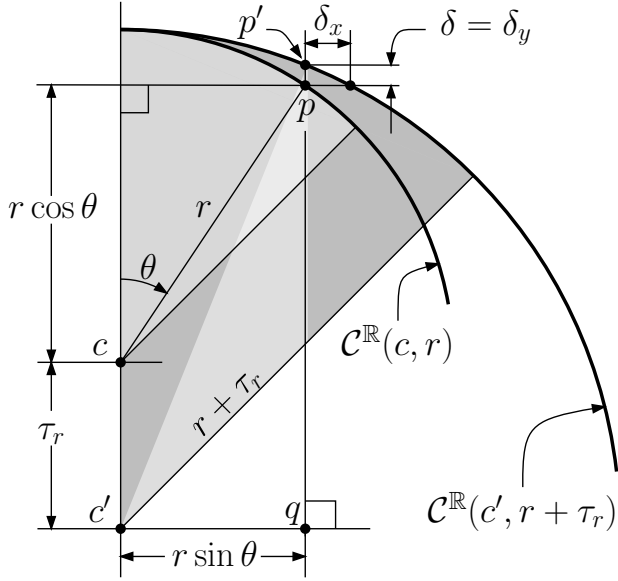


Supplemental File



Detailed Proof of Lemma 1 By Pythagorean theorem for triangle $c'p'q$ (Figure above),

$$(r + \tau_r)^2 = (r \sin \theta)^2 + (\delta + r \cos \theta + \tau_r)^2$$

$$\text{or, } \delta = -(r \cos \theta + \tau_r) + \sqrt{(r \cos \theta + \tau_r)^2 + 2r\tau_r(1 - \cos \theta)}, \text{ since } \delta > 0$$

$$\text{or, } \delta = -(r \cos \theta + \tau_r) + \sqrt{(r + \tau_r)^2 - r^2 \sin^2 \theta}.$$

Now, differentiating both sides with respect to θ ,

$$\frac{d\delta}{d\theta} = r \sin \theta - \frac{r^2 \sin \theta \cos \theta}{\sqrt{(r + \tau_r)^2 - r^2 \sin^2 \theta}} > r \sin \theta - \frac{r^2 \sin \theta \cos \theta}{\sqrt{r^2 - r^2 \sin^2 \theta}}, \text{ since } \tau_r \text{ is positive}$$

$$\text{or, } \frac{d\delta}{d\theta} > r \sin \theta - \frac{r^2 \sin \cos \theta}{r \cos \theta} = 0, \text{ or, } \frac{d\delta}{d\theta} > 0,$$

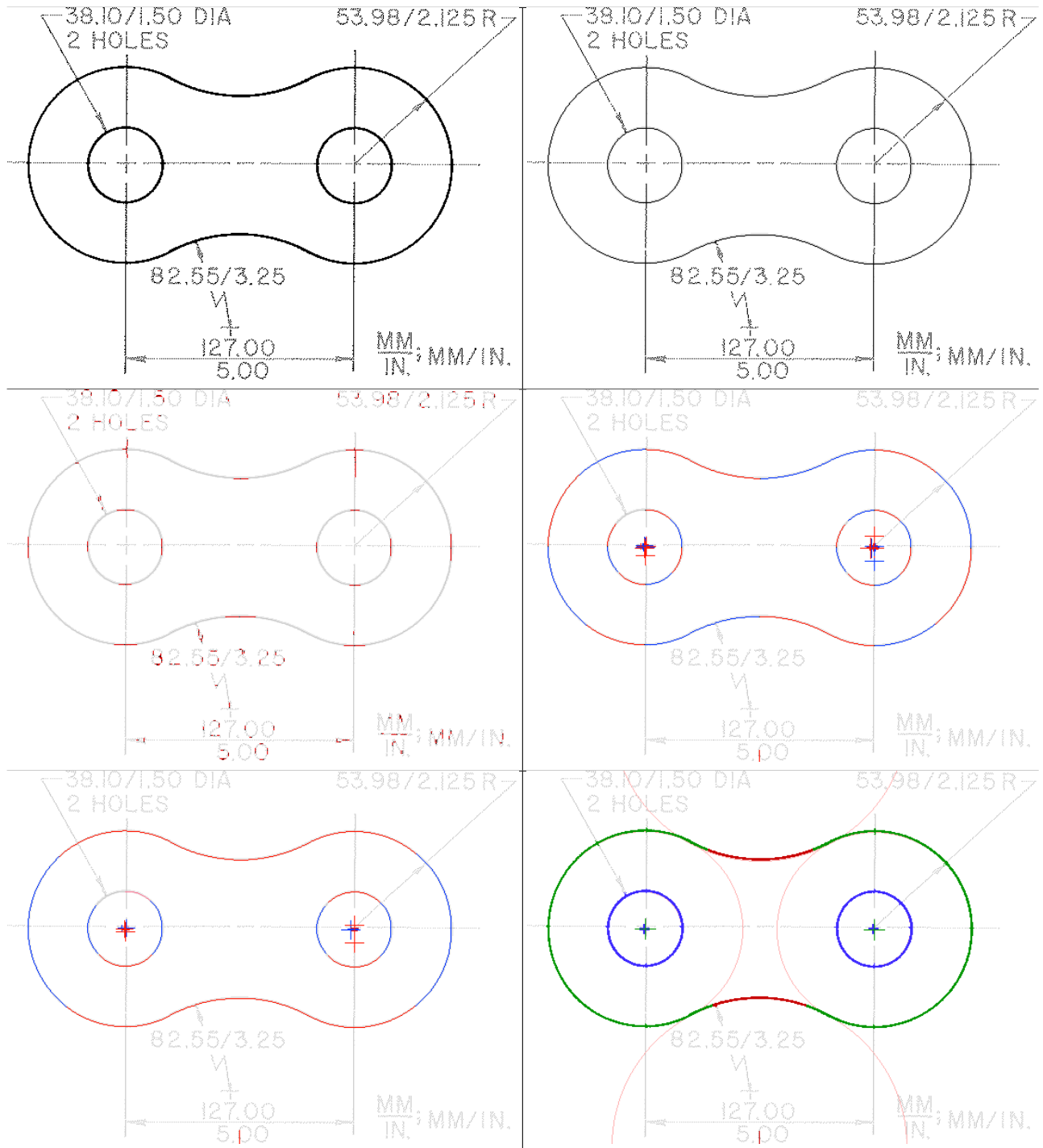
which implies that in Octant 1, δ increases monotonically with θ . Hence, substituting $\theta = \frac{\pi}{4}$, we get

$$\begin{aligned} \delta_{\max} &= -\left(\frac{r}{\sqrt{2}} + \tau_r\right) + \sqrt{(r + \tau_r)^2 - \frac{r^2}{2}} = -\left(\frac{r}{\sqrt{2}} + \tau_r\right) + \sqrt{\left(\frac{r}{\sqrt{2}} + \sqrt{2}\tau_r\right)^2 - \tau_r^2} \\ &\leq -\left(\frac{r}{\sqrt{2}} + \tau_r\right) + \left(\frac{r}{\sqrt{2}} + \sqrt{2}\tau_r\right) = (\sqrt{2} - 1)\tau_r. \end{aligned}$$

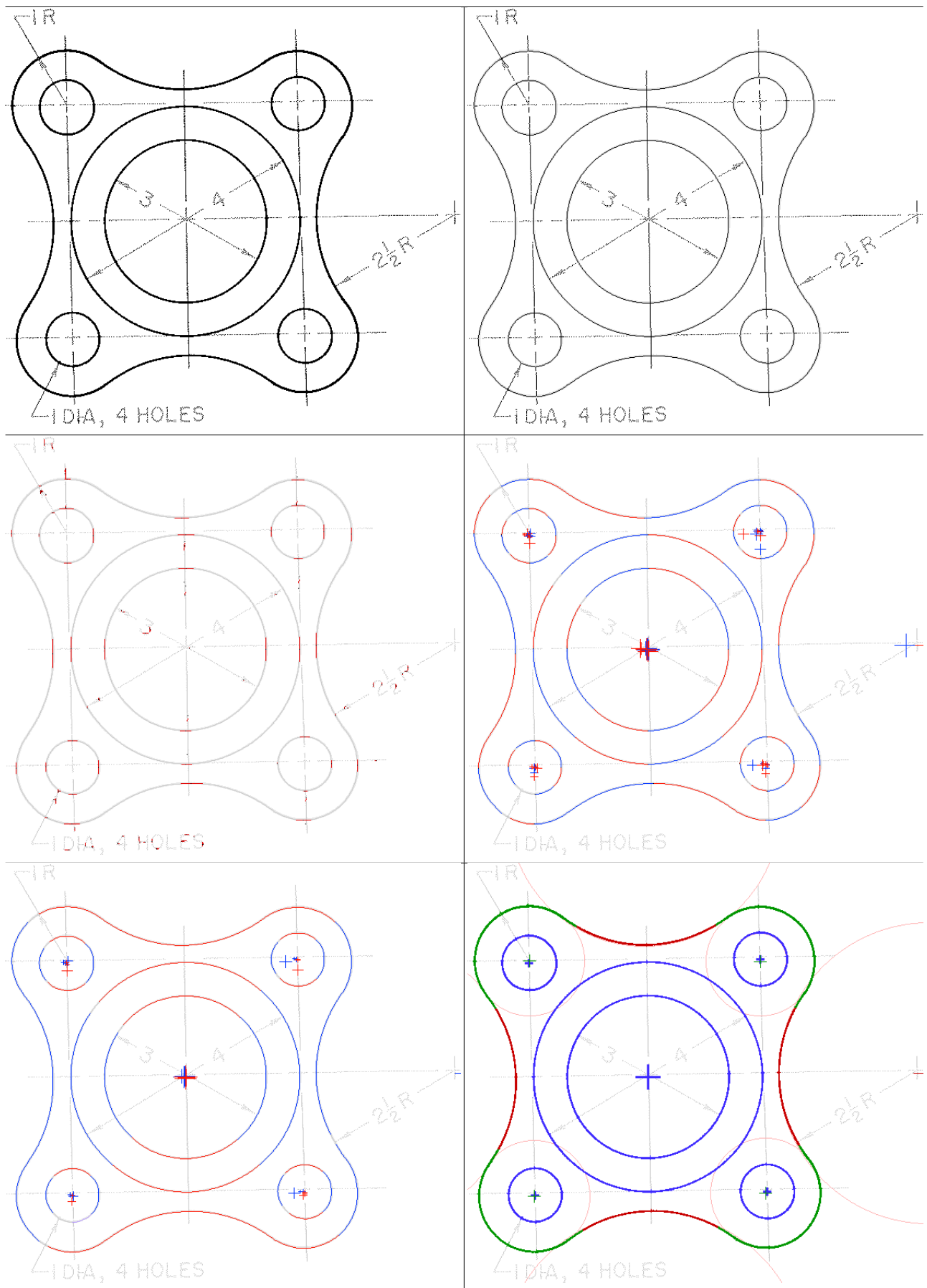
Procedure `GetRun`(p, k, Λ, oct). I is the thinned binary image, and (x, y) denote the row and the column values of p .

```
1  $\lambda \leftarrow 0$ 
2 switch  $oct$  do  $\triangleright$  traverse a run based on octant type
3   case 1
4     while  $I[x][y] = 1$  do
5        $y \leftarrow y + 1, \lambda \leftarrow \lambda + 1$ 
6      $x \leftarrow x + 1$ 
7   case 2
8     while  $I[x][y] = 1$  do
9        $x \leftarrow x - 1, \lambda \leftarrow \lambda + 1$ 
10     $y \leftarrow y - 1$ 
11  case 3
12    while  $I[x][y] = 1$  do
13       $x \leftarrow x + 1, \lambda \leftarrow \lambda + 1$ 
14     $y \leftarrow y - 1$ 
15  case 4
16    while  $I[x][y] = 1$  do
17       $y \leftarrow y + 1, \lambda \leftarrow \lambda + 1$ 
18     $x \leftarrow x - 1$ 
19  case 5
20    while  $I[x][y] = 1$  do
21       $y \leftarrow y - 1, \lambda \leftarrow \lambda + 1$ 
22     $x \leftarrow x - 1$ 
23  case 6
24    while  $I[x][y] = 1$  do
25       $x \leftarrow x + 1, \lambda \leftarrow \lambda + 1$ 
26     $y \leftarrow y + 1$ 
27  case 7
28    while  $I[x][y] = 1$  do
29       $x \leftarrow x - 1, \lambda \leftarrow \lambda + 1$ 
30     $y \leftarrow y + 1$ 
31  case 8
32    while  $I[x][y] = 1$  do
33       $y \leftarrow y - 1, \lambda \leftarrow \lambda + 1$ 
34     $x \leftarrow x + 1$ 
35  $k \leftarrow k + 1$ 
36  $\Lambda \leftarrow \Lambda + \lambda$ 
37 return ( $p, k, \Lambda, \lambda$ )
```

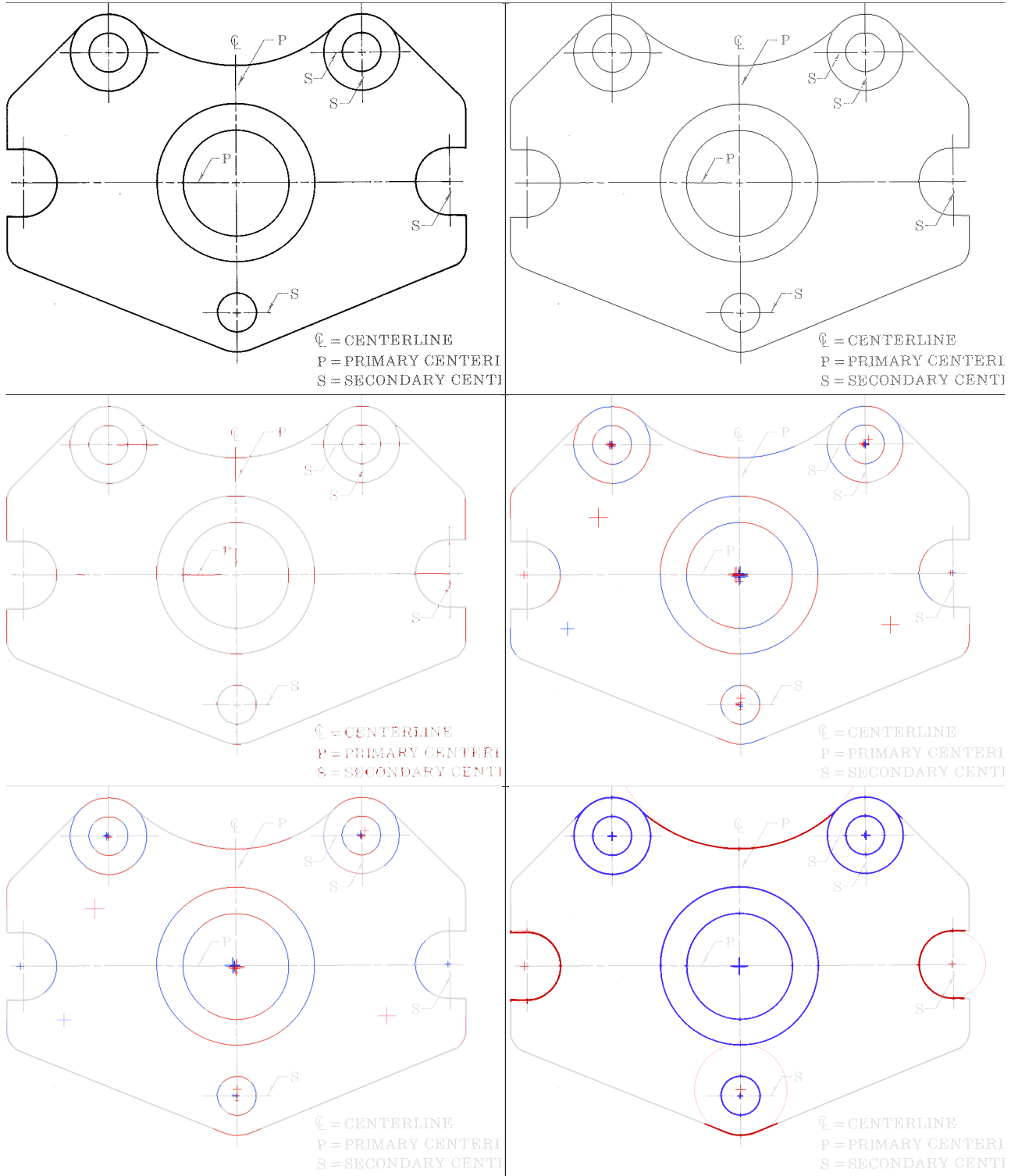
Results (input in black, output colored) of arc segmentation by our algorithm.
 Blue implies 4-cliques, green implies 3- or 2-cliques, and red 1-cliques.



