Jan. 4, 1955

F. H. PHILBRICK

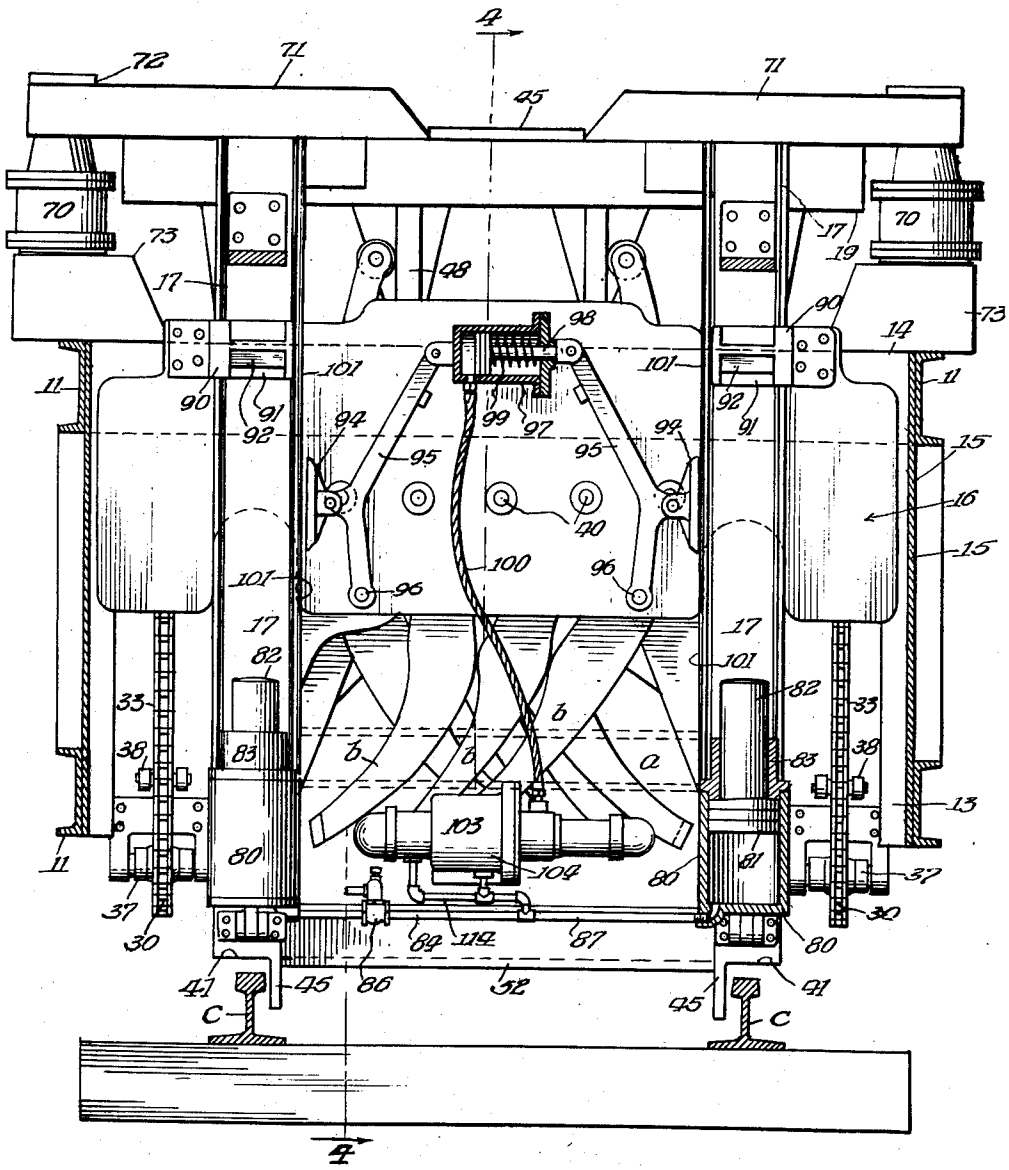
2,698,674

CUSHIONING MECHANISM FOR DROP-HEADS OF BALLAST DISPLACING MACHINES

Filed Feb. 4, 1952

5 Sheets-Sheet 1

FIG. 1



Inventor:
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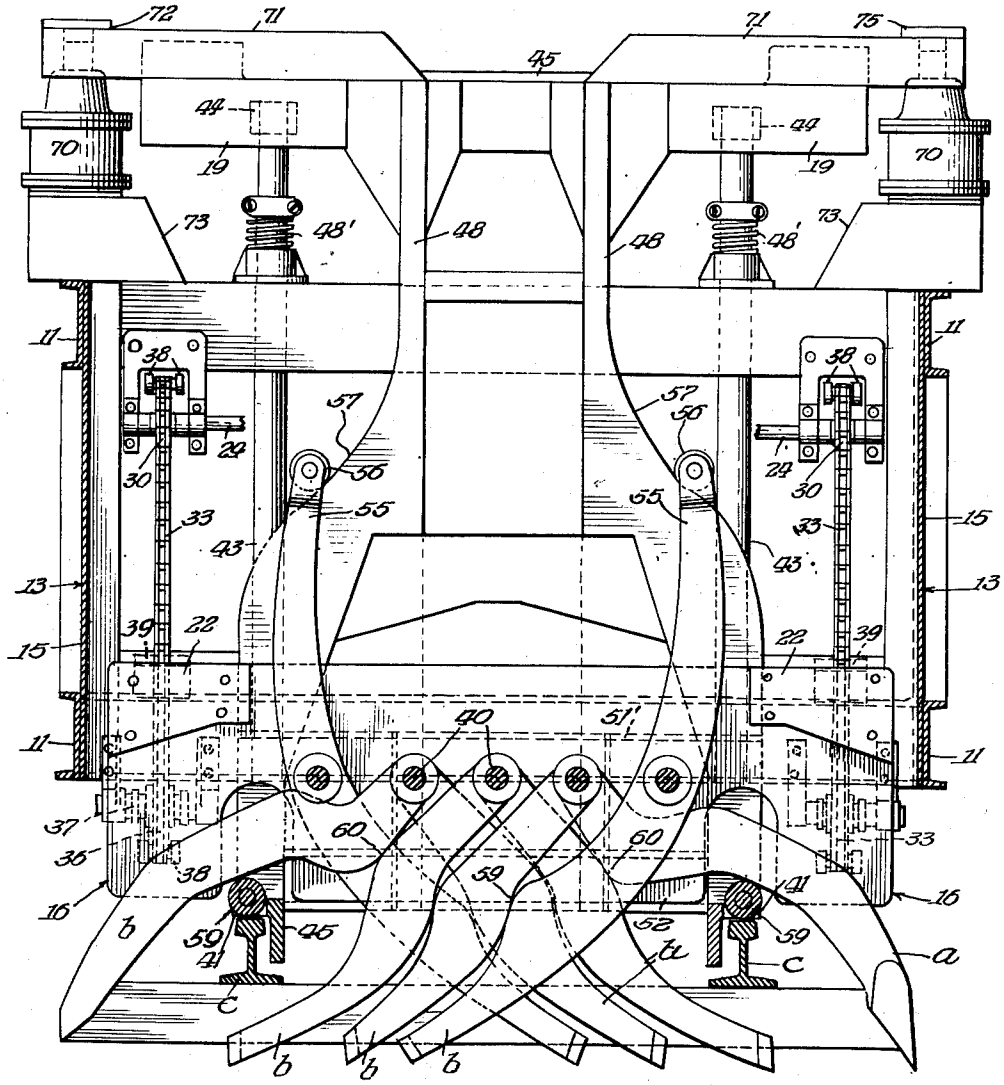
