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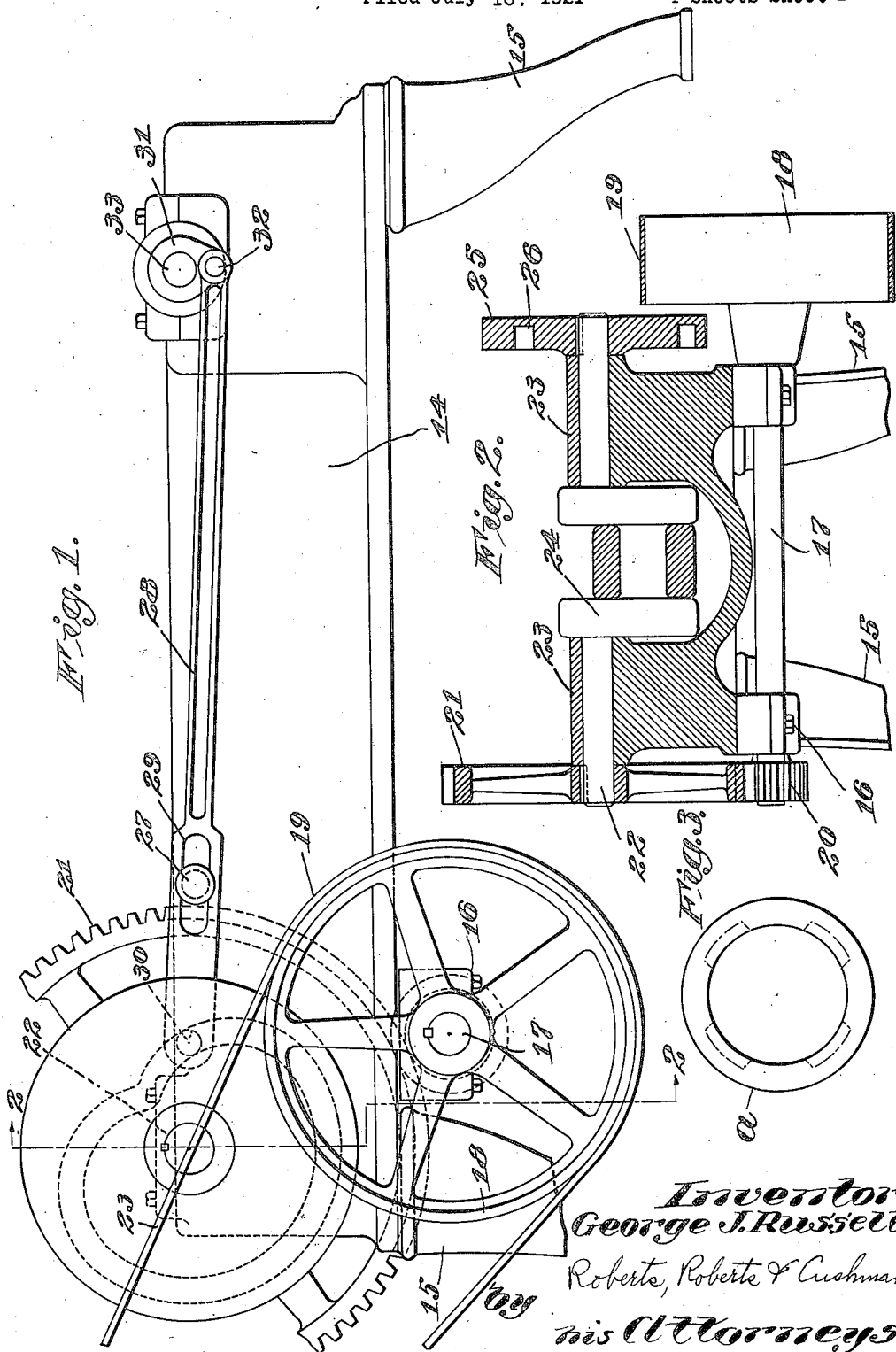
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G. J. RUSSELL

BROACHING

Filed July 16, 1921

4 Sheets-Sheet 1



Inventor
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Jan. 22 , 1924.