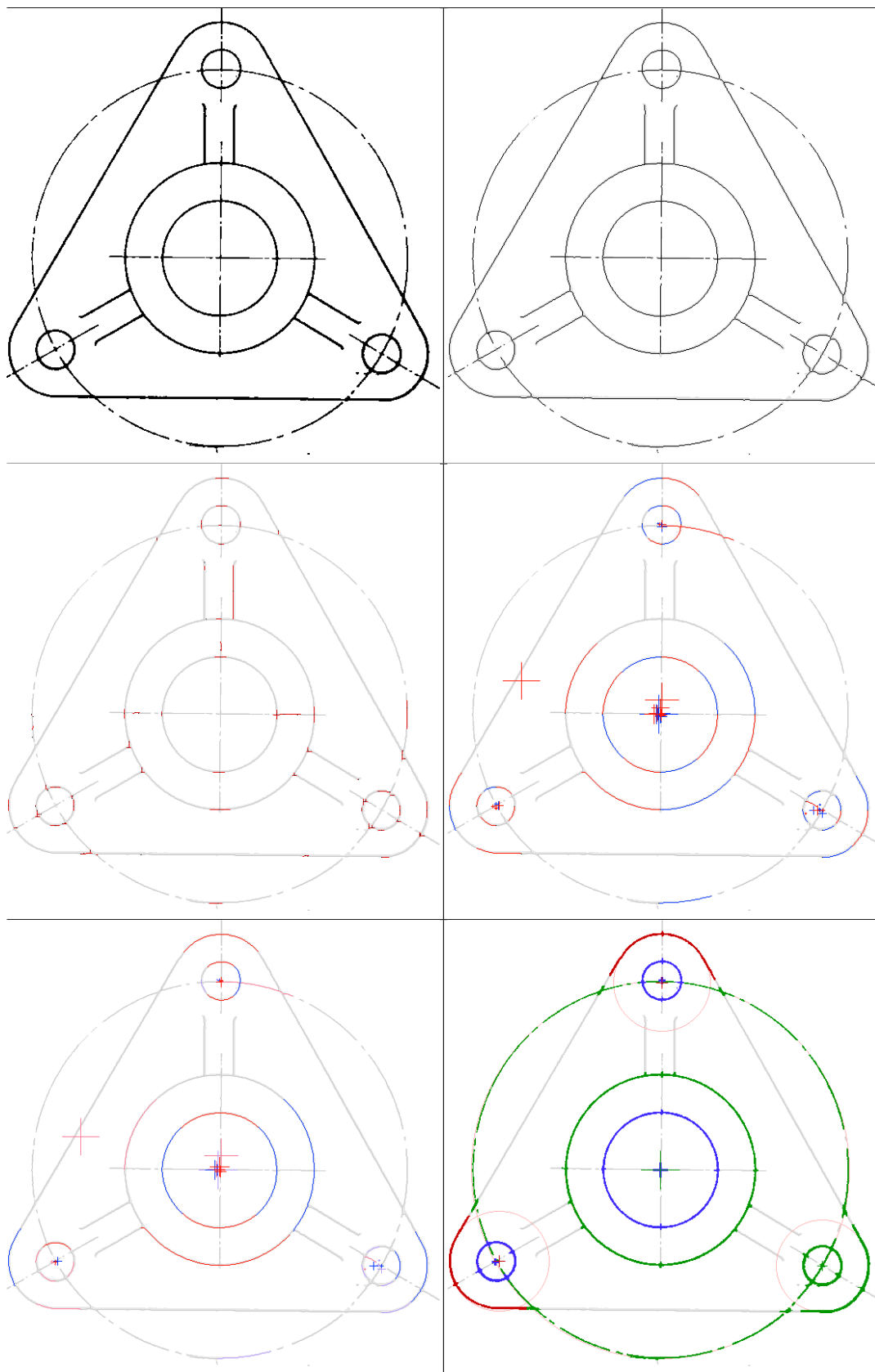
Step-by-step execution of by our algorithm on g-07-5.



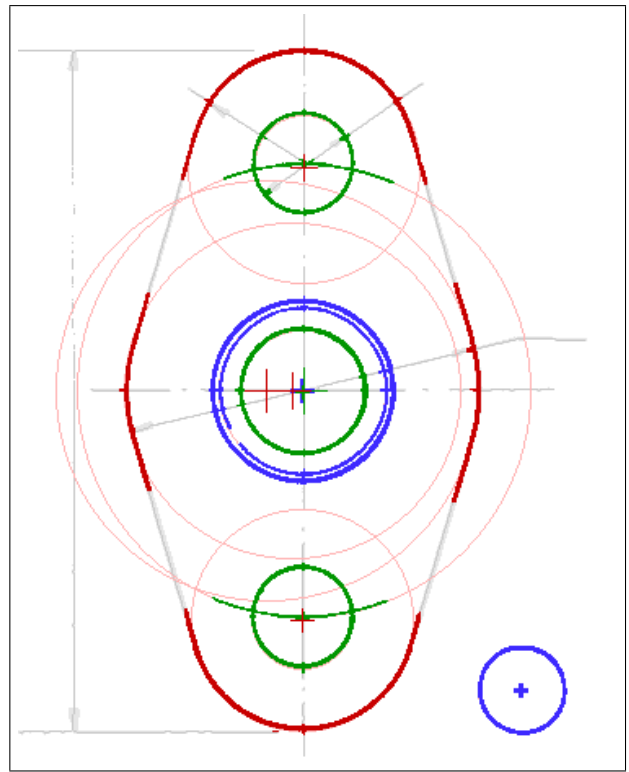
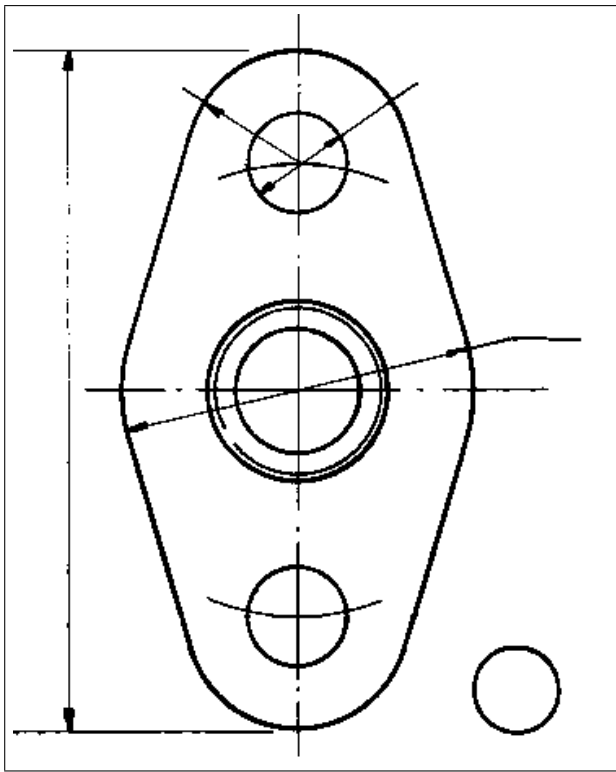
Step-by-step execution of by our algorithm on g-07-7.



Step-by-step execution of by our algorithm on P061-300dpi.

