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D. S. WAUGH.

VALVELESS HAMMER.

(Application filed Nov. 30, 1900.)

(No Model.)

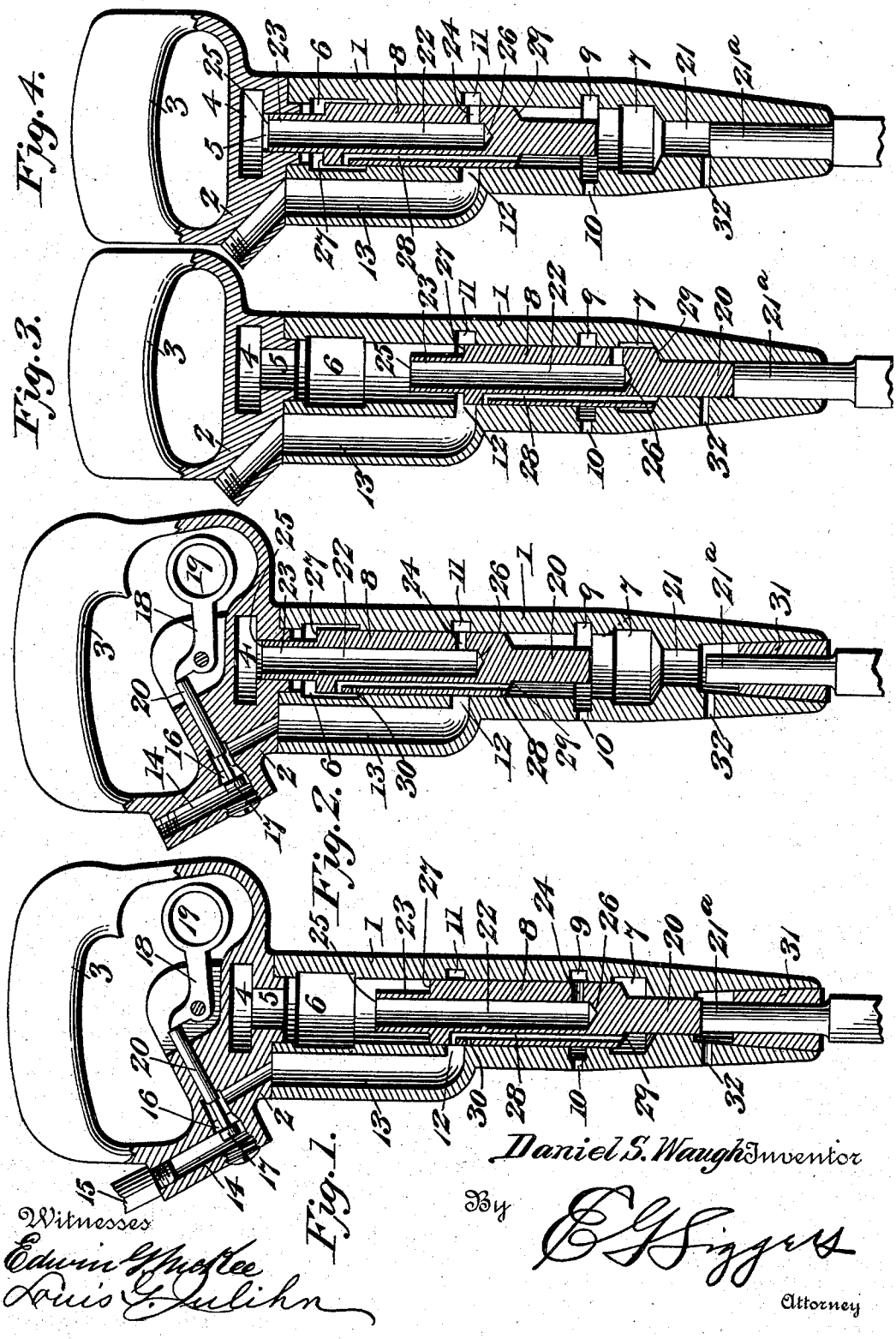


Fig. 4.

