

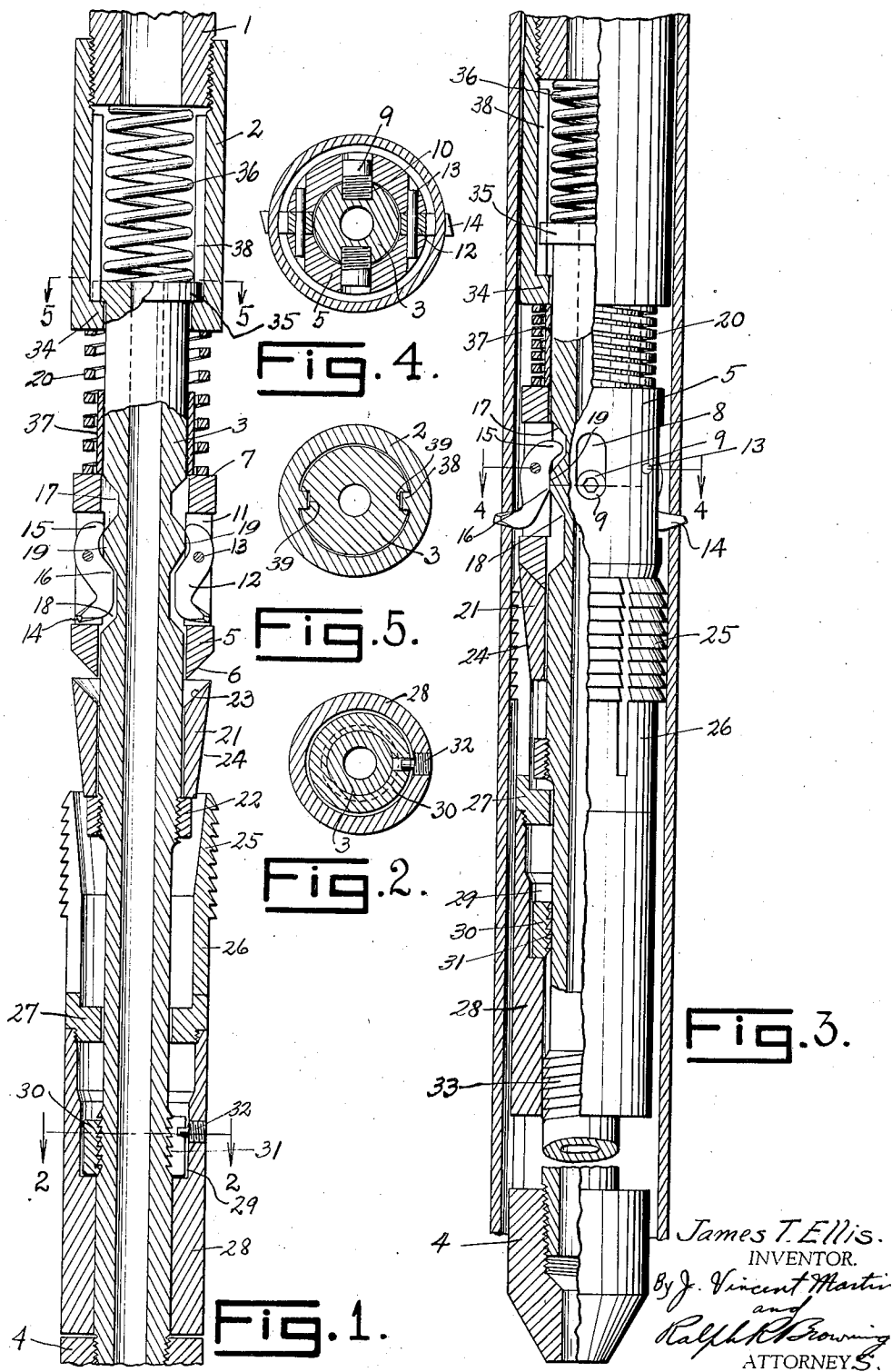
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PIPE CUTTER

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PIPE CUTTER

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11 Claims. (Cl. 164—0.7)

This application is in part a continuation of my co-pending patent application, S. N. 213,113, filed June 11, 1938, for Pipe cutter.

