(No Model.) 2 Sheets—Sheet 1.

# D. DRAWBAUGH.

## PNEUMATIC TOOL.

No. 482,942. Patented Sept. 20, 1892.

Fig. 1.

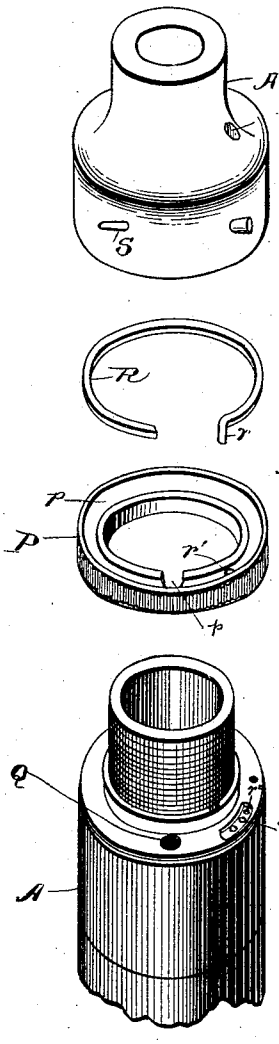


Fig. 2.

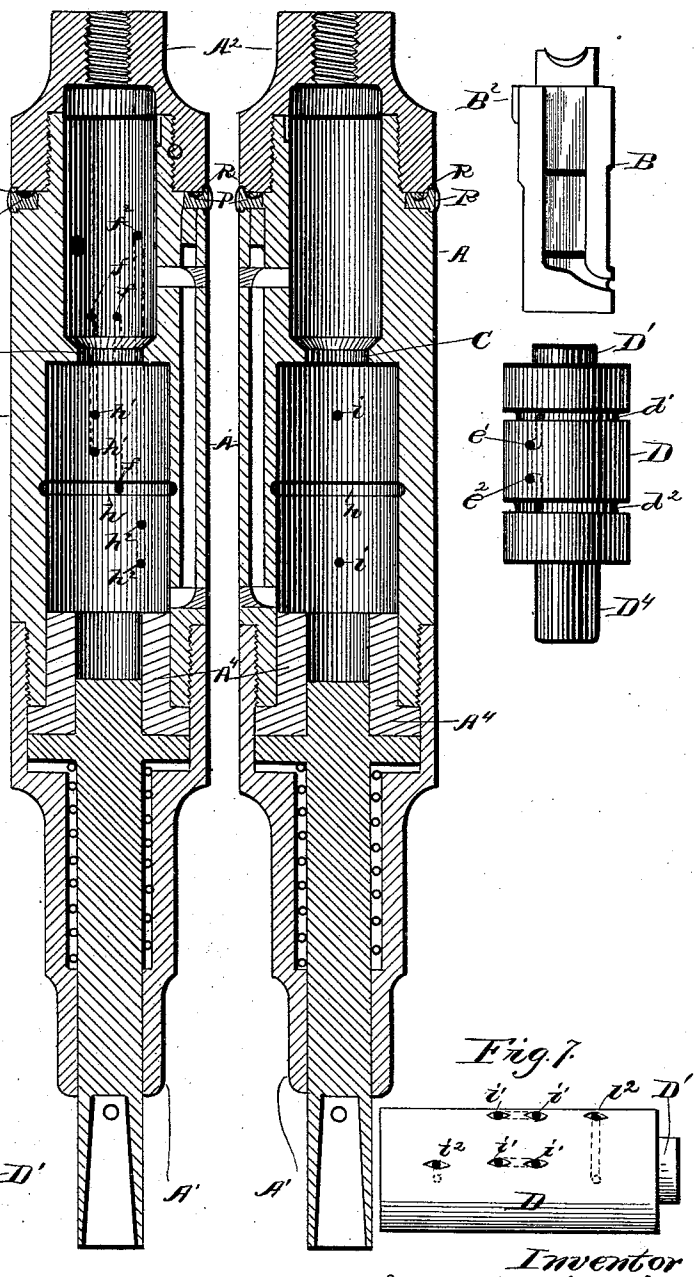


Fig. 6.

