TECHNICAL TIPS

1. USE A SHARP PENCIL AND A HIGH QUALITY ACCURATE COMPASS.

2. LINE UP THE METAL TIP AND THE MARKING TIP ON THE COMPASS BEFORE USING.

3. BE SURE THE LEGS OF YOUR COMPASS ARE SECURELY POSITIONED BEFORE STARTING TO DRAW.

4. PLACE SOMETHING BETWEEN THE PAPER AND DESK SO THAT THE METAL TIP OF YOUR COMPASS DOESN'T DAMAGE THE DESK TOP.

5. USE A PENCIL OR PEN THAT DOESN'T SMEAR. A STRAIGHT EDGE WITH AN ELEVATED EDGE HELPS PREVENT SMEARING. DRAFTING OR MASKING TAPE ON THE BOTTOM OF THE STRAIGHT EDGE CAN BE USED TO LIFT THE EDGE OFF THE PAPER.

6. LARGER CONSTRUCTIONS USUALLY PROVE TO BE EASIER AND MORE ACCURATE.

7. WHEN MAKING INK DRAWINGS, YOU MAY WISH TO COMPLETE THE DRAWING IN PENCIL BEFORE INKING.

8. TYPING CORRECTION FLUID MAY BE USED TO CORRECT INKING ERRORS.

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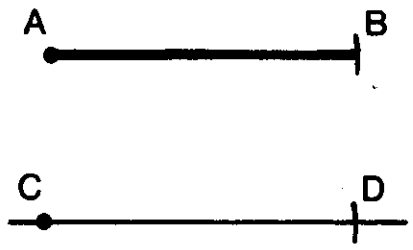
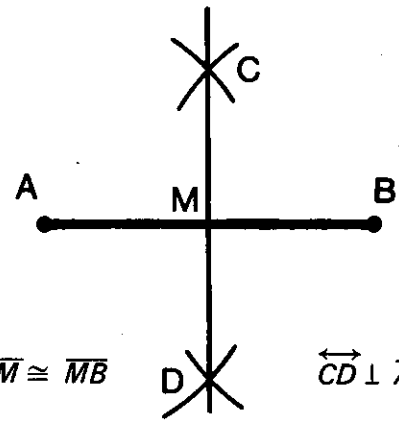
BASIC GEOMETRIC CONSTRUCTIONS

COPIED LINE SEGMENT



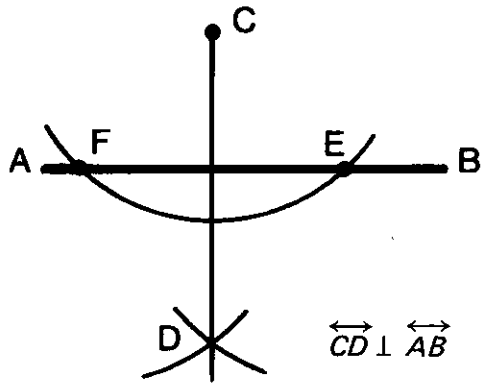
$\overline{AB} \cong \overline{CD}$

BISECTION OF A LINE SEGMENT



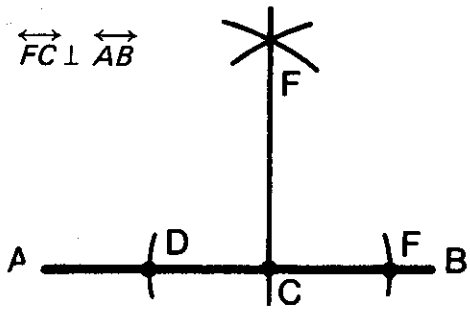
$\overline{AM} \cong \overline{MB}$ $\overleftrightarrow{CD} \perp \overline{AB}$

CONSTRUCTION OF A PERPENDICULAR TO A LINE FROM A POINT OFF THE LINE



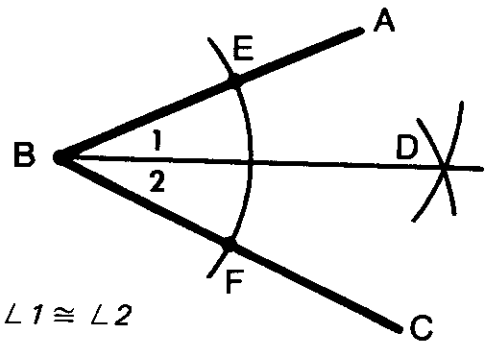
$\overleftrightarrow{CD} \perp \overleftrightarrow{AB}$

CONSTRUCTION OF A PERPENDICULAR TO A LINE FROM A POINT ON THE LINE



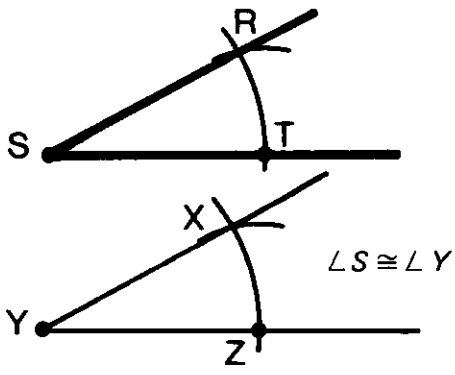
$\overleftrightarrow{FC} \perp \overleftrightarrow{AB}$

BISECTION OF AN ANGLE



$\angle 1 \cong \angle 2$

COPIED ANGLE



$\angle S \cong \angle Y$

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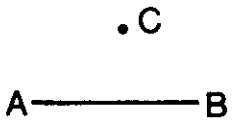
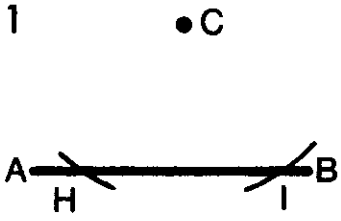
TO CONSTRUCT A PERPENDICULAR TO A LINE FROM A POINT OFF THE LINE

OBJECTIVE: CONSTRUCT A PERPENDICULAR TO $\overleftrightarrow{AB}$ PASSING THROUGH *C*.

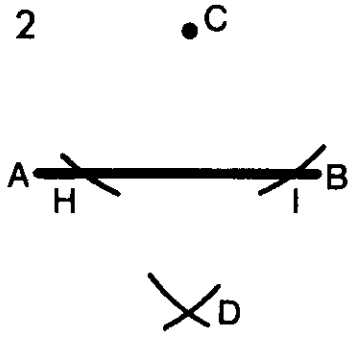


1



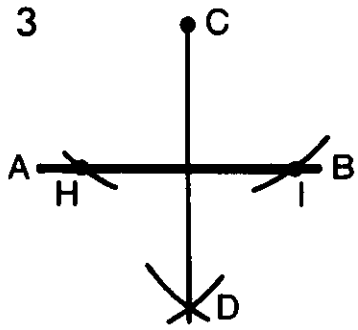
USING *C* AS A CENTER AND ANY CONVENIENT LENGTH AS A RADIUS, DRAW AN ARC WHICH INTERSECTS $\overleftrightarrow{AB}$ AT TWO POINTS (*H* AND *I*).

2



USING POINTS *H* AND *I* AS CENTERS, DRAW ARCS WITH EQUAL RADII THAT INTERSECT AT A POINT (*D*) BELOW THE LINE.

3



DRAW $\overline{CD}$. $\overline{CD} \perp \overleftrightarrow{AB}$.

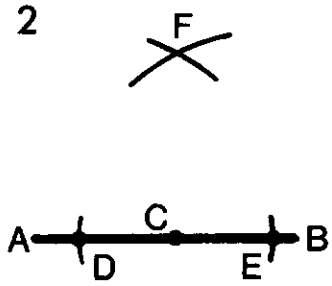
TO CONSTRUCT A PERPENDICULAR TO A LINE FROM A POINT ON THE LINE

OBJECTIVE: CONSTRUCT A PERPENDICULAR TO $\overleftrightarrow{AB}$ PASSING THROUGH *C*.

1

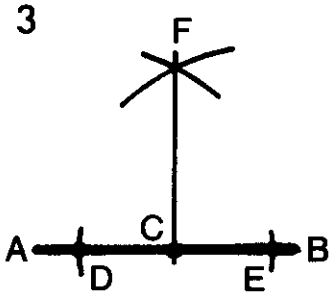
USING *C* AS A CENTER DRAW TWO ARCS, WITH EQUAL RADII, INTERSECTING $\overleftrightarrow{AB}$ AT TWO POINTS (*D* AND *E*).

2



USING POINTS *D* AND *E* AS CENTERS, DRAW ARCS WITH EQUAL RADII INTERSECTING AT A POINT (*F*).

3



DRAW $\overleftrightarrow{CF}$. $\overleftrightarrow{CF} \perp \overleftrightarrow{AB}$

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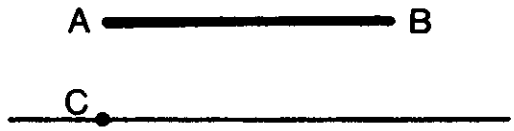
TO COPY A LINE SEGMENT

1 OBJECTIVE: COPY LINE SEGMENT $\overline{AB}$

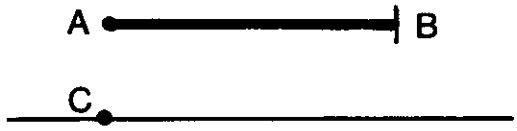
DRAW A SEGMENT LONGER THAN $\overline{AB}$.

2



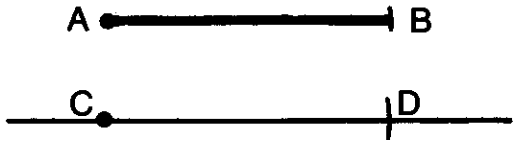
ESTABLISH A POINT (*C*) ON THE LONGER LINE THAT CORRESPONDS WITH *A* ON $\overline{AB}$

3



PLACE COMPASS TIPS ON *A* AND *B*.

4

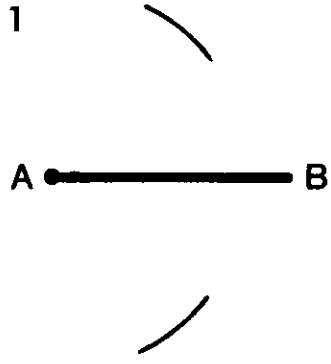


WITH METAL TIP AT *C*, TRANSFER LENGTH OF $\overline{AB}$ TO LONGER LINE. LABEL *D*. $\overline{CD} \cong \overline{AB}$

TO BISECT A LINE SEGMENT

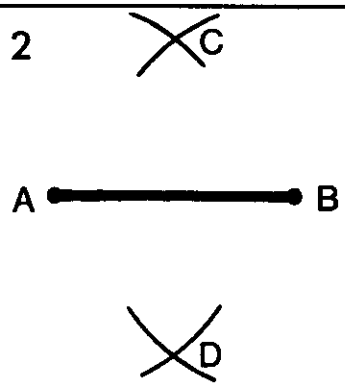
OBJECTIVE: DIVIDE $\overline{AB}$ INTO TWO CONGRUENT SEGMENTS.

1



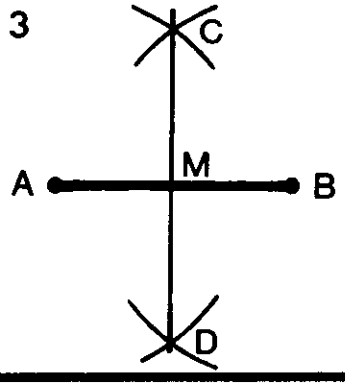
PLACE METAL COMPASS TIP AT *A*. USING ANY CONVENIENT RADIUS DRAW ARCS ABOVE AND BELOW $\overline{AB}$

2



USING THE SAME RADIUS, AND *B* AS THE CENTER, DRAW ARCS WHICH INTERSECT THE FIRST TWO ARCS.

3



DRAW $\overline{CD}$. $\overline{AM} \cong \overline{MB}$ AND $\overline{CD} \perp \overline{AB}$. *M* IS THE *MIDPOINT* OF $\overline{AB}$.

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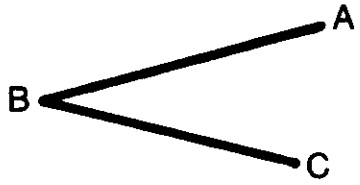
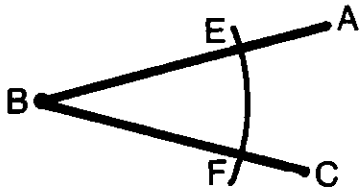
TO BISECT AN ANGLE

OBJECTIVE: DIVIDE $\angle ABC$ INTO TWO CONGRUENT ANGLES.

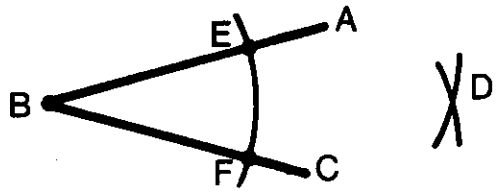


1



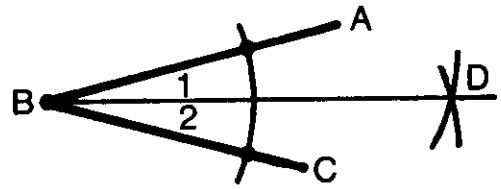
USING B AS A CENTER, DRAW AN ARC WHICH INTERSECTS $\overrightarrow{BA}$ AND $\overrightarrow{BC}$ AT E AND F.

2



USING E AND F AS CENTERS, DRAW TWO ARCS WITH EQUAL RADII INTERSECTING AT A POINT D.

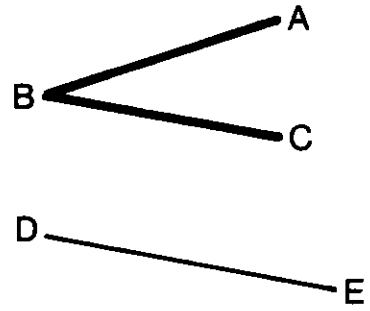
3



DRAW $\overrightarrow{BD}$. $\overrightarrow{BD}$ BISECTS $\angle ABC$. $\angle 1 \cong \angle 2$

TO COPY AN ANGLE

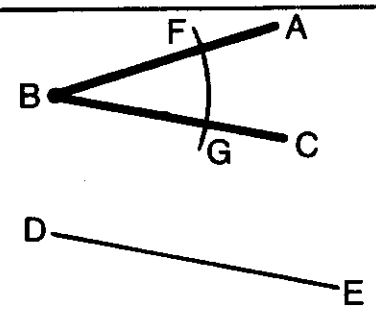
1



OBJECTIVE: CONSTRUCT AN ANGLE $\cong$ TO $\angle ABC$.

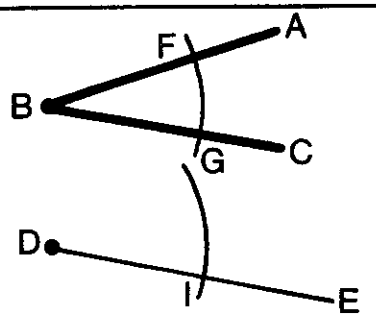
DRAW A RAY ($\overrightarrow{DE}$)

2



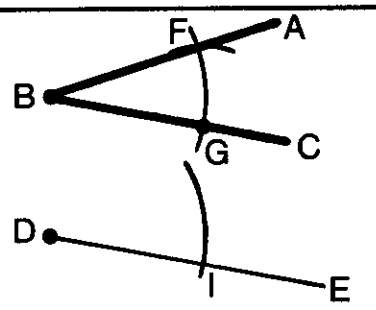
USING B AS A CENTER, MAKE AN ARC WHICH INTERSECTS $\overrightarrow{AB}$ AND $\overrightarrow{AC}$ AT F AND G.

3



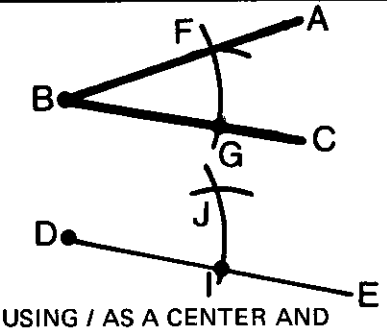
USING D AS A CENTER MAKE AN ARC WITH THE SAME RADIUS AS IN STEP TWO CORRESPONDING TO $\overline{FG}$

4



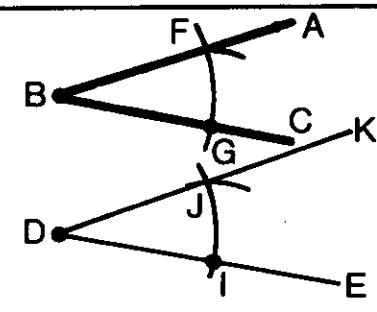
USING G AS A CENTER MEASURE $\overline{FG}$ WITH THE COMPASS.

5



USING I AS A CENTER AND $\overline{FG}$ AS A RADIUS, MAKE AN ARC INTERSECTING THE PREVIOUS ARC AT J.

6



DRAW $\overrightarrow{DJ}$. $\angle KDE \cong \angle ABC$

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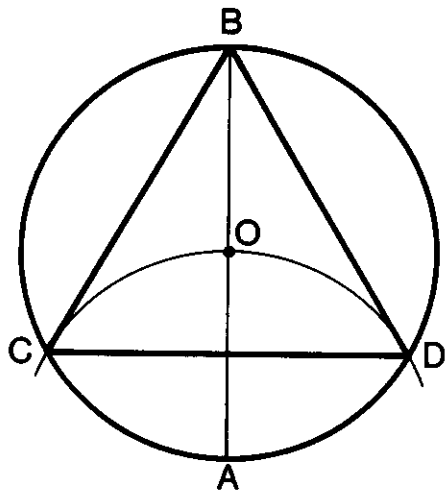
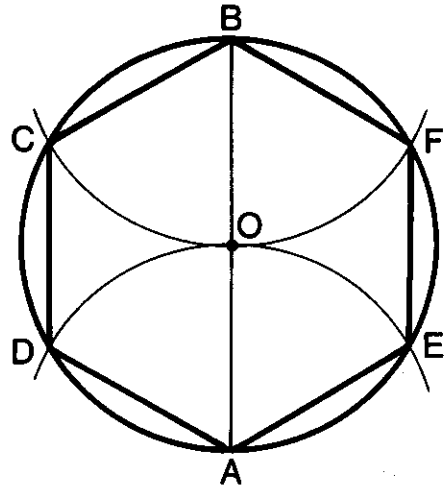
INSCRIBING REGULAR POLYGONS



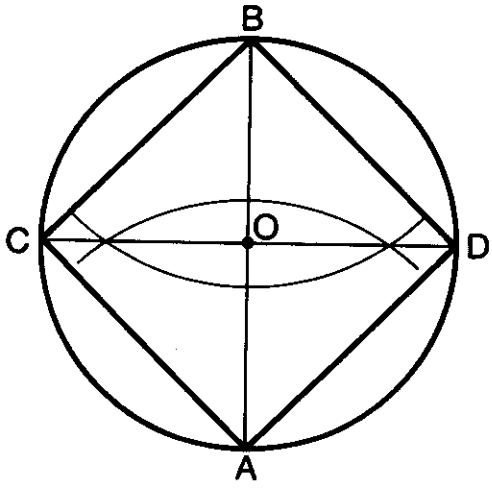
INSCRIBE AN EQUILATERAL TRIANGLE

1. In the given circle O, draw a diameter $\overline{AB}$.
2. Using A as a center and AO as a radius, draw an arc intersecting the circle at C and D.
3. Connect B, C, and D to form the triangle.



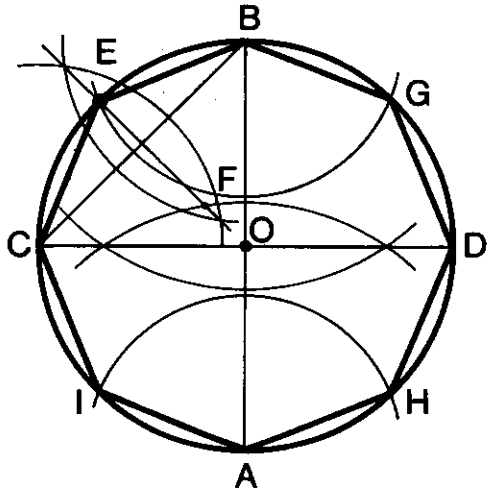
INSCRIBE A REGULAR HEXAGON

1. In the given circle O, draw a diameter $\overline{AB}$.
2. Using A and B as centers and AO as a radius, draw arcs intersecting the circle at C, D, E, and F.
3. Connect A, E, F, B, C, and D to form the hexagon.



