No. 772,706. PATENTED OCT. 18, 1904.

A. H. M. DRIVER & G. NORMAN.

BARREL BORING MACHINE.

APPLICATION FILED MAR. 31, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

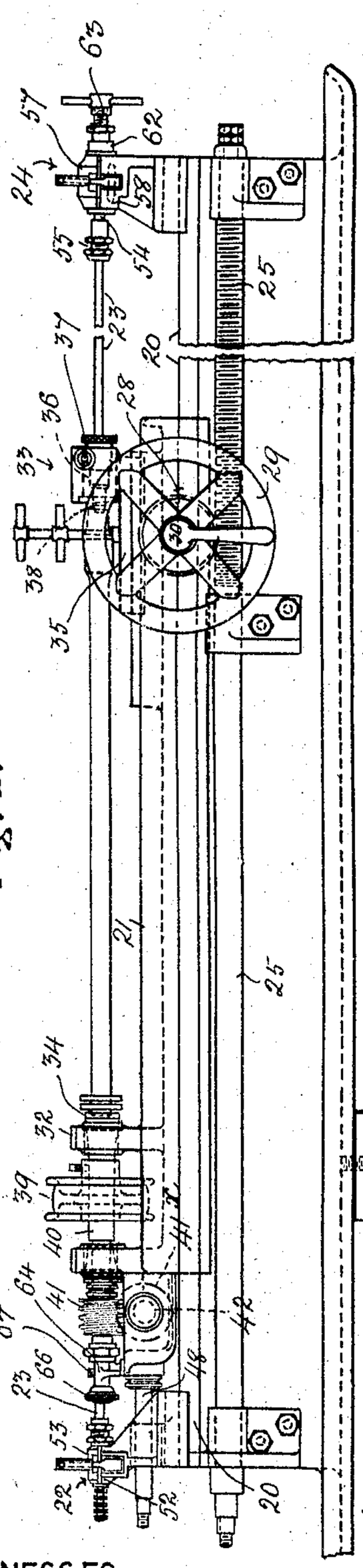

Fig. 1.

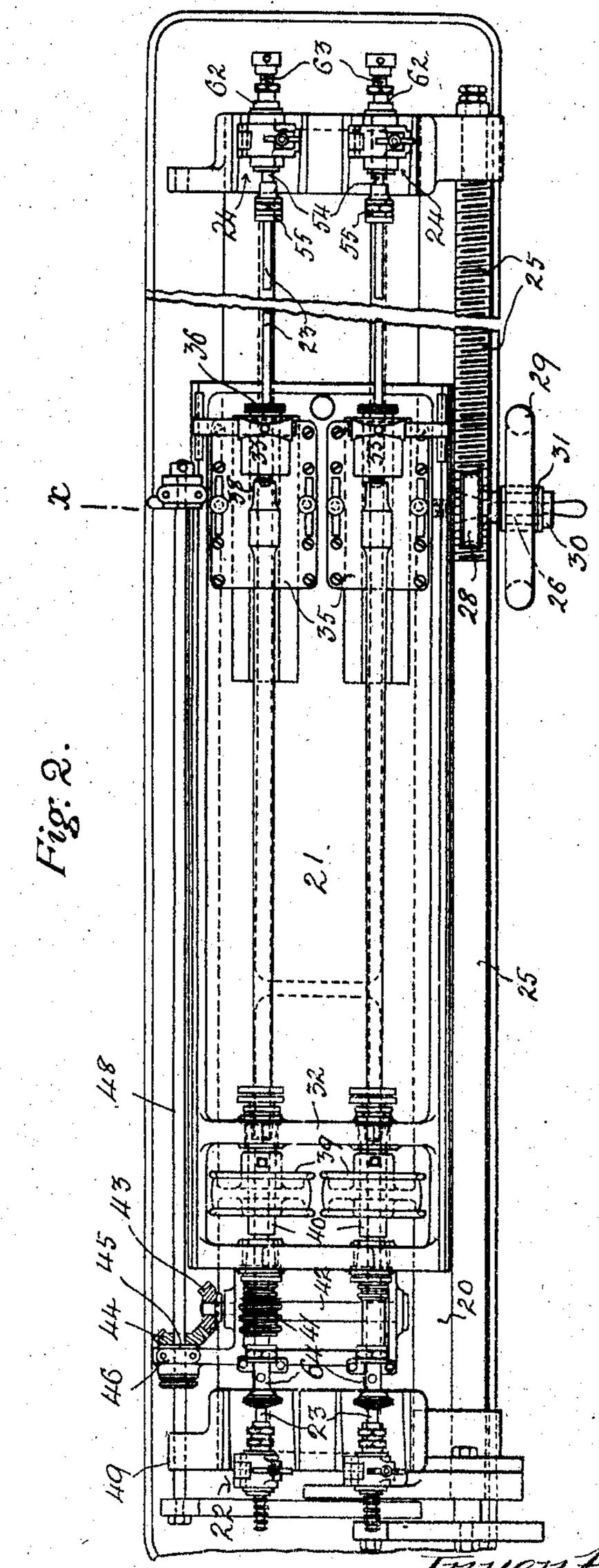

Fig. 2.

WITNESSES

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Fig. 3.