Fig. 3.

Fig. 2.

Fig. 1.

Witnesses
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VALVELESS HAMMER.

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To all whom it may concern:

Be it known that I, DANIEL SHAW WAUGH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Automatic Valveless Hammer, of which the following is a specification.

This invention relates to a novel automatic hammer of the class characterized by a shell or casing fitted with a handle to facilitate its manipulation and inclosing a reciprocatory piston or hammer operated by a fluid motive agent to strike repeatedly upon the shank of the tool fitted in one end of the shell.

The object of the invention is to produce a valveless hammer in which all small, delicate, or fragile parts are eliminated and embodying a construction which results in the reduction to a minimum of the vibration necessarily incident to the operation of devices of this character.

A further object of the invention is to so construct the hammer that, if desired, the initial or throttle valve, by means of which the operation of the device is usually controlled, may be dispensed with and the starting and stopping of the piston or hammer proper controlled by the insertion or withdrawal of the tool.

By means of the construction and arrangement to be described the vibration of the shell is reduced by three distinct peculiarities of the device: first, by reducing the effective pressure upon the hammer or piston at the beginning of its stroke, which pressure increases toward the termination of the stroke; second, the return of the hammer under pressure exerted only during the first or initial portion of its return movement or upstroke; third, by relieving the compression opposed to the return of the piston, such relief being effected during the final portion of the return stroke.

Other objects and advantages of the invention incidental to those enumerated will appear in the course of the following description of the preferred embodiment of my invention, which is illustrated in the accompanying drawings and embraced within the scope of the appended claims.

In said drawings, Figure 1 is a longitudinal sectional view through a pneumatic hammer constructed in accordance with my invention and embodying an initial valve and a valve lever or trigger disposed in convenient relation to the handle by means of which the device as a whole is held by the workman, the hammer or piston in this figure being at the limit of its effective stroke and ready to be returned to the upper or inner end of the shell. Fig. 2 is a view similar to Fig. 1, showing the hammer or piston at the opposite limit of its effective stroke and ready to again descend for the purpose of striking a blow upon the tool. Fig. 3 is a longitudinal section through another form of hammer, omitting the initial valve and trigger and designed to have its operation controlled by the insertion of the tool in the end of the shell or its withdrawal therefrom, the hammer in this figure being disposed at the extreme lower end or outer limit of its movement. Fig. 4 is a view similar to Fig. 3, but showing the hammer at the upper or inner end of the shell.

Referring to the numerals employed to designate corresponding parts throughout the views, 1 indicates a shell or casing, to the upper end of which is secured in any suitable manner a head 2, equipped with a handle 3, by means of which the tool is manipulated. Within the head 2 beyond the end of the shell 1 is formed the main or initial compression-chamber 4, communicating with the interior of the shell through a reduced extension 5 of said chamber. The internal diameter of the shell 1 is increased somewhat adjacent to its upper end to form an auxiliary compression-chamber 6 and at its outer extremity is similarly enlarged to form what may be termed a "return" compression-chamber 7, so called because the admission of the motive fluid within this chamber imparts an initial impetus in an upward or return direction to a hammer or piston 8, which is mounted to reciprocate within the shell. At a point above the return compression-chamber 7 the inner wall of the shell is formed with an annular exhaust-channel 9, communicating with an exhaust-port 10, piercing the wall of the shell, and at a point intermediate of the channel 9 and the chamber 6 a similar annular cavity 11 is formed. The cavity or channel 11 is designed, however, to supply the motive fluid for the op-

eration of the piston and is therefore in communication with a supply-port 12, communicating with the lower end of what may be termed a "supply-chamber" 13, formed in a laterally-offset portion of the shell and extending longitudinally to the upper end thereof. This chamber 13 is of comparatively great diameter in order that when the device is operating at a high rate of speed a considerable quantity of the fluid under compression will be stored for instant delivery to the shell. In this form of the hammer the chamber 13 is supplied with the motive fluid from an initial supply-port 14 within the head 2, said port communicating at the rear end of the handle 3 with a suitable, preferably flexible, supply-pipe 15.

