July 26, 1938. F. H. LE JEUNE 2,124,923

METALWORKING MACHINE

Filed Feb. 15, 1937 3 Sheets-Sheet 1

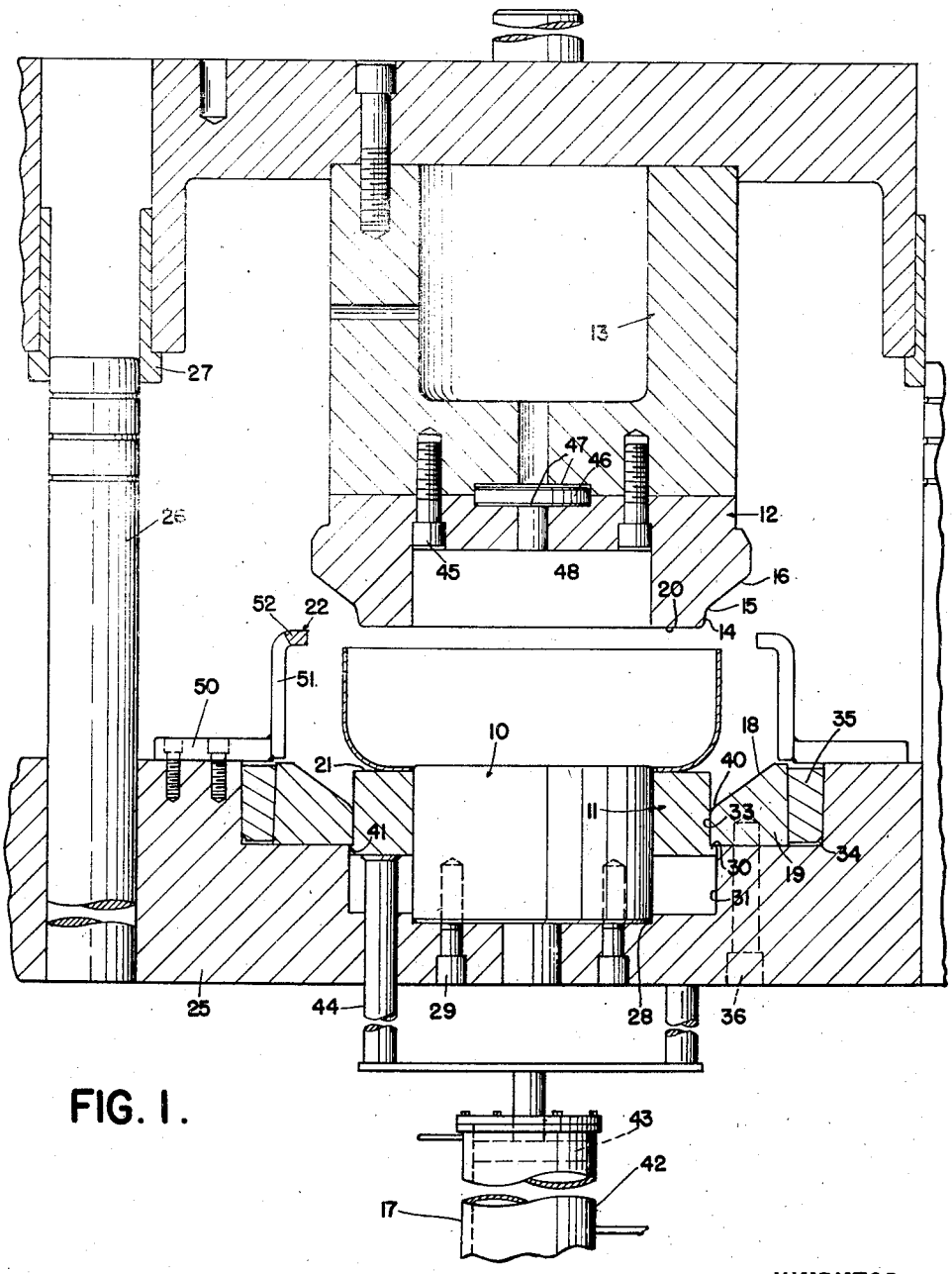


FIG. 1.

