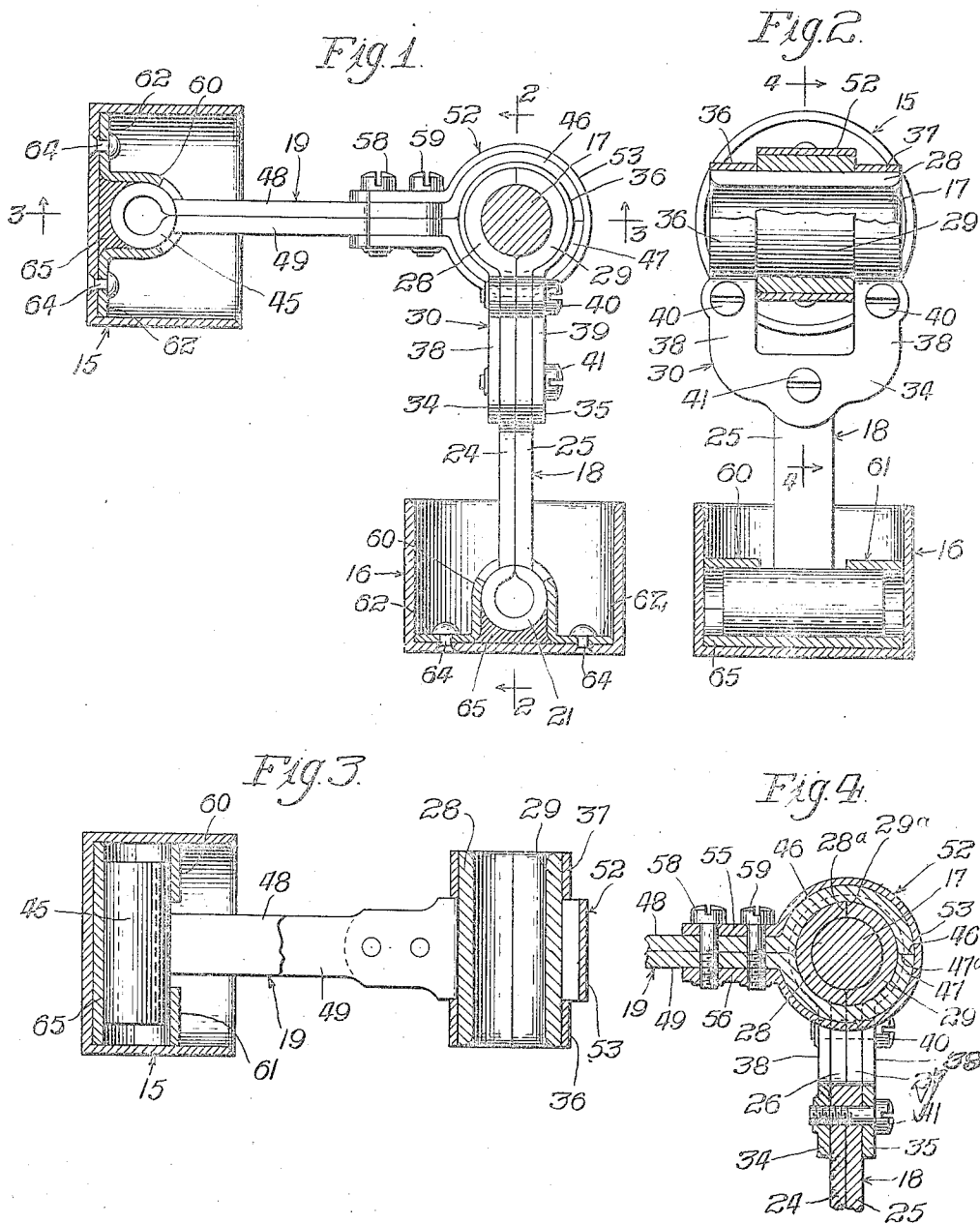


A. LEVEDAHL.
CONNECTING ROD FOR PNEUMATIC DRILLS.
APPLICATION FILED SEPT. 30, 1915.

1,208,338.

Patented Dec. 12, 1916.
2 SHEETS—SHEET 1.