At a point intermediate of the ends of the port 14 within the head 2 is provided a tapering valve-seat 16 for the reception of the initial valve 17, which controls the passage of motive fluid to the supply-chamber and is controlled by a valve lever or trigger 18, having a conveniently-disposed finger-ring or handle 19 at one end and bearing at its opposite end against the extended stem 20 of the valve 17. This arrangement of the valve and its lever or trigger enables the workman to control the operation of the hammer with great nicety, as it will be seen that the fluid-pressure within the outer end of the port 14 will keep the valve seated without necessity for the employment of springs or other reactive devices, and at the same time the tapering of the valve-seat will permit the valve to be adjusted with great nicety as the trigger is moved by a finger passed through the ring 19.

The hammer 8 is of cylindrical form and is provided at its lower end with a solid reduced extension 20, extending through an axial bore 21 within the shell 1 below the chamber 7. The lower end of this extension 20 constitutes the impact-face of the hammer and serves to strike a sharp blow upon the upper end of the tool 21^a when the hammer descends to the position shown in Fig. 1 of the drawings. The hammer 8 is hollow to form an internal chamber 22; but its lower end is closed to form a solid support or backing for the extension 20 thereof, and at its opposite end the hammer is provided with a reduced hollow extension 23, designed to fit within the reduced extension 5 of the compression-chamber 4 for the purpose of reducing the effective pressure-surface of the hammer during the initial portion of its downward stroke, as will be better understood hereafter. Inasmuch as the piston or hammer is designed to control the supply of motive fluid to the shell at its opposite ends, said hammer is provided adjacent to the lower end of its internal chamber 22 with the transverse port 24, designed in different positions of the hammer to establish communication between the supply-channel 11 and the chamber 22 or between said chamber and the exhaust channel or port 9. Thus it will appear that when the piston is in the position shown in Fig. 2 of the drawings the motive fluid will be supplied from the supply-chamber 13 through the port 12, channel 11, and port 24 to the internal chamber 22 of the hammer and to the compression-chamber 4 in the head 2. The end face 25 of the hammer extension 23 and the lower end wall 26 of the chamber 22 will combine to present a comparatively limited effective pressure area, against which the motive agent will act to drive the hammer toward the tool. As soon, however, as the hammer extension 23 is withdrawn from the chamber extension 25 the pressure area of the piston will be increased by the addition of the annular shoulder or surface 27, defined at the upper end of the hammer between its edge and the outer wall of the hammer extension—that is to say, the withdrawal of the hammer extension 23 from the chamber extension 5 will permit the motive agent to expand within the auxiliary compression-chamber 6 and to exert its pressure upon the shoulder 27. This increase of the effective pressure area of the hammer serves to accelerate the movement of the latter as it reaches the final limit of its downward stroke, and in this peculiarity will be found the basis for the statement heretofore made that the vibration of the tool is in part decreased by the subjection of the hammer to reduced pressure at the beginning of its effective stroke. The descent or outward movement of the hammer, as described, will cause its solid extension or mandrel to strike a sharp blow upon the upper or inner end of the tool 21, and the hammer will assume the position shown in Fig. 1 of the drawings, with the hammer-port 24 opposed to the annular exhaust-chamber 9 to permit the exhaust of the motive fluid from the interior of the casing above the hammer.