Jan. 4, 1955 F. H. PHILBRICK 2,698,674

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5 Sheets-Sheet 2

Fig. 2



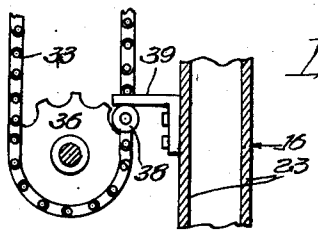


Fig. 3

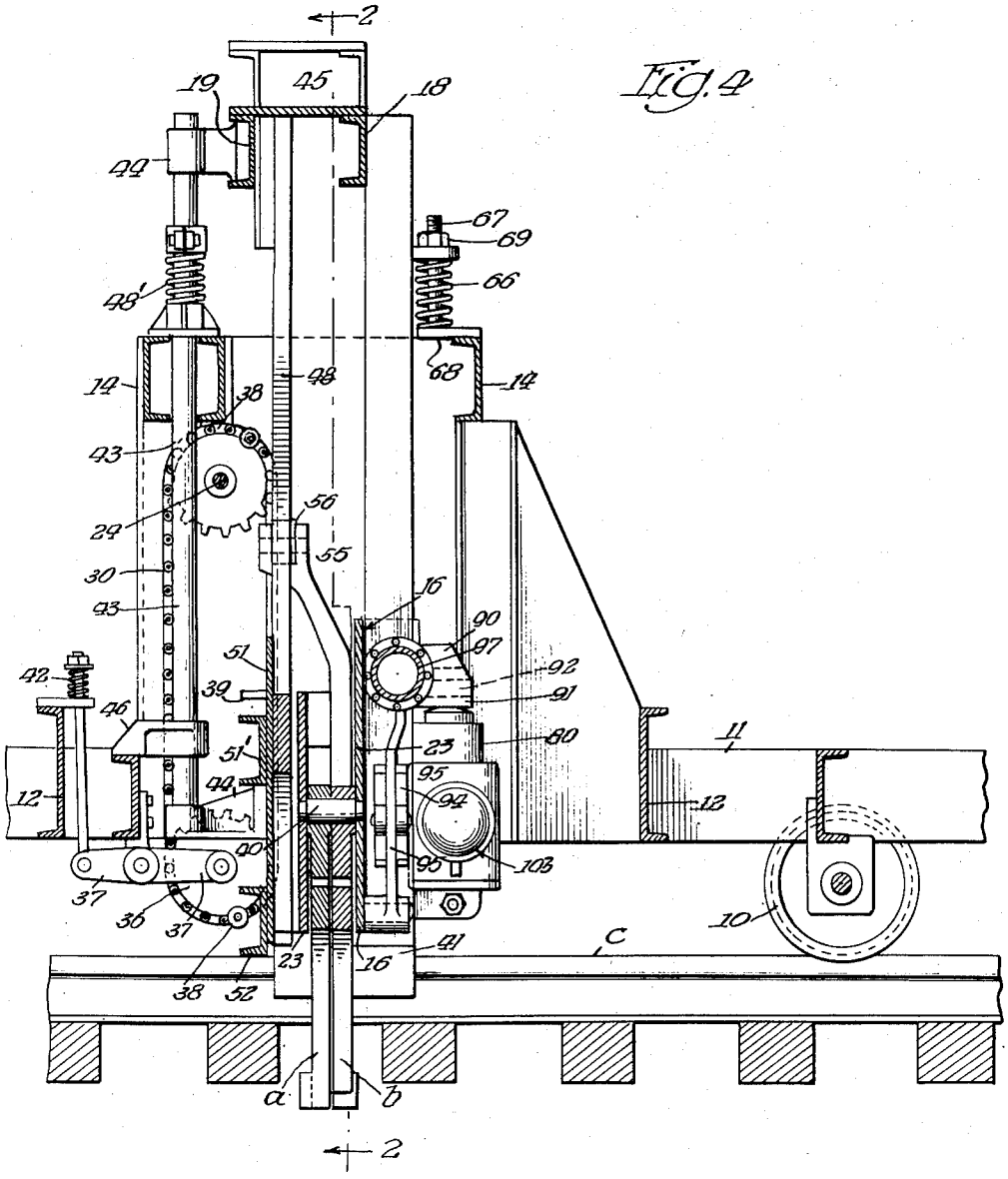
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CUSHIONING MECHANISM FOR DROP-HEADS OF BALLAST DISPLACING MACHINES