Witnesses:
A. S. Gauthier
S. H. Poole

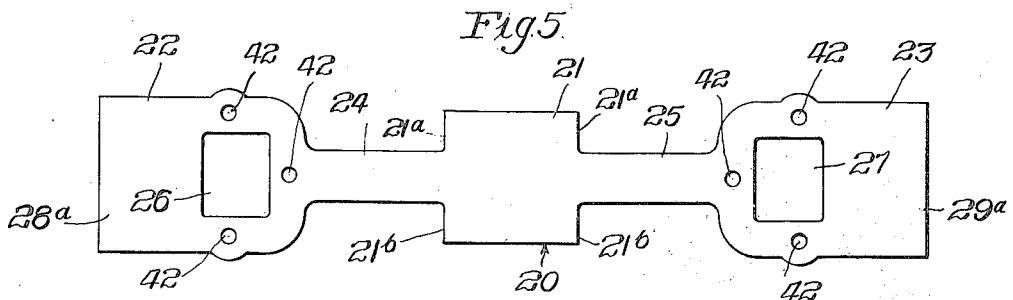
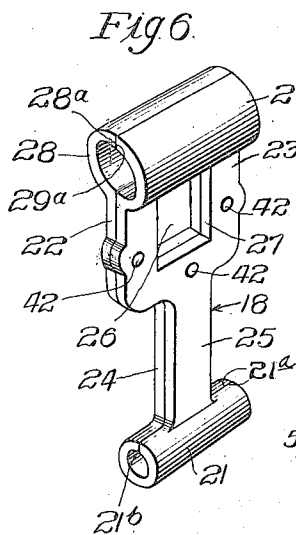
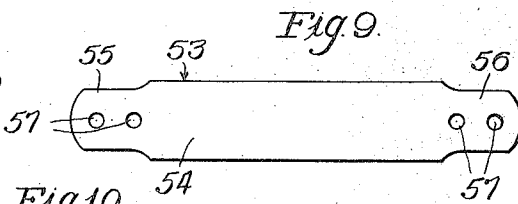
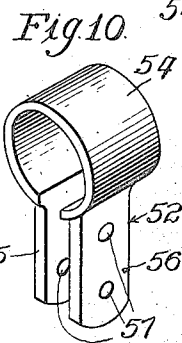
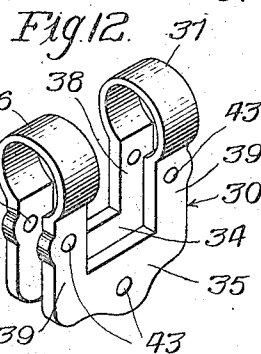
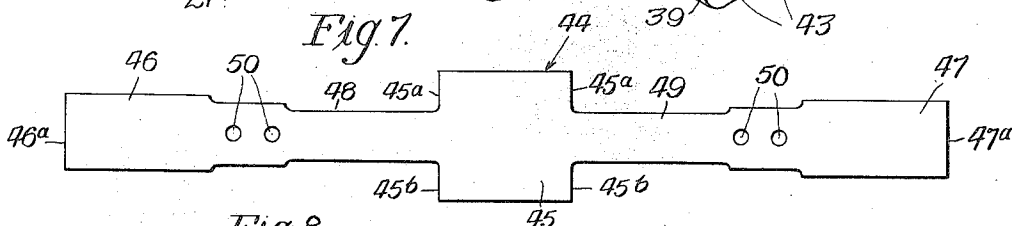
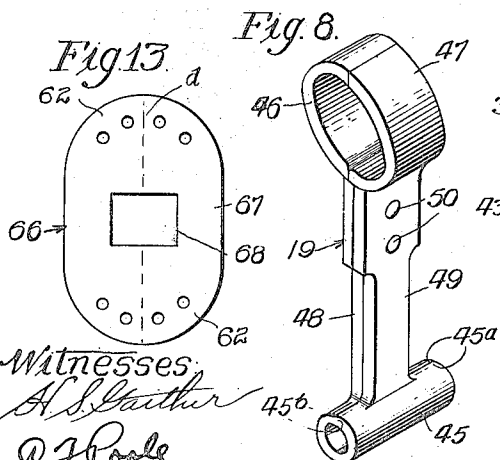
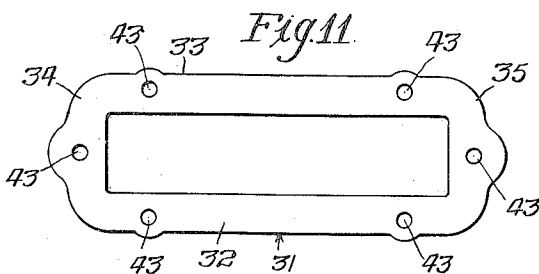
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

AXEL LEVEDAHL, OF AURORA, ILLINOIS, ASSIGNOR TO AURORA AUTOMATIC MACHINERY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

CONNECTING-ROD FOR PNEUMATIC DRILLS.

1,208,338.

Specification of Letters Patent.

Patented Dec. 12, 1916.

Application filed September 30, 1915. Serial No. 53,456.

To all whom it may concern:

Be it known that I, AXEL LEVEDAHL, a citizen of the United States, and a resident of Aurora, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Connecting-Rods for Pneumatic Drills; and I do hereby declare that the following is a full, clear and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in the construction of connecting rods and associated parts, and more particularly to the construction of connecting rods and parts for use in piston driven pneumatic drills and like tools.

