United States Patent [19]

Sugiki et al.

[11] **3,727,599**

[45] **Apr. 17, 1973**

[54] **METHOD OF AND APPARATUS FOR CUTTING HOLLOW PRECAST CONCRETE PILES OR THE LIKE**

[75] Inventors: **Rokuro Sugiki,** Ohta-ku, Tokyo; **Takemitsu Mori,** Kokubunji-shi, Tokyo; **Tomoyuki Hayakawa,** Kawasaki-shi, all of Japan

[73] Assignee: **Nippon Concrete Kogyo Kobushiki Kaisha,** Tokyo, Japan

[22] Filed: **July 27, 1971**

[21] Appl. No.: **166,391**

[52] **U.S. Cl.**.....**125/23 R,** 83/180, 225/1, 225/103

[51] **Int. Cl.**.....**B28d 1/00,** B26f 3/00

[58] **Field of Search**.....225/1, 93, 103; 125/23 R, 1; 166/55, 55.1; 61/53, 53.5, 83

[56] **References Cited**

UNITED STATES PATENTS

3,086,509	4/1963	Henley	125/23 R
3,171,312	3/1965	Fuchs, Jr. et al.	83/191
3,492,984	2/1970	Harper	125/23 R
3,567,088	2/1971	Anderson	225/103

Primary Examiner—Frank T. Yost

Attorney—Albert H. Oldham et al.

[57] **ABSTRACT**

Hollow precast concrete piles can now be cut in their state driven into the ground to remove their top portion extending above the ground with efficiency and without causing any substantial noise or any damage to the lower major pile portion set in the ground principally by mechanically applying a shearing force to the pile substantially radially in a transverse cross section thereof at the level where the pile is to be cut.

5 Claims, 12 Drawing Figures

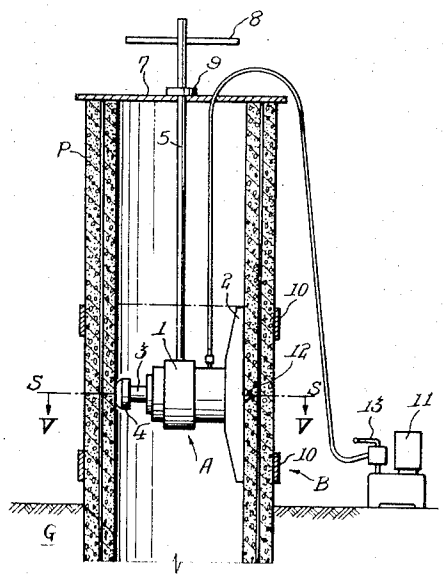


Fig. 1

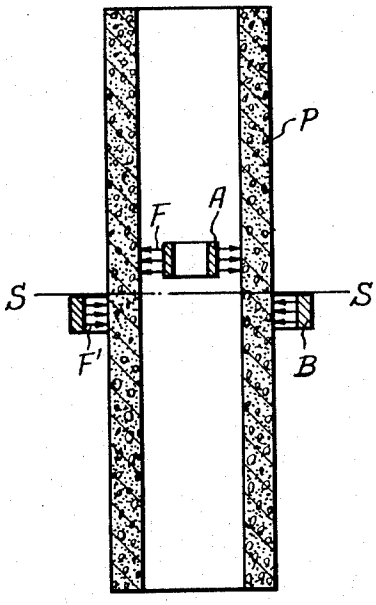


Fig. 3

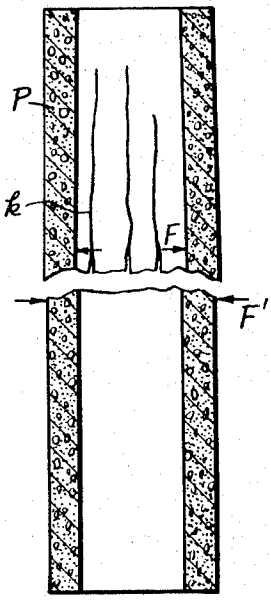
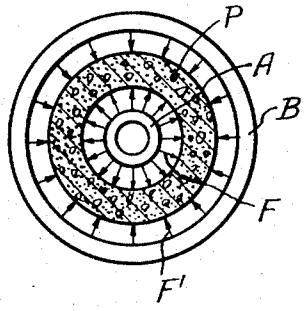


Fig. 2



INVENTOR
Rokuro Sugiki
Takemitsu Mori
Tomoyuki Hayakawa
BY Oldham & Oldham
ATTORNEY

Fig. 4.