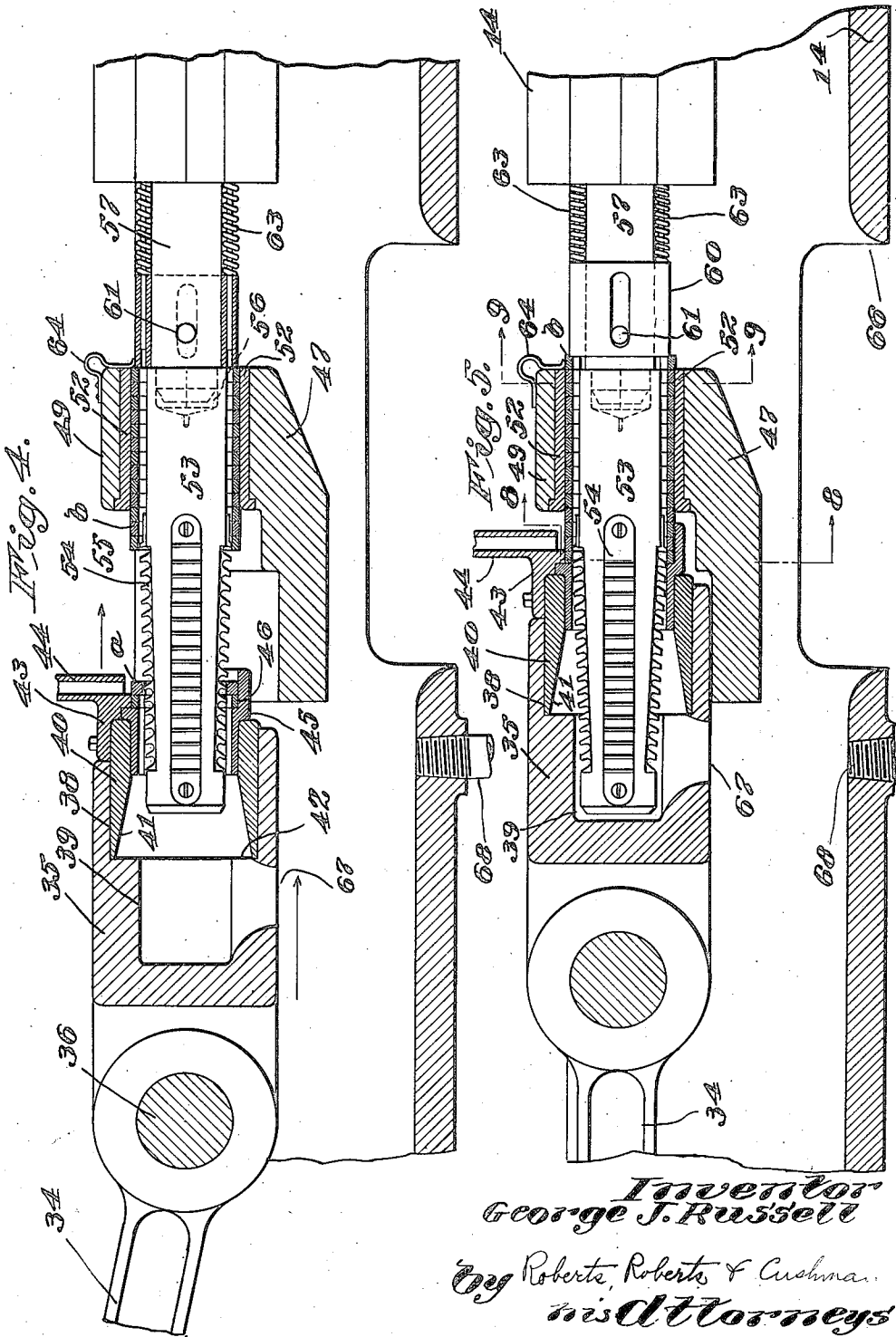
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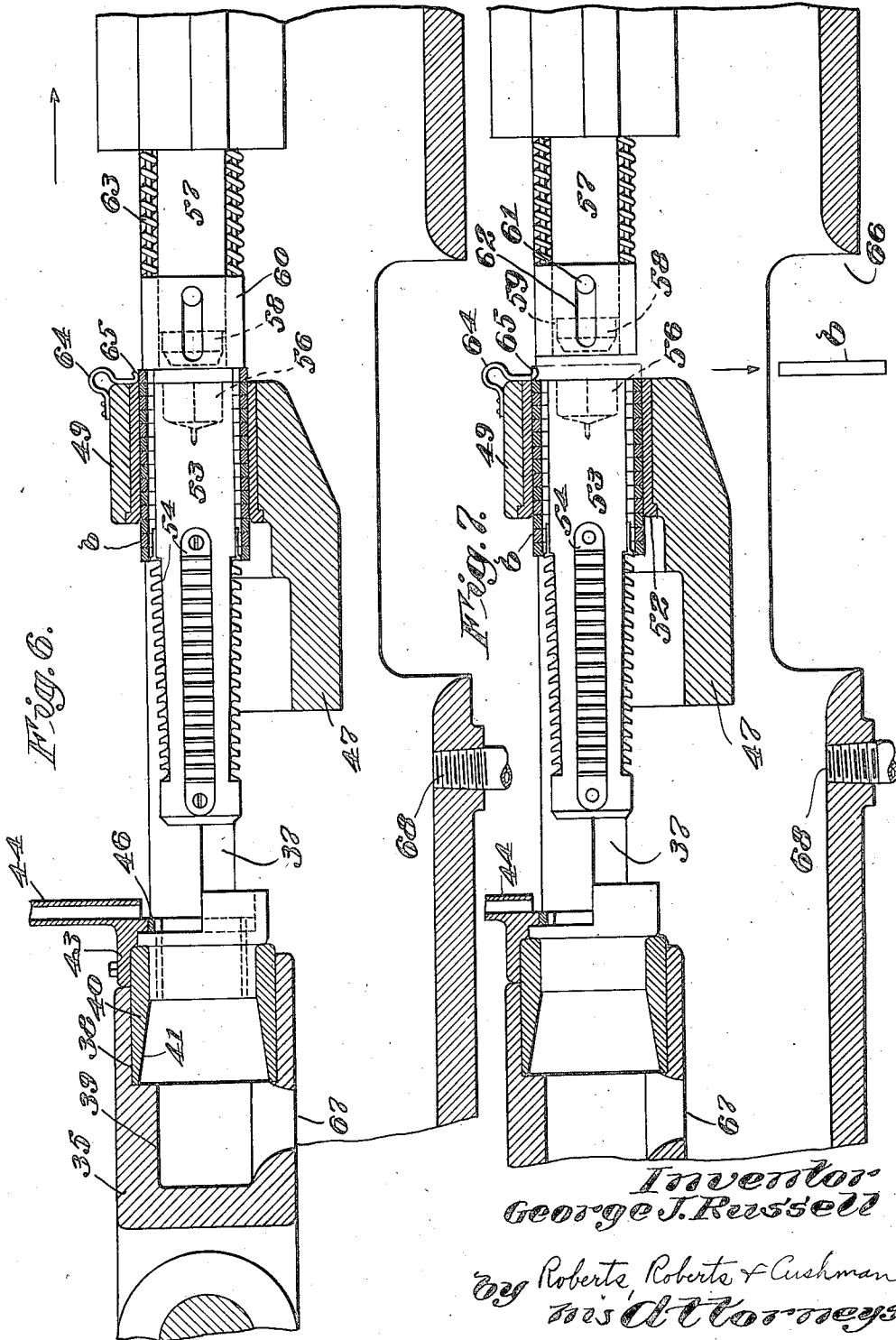
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4 Sheets-Sheet 3