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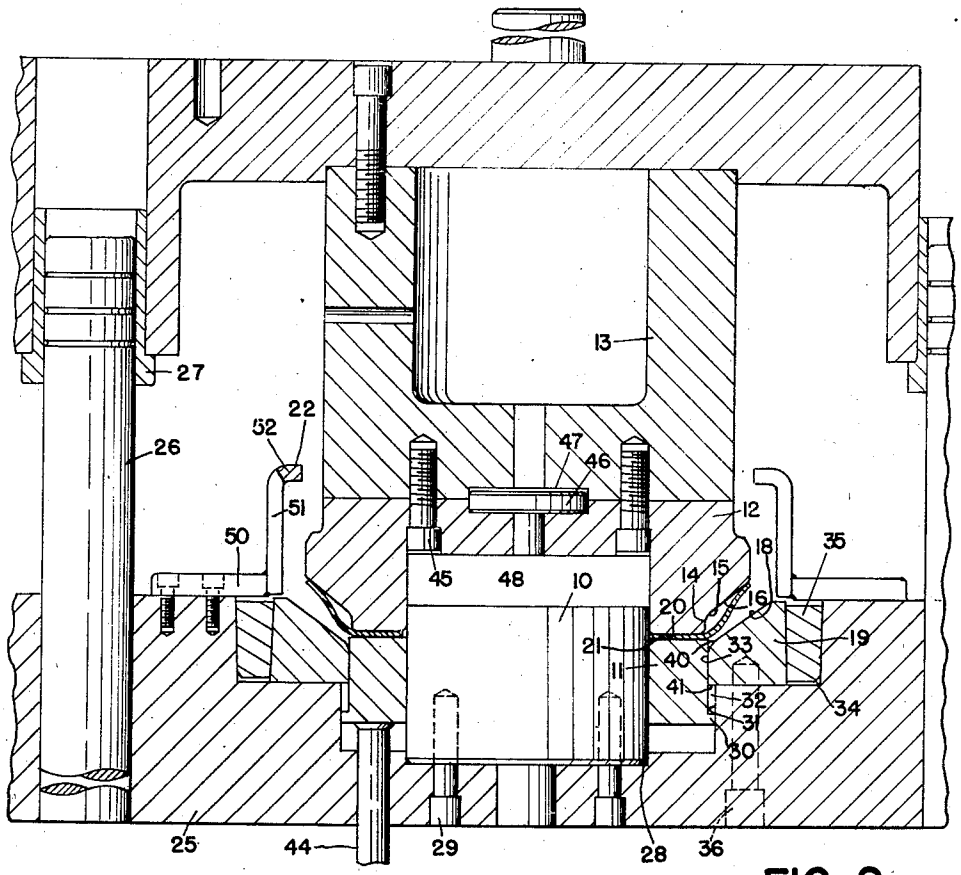


FIG. 2.

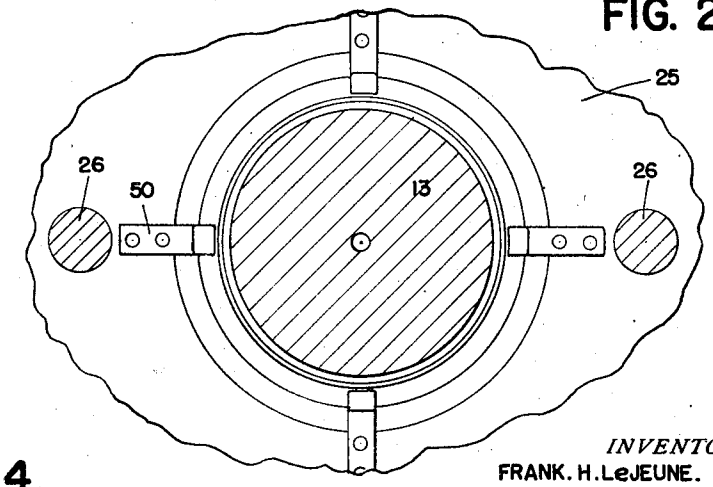


FIG. 4.