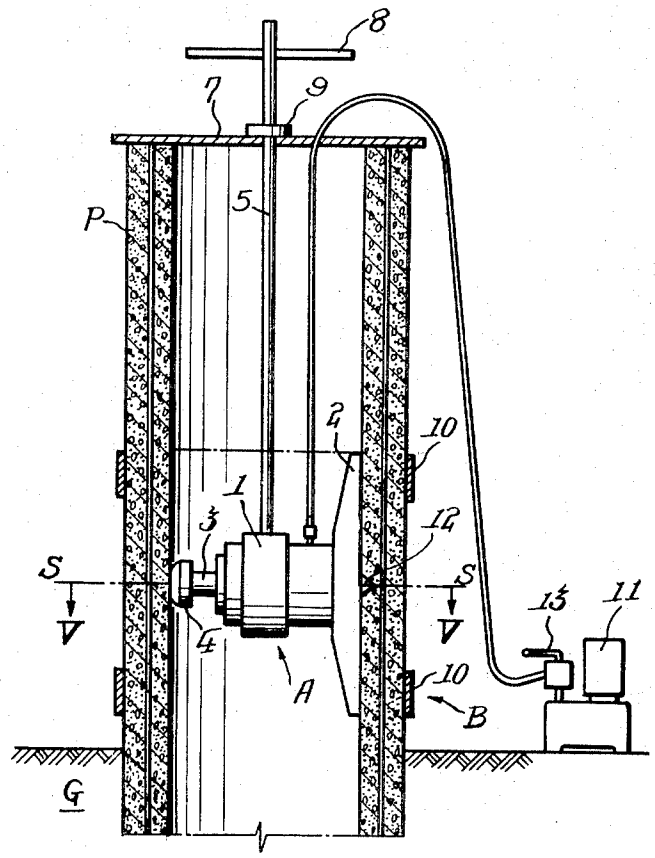
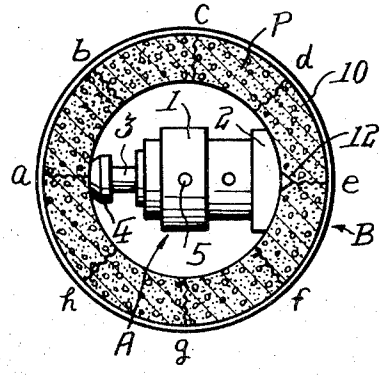


Fig. 5.



INVENTOR
Kokura Sugiki
Takemitsu Mori
Tomoyuki Hayakawa
BY Oldham & Oldham
ATTORNEY

Fig. 6

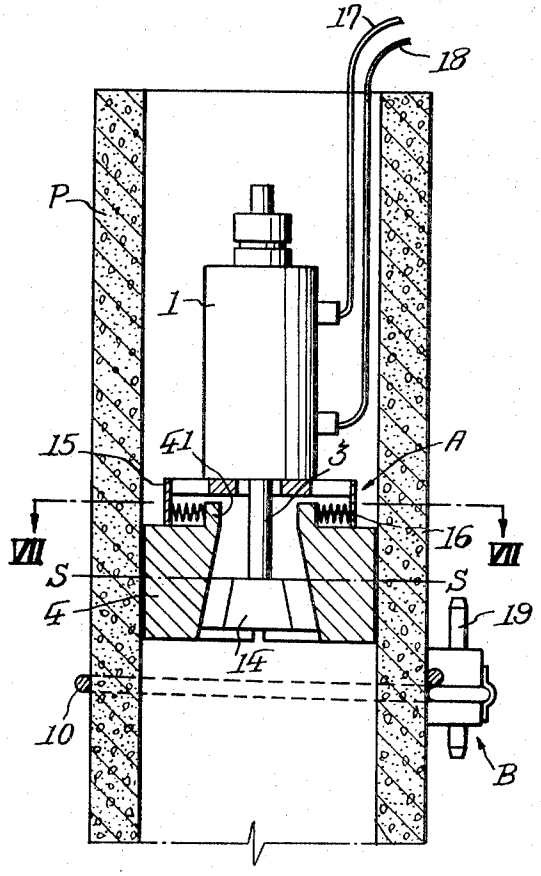
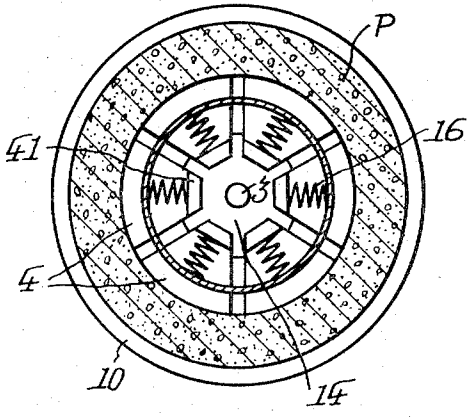