INSCRIBE A SQUARE

1. In the given circle O, draw a diameter $\overline{AB}$.
2. Construct another diameter, $\overline{CD}$, which is the perpendicular bisector of $\overline{AB}$.
3. Connect A, D, B, and C to form the square.



INSCRIBE A REGULAR OCTAGON

1. In the given circle O, locate points A, B, C, and D as in the construction for inscribing a square.
2. Draw $\overline{BC}$ and construct $\overline{EF}$, the perpendicular bisector of $\overline{BC}$.
3. Using A and B as centers and BE as a radius, draw arcs intersecting the circle at G, H, and I.
4. Connect A, I, C, E, B, G, D, and H to form the octagon.

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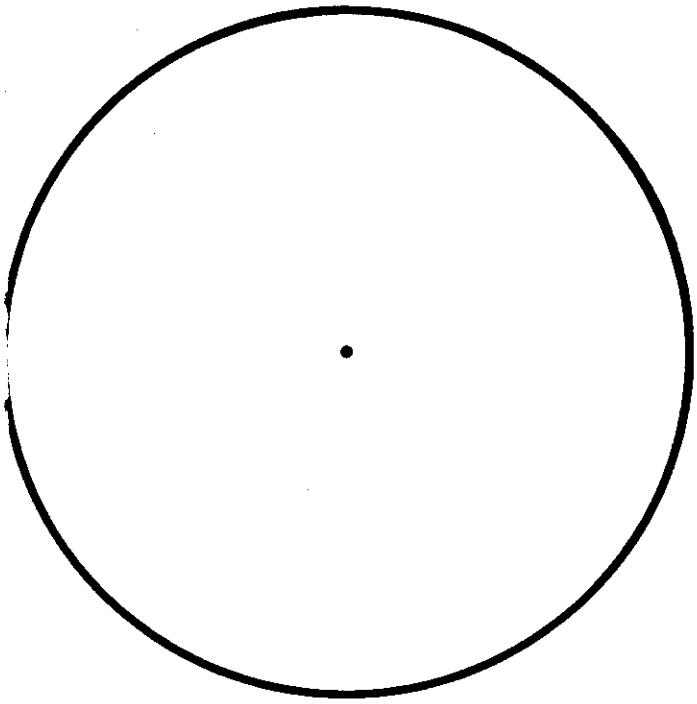
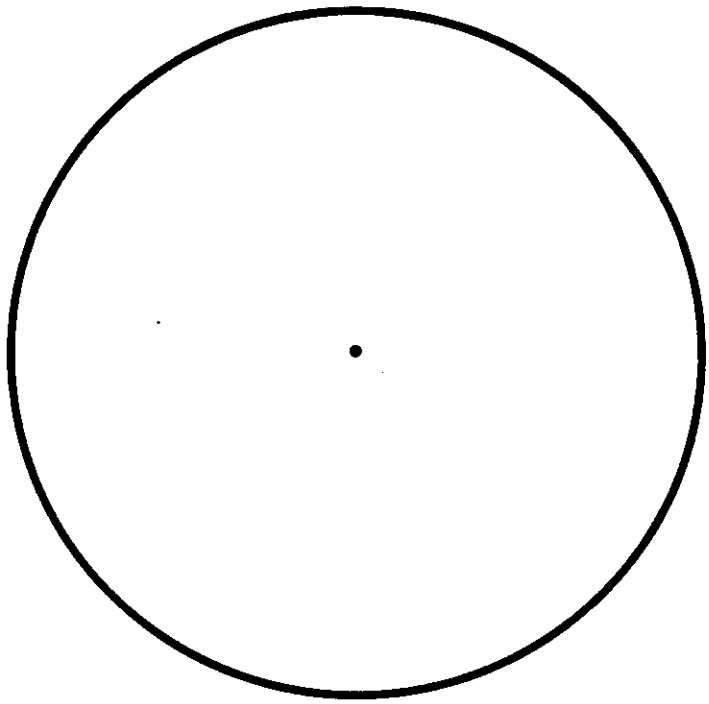
INSCRIBING REGULAR POLYGONS

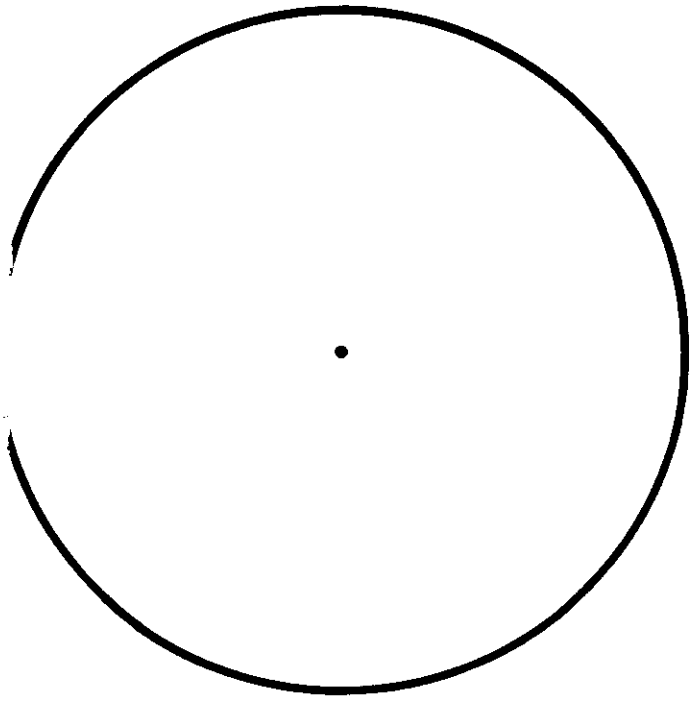
USE A STRAIGHT EDGE AND COMPASS TO CONSTRUCT THE SPECIFIED INSCRIBED REGULAR POLYGONS



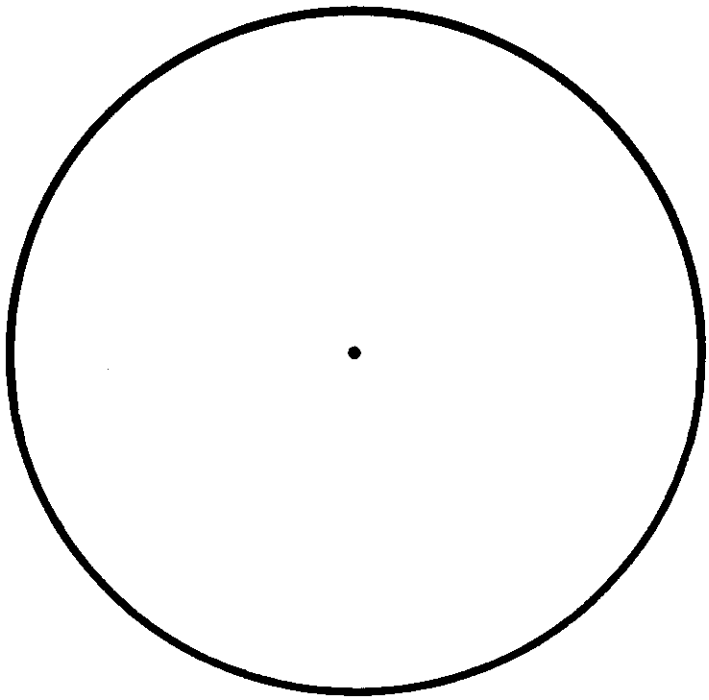
TRIANGLE



HEXAGON



SQUARE



OCTAGON

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INSCRIBING A REGULAR PENTAGON

1. In the given circle, *O*, draw a diameter, *AB*.

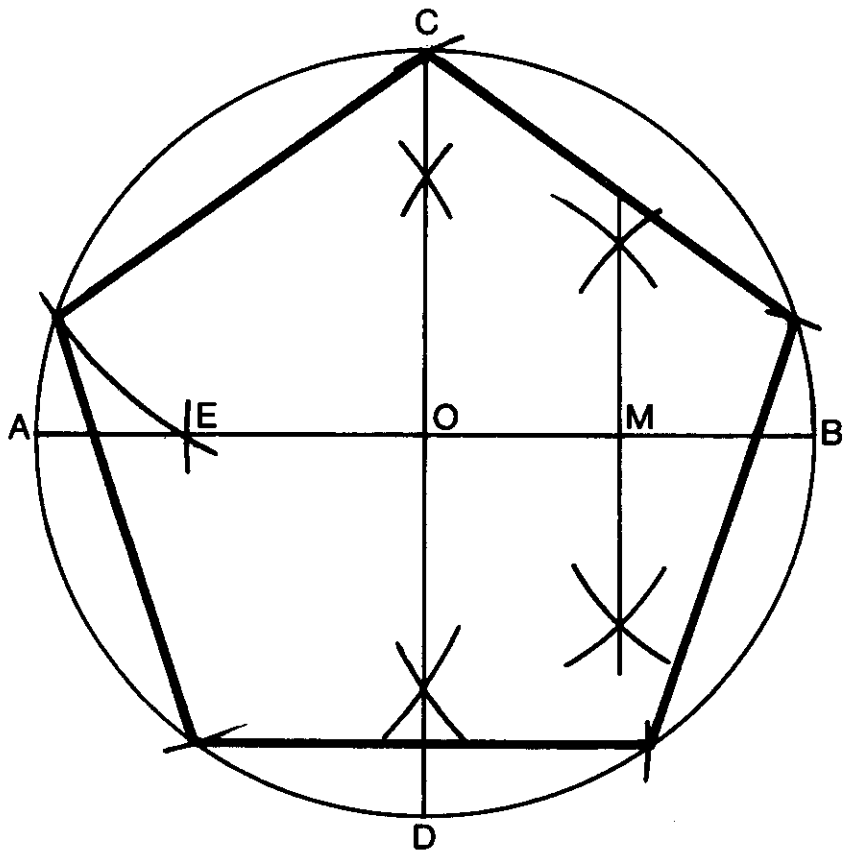
2. Construct another diameter, *CD*, which is the perpendicular bisector of *AB*.

3. Bisect *OB*. Label its midpoint *M*.

4. Using *M* as a center and *CM* as a radius, draw an arc intersecting *AO* at *E*.

5. *CE* is the required length of one side of the inscribed regular pentagon.

6. Mark five arcs with radius *CE* on the circle and connect their intersections to form the regular pentagon.



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INSCRIBING A REGULAR PENTAGON

1. In the given circle, O, draw a diameter, AB.

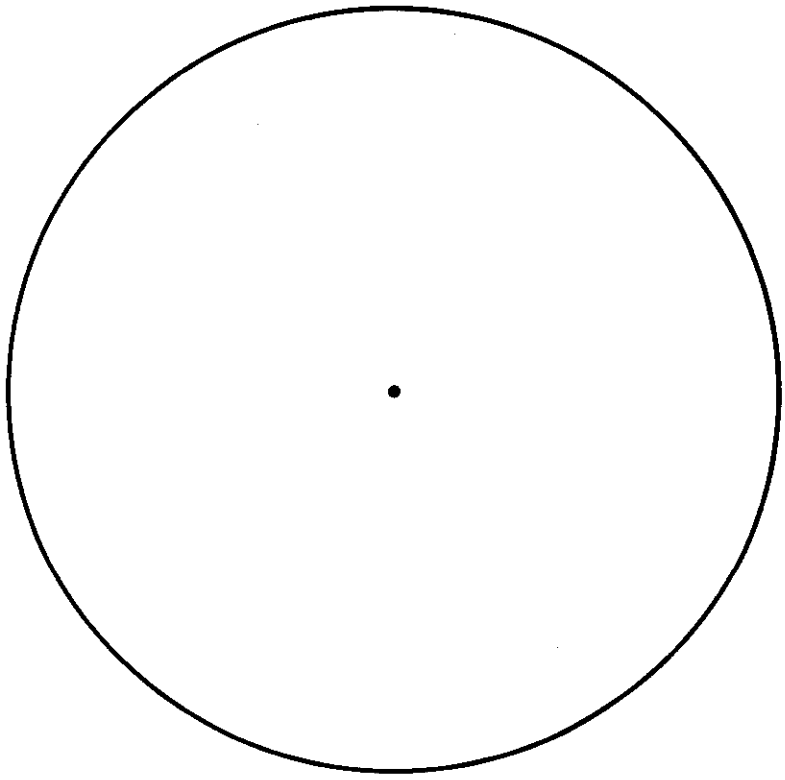
2. Construct another diameter, CD, which is the perpendicular bisector of AB.

3. Bisect OB. Label its midpoint M.

4. Using M as a center and CM as a radius, draw an arc intersecting AO at E.

5. CE is the required length of one side of the inscribed regular pentagon.

6. Mark five arcs with radius CE on the circle and connect their intersections to form the regular pentagon.



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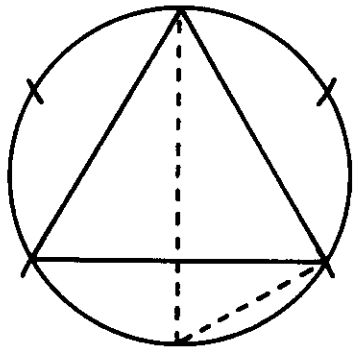
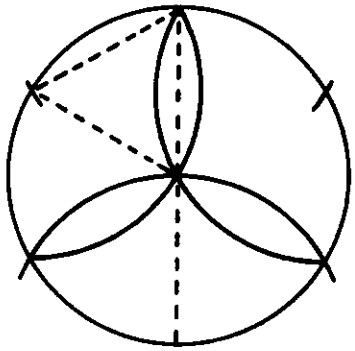
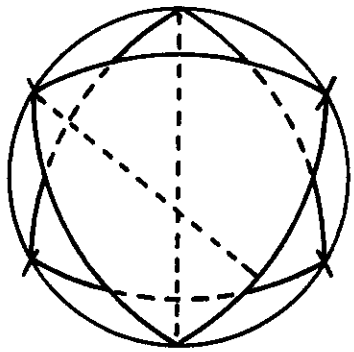
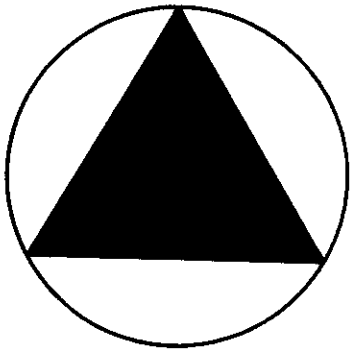
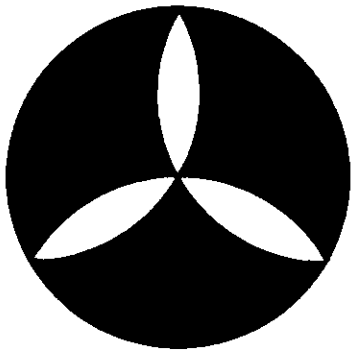
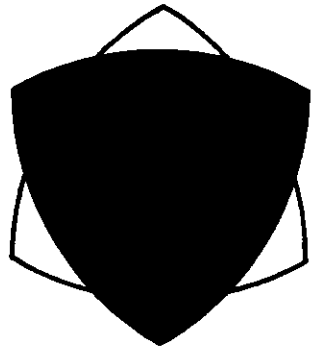
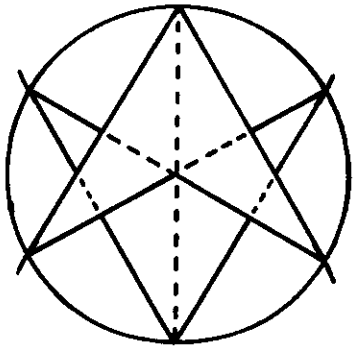
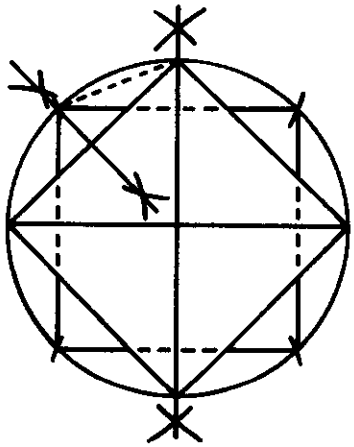
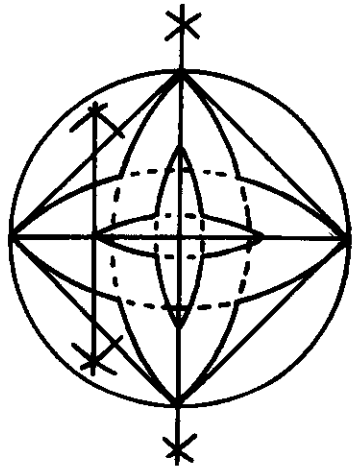
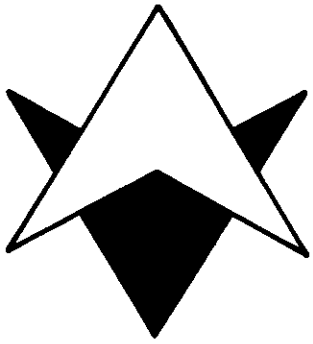
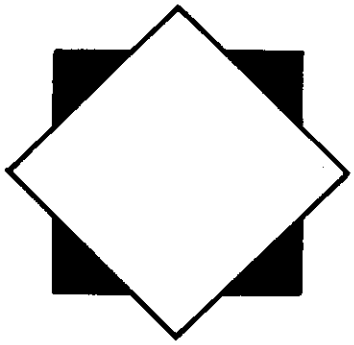
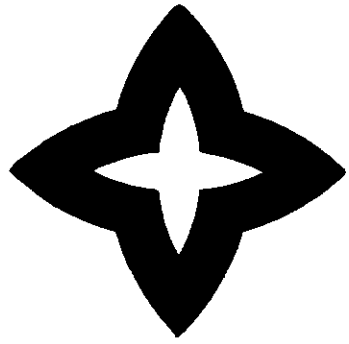
CREATING DESIGNS

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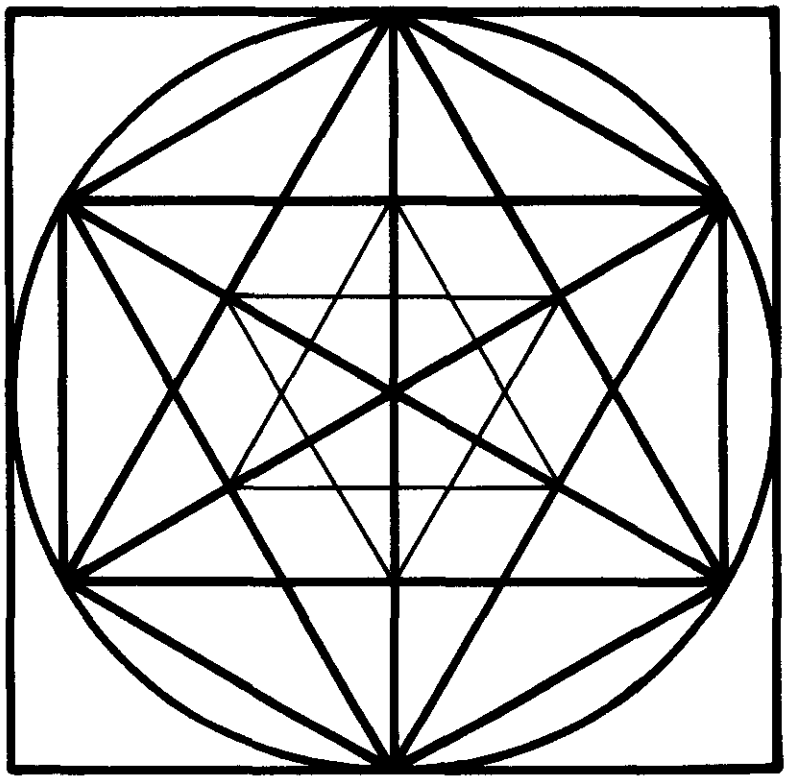
DESIGNS BASED ON TRIANGLES AND HEXAGONS

All of the designs on the next ten pages were constructed from a triangle or a hexagon inscribed in a circle. The lines and intersecting points in the figure below provide the basis for the lines, centers and arc radii of these designs.

How many of these designs can you construct? The designs have been reduced so that several can be shown on a page. It will be much easier for you to use a larger circle (10–15 cm diameter) as a basis for your designs.