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Fig. 4



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CUSHIONING MECHANISM FOR DROP-HEADS OF BALLAST DISPLACING MACHINES

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Fig. 5

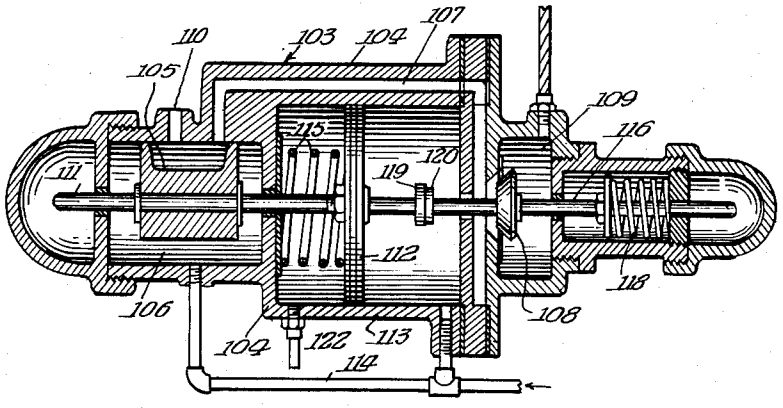


Fig. 6

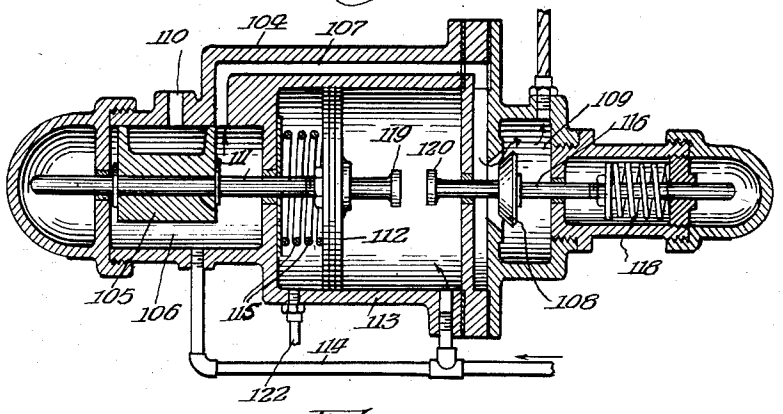
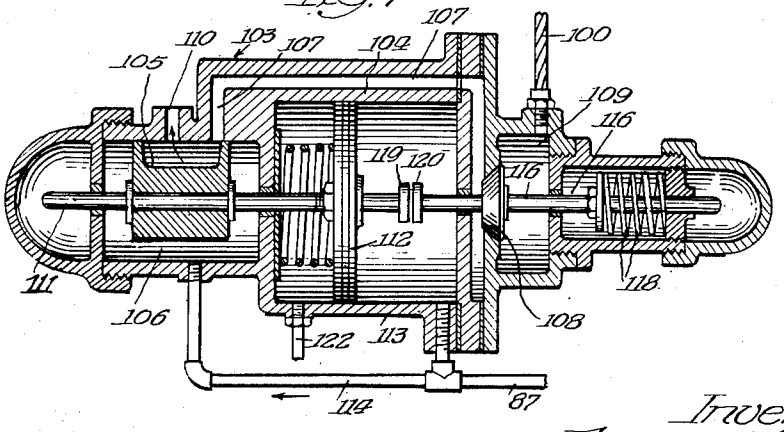


