national accelerator laboratory

TM-273
0650

# SECONDARY BEAM LINE TRIM SEXTUPOLE

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## PURPOSE

To design a trim 6-pole magnet for use in secondary beam lines.

## METHOD

An extension of the conformal transformation to cover the case of a 6-pole magnet has been carried out. The resulting program SIXPOLE incorporates the COIL subroutine of previous magnet codes to simulate coils by a finite number of current carrying wires.

## RESULTS

Table 1 gives the pole profile as given by SIXPOLE. Table 2 completes the design and performance parameters. Figure 1 shows one quadrant of the 6-pole magnet. Each axis is a line about which mirror symmetry may be employed to visualize the complete magnet. No calculations with finite permeability have been made because of the modest flux densities involved.

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Table 1 Pole Profile Segments

| x(in) | y(in) | x(in) | y(in) | x(in) | y(in) |
|---|---|---|---|---|---|
| .000 | 2.125 | 2.315 | 2.605 | 1.840 | 1.063 |
| .113 | 2.131 | 2.245 | 2.555 | 1.886 | .991 |
| .223 | 2.148 | 2.157 | 2.493 | 1.972 | .881 |
| .301 | 2.168 | 2.075 | 2.437 | 2.028 | .823 |
| .401 | 2.201 | 1.981 | 2.374 | 2.106 | .753 |
| .515 | 2.250 | 1.898 | 2.318 | 2.186 | .693 |
| .597 | 2.293 | 1.814 | 2.260 | 2.285 | .629 |
| .710 | 2.362 | 1.742 | 2.199 | 2.400 | .566 |
| .810 | 2.434 | 1.708 | 2.147 | 2.513 | .516 |
| .912 | 2.502 | 1.710 | 2.041 | 2.623 | .460 |
| 1.005 | 2.552 | 1.703 | 1.919 | 2.713 | .406 |
| 1.034 | 2.608 | 1.691 | 1.796 | 2.775 | .409 |
| 1.050 | 2.701 | 1.687 | 1.664 | 2.864 | .441 |
| 1.059 | 2.803 | 1.693 | 1.546 | 2.957 | .485 |
| 1.065 | 2.903 | 1.705 | 1.447 | 3.047 | .529 |
| 1.073 | 3.015 | 1.727 | 1.345 | 3.148 | .578 |
| 1.081 | 3.114 | 1.749 | 1.267 | 3.238 | .621 |
| 1.090 | 3.222 | 1.801 | 1.138 | 3.335 | .667 |
| 1.099 | 3.307 | 1.840 | 1.063 | 3.413 | .702 |

Table 2 Six-Pole Parameters

| | |
|---|---|
| Six-Pole Strength | 1.825 $kG/in^2$ |
| Aperture | 4.250 in |
| Width of Good Field | 4.000 in |
| Magnet Length | 30.0 in |
| Coil Turns per Pole | 12 |
| Copper Conductor Cross Section | .34 in x .34 in |
| Water Cooling Hole Diameter | .15 in |
| Conductor Corner Radius | .03125 in |
| Conductor Current (approximate) | 500 A |
| Current Density in Conductor | 5150 $A/in^2$ |
| Average Conductor Turn Length | 68.25 in |
| Coil Resistance per Pole | .006175 Ohm |
| Voltage Drop per Pole | 3.09 V |
| Power per Pole | 1.54 kW |
| Cooling Water Pressure Drop | 200 psi |
| Number of Water Paths per Pole | 1 |
| Water Flow | .69 GPM/pole |
| Temperature Rise | $8.5^{o}C$ ($15.3^{o}F$) |
| Outside Dimensions (approximate) | 11.25 in x 12.00 in |

SECONDARY BEAM LINE TRIM SEXTUPOLE

STRENGTH 1.825 kG/in$^2$

APERTURE 4.25 in

GOOD FIELD WIDTH 4.00 in

RUN SIXPOLE (10/22/70)