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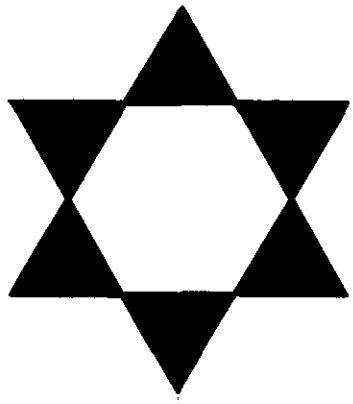

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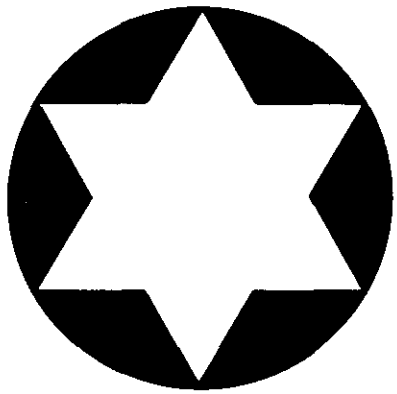

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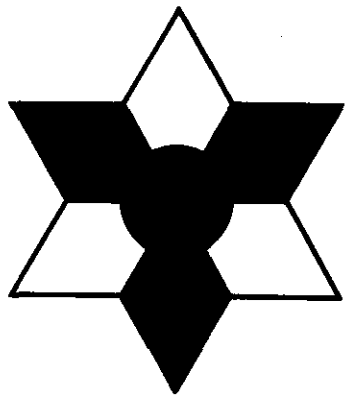

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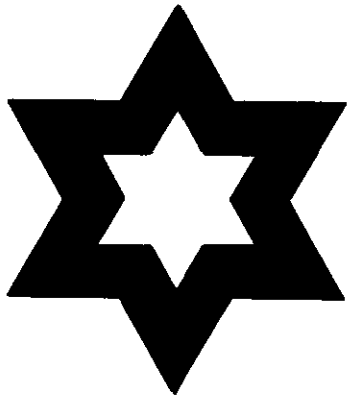

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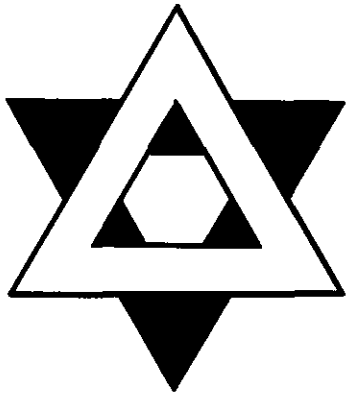

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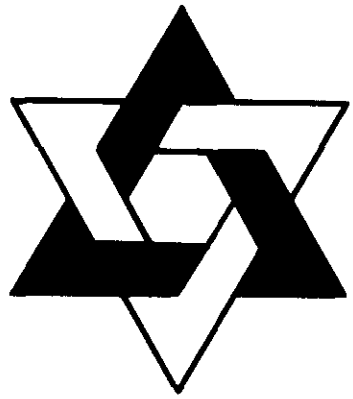

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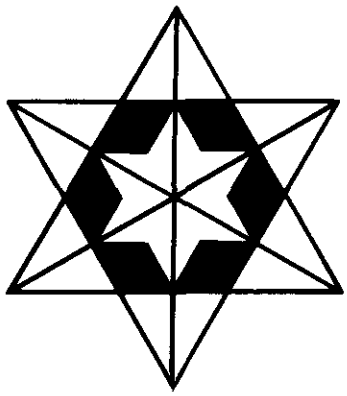

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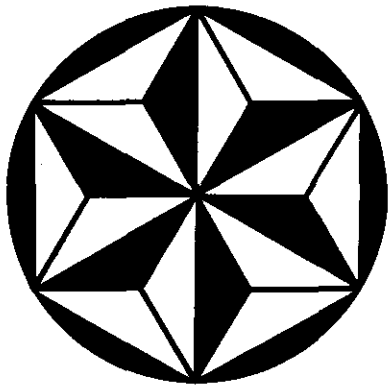

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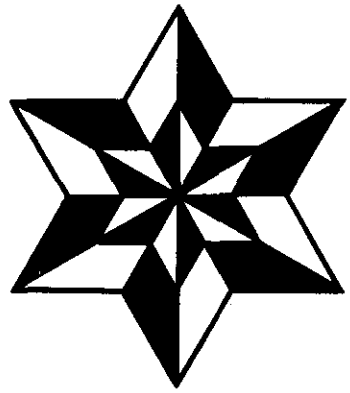

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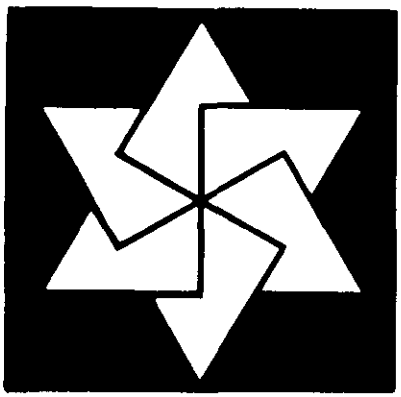

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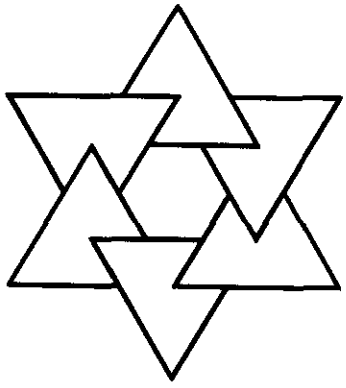

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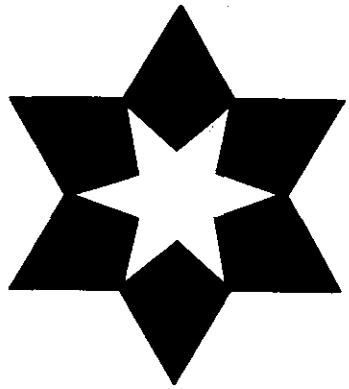

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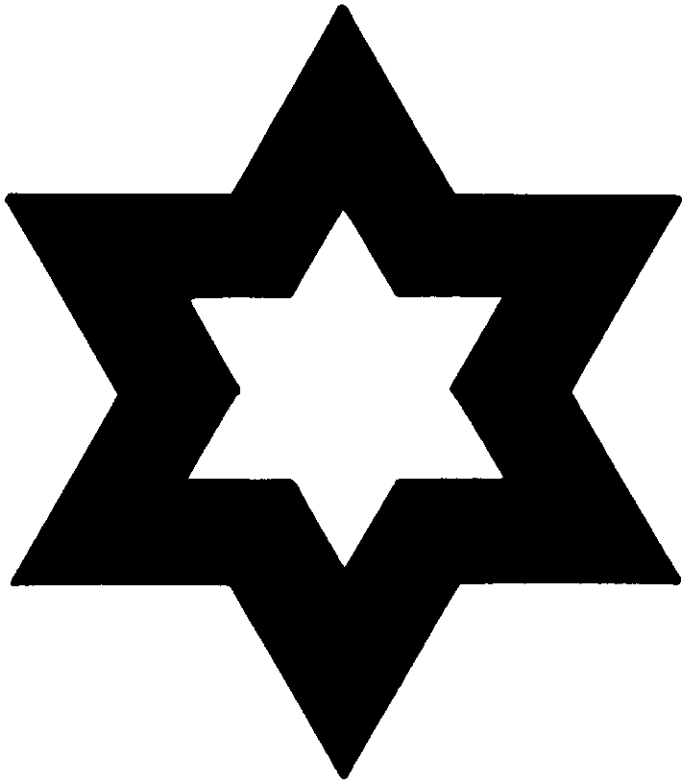

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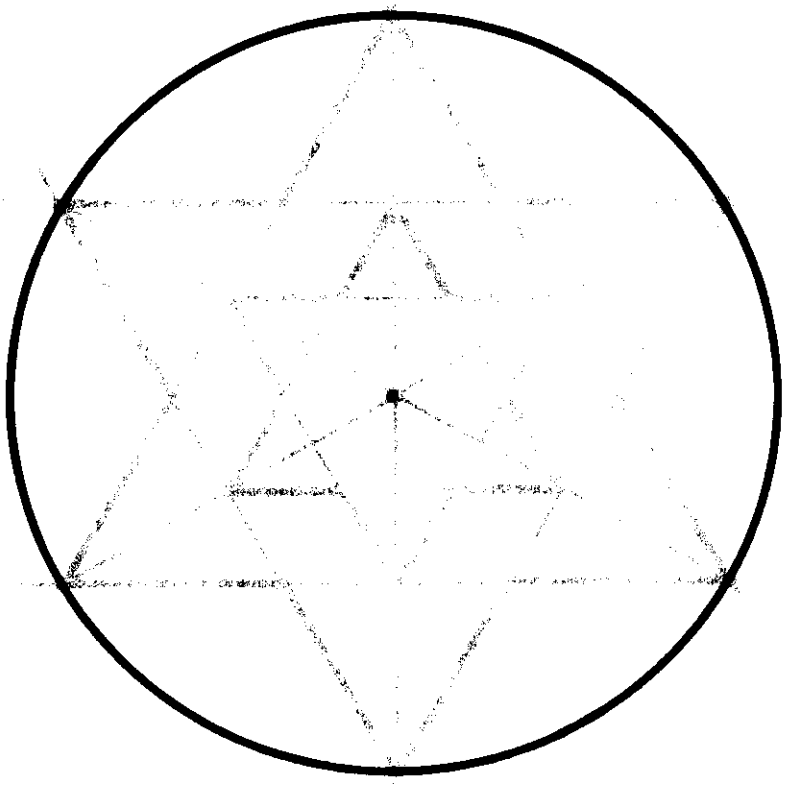

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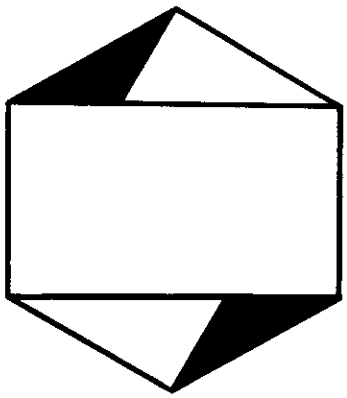

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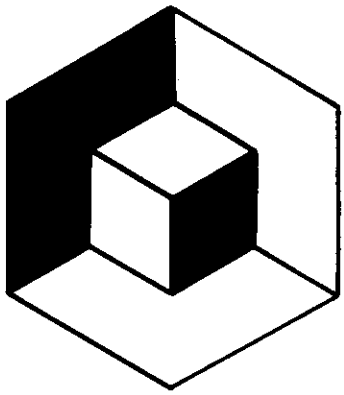

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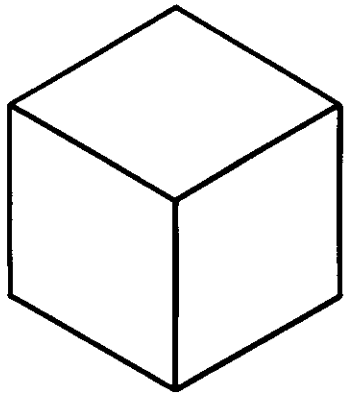

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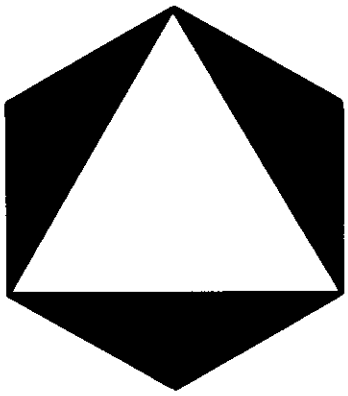

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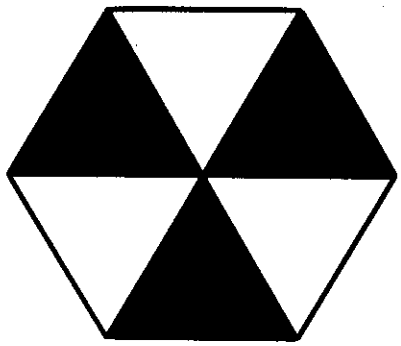

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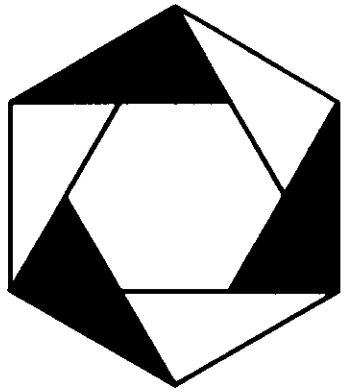

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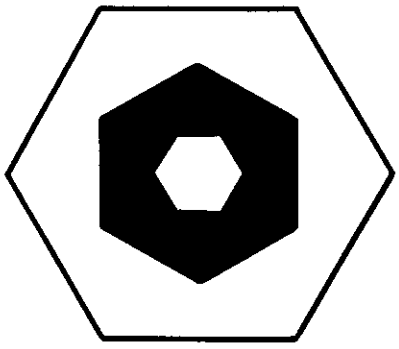

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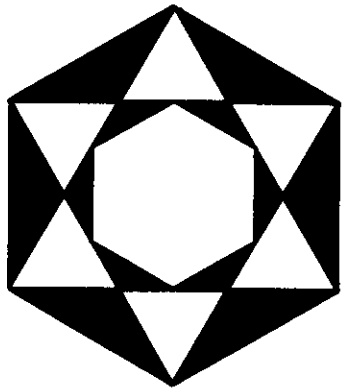

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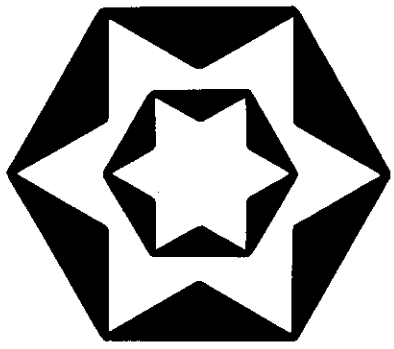

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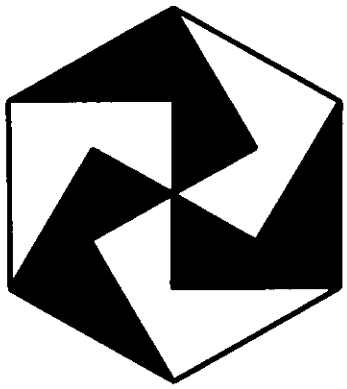

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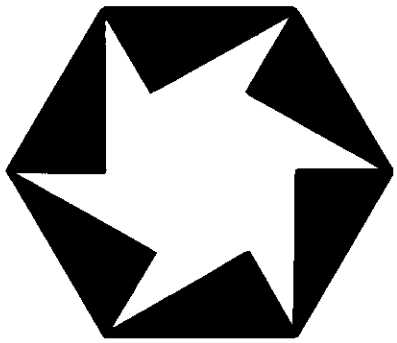

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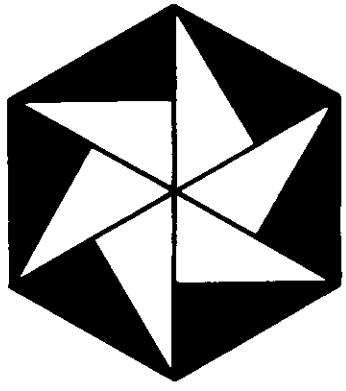

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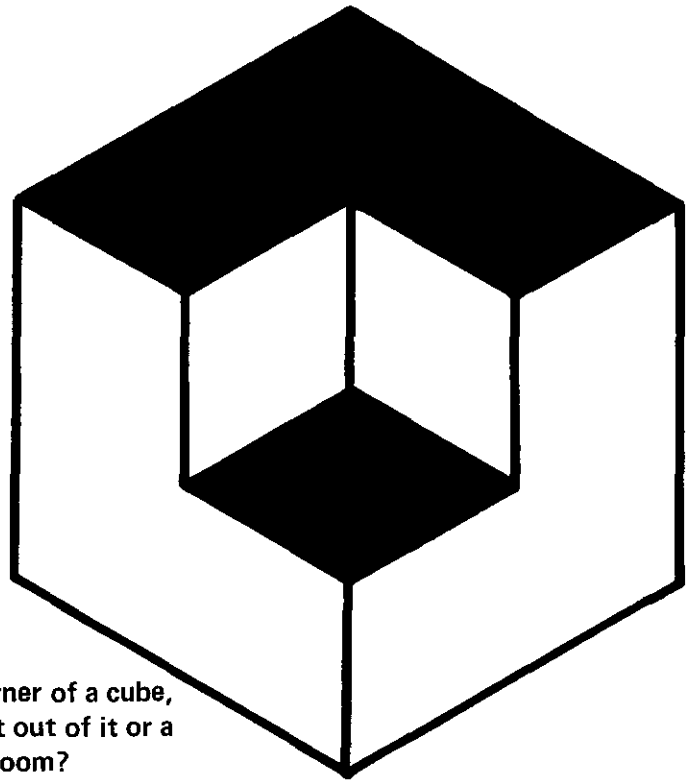

OPTICAL ILLUSION

Is this a cube on the corner of a cube, a cube with a corner cut out of it or a cube in the corner of a room?

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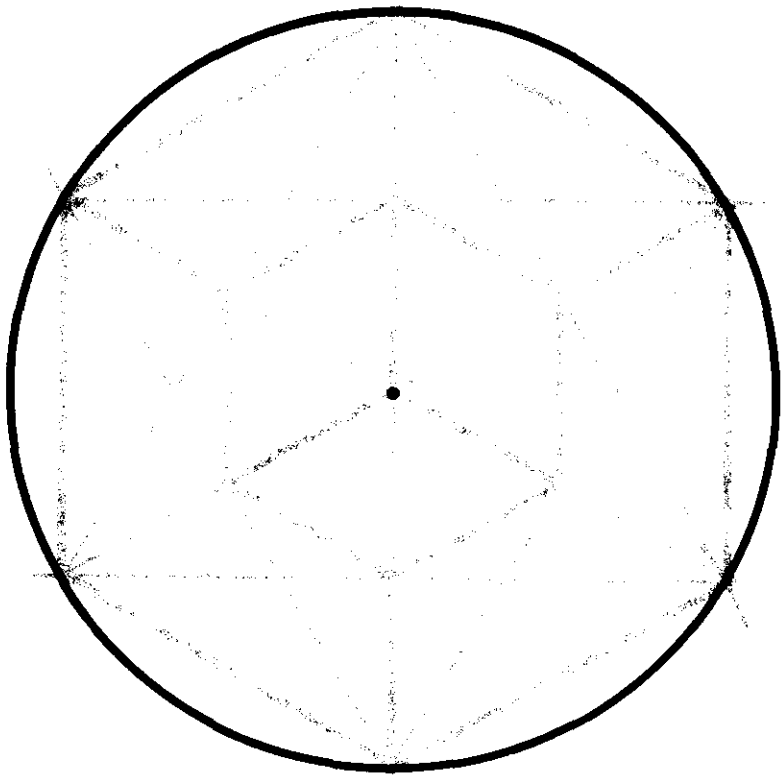

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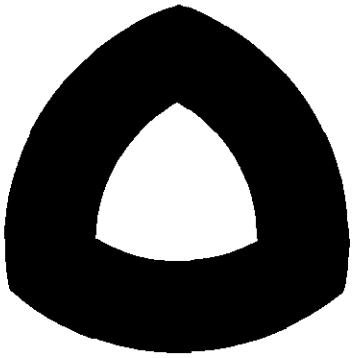

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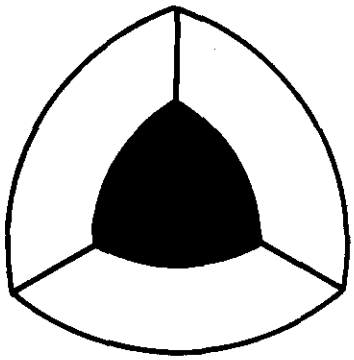

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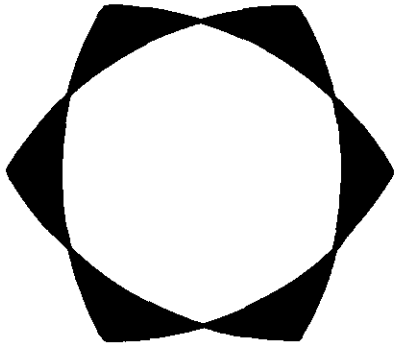

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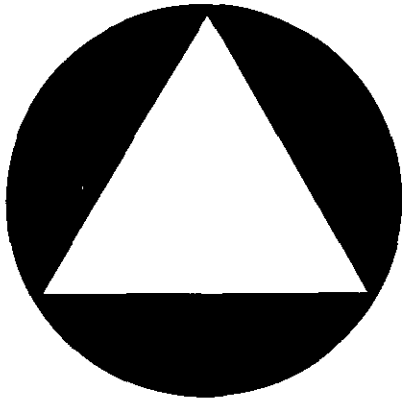