This invention relates to pipe cutters and has particular reference to that type of pipe cutter adapted to be lowered into a pipe in a well, or the like, for the purpose of severing the upper portion of the pipe from the lower portion thereof so that the upper portion of the pipe may be lifted from the well.

It is a general object of this invention to provide a pipe cutter of the type set forth in which the arrangement of parts is such that the operation of the cutter will involve the least possible vibration and the least likelihood of shifting of the cutter after the cutting operation has begun, to provide for the latching of the actuating and anchoring portions of the cutter in inoperative position when an upward pull is exerted upon the device by which the cutter is supported, and to prevent the application of an excessive feeding force to the cutter knives.

Various cutters have been designed for cutting pipe in place in a well, or the like, so that a portion of the pipe can be removed. Means have also been devised for latching the cutter actuating means in inoperative position when it is not intended to use the cutter, that is, when lowering the cutter into a pipe or removing it therefrom, thus avoiding the possibility of the cutter blades becoming expanded or moved to cutting position when not intended. However, in these previous constructions, the cutting blades have for the most part been located at a considerable distance from the means for anchoring the cutter with the consequence that more or less vibration took place when the cutter was operated. Furthermore, it has been found that during the cutting operation the action of the cutter blades is frequently such as to tend to release the slips, or the like, by which the cutter is usually anchored within the pipe. With previous constructions, also, it has been necessary in order to lock the cutter actuating means in inoperative position to rotate or otherwise manipulate the cutter support after retracting the cutter blades. That is, of course, not a sure method because it can never be certain when a device is located deep in a well whether the cutter actuating means has actually been latched in inoperative position or not. One must, therefore, simply carry out the steps which should latch the device in inoperative position and hope that nothing has interfered with the proper functioning of the latching means.

It is an object of this invention to provide a cutter in which the cutting blades are so positioned that they will make a cut as close as possible to the location of the cutter anchoring means when the anchoring means is in operative posi-

tion, and thus avoid in so far as possible excessive vibration of the cutter in operation.

It is further an object of this invention to so arrange the cutter blades and anchoring means that the action of the cutter blades during the cutting operation will tend to more firmly set the anchoring means.

It is an object of this invention to provide a pipe cutter having means for positively locking the blade actuating device in inoperative position by simply an upward pull upon the cutter support.

It is a further object of this invention to provide a pipe cutter of the type set forth in which the locking of the cutter actuating device will also lock the cutter blades in inoperative position.

Another object of this invention is to provide a pipe cutter of the type set forth in which the cutter actuating device and the cutter anchoring device will be simultaneously locked in inoperative position so that an operator can ascertain whether the cutter actuating device has been locked in inoperative position by determining whether the cutter anchoring device has been thus locked.

Another object of this invention is to provide a cutter of the type set forth in which there will be no substantial longitudinal movement of the cutter blades during the process of expanding said blades in severing a pipe.

In cutters of the general type illustrated the movement of the cutter blades toward cutting position may be caused in any one of a number of different ways. A great deal of trouble has been caused by the fact that in most such means in the prior art there has been no way of governing the amount of force applied to cause such movement. This naturally results in a tendency for the knives to dig in and take too much of the cut, or not to take any cut at all.

It is therefore a further object of this invention to provide a pipe cutter in which the movement of the cutter blades to cutting position can be governed and the force applied to cause such movement positively limited so that the tool will not take too deep a cut, yet the blades will at all times be pressed against the work with a force of a sufficient value to cause the blades to feed properly.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing in which like numerals indicate corresponding parts throughout. It is to be distinctly understood that said description and drawing are given by way of example and not by way of limitation upon the scope of this invention. Such limitation is to be only by the prior art and by the terms of the appended claims:

In the drawing:

Fig. 1 is a vertical cross section of a pipe cutter constructed in accordance with this invention showing the cutter actuator and the cutter anchoring device locked in inoperative position.

Fig. 2 is a horizontal cross section of the same device taken along the line of 2—2, Fig. 1.