Fig. 7



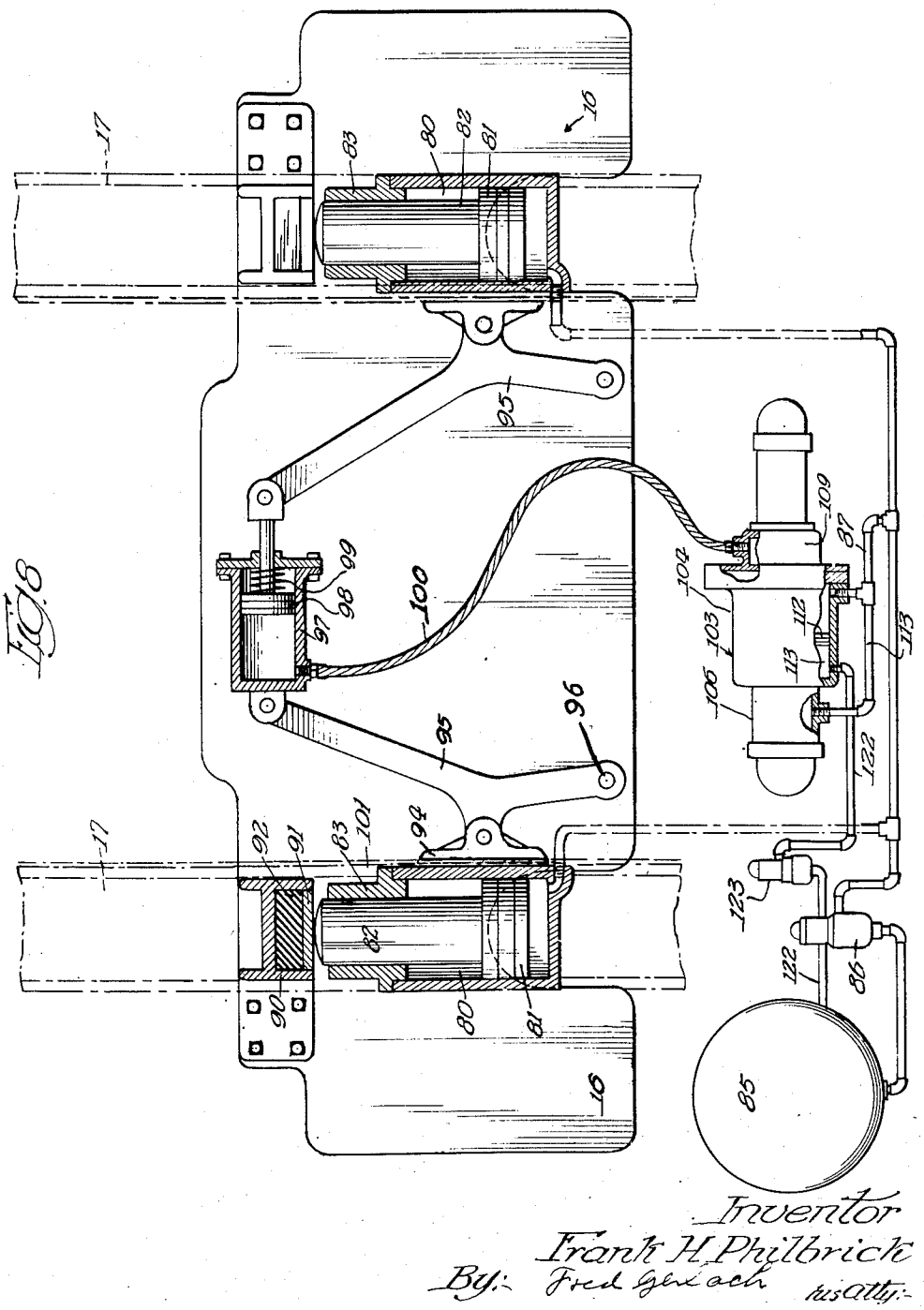
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CUSHIONING MECHANISM FOR DROP-HEADS OF BALLAST DISPLACING MACHINES

Filed Feb. 4, 1952 5 Sheets-Sheet 5

FIG 8



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United States Patent Office

2,698,674

Patented Jan. 4, 1955

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CUSHIONING MECHANISM FOR DROP-HEADS OF BALLAST DISPLACING MACHINES

Frank H. Philbrick, Evanston, Ill.

Application February 4, 1952, Serial No. 269,738

12 Claims. (Cl. 189—86)

The invention relates to ballast displacing machines, for example, those which are used to remove ballast from the cribs between the ties.

One object of the invention is to provide a ballast displacing machine of the drop head type which includes a series of digging tools for displacing ballast from a crib with efficient shock absorbing and arresting devices for the drop head which become effective when the remaining ballast in the crib is insufficient to absorb all the kinetic energy in the drop head.

In machines of the drop hammer type for imparting strokes to digging tools for displacing packed ballast from the cribs between ties of a railway track, the ballast resists the impact tools produced by the drop head and absorbs their kinetic energy until as the ballast is progressively displaced and the resistance progressively decreases. When the crib has been evacuated to the desired level, the drop strokes of the tools must be limited and a desideratum is to provide limit and cushioning devices by which the excess kinetic energy will be absorbed to reduce severe impact or shock stresses on the machine structure and the tools.

Another object of the invention is to provide a machine of the drop head type with pneumatic shock absorbing devices combined with brake means which will absorb the excess kinetic energy of the drop head as the resistance of the ballast decreases and will limit the downstrokes of the head and tools relatively to the machine structure.

Another object of the invention is to provide efficient pneumatic shock absorbing devices for drop heads which are adapted for heavy work, with brake means for checking rebound which results from the pneumatic devices.

Other objects will appear from the detailed description.

The invention consists in the several novel features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawings:

Fig. 1 is a front view of a machine exemplifying the invention, parts being shown in section, the drop head being shown in its raised position;

Fig. 2 is a section taken on line 2—2 of Fig. 4, the drop head being shown in its lowered position;

Fig. 3 is a detail of the abutment on the drop head which is intermittently engaged by the continuously driven lifting chain;

Fig. 4 is a longitudinal section taken on line 4—4 of Fig. 1;

Fig. 5 is a section of the valve mechanism for controlling the brake device in normal position;

Fig. 6 is a similar view of said mechanism in position for operating the brakes during the downstroke of the drop head;

Fig. 7 is a similar view of said mechanism in position for retaining the brakes set during the upstroke of the drop head; and

Fig. 8 is a diagrammatic view of the pneumatic and brake devices and the air connections for their operation.

The invention is exemplified with a machine including: a portable truck frame which is equipped with wheels 10 to travel on the rails *c* of a railway track, a motor and transmission gearing (not shown) for propelling the truck and for providing power for operating the ballast displacing tools. This frame comprises longitudinal beams 11, transverse beams 12 and 14, upright beams 13, and side plates 15 all rigidly secured together.

