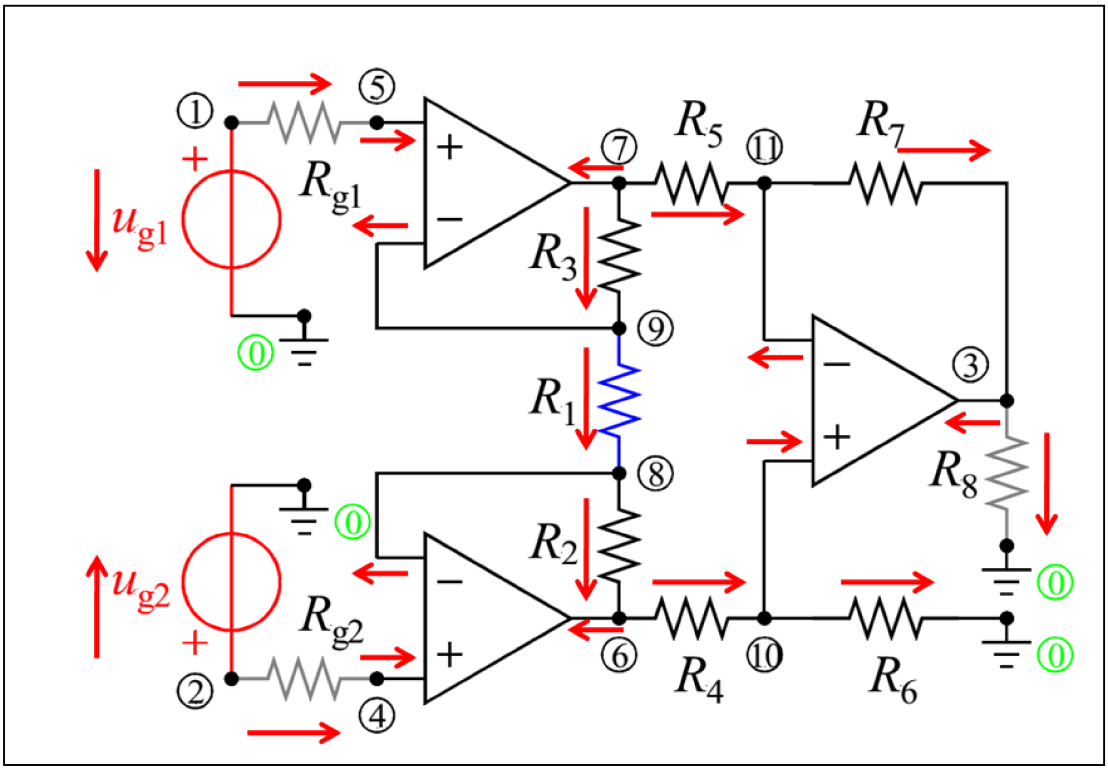
Figure 1: Инструментациони појачавач



```
(%i1) jednacine: [jg1 + (v1-v5)/Rg1 = 0,
                  v1 = ug1,
                 jg2 + (v2-v4)/Rg2 = 0,
                  v2 = ug2,
                  j3 + v3/R8 - (v11-v3)/R7 = 0,
                  -(v2-v4)/Rg2 + iul2 = 0,
                  -(v1-v5)/Rg1 + iul1 = 0,
                  j2 + (v6-v10)/R4 - (v8-v6)/R2 = 0,
                  j1 + (v7-v11)/R5 + (v7-v9)/R3 = 0,
                  -iul2 - (v9-v8)/R1 + (v8-v6)/R2 =0,
                  -iul1 - (v7-v9)/R3 + (v9-v8)/R1 = 0,
                  -(v6-v10)/R4 + v10/R6 + iul3 = 0,
                  -(v7-v11)/R5 + (v11-v3)/R7 - iul3 = 0,
                 iul1 = 0,
                 iul2 = 0,
                 iul3 = 0,
                 v5 = v9,
                 v4 = v8,
                 v10 = v11];
```

(%o1)

$$\left[\frac{v1-v5}{Rg1}+jg1=0,\ v1=ug1,\ \frac{v2-v4}{Rg2}+jg2=0,\ v2=ug2,\ \frac{v3-v11}{R7}+\frac{v3}{R8}+j3=0,\ \frac{v4-v2}{Rg2}+iul2=0,\ \frac{v5-v1}{Rg1}+iul1=0,\ \frac{v6-v8}{R2}+\frac{v6-v10}{R4}+j2=0,\ \frac{v7-v9}{R3}+\frac{v7-v11}{R5}+j1=0,\ -\frac{v9-v8}{R1}+\frac{v8-v6}{R2}-iul2=0,\ \frac{v9-v8}{R1}-\frac{v7-v9}{R3}-iul1=0,\ \frac{v10-v6}{R4}+\frac{v10}{R6}+iul3=0,\ \frac{v11-v7}{R5}+\frac{v11-v3}{R7}-iul3=0,\ iul1=0,\ iul2=0,\ iul3=0,\ v5=v9,\ v4=v8,\ v10=v11\right]$$

```
(%i2) promenljive: [v1, v2, v3, v4, v5, v6, v7, v8, v9, v10, v11,
                    j1, j2, j3, iul1, iul2, iul3, jg1, jg2];
```

