

Feb. 20, 1934.

J. F. BOWERS

1,948,437

PROCESS OF PRODUCING CYLINDERS

Filed Aug. 25, 1931

2 Sheets-Sheet 1

FIG. 1.

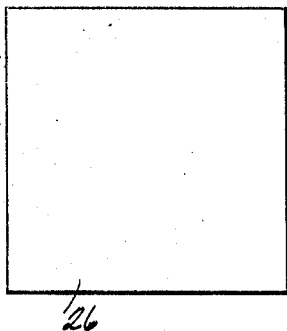


FIG. 2.

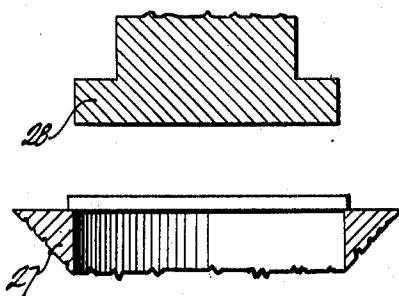


FIG. 3.

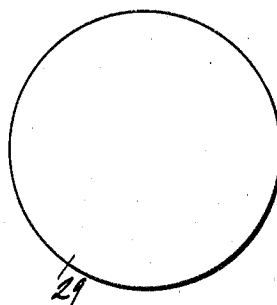


FIG. 4.

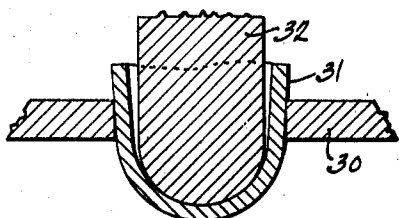


FIG. 5.

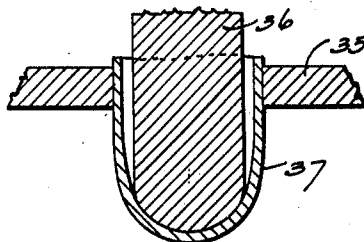


FIG. 11.

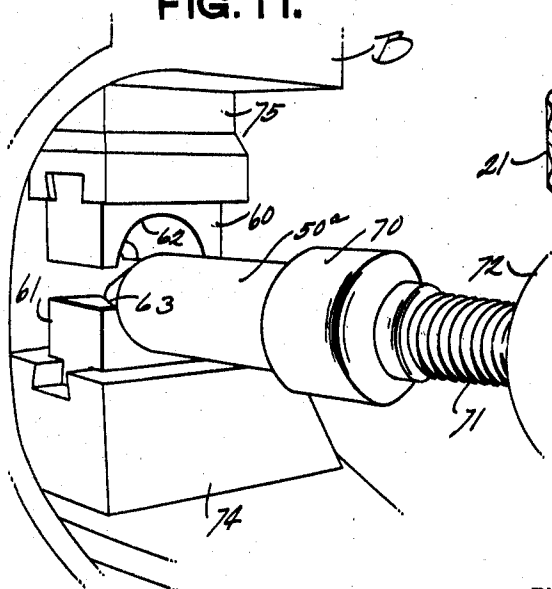
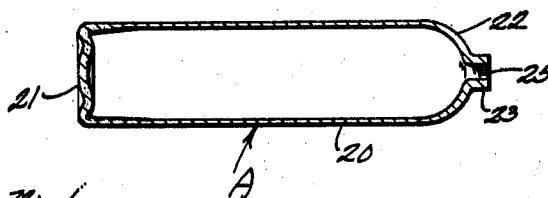


FIG. 10.



INVENTOR.
J. Fred Bowers

BY *Lancaster, Alluvio & Rommel*
ATTORNEYS.

Feb. 20, 1934.