A vertically movable cross head 16 functions as a drop head and has mounted thereon the ballast displacing tools. This head 16 is usually of sufficient weight, for example 3600 to 3000 lbs., to operate the tools for severe hammer blows to the ballast. Cross head 16 comprises plates 23 which are rigidly secured together and spaced apart by plates 22. The ballast displacing tools are pivotally movable on studs 40, which are supported in said plates 23. Lifting strokes are intermittently imparted to head 16 by mechanism which comprises a continuously driven transverse shaft 24 which is journalled on the truck frame; a sprocket 30 fixed to shaft 24; sprocket chains 33 extending around sprockets 30; idler sprockets 36 which are carried by levers 37 which are fulcrumed on the truck frame, and rollers 38 on chains 33 which are adapted to engage and release abutments 39 fixed on head 16 for imparting alternate lifting strokes of the head and for releasing it for drop strokes. During their upward travel rollers 38 engage abutments 39 and at the end of the upstroke, release abutments 39 for dropping head 16. Springs 42 are applied to the upper ends of rods which are pivoted to levers 37 for urging idler sprockets 36 to keep chains 33 taut. Drop head 16 is guided vertically in a guide and cam structure which comprises upright beams 17, cross beams 18 and 19 rigidly secured together by a plate 45, members 48 having their upper ends fixedly secured to cross beam 19, a plate 51 fixed to members 48, cross beams 51′ and 52 fixed to plate 51 and shoes 41 fixed to and connecting the lower ends of beams 17 and members 48. Drop head 16 extends between the side members 48 and upright beams 17.

Drop head 16 carries a series of pivotally movable tools *a* for digging into and progressively displacing the ballast in a crib transversely to one side of the track and an oppositely acting series of pivotally movable tools *b* for displacing the ballast transversely to the opposite side of the track. These tools are pivoted at their upper ends on studs 40 which are supported between the plates 23 of drop head 16. The displacing tools are swung transversely during the drop strokes of head 16 and as the level of the ballast is progressively lowered by displacement from the crib, the angular displacement of the tools increases. Members 48 are provided with edges having upper straight portions and cam surfaces 57 below said straight portions, for pivotally shifting the tools on drop head 16.

One of each series of tools *a* and *b* is provided with an upstanding arm 55 which carries a roller 56 on its upper end. Rollers 56 ride on the straight upper portions of the edges of members 48 of the cam structure during the upper portion of the drop strokes of head 16 for holding the tools against pivotal movement and on cam surfaces 57 during the lower portion of the stroke of said head to pivotally swing the tools. Tools *a* are positively shifted by an arm 55 and cam abutments 59 between the tools respectively for positively swinging this series of tools transversely and outwardly so that the lower ends of the tools will displace the ballast transversely from the crib. Tools *b* are provided with similar coacting cam abutments 60 for positively swinging this series of tools by the roller 56 and an arm 55 on one of the tools *b*. The displacing tools of each set are transversely arranged to progressively displace the ballast from the central portion of the track to one side thereof. The three inner tools *a* and *b* are adapted to work in the crib to displace the ballast outwardly under the rails, and the outer tools of each series extend over and to the outer sides of a rail for moving the ballast beyond the ends of the ties. The tools swing inwardly by gravity during their idle up-stroke and are positively controlled during their down-stroke by arms 55, rollers 56 and cam surfaces 57. The lower end of each of the outer tools *a* and *b* is also guided by a roller 59 which is on a shoe 45. The guide structure is movable vertically in the truck frame and guided by vertical rods 43 which are fixed in brackets 44 which are secured to beam 19 and plate 51 respectively, and are slidable in bearings 46 which are secured to upper and lower cross beams 14, respectively. Springs 48′ between upper bearings 46 and collars on rods 43 yieldingly support rods 43 and

the guide structure at its rear side. At its front side, the guide structure is yieldingly supported by compression springs **66** which surround rods **67**. Springs **66** are seated on abutments **68** engaging brackets fixed on a cross beam **14**. Rods **67** have their lower ends pivotally connected to brackets fixed to upright beams **17**, extend through the springs **66** and are provided at the upper ends with adjustable abutments **69** which bear on the upper ends of said springs. Shoes **41** are adapted to abut the upper face of the heads of rails *c* to transmit the down thrust stresses from the guide structure to the rails *c* when the drop head exerts downward stresses on the guide structure. Springs **48'** and **66** hold the guide and cam structure raised when the drop head **16** is supported by the lifting rollers **38** on chain **33**. During the portion of the strokes of head **16** when the rollers **56** for controlling the swinging of the tools, engage and exert a downward pressure on cams **57**, the guide and cam structure will be lowered against the force of springs **48'** and **16** until shoes **41** engage the track rails. When the drop head is in its raised position and supported by lifting rollers **38** shoes **41** will be lifted off the track rails by springs **48** and **66** for releasing the truck for travel to successive cribs. This guide and cam structure is also adapted to be raised for additional clearance between the shoes **41** and the track rails for extended travel of the machine on the tracks by a pair of pneumatic rams **70** which are supported on the truck frame and are adapted to engage bridge plates **71** on beams **73** which are fixed to cross beams **12** and **19**. When the rams are operated they will engage plates **72**, lift the cam and guide structure and shoes **41** into their lifted position.

When drop strokes are imparted to head **16** and the displacing tools, the ballast will be progressively removed from the cribs in which the tools are operated and the length of the drop strokes and the angular movements of the tools will increase as the ballast is displaced.

The tools at the beginning of an operation in a filled crib are checked or retarded by the ballast. As the operation continues, the ballast is loosened and partially displaced from the crib, the tools swing outwardly in increasing angles, the resistance of the ballast to the tools decreases to such an extent that it is necessary to cushion and check the downward travel of the drop head during the later portion of the drop strokes, particularly as the level of the ballast is lowered approaching the completion of an operation in a crib. It is also advantageous to leave the drop head free for hammer effects of the tools during the initial portion of crib operation while the ballast offers the maximum resistance to the tools. For attaining these advantages, the invention provides pneumatic shock absorbing or cushioning devices between the drop head and the guide structure which remain ineffective during that portion of each drop stroke of the cross head while the maximum force is necessary to operate the tools to dig into the ballast and which become effective to limit the stroke of and retard the head during that portion of each drop stroke of the head when the resistance of the ballast is decreased to avoid imposing severe impact stresses on the machine structure.

