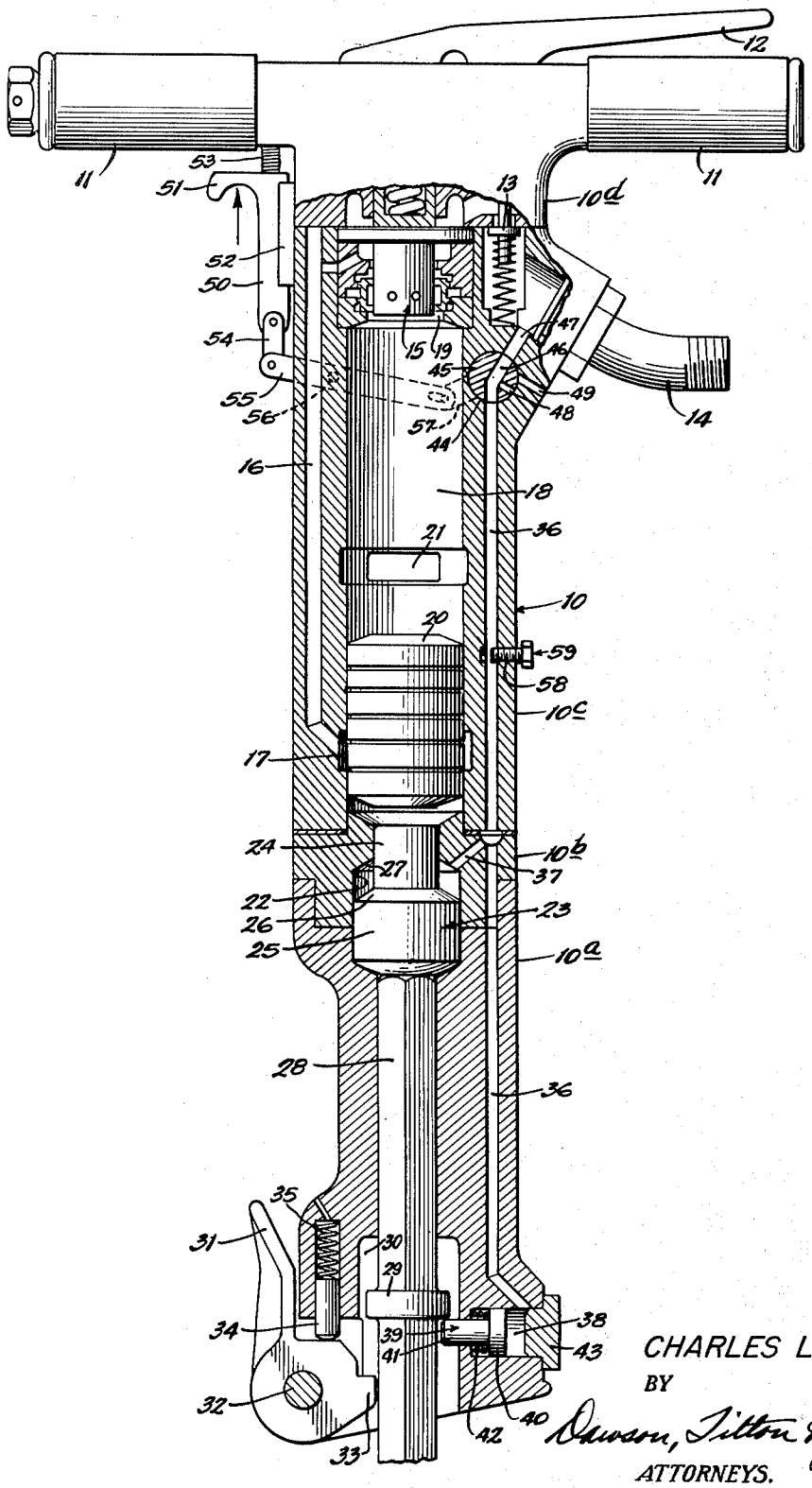
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PERCUSSION TOOL

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PERCUSSION TOOL

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This invention relates to percussion tools, and more particularly to paving breakers and the like wherein difficulty is experienced in removing the work member of the tool from a material it has penetrated.

It is well known that there are two distinct phases in the operation of paving breakers. First, the tool is operated in a manner to break a large section of material into smaller pieces, and during this breaking operation the work member of the tool penetrates the material and in so doing causes a piece thereof to break off of the larger section. Secondly, after the work member has penetrated the material to the full extent of its length, or a piece of material has broken away, or the operator determines that it is more desirable to penetrate the material at another point, the work member must be withdrawn or pulled out of the material it has penetrated before the tool can again be employed in a subsequent breaking operation.