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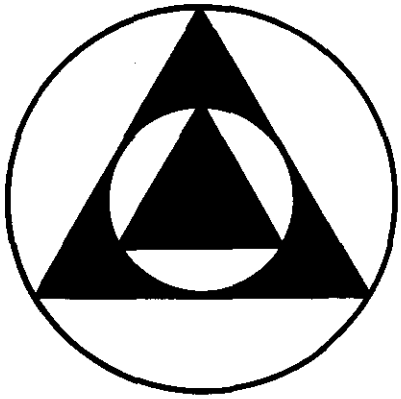

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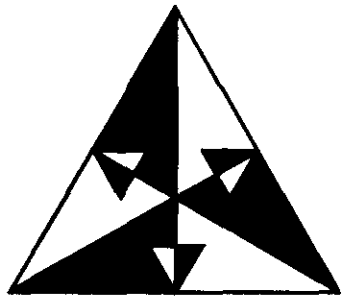

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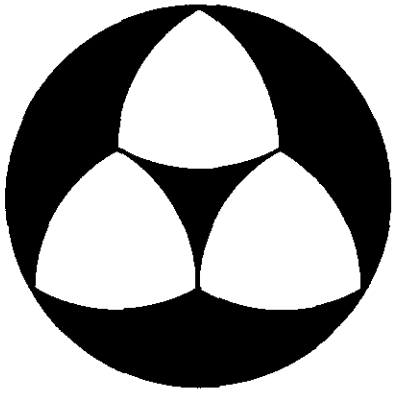

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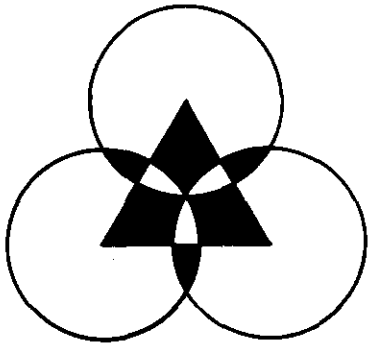

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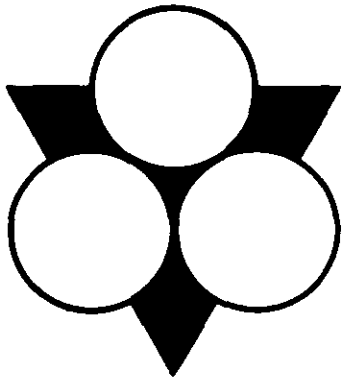

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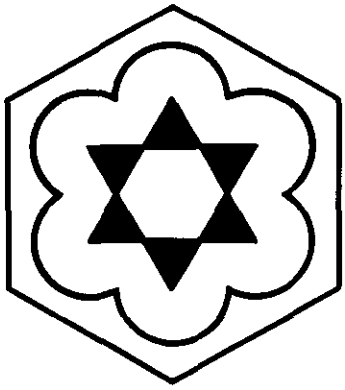

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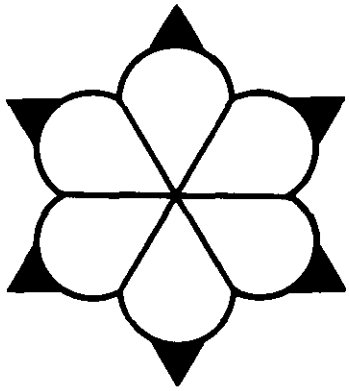

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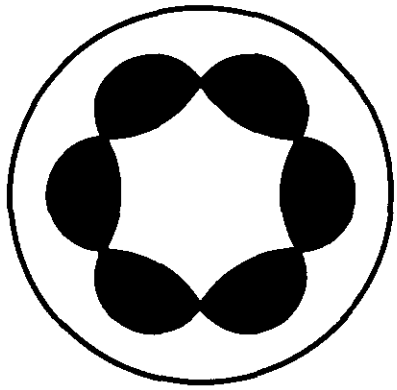

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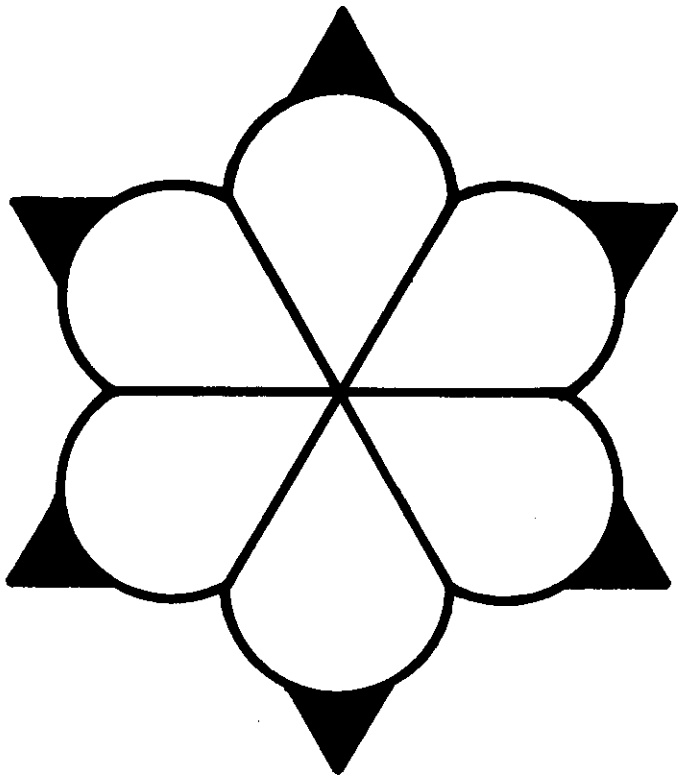

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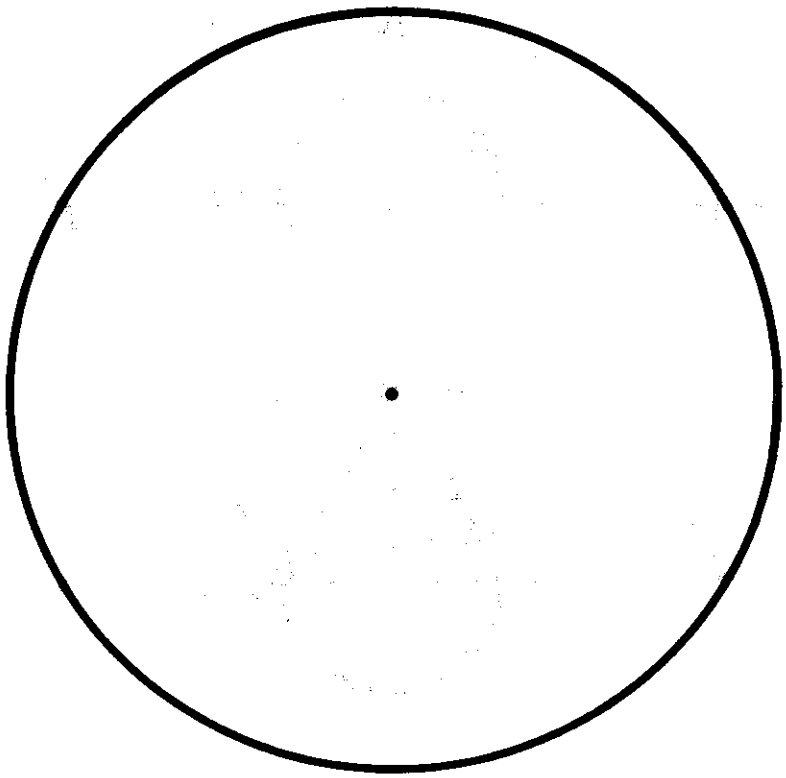

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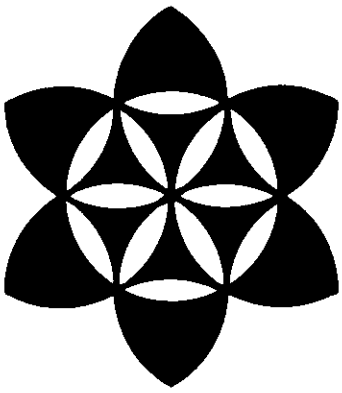

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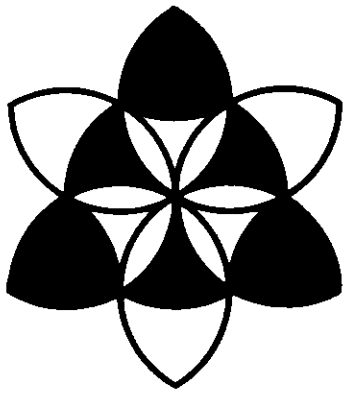

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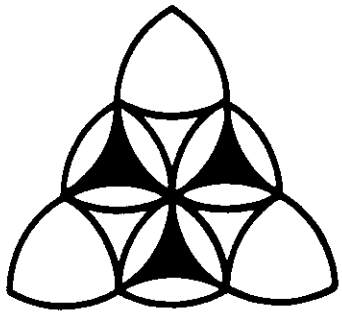

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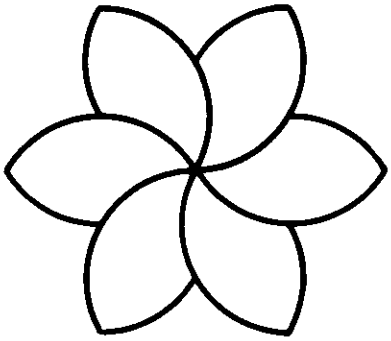

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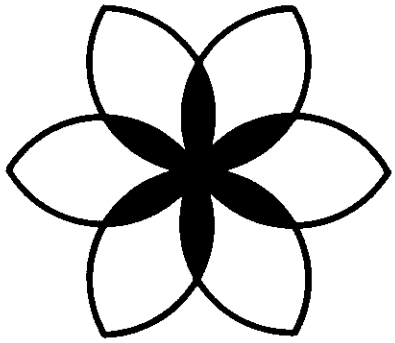

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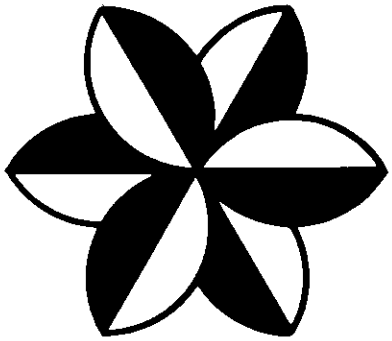

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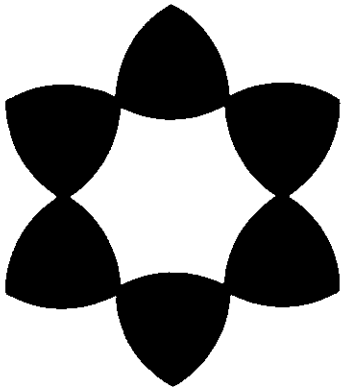

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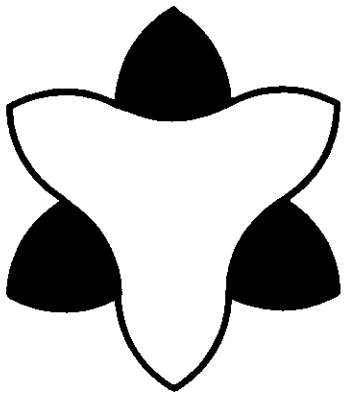

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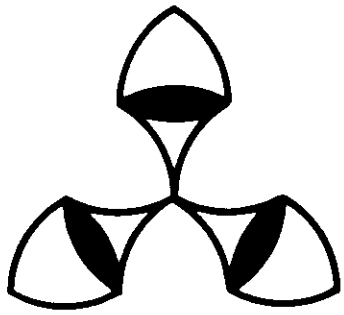

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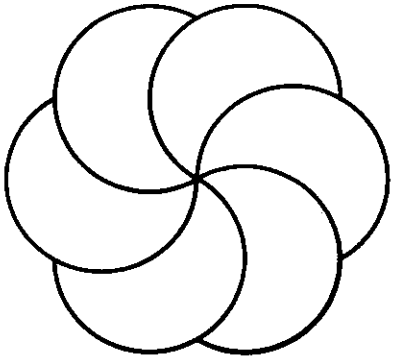

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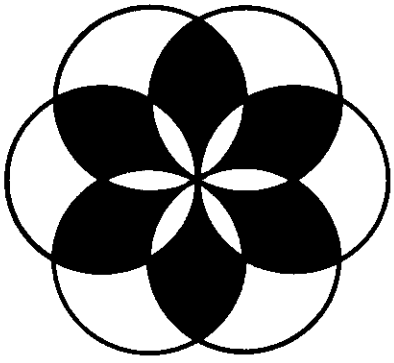

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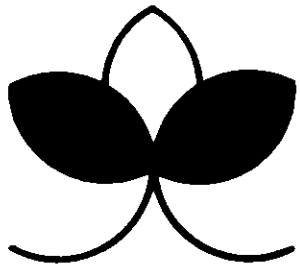

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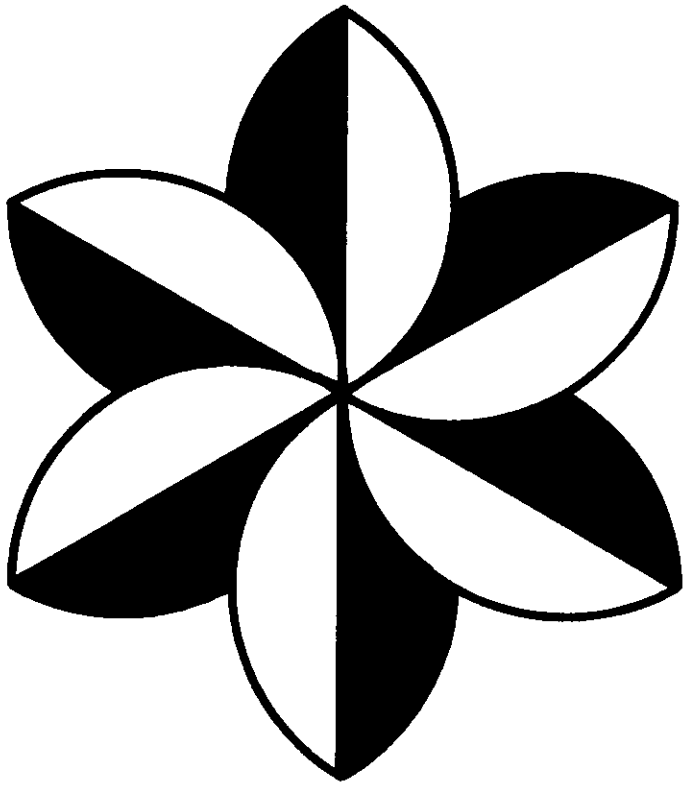

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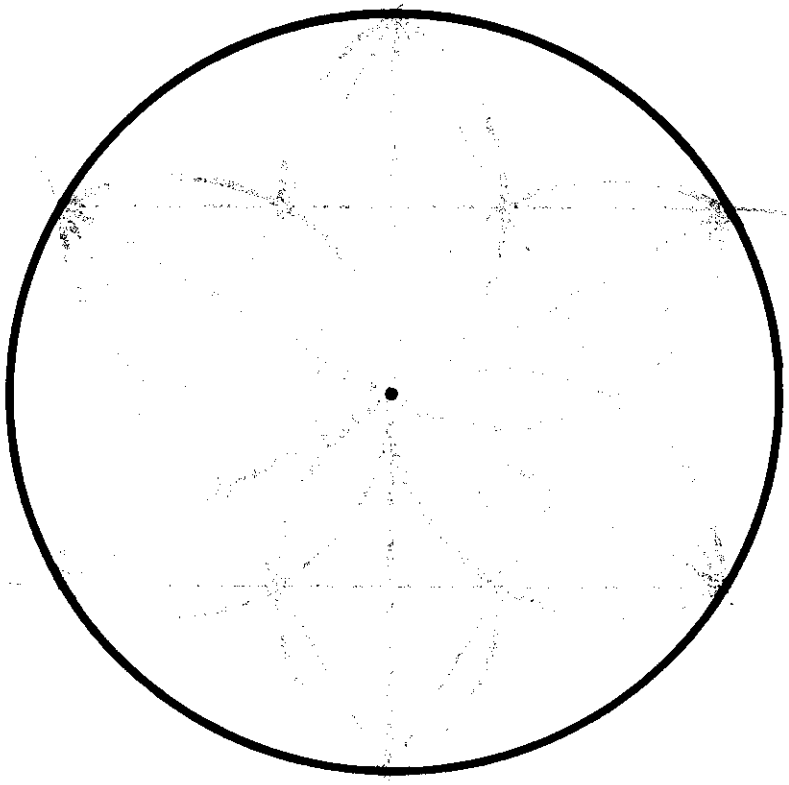

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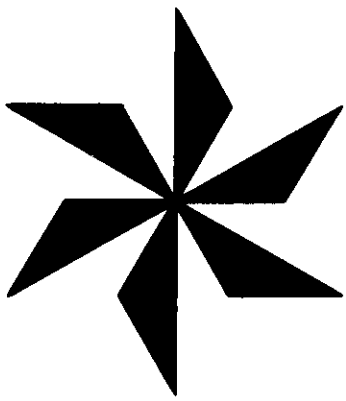

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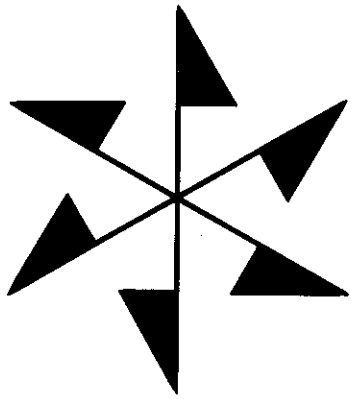

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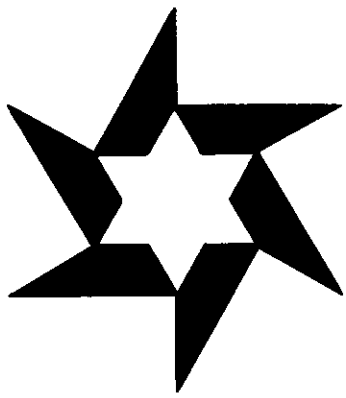

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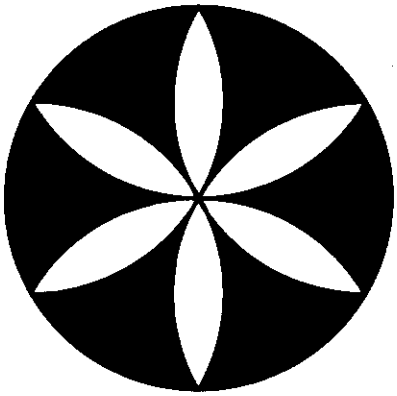

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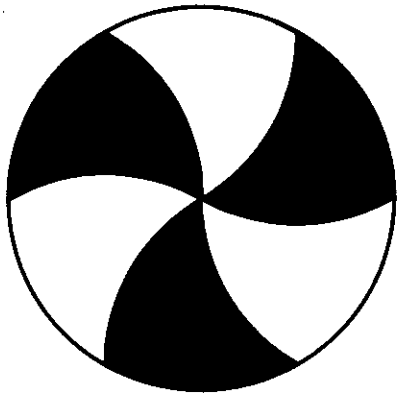

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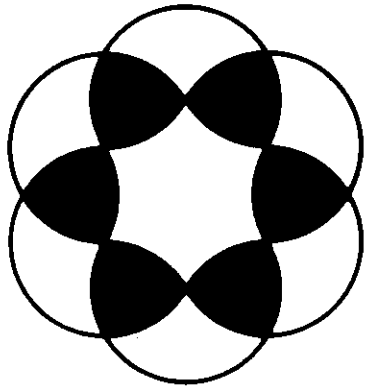

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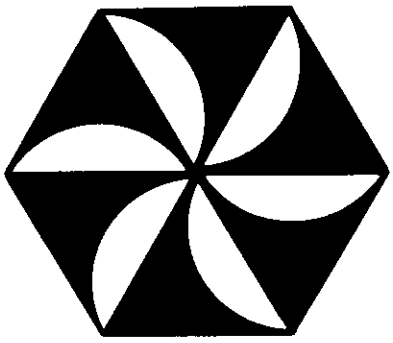

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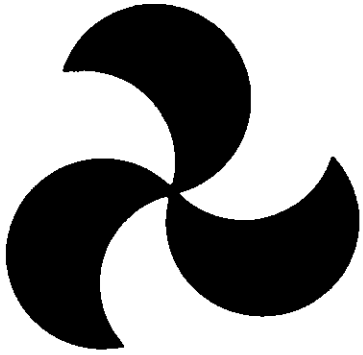