In the usual construction of tools of the class described the power is transmitted to the tool by the transformation of reciprocating motion into rotary motion by means of pistons, usually single acting, which are actuated by the admission of air pressure into cylinders carrying said pistons, the latter being connected to a crank shaft by the usual connecting rod. A common construction is to provide an arrangement of the cylinders whereby the same are located in the same plane and displaced at an angle to each other, preferably 90°, the connecting rod of each piston of said cylinders being connected at a single point on the crank. It is to this particular type of tool that my invention has reference, although its application is equally well suited for any form of tool or mechanism having reciprocating pistons.

Tools of this description are ordinarily run or operated at extremely high speeds, are subjected to rough handling, and often misused by the absence of lubrication in sufficient amounts. As a result of these conditions, the moving parts undergo severe usage and are required to withstand a considerable degree of vibration. The connecting rods in the usual form of tool are made from solid forgings, which are connected at their ends to the piston and crank by means of hinge-pins, bolts, screws, and the like. By reason of the extremely high speeds at which such tools are operated and the vibrations to which the connecting rods are subjected, as well as the extreme heat caused by the neglect of lubrication, the connecting rods,

bearings and parts of said rods have been found to admit of considerable relative movement, which in time effects such a degree of wear as to render the parts incapable of smooth and proper movement, and greatly increasing the liability of breakage thereof.

Among the objects of my invention is to provide a construction for connecting rods and associated parts that will successfully remove the difficulties hereinbefore set forth, and otherwise improve the operation and efficiency of air operated tools and the like.

In accomplishing the desired results, I propose primarily to form the connecting rod from a single piece of metal, the same being formed from a blank cut or stamped to the desired shape or contour from sheet metal, preferably cold rolled sheet steel. The blank thus formed is then bent at its central point upon itself, those portions of the blank intermediate the ends of the rod being folded in contact with each other and forming the shank of the rod of two thicknesses of sheet metal identical in contour. The end portions of the folded blank are likewise identical in form and are bent cylindric to provide a hollow cross pin or split bearing, as the case may be. To connect the connecting rod thus formed to the crank and to the piston, I provide clamp members or straps, the same being formed from a flat blank made from sheet metal such as steel, said straps being provided with substantially cylindric portions which encircle the cross pins or split bearings of the rod and are clamped by means of bolts or the like to the shank or rod.

As a further feature of my invention, and in connection with the form of tool embodying the angularly arranged cylinders as before mentioned, the split bearing of one rod is preferably made of sufficient length so that it forms a central bearing for the split bearing of the other connecting rod, the bearing or sleeve of the latter being clamped about or encircling the split bearing of the first mentioned rod.

The features of my invention will be more readily understood as I proceed with the description of the invention and in connection with the accompanying drawings, wherein the parts are shown by figures as follows:

Figure 1 is a view in side elevation of two pistons located in the same plane and ar-

ranged at an angle to each other and each
 connected with a single crank-shaft, the pis-
 tons being shown in section; Fig. 2 is a ver-
 tical sectional view taken on line 2—2 of
 5 Fig. 1, with parts in elevation; Fig. 3 is a
 horizontal sectional view taken on line 3—3
 of Fig. 1, with parts in elevation; Fig. 4 is
 a fragmentary view in vertical section taken
 on line 4—4 of Fig. 2; Fig. 5 is a top plan
 10 view of a sheet metal blank from which
 one of the connecting rods is formed; Fig.
 6 is a perspective view of a connecting rod
 formed from the blank shown in Fig. 5;
 Fig. 7 is a top plan view of a sheet metal
 15 blank from which another connecting rod
 is formed; Fig. 8 is a perspective view of
 the connecting rod formed from the blank
 shown in Fig. 7; Fig. 9 is a top plan view
 of the flat blank from which the clamp
 20 member or strap used with the connecting
 rod shown in Fig. 8 is formed; Fig. 10 is a
 perspective view of the clamp member or
 strap formed from the blank shown in Fig.
 9; Fig. 11 is a top plan view of the flat
 25 blank from which the clamp member or
 strap used with the connecting rod shown
 in Fig. 6 is formed; Fig. 12 is a perspective
 view of the clamp member or strap formed
 from the blank shown in Fig. 11; and Fig.
 30 13 is a top plan view of the sheet metal
 blank from which is formed the strap for
 connecting the cross pin of the connecting
 rod to the piston.

Referring to the drawings, wherein is set
 35 forth in detail the construction for connect-
 ing rods and associated parts embodying the
 features of my invention, two pistons 15 and
 16 are shown (Figs. 1, 2, and 3) adapted for
 reciprocating movement in cylinders of a
 40 pneumatic tool (not shown) located in the
 same plane and arranged at an angle of 90°
 to each other. Said pistons are each oper-
 atively connected with the same or a com-
 mon crank-shaft, pin, or the like 17 by con-
 45 necting rods 18 and 19, respectively.