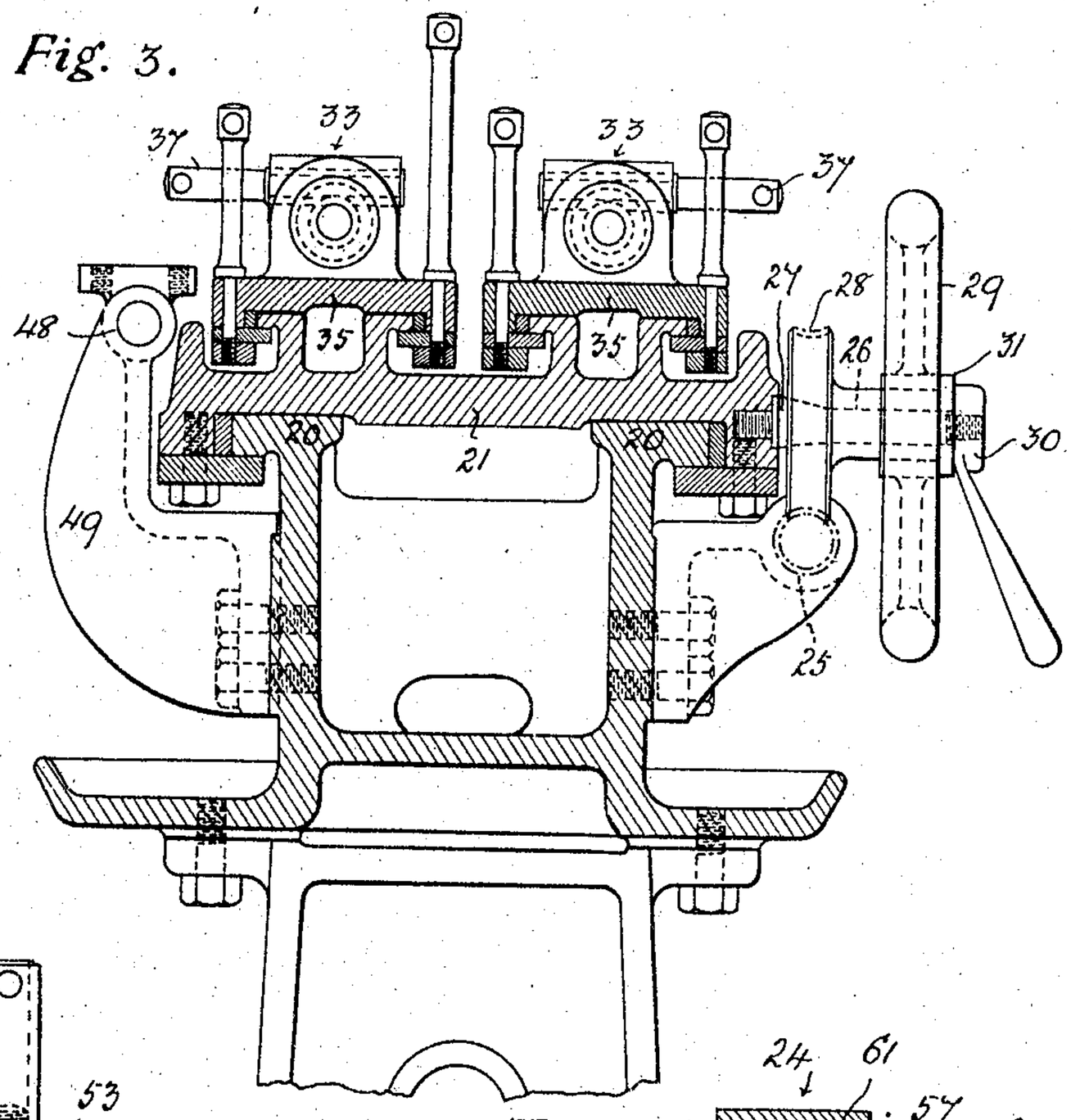
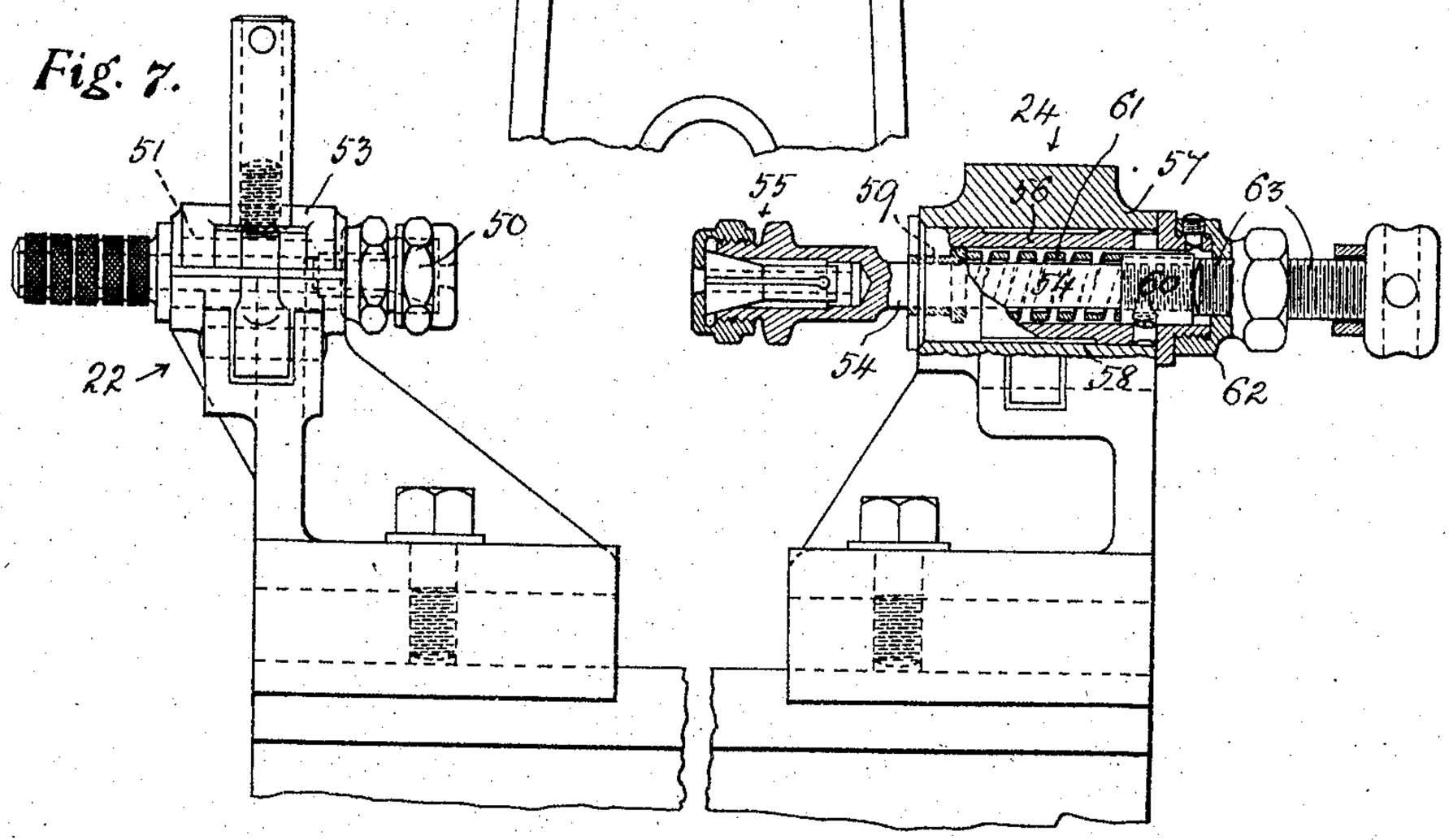