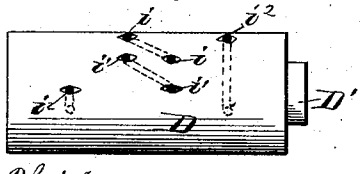


Fig. 7.




Witnesses.

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(No Model.) 2 Sheets—Sheet 2.

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## PNEUMATIC TOOL.

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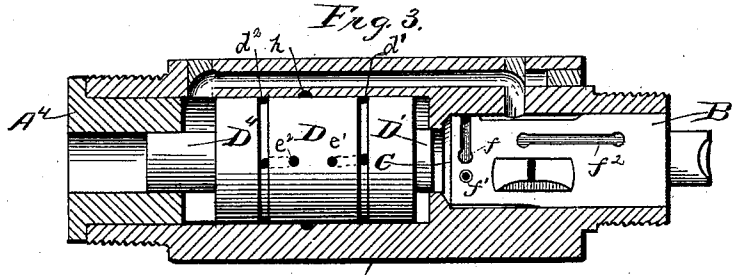
Fig. 3.




A Fig. 4.

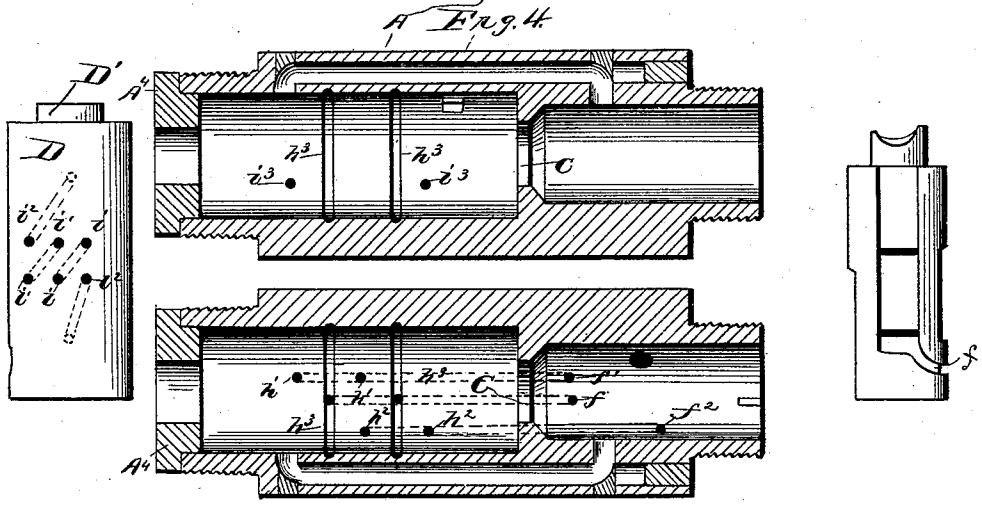
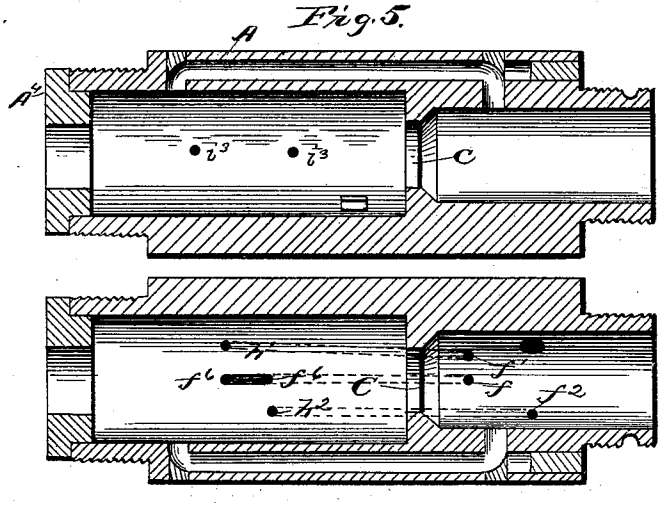



Fig. 5.




Witnesses

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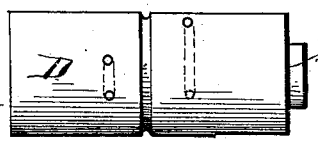


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# UNITED STATES PATENT OFFICE.