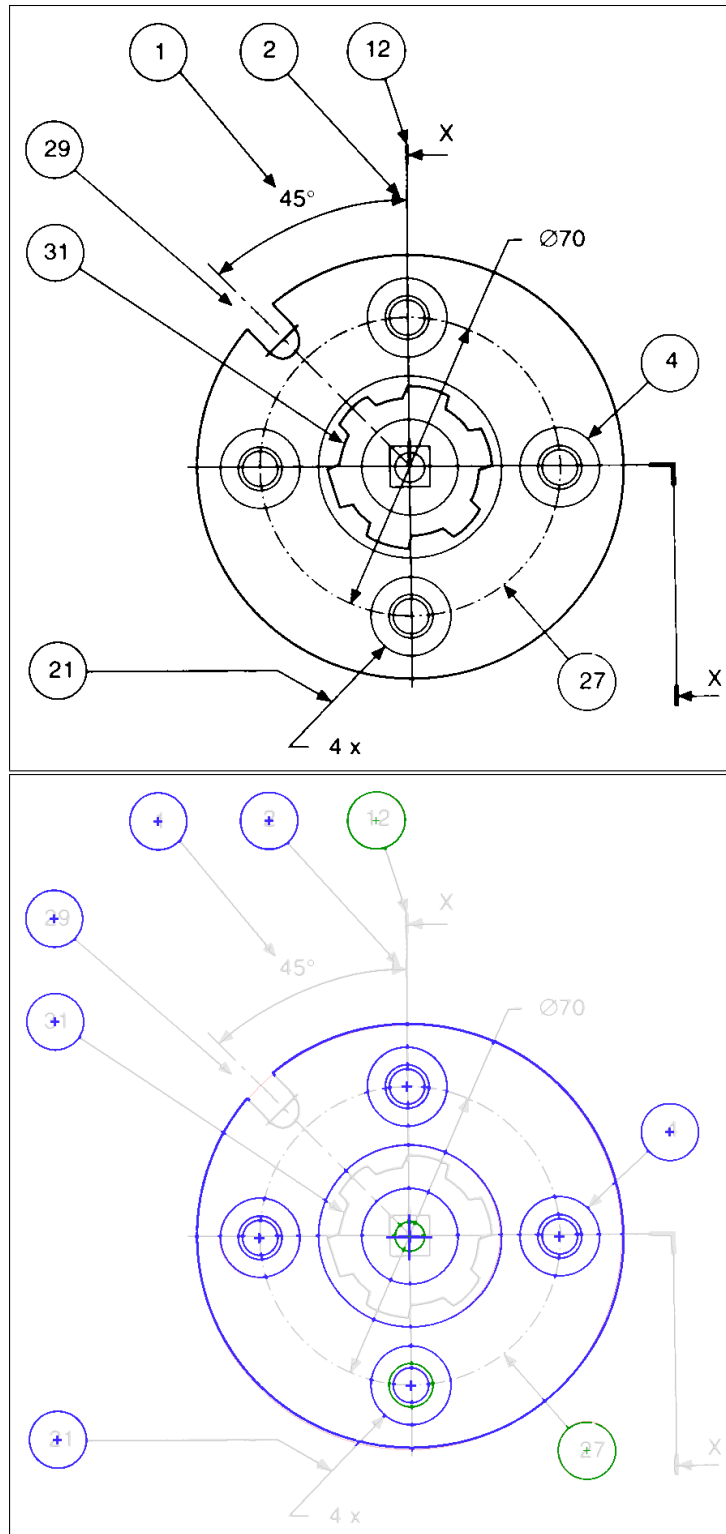


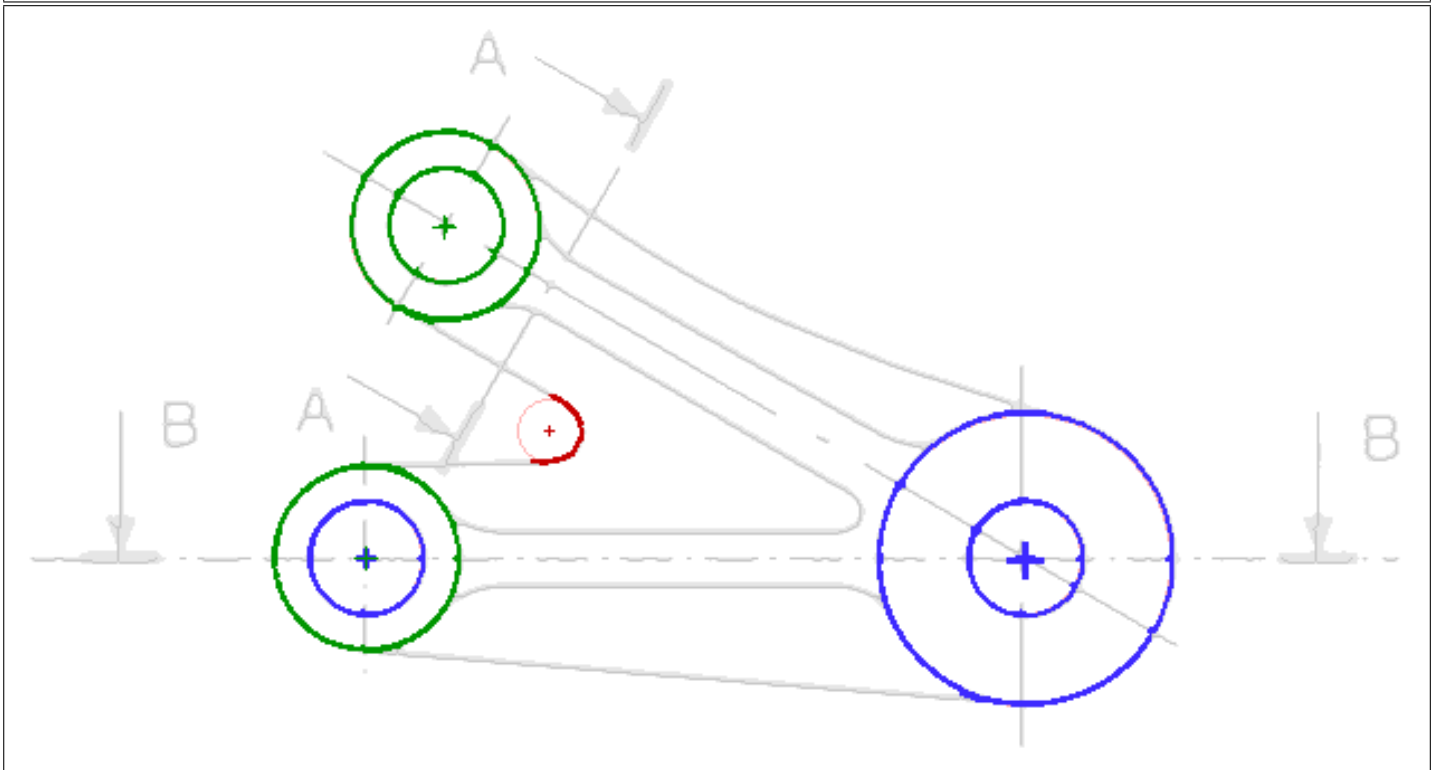
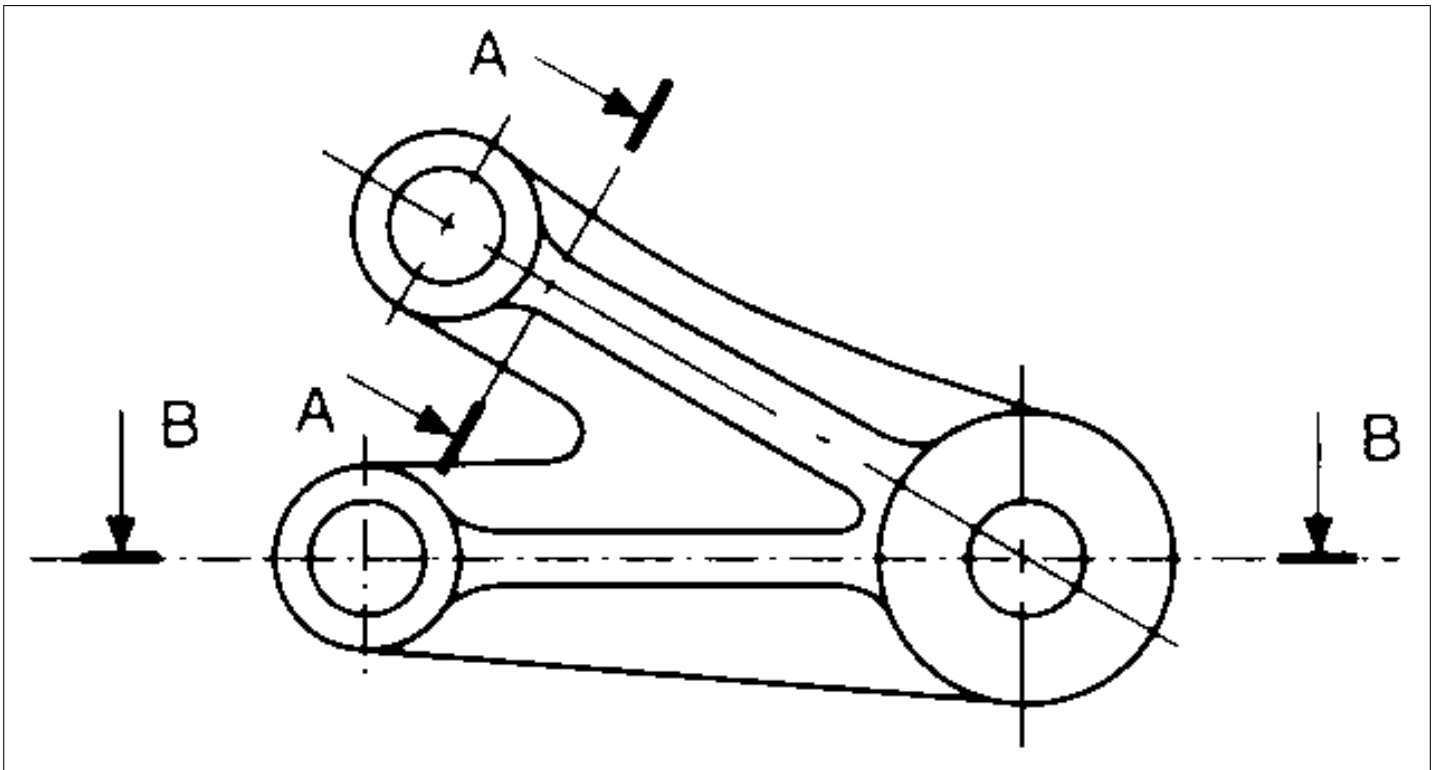
Step-by-step execution of by our algorithm on g-07-8.

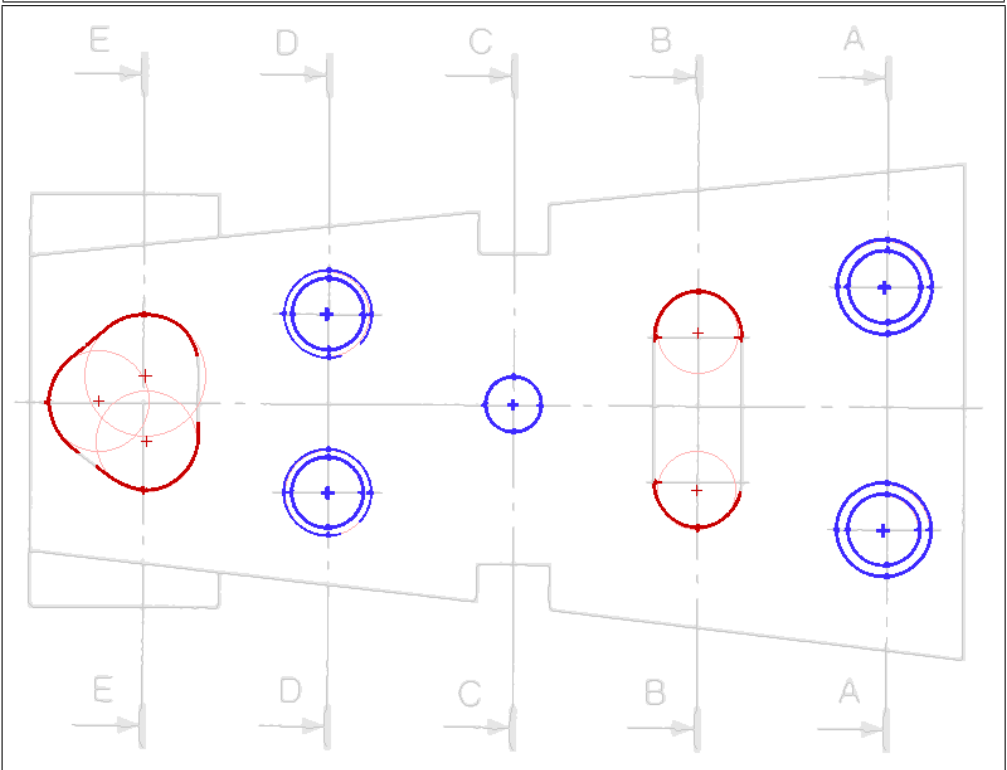
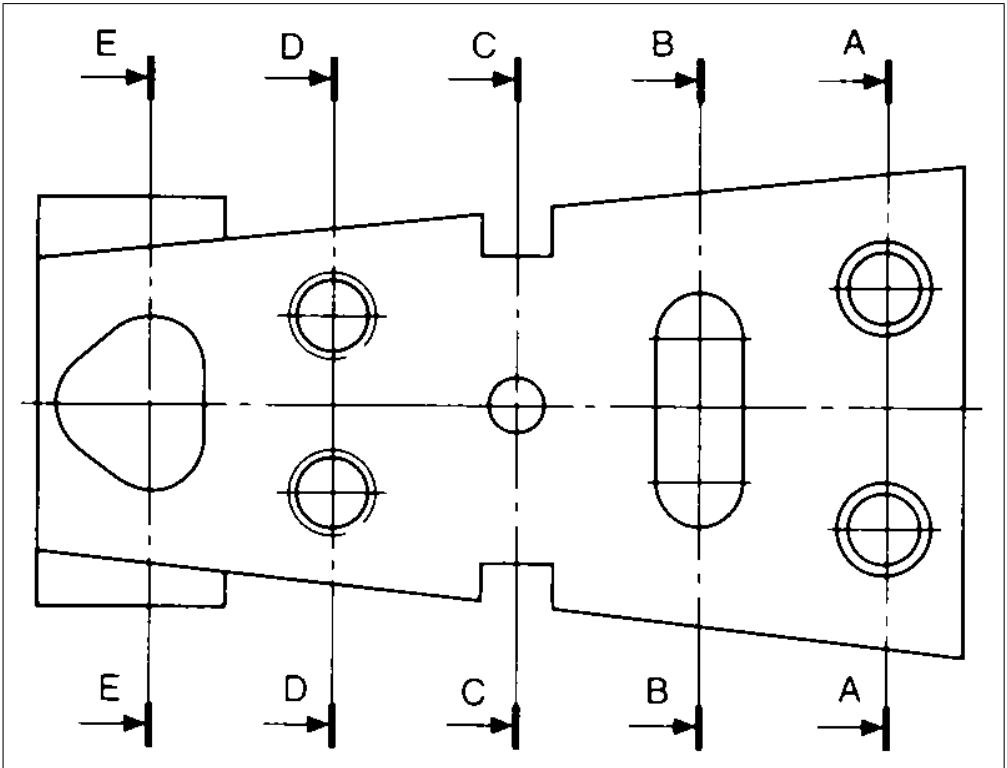


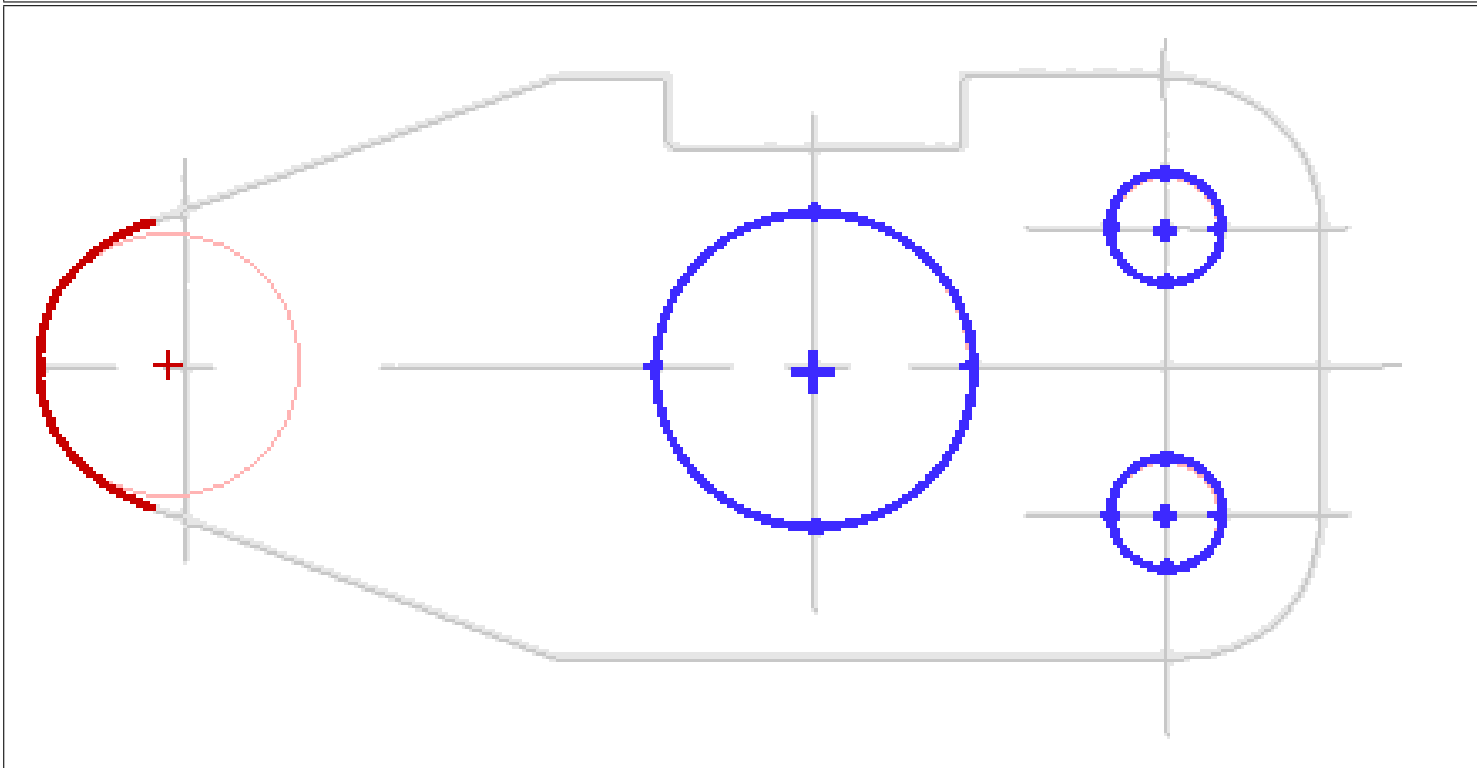
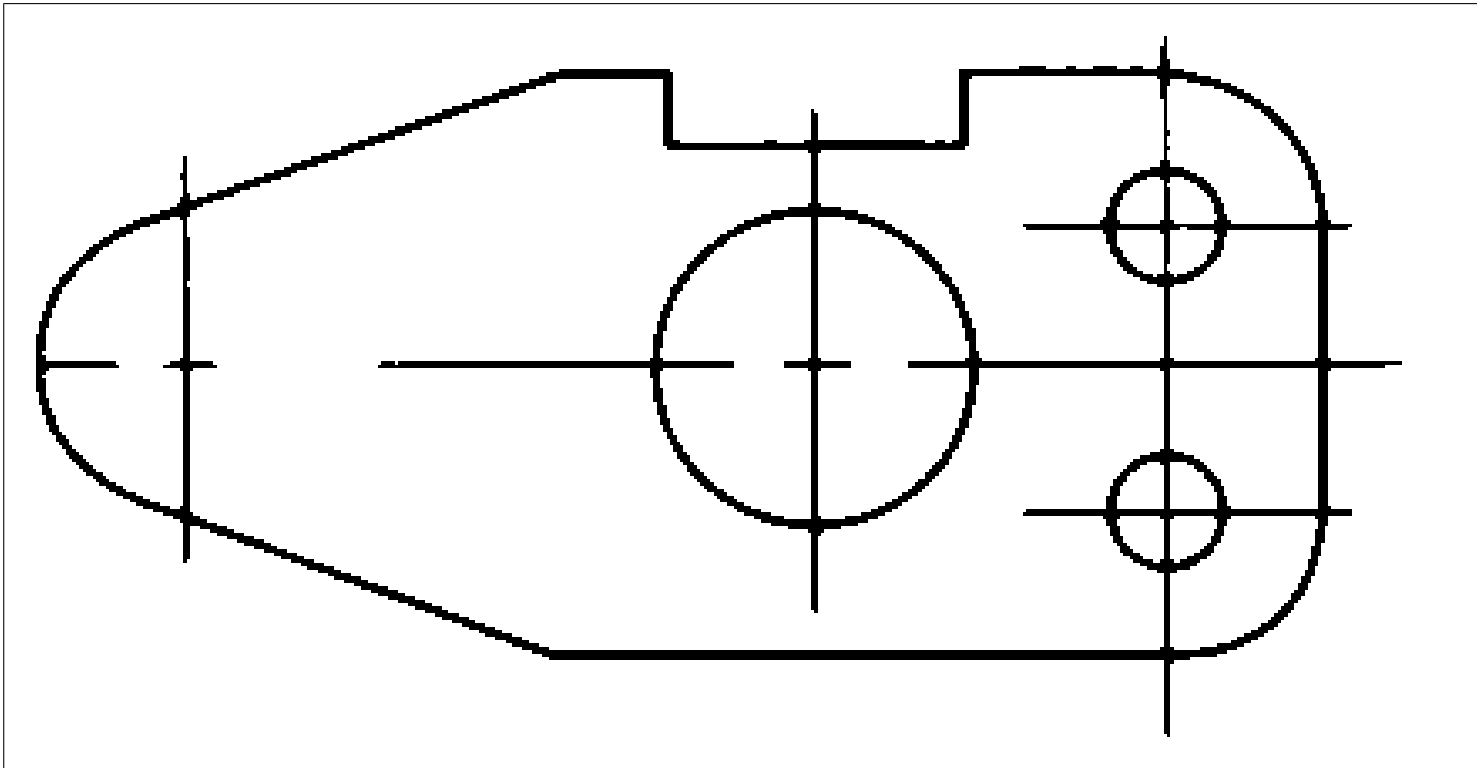
g03-t-1