Fig. 3 is a view similar to Fig. 1 but showing the cutter anchored in place within a pipe and the cutter blades fully expanded as they would appear after severing the pipe.

Fig. 4 is a horizontal cross section taken along the line of 4—4 of Fig. 3.

Fig. 5 is a horizontal cross section taken along the line 5—5 of Fig. 1.

The numeral 1 indicates a string of tubing upon which the pipe cutter of this invention is adapted to be lowered into a pipe to be severed. The numeral 2 indicates a fitting at the lower end of the tubing 1 by which this tubing is connected to the tubular cutter actuating member 3. This actuator 3 extends downward through the entire length of the cutter and carries on its lower end a guide shoe 4 which is threaded thereto. Surrounding the actuator 3 a relatively short distance below the lower end of the fitting 2 is a blade carrying sleeve 5 having a tapered lower end 6 and a substantially square cut upper end 7 forming a shoulder. Intermediate its ends this sleeve is provided with slots 8 adapted to retain pins 9 which are threaded at 10 into the body of the actuator 3, so as to retain the sleeve 5 against rotative movement on the actuator 3 while permitting a limited longitudinal movement of this sleeve upon the actuator. This sleeve is also provided with two other longitudinal slots 11 located substantially at 90 degrees from the slots 8 and in these slots 11 there are pivotally mounted a pair of cutter arms 12. These arms 12 are pivoted at 13 on pins carried in the sleeve 5 on opposite sides of the slots 11. At their lower ends, these cutter arms are provided with cutter blades 14, and extending inwardly from the upper ends 15 of these levers and from an intermediate portion 16 thereof, are actuating surfaces which project into recesses 17 and 18 respectively in the actuator. Between the recesses 17 and 18 is a projection 19 on each side of the actuator 3 adapted to engage the portions 15 and 16 of the cutter arms and positively position these cutter arms with respect to the sleeve depending upon the position of the sleeve upon the actuator 3. It will be noted that due to the shape of the recesses 17 and 18, and of the cutter arms 12, the cutter blades, when the sleeve is in its lower position upon the actuator will be fully contracted and held in inoperative position and when this sleeve is moved upwardly the blades 14 will be positively moved outwardly to expanded or active position. A spring 20 surrounds the actuator intermediate the shoulder formed by the lower end of the fitting 2 and the part 7 on the upper end of the sleeve 5, so as to normally and resiliently hold this sleeve in its lowermost position upon the actuator.

Surrounding the actuator below the sleeve 5 is a tapered ring-shaped mandrel and bearing member 21 having its downward movement limited by a nut 22 threaded onto the actuator 3. This member 21 is provided with a tapered upper surface 23 adapted to seat against and provide a bearing for the lower end 6 of the sleeve 5, and with a conical external surface 24 adapted to receive and expand the anchoring slips 25 when

the actuator and the member 21 are moved downwardly with respect to these slips.

The slips 25 are carried by upwardly extending arms 26 on a ring 27 and to the lower end of this ring is threaded a sleeve 28 recessed at 29 to receive a split ring 30 having inwardly extending upwardly directed spiral teeth 31. This ring 30 is permitted to move upwardly and downwardly within a recess 29 but is prevented from rotation therein by means of the guide part 32 threaded into the wall of the sleeve 28. It will be noted that the lower part of the recess 29 is of lesser diameter than the upper part thereof so that when the ring 30 is in the lower part of this recess it will be prevented from expanding, but that when it is in the upper part thereof it may expand.

Formed on the exterior of the actuator 3 when positioned to cooperate with the teeth 31 on the split ring are a series of spiral downwardly directed teeth 33. It will be seen that these teeth may be engaged with the teeth in the ring 30 to hold the actuator in its upper position with respect to the anchoring slips 25, and when the parts are in this position, the sleeve 5 which carries the cutter blades will likewise be held in its lowermost position with respect to the actuator by means of the spring 20.