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## PNEUMATIC TOOL.

SPECIFICATION forming part of Letters Patent No. 482,942, dated September 20, 1892.

Application filed April 30, 1892. Serial No. 431,224. (No model.)

*To all whom it may concern:*

Be it known that I, DANIEL DRAWBAUGH, of Eberly's Mill, in the county of Cumberland and State of Pennsylvania, have invented certain new and useful Improvements in Pneumatic Tools; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the letters of reference marked thereon.

This invention relates to improvements in pneumatic tools for rock-cutting, boiler-calking, &c., and has for its object to improve the construction and increase the efficiency of such tools, particularly that described in my prior patent, No. 472,495, dated April 5, 1892, to which reference is hereby made for a more complete understanding of the general details of construction not specifically described herein.

The invention consists in certain novel details of construction and combinations and arrangements of parts, all as will be hereinafter described, and pointed out particularly in the appended claims.

Referring to the accompanying drawings, Figure 1 is a perspective view of the rear end of the tool with the parts separated to show the cut-off ring and retainer therefor. Fig. 2 is a sectional view of a tool, showing both halves and the hammer or beater and valve-casing in elevation. Fig. 3 is a view of one half with the valve and beater in place to show air-cushion space in rear of the beater. Fig. 4 is a view similar to Fig. 2, showing the annular pressure grooves or channels in the casing. Fig. 5 is a similar view showing a single annular pressure groove or channel in the beater. Figs. 6 and 7 show modified forms of beater.

Similar letters of reference in the several figures indicate the same parts.

In general construction and appearance the tool shown and embodying the present invention is similar to that shown and described in my said prior patent—that is to say, a casing or body-section A is provided, having the cylinder and valve-chamber formed in alignment therein and adapted for the reception of a point-section A′, carrying the tool-stock, and a cap-section $A^2$, adapted for the attachment of the pressure-supply pipe. Within the valve-chamber is located a valve-casing B, having the necessary ports and passages communicating with ports and passages in the casing and leading to opposite ends of the cylinder, just as described in said prior patent, and to opposite ends of the valve, the arrangement of the latter ports and passages being novel, as will presently appear, the valve-casing B in the present instance being positioned by a small key $B^2$ at the upper end fitting a corresponding groove or keyway in the casing, as shown.

Difficulty has been experienced with tools of this class because of the great vibration incident largely to the concussion of the beater on the return stroke, and it is one of my principal objects to remedy this defect. Attempts have been made to cushion the return stroke of the hammer or beater by mechanical cushions and by confining a body of air in the end of the cylinder as the beater neared the end of its stroke; but the first means mentioned, besides being inefficient, was soon destroyed and became entirely useless, causing its abandonment, and the latter as formerly employed was unsatisfactory, rendered the construction of tool expensive, and impaired its efficiency by reason of the difficulty in starting should the beater come to rest in the upper end of the cylinder. To overcome all these difficulties, I now propose to confine a body of air at the upper end of the cylinder, which shall act as a cushion, operating on a part only of the cross-sectional area of the beater, while the remainder of such area is open to the action of live pressure from the valve to give the initial movement to the beater on the return stroke.

Of course many mechanical constructions will at once occur to those skilled in the art for carrying this invention into practice, and I have shown in the drawings one form which is at once simple and effective. Thus the passage leading from the valve-chest to the cylinder is enlarged and forms a part which might more correctly be termed a "reduced" portion of the cylinder, (lettered C in the drawings,) and into this reduced portion of the cylinder a correspondingly-shaped por-

tion D′ of the beater D is adapted to fit and close the same before the beater reaches the extreme upper limit of its movement. This, it will be seen from Fig. 3, cuts off communication between the cylinder and air-passage and confines a body of air in the cylinder around the reduced portion of the beater, which as the beater continues its backward movement becomes compressed and effectually cushions or deadens the stroke. It leaves, however, a portion of the cross-sectional area of the beater open to the air passage or port and the pressure exerted upon it initiates the return movement of the beater, facilitated by the elasticity of the cushioned air.