In order to remove the work member from a material-penetrating position, the operator or workman must pull or lift the tool away from the material so that the casing of the tool moves axially with respect to the work member to bring a casing portion (usually the inwardly-extending ear of a retainer member) into abutting engagement with a portion of the work member (a laterally-extending retaining flange with which the work member is equipped). When this physical relationship between the paving breaker casing and work member is established by an active pull or lift upon the heavy casing by the workman, conditions are proper for the withdrawal or pull out of the work member.

Conventionally, paving breakers operate with a considerable amount of vibration, and the incessant vibratory movement of the tool casing is extremely fatiguing for the operator. The vibration is utilized to advantage, however, during the pull out of the work member from material-penetrating position. This results because once the workman has lifted the casing of the tool until the retainer member substantially abuts the retaining flange of the work member and thereafter maintains this physical relation, the upward component of the vibratory motion, or the component of the vibration in a direction away from the material, causes the casing (through the retainer member) to repeatedly impact the retaining flange of the work member and the repetitious impact forces drive the work member from the material it has penetrated.

It is apparent that the vibratory component in a direction away from the material is used to accomplish the work member pull out at the expense of increasing fatigue of the workman, since he must lift the heavy tool casing during the pull out phase of operation and he is therefore tense and his muscles tightened and the full pounding effects of the casing vibration are absorbed by him without attenuation in relaxed muscles. Fatigue is thereby hastened and the workman's efficiency decreases rapidly with the frequency of the pull out operation.

Fatigue of the workman, in addition to bringing about the general decrease in his efficiency, results in his inability to lift the paving breaker casing with sufficient force (often in the nature of about 150 pounds) to bring the retainer member and retaining flange of the work member into substantially abutting relation. Thus, the speed of the pull out phase of the tool operation decreases because a portion of the force that vibrates the tool casing in a direction away from the penetrated material is dissipated in lifting the casing through a relatively large distance to bring the retainer member and retaining flange into abutting relation and is not, therefore, translated into impact between these two members. Impact force is thereby lost and efficiency of the pull out operation suffers. This condition is particularly serious where the material penetrated by the work member is a heavy concrete slab and the pull out operation is slow at best. With material such as this, often the work member cannot be removed by the customary pull out operation because the frictional forces gripping the work member are in the order of from 500 pounds to 2,000 pounds, and other removal means must be adopted.

There has long been a need for percussion paving breakers and like tools wherein it is unnecessary for the operator to lift the heavy tool casing during the removal of the work member of the tool from a material it has penetrated, and it is accordingly an object of this invention to provide such a tool. Another object of the invention is to provide a paving breaker or the like in which the pull out phase of its operation is quite rapid as compared with conventional tools and in which the tool casing is automatically lifted, when desired, relative to the work member to provide the most desirable positioning therebetween for purposes of the work member's removal from embedded position in the material it has penetrated. A further object of the invention is the provision of impact means selectively operable with the casing lifting means to substantially abut the work member retaining flange when the casing is raised relative to the work member, whereby the full force tending to vibrate the casing in a direction away from the material penetrated by the work member is translated into impact against the retaining flange and portions of this force are not, therefore, dissipated in further lifting of the casing. Still another object of the invention is to provide selectively operable fluid pressure means for lifting the paving breaker casing relative to the paving breaker work member and establish therebetween a physical relationship for purposes of achieving efficient and rapid removal of the paving breaker work member from embedded position in the material it has penetrated and without the requirement of the workman's lifting the tool casing. Yet a further object resides in providing a fluid pressure actuated impact pin automatically actuated upon operation of the fluid pressure lifting means for impacting the retaining flange of the work member upon movement of the tool casing during the portions of the vibration when the casing moves in a direction away from the material penetrated by the work member.

Yet a further object is to provide means whereby the actuation of the impact pin does not occur until the casing of the paving breaker has been lifted to its maximum position relative to the work member, and in which the impact pin is deactuated prior to the return of the casing to its normal lowered position. Still another object is to accurately position the impact pin relative to the retainer member whereby the tool operates in a conventional manner without danger of breakage of the retainer member upon movement of the work member and

wherein the impact pin is also positioned relative to the work member retaining flange so that efficient pull out of the tool is accomplished by the impact between the retaining flange and impact pin, as hereinbefore described. Additional objects and advantages will appear as the specification proceeds.