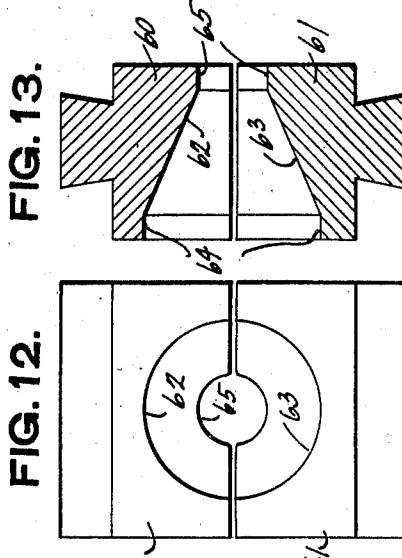
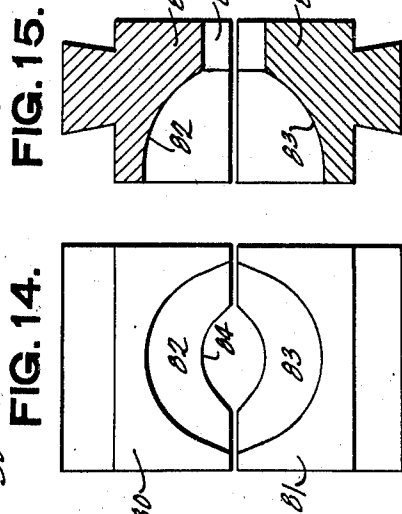
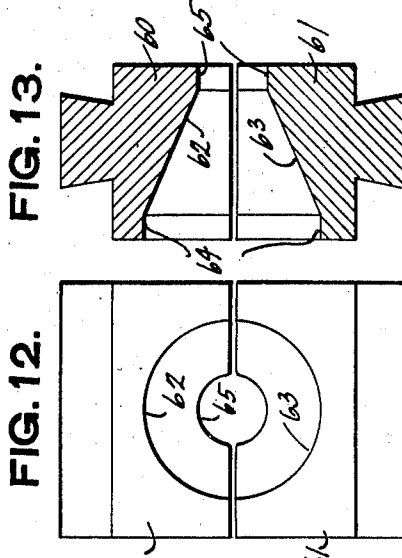
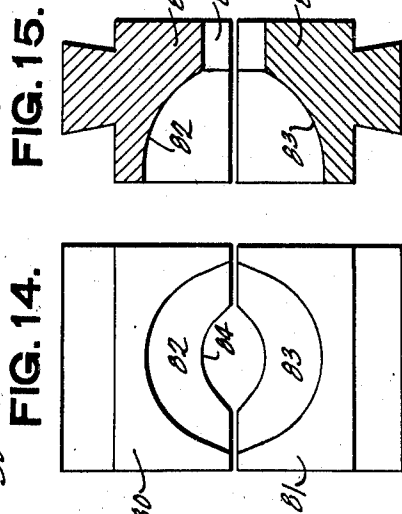
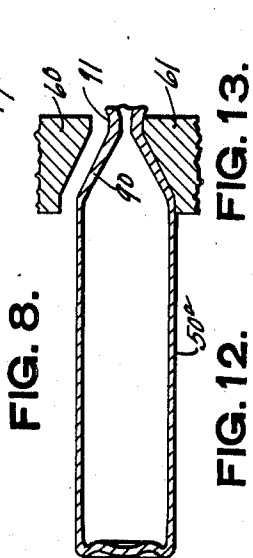
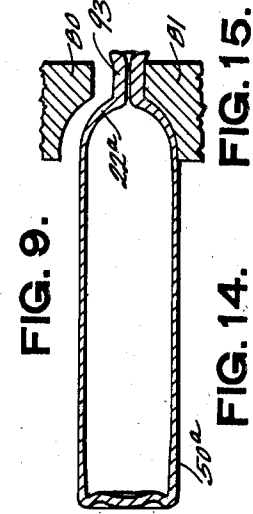
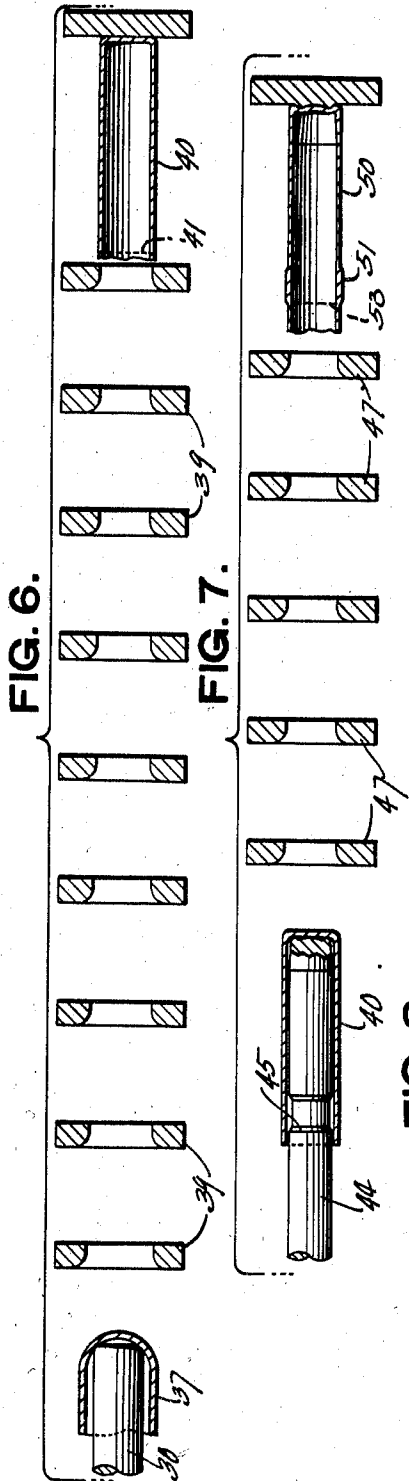
J. F. BOWERS