It will be particularly noted that the connection between the fitting 2 and the actuator 3 is a lost motion telescoping connection permitting relative longitudinal movement of these parts. The lower end of the fitting 2 is formed with an internal flange 34 and the upper end of the actuator 3 is formed with an external flange 35 adapted to cooperate therewith to prevent these parts from moving apart and becoming separated from each other. The parts are normally held extended, however, by means of the spring 36 within the fitting 2, so that any downward movement of the tubing 1 will cause the actuator 3 to be resiliently urged downwardly. Downward movement of the tubing with respect to the sleeve 5 is limited by a sleeve 37 within the spring 20.

While the joint between the fitting 2 and the actuator 3 is a telescoping joint, the interior of the fitting 2 is provided with splines 38 which operate in grooves 39 in the flange 35 on the actuator, so that rotation of the tubing 1 will cause rotation of the actuator.

In operation, the cutter, with the parts in position as shown in Fig. 1, is lowered into a pipe to be cut. The slips 25 are so positioned that they will be constantly in contact with the inner surface of the pipe to be cut, these slips being held under slight tension against such surface by virtue of the resiliency of the arms 26. The sleeve 5 is held in the position shown in Fig. 1 by means of the spring 20, and when in this position it will be apparent that the cutter blades will be held in retracted position. When the cutter reaches the position where it is desired to sever the pipe, the tubing 1 will be rotated to the right by a number of turns sufficient to release the spiral teeth 33 from the spiral teeth 31. During this rotation the sleeve 28 will be held against rotation by engagement of the slips 25 and the wall of the pipe and the ring 30 will be prevented from rotating by means of the part 32.

When the actuator has been released from the ring 30, it may then be lowered while the slips 25 and the sleeve 28 will be held in the same position by virtue of the engagement between the slips 25 and the wall of the pipe to be cut. When the actuator has been lowered sufficiently, the

upper inner surfaces of the slips 25 will engage the conical expanding mandrel 21, causing the slips to further expand to positively engage the inner wall of the pipe and anchor thereagainst. The actuator may then be lowered further until the lower end of the sleeve 5 comes in contact with the upper end of the member 21 at which time the sleeve 5 will be prevented from further downward movement with the actuator and the member 21 will be driven home to further anchor the slips 25 within the pipe.

It will be seen that upon downward movement of the tubing after the slips have been anchored, the spring 20 will be compressed and the actuator will be moved downwardly by the spring 36 until the cutter blades are moved inwardly and engage the work. Further downward movement of the tubing will merely compress both springs until the lower end of the fitting 2 engages the sleeve 37 and stops its downward movement. Since the force on the actuator tending to expand the cutter blades is exerted only through the spring 36, and since the movement of the tubing to compress the spring 36 is limited by the contact of the tubing with the sleeve 37, the force which can be exerted to expand the knives is limited. The tool can then be rotated with all of the weight of the tubing on the sleeve 37 if desired, without danger of exerting an excessive expanding force on the knives, and the knives will be fed by the spring 36 as the cut is made.

After the pipe has been severed, it being desirable to move cutter mechanism out of the well or to a new location in the well, an upward pull is exerted upon the tubing 1. This upward pull causes the actuator 3 to move upwardly within the sleeve 5, the expander 21, the ring 27 and the sleeve 28. When the upper ends of the teeth 33 on the actuator strike the lower ends of the teeth 31 in the ring 30, this ring will be lifted into the enlarged upper portion of the chamber 29 where it will be permitted to expand and will be caused to expand by virtue of the inclination of the teeth 33 and 31. This expansion will permit the ring 30 to move downwardly over the teeth 33 so that when the actuator is again moved downwardly with respect to the sleeve 28, it will be held against such movement as would permit the slips 25 to move upwardly into expanding engagement with the expander 21. The expander 21 will be held up out of engagement with the slips 25 by means of the nut 22 and the parts will occupy the position substantially as illustrated in Fig. 1.

It will be seen from the foregoing that a pipe cutter has been provided which is capable of carrying out all of the objects and advantages sought by this invention, that by pulling up the tubing supporting the cutter mechanism the cutter anchoring and actuator means will be positively locked against operation so that the cutter may then be moved to a different location or removed from the pipe, and it will further be seen that this locking may be released quickly and easily when desired and that when so released the operator will have a positive indication thereof by virtue of the anchoring of the cutter device in the pipe.