An embodiment of my invention is illustrated in the accompanying drawing, in which a longitudinal sectional view is shown.

The paving breaker illustrated is for the most part conventional and includes a casing **10** having a front head portion **10***a*, tappet seat portion **10***b*, cylinder casing portion **10***c*, and rear head portion **10***d*. The rear head **10***d* is equipped with a pair of laterally-extending handles **11**, and mounted above one of the handles **11** is an actuating lever **12** adapted upon movement to open the valve **13** to admit pressure fluid through the supply fitting **14** from a suitable pressure fluid source (not shown). A valve assembly designated generally by the numeral **15** is operative to direct the flow of pressure fluid alternately through passage **16** and port **17** into the lower portion of the cylinder **18** and then through the inlet port **19** to the upper end of the cylinder **18**. This valve and its operation are conventional and a detailed description is therefore believed unnecessary. It is sufficient to say that the valve is cyclically operable to first cause the flow of pressure fluid into the cylinder **18** adjacent the lower end thereof and then into the cylinder **18** adjacent the upper end thereof.

Slidably mounted within the cylinder **18** is a piston or hammer **20** that reciprocates within the cylinder **18** upon application of the pressure fluid to opposite ends of the cylinder. Mounted intermediate the ends of the cylinder **18** is an exhaust port **21** that is operative to exhaust opposite ends of the cylinder **18** as the hammer **20** reciprocates therein.

Slidably mounted in a chamber **22** provided by the tappet seat **10***b* is a tappet or anvil (sometimes referred to as a pedestal) **23**. The tappet **23** has a relatively small upwardly-extending portion **24** that is adapted to extend into the lower portion of the cylinder **18** for receiving impact blows from the hammer **20**. The tappet **23** also has an enlarged lower or body portion **25** formed integrally with the reduced portion **24** and connected thereto by a relatively large inclined shoulder **26**. The inclined shoulder **26** engages a frusto-conical shoulder **27** provided by the tappet seat member **10***b* when the tappet **23** is in its uppermost position. The tappet **23** translates impact force from the hammer **20** to a work member **28** slidably mounted within the front head **10***a* of the tool casing. The work member **28** is free to slide axially within the casing and upon impact of the hammer **20** against the tappet **23** the work member **28** is driven by the impact and moves a small distance relative to the casing.

The work member **28** is equipped intermediate its ends with an annular retaining flange **29** that slides freely within an enlarged chamber **30** provided by the front head **10***a*. To prevent the work member **28** from falling from the casing **10**, the front head portion **10***a* of the casing is equipped with a retainer member **31** pivotally mounted upon a pin **32**. The retainer member **31** is equipped with an inwardly-extending ear **33** adapted to engage the annular retaining flange **29** of the work member and to thereby confine the work member within the casing. A pin **34** biased by a spring **35** into engagement with the retainer member positions it so that the ear **33** is normally extended into the chamber **30**. However, the retainer member **31** may be pivoted in a counterclockwise direction to withdraw the ear **33** from the chamber **30** and to permit the work member **28** to be readily removed or inserted into the position illustrated within the casing.

In the conventional paving breaker so far described, I equip the casing **10** with an axially-extending passage **36**. At the junction between the cylinder casing portion **10***c* and the tappet seat member **10***b* a branch passage **37** is provided that extends to the shoulder **27** and is in open communication with the chamber **22** provided by the tappet seat member **10***b*. At its lower end the passage **36** is in open communication with a cylinder **38** having slidably mounted thereon and in sealing engagement therewith an impact pin member **39** equipped with an enlarged head portion **40** and a reduced inwardly-extending impact portion **41**. A coil spring **42** normally biases the impact pin **39** in an outward direction so that the reduced impact portion **41** does not extend into the chamber **30** and it does not therefore provide an obstruction engaging the annular flange **29** of the work member so as to prevent free axial movement of the work member. A plug **43** is received within the outer end of the cylinder **38** to provide a seal therefor. The plug **43** may be pressed within the outer end of the cylinder or it may be threadedly received within a threaded portion provided at the outer end of the cylinder. In any event, it is desired that a fluid-tight seal be formed between the plug and outer cylinder portion. It is also desired that the enlarged head portion **40** provide a fluid seal with the cylinder **38**.