1,948,437

PROCESS OF PRODUCING CYLINDERS

Filed Aug. 25, 1931

2 Sheets-Sheet 2



INVENTOR.
J. Fred Bowers

BY *Lancaster, Alluvius and Rommel*
ATTORNEYS.

UNITED STATES PATENT OFFICE

1,948,437

PROCESS OF PRODUCING CYLINDERS

John Frederick Bowers, Harrisburg, Pa., assignor
to Harrisburg Pipe and Pipe Bending Company,
Harrisburg, Pa., a corporation

Application August 25, 1931. Serial No. 559,333

15 Claims. (Cl. 29—148.2)

This invention relates to improvements in methods of producing metal cylinders.

The primary object of this invention is the provision of an improved method or process for the production of a forged steel cylinder which will be very durable and capable of safely retaining liquids or gases therein under super-atmospheric pressure.

A further object of this invention is the provision of an improved process for the manufacture of forged steel cylinders or tubes, in which the necking operation is accomplished in an improved manner for the production of a cylinder which has an effectively reinforced neck, and sufficient material at the neck and mouth of the cylinder for proper tapping.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In the accompanying drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention only.

Figure 1 is a plan view of a blank of metal from which the cylinder is formed.

Figure 2 shows the blank of metal placed upon a stamping machine.

Figure 3 is a plan view of a disc stamped upon the machine of Figure 2, from the blank of metal shown in Figure 1.

Figures 4 and 5 show, rather diagrammatically, successive cutting steps wherein the disc of Figure 3 is initially cupped.

Figure 6 is a rather diagrammatic view showing the manner in which the cupped metal taken from the cupping operation of Figure 5 is drawn into cylindrical formation.

Figure 7 is a further diagrammatic view showing a successive drawing of the cylinder.

Figure 8 is a view showing the treatment of the cylinder in the first neck reducing operation.

Figure 9 is a view illustrating a successive necking step in the method of treating the cylinder.

Figure 10 is a view showing the completed cylinder.

Figure 11 is a perspective view showing the manner in which the cylinder is mounted and manipulated in connection with the die stamping and necking operations of Figures 8 and 9.

Figures 12 and 13 are respectively an elevation and section of a cone-shaped necking die utilized in the first necking operation.

Figures 14 and 15 are respectively an elevation and section of the elliptic die utilized in the finishing step of necking the cylinder.

In the drawings, wherein similar reference

characters designate corresponding parts throughout the several views, the letter A may generally designate the finished forged steel cylinder. It is adaptable for receiving fluids under superatmospheric pressure and consists of a cylindrical body portion 20, with a bottom wall 21 of any approved construction, and a convexly arcuated top wall 22 which merges into a reduced nipple-like neck 23 provided with a screw threaded opening 25 therein for receiving a valve, plug, or whatever it is desired to connect therein.