Fig. 7.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.

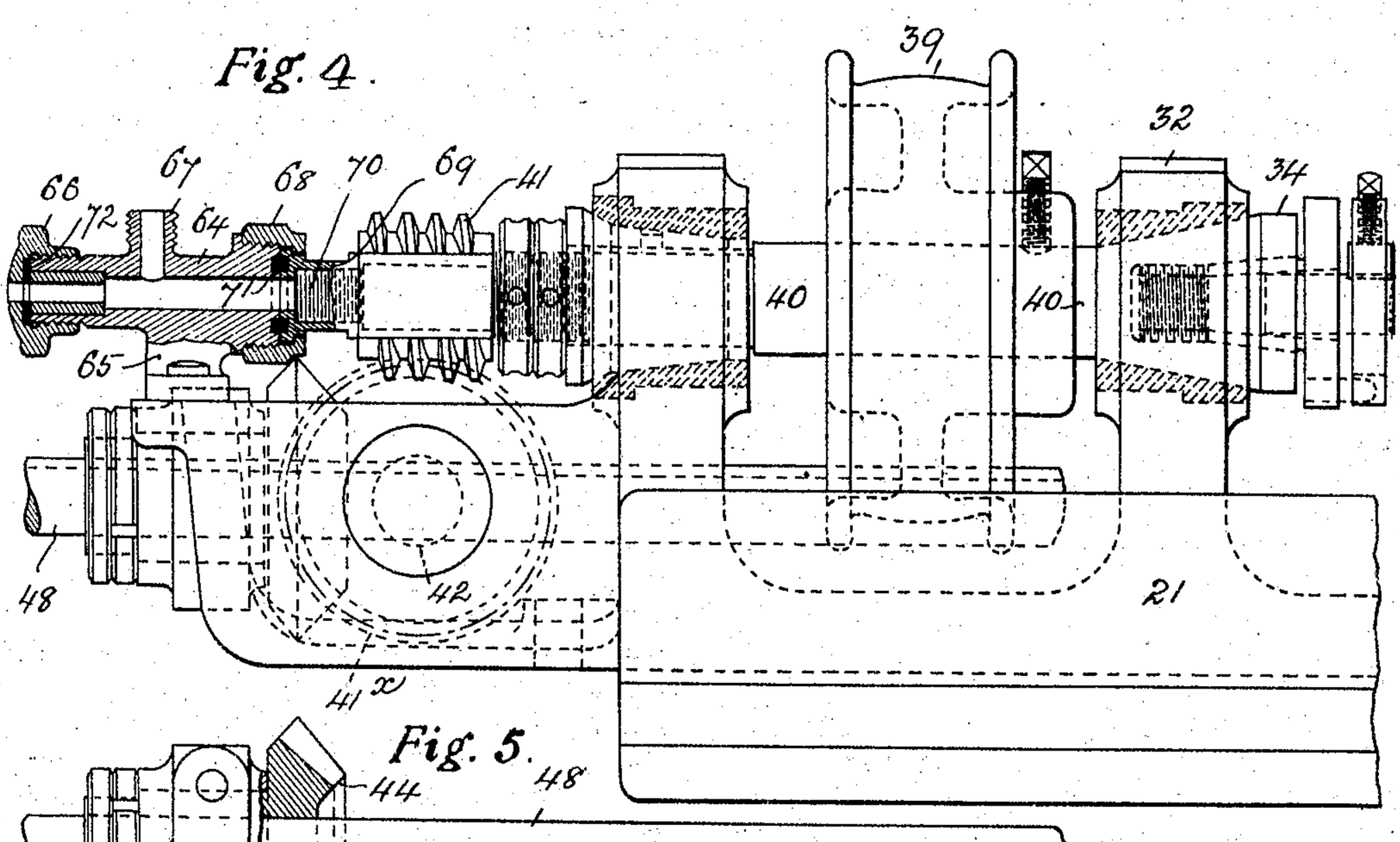


Fig. 5.