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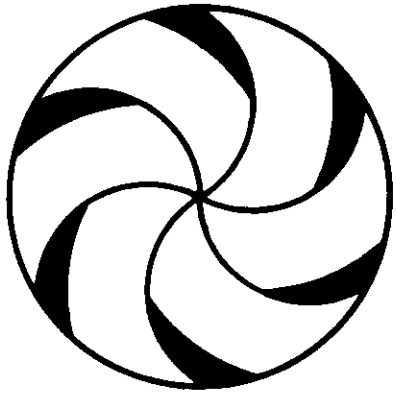

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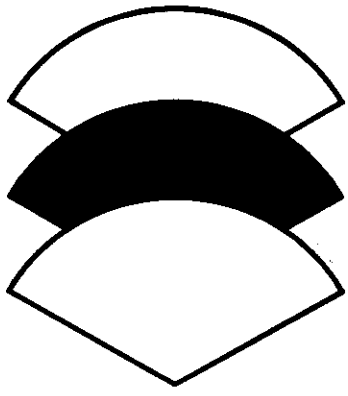

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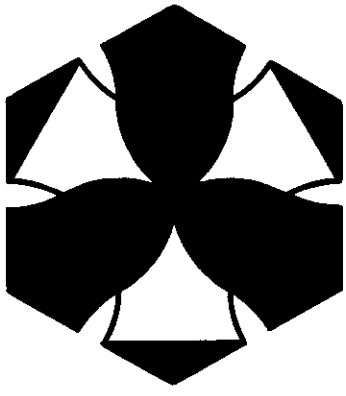

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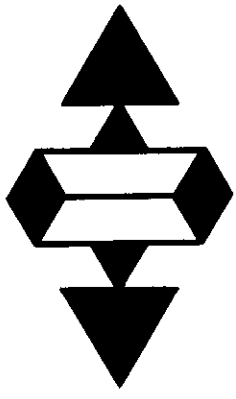

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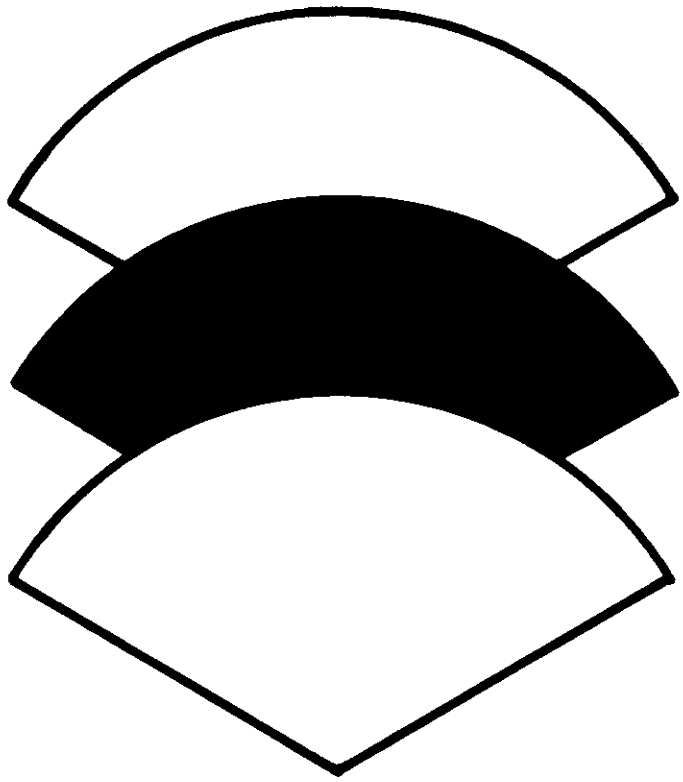

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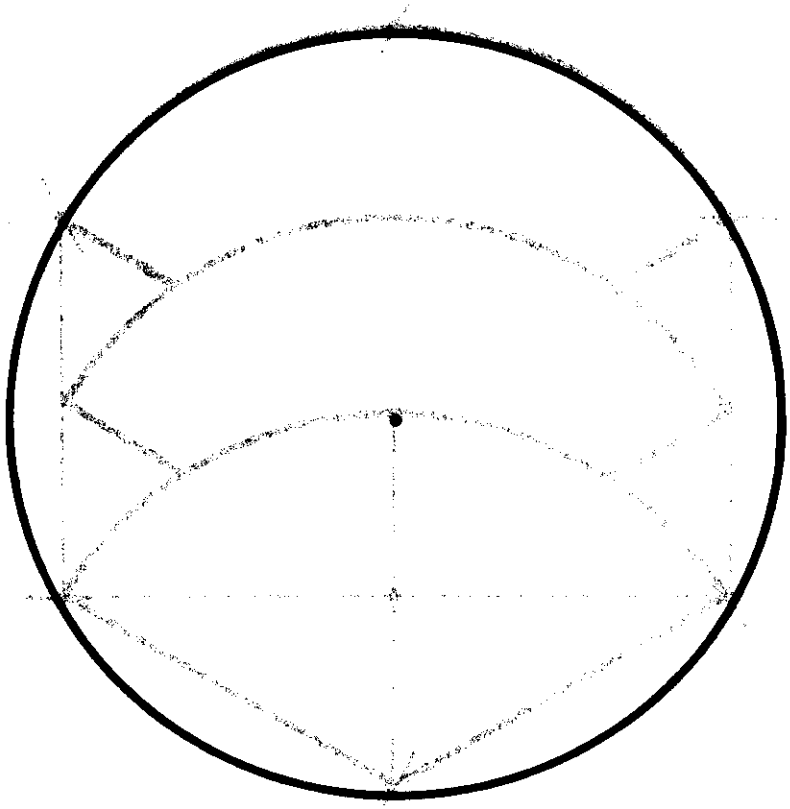

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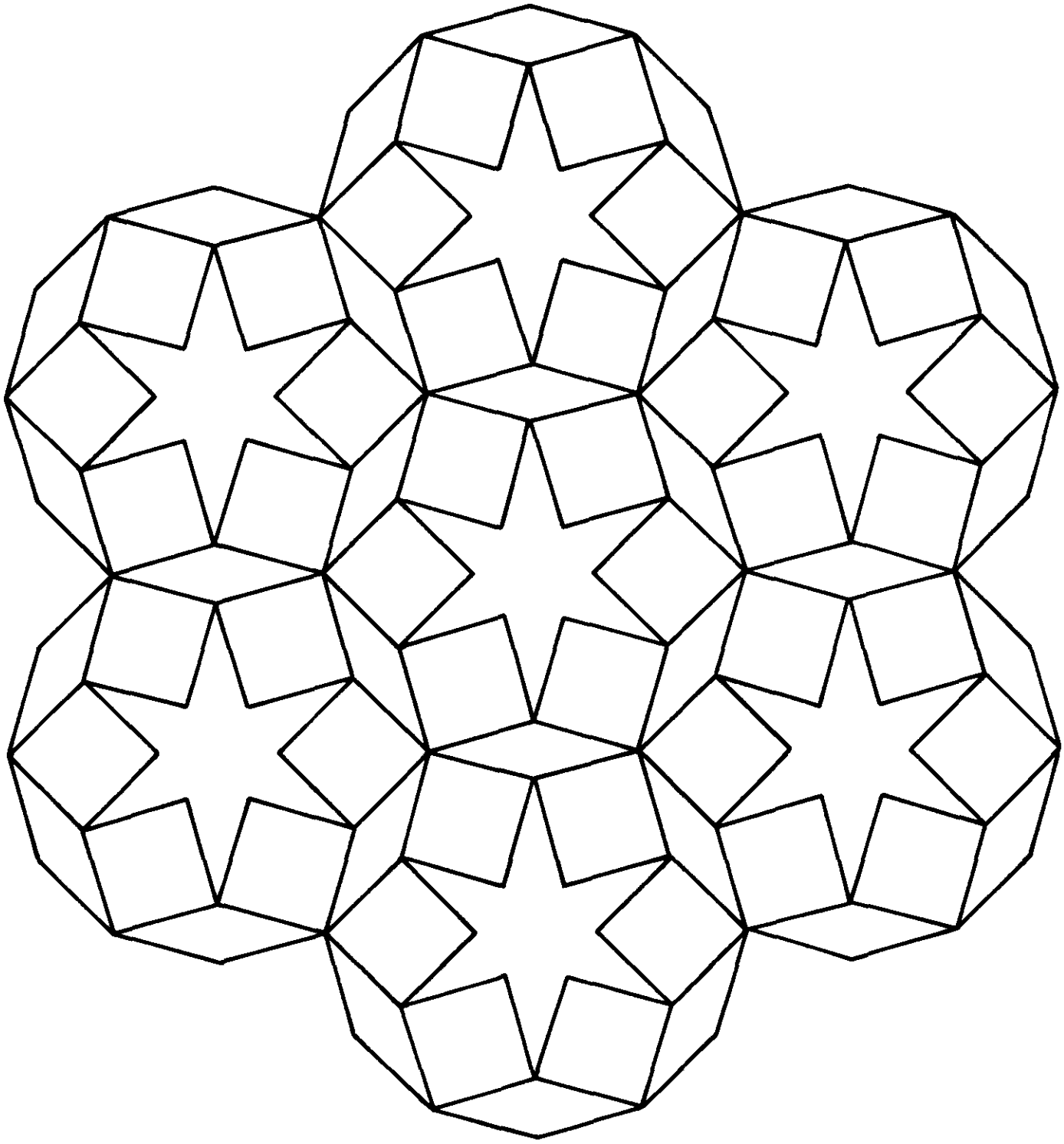

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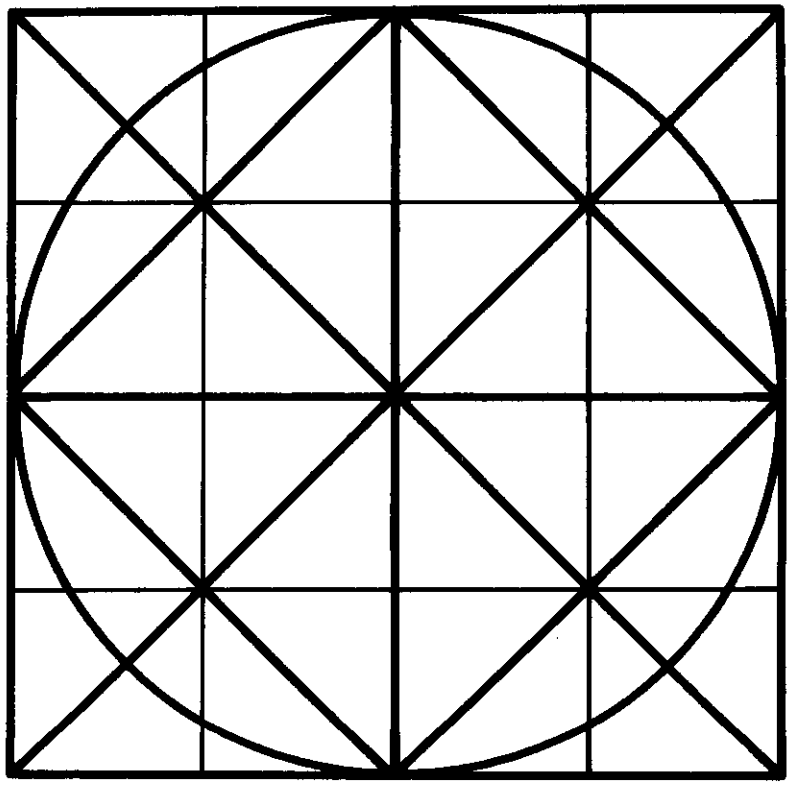
DESIGNS BASED ON SQUARES AND OCTAGONS

All of the designs on the next ten pages were constructed from a square or an octagon inscribed in a circle. The lines and intersecting points in the figure below provide the basis for the lines, centers and arc radii of these designs.

How many of these designs can you construct? The designs have been reduced so that several can be shown on a page. It will be much easier for you to use a larger circle (10–15 cm diameter) as a basis for your designs.



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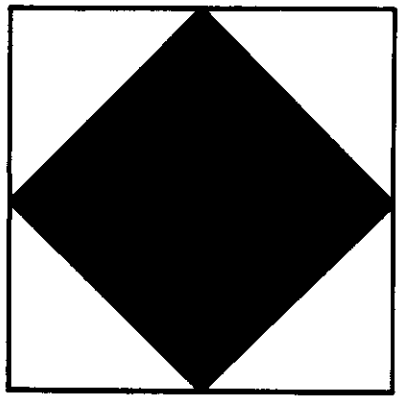

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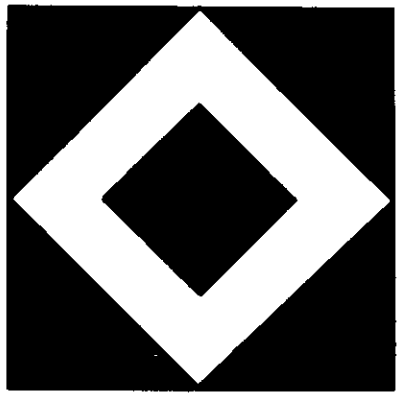

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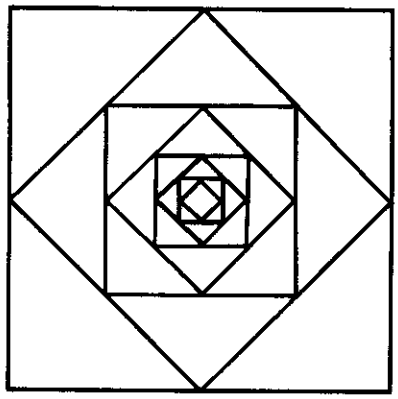

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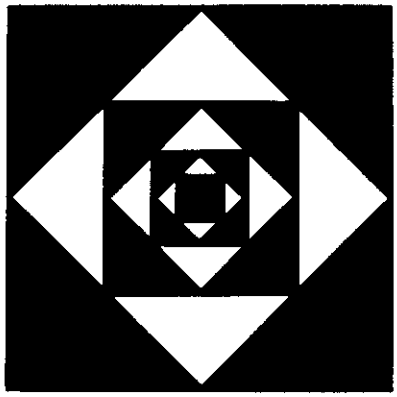

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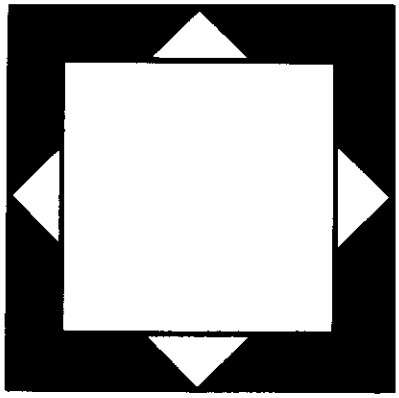

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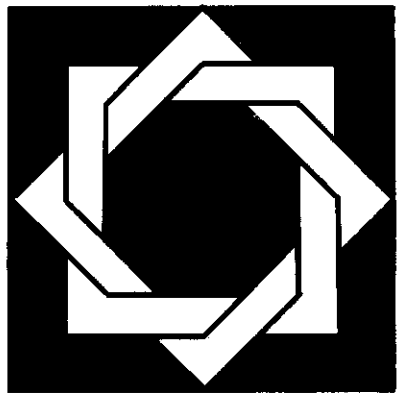

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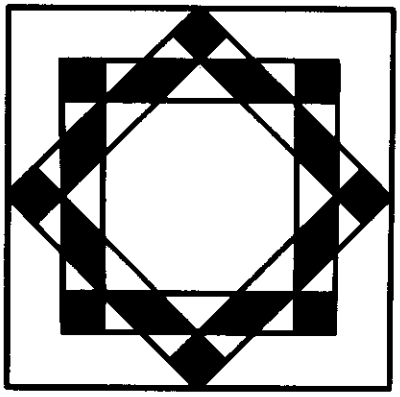

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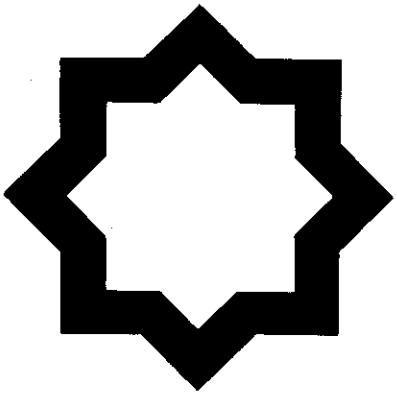

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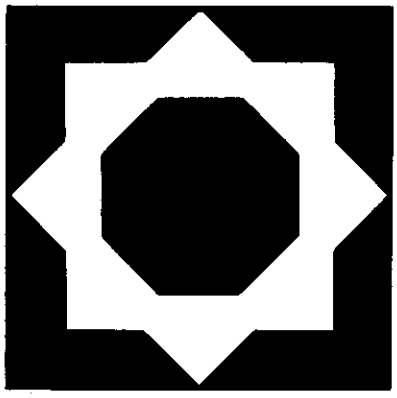

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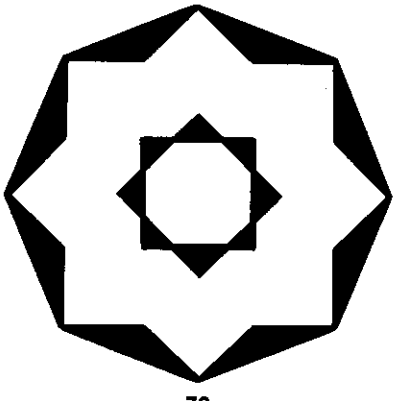

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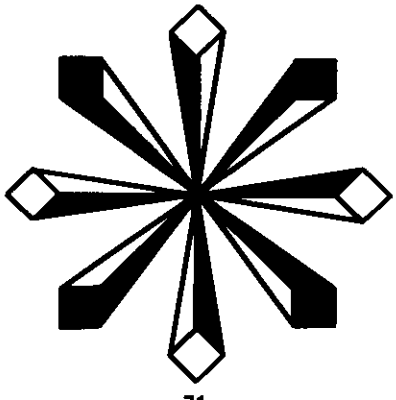

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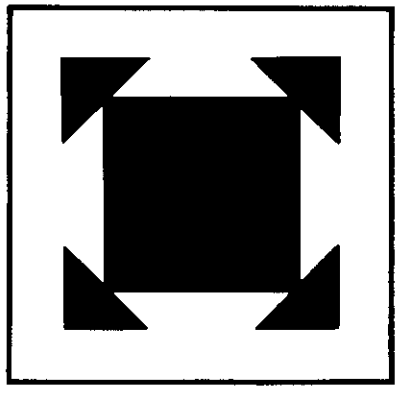

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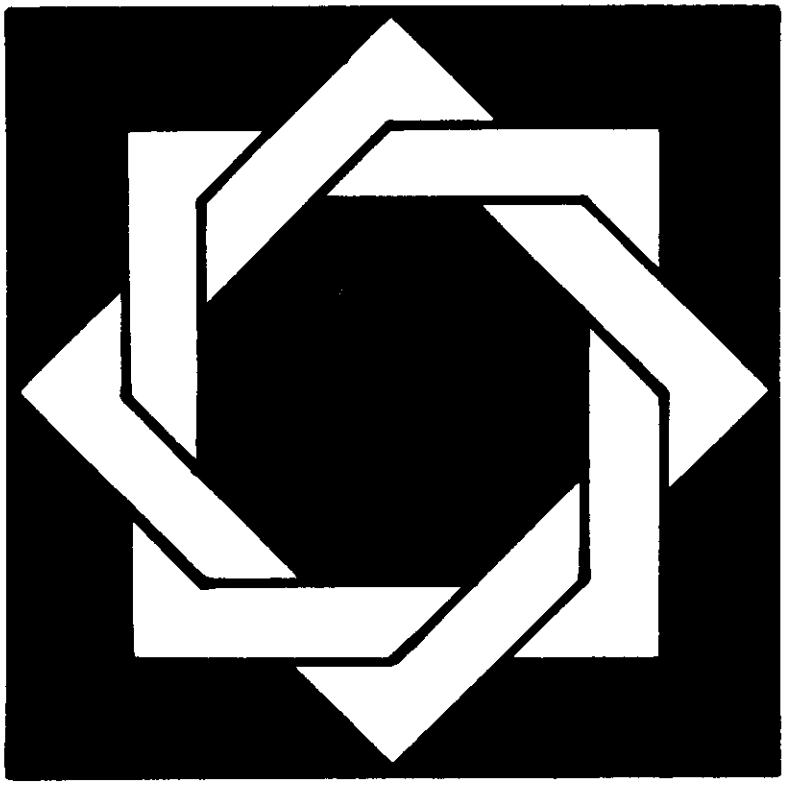