Fig. 7



Rokuro Sugiki INVENTOR
Takemitsu Mori
Tomoyuki Hayakawa

BY Oldham & Oldham

ATTORNEY

Fig. 8

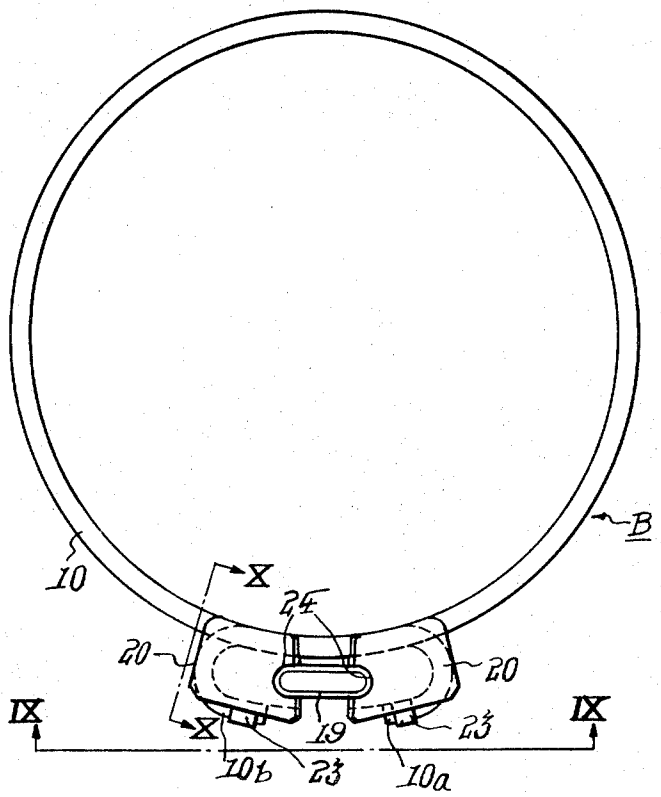


Fig. 9

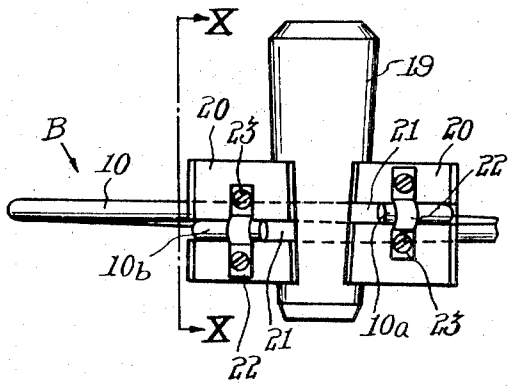
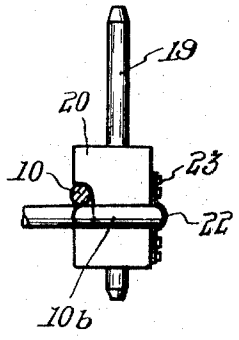


Fig. 10



Rokuro Sugiki INVENTOR
Takemitsu Mori
Tomoyuki Hayakawa
BY Oldham & Oldham
ATTORNEY