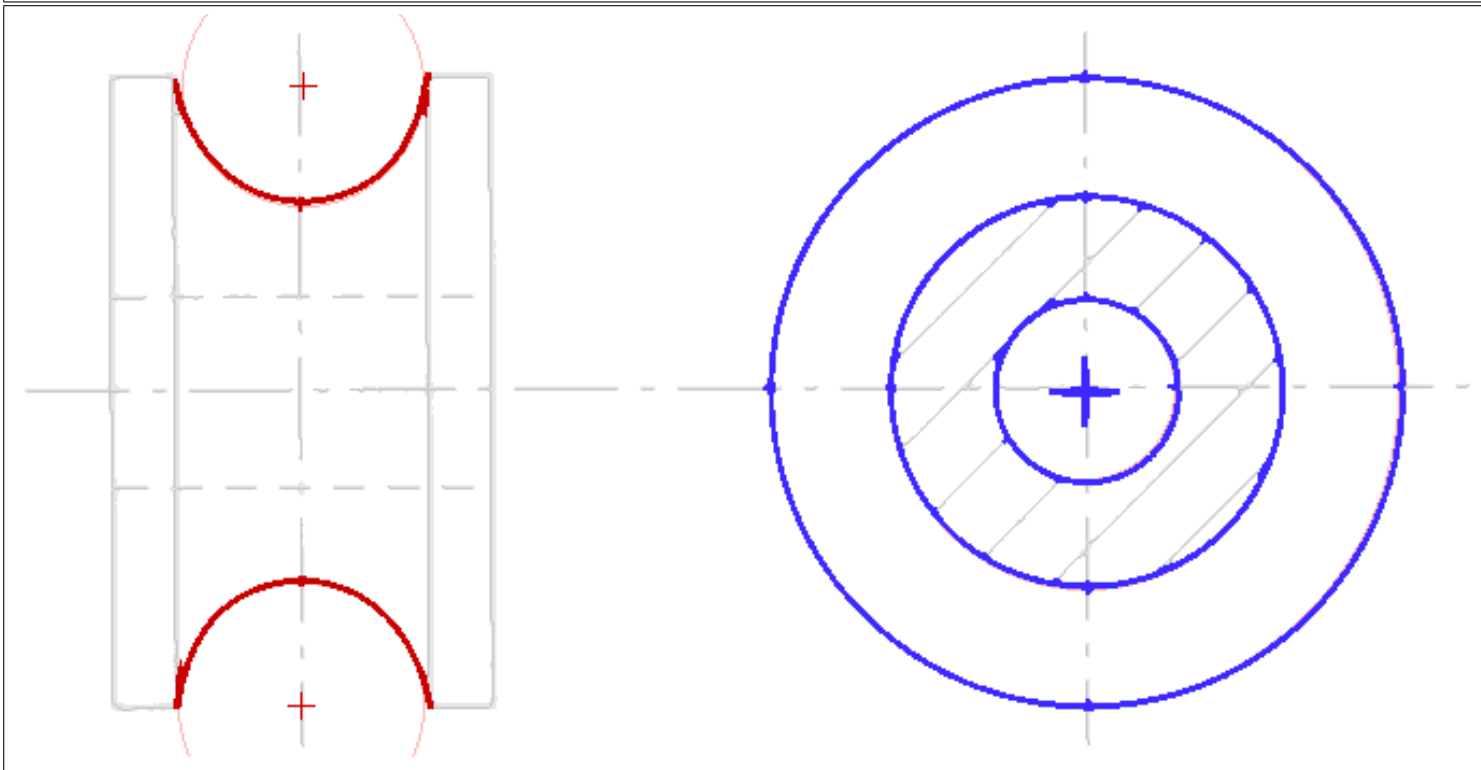
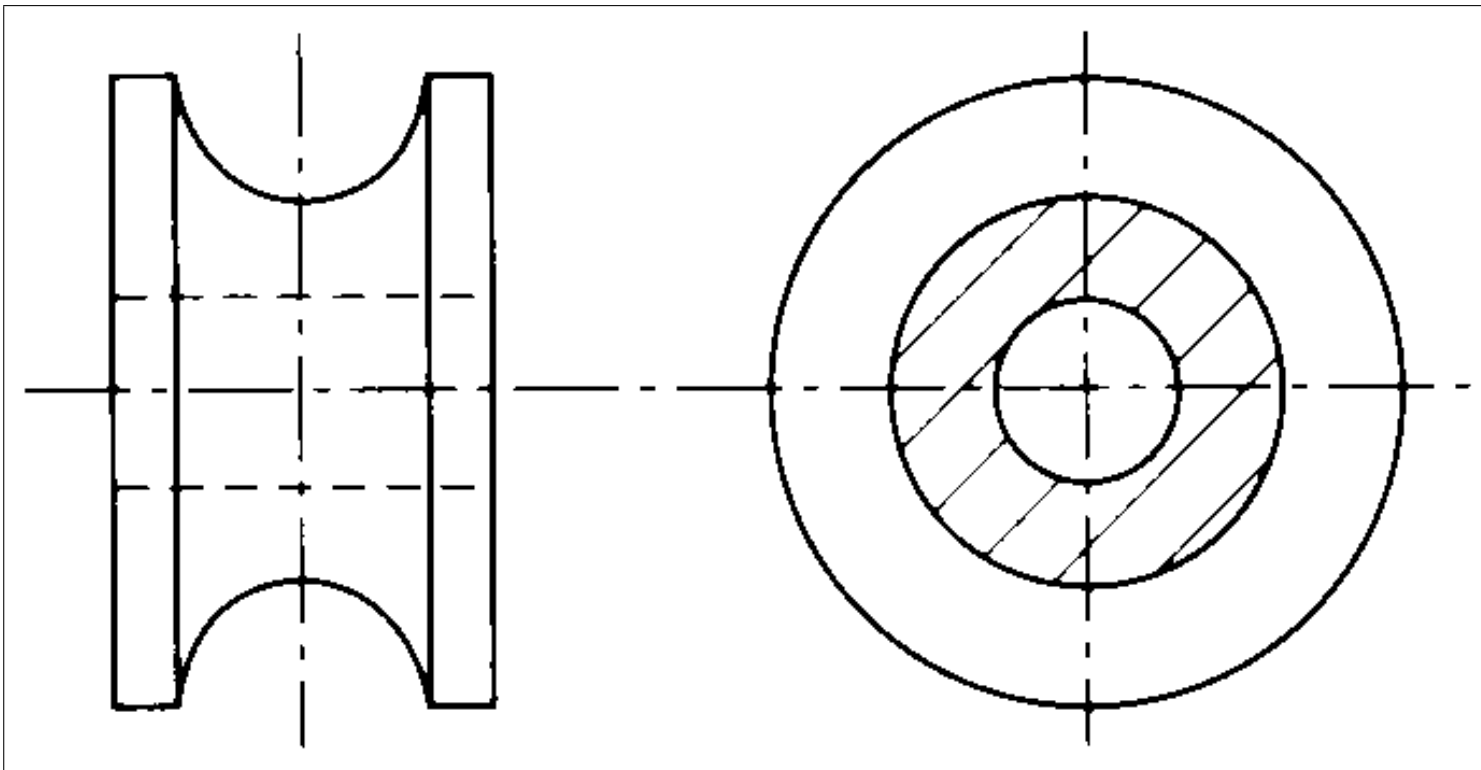
Results (input in black, output colored) of arc segmentation on some images from SMP dataset.

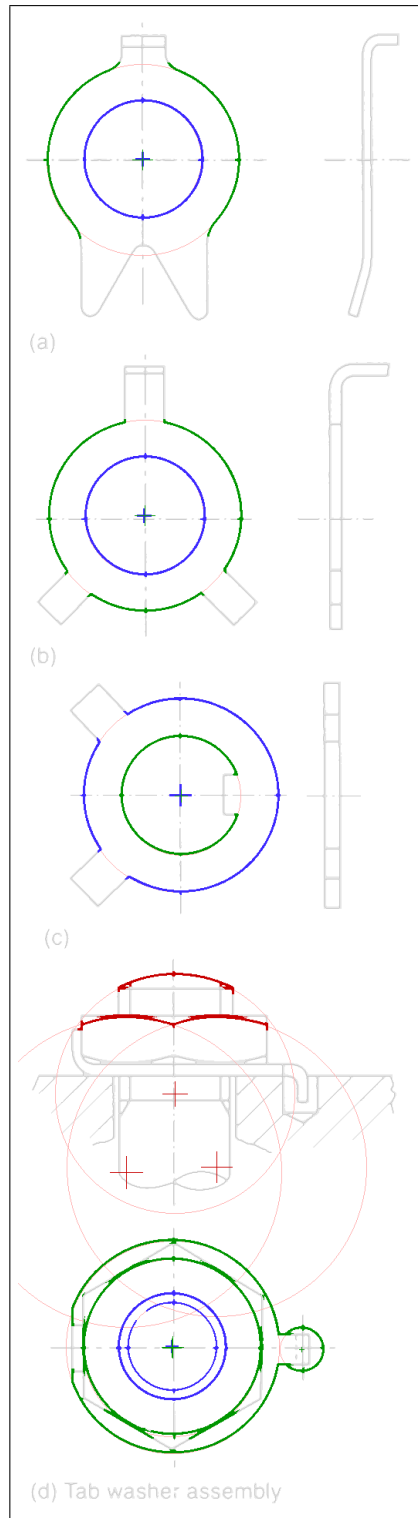
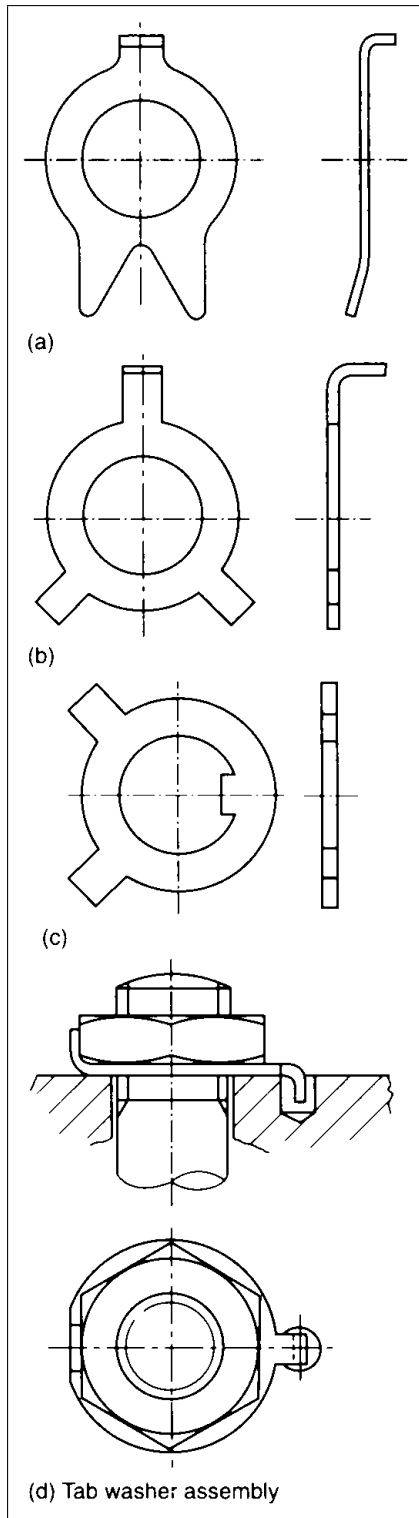


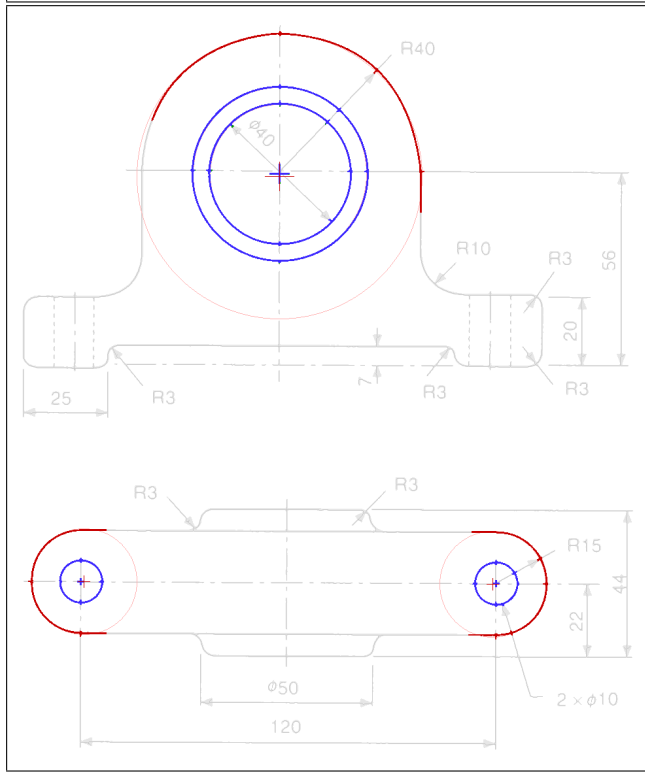
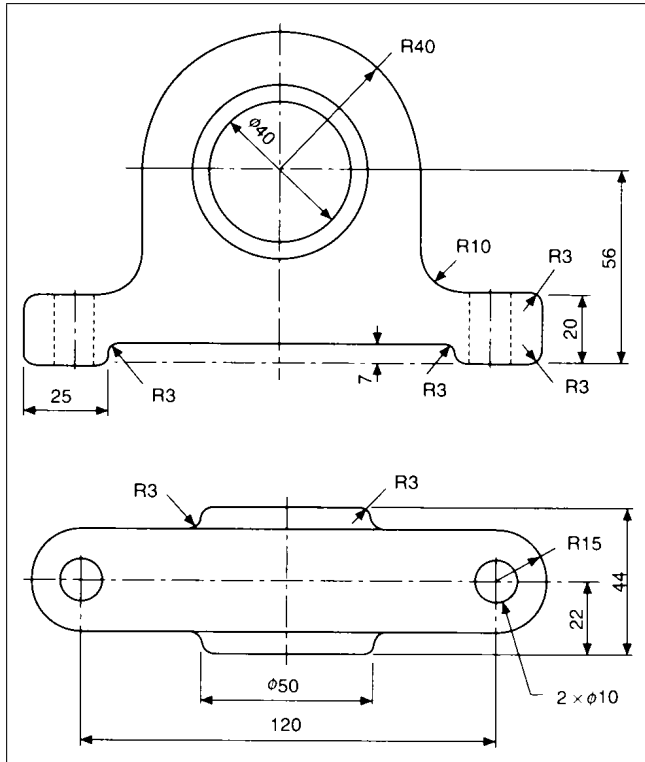