The connecting rod 18, which connects
 the piston 16 with said crank-shaft 17, is
 formed from a flat blank 20 cut or stamped
 from sheet metal, preferably cold rolled
 50 steel, in the form shown in Fig. 5, and as
 illustrated, comprises a rectangular central
 portion 21 and two larger portions 22, 23
 identical in form and in size and disposed
 on opposite sides of and spaced at an equal
 55 distance from said central portion 21. Said
 rectangular end portions 22, 23 are integral
 with and connected to said central portion
 21 by longitudinal portions 24, 25 extend-
 ing laterally from opposite sides of said
 60 central portion 21, said longitudinal por-
 tions 24, 25 being equal in length and width
 and, as shown, laterally narrower than
 either the central or end portions of the
 blank. Each end portion 22, 23 is provided
 65 within its margins with a rectangular open-

ing or aperture 26, 27, respectively, the same
 being equal in size and located in corre-
 sponding positions in said end portion 22,
 23. The connecting rod 18 is formed from
 said blank 20 by bending said blank at its
 70 central portion upon itself, so that the lon-
 gitudinal portions 24, 25 and the end por-
 tions 22, 23 are brought against and flatwise
 into contact with each other with the open-
 75 ings 26, 27 of the latter in registering rela-
 tion. In the operation of forming the con-
 necting rod, the central portion 21 is bent
 cylindric in shape, as shown in Fig. 6, the
 opposed margins 21^a, 21^b of said central por-
 tion being disposed in abutting relation,
 80 when the same is given its cylindric form.
 The central portion thus formed constitutes
 a hollow cylindric cross-pin at the piston
 end of the rod, adapted to be pivotally at-
 85 tached to the piston, as will hereinafter be
 set forth. The opposite ends of the rod,
 consisting of the end portions 22 and 23,
 which are brought flatwise into contact with
 each other by the bending of the blank, are
 90 each bent, by means of a mandrel, into a
 semi-cylindrical form throughout the end
 portions beyond the apertures 26 and 27, the
 end margins 28^a, 29^a being brought into
 abutting relation, as shown in Fig. 6. These
 95 semi-cylindric portions 28, 29 of the end
 portions 22 and 23, respectively, form a
 split bearing at the crank end of the con-
 necting rod, which is adapted to embrace
 the crank 17 of the driving shaft of the tool.
 The rod is connected to the crank 17 by
 100 spreading apart the two semi-cylindric
 members 28, 29 of the split bearing and in-
 serting the crank between them, the resil-
 iency of the members permitting the spread-
 105 ing of the parts as well as serving to main-
 tain the parts 28 and 29 in close contact with
 the crank. In order to clamp the members
 28, 29 of the split bearing about the crank-
 shaft 17 and prevent said members from
 spreading apart or moving laterally rela-
 110 tively to each other, when the rod is subject-
 ed to vibrations, a clamp member or strap
 30 is provided (Fig. 12), the same being
 formed from a blank 31, which is stamped
 or cut from sheet metal, in the form of a
 115 flat plate, as shown in Fig. 11. As illus-
 trated, said blank 31 comprises two flat, sub-
 stantially parallel, laterally spaced, longi-
 tudinal members 32, 33 equal in length and
 connected with each other at the ends there-
 120 of by flat, transversely parallel, end mem-
 bers 34, 35, the latter being equal in length
 and integral with the longitudinal members
 32, 33.

To form the complete clamp member or
 125 strap 30, the blank 31 is bent, by suitable
 tools, intermediate its ends and centrally
 upon itself, the central portions of the lon-
 gitudinal members being curved substan-
 tially cylindric in form, thereby providing 13

laterally spaced cylindric parts 36, 37, the ends of which are separated from each other. The portions of the longitudinal members beyond the cylindric portions, together with the transverse end portions, are maintained flat and in the bending of the blank are brought opposite each other in parallel relation, the same being separated by a space, as shown in Fig. 12. The strap 30 is preferably made from rather heavy sheet material, so as to give rigidity and strength to the parts, although the thickness of the metal throughout the cylindric portions 36 and 37 is reduced by boring out the inner surfaces thereof, thereby affording a degree of elasticity necessary in applying the strap, as will presently appear. The clamp member or strap 30 thus formed is applied to the crank end of the connecting rod 18 for the purpose of securing the members 28, 29 of the split bearing of the connecting rod tightly about the crank-shaft, this being accomplished by springing or spreading apart the transverse end portions 34, 35 of said clamp member and forcing the same over the split bearing of the rod 18 until the cylindric parts 36, 37 encircle the split bearing of the rod. By reducing the thickness of the cylindric parts 36, 37 in the manner before suggested, the clamp member is rendered more flexible, thereby permitting the clamp member to be forced over the split bearing of the rod 18. When the clamp member or strap 30 is applied, the same occupies the position shown in Figs. 1 and 4, with the cylindric parts 36, 37 in contact with and encircling the members 28, 29 of the split bearing of the rod 18, the contacting apertured parts of the rod 18 being interposed between and overlapped by the parts 38, 39 and the end members 34, 35 of said clamp member. As shown, the openings formed between the parts 38, 39 and the transverse end portions 34, 35 of said clamp member register with the apertures 26, 27 in the rod 18. The clamp member 30 is secured to said rod 18 by screws 40, 41, or other suitable connecting members, extending through registering holes 42 and 43 formed in the connecting rod 18 and strap 30, respectively, said holes being preferably formed at the time the blanks are cut or stamped. The cylindric portions 36, 37 of the strap being spaced apart, it is to be noted that the same embrace only the end portions of the split bearings of the rod 18, the portion of the split bearing extending between said members 36, 37 of said clamp member 30 being exposed and providing a center bearing for the other connecting rod 19, as will hereinafter be pointed out.