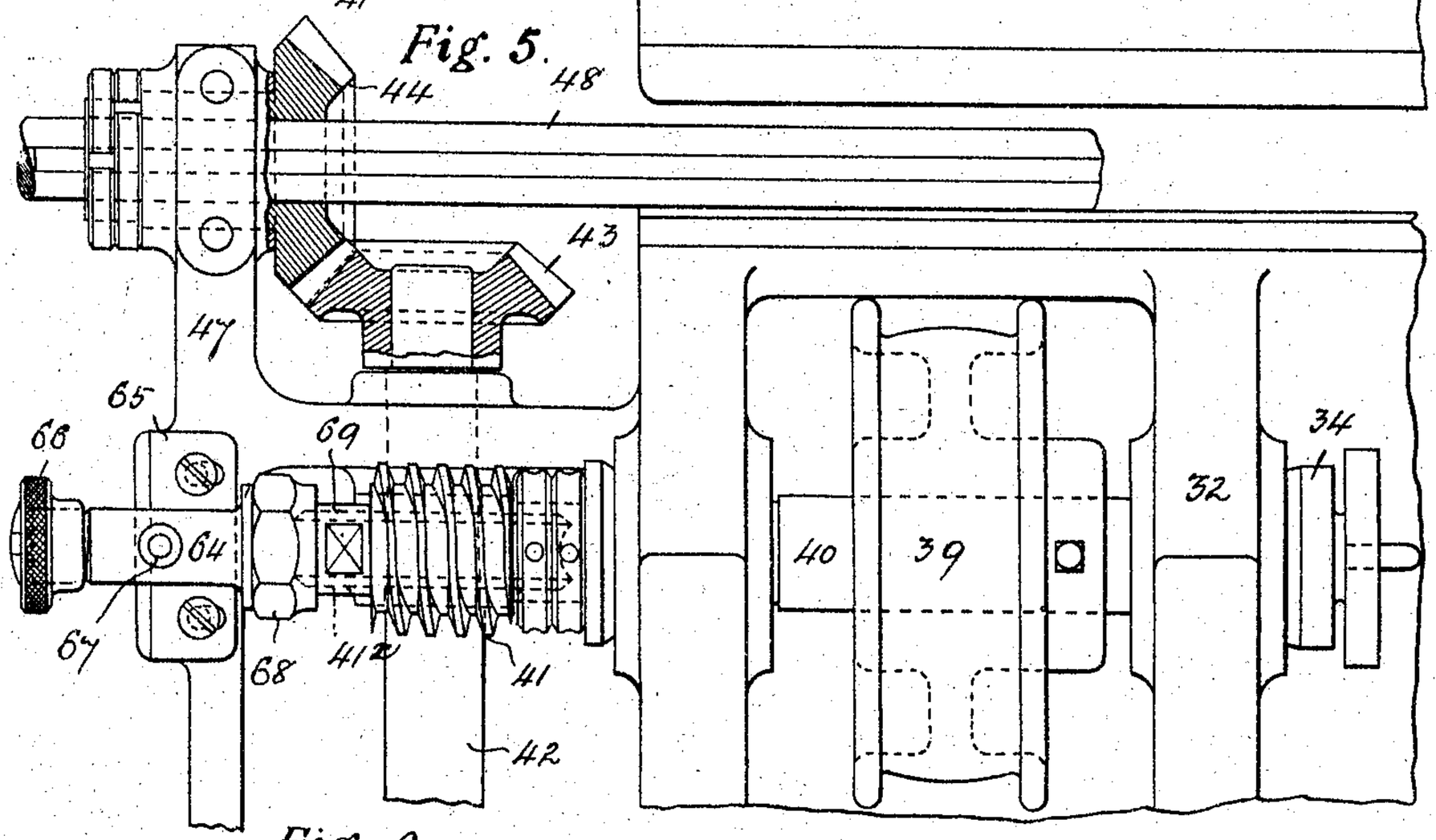
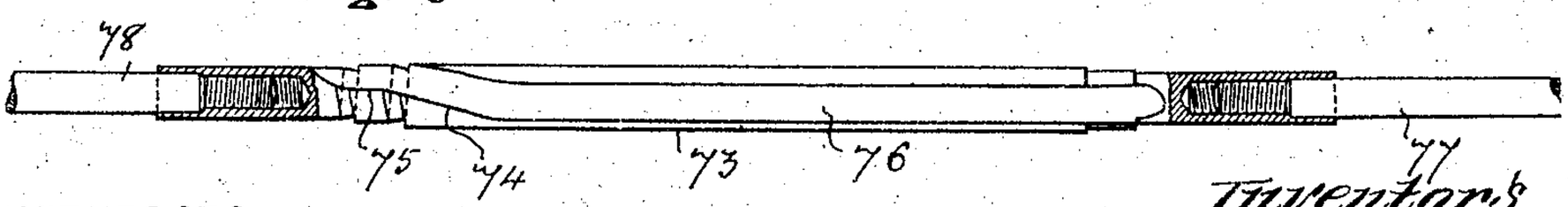


Fig. 6



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UNITED STATES PATENT OFFICE.