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Filed Feb. 15, 1937 3 Sheets-Sheet 3

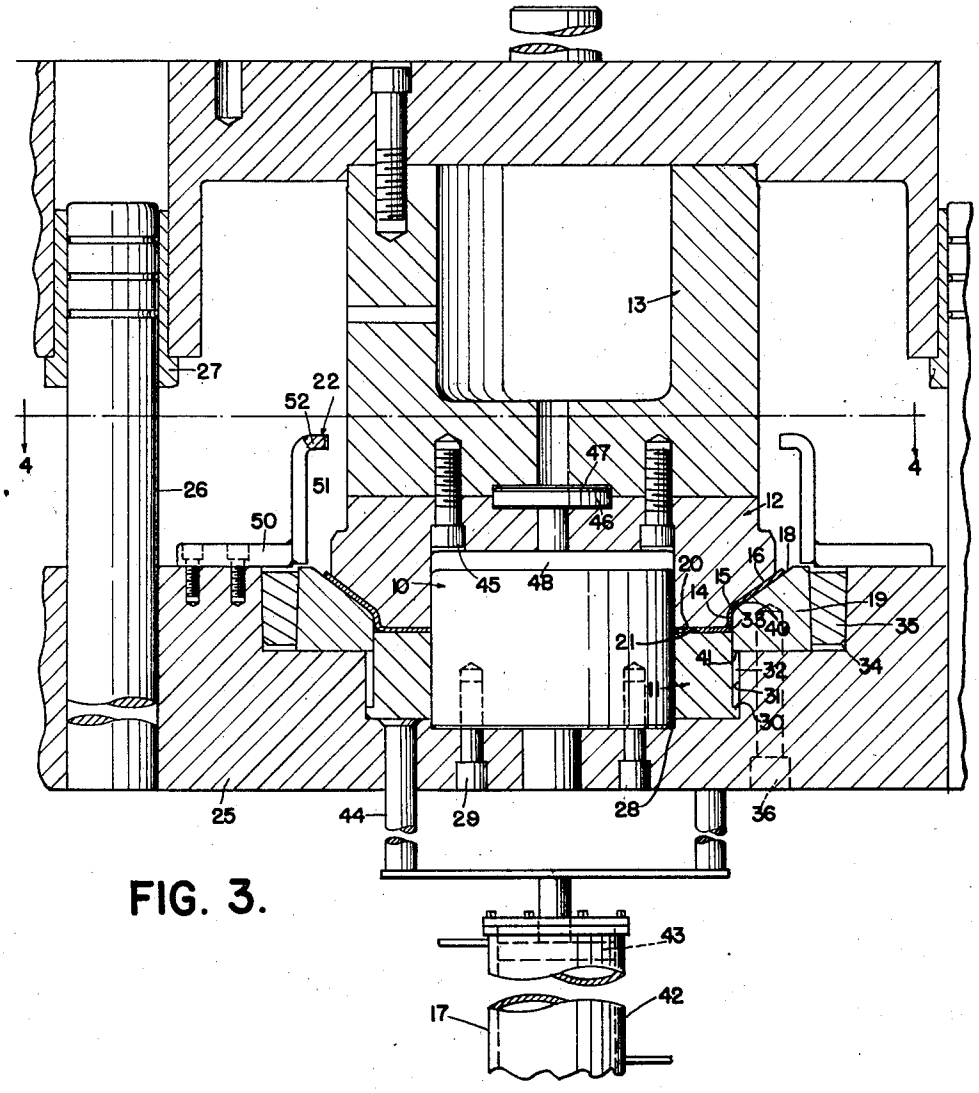


FIG. 3.

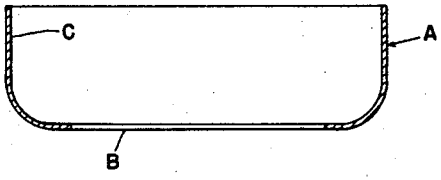


FIG. 5.

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UNITED STATES PATENT OFFICE

2,124,923

METALWORKING MACHINE

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Application February 15, 1937, Serial No. 125,867

3 Claims. (Cl. 153—21)

This invention relates generally to metal working machines and refers more particularly to apparatus for forming sheet metal discs and the like.

One of the principal objects of the present invention resides in the provision of metal working apparatus embodying means for fashioning a tubular element having an inwardly bowed flange at one end into a ring provided with a flat radial portion and a frusto-conical portion connected to the periphery of the radial portion by means of an axially extending annular portion.