The connecting rod 19, shown in Fig. 1 as connected with the piston 15, is formed in the same manner as the connecting rod 18, just described, namely, from a sheet

metal blank 44 having the form shown in Fig. 7. This rod is provided at its ends with cylindric portions as before, namely, a central portion 45 constituting the cross-pin having abutting margins 45^a and 45^b and two end portions 46 and 47 adapted to be brought into contact, and the end marginal portions shaped semi-cylindric to provide a split bearing. The connecting rod 19 differs from the connecting rod 18 in the formation of the crank end thereof, in that the end portions are substantially narrower and somewhat greater in length, although the shank portions 48 and 49 are identical in form as in said previously described rod 18, and but slightly narrower in width than the end portions 46 and 47. The end portions 46 and 47 are bent into cylindric form as before, with their end margins 46^a and 47^a brought into abutting relation, thus forming a split bearing, as shown in Fig. 8. The width of this bearing is substantially equal to the width of the apertures 26 and 27 of the connecting rod 18 and likewise equal to the distance between the adjacent margins of the cylindric portions 36 and 37 of the strap 30. The inside diameter of the split bearing is greater than that of the corresponding bearing of the rod 18; in fact, it is substantially equal to the outside diameter of the split bearing of said connecting rod 18. The reason for this construction will be manifest, when it is pointed out that the split bearing of the rod 19 embraces the split bearing of the rod 18 and engages that portion of the latter between the end portions thereof, as is clearly shown in Fig. 2. The connecting rod 19 is connected to the crank 17 by spreading the semi-cylindric parts of the split bearing apart and passing them around the central portion of the bearing of the rod 18, the latter thus serving as a bearing for the crank of the rod 19. In this manner the split bearing of the rod 19 surrounds that portion of the bearing of the rod 18 intermediate the cylindric portions 36, 37 of the strap 30, one part thereof extending through the apertures 26 and 27 of the rod 18.

The crank end of the rod being applied in the manner stated, it is firmly clamped by means of a strap 52, (Fig. 10), which is formed from a blank 53 (Fig. 9), bent to provide a substantially cylindric central portion 54 and two parallel end portions 55 and 56. The strap 52 has a single cylindric portion, which is of greater diameter than the cylindric portion of the strap 30, but, as before, has its inner surface bored out to provide a reduced thickness of metal in order to afford the degree of flexibility required to apply it to the connecting rod. The strap 52 is mounted in position by spreading the ends 55, 56 thereof apart and inserting the split bearing of the rod 19

into the cylindric portions thereof, said bearing being completely embraced by said strap. The end portions 55 and 56 of the strap 52 are brought into contact with and
 5 against the adjacent portions of the shank of the connecting rod, and are secured thereto by means of screws 58 and 59, which extend through registering holes 50 and 57
 10 portions of the strap 52, respectively, said holes being preferably provided when the blanks are formed. It is to be noted that the cylindric portion of the strap 52 passes through the apertures 26 and 27 of the rod
 15 18, and occupies a position intermediate the cylindric portions of the strap 30 of the other rod 18. In this manner the connecting rod 19 is securely held in bearing engagement with the outer surface of the bearing
 20 of the rod 18, both rods being, in fact, connected to the crank 17 at substantially the same point, although the bearing of one rod acts as a bearing for the other rod. It is apparent that this construction affords the
 25 utilization of a minimum amount of space and reduces to a large degree the size of the crank and, consequently, the amount of metal required to provide bearings for both connecting rods.