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Fig. 8.

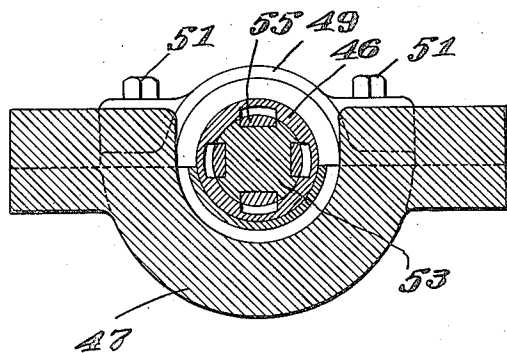


Fig. 10.

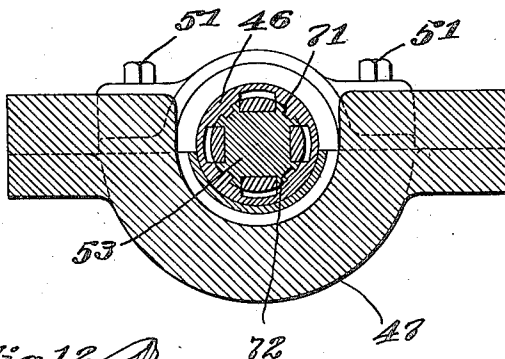


Fig. 9.

