section including a hydraulic cylinder slidably mounted upon said guide bar by said hydraulic cylinder which encloses said piston thereby defining a cylindrical chamber on each side of said piston;

a pneumatic stroke control means which comprises a control member connected to said elevating section for movement proportionally with the movement of said elevating section, said control member having a control groove with a cross-sectional area which varies along the length thereof in the external surface of said control member and a pneumatic control chamber mounted on said base, said chamber having openings in the ends thereof for permitting slidable movement of said control member which extends through said chamber;

a pneumatic-hydraulic transducer means connected by a pneumatic pressure line to said pneumatic stroke control means, and by a pair of hydraulic pressure lines to the cylindrical chambers on each side of said piston within the hydraulic cylinder, said pneumatic-hydraulic transducer means comprising means for controlling the position of said elevating section.

2. The elevating device of claim **1**, wherein said control member comprises a rod-shaped member substantially parallel to and coextensive with the length of said hydraulic cylinder.

3. The elevating device of claim **1**, wherein said pneumatic-hydraulic transducer means comprises means for measuring the magnitude of the stroke of movement of said elevating section and means for adjusting the location of the elevating range of said elevating section.

4. The elevating device of claim **1**, wherein said pneumatic-hydraulic transducer means comprises pneumatic measuring means having means for controlling the length of the stroke and the location of the stroke range of said elevating section, pneumatic fluid amplifying means, pneumatic-hydraulic pressure converting means, and pressure reversing means controlling the pressure in the pair of hydraulic pressure lines to the hydraulic cylinder.

5. The elevating device of claim **4**, wherein said measuring means comprises a pressure gauge having a pointer and a control vane attached to said pointer and a plurality of nozzle valves seated on a bridge adjustable with said pointer and vanes, at least one of said nozzle valves being adjustable with respect to said bridge.

6. The elevating device of claim **4**, additionally comprising a contact manometer for measuring the pressure in the pneumatic portion of the pneumatic-hydraulic transducer means.

7. The elevating device of claim **4**, additionally comprising means for adjusting the dynamic pressure in the pneumatic control chamber.

8. The elevating device of claim **7**, wherein said means for adjusting the dynamic pressure comprises converter valve means and impulse valve means.

9. The elevating device of claim **1**, wherein said control member has a plurality of control grooves in the external surface thereof.

10. The elevating device of claim **9**, wherein one of said plurality of control grooves is operatively connected to activate a means for measuring the position of said elevating section.

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