30 The connecting rods 18 and 19 are connected at the piston ends thereof to each of their associated pistons 15 and 16, respectively, by straps or yokes 60, preferably made as follows: Each yoke is formed from
 35 a sheet metal blank 66 (Fig. 13) having curvilinear end margins and provided at its central portion 67 with a rectangular aperture 68. The central portion of the blank is bent to provide a semi-cylindric yoke
 40 portion extending transversely from either side of the central aperture 68. Each strap is preferably cut into two parts along a longitudinal central line *d* (Fig. 13), each part constituting a strap adapted to engage
 45 an end portion of a cross-pin, as shown in Fig. 2, the same being journaled in a bearing block 65 having a concave seat and extending throughout the length of the cross-pin and beyond the ends thereof. The yoke
 50 portion of each strap embraces the bearing block, together with the ends of the cross-pin, the remaining portion of the strap constituting flanges 62, which fit within the bottom of the piston and are attached to
 55 the cylinder head by means of rivets 64 extending through holes formed in said flanges of the strap and the head of said piston. By this construction, the impact of the air against the piston is received by the
 60 bearing block 65 and transmitted to the connecting rod through the cross-pin which is journaled to said block, thereby relieving the straps of any strain during the power stroke as would tend to loosen the rivets
 65 by which said straps are secured to the pis-

ton and permit breakage. This is apparent since the pistons are single acting, and hence power is applied only during one stroke of the piston, namely, in the direction which the piston would be moved by
 70 the pressure of the air acting upon the outer surface of the piston head.

It is to be noted that the cross-pins are slightly less in length than the bearing blocks 65, and also that the space between
 75 the yokes of the straps is slightly greater than the width of the shank portions of the connecting rods. This arrangement permits a degree of relative lateral movement between the piston and the connecting rod,
 80 thus admitting of a slight adjustment between these members in case any inaccuracy occurs in the boring of the cylinders, or a slight deviation of the cylinders from a
 85 common plane.

The advantages resulting in the application of this construction for connecting rods and associated parts thereof to pneumatic tools are numerous, among which a few may be mentioned at this time. One of the features
 90 already pointed out is the formation of the connecting rod from a single piece of metal. By this construction a rigid and integral unit is provided which is connected directly to the crank by means of the bearing formed
 95 integral with the rod, and to the piston by a strap which acts to journal a cross-pin also integral with the rod. This results in the elimination of several members connected together by hinge-pins, bolts, screws, and
 100 the like, which in time are liable to work loose, thereby permitting a degree of play that would increase the wear and otherwise materially affect the operation of the tool.

A further advantage is to be noted in the
 105 manner in which the rods are journaled upon the crank. By providing a split bearing integral with connecting rods, it is possible to provide a full journal or bearing surface for one of the rods, and at the same
 110 time permit the use of a strap to securely hold the parts of the bearing together, and at the same time obtain sufficient space on said bearing to permit it to act as a bearing for the other rod. In this manner one rod is
 115 provided with a journal or bearing surface sufficient to effect the proper transmission of power from both pistons to the crank.

A further advantage to be secured, and one that has already suggested itself, is the
 120 lightness and cheapness of construction that can be obtained by the exclusive use of sheet metal in the manufacture of the parts. The stamping of the parts from sheet metal by the use of dies is admittedly the least ex-
 125 pensive method of machine work, this fact being of vital importance, in that it reduces the cost of production to a large degree. In addition to this advantage, it is possible to use sheet metal that is cold rolled,
 130

a process that produces a material much superior to those ordinarily used in the manufacture of articles of this nature.

A further feature resulting from the use of connecting rods made and arranged in accordance with my invention is the adaptability of the parts to a minimum amount of space and particularly that space required to contain the crank. This advantage is secured not only by the manner in which one rod is journaled upon the bearing of the other rod, thus requiring but a single bearing on the crank, but from the fact that the use of screws, bolts, or lugs at the ends of the rods is entirely eliminated by the use of the straps, which merely surround the split bearings at the crank ends and have no parts projecting beyond their surfaces as would necessitate the provision of sufficient space to permit their free movement.

The last advantage to be mentioned concerns the simple and effective method that can be employed in securing the piston to the connecting rod. The use of the concave bearing block and the straps riveted to the piston head and provided with the yokes, which act to journal the cross-pins in said bearing blocks, makes it possible to construct the piston in a comparatively inexpensive manner, since the head need not be thicker than the walls, for the reason that no portion or connecting parts of the rod extend through the piston head, thereby requiring a sufficient thickness of metal to properly connect the piston and the connecting rod together. For this reason it is even possible to form the pistons from sheet metal as well as the connecting rods and straps, thereby securing the advantages before pointed out with respect to said connecting rods and straps. In addition to the possibility of the almost exclusive use of sheet metal and die work in attaching the piston to the connecting rods, a further advantage results from the fact that no part of the connecting rod extends through the head of the piston, namely, that when the pistons and connecting rods are assembled, there is no opportunity for leakage through the bottom of the piston, since there is no part of the connecting rod that extends through the piston head that may become loosened and admit the passage of air, which would manifestly reduce the efficiency of the tool.