Fig. 11

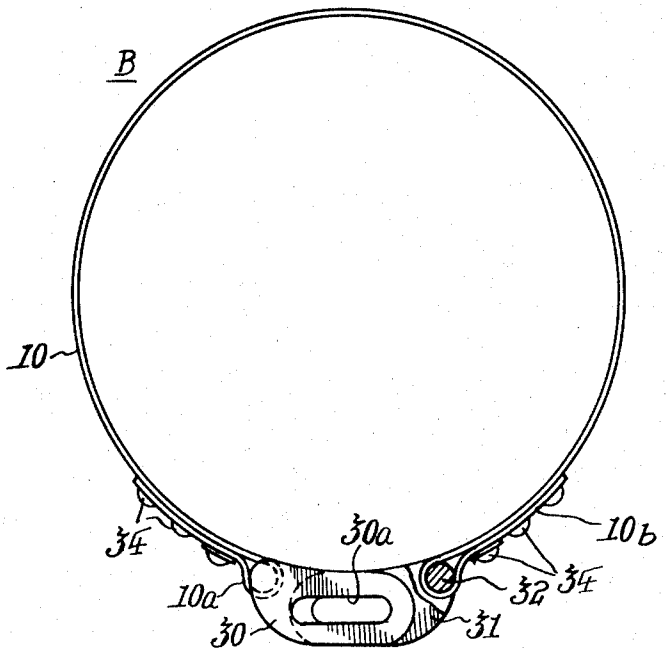
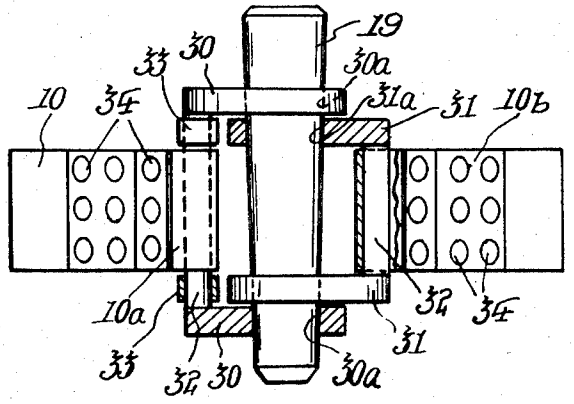


Fig. 12



Rokuro Sugiki INVENTOR
Takemitsu Mori
Tomoyuki Hayakawa

BY Oldham & Oldham
ATTORNEY

METHOD OF AND APPARATUS FOR CUTTING HOLLOW PRECAST CONCRETE PILES OR THE LIKE

BACKGROUND OF THE INVENTION

In use of precast concrete piles, it is usual that they remain partly above the ground in their state just finally set in the ground and their exposed top portion must be cut off by some means or other. For such pile cutting, however, no satisfactory mechanical method has previously been proposed and usual practice has been to remove the exposed pile portion by manually chipping the material bit by bit with a hand tool or a powered device such as a concrete breaker.

Such practice, however, has involved various deficiencies. First, impacting blows of the chisel result in a damage to the pile regions adjacent to the cross-sectional cut made, causing cracks running axially through the lower pile portion. This apparently results in reduction in compressive strength of the pile foundation. Moreover, the manual cutting operation, naturally requiring much labor and extended time of operation, is extremely low in efficiency.

Under these circumstances, there has been a strong demand in the art for methods of and apparatus for cutting precast concrete piles, poles or the like, which overcome such difficulties as described above.

SUMMARY OF THE INVENTION

The present invention is principally intended to meet the above demand in the art, and purposes to cut hollow precast concrete piles, poles or the like by breaking the desired cross-sectional region thereof principally under the shearing action effected by applying radial forces to the pile region both internally and externally thereof.

It is an object of the present invention to provide a mechanical method of cutting hollow precast concrete piles or the like without causing any substantial noise during operation.

It is another object of the invention to provide an apparatus capable of cutting hollow precast concrete piles or the like without causing any substantial noise during operation.

A further object of the present invention is to provide a mechanical method of cutting hollow precast concrete piles or the like and more particularly of breaking only the concrete section thereof without cutting any reinforcing bars embedded therein.

Another object of the present invention is to provide a mechanical method of cutting hollow precast concrete piles or the like in which a plurality of radially movable pressure pieces are employed to apply internal pressure to the corresponding number of circumferentially spaced points on the inside of an annular transverse cross-sectional pile region at which the pile is to be cut thereby to produce shearing forces effective to break the pile region.