The operations necessary to provide the forged steel cylinder are as follows:—

A plate 26, preferably flat and of polygonal outline is heated to a forging temperature and placed upon a suitable bed 27. While thus heated a shearing hammer 28 is brought into contact therewith for shearing out the circular disc-like plate 29. While under the forging heat the latter is then placed upon a suitable apertured die plate 30 and initially drawn into a cup-shaped member 31, shown in Figure 4, with the aid of a ram 32. A second cupping operation then takes place, while still under the initial forging heat; the cup-shaped member 31 being placed upon a second apertured die plate 35 and operated upon by a ram 36 to produce the cup-shaped article 37 shown in Figure 5. In this second cupping operation the metal is somewhat extruded, for elongating the cup and thinning the walls thereof.

The cup 37 is then re-heated to a forging temperature, placed upon a horizontal ram 38 and forced through a series of rings 39 which are mounted on a suitable draw bench, as can well be understood. These rings have openings therein of successively decreasing diameter, and forcing the cup 37 through the rings draws the same into the shape of a cylinder 40, also shown in Figure 6. The open end of the cylinder 40 is then squared off by trimming along the dotted line 41 with a circular saw.

The cylinder 40 is then re-heated to a forging temperature and placed upon a ram 44 for extruding the cylinder still further. In this particular operation the ram 44 is annularly under-cut at 45 so as to form a shroud to increase the wall thickness of the cylinder at this location. It is readily apparent that forcing the cylinder 40 through the draw rings 47 of the draw bench in the second drawing operation will lengthen the cylinder and thin out the walls; the metal of the cylinder flowing into the annular recess 45 of the ram, and when the latter is withdrawn after passing through the draw ring, the excess metal which has entered the annular recess 45 is drawn

radially outward for the purpose of annularly increasing the thickness of the walls of the cylinder 50, as shown at 51, which is of course at the open end of the cylinder 50. The extreme forward end of the ram 44 may be suitably recessed to finish the bottom or end wall, at the closed end of the cylinder, in any desired configuration. The cylinder 50 is then squared off by cutting on the dotted line 53, shown in Figure 7 of the drawings, to bring the cylinder to the desired length.

The open end of the cylinder 50 as thus formed is then heated to a forging temperature and while thus heated the first necking operation is accomplished.

The necking of the cylinder is of particular importance, for the reason that an excess of metal must be worked in about the neck in order that the same will not be unduly weakened when the opening through the neck is bored and tapped. The first necking operation is accomplished by the utilization of cone-shaped complementary die parts 60 and 61, which are provided with recesses 62 and 63 therein defining a frusto-conical passageway, which at the larger end has a shallow entrance opening 64 of uniform diameter and at the smaller end has a similar shallow neck protruding passageway 65 of uniform diameter. It is to be noted that the surfaces of the conical opening through the complementary die part measured axially of the passageway is of straight line formation, in contradistinction to a convex or concave curvature.

The cylinder 50 after trimming the free end and heating the open end as mentioned, is secured at its closed end in a suitable coupling 70 mounted at the outer end of a screw 71. The latter is threaded in a supporting frame 72 and a shaft slowly rotates the screw 71 for feeding the cylinder 50^a forwardly into the complementary die parts 60 and 61. A hammer press B is provided, having the lower stationary die part 61 mounted on the base 74, and the hammer press platen 75 movably carries the upper die part 60. The hammer press reciprocates the upper die part rapidly and of course the open end of the cylinder 50^a is subjected to rapid blows between the die parts 60 and 61 at the same time that the cylinder 50^a is fed forwardly into said die parts incident to slow rotation of the screw 71. The utilization of a conical passageway die for the first necking operation is very important, since it eliminates a number of operations previously found necessary in the utilization of a plurality of elliptically shaped dies. By utilizing the conical passageway first, the tendency of the steel to creep in the direction of the axis of the cylinder is obviated, and the desired wall thickness is thus gathered directly in the neck of the cylinder. The finishing step of the necking operation is completed in an elliptical die comprising upper and lower parts 80 and 81 respectively, which are suitably recessed at 82 and 83 respectively, to provide an elliptical shaped opening or passageway with a relatively long reduced neck receiving outlet opening 84, as shown in Figure 15. The second necking operation is preferably carried out after reheating the end of the cylinder to a forging temperature, and it is readily understandable that the neck of the cylinder is closed in somewhat more after working between the dies 80 and 81. The latter die parts are of course supported by the hammer B in the same manner as shown for the conical die parts in Figure 11 of the drawings.