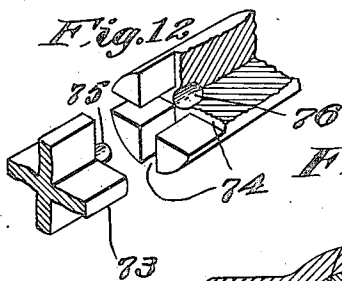
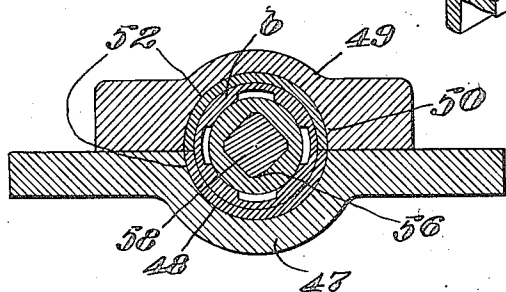


Fig. 11.

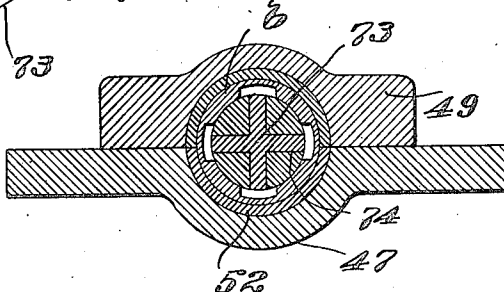
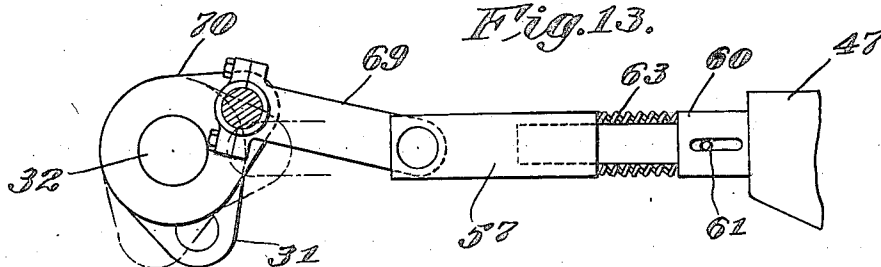


Fig. 13.



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UNITED STATES PATENT OFFICE.

GEORGE J. RUSSELL, OF LOWELL, MASSACHUSETTS.

BROACHING.

Application filed July 16, 1921. Serial No. 485,363.

To all whom it may concern:

Be it known that I, GEORGE J. RUSSELL, a citizen of the United States of America, and resident of Lowell, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Broaching, of which the following is a specification.

This invention relates to a method and apparatus for broaching articles and has for its objects to increase the rate of broaching, to make the operations entirely automatic, and generally to improve the art of broaching.

According to the present invention the articles are continually and automatically passed over the broach and thence automatically removed from the broach at the same rate. A series of articles are on the broach at any time and this series is added to at one end and subtracted from at the other end continually and automatically. Thus the broach floats on or is supported by the stock.

In a more specific aspect the invention is characterized as follows: The stock is received by a die carrier which moves the stock forward into operative contact with the broach until the broaching operation is completed. The die carrier then retracts leaving the broached stock in a position to support the broach. When the die carrier again moves forward with more stock it forces the previously deposited stock farther along under the broach which continues to be supported by the stock already broached. As the operation continues the stock is finally forced off the other end of the broach and is ejected from the machine.

In order that the broach may remain stationary a movable abutment is provided which moves forward against the broach and is arranged to hold the latter against movement endwise, tipping, angular or circumferential, as well as to properly center it when the die carrier moves forward with the stock to be broached. When the die carrier retracts the abutment is likewise withdrawn from its operative position permitting the stock forced beyond the end of the broach to be ejected from the machine.

Restraining the broach from movement in all directions is desirable to enable efficient operation of the machine. The broach must be centered relative to the reciprocating die

carrier and all angular movements either in an axial plane as in tipping or in a transverse plane such as a circumferential movement must be prevented since otherwise the broach will not register with the die.

A further object is to provide means for removing the chips and bits of materials cut from the stock by the teeth of the broach. A further object is to provide positive ejecting means for the broached stock.