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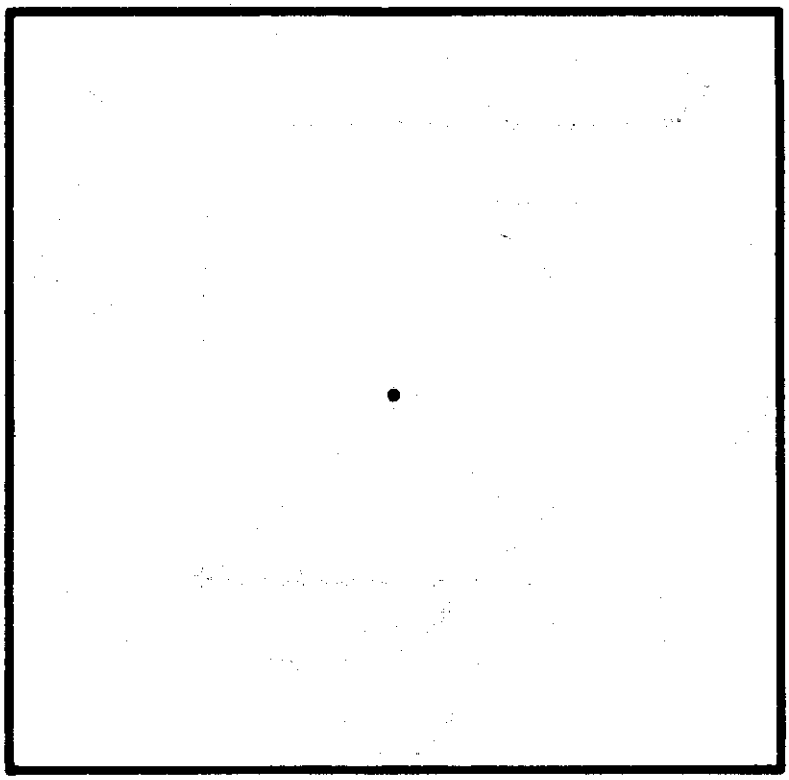

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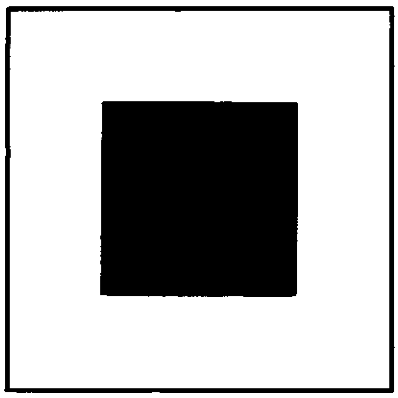

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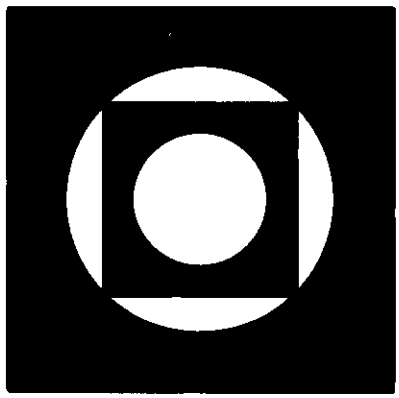

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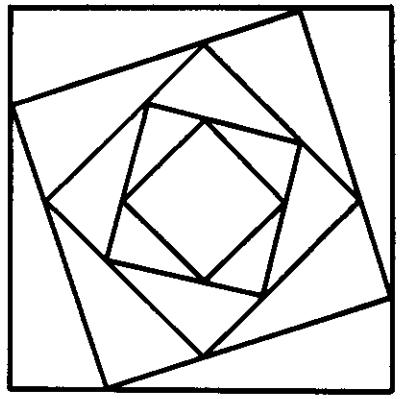

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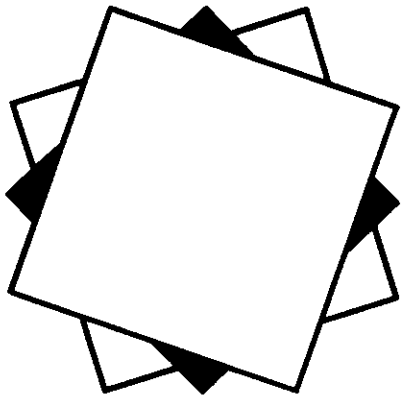

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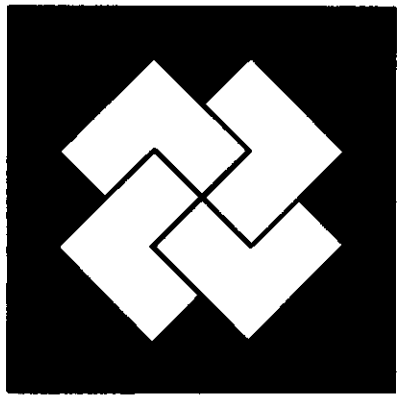

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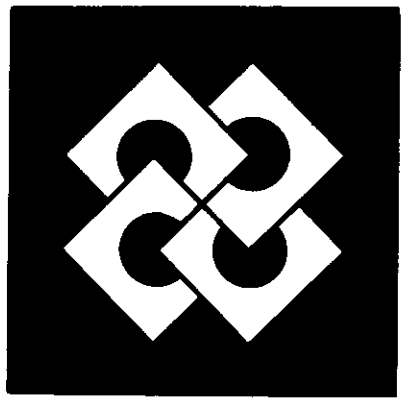

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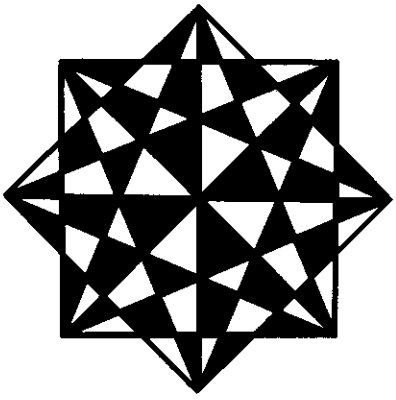

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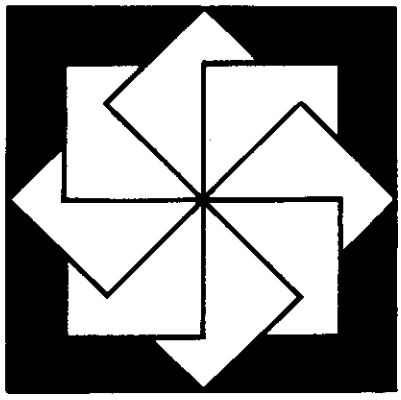

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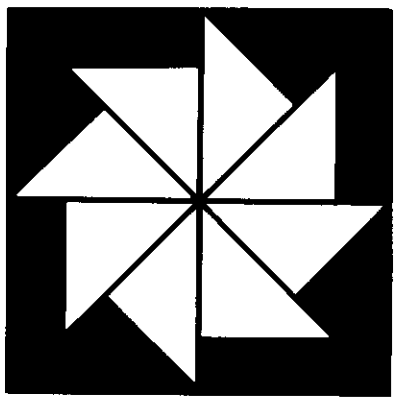

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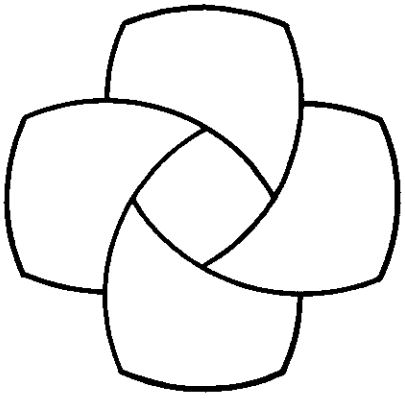

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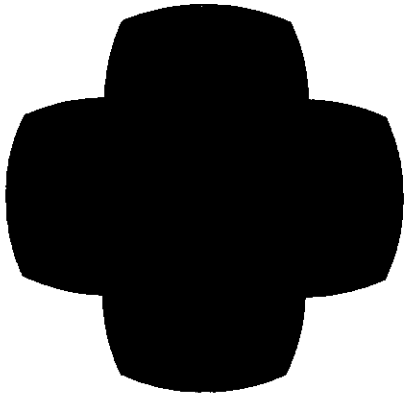

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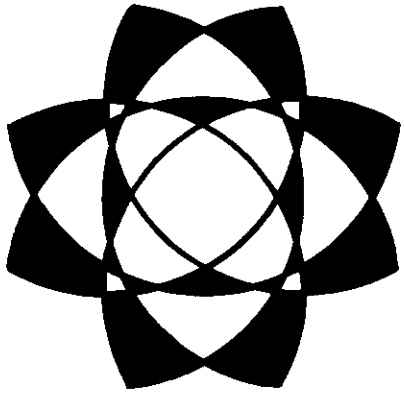

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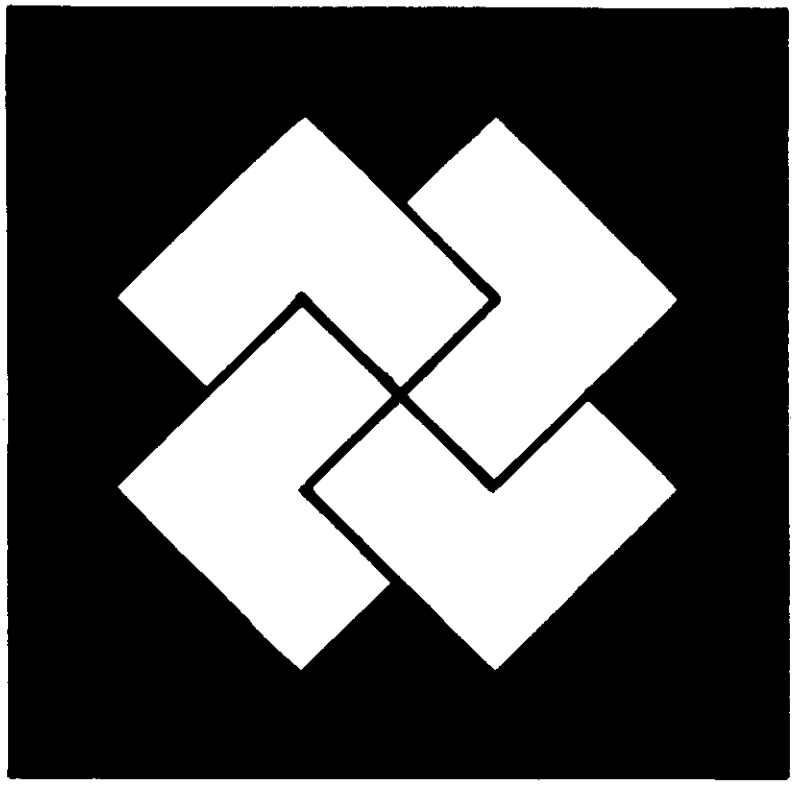

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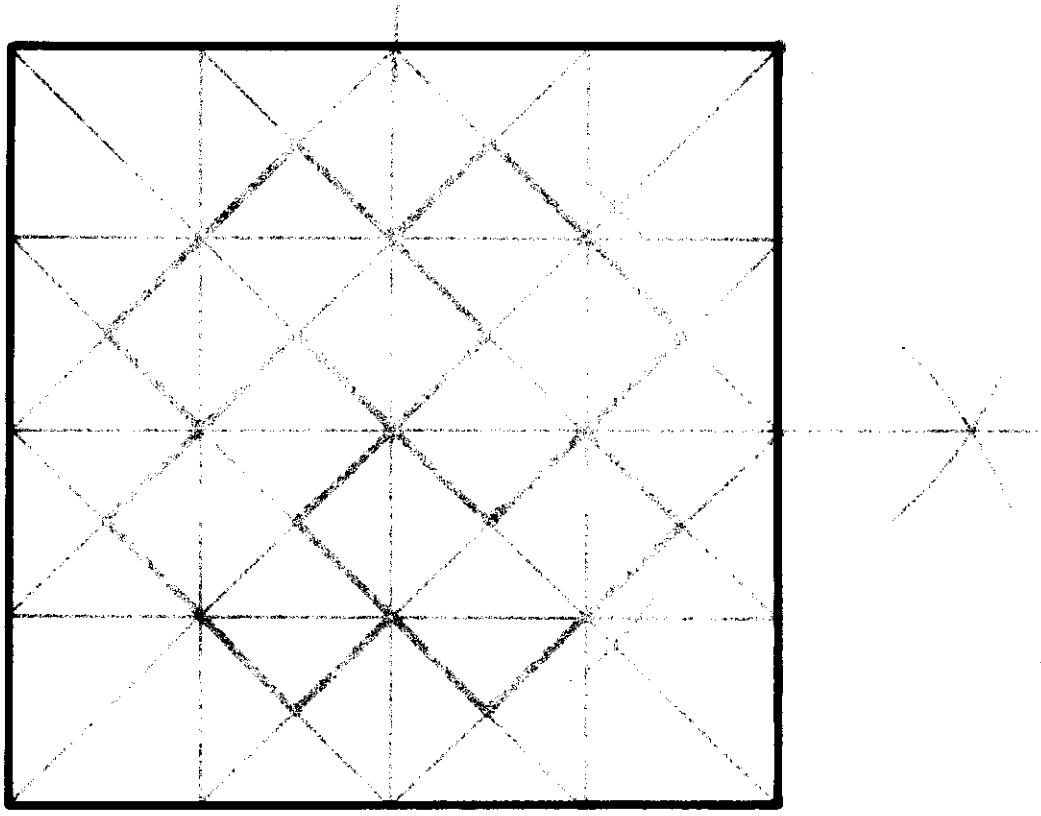

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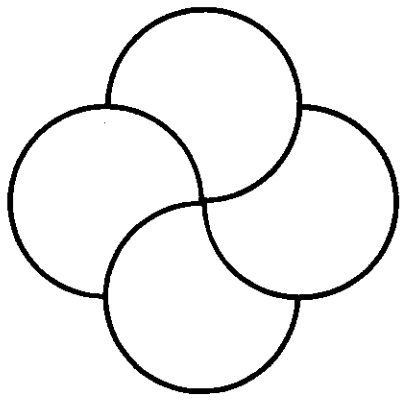

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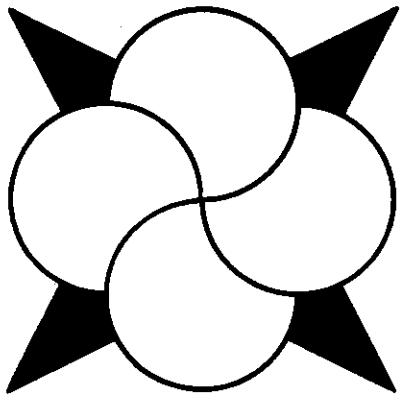

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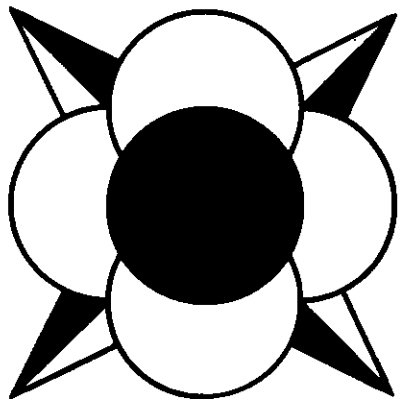

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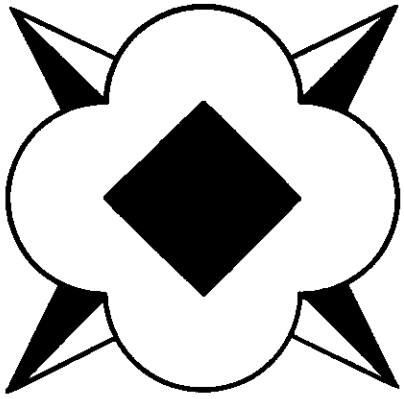

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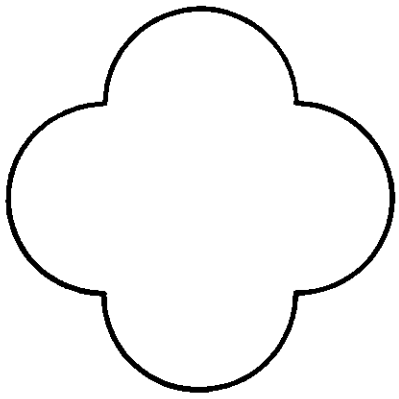

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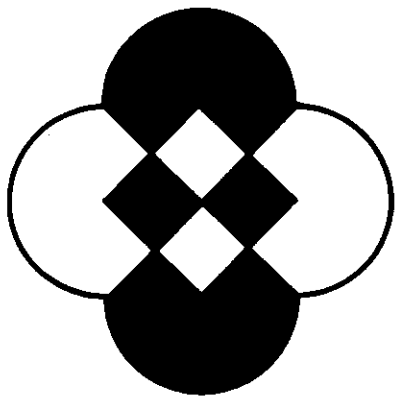

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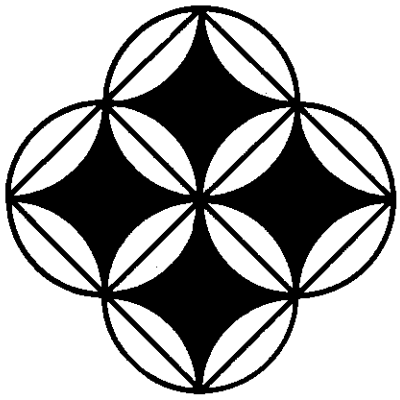

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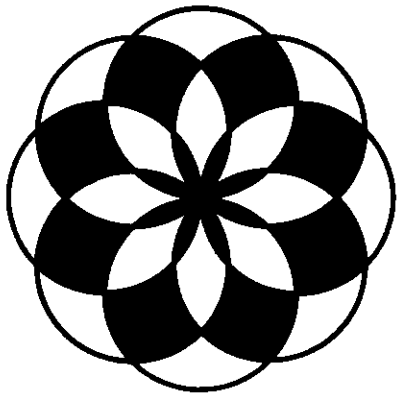

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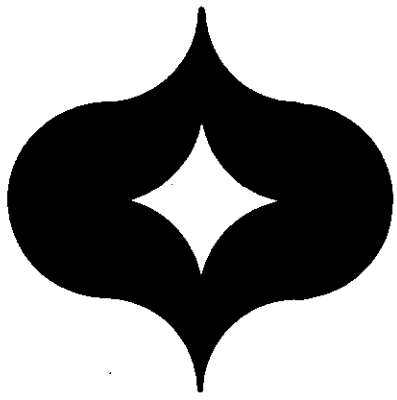

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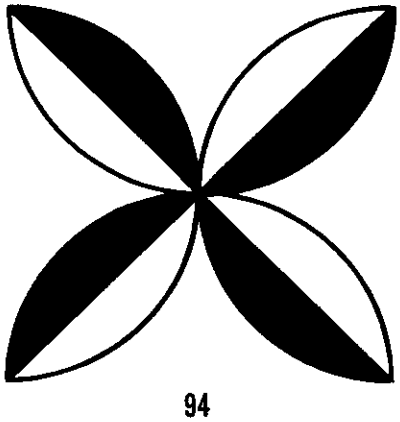

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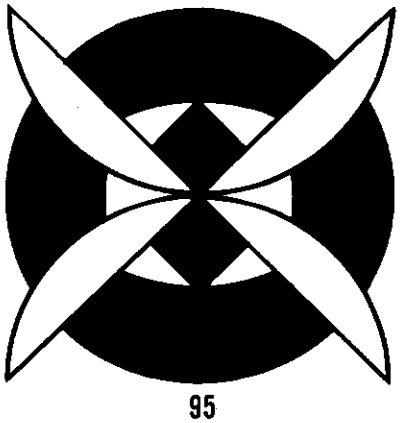

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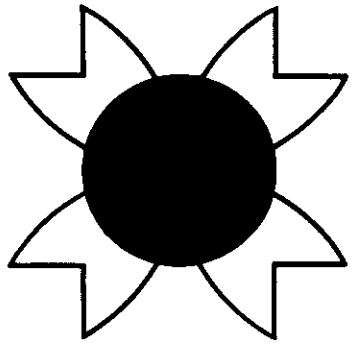