It is very important to understand that the

necking of the cylinder, first in a conical die, and then in an elliptical die, accomplishes in two operations what formerly was done in three to five passes.

In Figure 8 is shown the cylinder 50^a as operated upon between the die parts 60 and 61; it being shown that the open end of the cylinder is conically tapered at 90 with an increasing thickness of metal from the body of the cylinder in the direction of the neck shank 91. In Figure 9 is shown the cylinder 50^a after treatment between the die parts 80 and 81, showing the end of the cylinder to have been convexly shaped at 22^a with a long protruding neck 93 in which the passageway is almost completely closed. This neck 93 has a thickness of metal materially greater than the thickness of metal in the body walls of the cylinder, as shown in Figure 9, which enables an opening to be bored and later tapped therethrough without destroying the proper wall thickness in the neck of the cylinder.

After the cylinder 50^a has been shaped in the elliptical die the cylinder is annealed at proper furnace temperature to make the steel machineable. The neck end 93 is then properly trimmed, and an opening bored therethrough. The final tapped opening 25 is then made. The trimming, boring, and tapping of the opening may all be executed on one machine having a turret head attachment.

It is of course to be understood that the various steps of the method herein outlined may be utilized for the formation of cylindrical or tubular articles other than those adapted to receive high pressure fluids, such as carbonic gas. This process can be used in the formation of cylinders or tubes from billet pierced tubes. It will be apparent to those skilled in the art that among the major advantages of securing the additional metal at the open end of the cylinder are ease of necking, sufficient metal after being necked to provide a long threaded section with proper final wall thickness, and elimination of laps, seams, and folds, with great strength in the neck and shoulder.

Various changes in the steps of the process and method herein outlined, and in the shape, size, and construction of the article worked upon may be made without departing from the spirit of the invention or the scope of the claims.

I claim:

1. The process of forming a forged steel hollow tube which consists in initially forming a tubular body, reducing an end of the body by die stamping under forging temperatures with a die having a true frusto-conical passageway therethrough to produce a thickened neck, and subsequently completing the necking of the article and the formation of a passageway through said neck.

2. The steps in the process of manufacturing forged steel tubular articles which consists in initially forming a forged tube, and subsequently reducing and necking an end of said tube by die stamping under forging temperatures between complementary parts of a die having a passageway therethrough in substantially the shape of the frustum of a cone.

3. The steps in the process of manufacturing forged steel tubular articles which consists in initially forming a forged tube, subsequently reducing and necking an end of said tube by die stamping under forging temperatures within a die having a passageway therethrough in substantially the shape of the frustum of a cone,

and at the same time rotating the cylinder and longitudinally moving the cylinder axially in the direction of the die passageway toward the smaller end of the passageway to produce a thickened neck.

4. The steps in the process of manufacturing forged steel tubular articles which consist in initially forming a forged steel tubular body, subsequently while under forging temperature reducing an end of the article in a die having a passageway therethrough in the shape of a frustum of a cone, and subsequently additionally necking and reducing the end of the article by treatment while under forging temperatures within a die having an elliptical passageway therethrough.

5. In the process of producing a forged steel cylinder the steps which consist in the drawing of a cylinder, heating an end of the cylinder to a forging temperature, reducing the heated end of the cylinder in a necking operation while under forging temperature within a die having a passageway therethrough in the shape of a frustum of a cone, and subsequently reducing and necking the end of the cylinder while under forging temperature in a die having a passageway therethrough of concavely shaped formation.

6. In the method of producing a forged steel cylinder the steps which consist in drawing while heated a seamless forged steel cylinder having a body wall of predetermined thickness closed at one end and with a thicker wall portion at the other end thereof, heating the said thicker end wall portion of the cylinder to a forging temperature, while under such temperature reducing and necking the said thickened wall portion to provide a neck of predetermined increased thickness and length, and subsequently providing a passageway through said neck of predetermined diameter.

7. The process of manufacturing a forged steel cylinder for receiving high pressure fluids which consists in initially providing a forged steel cylindrical body having an open end, and subsequently heating the said open end to a forging temperature and reducing and necking the said open end of the cylinder in successively die stamping operations with dies having passageways therethrough in the shape of a frustum of a cone and an ellipse.