The aforesaid and other objects of the invention will be clearly set forth in the detailed description of the machine illustrated in the accompanying drawings which embody the essential features of the invention.

In the drawings:—

Fig. 1 is a side elevation of the machine;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a plan view of a piece of stock operated upon showing in broken lines the cuts made by the broach;

Fig. 4 is a vertical section through a portion of the machine showing the broach and associated parts;

Figs. 5, 6 and 7 are views similar to Fig. 4 showing the parts in different positions and illustrating the operation of the machine;

Fig. 8 is a sectional view on the line 8—8 of Fig. 5;

Fig. 9 is a sectional view on the line 9—9 of Fig. 5;

Fig. 10 is a sectional view similar to Fig. 8 showing a modification of means for holding the broach against movement;

Fig. 11 is a view similar to Fig. 9 showing another modification;

Fig. 12 is a detail view showing in perspective and partly in section the modified means for preventing movement shown in Fig. 11; and

Fig. 13 is a detail elevational view of the operating means for the abutment member.

The particular embodiment of the invention shown for the purpose of illustration is a machine for broaching circular stock such as is indicated by reference character *a*, and shown in Fig. 3. The machine comprises a bed 14 supported upon legs 15 and provided with a central recess in which the operative parts of the machine are housed. Supported in bearings 16 attached to the under-side of the bed is a shaft 17, to which

is keyed a pulley 18 driven by a belt 19 from any suitable source of power. On the end of the shaft opposite the pulley is keyed a pinion 20 in mesh with gear 21 keyed upon main shaft 22 mounted in bearings 23 in the bed of the machine above shaft 17. The central portion of the shaft 23 has a crank 24 and upon the end of the shaft opposite to the gear is keyed a disc 25 provided with cam slot 26. Mounted upon the side of the bed by means of pivot 27 is a link 28 having a slot 29 through which the pivot 27 projects. At one end the link is provided with a roller 30 adapted to operate in cam slot 26 in disc 25. The other end of the link is attached to a crank 31 by pivot pin 32, the crank being keyed upon a shaft 33 in parallel relation to main shaft 22 but at the other end of the machine.

The operative parts of the machine, which consist of a broach, a reciprocating die carrier, and a reciprocating abutment for the broach, and which are mounted within the central recess of the bed, will now be described, reference being had in particular to Figs. 4-7. Attached to crank 24 (Fig. 2) is a pitman 34 connected to die carrier 35 through pivot 36. The die carrier is provided with ribs (not shown) at either side sliding in guide slots 37 (Figs. 6 and 7). The die carrier is hollowed out and has two bores, the outer one 38 being of greater diameter than the inner one 39. These bores provide an opening in which the broaching tool is nested when the die carrier moves forward into operative position. Housed in outer bore 38 is a bushing 40 whose inner periphery is beveled as indicated by reference character 41 on the end which contacts with shoulder 42. The bushing 40 extends beyond the end of die carrier 35 and the upper portion of the die carrier is cut away to provide a rest for a semi-circular retaining member 43 having a chute 44 for feeding the stock to be operated upon. This retaining member 43 is bolted to the die carrier and holds a bushing or liner 45 adapted to fit within the outer end of bushing 40 and to extend beyond the same. The lower portion of the bushing or liner 45 has a semi-circular extension upon which is placed the die 46, also held in place by the removable retaining member 43.

Connecting the sides of the bed is a web member 47 shown in cross section in Figs. 8 to 11. This web member has a semi-circular recess 48 (Fig. 9) over which is secured by bolts 51, a cap member 49 having a coaxial semi-circular recess 50. Within the cooperating semi-circular recesses of the web member and the cap are placed the usual bearing liners 52. Loosely supported within the cooperating semi-circular recesses by the stock 53 is a stationary broach 53. The broach is a cylindrical body having the same

diameter throughout and provided at one end with longitudinal recesses cut at an angle to its axis in which are removably fastened strips 54 provided with broaching teeth 55. The opposite end of the broach has a squared axial recess 56.