Pneumatic devices are provided on the guide and cam structure and brake devices are provided between the drop head and upright beams **17** for limiting and cushioning the drop head as it approaches the end of its down strokes.

The invention utilizes air cylinders or dashpots and air operable brakes for cumulatively retarding or checking the drop strokes of the drop head and the air operated brakes for checking rebound during upstrokes of the drop head.

The devices for cushioning and limiting the movements of the drop head **16** comprises a pair of vertical cylinders or dashpots **80**, each fixedly secured on one of the upright beams **17**, a piston **81** slidable in each cylinder or dashpot **80** and a stem **82** fixed on each piston **81** and extending through and projecting above a head **83** on the upper end of said cylinder. The lower end of cylinders **81** is connected to receive air via a pipe **84**, a valve **86** and a pipe **87** from a reservoir **85** in which a supply of compressed air is maintained at a predetermined pressure. Valve **86** is of the pressure-regulator type whereby air of higher pressure from reservoir **85** is controlled to supply air of a predetermined pressure, for example 70 p. s. i., to the pipe **87** and the lower ends of cylinders **80**, and to maintain such a supply of air in cylinders **80** to replenish the air used from cylinders **80** in the operation of the shock absorber system as hereinafter explained.

Abutments are provided on the drop head which are adapted to operate the pistons **81** downwardly in cylinder **80** against the predetermined air pressure normally maintained in the lower ends of said cylinder and to compress the confined air between the lower ends of the pistons **81** and cylinders **80** as the drop head continues its downstrokes after striking the piston stems **82**. These abutments each include a bracket **90** fixed to drop head **16**, a striker adapted to abut a stem **82**, and a rubber cushion **92** interposed between bracket **90** and striker **91**. These abutments are disposed on the drop head **16** so that they will engage stems **82** during a predetermined end portion of the drop stroke of head **16**, for example 7" or 8". During this portion of the downstroke, the ballast is progressively displaced from the cribs and the necessity for absorbing shock occurs.

During this portion of the downstroke of head **16**, the strikers **91** will operate stems **82** and pistons **81** downwardly in cylinders **80** and the air will be progressively compressed to the end of the downstrokes until it reaches, for example, 300 p. s. i. As a result, this air will retard the downward movement of the head **16** with progressively increasing pressure.

Air brake means are controlled by the drop head **16** through pressure developed in cylinders **80** to apply the brakes for retarding the downstrokes of head **16** for retardation supplemental to that of piston **81** and cylinders **80**. This means includes a pair of brake shoes **94** on and carried by operating levers **95** which are fulcrumed at **96** on the drop head **16**, an air cylinder **97** supported on levers **95**, a piston **98** slidable in cylinder **97** and connected to one of the levers **95**, a spring **99** for retracting the piston to release the brake shoes, and a flexible pipe **100** for supplying air to cylinder **97** for applying the brakes. Brake shoes **94** are adapted to engage flat rails **101** which are secured to the confronting faces of upright beams **17**. The brake shoes **94**, levers **95** and cylinder **97** are movable vertically with the drop head so that when shoes **94** are applied to rails **101**, the vertical movement of the drop head in its supporting structure will be frictionally retarded supplementally to resistance produced by air in the cylinders **80**. The operation of the brakes is controlled by valve mechanism generally designated **103**, which is controlled by the increase of air pressure in cylinders **80** during the downstrokes of pistons **81**. Pipe **100** for delivering air into and exhausting air from brake cylinder **97** is connected to and controlled by said mechanism.

Mechanism **103** comprises a casing **104**, a slide valve **105** in a chamber **106** which is communicatively connected by pipe **87** to the lower ends of cylinders **80**, and controls the flow of air from chamber **106** via a port **107** in casing **104**, a check valve **108** which controls the flow of air between port **107** and a chamber **109** in casing **104** to which air brake pipe **100** is connected. Valve **105** also controls the exhaust of air from brake cylinder **97** to air exhaust port **110**. Valve **105** is operated by a stem **111** which is slidable in casing **104** and a piston **112** which is slidable in a cylinder **113** in casing **104** and is responsive to air of predetermined pressure admitted into cylinder **113** from a branch **114** of pipe **87**. A spray **115** retracts the piston **112** when the pressure drops in cylinder **113**. Check valve **108** is mounted on a stem **116** which is slidable in the casing **104** and extends into the cylinder **114**. A spring **118** is applied to stem **116** for urging check valve **108** into its closed position until there is a predetermined pressure drop in chamber **106** and duct **107**. Stem **111** for piston **112** is provided with an abutment **119** for engaging an abutment **120** on the stem **116** of check valve **108** to open said check valve when there is a predetermined pressure drop in the right hand end of cylinder **113** and in the lower portion of cylinder **80**. In practice, it is desirable to vary the resistance to the outstroke of piston **112** for regulating the operation of piston **112** and the brakes responsive to different predetermined pressures in the cylinders **80**. For this purpose, a pipe **122** is connected to the supply reservoir **85** and to cylinder **113** at the spring loaded side of piston **112** and an adjustable pressure regular valve **123** is included in said pipe. By adjusting the valve **123** to increase or decrease the pressure against piston **112** the predetermined pressure from cylinders **80** at which valve **105** is shifted to deliver air into air brake cylinder **97**, may be varied.