At its upper end the passage **36** communicates with a valve chamber **44** equipped with a rotatably-mounted valve **45** having a passage **46** therethrough. When the valve **45** is in open position, as illustrated, the valve passage **46** communicates at one end with the passage **36** and at its other end with a short passage **47** that is in open communication with the supply fitting **14**. The valve **45** is also provided with a relatively small passage **48** that communicates with the passage **36** when the valve is closed, and when in closed position the end of the valve passage **46** communicates with a relatively small passage **49** extending through the side wall of the casing and communicating with atmosphere. The small passages **48** and **49** are operative in conjunction with the passage **36** and valve passage **46** to exhaust the passage **36** to atmosphere when the valve is closed.

Control of the rotatably-mounted valve **45** is attained through a trigger or lever member **50** equipped at its upper end with a finger grip **51**. The trigger **50** is slidably mounted within a channel provided by flange members **52** formed rigidly with the casing walls. A coil spring **53** normally holds the trigger member **50** in lowered position to close the valve **45**. The trigger member **50** is equipped at its lower end with a link **54** pivotally secured to a lever **55** pivoted intermediate its ends upon a pivot pin **56** mounted in the casing wall. At its opposite end the lever **55** is slidably and pivotally connected with a crank **57** by means of a slot and pin arrangement illustrated. The crank **57** is rigidly secured to the valve **45** and it is apparent that movement of the trigger member **50** is operative to rotate the valve **45** between opened and closed positions.

Above the junction of the passages **36** and **37**, the casing is equipped with a threaded aperture **58** that threadedly receives a threaded needle-shaped restriction member **59**. The purpose of the member **59** is to restrict the passage **36** and thereby retard the flow of pressure fluid therethrough. If desired, the member **59** may be adjustable so that the restriction provided in the passage **36** may be altered as required to meet particular situations. The passage **36** may be of relatively small cross section and if desired a conduit might be provided along the outer wall of the casing **10** as an alternative to the passage **36** extending through the casing wall. Such a change, however, would not affect the operation of the structure.

Operation

The paving breaker illustrated will be operated in the conventional manner to bring about the breaking up of any given material. The workman will grasp the paving breaker by the handles **11** and position the work member **28** thereof at a point being the most desirable to com-

mence the work phase of the operation wherein the work member **28** is driven into the material having work performed thereon. When the workman depresses the valve control handle **12**, the valve is opened and pressure fluid flows through the supply fitting **14** and valve assembly **15** alternately to the lower portion of the cylinder **18** through the passage **16** and drives the hammer **20** upwardly in the cylinder **18**. Since the pressure fluid exerts forces in all directions, at the same time it is pushing the hammer **20** upwardly it is also pushing downwardly upon the lower end of the cylinder **18** and thereby pushes the casing of the paving breaker downwardly relative to the work member **28** which is either resting upon or is embedded in the material being broken. As the hammer **20** rises in the cylinder **18** and passes above the exhaust port **21**, the lower portion of the cylinder **18** is exhausted to atmosphere through the exhaust port and at this moment the valve within the valve assembly **15** is reversed automatically and pressure fluid is discharged into the cylinder **18** adjacent the upper end thereof through the inlet port **19**. The entry of pressure fluid into the upper end of the cylinder **18** is operative to drive the hammer **20** downwardly and at the same time reacts against the upper end of the cylinder **18** and lifts the casing relative to the work member **28**. When the hammer **20** has moved downwardly beyond the exhaust port **21**, the upper end of the cylinder **18** is exhausted to atmosphere and the hammer impacts the upper end of the tappet **23** (which will be extending into the cylinder **18**) and the impact force will be transferred through the tappet **23** to the work member **28** to drive it a small distance into the material being broken. The cycle is then completed and is repeated about 1200 times per minute. It is seen, then, that the upward and downward movement of the casing **10** occurs very rapidly and is apparent as a vibratory movement that seriously affects the workman's operation of the tool.

When it is desired or necessary to remove the work member **28** from embedded position within the material it has penetrated during the work operation previously described, the workman lifts upwardly on the handles **11** with a force sufficient to raise the casing **10** relative to the work member **28** to bring the ear **33** of the retainer member **31** into abutting relation with the annular retaining flange **29** of the work member (assuming a conventional paving breaker structure, not having the impact pin **39**, passages **36**, etc., incorporated therein). Where the paving breaker is relatively large, the lift applied to the handles **11** by the workman in order to bring the ear **33** and flange **29** into engagement is often in the order of about 150 pounds. This is a considerable force and creates a serious strain upon the workman and the effects are amplified since, when strained, he is tense and the muscles are taut and the full effects of the vibratory movement of the paving breaker are absorbed by him. The lift applied to the handles, however, is not sufficient to prevent the casing **10** from vibrating and the upward component of the forces causing the vibration is translated through the casing **10** and ear **33** of the retainer member **31** into impact against the retaining flange **29** of the work member and the work member is thus driven from its embedded position in the work material.