The valve is a pressure-actuated one, and the entrance and exhaust of air from opposite ends is controlled by the beater through the medium of passages and ports opening into the cylinder at an intermediate point and cooperating ports and passages in the beater, the general operation being for the beater to put the passage *f*, which is open to pressure at all times, into communication alternately with the passages $f'$ and $f^2$, opening into the valve-chest at opposite ends of the valve, the changes being effected at the proper moments to throw the valve into position for maintaining the reciprocations of the beater in the ordinary manner.

With a view of more perfectly balancing the lateral pressure on the beater I form one or more pressure-grooves in the wall of the casing or beater, or both, which serve as the ports and distribute the pressure evenly around the whole beater, thereby reducing friction and preventing wear, &c. In Figs. 2 and 3, which is the most approved form, because with it the beater may be run without a spline and groove to prevent its rotation, the passage *f* opens at the bottom into a pressure-groove *h* of approximately the cross-sectional area of the passage, and the passages $f'$ $f^2$ have at their lower ends ports $h'$ $h'$ and $h^2$ $h^2$, respectively, the ports $h'$ $h'$ being located a distance apart corresponding approximately to the range of longitudinal movement of the beater and preferably above the groove *h*, and the ports $h^2$ $h^2$ are correspondingly located below the groove *h*. The beater D is provided with two peripheral grooves $d'$ $d^2$, adapted to register simultaneously with the uppermost of the pairs of ports $h'$ $h^2$ when the beater is retracted, or with the lowermost of said ports when the beater is at the lower extreme of its movement. In the opposite side of the casing or at any suitable point laterally are exhaust-ports *i i*, located, preferably, in the same transverse plane as the uppermost and lowermost ports $h'$ $h^2$ and registering with the grooves $d'$ $d^2$ simultaneously with said ports $h'$ $h^2$, respectively, thus opening the exhaust to opposite ends of the valve-chest as the beater reaches opposite extremes of its movement. To simultaneously admit pressure to the end of the valve not open to the exhaust, ports $e'$ $e^2$ are formed in the beater between the grooves, but communicating, respectively, with the grooves $d'$ $d^2$ through suitable channels, (shown in dotted lines,) and these ports register, respectively, with the central groove in the casing when the beater is at opposite extremes of its stroke. Thus the beater is caused to control the air for moving the valve and the valve to control the air for the beater in the well-understood manner. As shown in this form, the beater is provided with a nose or forward projection $D^4$, passing into or through a collar $A^4$, held in the lower end of the cylinder by the point-section, and the tool-stock is preferably provided with a similar nose or projection. In this form the beater is free to rotate in the cylinder, dispensing entirely with the spline and groove, quite a material advantage. However, should it be desired, the spline and the groove or equivalent may be used, and when used a number of variations in the arrangement of the ports and pressure-balancing grooves may be made. For instance, in Fig. 4 the pressure-passage *f* opens into two annular grooves in the casing, (lettered $h^3$ $h^3$,) and the passages $f'$ $f^2$ to opposite ends of the valve have the ports $h'$ $h'$ and $h^2$ $h^2$, just as in the former instance, the only difference being that the ports $h'$ $h'$ open, respectively, above and below the lowermost groove $h^3$ and the ports $h^2$ $h^2$ open, respectively, above and below the uppermost groove.

The beater may have its ports and passages variously arranged. In said Fig. 4 it has three pairs of ports arranged transversely of the beater, the upper line of ports $i^2$ *i* $i'$ registering with the upper groove when the beater is retracted and the lower line (similarly lettered) with the lower groove when the beater is advanced. The ports *i i* and $i'$ $i'$ are respectively connected by diagonal passages, (shown in dotted lines,) and the ports $i^2$ $i^2$ (the exhaust-ports) are connected by diverging passages with ports on the opposite side in position to register with the ports $i^3$ $i^3$ of the exhaust-passage, respectively, when the beater is at opposite ends of its stroke.