The operation will be as follows: The machine will be spotted along the railway track so that the tools *a* and *b* will be operable in a crib. Alternate lifting and drop strokes will be imparted to head **16**. During said drop strokes rollers **56** on tools *a* and *b* will engage cam surfaces **57** and force the cam and guide structure downwardly until shoes **72** engage the railway rails *c*. During the lifting strokes of the head **16**, rollers **38** will engage abutments **39** on said head which will be then supported by chains **33**. During the upper portion of the upstrokes of head **16**, rollers **56** on levers **55** will ride on the upper straight members **48** and springs **42** and **66** will lift the guide and cam structure and raise shoes **72** off the track rails *c*.

When the crib is filled with ballast, the tools *a* and *b* will progressively dig and displace the ballast from the crib during the last portion of each downstroke of the head **16**, and the ballast will absorb kinetic energy from said head. As the ballast is progressively displaced, its level is lowered and the drop strokes increase in length, the angular movement of the tools is also increased in magnitude and the kinetic energy absorbed by the ballast progressively decreases. As the ballast in the crib is removed, the angular movement of the tool is increased and the ballast is deflected laterally. The bending stresses on the tools are severe without adequate checking and cushioning of the drop head. For this purpose the checking and shock absorbing devices become operative with progressively increasing effect during a predetermined end portion of the downstroke of the head. Before that, the drop head is free to drop and develop kinetic energy for operating the tools, for example, 8" of the end of its downstroke. As the ballast is progressively displaced from a crib, the drop stroke of head **16** and tools *a* and *b* is increased and striker **91** on said head will engage stems **82** on pistons **81** in cylinders **80** in which a predetermined air pressure, for example, 75 p. s. i. is maintained from reservoir **85** through pressure regulator valve **86**. As the stroke of pistons **81** increases, the pressure in the lower ends of cylinders increases progressively until said pressure is increased, for example, to 300 p. s. i. when a full stroke is imparted to pistons **81**. During this increase of pressure, kinetic energy from the drop head will be absorbed by the air pressure in the lower ends of cylinders **80** to cushion and arrest the downstroke of the tools. When the maximum pressure is reached in cylinders **80**, it will be sufficient to support the static load and absorb excess kinetic energy at the end of full drop strokes.

While pistons **81** are in normal position and the drop head **16** is raised, air pressure corresponding to the same air pressure in cylinders **80**, (for example 75 p. s. i.), will be maintained in cylinder **113** and chamber **106** of valve **104**, and piston **112** will be held in the position shown in Fig. 5 by spring **115**. Slide valve **105** will cut off the flow of air from chamber **106** to port **107**, the pipe **100** and brake cylinder **97**. Stem **111** engages stem **116** of check valve **108** and holds check valve **108** open against the force of spring **118**. Piston **98** in cylinder **97** will be retracted by spring **99** and the brake shoes **94** will be disengaged from rails **101**. During the downstroke of the drop head **16** the pistons **81** are operated and increase the pressure in cylinder **80** to a predetermined degree. The air resistance to the drop head is supplemented by retardation by the brakes when the pressure in the right hand end of cylinder **113** is correspondingly increased to preponderate the resistance of spring **115** and the limited air pressure in the left hand end of cylinder **113**. When that occurs piston **112**, stem **111** and valve **105** will be shifted to the position shown in Fig. 6. Air under pressure will then pass from cylinders **80** via pipe **114**, chamber **106**, port **107** and pipe **100** to the brake cylinder **97**, and operate piston **98** to shift levers **95** and apply the brake shoes **94** to rails **101**. The brakes will then frictionally retard the downward movement of the head **16** and the tools *a* and *b*, while the air pressure in cylinders **80** simultaneously checks and cushions the drop head as it approaches the end of its downstroke. During the initial portion of the succeeding upstroke of the drop head **16**, strikers **91** move upwardly and release the stems **82** and pistons **81**. The air in cylinders **80** will expand during the upstroke of pistons and reduce the pressure in the right hand end of cylinder **113** against piston **112**, so that spring **115** and the limited air pressure in the left hand end of cylinder will shift piston **112** towards its normal position shown

in Fig. 5. In transit to its normal position, piston **112** will shift valve **105** to exhaust air from duct **107**, through exhaust port **110** as shown in Fig. 7. As the pressure drops in duct **107**, spring **118** will close check valve **108** and retain the pressure in brake cylinder **97** for holding the brake shoes set. As the pistons **81** approach the end of their upstroke, abutment **119** engages abutment **120** on stem **116** and opens check valve **108** against the force of spring **118** so that air will be exhausted from brake cylinder **97** via pipe **100**, port **107**, valve **105** and exhaust port **110**, and spring **99** will retract piston **98** and operate levers **95** to release the brake shoes. As a result of this construction and operation, the brake shoes will remain effective to check upward rebound of the drop head during a predetermined initial portion of the upstroke of the drop head and while the pistons **81** are moving upward in cylinders **80** and pressure is dropping in cylinders **80** and the right hand end of cylinder **113** to the normal. In each operation of the pistons **81** and piston **98** causes a loss of air by the exhaust from the brake cylinder **97** to atmosphere. This produces a pressure drop in pipe **87** until the pressure regulated feed valve **86** opens and admits sufficient air to cylinders **80** to the normal pressure (for example 75 lbs.) in said cylinders and cylinder **113**, for initiation of the succeeding operation of the brakes and the pistons **81** for the next downstroke of head **16** and tools *a* and *b*. By adjusting the valve **123**, the pressure of air at the left side of cylinder **113** which supplements spring **115** in resisting movement of piston **112**, can be varied to vary the predetermined pressure required to shift valve **105** for supplying air to the air brake cylinder **97**, and the timing of the air brake during the downstroke imparted to pistons **81** by striker **91** on the drop head **16**.