Yet another object of the invention is to provide a mechanical method of cutting hollow precast concrete piles or the like in which a hydraulically actuatable bit means is employed to apply internal pressure successively to a plurality of circumferentially spaced points on the inside of an annular transverse cross-sectional pile region at which the pile is to be cut in a manner so as to produce a shearing force effective to partly break the pile region at each of the respective points.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIGS. **1** to **3** schematically illustrate the principles of the method of the invention and FIG. **1** represents a longitudinal axial cross section of a hollow precast concrete pile, FIG. **2** representing a transverse cross section of same taken along the line S—S in FIG. **1**, and FIG. **3** represents a view similar to FIG. **1**, illustrating the pile in its cut state;

FIG. **4** is a longitudinal axial cross section of a hollow precast concrete pile being cut with an apparatus embodying the present invention;

FIG. **5** is a transverse cross section of the pile taken along the line V—V (S—S) in FIG. **4**;

FIG. **6** is a view similar to FIG. **4**, illustrating a modification of the cutting apparatus shown in FIGS. **4** and **5**;

FIG. **7** is a transverse cross section taken along the line VII—VII in FIG. **6**;

FIGS. **8** to **10** illustrate the details of an annular band used on the outside of the hollow pile to be cut and FIG. **8** represents an enlarged plan view of the band;

FIG. **9** is a side view on the section along the line IX—IX in FIG. **8**;

FIG. **10** is a cross sectional view along the line X—X in FIG. **8** or **9**;

FIG. **11** is a partly cutaway plan view of a modified form of annular band; and

FIG. **12** is a side elevation of same, partly in cross section.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **1** and **2**, reference character P indicates a hollow precast concrete pile or pole; A indicates an internal pressure device designed to apply pressure to the inside wall surface of the hollow concrete body P; and B indicates an external pressure device designed to apply pressure to the outside wall surface of the body P.

As will readily be seen, if the internal pressure device A operates to apply a substantially uniform internal pressure F radially to the inside wall surface of the hollow concrete pile P just above the level of transverse cross section S—S, at which the pile is to be cut, and simultaneously the external pressure device B operates to apply a substantially uniform external pressure F′ radially to the outside wall surface of the pile just beneath the level of transverse cross section S—S, then a shearing action occurs in the cross section S—S. Under this state, it will be recognized that the purpose of cutting the hollow concrete pile can be readily attained by increasing both the internal and external pressures to such an extent as to cause instantaneous rupture of the pile under increased shearing action, as illustrated in FIG. **3**. In this connection, it is to be noted that, though in the top pile portion extending above the cut line S—S and subjected to the internal pressure F cracks occur as indicated at *k* in FIG. **3**, the lower pile portion can be kept free from such cracking under the external pressure F′ applied thereto. In other words, the major pile portion set in the ground can remain undamaged.

Incidentally, it is obvious that not only the concrete section of the pile but also the reinforcing bars embedded therein are subjected to shearing action during the cutting operation described above. It is to be understood, however, that, since the reinforcing bars much exceed the concrete material in shear strength, they remain uncut and only the concrete section is cut by the operation.

Having described the principles of the present invention, description will next be made of some preferred forms of cutting apparatus embodying the principles of the invention with reference to FIGS. **4** to **12**.

Referring first to FIG. **4**, the illustrated internal pressure device A comprises a hydraulic jack **1** which includes a piston rod **3** carrying a bit **4** at its extremity and a bearing plate **2** fixed to the rear end of the jack casing. As shown, the bearing plate **2** is formed on its back or bearing surface with a projection **12** to serve the purpose of preliminary breaking.

In use of this embodiment, the internal pressure device A is supported by hanging rod means **5**, for example, inside a precast concrete pile P previously driven into the ground G, so as to lie in the level S—S at which the pile is to be cut. Hanging rod **5** carries a positioning collar **9** thereon which rests on a support plate **7** arranged on the top end of the pile P, as shown. As will readily be understood, the hanging rod **5** is vertically positioned by operation of a handle **8** fixed to the top of the rod **5** so as to set the forward end of the bit **4** in the cutting level S—S. The pile P is clamped on its outside with a metal band **10**, which corresponds to the external pressure device B described and shown hereinbefore in connection with FIGS. **1** and **2**, at least at one level below the cutting level S—S and preferably at two levels above and below S—S, as shown.