AUGUSTUS HENRY MURRAY DRIVER AND GEORGE NORMAN, OF BIRMINGHAM, ENGLAND.

BARREL-BORING MACHINE.

SPECIFICATION forming part of Letters Patent No. 772,706, dated October 18, 1904.

Application filed March 31, 1903. Serial No. 150,452. (No model.)

To all whom it may concern:

Be it known that we, AUGUSTUS HENRY MURRAY DRIVER and GEORGE NORMAN, both subjects of the King of Great Britain, residing at Small Heath, near the city of Birmingham, England, have invented certain new and useful Improvements in Barrel-Boring Machines, of which the following is a specification.

This invention relates primarily to the boring of small bores of barrels of small-arms, but is also applicable to the boring of other parts of small-arms, such as bolt-holes.

The invention further relates to the fine-boring or finishing of previously-formed or rough-bored holes in barrels of small-arms and other small-bored hollow or tubular articles; and the principal object of the said invention as regards the fine-boring of gun-barrels is to produce truly-cylindrical, straight, and parallel-sided finished holes, such being obtained by means of the special methods, machinery, and appliances hereinafter described.

The accompanying drawings represent the construction and arrangement of a duplex machine for fine-boring rifle-barrels in which a tensioned boring-bar is held stationary while the previously-drilled barrel is rotated and traversed for feed in accordance with our invention.

Figure 1 represents a side elevation, and Fig. 2 a top side plan, of a machine, showing the driving mechanism, the barrel-feed carriage, and the fixed anchor and tensioning brackets of the boring-bars. Fig. 3 is a cross-sectional view taken upon the dotted line *x*, Fig. 2. These three figures show the general arrangement and relative dispositions of all the principal parts of the machine, with the boring-bars in position and a pair of barrels mounted upon the barrel-carriage ready to be traversed over the cutters of the said bars. Fig. 4 represents, upon an enlarged scale, a side elevation, partially in section, of a part of the machine, showing portions of the gearing provided for driving round the barrels and traversing the feed-slide, also the means for supplying the inside of one of the barrels and its boring-bar with lubricant and the directly-driven hollow chuck for centering and holding the one end of the barrel and guiding the boring-bar. Fig. 5 is a top side plan of Fig. 4. Fig. 6 is a view of the cutter, showing the form of same and how it is attached to the halves of the boring-bar. Fig. 7 represents, upon the same scale as Fig. 6, an elevation of one of the fixed anchor-brackets, which is arranged at one end of the machine for the attachment of the boring-bar, and a longitudinal vertical section of the tensioning anchor-bracket arranged at the opposite end of the machine to the fixed bracket and to which the other end of the boring-bar is connected.

The same numerals of reference indicate corresponding parts in the several figures of the drawings, which show a duplex machine adapted to fine-bore two barrels simultaneously; but as the parts provided for each barrel are simply duplicate arrangements duplicated parts are marked throughout with the same numerals, and the machine is generally described as though it were a single one for fine-boring only one barrel at a time.

The main bed 20, on which the barrel-carriage 21 slides, is mounted upon suitable standards and has the fixed anchor-bracket 22 of the boring-bar 23 mounted at its left-hand end, together with the driving and feed gearing, while the tensioning-bracket 24 of the boring-bar is mounted at the other or right-hand extremity of the machine. The boring-bar 24 is light, slender, and of long length, and it has been found necessary to insure the satisfactory working, owing to the construction of the bar, that the said bar should be tensioned at one end. The barrel-feed carriage is mounted to slide longitudinally upon suitable ways or guides and is fed by a long screw-threaded shaft or wormed spindle 25, deriving its motion from the transmission-gear, the movement of the said screw being imparted to the carriage by an arrangement of mechanism which embodies a clutch device for stopping and starting the feed. Thus at the front of the carriage is fixed a projecting stud or spindle 26, whose inner end is coned at 27, and upon this stud is mounted a worm-wheel 28, whose teeth engage with the thread of the driving-screw and which is internally

coned at its inner side to correspond with the coned part of the stud. A hand-wheel 29 is keyed to the sleeve or bush of the worm-wheel, and a levered nut 30 and pressure-plate 31 are disposed upon the screwed outer extremity of the said stud. When the lever is rotated to screw home the nut, the pressure against the end of the worm-wheel bush forces the coned surfaces of wheel and stud onto one another, and the worm-wheel is frictionally locked to and is stationary with the carriage, and the teeth, which are for the time being in gear with the screw, act as portion of a nut, whereby the carriage with barrel is traversed longitudinally upon the ways or guides of the main bed. In order to disconnect the carriage from the driving-screw and allow it to remain stationary during the time that a barrel is being placed in or removed from the machine or while any adjustment is being performed, the lever-nut is turned back off the screwed end of the stud and the worm-wheel is liberated from its frictional connection with the carriage and is rotated idly without imparting or transmitting any motion from the driving-screw. When at the end of its traverse, the parts of the clutch are unlocked and the rotation of the hand-wheel which is keyed to the bush of the worm-wheel takes the carriages back to the opposite end of the bed by the teeth of the said wheel running over the thread of the driving-screw, which serves as a toothed rack. It is, however, to be understood that the invention is not confined to this particular arrangement of carriage-driving and clutch mechanism, as the same may be varied or any equivalent arrangement may be employed in lieu thereof.