Slidable in a suitable bearing in the bed of the machine at the rear of the broach is the abutment 57. Abutment 57 is provided with a squared extension 58 which fits in the squared recess 56 of the broach when the abutment is in its operative position. The extension 58 forms with the abutment member itself a shoulder 59 which is adapted to contact and press against the rear end of the broach and hold the same against movement when the stock is forced forward across the teeth of the broach by the die carrier. Slidably mounted upon the abutment 57 is a collar 60 the range of movement of which is limited by pin 61 operating in slot 62, the collar being held in its forward position by coil springs 63. Attached to cap member 49 is a spring ejector 64 adapted to press down upon the broached stock as it is forced off the rear end of the broach and to eject the same from the machine on retraction of the abutment. The spring ejector 64 has its lower end provided with a cam surface 65 which permits the spring ejector to be raised by collar 60 when the abutment moves forward. To permit the finished stock 6 to be ejected from the machine the bed has an opening 66 directly below spring ejector 65.

As this machine is adapted to be operated continually, provision should be made for removing the chips and fragments of stock made by the teeth of the broaching tool. A large portion of the fragments so produced will be deposited within the bores of the die carrier. For this reason the inner end of the bushing 40 is beveled as already described producing at one point an enlargement of the chamber into which the broach extends. The bottom of the die carrier is preferably provided with an opening 67 through which the chips and fragments fall to the bed of the machine and are removed by any suitable means. Directly below the cutting end of the broach is an opening 68 into which a pipe is threaded to be used for a blast of air for removing chips from the teeth of the broaching tool when the die carrier is retracted. When the broaching tool is used for broaching metal stock, an oil spray may be substituted for the blast of air.

The operative connection of the abutment with the main shaft of the machine is made by means of the pitman 69 (Fig. 13) which is pivotally attached to a crank 70 positioned near the center of shaft 33 which in turn is connected to the main shaft through link 28 and cam disc 25. It is to be noted

that when the crank 70 is on dead-center the abutment is in contact with the broach and that the crank is on dead-center at the time of the forward thrust of the die carrier.

5 An important feature of the invention involves holding the broach during the broaching operation against all angular movements either in an axial plane, as in tipping, or in a transverse plane such as a
10 circumferential movement. There are various ways of accomplishing this object. In the form of the invention just described the long squared extension 58, cooperating with the squared recess 56 in the broaching tool and the contacting of the shoulder 59 of
15 the abutment member with the broaching tool, accomplish this result. Other means are shown in the modifications illustrated in Figs. 10, 11 and 12. Fig. 10 is a cross section
20 through the die member and clearly shows projecting guide ribs 71 on the inner periphery of the die member co-acting with guide slots 72 in the broach. These projections may be either square or rounded in
25 cross-section. In Figs. 11 and 12 a modification of the co-acting portions of the abutment member and the broaching tool is shown, reference character 73 indicating a cross-bar extension upon the abutment
30 adapted to register with corresponding slots 74 in the end of the broach. A centering nipple 75 is also provided on the abutment to co-act with a corresponding recess 76 on the broach to insure proper centering of the
35 operative parts of the machine.

The operation of the machine is briefly as follows: Referring first to Fig. 7 the relative positions of the operative parts of the machine are shown at the end of one
40 broaching operation and just before the beginning of another. In this figure the die carrier and the abutment member are completely retracted and a broached piece of stock is dropping out of the machine. A
45 new piece of stock is about to drop through chute 44 upon the semi-circular extension of bushing 45 and directly in front of die 46 on the die carrier 35. Fig. 4 shows the die carrier upon its forward stroke with the
50 teeth of the broaching tool beginning to cut into newly deposited piece of stock. Abutment member 57 is pressed against the rear end of broach 53 holding the same stationary and properly centered as the die carrier
55 moves forward. Fig. 5 shows the position of the parts at the completion of the forward stroke of the die carrier. The new piece of stock has now been completely broached and has forced the row of already broached
60 pieces of stock, which are supporting the broaching tool 53, forward so that the last piece of stock in the row has been forced off the broaching tool under the ejecting member 64. It is to be noted that the collar
65 60 is now pressed back so that pin 61 con-

tacts with one end of slot 62 and the collar is wholly out of contact with the broach. Fig. 6 shows the die carrier retracted and the abutment member partially retracted, the piece of stock under the ejecting member
70 being held only by the pressure of the spring-pressed collar 60. In Fig. 7 the abutment member is completely retracted, the collar no longer contacts with the piece of stock, and the ejecting member 64 has acted
75 upon it and thrown it from the machine.

While the chute 44 is shown as adapted to feed one piece of stock at a time to the die carrier, it has been found by actual experiment that the machine works equally
80 well when the stock is fed in multiples of two or more. Aside from making the parts of proper strength the only limit to the number of pieces of stock which can be fed and operated upon at one stroke of the die carrier appears to be that set by the difficulty in removing the chips and fragments
85 of material cut away by the broaching teeth.