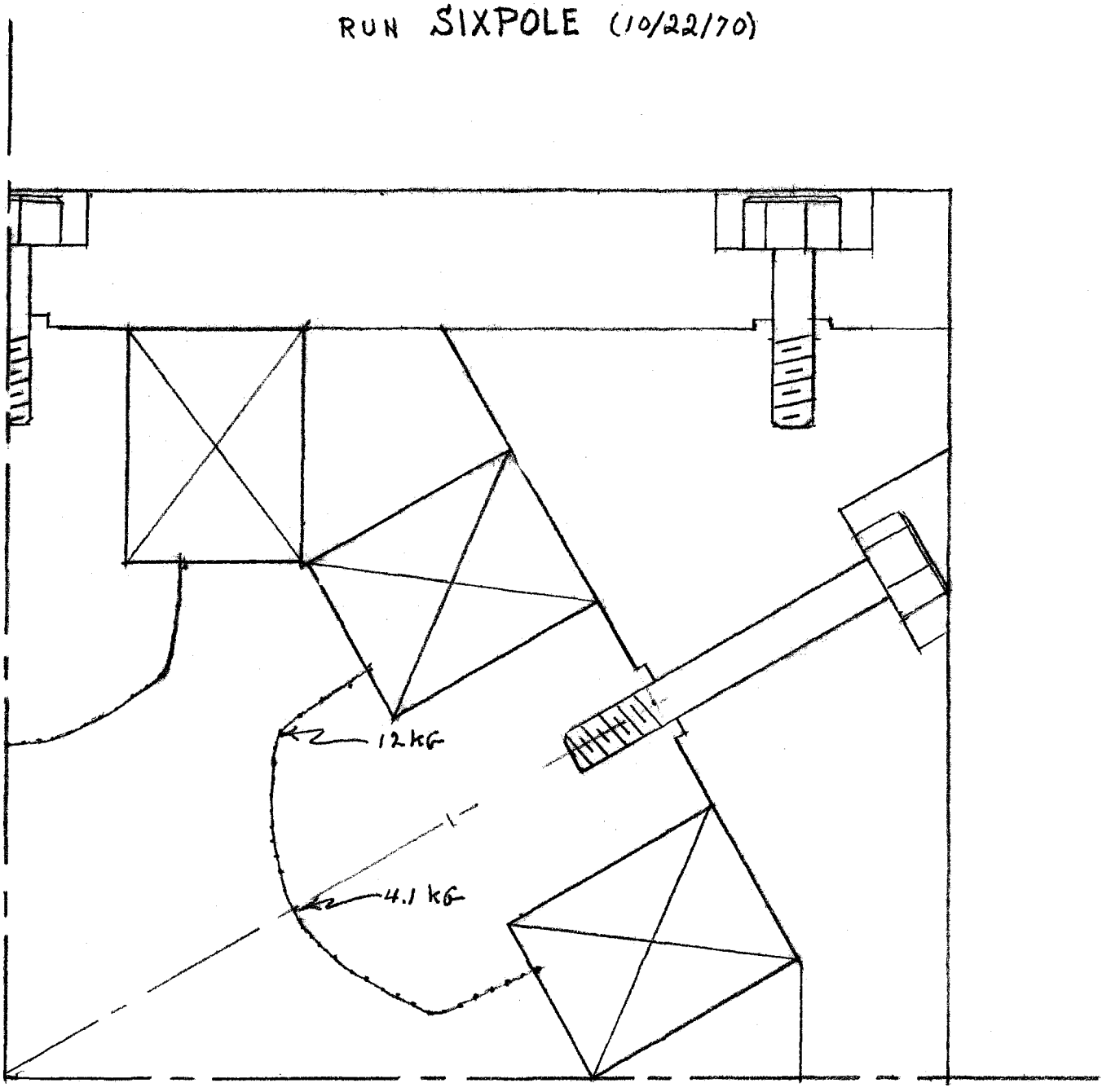


Fig. 1