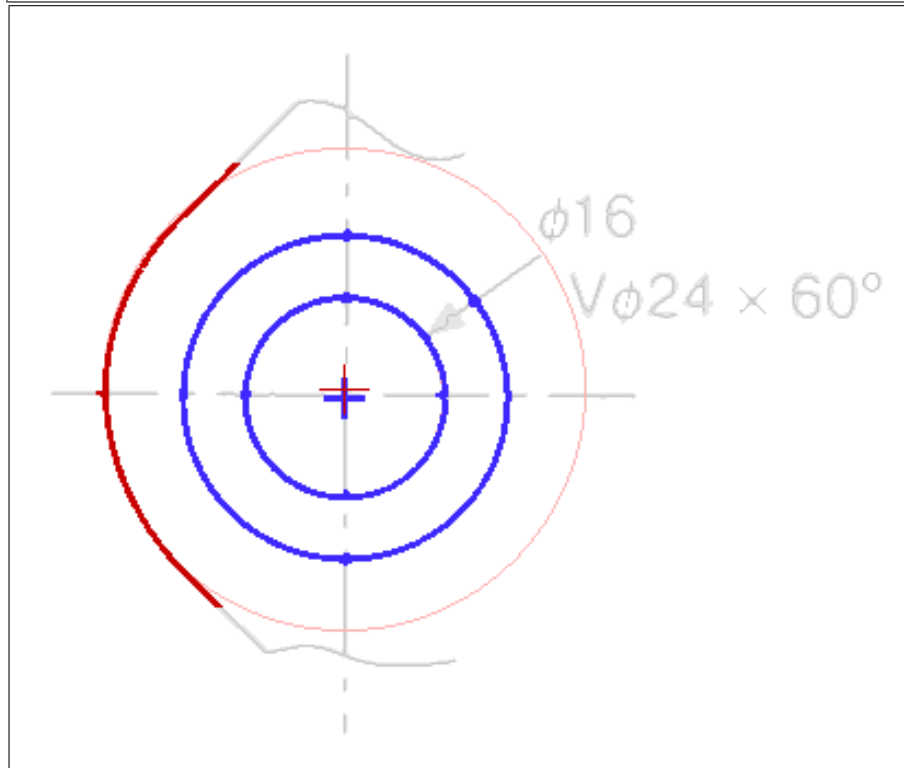
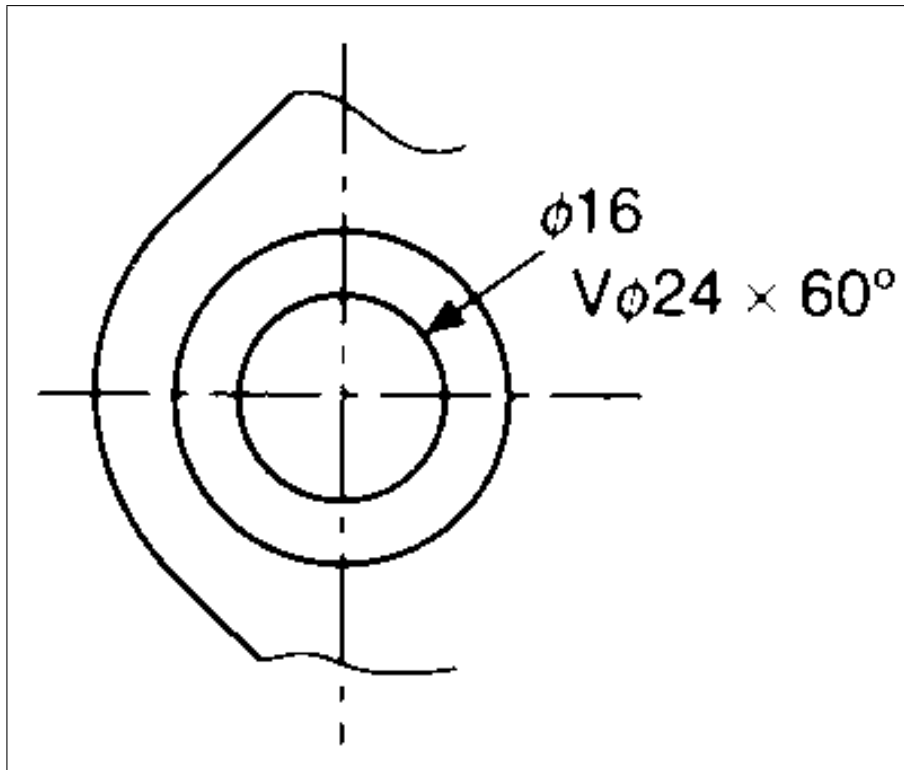


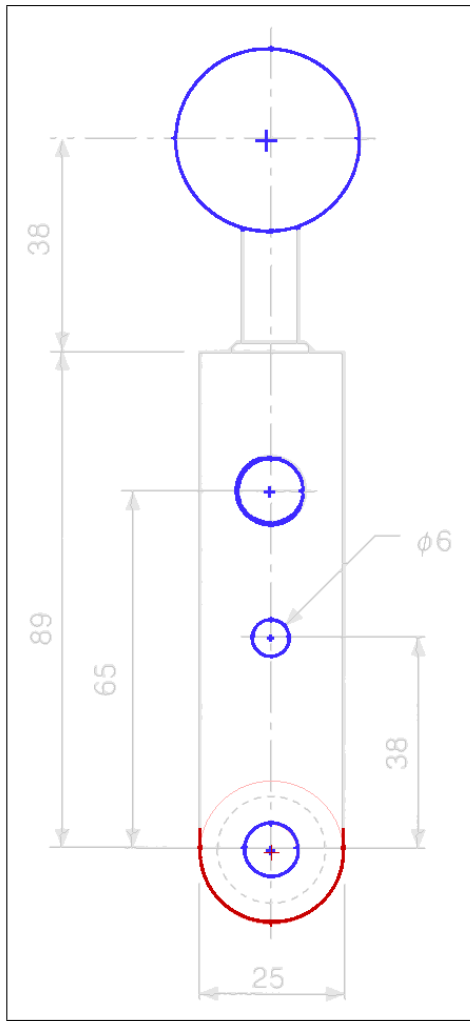
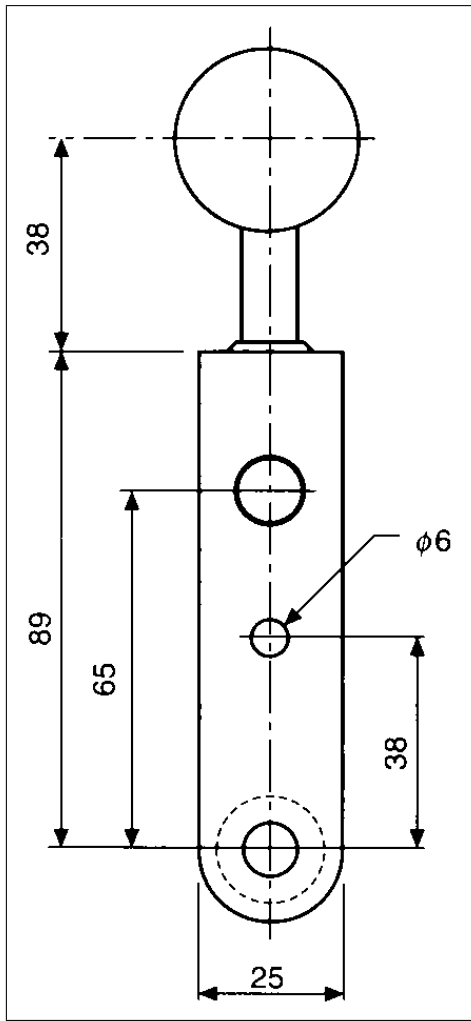


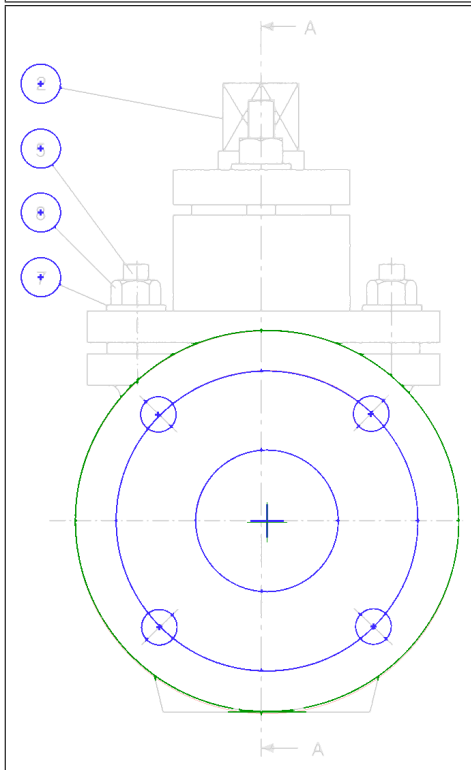
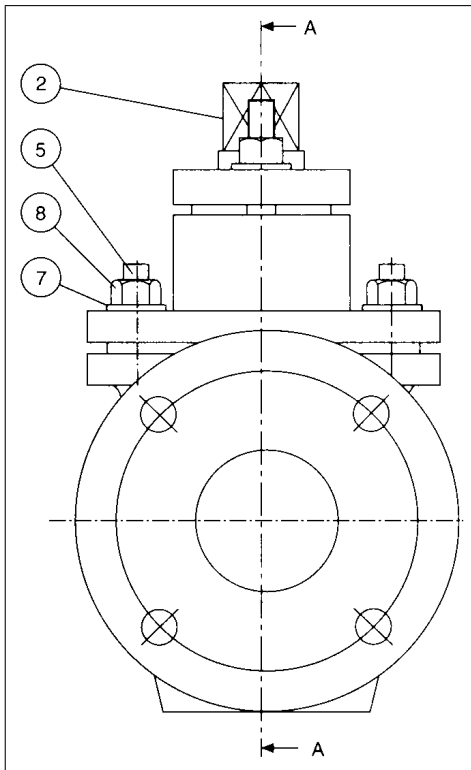


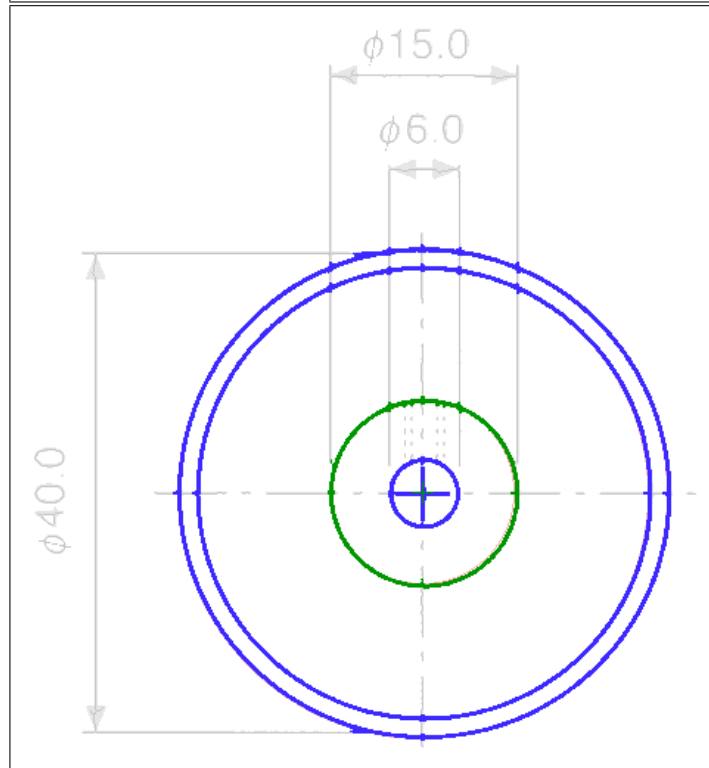
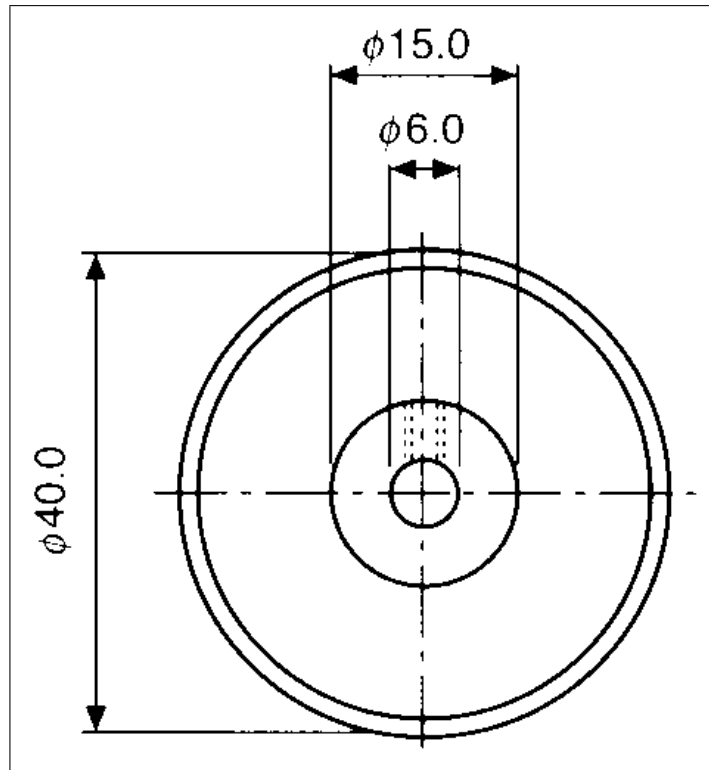