In operation when the beater is retracted the upper line of ports is over the upper groove, the exhaust-port $i^2$ is cut off on the opposite side of the beater because of the non-registry with port $i^3$, and the lower port *i* is over the port $h^2$, leading to the upper end of the valve, and admits pressure thereto from the upper groove through said ports *i*. At the same time the lower port $i^2$ is open to the port $h'$, and on the opposite side of the cylinder it communicates with exhaust through the lower port $i^3$ and opens the lower end of the valve to exhaust. When the beater is advanced, this arrangement is just reversed, the lower groove being put into communication with the lower end of the valve through ports $i'$ $i'$ and the upper end of the valve is opened to exhaust through the upper port $i^2$. Figs. 6 and 7 show two other arrangements of ports in the beater for use in this casing.

Thus in Fig. 6 the ports $i\ i$ and $i'\ i'$ preserve the same positions; but the ports $i^2\ i^2$ are moved nearer the ends of the beater and register with the ports $h'\ h'$ above and below the two grooves, respectively, these last-mentioned ports not being of use with the first form of beater. Otherwise the arrangement and operation are similar in all respects to those just described, and they are somewhat more convenient, because the ports and passages $i^2$ may be bored straight through the beater. In Fig. 7 the ports $i^2\ i^2$ are arranged just as they are in Fig. 6; but the ports $i\ i$ and $i'\ i'$, instead of being arranged diagonally, each port is arranged in the same longitudinal plane as the corresponding port $h'$ and $h^2$, with which they alternately communicate. The operation is essentially the same as that just described, save that a flow of air is kept up through both the ports $i\ i$ and $i'\ i'$ when the beater is at each extreme of its movement, tending to keep the passages clean by preventing accumulations therein during the periods when in the other forms no air passes through them.

It is not essential that the pressure-equalizing groove be located in the casing, as in some instances it may be found desirable to locate it in the beater, leaving the surface of the cylinder smooth, and to accomplish this the structure shown, for instance, in Fig. 5 may be employed, wherein it will be seen that the passage $f$ has two ports $f^6$ in line with each other and about a distance apart equal to the length of stroke of the beater and preferably connected, as shown, to form one long port, which is always in communication with the groove in the beater to maintain the pressure therein more evenly. The passages $f'\ f^2$ have their ports $h'\ h^2$ respectively in line transversely with upper and lower parts of the port or ports $f^6$. Thus when the beater is retracted the upper end of the valve is put in communication with pressure, and when the beater is advanced the lower end is put in communication with the same. The exhaust-ports $i^2\ i^2$ in this instance run straight through the beater, as before explained, and are located in line longitudinally with the ports $h'\ h^2$, respectively, and above and below the groove, in position to register with the port $h'$ or $h^2$, which is not in communication with the pressure-ports, and at the same moment to communicate with the exhaust-ports $i^3\ i^3$ in the opposite side of the casing. The operation is so nearly like that of the other forms and so obvious as to need no further detail description.

To govern or regulate the tool, I prefer to employ a cut-off or throttle for the exhaust in the form of a ring P, having a milled edge, and a passage $p$, adapted to register with the exhaust-passage Q, passing up through the casing and cap-sections. The cut-off ring is rotatable to open or close the passage and is limited in its rotation and held in adjusted position by the spring R, lying in an annular groove or seat in the top of the ring and having one end $r$ bent and passed through an aperture $r'$ in the ring in position to enter or engage any one of a series of notches or irregularities $r^2$ in the casing adjacent the ring. The ring affords lateral support for the end of the spring and the employment of a pin is dispensed with. The cap-section seats on the spring and holds it securely in place, making the device cheap and simple. The cap-section is held in place by a taper key S, and the point-section may be similarly held, if desired, although there is less danger of the point-section working loose.

A tool constructed in accordance with this invention will be found highly efficient in use, the wear on the beater and casing being reduced to a minimum by the equal pressure thereon due to the annular pressure-grooves, and besides equalizing the pressure the pressure-grooves serve to distribute a film of air between the beater and casing on which the beater seems to float almost frictionless. My present theory as to this action is that the large area of the pressure groove or grooves distributes the film of air, as aforesaid, and as the exhaust-ports are so exceedingly small in proportion to the area of the beater and pressure-ring much more air finds its way in between the wall of the cylinder and beater than finds its way out, maintaining a film of air between the moving parts. This constant pressure in the groove prevents leakage from either end of the beater to the exhaust-ports, or from one end to the other, the infinitesimal leakage from the groove itself to the said exhaust-ports or to either end of the beater amounting to practically nothing. Besides these advantages, the absence of harmful vibration is an advantage which will be at once appreciated by those skilled in handling this class of tool.

