This invention relates to side tracking apparatus.

It is an object of the invention to provide apparatus of the type described adapted for use in a pipe in a well bore for forming a lateral opening, or window, through the pipe through which the drilling apparatus may thereafter operate to side track the bore beneath.

In carrying on drilling operations the bore sometimes becomes obstructed so that drilling cannot be continued to deepen the original bore and consequently the obstruction must be side tracked and drilling operations carried on alongside the original obstructed bore. The apparatus herein described has been specially designed for use in a well having a casing therein through which a lateral opening or window must be formed to permit the carrying on of the subsequent drilling operations through said side opening in the casing.

It is another object of the invention to provide a special type of whip stock adapted to be set in the pipe to be perforated and a special form of milling tool shaped to cooperate with the whip stock and whereby an elongated opening may be formed through the side of the pipe or casing in the well through which drilling may be subsequently continued.

It is another object of the invention to provide, in combination, a whip stock and a mill having cooperating guide means whereby the mill will be held in operative relation with the pipe to be perforated and maintained out of contact with the upper end of the whip stock until the mill has cut through the pipe to be perforated to the end that both the mill and the whip stock will be protected and the work of the milling tool will be concentrated against the side of the pipe to be perforated, thus minimizing the wear on the whip stock and mill.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:

Figure 1 shows a side elevation of a whip stock shown partly in section, as suspended from the milling tool while being lowered into the well.

Figure 2 shows a cross sectional view taken on the line 2--2 of Figure 1.

Figure 3 shows a cross sectional view taken on the line 3--3 of Figure 1.

Figure 4 shows a fragmentary side elevation partly in section of the apparatus at the beginning of the milling operation.

Figures 5 and 6 show fragmentary side elevations, partly in section of the apparatus in the position it will occupy during the progress of the work.

Figure 7 shows a fragmentary side view partly in section, illustrating a conventional type of milling tool for completing the work.

Referring now more particularly to the drawings, wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates a pipe adapted to be set in a well bore and which is to be perforated. In carrying on the perforating operations, a whip stock, such as 2, is set in the well in any conventional manner at the point where the pipe is to be perforated. This whip stock has the usual upwardly tapering arcuate guide face 3. Near the upper end of the whip stock the guide face is formed with an inwardly thickened boss 4 whose upper and under faces converge inwardly as shown.

The numeral 5 designates a special type of milling tool which may be attached to the lower end of the operating string 6 extending to the ground surface. Depending from the milling tool there is a downwardly tapering guide which is circular in horizontal cross section. The lower end 8 of this guide is flattened and is attached to the upper end of the whip stock by means of a frangible set screw 9 whereby the assembly consisting of the whip stock and mill may be lowered into the well and the whip stock set at the desired location.

When the whip stock is set the weight of the operating string 6 may be released and the set screw 9 will be thereby sheared and as the string is further lowered the guide 7 will be guided by the boss 4 so as to hold the mill 5 over against the pipe 1, opposite and above the whip stock as illustrated in Figure 4 and upon rotation of the operating string 6 the mill 5 will be caused to cut into and eventually perforate the side of the pipe 1 opposite the whip stock. As the work progresses the mill 5 will gradually move downwardly and will be moved laterally by the guide 1 and boss 4 causing the milling tool to perforate the pipe as illustrated in Figure 5 and thereafter the work is continued the mill operating both against the pipe 1 as well as the boss 4. The window or opening 10 through the pipe 1 will be gradually elongated downwardly as the work progresses and the mill will also cut away and remove the boss 4. Thereafter the sloping guide face 3 of the whip stock will hold the mill firmly against the
work until the guide comes into contact with the pipe and the work of perforating can not be further carried on with this type of mill. Thereupon the operating string $\$ and the mill $\$ are removed from the bore and a conventional type of mill 11, not having the guide 7, is substituted for the mill $\$ and the perforating operation is completed with this last mentioned type of mill.

10. The drawing and description disclose what is now considered to be a preferred form of the invention by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

15. What I claim is:

1. Side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face, a milling tool, said face having a fixed boss and the tool having a guide arranged to slidably engage the boss to move the tool laterally as the tool is moved downwardly.

2. Side tracking apparatus comprising a deflector adapted to be located in a pipe in a well and having a tapering face provided with a raised portion, a milling tool provided with a guide arranged to slidably engage said raised portion to move the tool laterally as the tool moves downwardly.

3. Side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face provided with an elevation, a milling tool having a depending tapering guide arranged to slidably engage said elevation to guide the tool as the tool is moved downwardly.

4. Side tracking apparatus comprising a deflector adapted to be located in a pipe in a well and having a tapering guide face, a boss on said face, a milling tool having a downwardly tapering guide arranged to ride against said boss throughout the length of the guide to guide the milling tool between the boss and pipe as the tool moves downwardly whereby said tool will operate, upon rotation, against the boss and pipe to remove said boss and to cut a side opening in the pipe.

5. In side tracking apparatus, a milling tool having a depending guide which tapers from the tool downwardly and is approximately circular in cross section.

6. Side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face, a milling tool having a depending guide, a setting string to which the milling tool is attached and releasable means through which the whip stock may be attached to the guide whereby the whip stock and tool may be lowered into position to set the whip stock.

7. A side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face provided with a boss, a milling tool having a depending tapering guide arranged to frictionally engage, and to move downwardly relative to the boss, said guide and boss forming means for maintaining said milling tool in working relation with the pipe to form a side opening in said pipe as the milling tool moves downwardly.

8. Side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face, a milling tool, means formed on the whip stock and a guide carried by the tool and slidably engaging said means whereby the milling tool is maintained out of contact with said face and in cutting relation with the pipe as the milling tool is rotated and moved downwardly.

9. Side tracking apparatus comprising a deflector adapted to be located in a pipe in a well and having a tapering guide face, a boss on said face, a milling tool having a downwardly tapering guide arranged to ride against the boss throughout the length of the guide to guide the milling tool between the boss and pipe as the tool moves downwardly whereby said tool will operate, upon rotation, against the boss and pipe to remove said boss and to cut a side opening in the pipe.

10. Side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face provided with an outstanding boss formed integrally with the whip stock, a milling tool having an inverted, frustoconical shaped guide depending from the lower end of the milling tool and arranged to slidably engage the boss as the milling tool moves downwardly to gradually move said tool laterally and to maintain the same in working relation with the pipe to form a side opening in the pipe upon such downward movement.

11. Side tracking apparatus comprising a whip stock adapted to be located in a pipe in a well and having a tapering face and a projection extending radially inwardly from said face, an inverted conical shaped guide adapted to slidably engage the projection, a milling tool adjacent the upper end of the guide, means for rotating the milling tool, said guide and projection forming means for maintaining the milling tool in working relation with the pipe to form a side opening therein upon downward movement of the milling tool.