However, with my invention, once the work member **28** is embedded and it is desired to remove the same, the workman does not apply a lifting force to the handles **11**. Instead, he simply raises the trigger member **50** to open the valve **45** and establish communication between the pressure fluid supply fitting **14** and the passage **36**. Pressure fluid immediately flows through the short passage **47**, valve passage **46** and passage **36** to the branch passage **37**. The pressure fluid then flows through the passage **37** and into the chamber **22** provided in the tappet seat member **10***b* and this pressure is exerted in all directions and forces the tappet **23** downwardly. If the tappet **23** is resting upon the upper end of the work member **28**, as will be the case when the work member **28** is embedded

or is resting upon the material and the valve handle **12** is released to close the valve **13**, the pressure fluid flowing through the passages **36** and **37**, upon opening of valve **45**, and acting between the shoulders **26** of the tappet and **27** of the tappet seat member will raise the casing **10** relative to the work member **28** and tappet **23**. The casing **10** will be raised until the tappet member **23** is seated on the lower end of the tappet seat member. This follows because the forces exerted by the pressure fluid within the chamber **22** acts against the casing **10** and the work member **28** (through tappet **23**), and since these members are movable relative to each other, the casing raises, the force being sufficient to establish this condition.

It may be pointed out that to safeguard against a workman's pressing downwardly upon the handles **11** at this time with sufficient force to prevent the raising of the casing **10** relative to the work member, the angular shoulder **27** may be made as wide as required so as to provide a lifting force on the casing of sufficient magnitude to forestall this possibility. The required width of the shoulder may be easily determined through the relation of force (necessary lift) being equal to the pressure of the pressure fluid times the area of the shoulder. The pressure of the fluid is known and is a constant and the force is a known constant, being equal to the weight of the casing plus whatever down-push of the workman it is desired to overcome.

At the same time that pressure fluid flows through the branch passage **37** to raise the casing **10**, the pressure fluid also flows through the lower portion of the passage **36** and into the cylinder **38** to actuate the impact pin **39** and force the reduced end portion thereof outwardly and into the chamber. The actuation of the impact pin **39** will be delayed slightly and will follow behind the lifting of the casing **10** for two reasons. First, the spring **42** is selected so that the force exerted thereby to normally hold the impact pin **39** outwardly will require a greater pressure to actuate the impact pin **39** and force it inwardly against the biasing action of the spring **42** than the pressure necessary to raise the casing **10** relative to the work member. In other words, if the shoulders **26** and **27** are sufficiently large so that a pressure of 50 pounds per square inch will raise the casing **10** to its maximum position relative to the work member **28**, the spring **42** may be selected so that a pressure of 60 pounds per square inch, for example, will be required to actuate the impact pin **39**. Secondly, to forestall an instantaneous increased maximizing of the pressure within the passages **36** and **37** upon opening of the valve **45** whereby the casing might be raised and the impact pin actuated simultaneously, the passage **36** above its junction point with the passage **37** is restricted by means of the needle-shaped restrictor member **59** so that the build-up of pressure in the chamber **22** and in the cylinder **38** is relatively slow. Therefore in the example set out the pressure in the chamber **22** and in the cylinder **38** would attain 50 pounds per square inch sometime prior to a build up of pressure equalling 60 pounds per square inch, whereby the casing **10** will be lifted prior to actuation of the impact pin.

It is apparent that numerous arrangements may be employed to accomplish the relatively slow build-up in pressure within the chamber **22** and cylinder **38**, and the restrictor member **59** is exemplary of such devices, the important relationship being that the volumes of the chamber **22** and cylinder **38** and also the branch passage **37** and lower portion of the passage **36** be relatively large with respect to the orifice through which the pressure fluid must flow to establish the required pressure build-up in the chamber and cylinder.

It is desired that the casing **10** be raised relative to the work member **28** prior to actuation of the impact pin so that the retaining flange **29** of the work member is not trapped below the impact pin **39**, which might be the

case in the event the impact pin were actuated prior to the raising of the casing. If this should occur, the impact pin would be inoperative to remove an embedded work member.