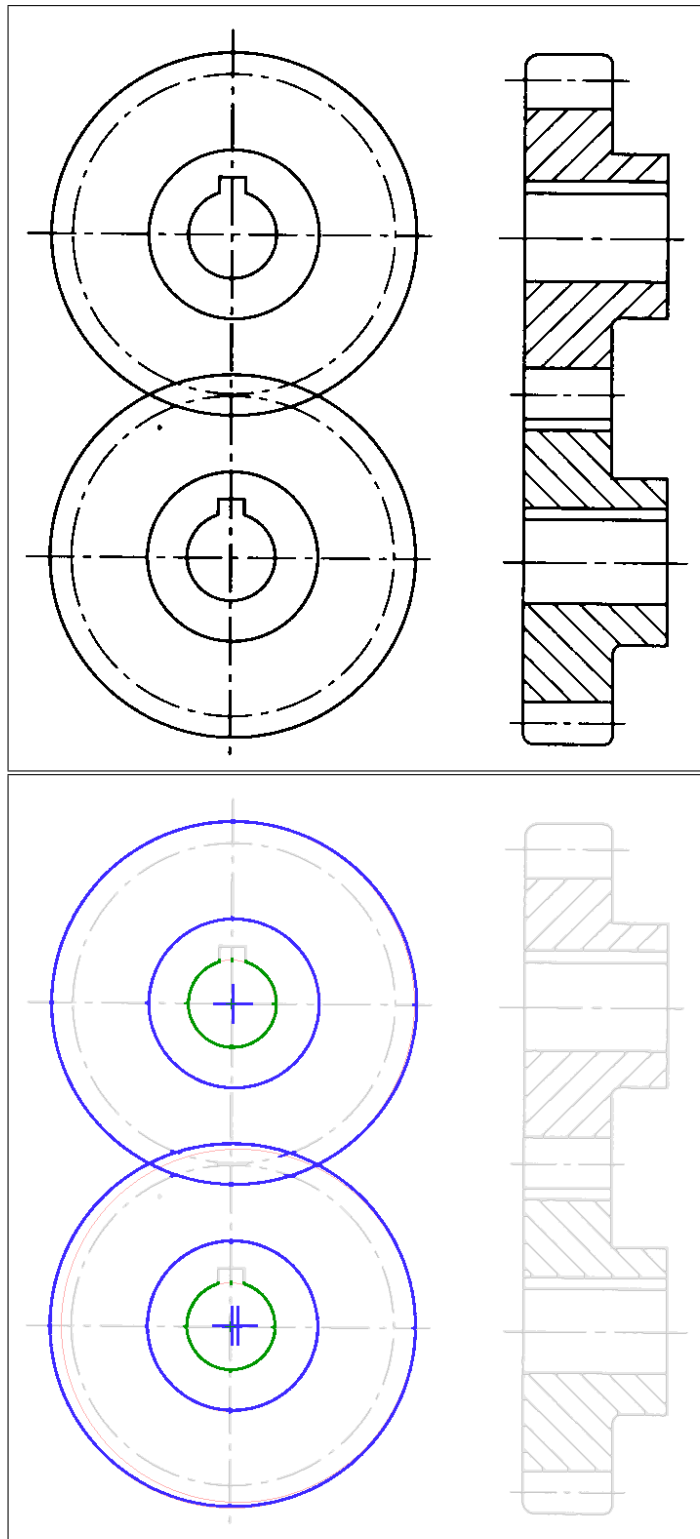


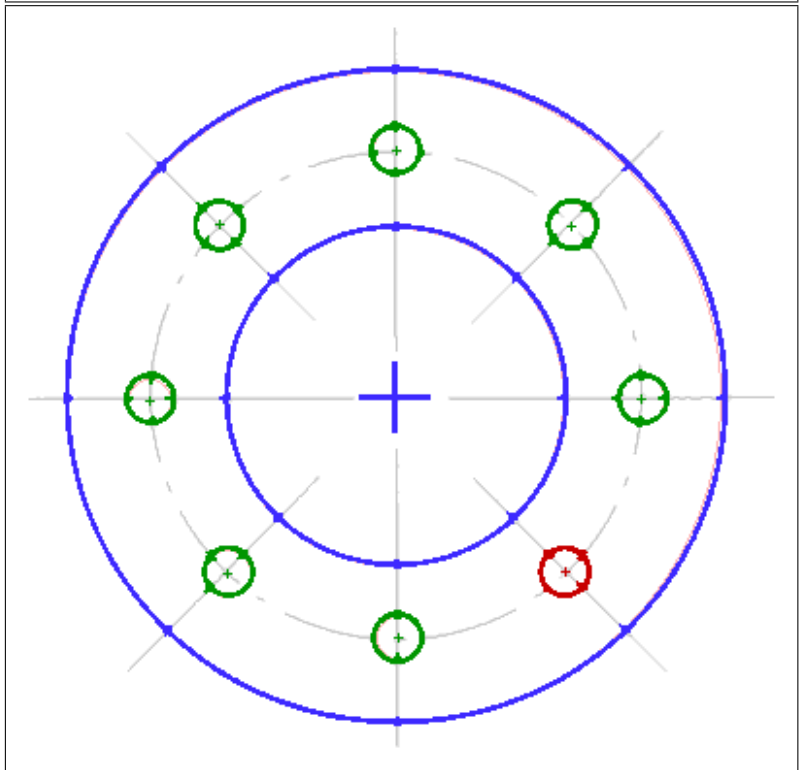
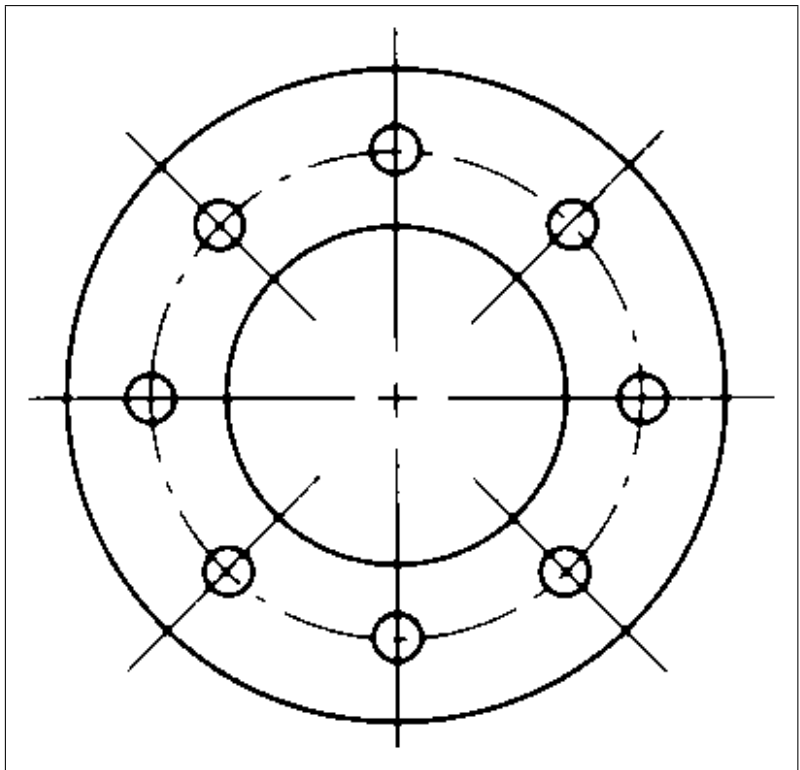


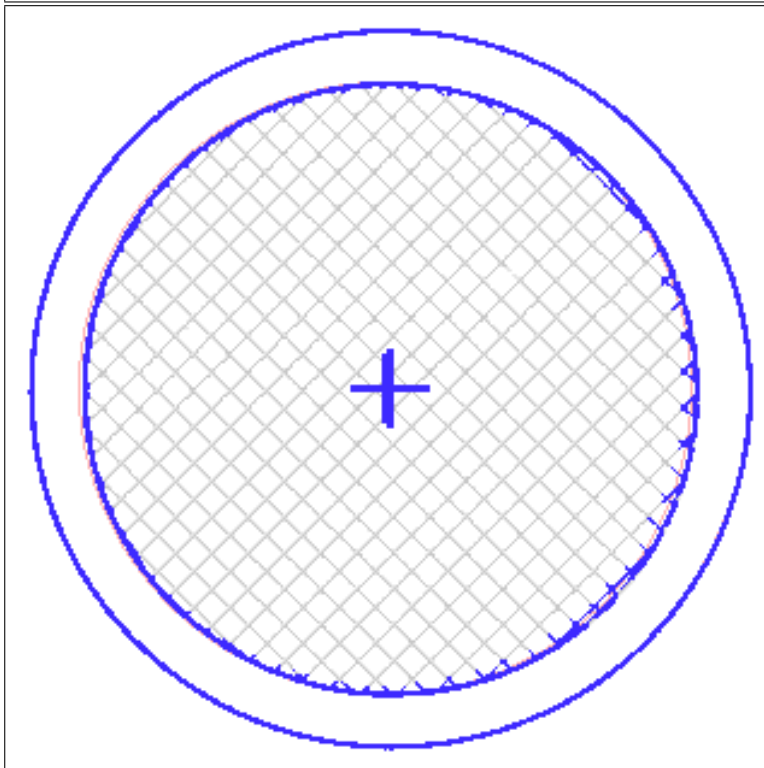
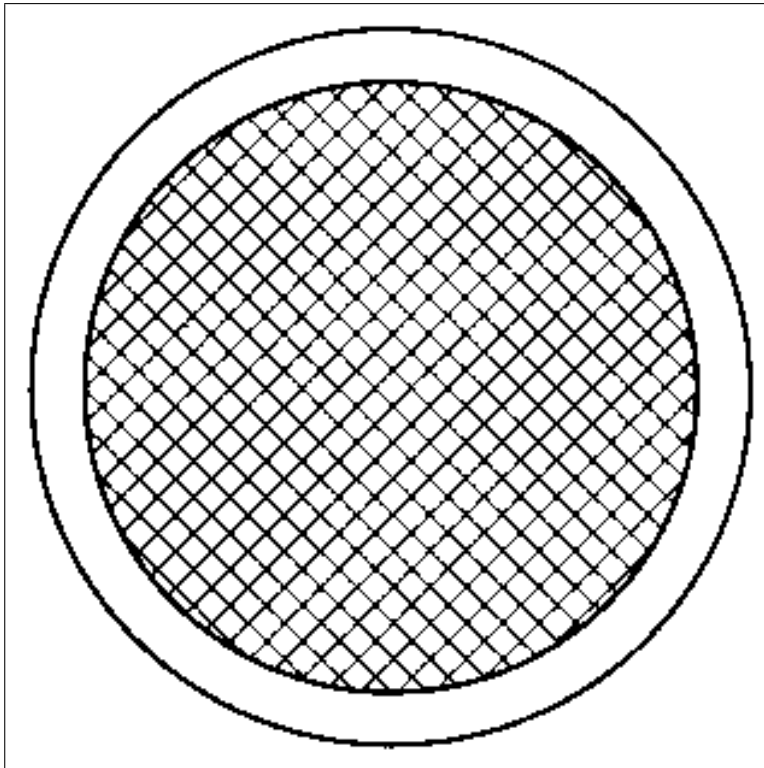


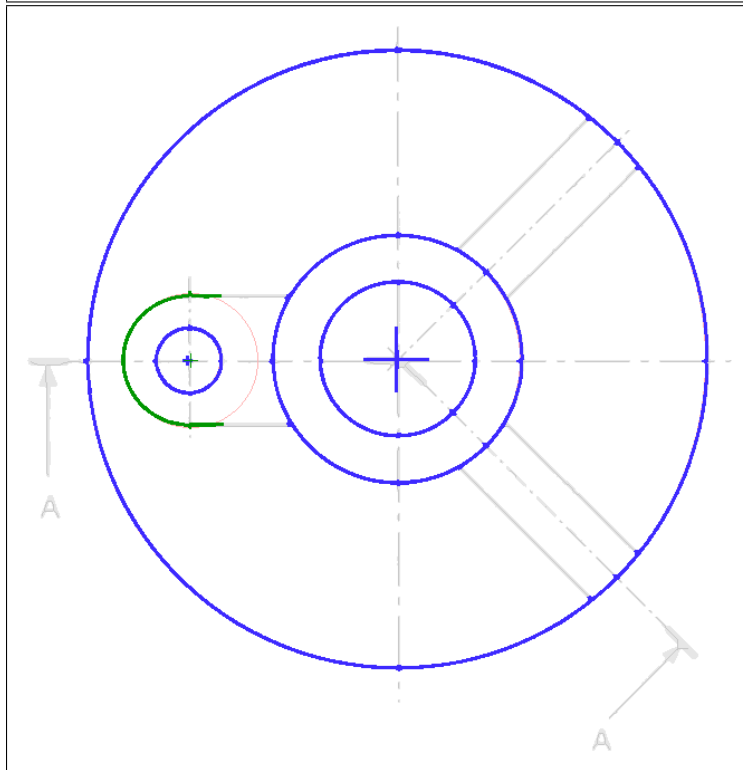
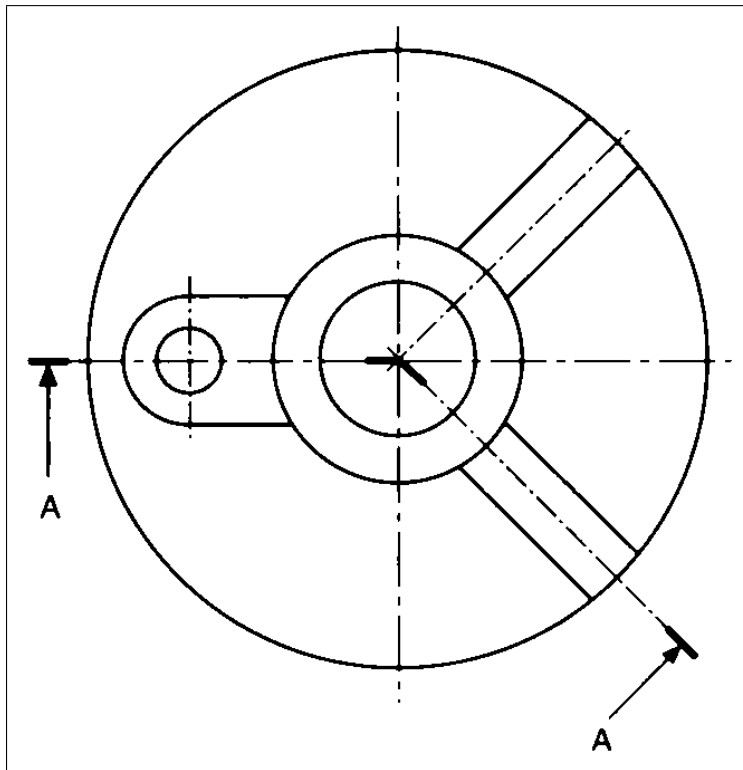