This construction exemplifies pneumatic devices with coacting brake devices for cushioning and arresting the drop head and tools thereon when approaching the end of each downstroke and checking rebound of the drop head and tools thereon during commencement of the upstroke, with the result that smoothness in operation is achieved with a heavy duty drop head. The combined effect of the pneumatic devices and the brakes is utilized while the greatest angular movement of the tools occurs during the displacement of the last portion of the ballast from the crib. This pneumatic return action of the crosshead from the position of greatest angularity of the digger members where the cam friction of the digger members is the greatest, very materially assists the crosshead lifting chains in raising the digger head assembly from rest without shock.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, cylinders mounted on the structure, pistons in the cylinder, each provided with a stem projecting from the upper end of a cylinder, abutments on the head for engaging the stems and operating the pistons in the cylinders during the end portion of the drop strokes and operable from the stems during upstrokes of the drop head, means for supplying air pressure from said source under a predetermined pressure into the lower end of the cylinders, the pistons being operable by said abutments to progressively increase the pressure of air in the lower ends of the cylinders for absorbing kinetic energy from the drop head, and means controlled by such increase of pressure for checking rebound of the drop head during the initial portion of the upstroke of the head.

2. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, cylinders mounted on the structure, pistons in the cylinders, each provided with a stem projecting from the upper end of the cylinder, abutments on the head for engaging the stems and operating the pistons in the cylinder during the end portion of the drop strokes, means for supplying air pressure from said source under a predetermined pressure into the lower end of the cylinder, the pistons being operable by said abutments to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, and means controlled by the

pistons for checking rebound of the head during the initial portion of the upstrokes.

3. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, cylinders mounted on the structure, pistons in the cylinders, each provided with a stem projecting from the upper end of a cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, and separable from the stems during their upstrokes, means for supplying air of a predetermined pressure from said source under a predetermined pressure into the lower ends of the cylinders, the pistons being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, and means controlled by such increase of pressure for retarding the downstroke of the head and checking rebound during the initial portion of the upstroke of the head.

4. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, means for supplying air from said source under a predetermined pressure in the lower end of the cylinder, the piston being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, brake means for checking the movement of the drop head, and means controlled by said increase of pressure for controlling the brake means.

5. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, means for supplying air from said source under a predetermined pressure in the lower end of the cylinder, the piston being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, brake means for checking the movement of the drop head, and means controlled by said increase of pressure in the cylinder for applying the brake means during the end portion of the down stroke and the initial portion of the upstroke of the head.

6. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, means for supplying air from said source under a predetermined pressure in the lower end of the cylinder, the piston being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, brake means for checking the movement of the drop head, and valve mechanism controlled by such increase of pressure in the cylinder for rendering the brake effective during the portion of the downstroke and the initial portion of the upstroke.

7. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, means for supplying air from said source under a predetermined pressure into the lower end of the cylinder, the piston being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, air brake means mounted on the drop head and applicable to the structure for checking the drop head, and valve mechanism controlled by the pressure in the cylinder for delivering air to said brake means to retard the movement of the drop head.

8. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, means for supplying air from said source under a predetermined pressure into the lower end of the cylinder, the piston being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, air brake means mounted on the drop head and applicable to the structure for checking the drop head, and valve mechanism controlled by the pressure in the cylinder for delivering air to said brake means to retard the movement of the drop head and for exhausting air from the brake means.

9. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the end portion of the drop strokes, means for supplying air from said source under a predetermined pressure into the lower end of the cylinder, the piston being operable by said abutment to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from the drop head, air brake means mounted on the drop head and applicable to the structure for checking the drop head, and valve mechanism controlled by the pressure in the cylinder for operating the brake means to check the drop head during the end portion of the downstroke and during the initial portion of the upstroke of the drop head.

10. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a plurality of cylinders on the structure, pistons slidable in the cylinders, each provided with a stem projecting from the upper end of a cylinder, abutments on the head for engaging the stems and operating the pistons during the end portion of the drop strokes, means for supplying air of a predetermined pressure from said supply to the lower ends of said cylinders, the pistons being operable to progressively increase the pressure of air in the lower ends of the cylinders for absorbing kinetic energy from the drop head, air brake means for checking the movement of the head and means controlled by the pressure in the cylinders for controlling the operation of the brakes.

11. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a plurality of cylinders on the structure, pistons slidable in the cylinders, each provided with a stem projecting from the upper end of a cylinder, abutments on the head for engaging the stems and operating the pistons during the end portion of the drop strokes, means for supplying air of a predetermined pressure from said supply to the lower ends of said cylinders, the pistons being operable to progressively increase the pressure of air in the lower ends of the cylinders for absorbing kinetic energy from the drop head, air brake means for checking the movement of the head, and valve mechanism controlled by the pressure in the cylinders for supplying air to the brake means for its operation to check the head during the end portion of its downstroke and during the initial portion of the upstroke.

12. Apparatus for cushioning the strokes of a power lifted drop head provided with tools for impacting ballast, comprising: a supply of air under pressure, a cylinder mounted on the structure, a piston in the cylinder provided with a stem projecting from the upper end of the cylinder, an abutment on the head for engaging the stem and operating the piston in the cylinder during the ultimate portion of the drop strokes, means including a pressure regulated valve for supplying to and retaining air of a predetermined pressure from said source, in the lower end of the cylinder, the piston being operable to progressively increase the pressure of air in the lower end of the cylinder for absorbing kinetic energy from and supporting the static load of the drop head, air brake means for checking the head and

valve mechanism controlled by the pressure in the cylinder, valve for delivering to and exhausting air from the brake means, a check valve for retaining air in the brake means, and a piston responsive to pressure in the cylinder for opening the check valve to exhaust air from the brake means.

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