After the trigger member **50** has been raised by the workman to lift the casing **10** and actuate the impact pin **39**, the physical relationship between the various members is as illustrated in the drawing. It is noted that when the casing is in raised position the upper end of the tappet **23** is flush with the lower end of the cylinder **18** and the member **20**, when it moves downwardly, will not impact the tappet member **23** so as to drive the work member **28** downwardly. Actually, the hammer member **20** does not normally reach the lower end wall of the cylinder **18**, because a quantity of air is trapped below the lower end wall of the cylinder and the inlet port **17** by the downward movement of the hammer and as it moves downwardly, the pressure of the trapped air or air cushion increases to a point sufficient to interrupt the movement of the hammer before it strikes the lower end wall of the cylinder **18**. It is apparent also that the lower end of the tappet **23** rests upon the upper end of the work member **28** and this position of course is required to maintain the casing in raised position, for there must be some element apart from the casing **10** against which the pressure fluid in the chamber **22** can react before it can be effective to raise the casing.

The drawing further makes it clear that the position of the impact pin **39** is such that it substantially abuts the annular retaining flange **29** when the tappet **23** is in its lowermost position and is resting against the upper end of the work member **28**. Therefore, when the workman depresses the lever **12** to open the control valve **13**, the casing **10** vibrates as usual and, as described hereinbefore, the downward component of the vibratory motion moves the casing and impact pin **39** downwardly and away from the retaining flange **29** and the upward component of the vibratory motion moves the casing upwardly and, consequently, the impact pin into engagement with the flange **29**. Since this movement is very rapid and occurs about 1200 times per minute, the movement of the casing is rapid and sharp and the impact pin **39** strikes or impacts the retaining flange **29** and, since the impact is of a very short duration, the force upon the flange **29** and consequently upon the work member **28** is relatively large and each impact is effective to drive the work member a short distance from its embedded position in the gripping material it has penetrated.

The casing **10** is maintained in its uppermost position relative to the work member **28** by the lifting action of the pressure fluid in the chamber **22** with the result that a portion of the force causing the upward component of the vibratory motion is not dissipated in lifting the casing and substantially all of this force is translated into impact against the retaining flange **29**. The work member **28** is thereby driven from the gripping material it has penetrated very quickly and without necessity of the workman's lifting the casing, while the work member may also be removed from penetrating position in heavy concrete slabs where the friction grip of the material is exceedingly large and could not heretofore be overcome.

Upon removal of the work member **28** from the work material, the workman releases the lever **12** to close the valve **13** to discontinue operation of the paving breaker and at the same time releases the trigger member **50** to close the valve **45**. It is noted that when the valve **45** is rotated to closed position, the small passage **48** is brought into communication with the passage **36** and the valve passage **46** is moved into communication with the small passage **49**. The passage **36**, chamber **22**, and cylinder **38** are thereby exhausted to atmosphere and deactuation of the impact member **39** and lowering of the casing is insured.

The restriction in the upper portion of the passage **36** resulting from the entry of the restrictor member **59** into the passage insures deactuation of the impact pin **39** prior to the lowering of the casing **10** relative to the work member **28**. Because the upper portion of the passage **36** is restricted by the restrictor member, the pressure release in the lower portion of the passage **36**, the branch passage **37**, the chamber **22** and the cylinder **38** is relatively slow and is not in any sense instantaneous. Therefore, the pressure within these enumerated elements falls below 60 pounds per square inch (using the example previously set out) and the impact pin **39** is thereby deactuated. The pressure then falls below 50 pounds per square inch and the casing **10** is lowered relative to the work member **28**. Thus, there is no possibility of the pressure within the chamber **22** being released prior to deactuation of the impact pin **39** and this prevents any possibility of the hammer **20** impacting the tappet **23** to drive the work member **28** whereby the flange **29** of the work member may be driven against the impact pin **39**, creating the danger of shearing off the impact pin. While the impact pin is designed to withstand impact against the flange **29** resulting from vibratory movement of the casing **10**, it need not be designed to withstand the larger impact force resulting from a blow imparted thereto by the hammer **20**.