It will further be seen and is clearly illustrated in Fig. 3 that when the pipe cutter set forth is anchored in place within a pipe and the cutting blades expanded to contact with the pipe, the cutting portions of the blades in contacting the pipe will tend to move not only radially outwardly but also slightly upwardly with respect to

the main body of the cutter and with respect to the slips by which the cutter is anchored. This tendency on the part of the cutter blades will as the blades are expanded tend to cause the slips to become more firmly anchored rather than to cause them to become dislodged.

It will be further apparent that by virtue of the arrangement illustrated in the drawing and set forth in the specification, and particularly by virtue of the fact that the cutter blades are carried on the lower extremities of their arms, these blades will be positioned closely adjacent to the anchoring slips and the cutting will take place closely adjacent the point at which the cutter is anchored. This, it will be appreciated, will definitely reduce the tendency toward any vibration as the cutting takes place and thereby not only increases the efficiency of the cutter during the cutting operation and prolongs its life by relieving it from the destructive effects of vibration, but at the same time one of the factors which in previous constructions has tended to cause the cutter to slip from its anchorage has been removed.

In the pipe cutter illustrated, also, the force tending to feed the cutter blades into the pipe to be cut will be limited to a predetermined amount and yet it will be possible for the operator at all times to know that enough such force is being applied.

A pipe cutter has, therefore, been provided which will be found to be thoroughly reliable, as well as simple in operation, and very durable.

Having described my invention, I claim:

1. In a pipe cutter, in combination, an outwardly, movable cutting blade, means for resiliently urging said blade, and means for limiting the force transmitted to said blade by said resilient means.

2. In a pipe cutter, means for anchoring said cutter in a pipe, an outwardly movable cutting blade to be anchored thereby against longitudinal movement in said pipe, means for forcing said cutter blade outwardly, and means for positively limiting the amount of force which may be applied to said blade by said forcing means.

3. In a pipe cutter, an outwardly movable cutter blade, an actuator movable to positively force said blade outwardly, resilient means for so moving said actuator, and means, independent of said actuator, for limiting the degree to which said resilient means may be tensioned.

4. In a pipe cutter, an outwardly movable blade, an actuating means for moving said blade outwardly, said means including a lost motion correction and a resilient means for urging said lost motion connection toward one extreme position, means for moving one part of said connection to tension said resilient means and transmit an expanding force to said blade, and means for limiting such movement of said last mentioned part.

5. In a pipe cutter, a cutter carrier, an anchoring device therefor, a cutter blade mounted therein for outward movement with respect thereto, a resilient means for applying an expanding force to said blade, means movable to distort said resilient means and cause it to apply such force, and means for limiting the movement of said last mentioned means.

6. In a pipe cutter, a cutter carrier, means for anchoring said carrier against downward movement in a pipe to be cut, an outwardly movable cutter blade on said carrier, an actuator mandrel movable downwardly with respect to said blade

and carrier to apply an expanding force thereto, a tubing movable downwardly to apply a downward force to said mandrel, a resilient member between said tubing and said mandrel for transmitting such force to said mandrel, and means independent of said mandrel for limiting the downward movement of said tubing with respect to said cutter carrier.

7. In a pipe cutter, an elongated cutter support having cam surfaces thereon, a sleeve slidable upon said support, a cutter arm pivotally mounted on said sleeve and having parts adapted to cooperate with said cam surfaces to move said arm about its pivot with respect to sleeve when said support is moved longitudinally with respect to said sleeve, an outwardly directed cutter blade on said arm below its pivotal support, means for urging said sleeve downwardly with respect to said support to retract said cutter blade, movable means carried by the said support below said sleeve and longitudinally movable on said support to move said sleeve upwardly on said support, anchoring means longitudinally movable with respect to said support and adapted when expanded to prevent downward movement within a pipe, said anchoring means being adapted to engage said movable means to cause expansion of said anchoring means when said support is moved downward with respect to said anchoring means, and releasable means for holding said support against downward movement with respect to said anchoring means.