Another advantageous feature of this invention consists in the provision of metal working apparatus rendering it possible to form a disc or ring of the contour previously set forth from a tubular blank of the above character by a relatively simple punching operation. With the above in view, the present invention consists in the novel construction of the several parts of the apparatus and in the manner in which these parts cooperate to perform the above functions. This novel arrangement will be more fully understood upon considering the following description of the apparatus in view of the accompanying drawings, wherein:—

Figure 1 is a sectional view through a metal working machine constructed in accordance with this invention;

Figure 2 is a view similar to Figure 1 showing the parts in a different position;

Figure 3 is also a view similar to Figure 1 showing the several parts of the apparatus in still another position;

Figure 4 is a cross sectional view taken substantially on the plane indicated by the line 4—4 of Figure 3; and

Figure 5 is a longitudinal sectional view through a sheet metal blank of the type adapted to be fashioned by the metal working machine.

In general, a cupped blank A of the contour illustrated in Figure 5 is placed over the pilot 10, with the inturned flange B seated on the raised pad 11 and with the top edge of the tubular side walls C positioned for engagement by the punch head 12 upon downward movement of the latter from the position thereof shown in Figure 1. As the punch head 12 is initially lowered by the ram 13, the axially extending annular portion 14 at the lower end of the head slides into the upper end of the blank A to engage the radius or outwardly curved portion 15 of the punch with the upper edge of the tubular side walls C of the blank A. The radius 15 connects the upper end of the axially extending surface 14 with an outwardly and upwardly tapered frusto-conical surface 16, with the result that continued downward movement of the punch flares the upper end of the tubular side walls C of the cupped blank A outwardly in the manner clearly illustrated in Figure 2. In the present instance, the angle of taper of the frusto-conical surface 16 is predetermined to afford the maximum degree of flare of the upper end of the blank A, without cracking or wrinkling the metal of the blank.

It will, of course, be understood that downward movement of the punch head 12 to flare the upper end of the cupped blank A exerts a downward thrust on the pad 11 and, in the present instance, this pad is in the form of an air cushion normally maintained in its uppermost position by means of a constant pressure supplied by the air cylinder 17. With this arrangement, it will be apparent that when the downward thrust on the pad 11 exceeds the pressure acting upon the pad to maintain the latter in its uppermost position, the pad is moved downwardly against this pressure. As the punch head 12 continues to move downwardly, the upper portions of the annular side walls C are actually bent outwardly by the frusto-conical surface 16 toward a correspondingly tapered surface 18 on the upper side of a fixed annular die 19 having an internal diameter predetermined to slidably receive the annular pad 11. During this operation, the downward thrust on the pad 11 exceeds the pressure tending to maintain this pad in its uppermost position and causes the pad to move downwardly into the die 19. As the upper end of the pad 11 moves downwardly beyond the inner edge of the frusto-conical surface 18 on the die, the axially extending portion 14 of the punch head forces the metal into the annular space provided between the outer surface of the annular portion 14 of the punch head and the internal annular surface of the die 19. The construction is such that when the punch head 12 is in its lowermost position shown in Figure 3, wherein the frusto-conical surface 16 clamps the upper side wall portions of the blank A against the frusto-conical surface 18 of the die, the pad 11 is in its lowermost position and the bottom surface 20 of the punch head positively clamps the inturned flange portion B of the blank against the top surface 21 of the pad 11. These surfaces are arranged in radial planes and cooperate with each other in forming the radial portion E of the finished ring D. The flow of

metal in the radial portion E of the ring inwardly is obstructed by the adjacent cylindrical surface of the pilot 10 and, as a consequence, the latter determines the internal diameter of the finished ring. When the ring is completed, the latter is not only provided with the radial portion E, but also comprises a frusto-conical flange F connected to the periphery of the radial portion 20 by means of an axially extending portion G.

Upon completion of the forming operation, the punch head 12 is raised by the ram 13 and the ring D is ejected from the die 19 by the pad 11 as it is returned to its uppermost position by the air cylinder 17. Continued upward movement of the punch head relative to the pad causes the strippers 22 to engage the periphery of the frusto-conical flanges F on the ring D and to strip the latter from the punch head 12.