The machine herein described is adapted for general use in broaching articles of different sizes. By removing retaining member 43 bushings 40 and 45 and die 46 can be readily taken out and new ones of a different size inserted. In a like manner by removing cap member 49 the broach 53 and the
90 bearing liners 52 can be taken out and new ones of a size corresponding to the new die may be inserted. The fact that the pipe 68 has already been described as to be used for a jet of air when stock of a relatively soft
95 nature such as fibre is being broached, and for an oil spray when metal stock is being broached likewise indicates the adaptability of the machine for stock of different materials as well as of different sizes.

I claim:

1. The method of broaching which comprises continually feeding articles over a broach from one end and concomitantly removing the broached articles from the other
100 end at the same rate.

2. The method of broaching which comprises placing a series of articles on a broach, continually adding articles to the series from one end, and concomitantly removing
105 broached articles from the other end at the same rate.

3. The method of broaching which comprises placing a series of articles on a broach, and recurrently advancing the series step by step by forcing articles over the broach, thereby simultaneously forcing the foremost articles off the broach.

4. The method of broaching which comprises recurrently feeding articles over one end of a broach, simultaneously holding the broach against endwise movement, and alternately removing broached articles from the other end of the broach.

5. The method of broaching which com- 130

prises recurrently passing articles over a broach and removing the broached articles, and counteracting the thrust of the articles on the broach while permitting the unobstructed removal of the broached articles.

6. The method of broaching stock which comprises recurrently feeding articles over one end of a broach, supporting the broach upon the articles fed thereon, holding the broach against endwise movement as the articles are fed thereover and alternately removing broached articles from the other end of the broach.

7. The method of broaching which comprises recurrently passing articles over a broach and removing the broached articles, supporting the broach on the articles passed therealong, and counteracting the thrust of the articles on the broach while permitting the unobstructed removal of the broached articles.

8. The method of broaching stock which is characterized by feeding the stock to one end of a broach, and forcing the stock along the broach and off at the other end.

9. The method of broaching stock comprising supporting the broach upon stock already broached, forcing new stock along the broach to displace the stock already broached, and holding the broach stationary during the broaching operation.

10. The method of broaching stock comprising feeding the stock over the broach, forcing the stock along the broach to perform the broaching operation, and supporting the broach upon the stock during the broaching operation.

11. The method of broaching stock comprising feeding the stock to the broach at one end, forcing the stock along the broach to perform the broaching operation and off at the other end, and supporting the broach upon the stock during the broaching operation.

12. The method of broaching stock which comprises passing the stock over and along the broach from one end to the other, and supporting the broach on the stock while the latter is being passed therealong.

13. The method of broaching circular stock which comprises continually forcing the stock over and lengthwise of the broach from end to end, and supporting the broach on the stock forced therealong.

14. The method of continually broaching stock which comprises feeding the stock to the broach, forcing the stock along the broach to perform the broaching operation, supporting the broach upon the stock, and forcing the stock from the end of the broach.

15. The method of broaching stock which comprises continually feeding the stock upon one end of the broach, forcing the stock along the broach so that the broaching operation is performed, supporting the

broach upon the stock as it is forced along, and ejecting the broached stock from the other end of the broach.

16. In a broaching machine, a broach and means for forcing stock into operative contact with the broach, said broach being constructed and arranged to be supported upon the stock.

17. In a broaching machine, a broach, means for forcing stock into operative contact with the broach and means for supplying stock to the forcing means, said broach being constructed and arranged to be supported upon the stock.

18. In a broaching machine, a broach, reciprocating means for forcing stock into operative contact with the broach, said broach being adapted to be supported by the stock.

19. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against endwise movement.

20. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against angular movement.

21. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against circumferential movement.

22. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against both endwise and angular movement.

23. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against both endwise and circumferential movement.

24. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against both angular and circumferential movement.

25. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for holding said broach against endwise tipping and circumferential movement.

26. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, means for forcing stock into operative contact with the broach and means for holding the broach against movement during the broaching operation.

27. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, means for forcing stock into operative contact with the broach and reciprocating means for holding the broach against movement during the broaching operation.

28. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock, and an abutment adapted to reciprocate to and from operative engagement with the broach.

29. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock in fixed position in the machine, and an abutment adapted to reciprocate to and from operative engagement with the broach to hold the broach in fixed position during the broaching operation.

30. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock, an abutment adapted to reciprocate to and from operative engagement with the broach, and cooperating means on the abutment and on the broach to center the latter.

31. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock in fixed position in the machine, an abutment adapted to reciprocate to and from operative engagement with the broach to hold the broach in fixed position during the broaching operation, and cooperating means on the abutment and on the broach to prevent angular movement of the latter.

32. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock, an abutment adapted to reciprocate to and from operative engagement with the broach, and cooperating means on the abutment and on the broach to prevent circumferential movement of the latter.

33. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock, an abutment adapted to reciprocate to and from operative engagement with the broach, and means for forcing the stock from the broach and out of the machine.

34. In a broaching machine, means for supporting the stock, a broach arranged to be supported by the stock in fixed position in the machine, an abutment adapted to reciprocate to and from operative engagement with the broach to hold the broach in fixed position during the broaching operation, means for forcing the stock from the broach, and means for ejecting the stock from the machine.

35. In a broaching machine, a broach, intermittent broach engaging means for retaining the broach in fixed position in the machine, and a reciprocating die carrier for forcing stock over said broach to produce the broaching operation.

36. In a broaching machine, a broach constructed and arranged to be supported in the machine by the stock forced thereover, a die carrier arranged to reciprocate toward

and from said broach to force stock over said broach to produce the broaching operation, and an abutment adapted to reciprocate to and from operative engagement with said broach to hold the latter against movement during the broaching operation.

37. In a broaching machine, a broach constructed and arranged to be supported in the machine by the stock forced thereover, a die carrier arranged to reciprocate toward and from said broach to force stock over said broach to produce the broaching operation, an abutment adapted to reciprocate to and from operative engagement with said broach to hold the latter against movement during the broaching operation, and ejecting means for said stock arranged to operate when said abutment has reached its retracted position.

38. In a broaching machine, a broach constructed and arranged to be supported in the machine by the stock forced thereover, a die carrier arranged to reciprocate toward and from said broach to force stock over said broach to produce the broaching operation, an abutment adapted to reciprocate to and from operative engagement with said broach to hold the latter against movement during the broaching operation, and means for supplying stock to said die carrier.

39. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for removing chips from the teeth of the broaching tool.

40. In a broaching machine, a broach constructed and arranged to be supported upon the stock operated on, and means for directing a jet of air toward the broach for removing chips therefrom.

41. In a broaching machine, a broach, a die carrier, a recess therein to receive said broach and an opening in the lower part of said die carrier communicating with said recess to permit the chips made by the broach to fall out.

42. In a broaching machine, a broach, a die carrier, a recess therein to receive said broach, said recess having an enlargement between its ends to accommodate the chips made by the broach.

43. In a broaching machine, a broach, a die carrier, a recess therein to receive said broach, said recess having an enlargement between its ends to accommodate the chips made by the broach, and an opening in the lower part of said die carrier communicating with said recess to permit the chips made by the broach to fall out.

44. A machine of the character described having a floating broach, means intermittently engaging the broach for holding the latter in position, means for forcing work pieces over the broach while held by said first means, and an ejector operable inter-

mediate the intermittent holding engagements of the broach.

45. A machine of the character described including a work support, a broach floatable
5 within the support, means for forcing work along the broach and beyond the broaching support, means for holding the broach during the forcing operation, and a spring ejector member carried by the support for
10 laterally displacing completed work articles as they are shifted beyond the broach.

46. A machine of the character described including a work support and a broach floatable within the support, means for forcing
15 ing work articles over the broach, means for intermittently engaging and steadying the broach, yielding means engaging the completed work pieces during the steadying of the broach, means for withdrawing said

last two means, and additional resilient
20 means for ejecting the completed work when the parts are in disengaged position.

47. In a machine of the character described the combination with a reciprocating tool steadying member of a work steadying
25 member associating therewith and means for sequentially withdrawing said parts from operative position.

48. A machine of the character described including a support through which the work
30 passes, a work engaging tool adapted to float on the work, work forcing and tool steadying means, and means for concomitantly shifting the forcing and steadying means into and out of engaging position.
35

Signed by me at Lowell, Mass., this 14th day of July, 1921.

GEORGE J. RUSSELL.