The barrel-carriage is provided with head and tail stocks 32 33, provided with hollow centers for centering the drilled barrel and guiding the boring-bar, and the head-stock has a hollow chuck or carrier 34 for holding and driving the said barrel during the fine-boring process. The tail-stock may, if necessary, be mounted, as shown, upon a supplementary slide-rest 35, adjustable longitudinally upon the main carriage toward or away from the head-stock, so as to admit of the distance between the head and tail centers being varied to accommodate barrels of various lengths. The tail-stock itself is provided with a bush or sleeve 36, having a longitudinal adjustment by a sliding or screwing action within the fixed bracket of the stock and provided with a cross clamping-pin 37 for locking same to the said bracket. This adjustable sleeve carries a rotatable centering-plug 38, which is hollow from end to end for the boring-bar to pass through, and thus acts as a guide for the said bar. The inner extremity of the said plug projects beyond the end of the bush or sleeve and toward the head-stock and is coned to engage with the end of the barrel. To adjust and advance or retire the coned end of the spindle into and out of the end of the barrel, it is either rotated (when adjusted by a screw action) or simply pushed into position, after which it is locked by the cross clamping-pin, which may have pressure-blocks bearing upon a plain part of the sleeve, or any other equivalent frictional device may be employed in lieu thereof. With this arrangement of tail-stock the adjustable sleeve is held stationary with the fixed bracket and serves as a rigid guide or bearing for the boring-bar; but as an alternative this end of the barrel may be fixed within an internally-coned or plain bearing or chuck, (similar to that shown in connection with the head-stock.) The spindle 40 of the head-stock, which is a fixture to the top side of the traversing carriage, is also hollowed for the boring-bar to pass through and be guided thereby and is rotated in suitable bearings, while the end opposed to the tail-stock is provided with the chuck 34, which is internally coned and into which the muzzle end (or breech end) of the barrel is made fast after being truly centered by the said coning, so that the barrel, chuck, and spindle rotate together while the boring operation is being performed. The hollow spindle is driven by a pulley 39 and a band which passes over a long drum on an overhead shaft, the length of this drum being equal to or greater than the traverse of the carriage, and the band moves along this drum as the carriage advances along the bed. In addition to driving the spindle for rotating the barrel the band-pulley also serves to transmit motion to the screw which traverses the carriage. For this purpose the hollow spindle is extended beyond the head-stock toward the left-hand end of the machine and is provided with a worm 41, gearing with a worm-wheel $41^{\times}$, keyed to a small counter-shaft 42, directed underneath and at right angles to the head-stock spindle. At the back end of the counter shaft is a bevel-wheel 43, gearing with a second bevel-wheel 44, having a bush 45, rotating in a bearing 46, carried by an arm or extension 47 from the traversing-carriage. This second bevel-wheel thus travels along with the carriage and is thereby made to slide along a feathered shaft 48, carried by brackets 49, fixed at the back of the bed of the machine, the length of this shaft being sufficient to admit of the bevel-wheel moving with the carriage throughout the whole of the feed traverse. Motion is transmitted from the feathered counter-shaft to the driving-screw at the front of the machine by a suitable arrangement of change wheels and pinions disposed at the left-hand end of the bed, (see Fig. 2,) the ratio of the several wheels being in accordance with the speeds at which the barrel is to be rotated relative to the rate of its traverse motion along the boring-bar.

At the left-hand end of the fixed bed of the

machine and in axial line with the head and tail stocks of the traveling barrel-carriage is the fixed anchor-bracket 22 for rigidly affixing the one end of the tensioned boring-bar. This bracket consists of a removable or detachable chuck 50, of any suitable pattern, adapted to grip and hold one end of the boring-bar and having a shank or stem 51 adapted to lie within a housing 52, formed at the summit or other part of an upright or standard fixed to the bed of the machine. The chuck is locked or fixed within the housing by a swing-over clip 53, fastened by a nut and bolt or any other equivalent device which will hold the boring-bar rigidly and prevent its rotation relative to the barrel. When the clip is swung back, it admits of the chuck being unshipped or removed from its housing bodily with the boring-bar. The bar-tensioning bracket 24 is fixed at the opposite end of the machine in line with the fixed anchor-bracket and the head and tail stocks of the carriage, and the axes of the chucks of both brackets are disposed in line with the hollow center-plug of the carriage tail-stock and the hollow chuck of the head-stock. The tensioning-chuck is adapted to grip and hold the right-hand end of the boring-bar, thus holding the boring-bit steady and insuring the boring of an absolutely true and straight hole. The tensioning strain is applied to the bracket 24 by a spring, weight, or screw arrangement. When a spring is employed, as in the arrangement shown, the shank 54 of the chuck 55 is adapted to slide within a sleeve 56, carried and secured by a clip 57 within a housing 58 at the top of a standard or other support. The forward end of the sleeve is fitted with a collared guide-bush 59, wherethrough the chuck-shank works, and the right-hand extremity of the said shank is provided with a stop or collar 60 of the same diameter as the interior of the sleeve. A strong spiral spring 61 is disposed around the chuck-shank, with one end bearing against the collar of the guide-bush, while the other end bears against the collar 60 on the shank, the arrangement being such that the expansion of the spring tends constantly to pull the chuck and boring-bar outward or away from the anchor-bracket, and thus apply the tension. A cap 62 is screwed onto the right-hand end of the sleeve, and a tension-regulating screw 63 is directed through the middle of it, with the inner end bearing against the outer side of the end collar of the chuck-shank, so that by advancing or retiring this screw and either compressing the spring or allowing it to expand more or less the tension applied to the boring-bar may be regulated as desired. The chuck, with the sleeve containing the tensioning-spring and regulating-screw, may be unshipped and removed from the housing of the bracket by turning back the clip which embraces and confines the said sleeve, whose longitudinal motion is prevented by collars at its opposite ends. With this construction the chucks of both the anchoring and the tensioning brackets may be readily removed with the boring-bar when necessary; but in the ordinary sequence of operations when the barrel-carriage has completed its traverse and the boring is completed the boring-bar is released from the chuck of the anchor-bracket, while the clip of the tensioning-bracket is unfastened to admit of the unshipping of the chuck bodily with the bar. The latter is then withdrawn longitudinally from the hollow spindles of the head and tail stocks and from the barrel which is centered between them, after which the barrel is freed or disconnected from the centering-spindles and removed.