It will now appear that provision must be made for effecting the automatic return of the hammer 8 to its initial position, in order that it may reciprocate at a high rate of speed to cause it to strike successive blows upon the chisel or other tool. This end is attained by providing the hammer with an elongated longitudinal return-port 28, opening at its upper end adjacent to the upper extremity of the hammer and opening at its lower end through the shoulder 29, defined between the outer edge of the hammer and the extension 20. The arrangement of the port 28 is such that when the port 24 is opposed to the exhaust-channel 9 the upper end of the port 28 will be disposed before the supply-channel 11 or the port 12, communicating therewith. Thus when the hammer has descended and the motive agent is exhausted from the upper end of the shell the lower end of the hammer will cut off the communication between the return compression-chamber 7 and the exhaust-channel 9 and the fluid will be admitted into the chamber 7 through the port 28. The effect of this admission will be to impart an initial return impetus to the hammer, which

will not be subjected to pressure from below during the final portion of its return stroke, for the reason that as soon as the lower end or shoulder 27 of the hammer is elevated above the lower edge of the exhaust-channel 9 the motive agent will be exhausted from the chamber 7 and further supply to said chamber will have been cut off by the passage of the upper end of the port 28 beyond the port 12. In this peculiarity will be found the basis for another statement heretofore made—to wit, that the vibration of the tool is decreased in part by the subjection of the hammer to pressure during the first portion only of its return movement, the purpose of which is to permit the hammer to come to a comparatively gradual stop as it approaches the upper or inner limit of its return movement. If now we follow the operation of the device carefully, it will be seen that as the hammer ascends and the upper end of its extension 23 enters the chamber extension 5 of the head a considerable head of air will be occluded within the upper end of the shell around the extension 24 and will oppose by its compression considerable resistance to further upward or inward movement of the hammer. The space within which this air accumulates and is compressed is the necessary result of the reduction of the upper end of the hammer in order to decrease the effective pressure area thereof during the initial portion of its downstroke, and it will be readily seen that the pressure of air within this space will present sufficient resistance to the upstroke of the piston to cause considerable vibration of the tool as the hammer reaches the limit of its return movement. It is therefore necessary to relieve the objectionable compression, and for this reason I have enlarged the internal diameter of the shell to produce the auxiliary compression-chamber 6, which in one aspect is a relief-chamber, inasmuch as such enlargement enables the compression above the shoulder 27 to be relieved through the return-port 28, the upper end of which is arranged to pass above the lower edge of the chamber 6 immediately after the upper end of the extension 23 of the hammer enters the extension 5 of the chamber 4. It is therefore obvious that the compression which would otherwise oppose the return movement of the piston during the final portion of its stroke will be relieved through the port 28 and will pass into the lower end of the shell, which in this position of the hammer is in direct communication with the exhaust-port 10. Here we find the third feature of the invention, which contributes directly to the decrease of the vibration which is usually imparted to the hand of the workman who manipulates the tool by grasping the handle 3 in an obvious manner—that is to say, we have discovered in what manner the hammer is subjected to reduced pressure during the initial portion of its downward movement or effective stroke, in what manner the hammer is returned under pressure exerted only during the initial portion of its return stroke, and in what manner the relief of the compression above the hammer is effected during the final portion of its return movement. In considering this form of the invention, therefore, it remains only to call attention to the small auxiliary return-port 30, opening through the side of the hammer and communicating with the port 28 a short distance below the upper end thereof. This auxiliary port is particularly useful in starting the hammer without excessive vibration, and its utility will be made apparent by the following description of the manner in which the tool is started when it is desired to begin operations therewith: The workman grasping the handle 3 and manipulating the device as an entirety positions the chisel or other tool for use and by inserting the forefinger through the ring 19 of the trigger swings the latter sufficiently to open the initial valve 16. The motive fluid is thus permitted to fill the supply-chamber 13 and passing through the return-port 28 in the hammer is liberated within the compression-chamber 7. The hammer is thus given an upward impetus until its movement establishes communication between the chamber 7 and the exhaust-port 10, when, as will be obvious, the compression of air above the hammer will cause the latter to descend until the small auxiliary port 30 is presented before the supply-port 11. A small quantity of air will thus be admitted through the port 28 to the compression-chamber 7, and the hammer will again rise with the same effect. In this manner the hammer is started with a short quick stroke, insufficient to cause it to strike the tool or to present the port 24 before the supply-channel 11. The operator now increases the effective pressure of the motive agent by throwing the initial valve 16 farther open, and thereby gradually accelerating the movement of the hammer until its impetus is sufficient to present the port 24 before the supply-channel 11, when, as will be obvious, the motive agent will pass to the interior of the hammer and expanding within the compression-chamber will inaugurate the effective operation of the device. If desired, the lower or outer end of the shell may be fitted with a tapering bushing 31 of hard steel, and in this event the space above the bushing will be relieved by a transverse port 32 to prevent the possibility of compression below the mandrel or extension 20 of the hammer, and this port will furthermore aid in effecting the prompt exhaust of the motive agent in the chamber 7, as the lower end of the hammer extension will be elevated above the lower wall of the chamber 7 at about the same time communication is established between the said chamber and exhaust-port 10.