Again referring to FIG. **4**, reference numeral **11** indicates an oil pump unit connected with the hydraulic jack **1** by way of an operating valve **13**. Upon operation of the oil pump **11** the jack **1** is actuated to bring the bearing plate **2** into close contacting engagement with the adjacent inside wall surface of the pile P while at the same time driving the piston rod **3** forwardly to cause the bit **4** thereon to bite into the adjacent inside surface of the pile P. As the result, a crack is produced in the pile region adjacent to the bit **4**, for example, as indicated at *a* in FIG. **5** and the pile is partly broken. Incidentally, it is preferable that the bearing plate **3** has its back face formed complemental to the inside wall surface of the pile and large enough for satisfactory bearing function.

After the first partial breaking or formation of crack *a*, valve **13** is operated to cause the piston rod **3** and bit **4** to retract and the jack assembly **1** is turned horizontally into a new angular position for the second breaking operation by means of the handle **8** fixed to the top of the hanging rod **5**. The jack **1** is then actuated again by operation of the valve **13** to force the bit **4** into biting engagement with the adjacent inside surface of the pile P by the aid of the bearing plat **2** again held in close contacting engagement with the pile wall. Reference character *b* in FIG. **5** indicates a crack produced by the second breaking action of bit **4**. The above operation is repeated progressively around the inner periphery of the pile wall until an array of cracks radially arranged at substantially regular intervals are obtained, for example, as indicated at *a*, *b*, *c*, *d*, *e*, *f*, *g* and *h* in FIG. **5**, to complete the cutting operation. Reinforcing bars embedded in the concrete pile remain uncut as pointed out hereinbefore and can subsequently be cut by flame cutting or other appropriate means.

As will readily be appreciated, the pair of upper and lower metal bands **10** clamped around the outside of pile P serves to prevent formation of cracks in pile portions other than the pile region at the cutting level S—S. Only, in the usual case of piles previously driven into the ground like the pile P shown in FIG. **4**, where the top pile portion extending above the level S—S is cut off, the upper metal band is not needed. The bit **4** on the jack **1** can apparently be made interchangeable and suitably selected according to the size of hollow precast concrete piles or pipes to be cut.

In another embodiment of the invention shown in FIGS. **6** and **7**, the internal pressure device A comprises a hydraulic cylinder **1**, a piston rod **3** extending downwardly therefrom, a wedge member **14** carried on said piston rod at its bottom end and having a plurality, e.g., six, of inclined peripheral surfaces, and the same number of radially movable pressure pieces **4** held in contact with the respective peripheral surfaces of the wedge member **14**. Conduits **17** and **18** are connected to the hydraulic cylinder **1** for introduction therein and exhaust therefrom of pressure fluid to cause upward and downward movement of the piston rod **3** and wedge member **14**. When the wedge member **14** is moved upward, the pressure pieces **4** are forced to move radially outwardly under the action of the respective inclined surfaces of the wedge member **14** and thus simultaneously pressed against the respective adjacent regions of the inside wall surface of the hollow pile P.

Subsequently, when the piston rod **3** and wedge member **14** is moved downward under operation of a valve (not shown) reversing the flow of fluid through conduits **17** and **18**, the pressure pieces **4** are allowed to return to their normal innermost position under the bras of radially arranged compression springs **16**, which are anchored at the outer end to an annular ring **15** secured to the bottom of the jack cylinder **1** and are each seated at its inner end against a projection **41**, which is formed on the top of the corresponding pressure piece **4** along its inner edge.

As with the case of the embodiment shown and described hereinbefore, the external pressure device B used in this embodiment takes the form of a metal band **10** which is tightly clamped, as shown in FIG. **6**, against the outside surface of the hollow concrete pile P just below (and, if desired, above) the cutting level S—S. The hydraulic cylinder **1** is supported by a support rod, not shown, so as to place the pressure pieces **4** in the plane of cutting level S—S of pile P. In this state, when fluid pressure is supplied to the cylinder **1** and the pressure pieces **4** are forcefully pressed against the inside wall surface of the pile P, cracks are produced in the concrete material at about the level of cutting S—S under shearing action of the pressure pieces **4** and thus the purpose of cutting the pile P at the desired level S—S is effectively attained.