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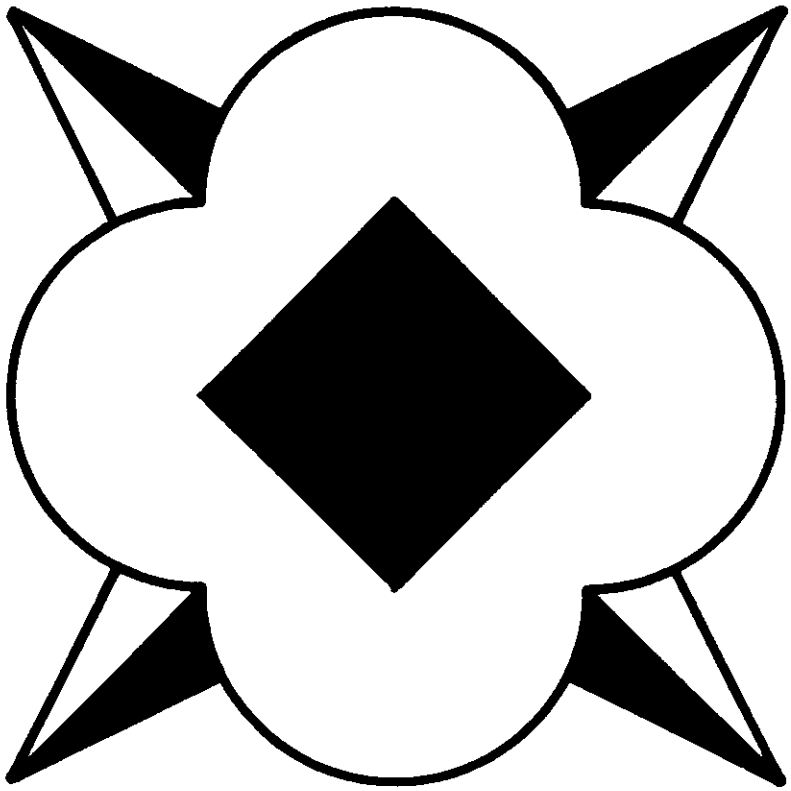

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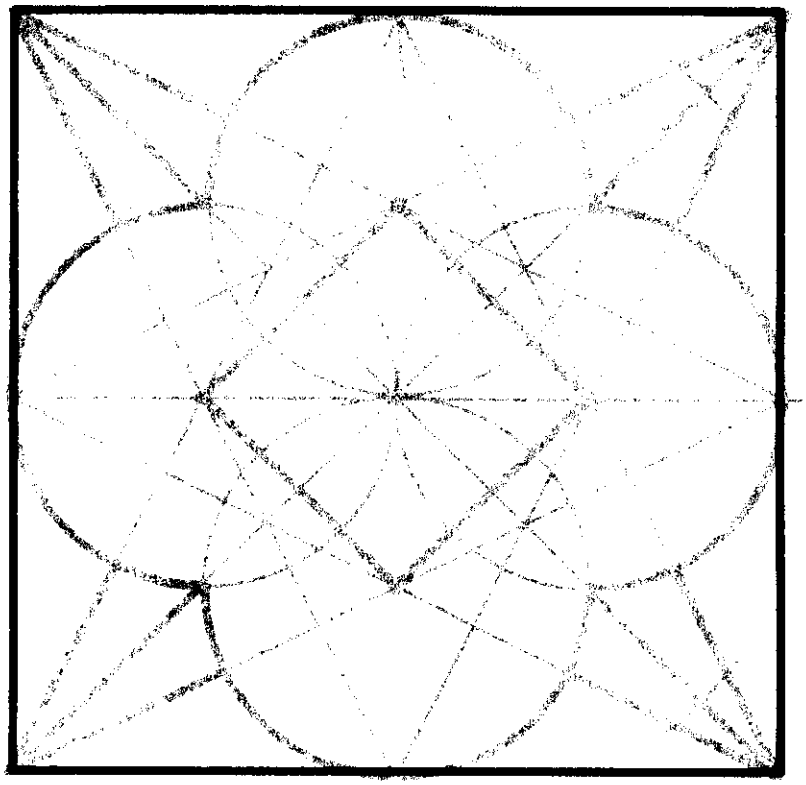

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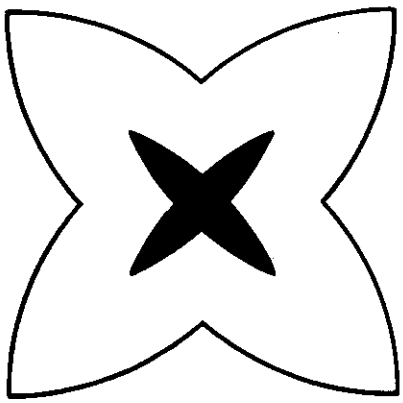

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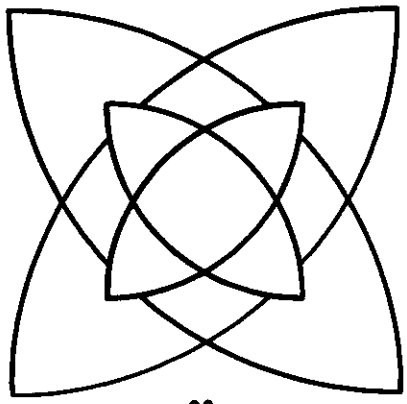

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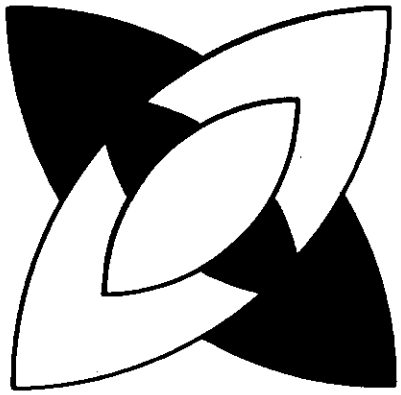

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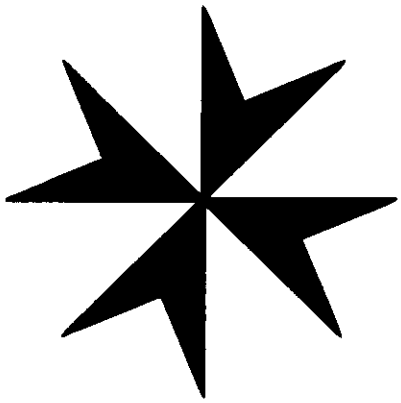

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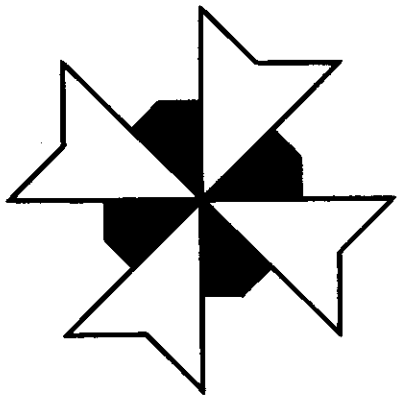

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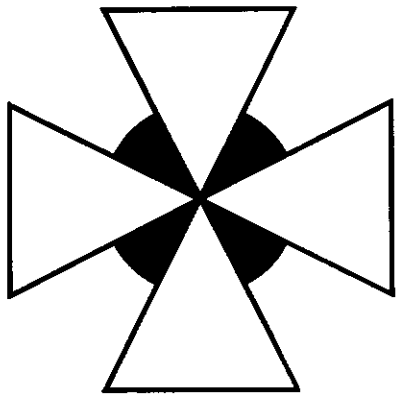

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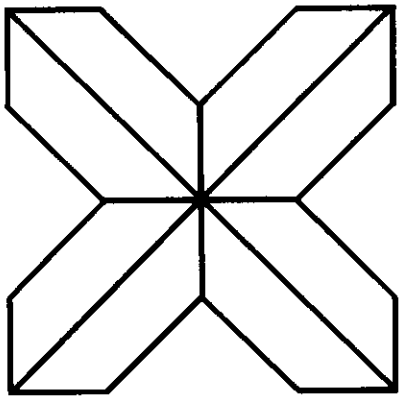

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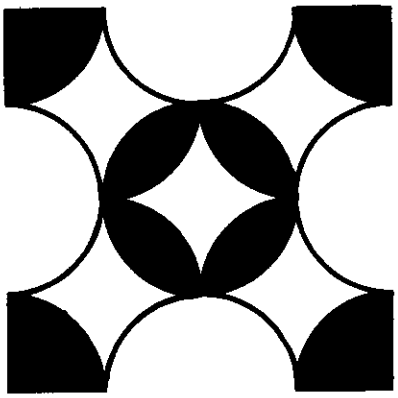

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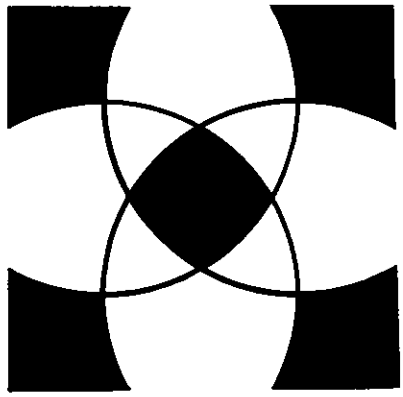

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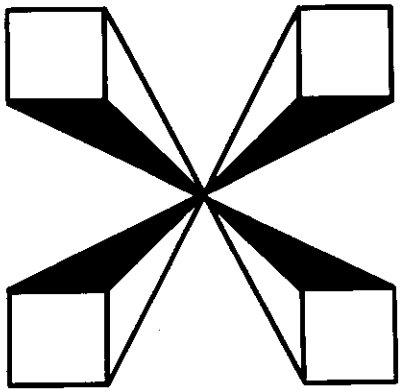

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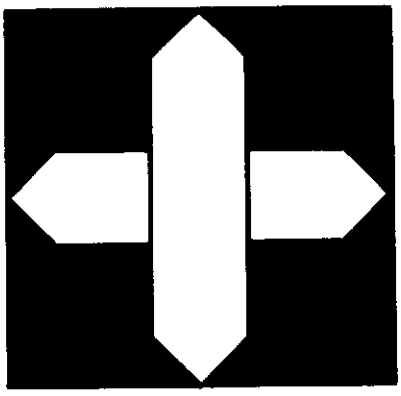

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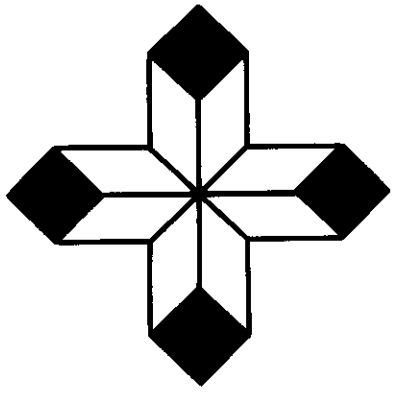

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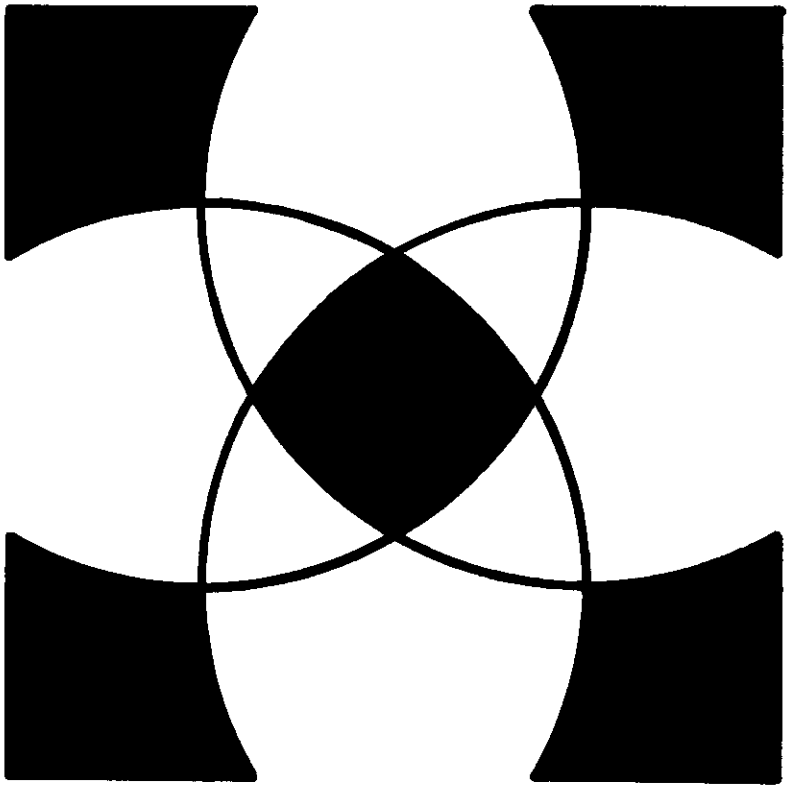

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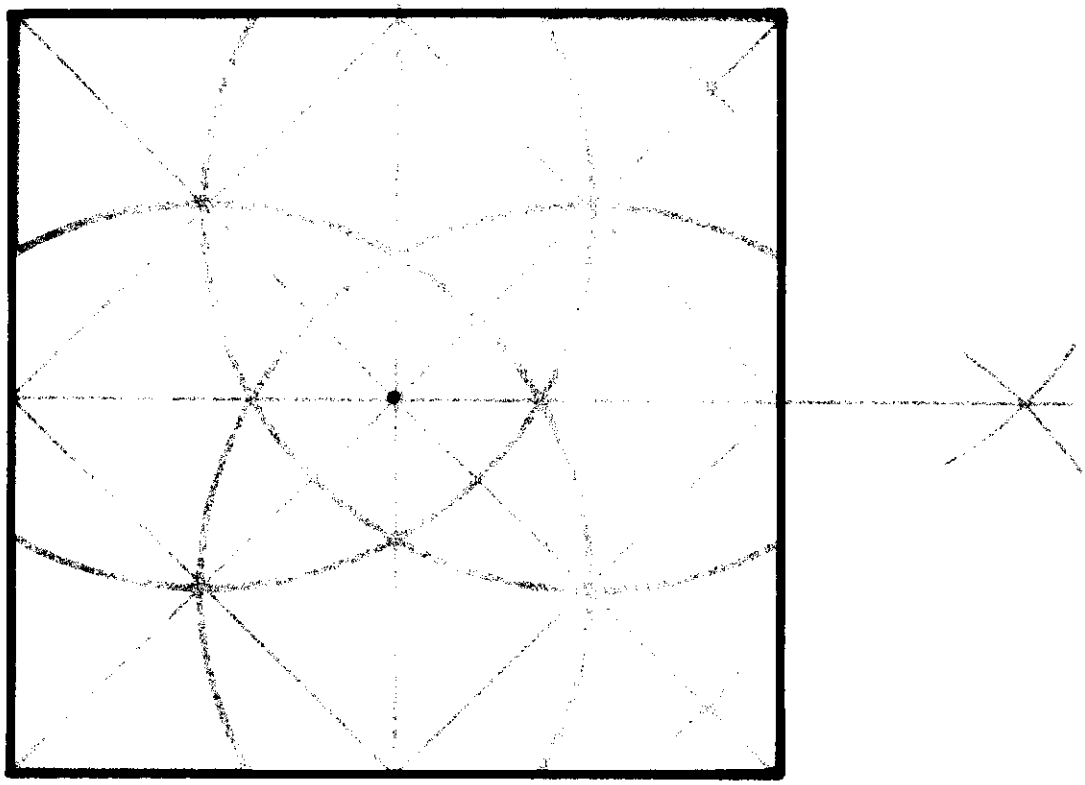

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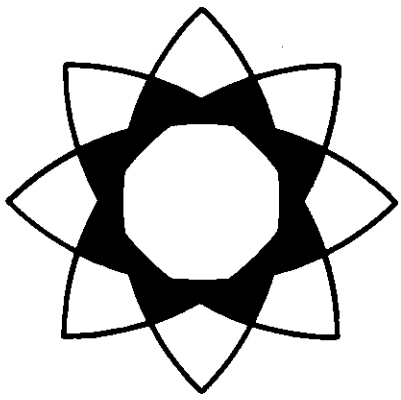

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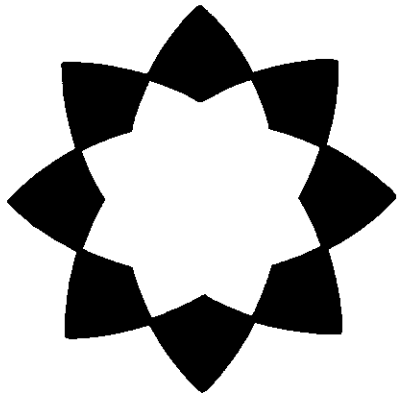

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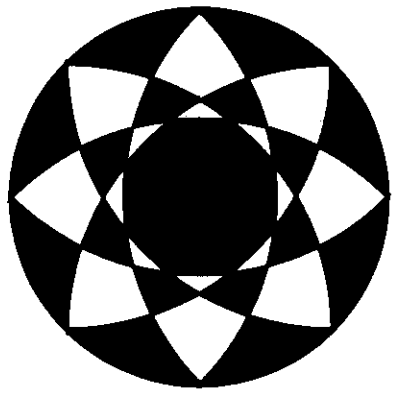

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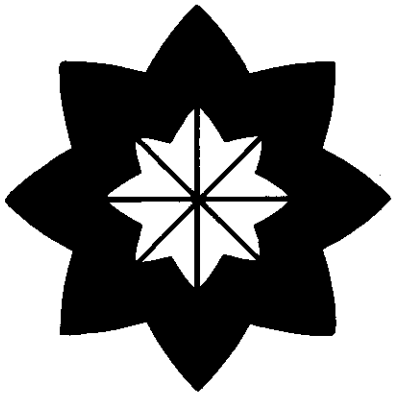

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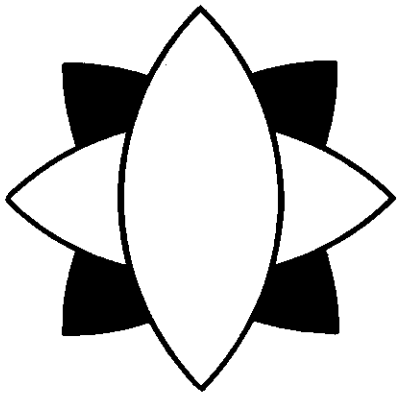

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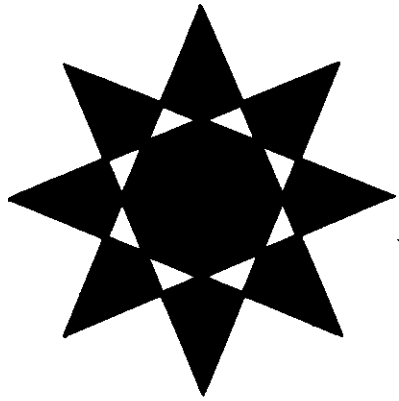

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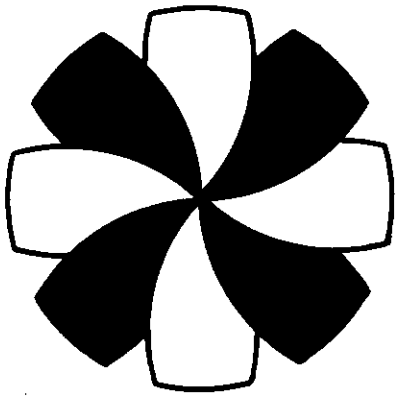

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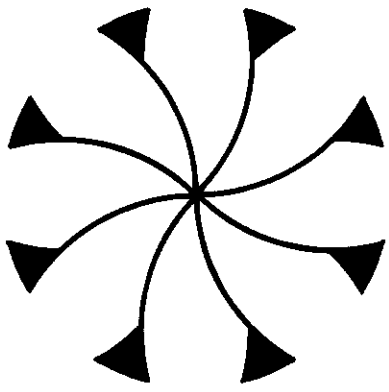

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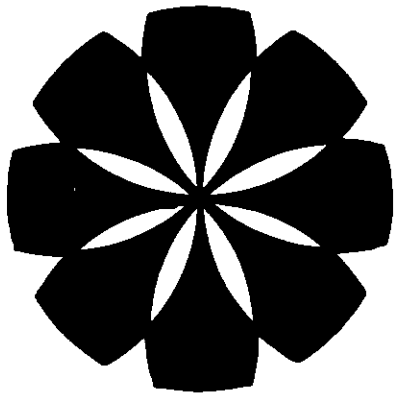

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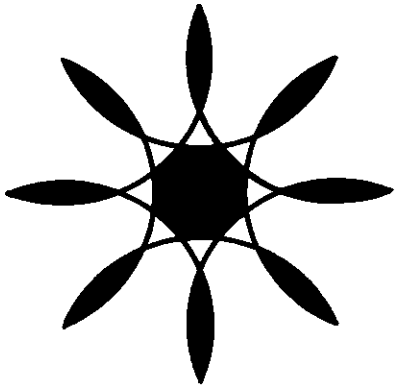

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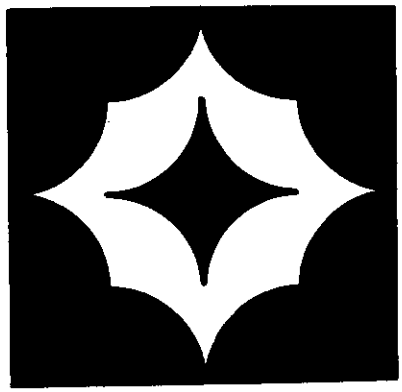