The details of construction of the parts embodying the features of my invention may be variously modified without departing from the spirit of my invention, and for that reason I do not wish to be limited to the particular construction herein described and illustrated, except in so far as specifically pointed out in the appended claims.

I claim as my invention:

1. The combination with pistons and a

crank, of connecting rods joining said pistons with said crank, said rods being formed from blanks cut from sheet metal and folded to provide a double thickness of metal throughout the length of the rods, and the free ends of said blanks being bent semi-cylindric in form to provide a tubular bearing at one end of each of said rods, the bearing of one of said rods being adapted to be journaled on said crank, and the bearing of the other of said rods being adapted to be journaled on the bearing of said first mentioned rod, and means for pivotally connecting the opposite ends of said rods with said pistons.

2. The combination with cylinders, pistons in said cylinders, and a crank, of connecting rods joining said pistons with said crank, said rods being formed from blanks cut from sheet metal and folded transversely at their central portions to provide a double thickness of metal throughout their lengths, each of said blanks being provided with enlarged end portions adapted to be bent semi-cylindric in form to provide a tubular split bearing at one end of each of said rods, the bearing of one of said rods being adapted to be journaled on said crank, and the bearing of the other of said rods being adapted to be journaled on the bearing of the said first mentioned rod, and means for pivotally connecting the opposite ends of said rods with said pistons.

3. In a device of the character described, the combination with pistons mounted in cylinders arranged at an angle to each other, and a crank, of connecting rods connecting said crank and pistons and formed from blanks cut from sheet metal, each of said blanks being folded upon itself to provide a double thickness of metal throughout its length, said rods being provided at one end with enlarged portions bent semi-cylindric in form to provide a split bearing, the bearing of one of said rods being journaled on said crank, there being provided an aperture in the shank portion of said rod adjacent to said bearing, and the split bearing of the other of said rods being journaled on the bearing of the first mentioned rod extending through said aperture thereof, and means for pivotally connecting the opposite ends of said rod with said pistons.

4. In a device of the character described, the combination with pistons mounted in cylinders arranged at an angle to each other, and a crank, of connecting rods connecting said crank and pistons and formed from blanks cut from sheet metal, each of said blanks being folded upon itself to provide a double thickness of metal throughout its length, one of said blanks being provided at one end with enlarged portions bent semi-cylindric in form to provide a split bearing adapted to be journaled on said crank and

provided with an aperture adjacent to said bearing, the other of said rods being provided with a bearing at its end journaled on and intermediate the ends of the bearing of the first mentioned rod and extending through said aperture thereof, a strap formed from a blank of sheet metal bent to form two cylindric portions adapted to surround the end portions of the bearing of the first mentioned rod at either side of the bearing of said last mentioned rod and end portions secured to the rod adjacent to said aperture, and means for pivotally connecting the opposite ends of said rod with said pistons.

5. In a device of the character described, the combination with pistons mounted in cylinders arranged at an angle to each other, and a crank, of connecting rods connecting said crank and pistons, and formed of a double thickness of sheet metal, one of said rods being provided at one end with enlarged portions bent cylindric in form to provide a bearing adapted to be journaled on said crank and provided with an aperture adjacent to said bearing, the end portions of the other of said rods being formed to provide a bearing of less width than that of the first mentioned rod, the same being journaled on the bearing of the first mentioned rod throughout a portion of its width and extending through said aperture thereof, a strap of sheet metal surrounding the split bearing of said last mentioned rod and fastened at the ends to the rod adjacent to said bearing, and a strap surrounding the free portions of the bearing of said first mentioned rod and fastened to the same adjacent to the bearing thereof.

6. In a device of the character described, the combination with pistons mounted in cylinders arranged at an angle to each other, and a crank, of connecting rods connecting said crank and pistons and formed from blanks cut from sheet metal, each of said blanks being folded upon itself to provide a double thickness of metal throughout its length, said rods being provided at one end with enlarged portions bent cylindric in form to provide a split bearing, the bearing of one of said rods being adapted to be journaled on said crank, there being provided an aperture in said rod adjacent to said bearing, the split bearing of the other of said rods being journaled on the bearing of the first mentioned rod and extending through said aperture thereof, a strap of sheet metal surrounding the split bearing of said last mentioned rod and fastened at the ends to the rod adjacent to said bearing, and a strap surrounding the end portions of the bearing of said first mentioned rod and fastened to the same adjacent to the bearing thereof.