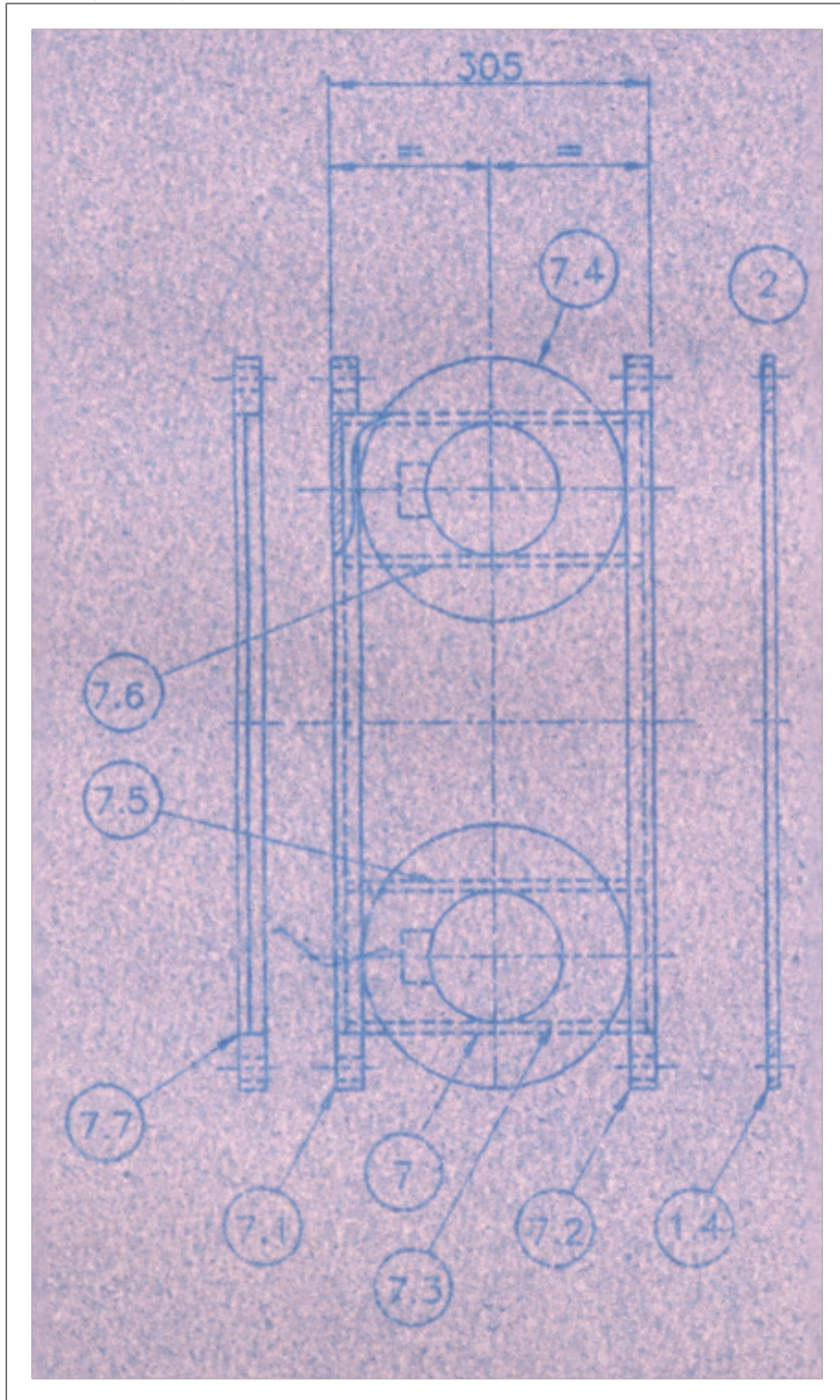


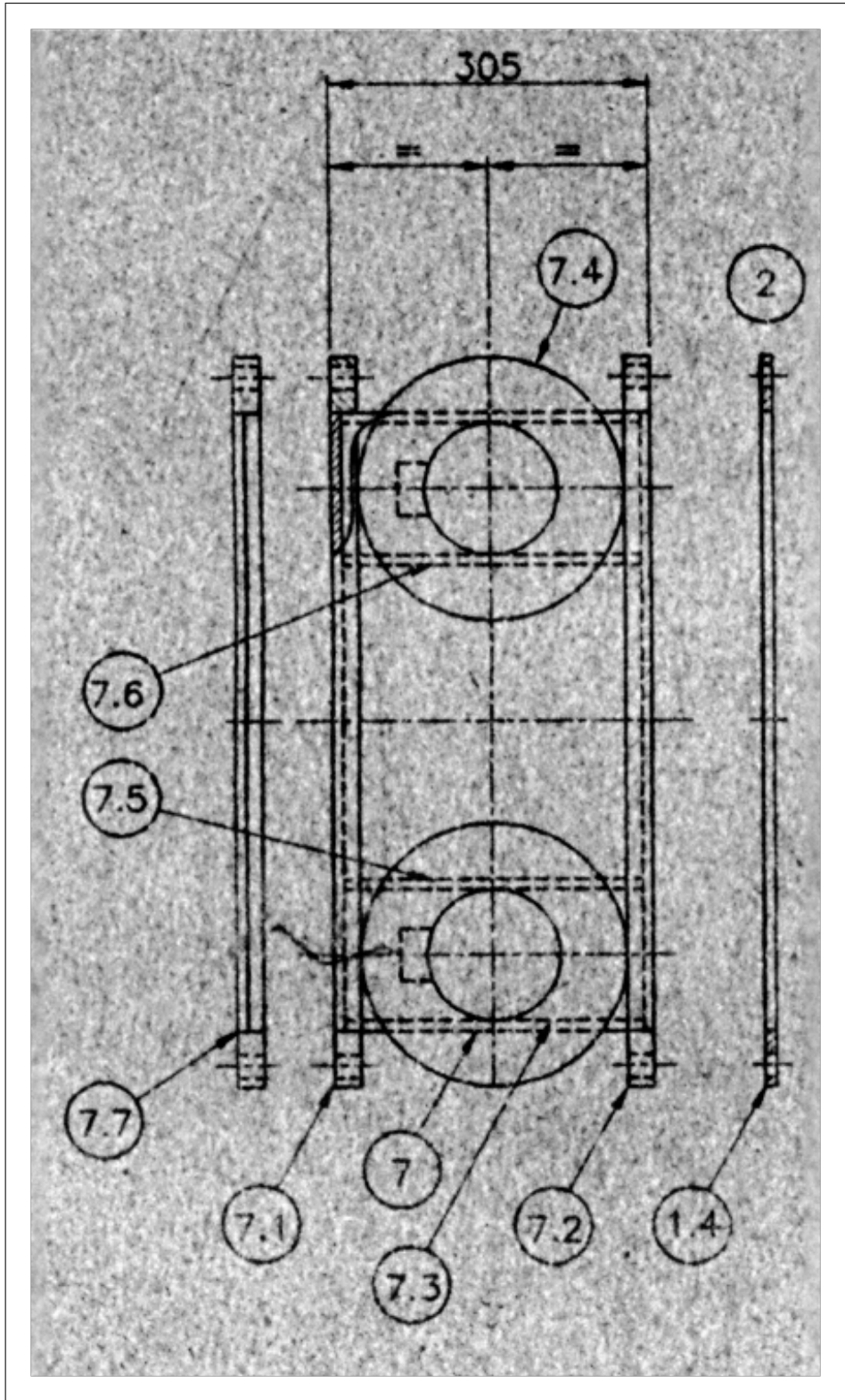


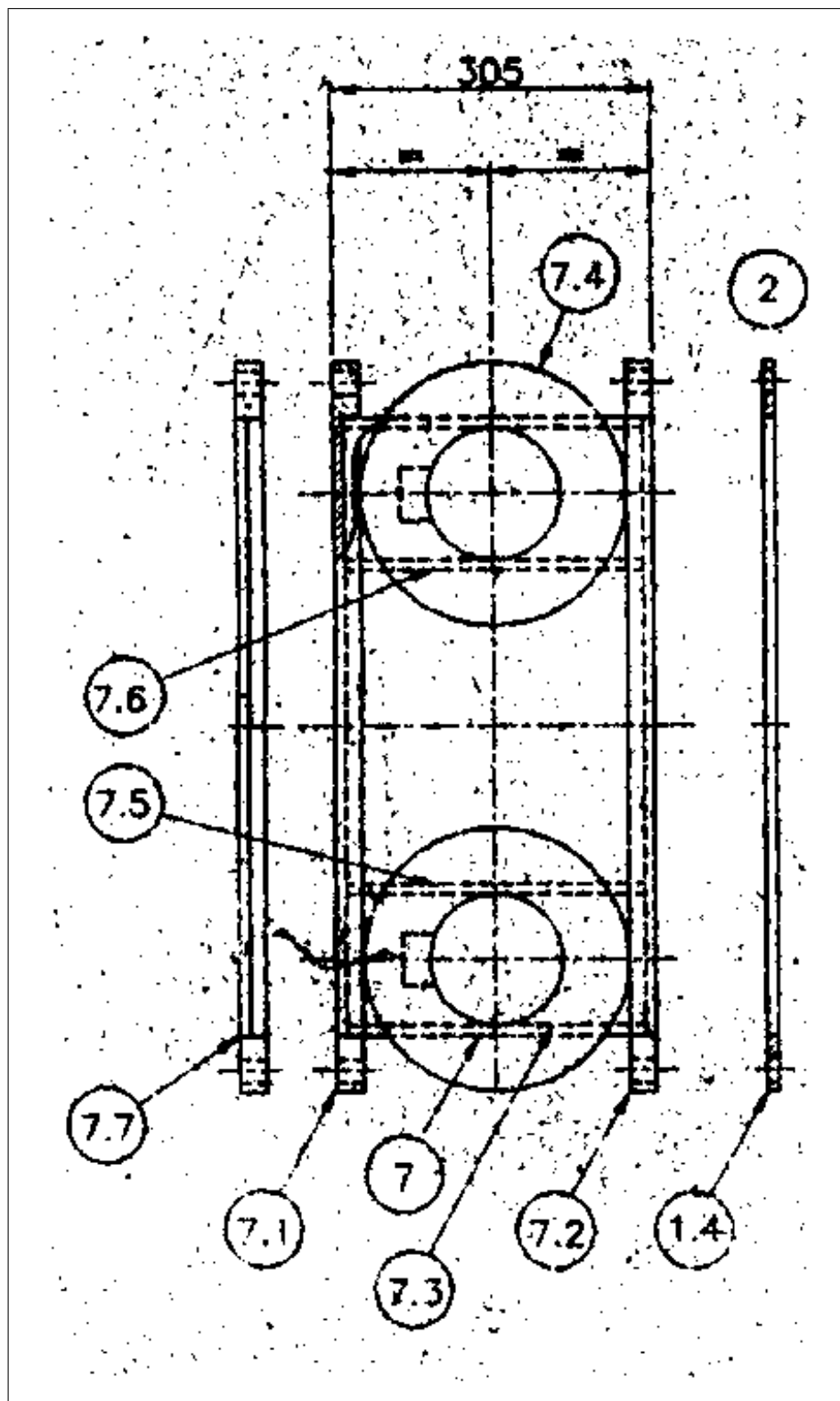


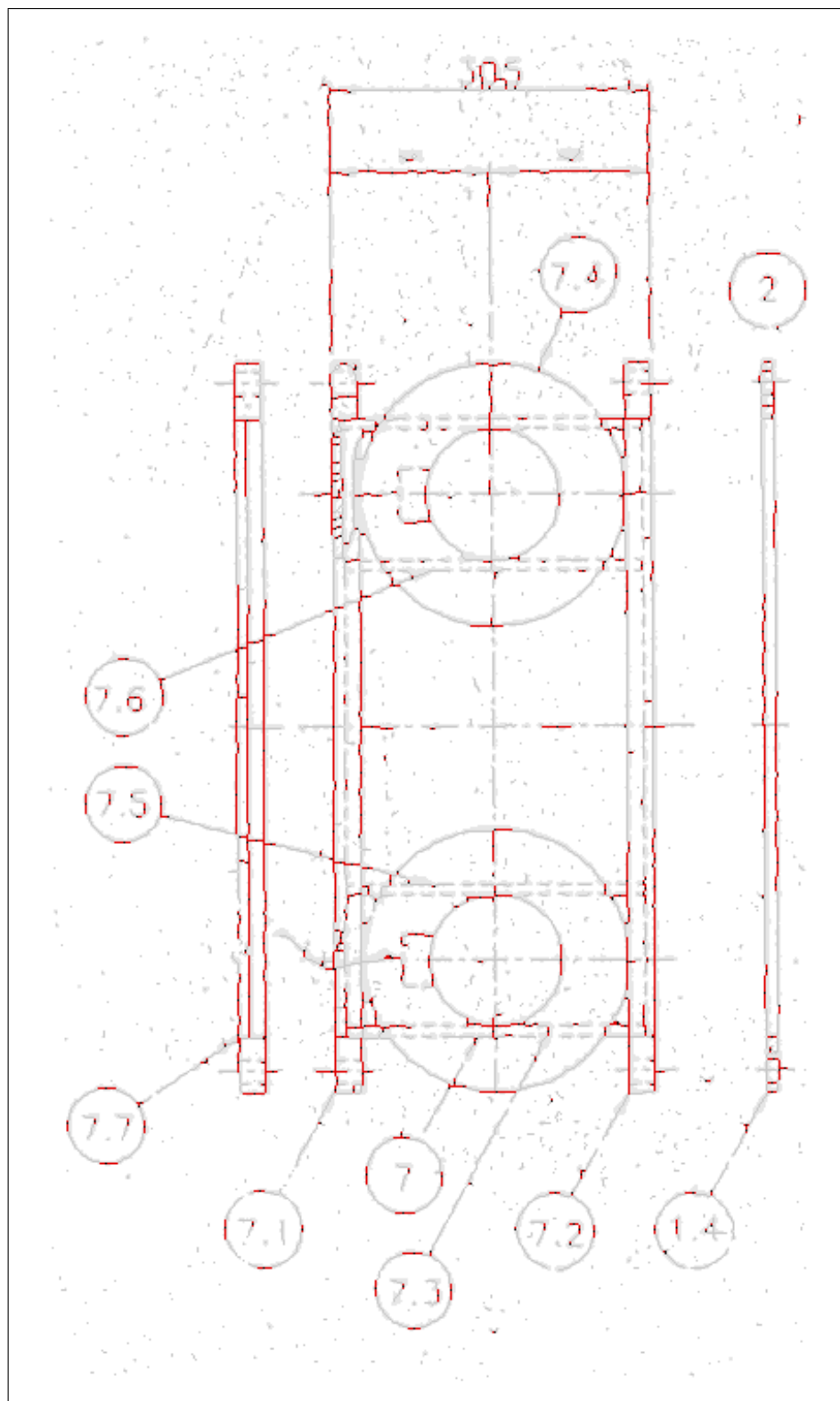
SAIL Dataset: Image 22514

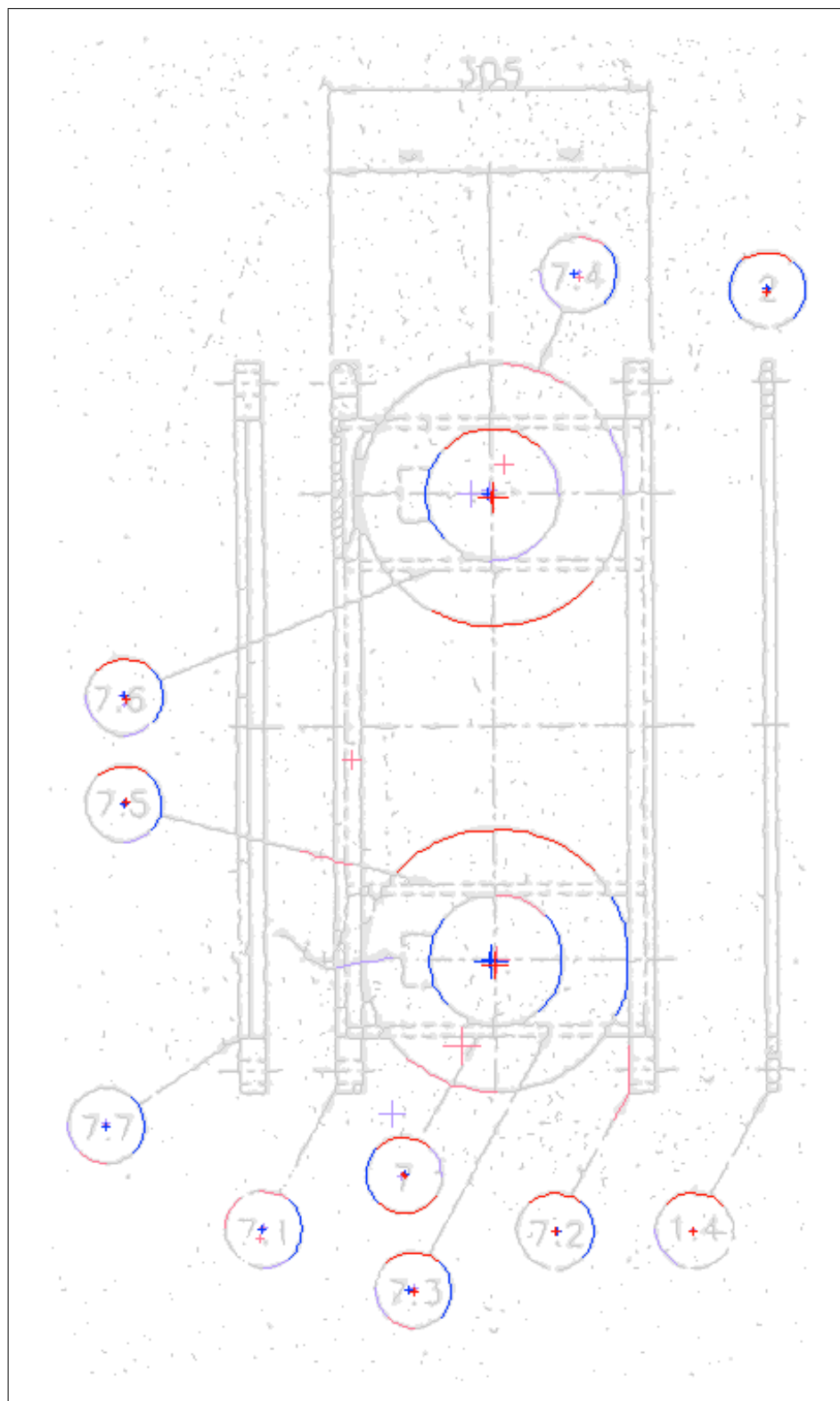
From top to bottom (6 pages): Input, gray-scale, binarized, extremum runs, paired arcs, final output.