The impact pin **39** and its positioning relative to the retainer member **31** plays an important part in the successful operation of the invention. As has been previously brought out, it is desired that the impact pin substantially abut the retaining flange **29** of the work member when the casing is raised relative to the work member. This position achieves full utilization of the forces causing the casing **10** to vibrate and these vibratory forces are translated into impact against the flange **29** without dissipation in the raising of the casing, with the result that the work member is more readily removed from the frictional grip of a material it has penetrated. The retaining member itself could not be used for this purpose because it would necessitate raising the retainer member upon the front head **10***a* of the casing until this desirable relationship were provided. Since the retainer member cannot have the ear **33** thereof move clear of the flange **29** during normal operation of the paving breaker, the impact transferred to the work member **28** from the hammer **20** would be evident as an impact between the flange **29** and ear **33** of the retainer member, and since the force of this impact is extremely large the ear **33** would be broken upon receiving the force of this impact. It is essential, therefore, that the retainer member **31** be positioned upon the front head **10***a* in its usual position so that when the retaining flange **29** is engaging the ear **33** the work member **28** is lowered to a point where it is incapable of receiving impact blows from the hammer **20** and tappet **23**. The impact pin **39** must, then, be mounted above the ear **33** of the retainer member and preferably the specific relationship is as illustrated in the drawing.

It has been seen that my invention utilizes the vibratory motion of the paving breaker casing to effectuate the removal of the paving breaker work member from the frictional grip of a material it has penetrated. At the same time, it is no longer necessary for the workman to lift the heavy casing of the paving breaker during the pull out operation, since I provide selectively operable fluid pressure means to accomplish this result. Muscular fatigue of the workman is thereby minimized, with an accompanying increase in his general efficiency. The automatic lifting of the casing establishes the most desirable relative positioning of the casing and work member and maintains this positioning during the entire pull out operation, whereby the pull out is more effective and efficient. The provision of the impact member and its timed actuation relative to the lifting of the casing of the paving breaker insures utilization of the entire forces causing the casing vibration to drive the work member from embedded position, while at the same time the impact pin and normal paving breaker elements are protected against breakage.

While in the foregoing specification I have set forth a specific embodiment of my invention in considerable de-

tail for purposes of illustration, it is evident that numerous changes may be made in the details by those skilled in the art without departing from the spirit of my invention.

I claim:

1. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: means for producing a pneumatic force between the casing and work member continuously urging the casing away from the work material and being inferior to said frictional force and substantially in excess of the weight of the casing, and an impact member arranged with said casing and work member for rigidly arresting the vibratory movements of the casing in a direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force but inoperative to substantially restrict vibratory movements of the casing toward the work material.

2. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: a pedestal interposed between opposed areas of said work member and casing, means for producing a pneumatic force between said pedestal and casing to drive said pedestal into engagement with said work member and move said casing relative thereto, said pneumatic force being inferior to said frictional force and substantially in excess of the weight of the casing.

3. In a paving breaker structure having a vibratory casing, a work member constrained for limited axial movement relative to said casing and a tappet member movably mounted within said casing and being adapted to transfer impact blows to said work member, said work member being equipped with a laterally extending flange and having the characteristic of sometimes being rigidly held by a frictional force developed between it and a work material penetrated thereby, an impact pin movably carried in said casing, means for selectively actuating said impact pin to move the same adjacent said work member for engagement with said annular flange, fluid pressure means communicating with said casing adjacent said tappet member for developing a fluid pressure force between said tappet member and said casing of a magnitude in excess of the weight of the casing, and means for selectively actuating said fluid pressure means, said fluid pressure means when actuated being operative to raise said casing to bring said impact pin, when actuated, into substantial abutment with said annular flange whereby the vibratory movements of said casing in one direction are rigidly arrested by the engagement of said impact pin with said annular flange, said impact pin being inoperative to arrest vibratory movement of said casing in the other direction.

4. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: means for producing a pneumatic force between the casing and work member continuously urging the casing away from the work material and being inferior to said frictional force and substantially in excess of the weight of the casing, and selectively operable means arranged with said casing and work member for rigidly arresting the vibratory movements of the casing in the direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force, but at the same time being inoperative to restrict vibratory movements of the casing in the opposite direction.

5. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: means for selectively producing a pneumatic force between the casing and work member operative to continuously urge the casing away from the work material and being less than said frictional force and substantially in excess of the weight of the casing, and impact means carried by said casing for impact engagement with said work member and being selectively operable for rigidly arresting the vibratory movements of the casing in the direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force, but inoperative to arrest the vibratory movements of the casing in the opposite direction.

6. In a percussive tool having a vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work material having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: means for producing a force operative between the casing and work member for urging the casing away from the work material and being inferior to said frictional force and in excess of the weight of the casing, and selectively operable means arranged with said casing for operable engagement with the work member for rigidly arresting the vibratory movements of the casing in a direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force but being inoperative to arrest the vibratory movements of the casing in the other direction.

7. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: means for selectively producing a pneumatic force between the casing and work member continuously urging the casing away from the work material and being substantially in excess of the weight of the casing, and an impact member carried by said casing for selective actuation and, when actuated, arranged with said work member for rigidly arresting the vibratory movements of the casing in a direction away from the work material so as to produce a repetitious impact force acting upon the work member of greater magnitude than said frictional force.

8. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: means for producing a pneumatic force between the casing and work member continuously urging the casing away from the work material and being in-

ferior to said frictional force and substantially in excess of the weight of the casing, a cylinder carried by said casing, an impact pin slidably mounted therein, means for selectively providing a pneumatic pressure to said cylinder for actuating said pin, and resilient means for biasing said pin in normally inoperative condition, said pin being arranged when actuated for operative engagement with said work member for rigidly arresting the vibratory movements of said casing in a direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force.

9. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: a pedestal interposed between opposed areas of said work member and casing, means for producing a pneumatic force between said pedestal and casing to drive said pedestal into engagement with said work member and to lift said casing thereon, and means arranged with said casing and work member for rigidly arresting the vibratory movements of the casing in the direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force.

10. In pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said casing providing a chamber therein adjacent the inner end of said work member adapted to receive the inner end of said work member therein, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: an impact transferring member movably mounted in said chamber and adapted to engage the inner end of said work member, means for producing a pneumatic force operative between said impact transferring member and a surface of said casing removed from said work member for urging the casing away from the work material, said pneumatic force being inferior to said frictional force and in excess of the weight of the casing, and means arranged with said casing and work member for, selectively, rigidly arresting the vibratory movements of the casing away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force.

11. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member, said casing providing a tappet chamber therein adapted to receive the inner end of said work member, and a tappet movably mounted in said chamber: said casing providing a flow passage communicating at one end with a source of pneumatic pressure fluid and at its other end with said tappet chamber so that a pneumatic force can be selectively provided that is operative between the casing and tappet to move said tappet against the inner end of said work member and urge said casing in a direction away from the work material, said pneumatic force being inferior to said frictional force and substantially in excess of the weight of the casing, and means arranged with said casing and work member for selective actuation for rigidly arresting when actuated the vibratory movements of the casing away from the work material by engagement with said work member so as to produce a repetitious impact force acting upon the worker member of greater magnitude than said frictional force.

12. In a pneumatic paving breaker having an axially vibratory casing equipped with a work member constrained for limited axial movement with respect thereto and adapted upon operation of the breaker to penetrate a work material, said work member having the characteristic of sometimes being rigidly held by a frictional force developed between such penetrated material and the work member: an impact member carried by said casing and, when actuated, arranged with said work member for operative engagement therewith for rigidly arresting the vibratory movements of the casing in a direction away from the work material so as to produce a repetitious impact force acting upon the work member and of greater magnitude than said frictional force but inoperative to arrest the vibratory movements of the casing in the direction toward said work material.

13. The structure of claim 7 in which said impact member is normally biased in an inoperative position, and means are provided for selectively actuating said impact member.

14. The structure of claim 7 in which means for actuating said impact member are pneumatic.

15. The structure of claim 8 in which said work member is equipped with an enlargement adapted to be engaged by said pin for rigidly arresting the vibratory movements of said casing.

16. The structure of claim 9 in which a valve-controlled passage communicates at one end with a source of pneumatic pressure fluid and at its other end with the space defined between said pedestal and said opposed area of said casing for providing said pneumatic force therebetween.

17. In combination with a tool having a work member adapted upon operation of the tool to penetrate and be frictionally gripped by a work material and having also a casing structure providing a mounting for the work member and vibrating relative thereto during operation of the tool, means developing a force arresting the vibratory movement of said casing in one direction relative to said work member when that member is frictionally gripped in a work material, said means comprising a pneumatic cushion operative, in effect, between said work member and casing to limit said force to a value normally less than the holding force applied to said work member by such frictional grip.

18. The combination of claim 17 in which said pneumatic cushion comprises a fluid pressure operative to limit said force to a value inferior to the intermittently active force that causes downward vibration of the casing.

19. The combination of claim 17 in which said pneumatic cushion comprises a fluid pressure operative to limit said force to a value less than the sum of the intermittently active force causing downward vibration of the casing and the weight of the casing.

20. The combination of claim 17 in which said force has a value substantially greater than the weight of said casing.

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