In Figs. 3 and 4 I have shown a pneumatic hammer constructed in accordance with my

invention, but eliminating the initial valve and trigger, so that the entire device is composed of but three parts—to wit, the shell, the head, and the hammer, the operation of the latter being controlled in this form of the device by the insertion or withdrawal of the tool into or from the shell. When the tool 21 is removed or is not forced fully to place, the hammer will be disposed in the position shown in Fig. 3, with its shoulder 29 resting upon the bottom wall of the return compression-chamber 7. In this position the motive agent—as, for instance, compressed air, gas, steam, or other fluid under compression—will pass into the upper end of the shell around the hammer extension and will hold the hammer securely in its depressed position with the interior of the shell entirely out of communication with the exhaust-port. If now the tool is passed into the shell and pressed inward with sufficient force to lift the hammer and establish communication between the exhaust-port 24 and the exhaust-channel 9 to exhaust the fluid from above the hammer and to further establish communication between the port 28 and the supply-port 12, the parts will be positioned as shown in Fig. 1 of the drawings, and the subsequent operation of the device will be similar to that heretofore described, except that as a full pressure of liquid is admitted at once the effective operation of the hammer will not begin gradually, as will be the case when the fluid-pressure is gradually increased by means of the initial valve.

From the foregoing it will appear that I have produced a simple, ingenious, and efficient pneumatic or other automatic hammer embodying a construction best calculated to accomplish the various objects stated; but while the embodiments of my invention herein illustrated and described are thought at this time to be preferable I do not limit myself to the structural details defined, but reserve the right to effect such changes, modifications, and variations as may be properly embraced within the scope of the protection prayed.

What I claim is—

1. An automatic hammer comprising a casing, a hammer movable therein, means for directing a fluid-pressure against a reduced area of the hammer during its initial movement and against the whole pressure area during the remainder of its movement in one direction, and means supplemental to the normal exhaust for relieving the compression opposed to the hammer during the final portion of its movement in the opposite direction.

2. In a fluid-operated hammer, the combination with a casing having means for admitting and exhausting motive fluid, of a plunger or hammer fitted within the casing for reciprocation by pressure of the motive fluid therein, means for reducing the pressure area of the hammer during the initial portion only of the movement of the hammer in one direction, and means for relieving the compression opposed to that portion of the pressure area defined by such reduction, said relief being effected during the final portion only of the return movement of the hammer.

3. In a fluid-operated hammer, the combination with a casing, a hammer movable therein and a primary compression-chamber defined in part by a reduced pressure area of the hammer, of an auxiliary compression-chamber defined in part by a separate pressure area of the hammer, means for exhausting the motive fluid from both compression-chambers, and means for subsequently relieving the compression within the auxiliary compression-chamber.

4. A fluid-operated hammer comprising a casing, a hammer movable therein, and means for admitting the motive fluid to the interior of the casing to operate the hammer, of means for exhausting the motive fluid opposed to the movement of the hammer in one direction, and a relief-port in the hammer for subsequently relieving the compression caused by such movement of the hammer.

5. A fluid-operated hammer comprising a casing, a hammer movable therein, and means for admitting the motive fluid to the interior of the casing to operate the hammer, of means for exhausting the motive fluid opposed to the movement of the hammer in one direction, and means for subsequently relieving the compression caused by such movement of the hammer, said relief being effective only during the final portion of the stroke and after the termination of the normal exhaust.