7. In a device of the character described,

the combination with pistons mounted in cylinders arranged at an angle to each other, and a crank, of connecting rods formed of a double thickness of sheet metal, each rod provided at one of its ends with a split bearing integral therewith, the bearing of one rod being journaled on said crank, there being provided an aperture in said rod adjacent to said bearing, a strap formed from a blank of sheet metal having open cylindric portions spaced apart and parallel end flanges extending from the open ends of said cylindric portions, said cylindric portions surrounding the end portions of said split bearing of said last mentioned rod, and the end flanges being secured to the rod adjacent to said bearing and in contact with the opposite ends thereof, said flanges being provided with apertures registering with said aperture in said rod, the split bearing of the other of said rods surrounding the bearing of said first mentioned rod intermediate the cylindric portions of the strap thereof and extending through said apertures, a strap surrounding said bearing and fastened to said rod adjacent to the bearing thereof, and means for pivotally connecting the opposite ends of said rods to said pistons.

8. The combination with a piston, of a connecting rod formed of a double thickness of sheet metal and provided at one end with a cylindric portion extending transversely of said rod and forming a journal integral with said rod, and a strap provided with a yoke surrounding an end of said journal and flanges rigidly connected to said piston.

9. The combination with a piston, of a connecting rod formed from a blank of sheet metal bent transversely upon itself to provide a double thickness of metal throughout its length, and provided at its end with a tubular portion extending transversely of said rod and forming an integral cross-pin, a bearing block having a concave seat in which said cross-pin is journaled, said bearing block being interposed between said rod and the piston, and straps provided with yokes surrounding the ends of said cross-pin and flanges rigidly connected to said piston.

10. The combination with a piston, of a connecting rod formed of a double thickness of sheet metal and provided at its end with a cylindric portion extending transversely of said rod and forming an integral cross-pin, and means for pivotally connecting said rod to said piston, comprising straps formed from a blank of sheet metal bent to provide semi-cylindric yokes surrounding the ends of said cross-pin, and rigidly connected to said piston.

11. The combination with a piston, of a

connecting rod formed of a double thickness of sheet metal and provided at its end with a cylindric portion extending transversely of said rod and forming an integral cross-pin, and means for pivotally connecting said rod to said piston, comprising a strap formed from a blank of sheet metal having a central aperture and bent to provide semi-cylindric yokes extending transversely from said aperture, said yoke portions surrounding the ends of said cross-pin and said rod extending through said aperture, the flanges of said strap having flat contact with the head of said piston and being rigidly attached thereto.

12. The combination with a piston, of a connecting rod formed from a blank of sheet metal bent upon itself to provide a double thickness of metal throughout its length and at its end with a hollow cylindric portion extending transversely of said rod and forming an integral cross-pin, and means for pivotally connecting said rod to said piston, comprising a strap formed from a blank of sheet metal bent to provide semi-cylindric yokes extending transversely from said aperture, said strap being cut into two parts along a longitudinal central line, each part being applied to the opposite ends of said cross-pin with the yoke portions surrounding said end portions of the pin, and the flange portion of each part in flat contact with the head of said piston and rigidly secured thereto.

13. The combination with a piston, of a connecting rod formed from a blank of sheet metal bent longitudinally upon itself to provide a double thickness of metal throughout its length and at its end with a hollow cylindric portion extending transversely of said rod and forming an integral cross-pin, a bearing block having a concave seat in which said cross-pin is journaled, said block being greater in length than said cross-pin, a strap formed of sheet metal bent to form semi-cylindric yoke portions surrounding the end portions of said yoke member and said bearing block, and flange portions rigidly secured to said piston, said strap being provided with an aperture through which said rod extends, the same being

greater in width than the rod, thereby permitting transverse movement of said rod.

14. The combination with a piston and a crank, of a connecting rod formed of a double thickness of sheet metal and having at one end a transverse cylindric cross-pin formed integral therewith adapted to be pivotally connected to said piston, and at the other end a tubular bearing adapted to be journaled on said crank, and straps formed from blanks of sheet metal bent to surround said cross-pin and said bearing and to be connected to said piston and connecting rod, respectively.

15. The combination with a piston and a crank, of a connecting rod formed from a blank cut from sheet metal and provided with an enlarged central portion, said blank being bent transversely upon itself at its central portion to provide a double thickness of metal, said central portion being formed cylindric to provide an integral cross-pin, and the free ends of said rod being formed semi-cylindric to provide a split bearing at the opposite end of said rod adapted to be journaled on said crank, and straps formed from blanks cut from sheet metal and bent to surround said cross-pin and said split bearing and to be secured to said piston and connecting rod, respectively.

16. The combination with a piston, of a connecting rod provided at one end with a cylindric portion extending transversely of said rod and forming an integral journal, and a strap surrounding the end portion of said journal and rigidly connected with said piston.

17. The combination with a piston, of a connecting rod provided at one end with a cylindric cross pin, a concave block on which said cross pin is journaled, and a strap surrounding said cross pin and block and rigidly secured to said piston.

In testimony that I claim the foregoing as my invention I affix my signature, in the presence of two witnesses, this 25th day of Sept., A. D. 1915.

AXEL LEVEDAHL.

Witnesses:

IVER A. HANSSEN,
FRANK S. RHOADS.