Oil under pressure is forced by a pump through the hollow head-stock spindle and through the barrel up to the boring-bit to lubricate the cutters while in operation and to carry away the swarf which is discharged with the oil through the open end of the tail-stock spindle into an oil-trough formed along the top of the main bed. In order to lead the oil into the head-stock spindle and also serve as a guide for the shank of the boring-bar, a ferrule and stuffing-box 64 is connected to the left-hand end of the said spindle, the said ferrule being supported by a small bracket 65 from the extension of the barrel-carriage, and the outer end has a small cap 66, with a central opening through which the boring-bar passes into the interior of the ferrule. The oil from a suitable force-pump is forced into the ferrule by a branch or nipple 67, extending from one side and connected with a flexible pipe leading to the oil-reservoir. The forward or inner end of the ferrule is screwed and coupled by a union-nut 68 to a collared or shouldered and inside-screwed sleeve 69, which makes a detachable connection between it and the correspondingly-wormed after end 70 of the rotating head-stock spindle, and the opposed faces of ferrule and sleeve are recessed and fitted with a gland or packing 71, which may consist of one or more washers of wood, fiber, or other substance, a similar packing 72 being fitted between the other end of the stuffing-box and the cap 66.

The stationary cutter or boring bit 73, which is solid, is carried at the middle of the boring-bar and is so formed that the forward end 74 of same is the only part which acts as a cutter, although it may or may not have a pilot-cutter part 75 at the front. A trough or channel 76 is made along the top side of the same for conducting the oil and swarf from the cutting-point, and the boring-bar is preferably made in two pieces 77 78, whose inner terminations are connected, respectively, to the opposite ends of the cutter by screwing. The screw-nipples may be formed at each end of the cutter with a depression

in the top side to correspond with the channel or oil-gutter 76. These nipples are screwed into the open ends of the hollow boring-bar sections, and when the diameter of the bar is practically the same as the rough bore of the barrel under treatment the bar-sections themselves may be depressed or formed with channels corresponding to those in the cutter, thus forming continuous oil-channels along the boring-bar sections and the cutter. These oil-channels may be of straight, spiral, or other form, as desired, with open ends for the admission and exit of oil to and from the cutting parts. The cutter may have one or more straight or spiral blades, but cutting upon the front edges only alike unto a crown-cutter, or as an alternative it may be arranged with cutting edges alike unto boring-bits of the reamer type.

The boring-bar 24 is very light and slender and of such long length that to hold its extremities between centers or fix it at both ends by rigid connections it would be useless. The holding of the long and slender bar in tension is to prevent any twisting or circumferential movement of the cutter and also to keep the sag out of the bar and hold it steady, while the cutter itself is of such shape that it assists in resisting the twisting action of the cut. Thus after the fine boring operation is started and the cutter has entered the bore of the barrel the bar is only supported by the tension applied to the ends and by the cutter itself in the middle part, and this method is found in practice to insure admirable results as regards accuracy, rapidity, &c. The coned guide or the hollow coned center (designated by the reference character 38) serves as a means for guiding and steadying the boring-bar and cutter when the latter is about to enter the barrel or start the boring operation and also as a support for one end of the barrel, which is free to revolve thereon; but as soon as the whole of the cutter has entered the barrel the cutter itself will take up the duty of supporting the boring-bar.

Before being placed within the machine the previously-drilled barrel may be prepared by concentrically coning the opposite ends of the bore or the outer ends of the barrel to take onto or into the hollow externally or internally coned ends of the centering-plugs, and these coned parts would act as guide-bushes for the boring-bar, or these guides may be dispensed with and the end of the barrel-bore may be concentrically recessed to receive the boring-bit, so as to give a start for the cutters.

Many parts of the invention hereinbefore described may be applied to boring-machines, in which the boring-bars are not held in tension, but in which the rotating barrel is drawn or pushed over the cutter or the cutter is drawn or pushed through the rotating barrel. In each such arrangement the parts removed at each cut form the guide for the boring-bit.

The application of this invention to the boring of bolt-holes in the bodies of Lee-Enfield and other bolt-action rifles, also for boring the tubes of naval guns and other ordnance, and other tubular articles differs in no essential respect from its application to a machine for boring rifle-barrels, as herein described.

Having fully described our invention, what we desire to claim and secure by Letters Patent is—

1. In a machine of the character described, the combination with a non-rotating boring-bar provided with a cutter, and an anchor-bracket attached to each end of said bar, of a traversing feed-carriage located between the brackets, a head and a tail stock mounted upon the carriage, a coned spindle carried by each of the stocks for centering and supporting the article to be operated upon, means for directly driving the spindle of the head-stock thereby rotating the article to be operated upon, and a gearing connected with and operated by the spindle of the head-stock for imparting movement to the carriage.