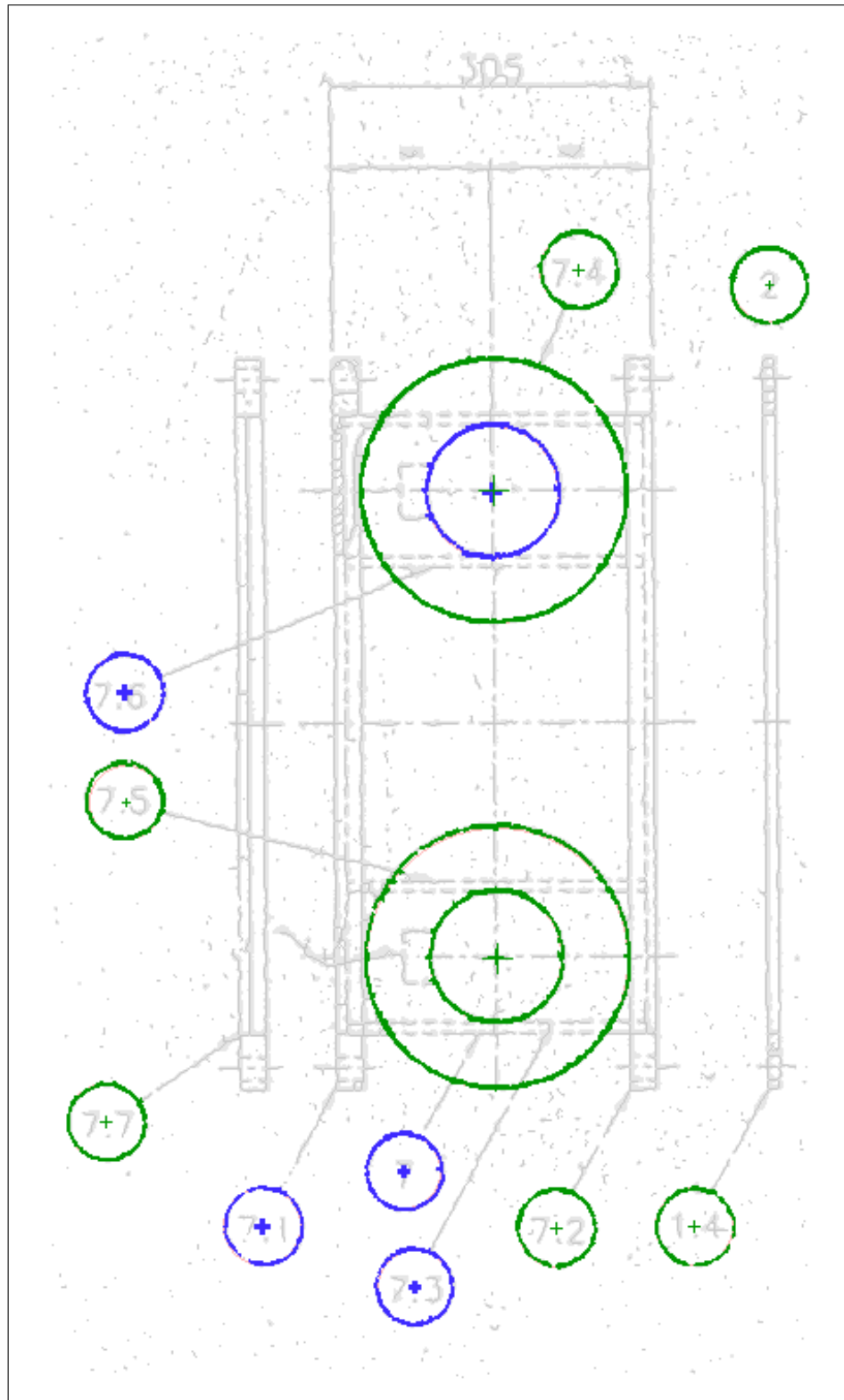






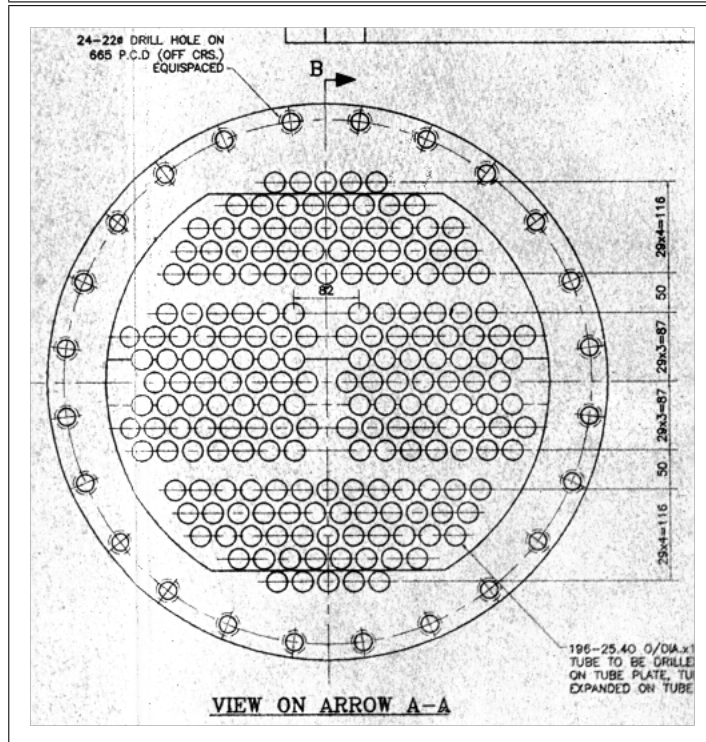
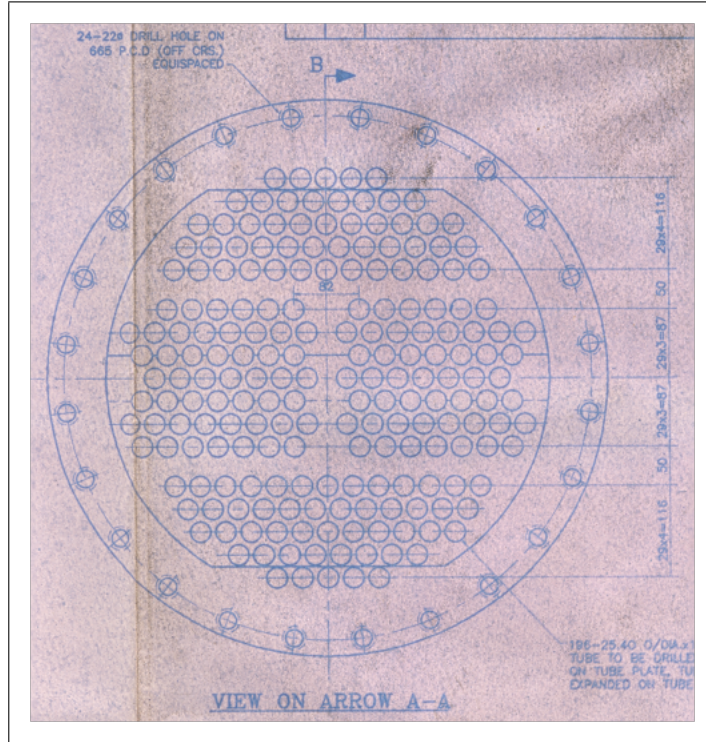


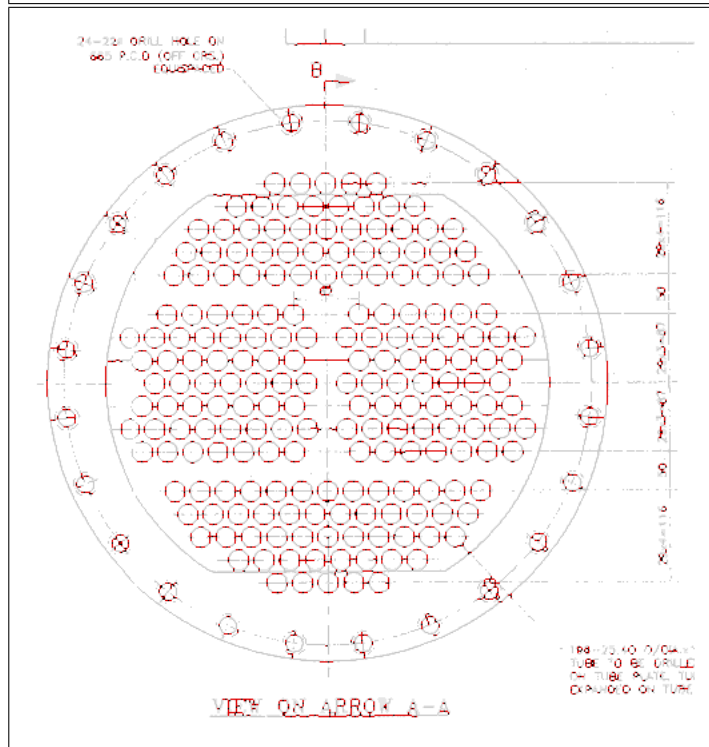
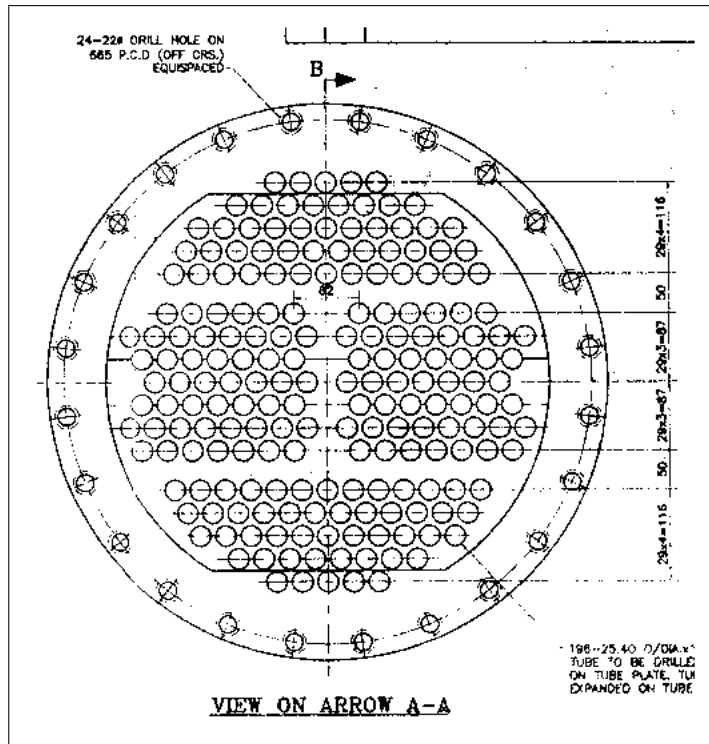


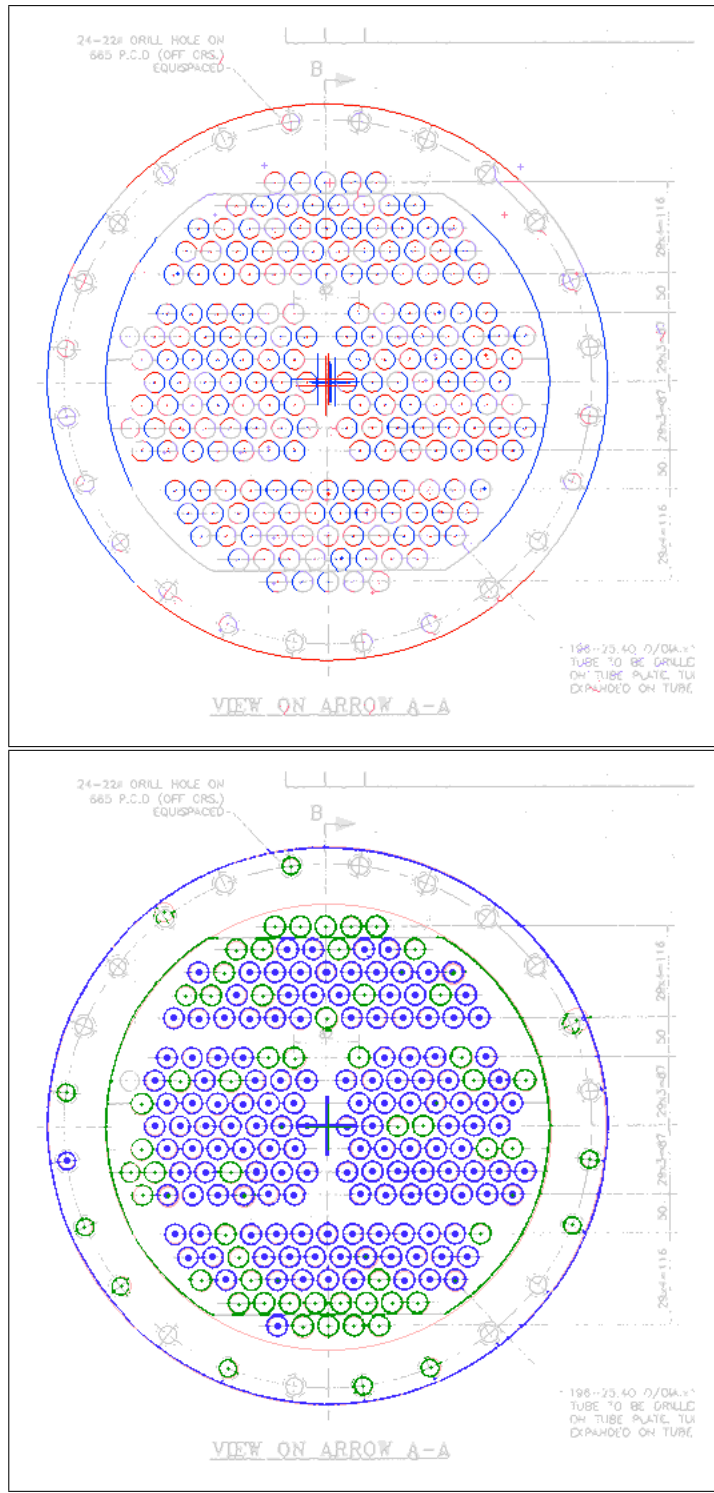


SAIL Dataset: Image 22513

From top to bottom (3 pages): Input, gray-scale, binarized, extremum runs, paired arcs, final output.







SAIL Dataset: Image 46787a

From top to bottom (6 pages): Input, gray-scale, binarized, extremum runs, paired arcs, final output.