Referring now more in detail to the particular construction of the apparatus, it will be noted that the same comprises a bolster plate 25 secured in any suitable manner to the machine frame and having guide pins 26 secured thereto on diametrically opposite sides of the path of travel of the ram. The guide pins 26 extend upwardly from the bolster plate 25 and slidably engage in suitable bushings 27 secured to the ram 13. The bolster plate 25 is centrally recessed, as at 28, to receive the lower end of the pilot 10 and the latter is secured to the bolster plate by means of the studs 29. As pointed out above, the annular pad 11 receives the pilot 10, and this pad is guided throughout its vertical movement by engagement of a radial extension 30 at the lower end of the pad with the cylindrical side wall 31 of a recess 32 in the bolster plate 25.

Upon reference to Figures 1 to 3, inclusive, it will be noted that the cylindrical exterior surface of the pad 11 has a sliding engagement with the cylindrical inner surface 33 of the annular die section 19 and the latter is positioned in an annular recess 34 in the bolster plate by means of a wedge-shaped ring 35. The wedge-shaped ring 35 is located in the recess 34 between the outer cylindrical surface of the die section 19 and the adjacent inner surface of the recess. These surfaces are tapered inwardly from the upper edges thereof and engage the correspondingly tapered side wall surfaces of the wedge 35. With this arrangement, the die section 19 is accurately positioned within the recess 34 and is held down on the plate 25 by means of the studs 36.

The upper surface of the die is tapered outwardly and upwardly from the inner cylindrical wall 33 of the die to form the frusto-conical surface 18 and the inner portion of this surface is connected to the upper end of the cylindrical surface 33 by means of a radius 40. As pointed out above, the annular pad 11 is reciprocably mounted in the central opening through the die 19 and, when this pad is in its lowermost position in engagement with the bottom of the recess 32 in the bolster plate 25, the top surface 21 cooperates with the surfaces 18 and 33 to form the complete die.

The pad 11, however, is normally urged to the position thereof shown in Figure 1, wherein the radial extension 30 at the lower end of the pad 11 is in abutting engagement with the underside of the portion 41 of the die 19 extending over the upper end of the recess 32. The pad is urged to this position by means of a constant pressure acting on the underside of the pad and serving to yieldably oppose the action of the punch head 12 during the forming operation. Any suitable type of air cushion may be employed to provide the desired pressure and, in the present instance, the air cushion comprises a cylinder 42 and a piston 43 connected to the underside of the pad 11 at circumferentially spaced points by means of the push rods 44. The bottom of the cylinder 42 communicates with a suitable fluid pressure supply line in order to maintain a constant pressure at the underside of the piston 43.

The punch head 12 is secured to the underside of the reciprocable ram 13 by means of the studs 45 and is accurately positioned with reference to the ram by means of a cylindrical pilot 46 slidably engaging in registering recesses 47, respectively, formed in the underside of the ram and upper surface of the punch head 12. It will be observed from Figures 1 to 3, inclusive, that the ram is centrally recessed, as at 48, to receive the upper end of the pilot 10 and the latter end of the pilot is tapered inwardly slightly to insure proper engagement of the pilot in the recess. It will also be observed from the above figures that the lower end of the pilot is shaped to have a contour corresponding to the working surface of the die when the pad 11 is in its lowermost position shown in Figure 3. The manner in which the punch head cooperates with the die to form the ring D is clearly brought out in the general description of the operation of the apparatus and will not be repeated at this time.

The means provided herein for stripping the ring D from the lower end of the punch, as the latter is returned to its uppermost position by the ram 13, is shown in Figures 1 to 3, inclusive, as comprising a plurality of devices 22 spaced from each other around the die 19. In detail, the devices 22 are provided with brackets 50 secured to the upper surface of the bolster plate 25 and having upwardly extending portions 51 at the inner ends thereof terminating in inwardly projecting fingers 52. The inner ends of the fingers are predeterminedly located with respect to the punch head 12 to engage the periphery of the sheet metal ring D as the punch head moves upwardly relative to the pressure ring 11. Inasmuch as the fingers 52 are fixed relative to the punch head, it follows from the above that these fingers serve to strip the sheet metal ring D from the lower end of the punch head 12.