FIGS. **8**, **9** and **10** illustrate an example of means for clamping the metal band **10**, used as an external pressure device B in the embodiment of FIGS. **4** and **5** or FIGS. **6** and **7**.

Referring to FIGS. 8, 9 and 10, the metal band 10 is a bar of spring steel having a diameter of the order of 10 mm. and shaped into an annular form with the opposite end portions 10*a* and 10*b* overlapping each other and secured at their extreme ends to respective end blocks 20 each by means of a strap 22 and fixing screws 23. Each of the end blocks 20 is formed in its outer peripheral surface with a groove 21 to receive the end portion 10*a* or 10*b* of the band 10. The two end blocks 20 are also formed in their opposing faces with vertical grooves 24 to receive a cotter 19 therebetween. By insertion of cotter 19 between the two blocks 20, the latter are displaced apart from each other against the resilience of the band material which tends to pull the blocks toward each other and in this manner the band 10 can be fully clamped against the outside surface of a concrete pile or the like P. After completion of the pile cutting operation the band 10 can be readily released by extracting the cotter 19 from between the blocks 20 and removed from the pile.

FIGS. 11 and 12 illustrate a modification of the band clamping means, which is particularly adapted for use with a band 10 formed of spring steel strip, for example, having a width of approximately 60 mm. and a thickness of from 3 to 4 mm. As shown, the band 10 is shaped into an annular form and its opposite end portions 10*a* and 10*b* are folded back around respective pins 32 and riveted as at 34 to form looped ends. The pins 32 are carried on a pair of U-shaped cotter-receiving fixtures 30 and 31, which are formed in their opposite leg portions with tapered apertures 30*a* and 31*a*, respectively, to receive a cotter 19. As shown, the opposite legs of one of the U-shaped fixtures 30 are so spaced apart from each other as to receive therebetween the opposite legs of the other U-shaped fixture 31. When the cotter 19 is forced into the tapered apertures 30*a* and 31*a*, as shown, the two U-shaped fixtures 30 and 31 are pulled toward each other to tightly clamp the band 10 against the outer peripheral surface of the concrete pile or the like to be cut. After completion of the pile cutting operation, the strip band 10 can be readily removed from the pile by releasing the cotter 19 just in the same manner as in the case of the embodiment of FIGS. 8, 9 and 10.

What is claimed is:

1. A method of cutting hollow precast concrete piles or the like comprising applying internal pressure radially outwardly against the inside wall surface of the hollow concrete body in a transverse cross section thereof while at the same time applying external pressure radially inwardly against the outside wall surface of the hollow concrete body in a plane axially slightly spaced from said transverse cross section thereby to produce rupturing cracks in the concrete material of the pile under the shearing force caused by the internal and external pressures.

2. Apparatus for cutting hollow precast concrete piles or the like comprising a combination of hydraulic means for applying pressure against the inside wall surface of the hollow concrete body in a transverse cross section thereof and including at least one pressure piece movable radially with respect to the inside wall surface of the hollow concrete body, and a metal band for clamping the hollow concrete body circumferentially along the outside surface thereof in a plane axially slightly spaced from said transverse cross section to resiliently apply external pressure to the hollow concrete body.

3. Apparatus according to claim 2, in which said hydraulic means includes a hydraulic cylinder, a wedge member vertically movable under control of said hydraulic cylinder and having a plurality of inclined outer surfaces, and a plurality of pressure pieces movable radially with respect to the inside wall surface of the hollow concrete body under the action of said respective inclined outer surfaces of said wedge member.

4. Apparatus according to claim 2, in which said metal band is formed of a bar of spring steel and having an annular form with the opposite end portions overlapping each other and secured to respective end blocks formed with opposite grooves to receive a cotter therebetween, said cotter serving to force said end blocks away from each other thereby to clamp said metal band tightly against the outside surface of the hollow concrete body.

5. Apparatus according to claim 2, in which said metal band is formed of a strip of spring steel and having an annular form with the opposite end portions secured to respective U-shaped end fixtures each having opposite leg portions formed with tapered apertures to receive a cotter therein, said cotter acting to pull said end fixtures toward each other in co-operation with said tapered apertures in said U-shaped end fixtures thereby to clamp the metal band tightly against the outside surface of the hollow concrete body.

* * * * *