6. A fluid-operated hammer comprising a casing, a hammer movable therein and means for admitting the motive fluid to the interior of the casing to operate the hammer, of means for exhausting the motive fluid opposed to the movement of the hammer in one direction, and means controlled by the hammer for relieving the compression produced by such movement of the hammer.

7. A fluid-operated hammer comprising a casing, a hammer movable therein and means for admitting the motive fluid to the interior of the casing to operate the hammer, of means for exhausting the motive fluid opposed to the movement of the hammer in one direction, and a relief-port within the hammer arranged to be uncovered subsequent to the exhaust of the motive fluid, whereby the compression produced by the movement of the hammer subsequent to the exhaust of the motive fluid will be relieved through said port.

8. In a fluid-operated hammer, the combination with a casing provided at one end with a primary compression-chamber having a reduced extension and an auxiliary compression-chamber, of a hollow hammer movable within the casing and provided with a reduced hammer extension designed to fit within the chamber extension in one position of the hammer, and means for relieving the com-

pression within the auxiliary chamber after the hammer extension has entered the extension of the primary compression-chamber.

9. In a fluid-operated hammer, the combination with a casing provided at one end with a primary compression-chamber having a reduced extension and an auxiliary compression-chamber, of a hollow hammer movable within the casing and provided with a reduced hammer extension designed to fit within the chamber extension in one position of the hammer, and a relief-port formed in the hammer and designed, after the hammer extension has entered the chamber extension, to relieve the compression within the auxiliary compression-chamber.

10. In a fluid-operated hammer, the combination with a casing and a hammer mounted for reciprocation therein, of means for subjecting the hammer to fluid-pressure during the initial portion only of its movement in one direction.

11. In a fluid-operated hammer, the combination with a casing and a hammer disposed for reciprocation therein, of means for subjecting the hammer to the action of the fluid motive agent during the entire effective stroke of the hammer, and means for effecting the return stroke of said hammer by subjecting it to fluid-pressure during the initial portion only of such return stroke.

12. In a fluid-operated hammer, the combination with a casing and a hammer mounted for reciprocation therein, of means for reducing the area of the surface of said hammer exposed to the pressure of a motive fluid during the initial portion of its effective stroke and for subsequently increasing such area during the effective stroke of the hammer, means for subjecting the hammer to fluid-pressure during the initial portion only of its return stroke, means for exhausting the motive fluid from behind the hammer to permit such return movement, and means operative subsequent to such exhaust for relieving the compression opposed to the return movement of the hammer.

13. In a fluid-operated hammer, the combination with a casing and a hammer mounted for reciprocation therein, of means for reducing the area of the surface of said hammer exposed to the pressure of a motive fluid during the initial portion of its effective stroke and for subsequently increasing such area during the effective stroke of the hammer, means for subjecting the hammer to fluid-pressure during the initial portion only of its return stroke, means for exhausting the motive fluid from behind the hammer to permit such return movement, and means effective only during the final portion of the return stroke of the hammer for relieving the compression produced by and opposed to such return movement.

14. In a fluid-operated hammer, the combination with a casing provided with supply and exhaust ports and having a primary compression-chamber and a return compression-chamber adjacent to its opposite ends, of a fluid-operated reciprocatory hammer within the casing, means for admitting the motive fluid to the primary and return chambers alternately through the hammer, means for exhausting said fluid from one of the chambers through the hammer, and means for effecting the direct exhaust of the other chamber by the initial movement of the hammer in one direction.

15. In a fluid-operated hammer, the combination with a casing provided with supply and exhaust ports, of a reciprocatory hammer within the casing, said hammer being provided with an axial chamber, a port in communication with said chamber, and a comparatively small return-port, said port and return-port of the hammer being arranged for alternate presentation before the supply-port of the casing.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

DANIEL SHAW WAUGH.

Witnesses:
GEO. H. LANE,
EUGENE S. COOK.