2. In a machine of the character described, the combination with a non-rotating boring-bar provided with a cutter, and a feed-carriage provided with a head and tail stock each carrying a hollow spindle for supporting and centering the article to be operated upon and for guiding the bar, of means for lubricating the cutter and the inside of the article when the machine is in operation, said means comprising a combined stuffing-box and boring-bar guide-ferrule detachably connected to and with the interior of the hollow spindle of the head-stock and provided with partly tight end cap having a central opening which passes over the boring-bar as the carriage is traversed, said ferrule further provided with means for the supply of a lubricant thereto.

3. A boring-machine involving a boring-bar fixed at one end and having means to longitudinally tension it applied to its other end.

4. A machine for fine boring having a stationary non-rotating elongated and slender boring-bar, and a tensioning device connected to one end of said bar for applying longitudinal tension thereto.

5. A machine for fine boring having a non-rotating elongated and slender boring-bar, an anchor-bracket attached to one end of said bar, and a tensioning device attached to the other end of said bar and adapted to apply longitudinal tension to the bar when the machine is operated.

6. A machine for fine boring having an elongated and slender boring-bar, an anchor-bracket attached to one end of said bar, and a tensioning-bracket attached to the other end of said bar and adapted to apply longitudinal tension to the bar when the machine is operated.

7. A machine for fine boring having a non-

rotating elongated and slender boring-bar, an anchor-bracket attached to one end of said bar, and a spring tensioning-bracket attached to the other end of said bar and adapted to apply longitudinal tension to said bar when the machine is operated.

8. A machine for boring small-bored tubular articles having a long and slender non-rotating boring-bar provided with a cutter, an anchor-bracket attached to one end of said bar, a tensioning device attached to the other end of said bar, a longitudinally-movable feed-carriage traveling between said bracket and said tensioning device, said carriage adapted to carry the article to be bored therewith, causing thereby the traversing of the article over said cutter, and means carried by the carriage for rotating the article operated upon as it is traversing over said cutter.

9. In a machine of the character described, the combination of a stationary boring-bar provided with a cutter, means for anchoring one end of the bar, a tensioning device attached to the other end of the bar and adapted to apply longitudinal tension to said bar when the machine is operated, a traversing carriage adapted to carry the article to be operated upon and to cause the traversing of the article over the cutter, said cutter acting as a support for the said bar as the article traverses over the cutter, means carried by the carriage for rotating the article operated upon as it traverses over said cutter, and a hollow coned guide carried by the carriage and adapted to guide and steady the boring-bar and cutter when the latter is about to enter the article and to act as a support for one end of the article.

10. In a machine of the character described, the combination of a stationary boring-bar provided with a cutter, a supporting means for each end of the bar, a longitudinally-movable feed-carriage traveling between the said supporting means, hollow spindles mounted on the carriage and adapted to support between them the article to be operated upon, said carriage adapted to cause the traversing of the article operated upon over said cutter, and means for driving one of the said spindles, causing thereby the rotation of the article as it traverses over the cutter of the boring-bar.

11. In a machine of the character described, the combination of a stationary boring-bar provided with a cutter, an anchor-bracket for one end of said bar, a tensioning-bracket for the other end of the bar, said tensioning-bracket adapted to apply longitudinal tension to said bar when the machine is operated, a longitudinally-movable feed-carriage traveling between the said brackets, hollow spindles mounted on the carriage and adapted to support between them the article to be operated upon, said carriage adapted to cause the traversing of the article operated upon over said cutter, and means for driving one of the said spindles, causing thereby the rotation of the article as it traverses over the cutter of the boring-bar.

12. In a machine of the character described, an elongated and slender stationary boring-bar provided with a cutter, an anchor-bracket attached to one end of said bar, a tensioning-bracket connected with the other end of said bar and adapted to apply longitudinal tension to the bar when the machine is operated, a longitudinally-movable feed-carriage traveling between said brackets, and adapted to carry the article operated upon and to cause said article to traverse over said cutter, a stationary head, an adjustable tail-stock mounted upon said carriage, coned spindles carried by said stock and adapted to support the article to be operated upon, and means for directly driving one of the said spindles, causing thereby the rotation of the article operated upon as it traverses over the cutter, said driving-spindle adapted to center and support the article operated upon and further adapted to form a guide for the boring-bar over which the spindles traverse as the carriage travels.

13. A machine of the character described having a non-rotating boring-bar provided with a cutter, anchor-brackets attached to each end of said bar, a longitudinally-movable feed-carriage traveling between the brackets and adapted to cause the work which is operated upon to traverse over said cutter, externally-coned hollow spindles mounted on the carriage and adapted to support between them the article to be operated upon, and means for driving directly one of the said spindles, causing thereby the rotation of the article as it traverses over the cutter.

14. A machine of the character described having a non-rotating boring-bar provided with a cutter, anchor-brackets attached to each end of said bar, a longitudinally-movable feed-carriage traveling between the brackets and adapted to cause the work which is operated upon to traverse over said cutter, externally-coned hollow spindles mounted on the carriage and adapted to support between them the article to be operated upon, means for driving directly one of the said spindles, causing thereby the rotation of the article as it traverses over the cutter, and means for applying longitudinal tension to said bar as the machine is operated.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

AUGUSTUS HENRY MURRAY DRIVER.
GEORGE NORMAN.

Witnesses:
HENRY SKERRETT,
ARTHUR SADLER.