Having thus described my invention, what I claim as new is—

1. In a pneumatic tool, the combination of the cylinder, valve, air-port, beater, and projection, said ports being so arranged as that the projection closes the air-port before the beater reaches the extreme of its movement, forming an air-cushion around the projection and leaving the cross-sectional area of the projection open to the air-port, whereby the return movement may be initiated, substantially as described.

2. In a pneumatic tool, the combination, with the cylinder, valve, and air-port opening into the cylinder in line with the beater in its longitudinal movement, of the beater and cooperating projection for closing said port before the beater reaches the limit of its movement, whereby the area of the projection is available to initiate the return movement, substantially as described.

3. In a pneumatic tool, the combination, with the cylinder, valve, and air-port opening into the cylinder in line with the beater in its longitudinal movement, of the beater and the projection entering the air-port to close the same before the beater reaches the extreme

of its movement, whereby an air-cushion is formed around the projection and the area of the projection is available to initiate the return movement, substantially as described.

4. In a pneumatic tool, the combination, with the cylinder, valve, and air-port opening into the cylinder in line with the beater and constituting a reduced portion of the cylinder, of the beater having the reduced end or projection entering said reduced portion of the cylinder to cut off the air-supply before the beater reaches the limit of its movement, whereby an air-cushion is formed around the projection, substantially as described.

5. In a pneumatic tool, the combination, with the casing having the cylinder and valve-chamber formed in alignment therein and the enlarged air-port in the wall between said cylinder and valve-chamber, of the beater having the projection entering said air-port to close the same before the beater reaches the limit of its movement, whereby an air-cushion is formed around the projection, substantially as described.

6. In a pneumatic tool, the combination, with the casing having the cylinder and valve-chamber formed in alignment therein with the enlarged air-port in the wall between said cylinder and valve-chamber, the valve-casing in said chamber having the passage leading to said port and the valve, of the beater having the reduced end or projection entering said port before the beater reaches the extreme of its movement to close the same and form an air-cushion around the projection, substantially as described.

7. In a pneumatic tool, the combination, with the cylinder, beater, and valve controlling the air-passages for each other, respectively, of the annular pressure-groove in communication with the air-supply and surrounding the beater, substantially as described.

8. In a pneumatic tool, the combination, with the cylinder, valve controlling the beater, and beater controlling the valve, of the relatively small exhaust-ports in the beater and cylinder for the passages from the ends of the valve and the annular pressure-groove in communication with the air-supply and surrounding the beater, substantially as described.

9. In a pneumatic tool, the combination, with the cylinder, valve controlling the beater, passages leading from pressure to approximately the center of the cylinder and from there to the ends of the valve, and the relatively small exhaust-passages, of the beater having the ports and passages registering with said ports and passages in the cylinder and the annular pressure-groove into which the pressure-passage in the cylinder opens, whereby pressure on the beater is equalized, substantially as described.

10. In a pneumatic tool, the combination, with the cylinder, valve controlling the beater, the pressure-groove in the inner surface of the cylinder in communication with the pressure-supply, and passages and ports leading from said cylinder to opposite ends of the valve and to exhaust, of the beater having ports and passages for connecting the pressure groove and passages to opposite ends of the cylinder and the latter passages with exhaust, substantially as described.

11. In a pneumatic tool, the combination, with the cylinder, valve, and annular pressure-groove in the inner face of the cylinder in communication with the pressure-supply and ports and passages leading to opposite ends of the valve, of the beater having grooves adapted to register with the last-mentioned passages and supply-passages connecting the pressure-groove and grooves in the beater when at opposite extremes of its movement, substantially as described.

12. In a pneumatic tool, the combination, with the cylinder, valve, and annular pressure-groove in the inner face of the cylinder in communication with the pressure-supply and ports and passages leading to opposite ends of the valve and to exhaust, of the beater having grooves adapted to register with the passages leading to opposite ends of the valve and with the exhaust-passages and passages in the beater in communication with said grooves and adapted to register with the pressure-groove in the cylinder, substantially as described.

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