8. In a pipe cutter, an elongated cutter support having cam surfaces thereon, a sleeve slidable upon said support, a cutter arm pivotally mounted on said sleeve and having parts adapted to cooperate with said cam surfaces to move said arm about its pivot with respect to sleeve when said support is moved longitudinally with respect to said sleeve, an outwardly directed cutter blade on said arm below its pivotal support, means for urging said sleeve downwardly with respect to said support to retract said cutter blade, a downwardly tapered mandrel carried by the said support below said sleeve and longitudinally movable on said support, anchoring means longitudinally movable with respect to said support and adapted when expanded to prevent downward movement within a pipe, said anchoring means being adapted to receive said tapered mandrel to cause expansion of said anchoring means when said support is moved downward with respect to said anchoring means, and releasable means for holding said support against downward movement with respect to said anchoring means.

9. In a pipe cutter, an elongated cutter support having cam surfaces thereon, a sleeve slidable upon said support, a cutter arm pivotally mounted on said sleeve and having parts adapted to cooperate with said cam surfaces to move said arm about its pivot with respect to sleeve when said support is moved longitudinally with respect to said sleeve, an outwardly directed cutter blade on said arm below its pivotal support, means for urging said sleeve downwardly with respect to said support to retract said cutter blade, a downwardly tapered mandrel carried by the said support below said sleeve and longitudinally movable on said support, slips longitudinally movable with respect to said support and adapted when expanded to prevent downward movement within a pipe, said slips being adapted to receive said tapered mandrel to cause expansion of said

slips when said support is moved downward with respect to said slips, and releasable means for holding said support against downward movement with respect to said slips.

10. In a pipe cutter, an elongated cutter support having cutter blade actuating means thereon, a cutter blade having parts adapted to cooperate with said cam surfaces to move said cutter blade to and from operative position when said support is moved longitudinally with respect to said blade, means for anchoring engagement with a pipe and adapted to be moved to anchoring position by longitudinal movement relative to said support, downwardly directed spiral ratchet teeth upon said support, a split ring adapted to embrace said teeth and having downwardly directed spiral ratchet teeth therein, and means for limiting longitudinal movement and for preventing rotational movement of said ring with respect to said anchoring means, whereby said cutter blade will normally be held in retracted position and said anchoring means will normally be held out of operative position, and whereby said support may be released from said split ring by rotation to permit it to be moved downwardly with respect to said anchoring means, thus moving said anchoring means to operative position, and whereby on upward movement of said support said cutter blade will be retracted and said split ring will again be engaged with the said support to latch said anchoring means in inoperative position.

11. In a pipe cutter, an elongated cutter support having cam surfaces thereon, a sleeve slidable upon said support, a cutter arm pivotally mounted on said sleeve and having parts adapted to cooperate with said cam surfaces to move said arm about its pivot with respect to sleeve when said support is moved longitudinally with respect to said sleeve, an outwardly directed cutter blade on said arm below its pivotal support, means for urging said sleeve downwardly with respect to said support to retract said cutter blade, a downwardly tapered mandrel carried by the said support below said sleeve and longitudinally movable on said support, slips longitudinally movable with respect to said support and adapted when expanded to prevent downward movement within a pipe, said slips being adapted to receive said tapered mandrel to cause expansion of said slips when said support is moved downward with respect to said slips, downwardly directed spiral ratchet teeth upon said support, a split ring adapted to embrace said teeth and having downwardly directed spiral ratchet teeth therein, and means for limiting longitudinal movement of said split ring with respect to said slips and for preventing rotational movement of said ring with respect to said slips, whereby said cutter blades will normally be held in retracted position and said slips will normally be held out of contact with said tapered mandrel, and whereby said support may be released from said split ring by rotation to permit it to be moved downwardly with respect to said slips, thus engaging said slips with said mandrel and expanding the same and upon continued downward movement expanding said cutter blade, and whereby on upward movement of said support said cutter blade will be retracted and said split ring will again be engaged with the said support to latch said anchor in inoperative position.

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