(%o2) $[v1, v2, v3, v4, v5, v6, v7, v8, v9, v10, v11, j1, j2, j3, iul1, iul2, iul3, jg1, jg2]$

(%i3) `odziv: linsolve(jednacine, promenljive);`

(%o3)
$$[v1=ug1,\ v2=ug2,\ v3=-((-R3\,R6-R2\,R6-R1\,R6-R3\,R4)\,R7-R2\,R5\,R6-R1\,R5\,R6)\,ug2+((R3\,R6+R2\,R6+R1\,R6+(R3+R1)\,R4)\,R7+R2\,R5\,R6)\,ug1)/(R1\,R5\,R6+R1\,R4\,R5),\ v4=ug2,\ v5=ug1,\ v6=-\frac{(-R2-R1)\,ug2+R2\,ug1}{R1},\ v7=\frac{(R3+R1)\,ug1-R3\,ug2}{R1},\ v8=ug2,\ v9=ug1,\ v10=-\frac{(-R2\,R6-R1\,R6)\,ug2+R2\,R6\,ug1}{R1\,R6+R1\,R4},\ v11=-\frac{(-R2\,R6-R1\,R6)\,ug2+R2\,R6\,ug1}{R1\,R6+R1\,R4},\ j1=-((-R5\,R6-R3\,R6-R2\,R6-R1\,R6+R4\,(-R5-R3))\,ug2+(R5\,R6+R3\,R6+R2\,R6+R1\,R6+R4\,(R5+R3+R1))\,ug1)/(R1\,R5\,R6+R1\,R4\,R5),\ j2=\frac{(-R6-R4-R2-R1)\,ug2+(R6+R4+R2)\,ug1}{R1\,R6+R1\,R4},\ j3=(((-R3\,R6-R2\,R6-R1\,R6-R3\,R4)\,R8+(-R3\,R6-R2\,R6-R1\,R6-R3\,R4)\,R7-R2\,R5\,R6-R1\,R5\,R6)\,ug2+((R3\,R6+R2\,R6+R1\,R6+(R3+R1)\,R4)\,R8+(R3\,R6+R2\,R6+R1\,R6+(R3+R1)\,R4)\,R7+R2\,R5\,R6)\,ug1)/((R1\,R5\,R6+R1\,R4\,R5)\,R8),\ iul1=0,\ iul2=0,\ iul3=0,\ jg1=0,\ jg2=0]$$

(%i4) `ev(v3, odziv);`

(%o4)
$$-(((-R3\,R6-R2\,R6-R1\,R6-R3\,R4)\,R7-R2\,R5\,R6-R1\,R5\,R6)\,ug2+((R3\,R6+R2\,R6+R1\,R6+(R3+R1)\,R4)\,R7+R2\,R5\,R6)\,ug1)/(R1\,R5\,R6+R1\,R4\,R5)$$

(%i5) `zamena: [R2 = R, R3 = R, R4 = R, R5 = R, R6 = R, R7 = R];`

(%o5)
$$[R2=R,\ R3=R,\ R4=R,\ R5=R,\ R6=R,\ R7=R]$$

(%i6) `v3_zamena: ev(v3, odziv), zamena;`

(%o6)
$$-\left(\left(R\,(-R\,R1-3\,R^2)-R^2\,R1-R^3\right)ug2+\left(R\,(R\,(R1+R)+R\,R1+2\,R^2)+R^3\right)ug1\right)/(2\,R^2\,R1)$$

(%i7) `ratsimp(%);`

(%o7)
$$\frac{(R1+2\,R)\,ug2+(-R1-2\,R)\,ug1}{R1}$$

```
(%i8) pobude: [ug1 = U·unit_step(t), ug2 = U·unit_step(t-T)],
      [U = 10, T = 1];
```

(%o8) $[ug1 = 10\ unit\_step(t), ug2 = 10\ unit\_step(t-1)]$

```
(%i9) ratsimp(%o7), pobude, [R = 1000, R1 = 2000];
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(%o9) $20\ unit\_step(t-1) - 20\ unit\_step(t)$

```
(%i10) wxplot2d([%o9], [t,-1,5], [y,-30,40])$
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(%t10)