8. The process of producing a forged steel cylinder for containing high pressure fluids which consists in drawing while under forging temperature a cylindrical body of predetermined wall thickness with an open end, heating the open end to a forging temperature, necking the open end of the cylinder while under such forging between the complementary die parts of a die having a conical passageway therethrough in the shape of a frustum of a cone and while thus die stamping the cylinder rotating the cylinder and feeding it axially into the said die passageway, subsequently heating the necked end of the cylinder to a forging temperature, and then die hammering the neck end of the cylinder between the complementary parts of a die having a passageway therethrough which is concaved longitudinally and elliptically shaped in cross section, and at the same time as the said die stamping operation feeding the cylinder axially into said last mentioned die and rotating the same.

9. The process of producing a forged steel cylinder for containing high pressure fluids

which consists in drawing while under forging temperature a cylindrical body of predetermined wall thickness with an open end, heating the open end to a forging temperature, necking the open end of the cylinder while under such forging between the complementary die parts of a die having a conical passageway therethrough in the shape of a frustum of a cone and while thus die stamping the cylinder rotating the cylinder and feeding it axially into the said die passageway, subsequently heating the necked end of the cylinder to a forging temperature, then die hammering the neck end of the cylinder between the complementary parts of a die having a passageway therethrough which is concaved longitudinally and elliptically shaped in cross section and at the same time as the said die stamping operation feeding the cylinder axially into said last mentioned die and rotating the same, and subsequently tapping an opening thru the neck of the cylinder as thus formed.

10. The steps in the method of providing a forged steel cylinder which consists in die stamping while under forging temperature a disc-shaped plate, cupping the plate while under forging temperature, drawing the forged steel cup as thus formed into a cylindrical body having an open end, further drawing the cylindrical body while under forging temperature for the purpose of lengthening the same and reducing the wall thickness throughout the major length thereof and increasing the wall thickness at the open end thereof, and subsequently reducing, necking and boring a passageway through the thickened end of the cylinder.

11. The steps in the method of providing a forged steel cylinder which consists in die stamping while under forging temperature a disc-shaped plate, cupping the plate while under forging temperature, drawing the forged steel cup as thus formed into a cylindrical body having an open end, further drawing the cylindrical body while under forging temperature for the purpose of lengthening the same and reducing the wall thickness throughout the major length thereof and increasing the wall thickness at the open end thereof, next necking the cylinder as thus formed at its open end while under forging temperature in a die having a passageway therethrough in the shape of a frustum of a cone, subsequently die necking the thus necked end of the cylinder in a die having a passageway therethrough which is concaved longitudinally, and subsequently providing a passageway through the thus formed neck of the cylinder.

12. The method of providing a forged steel cylinder which comprises the initial forging of a seamless steel cylinder with one closed end and an opposite open end portion having a wall appreciably thicker than the wall of the body of the cylinder, subjecting the thickened end wall portion of the cylinder to a swaging action under forging temperature in order to reduce and contract the said end into a nipple having a wall of greater thickness than the wall of the body of the cylinder, and subsequently providing an opening of desired size through the nipple.

13. The method of providing a forged steel cylinder which consists in initially drawing into shape a forged steel cylinder having an open end with a wall of greater thickness than the body portion of the cylinder, and subsequently subjecting the thickened wall portion of the forged cylinder while under forging temperature to successive reducing and swaging operations within con-

cal and elliptical dies to produce a reduced end having a relatively long nipple with a wall portion of greater thickness than the thickness of the wall of the body of the cylinder, and subsequently providing an opening thru the nipple of desired size.

14. In the process of forming a forged metal cylinder the steps which consist in drawing a heated blank into a forged hollow cylinder with an open end, reducing said open end while heated into the shape of the frustum of a cone with a thickened neck extension, and subsequently further reducing said end while heated into the shape of an ellipse having an elongated neck extension of increased thickness, and subsequently tapping said neck.

15. The method of producing a forged steel cylinder which consists in drawing while heated a forged seamless steel cylinder having a body of predetermined thickness with a closed end wall and an opposite open end, subjecting the open end of the seamless steel cylinder, while heated, to an external reducing and swaging action to form a nipple having a wall of greater thickness than the previous thickness of the wall at said open end and appreciably thicker than the body wall, and subsequently providing an opening through said nipple without destroying the proper wall thickness thereof.

JOHN FREDERICK BOWERS.

15	90
20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150