Thus, from the foregoing, it will be observed that I have provided a relatively simple and inexpensive apparatus for forming rings of a predetermined cross sectional contour from a cupped blank by a punching operation. It should also be understood that my improved apparatus offers the possibility of expanding the tubular end of the cupped blank to its maximum extent without tearing or wrinkling the metal.

What I claim as my invention is:

1. In a machine for fashioning a blank having a tubular portion and an inwardly extending flange at one end of the tubular portion, a die having an opening therethrough with substantially cylindrical side walls and having a surface of predetermined shape extending outwardly from the upper end of the opening, means engageable with the inwardly extending flange of the blank to support the latter in an upright position including a member mounted in the die opening for movement from a position wherein the supporting surface of said member is located above the opening in the die to a position wherein said surface is located below the upper end of the die opening, a punch movable toward and away from the die

and having a substantially cylindrical surface at the lower end thereof of less diameter than the die opening and movable in the adjacent end of the blank upon initial movement of the punch toward the die, said punch also having a surface extending outwardly from the upper end of the cylindrical surface in fixed relation to the latter and effective to flare the last mentioned end of the blank outwardly as the punch continues its movement toward the die permitting the bottom surface of the cylindrical portion of the punch to engage the inwardly extending flange of the blank and to move the supporting member downwardly into the die opening to the second named position aforesaid thereof, the outwardly extending surface of the punch conforming to the outwardly extending surface of the die and being moved by the punch as a unit with the cylindrical portion thereof to press the flared portion of the blank against the outwardly extending surface of the die.

2. In a machine for fashioning a blank having a tubular portion and having an inwardly extending flange at one end of the tubular portion, a die having an opening therethrough with substantially cylindrical side walls and having an annular surface inclined upwardly and outwardly from the upper end of the opening through the die, means engageable by the inwardly extending flange of the blank to support the latter in an upright position including a member mounted in the die opening for movement from a position wherein the supporting surface of said member is located substantially above the opening in the die to a position wherein said surface is located below the upper end of said opening, a punch movable toward and away from the die and having a substantially cylindrical surface at the lower end thereof of less diameter than the die opening and movable into the adjacent end of the blank upon initial movement of the punch toward the die, said punch also having an annular surface surrounding the upper end of the cylindrical surface of the punch in fixed relation to said latter surface, said annular surface on the punch being inclined to conform to the annular surface of the die and being positioned to flare the last mentioned end of the blank outwardly as the punch continues its movement toward the die permitting the bottom surface of the cylindrical portion of the punch to engage the inwardly extending flange of the blank and to move the supporting member downwardly into the die opening to the second named position aforesaid, said annular surface on the punch also being arranged to flatten the flared portion of the blank against the inclined surface of the die during the interval the supporting member approaches its lowermost position in the die opening.

3. In a machine for fashioning a blank having a tubular portion and having an inwardly extending flange at one end of the tubular portion, a die having an opening therethrough with substantially cylindrical side walls and having an annular surface inclined upwardly and outwardly from the upper end of the opening through the die, means engageable by the inwardly extending flange of the blank to support the latter in an upright position including a member mounted in the die opening for movement from a position wherein the supporting surface of said member is located substantially above the opening in the die to a position wherein said surface is located below the upper end of said opening, a punch movable toward and away from the die and having a substantially cylindrical surface at the lower end thereof of less diameter than the die opening and movable into the adjacent end of the blank upon initial movement of the punch toward the die, said punch also having an annular surface surrounding the upper end of the cylindrical surface of the punch in fixed relation to said latter surface, said annular surface on the punch being inclined to conform to the annular surface of the die and being positioned to flare the last mentioned end of the blank outwardly as the punch continues its movement toward the die permitting the bottom surface of the cylindrical portion of the punch to engage the inwardly extending flange of the blank and to move the supporting member downwardly into the die opening to the second named position aforesaid, said annular surface on the punch also being arranged to flatten the flared portion of the blank against the inclined surface of the die during the interval the supporting member approaches its lowermost position in the die opening, and means effective upon movement of the punch away from the die to move the supporting member to its uppermost position in the die and thereby eject the blank from the die opening.

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