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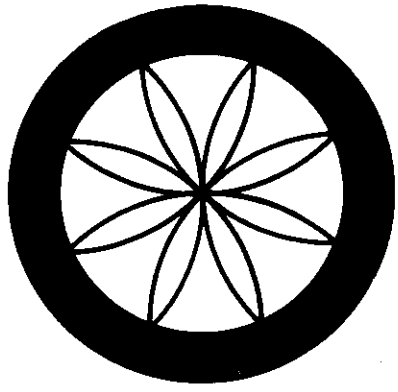

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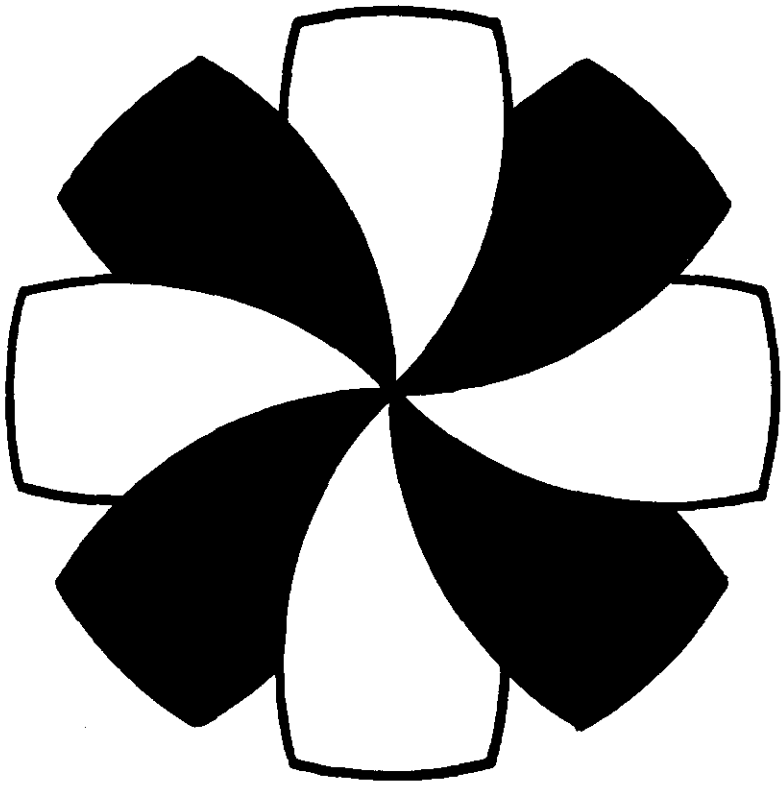

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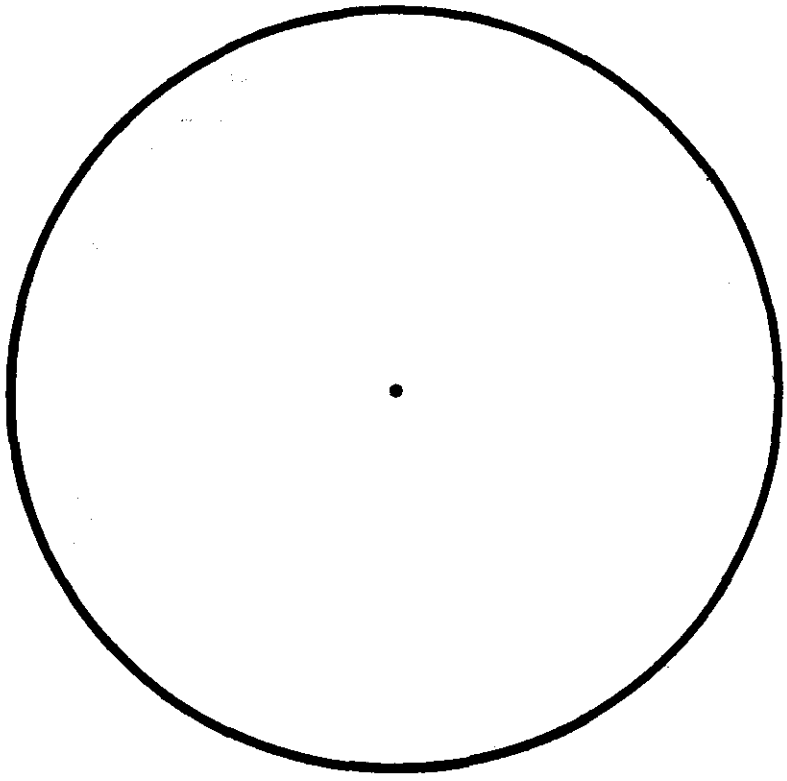

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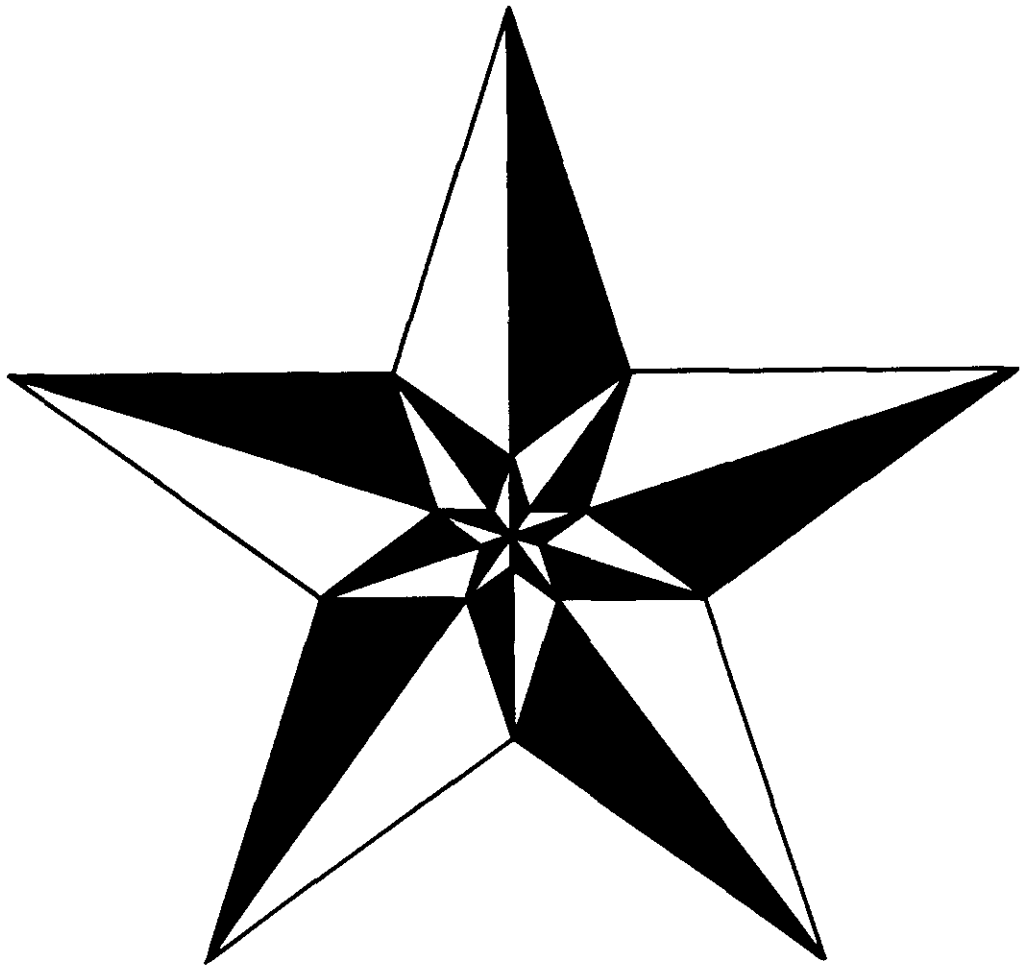

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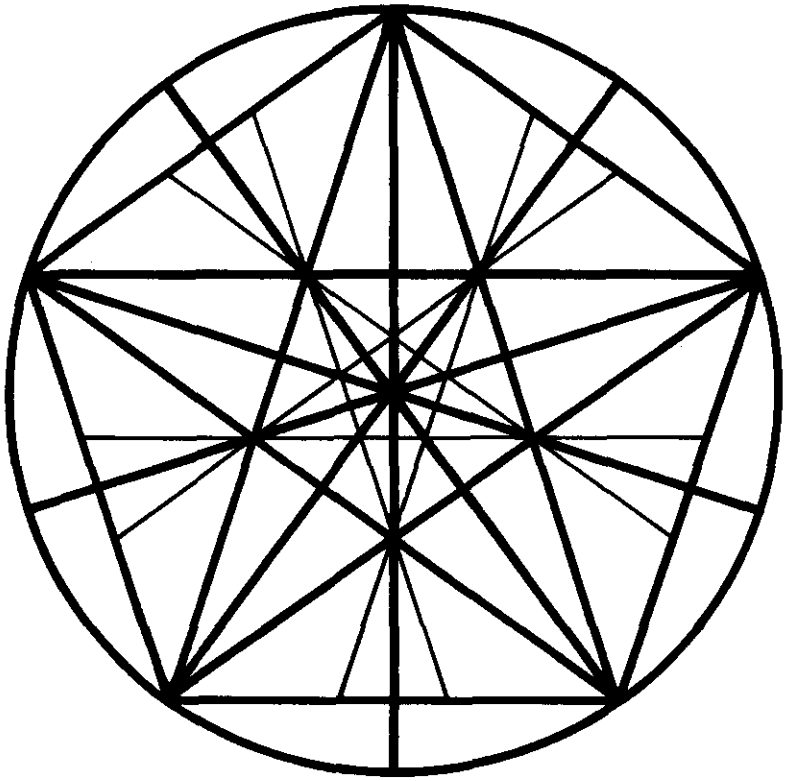
)ESIGNS BASED ON PENTAGONS AND DECAGONS

All of the designs on the next ten pages were constructed from a pentagon or a decagon inscribed in a circle. The lines and intersecting points in the figure below provide the basis for the lines, centers and arc radii of these designs.

How many of these designs can you construct? The designs have been reduced so that several can be shown on a page. It will be much easier for you to use a larger circle (10-15 cm diameter) as a basis for your designs.



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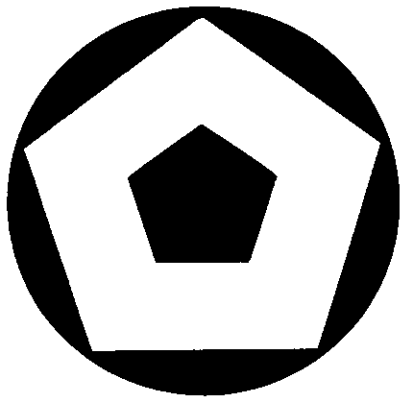

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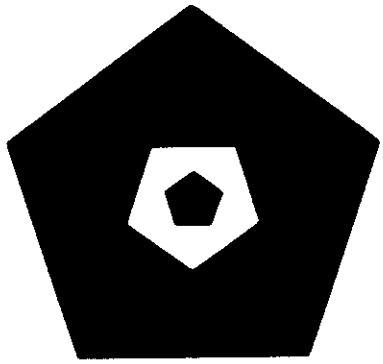

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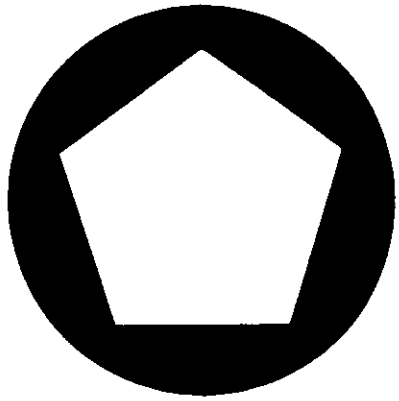

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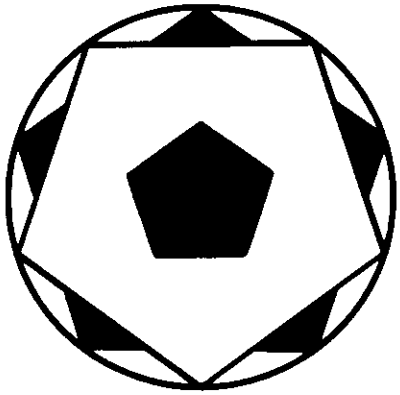

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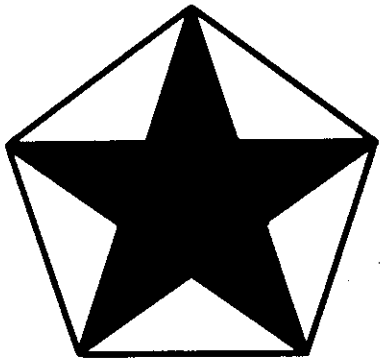

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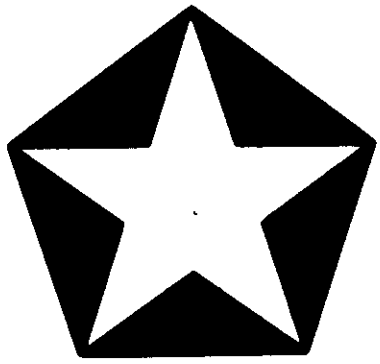

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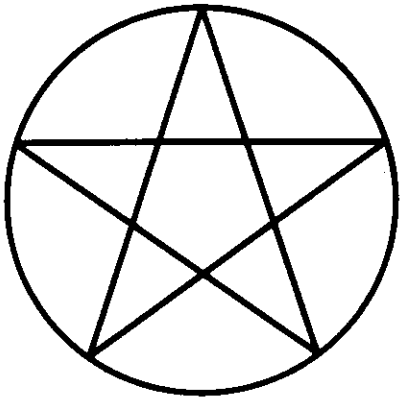

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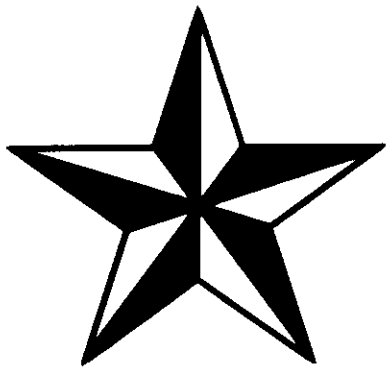

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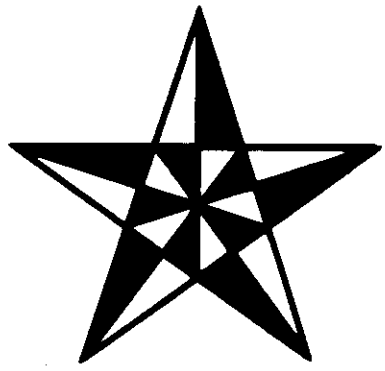

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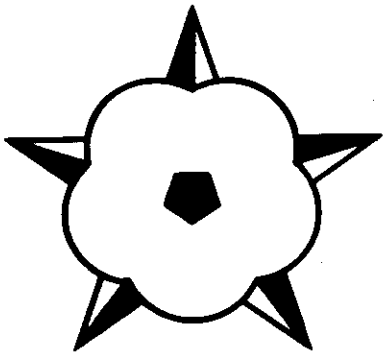

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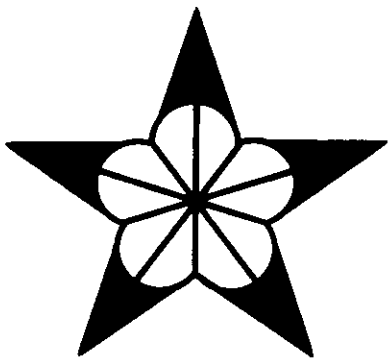

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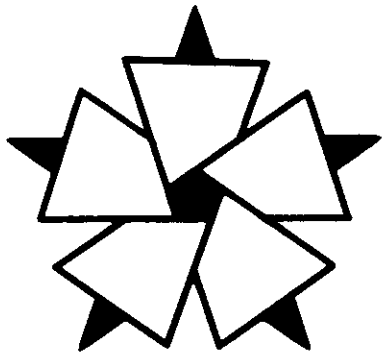

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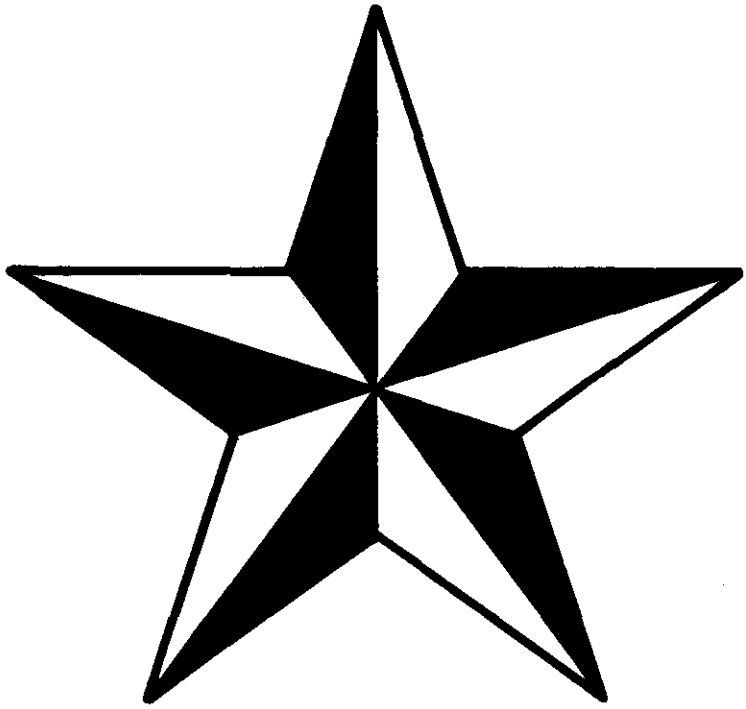

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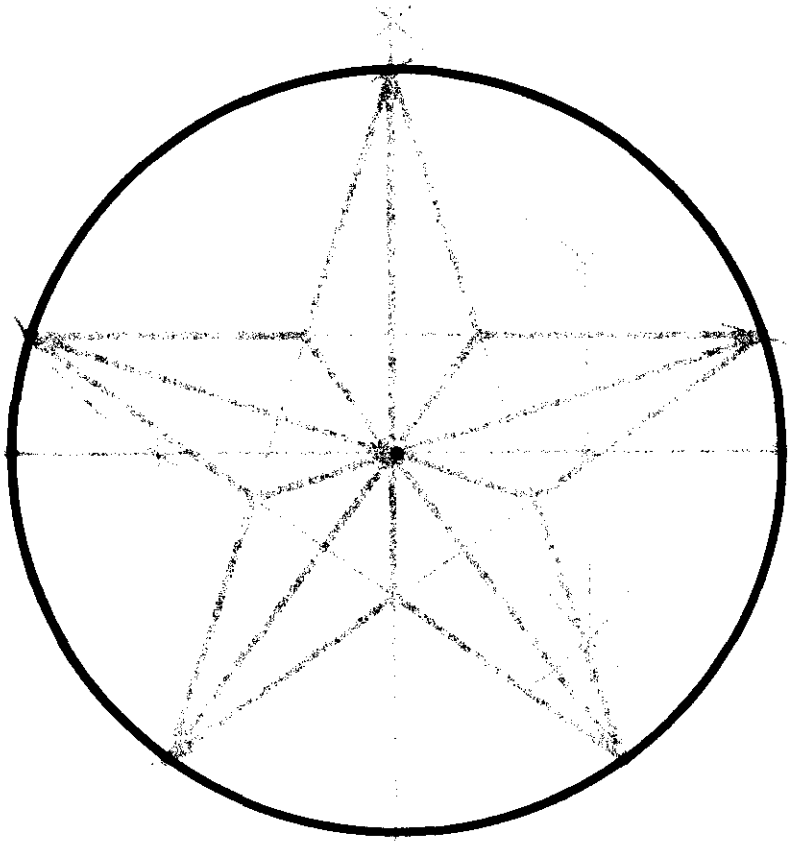

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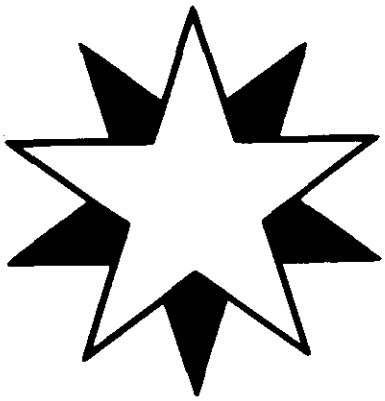

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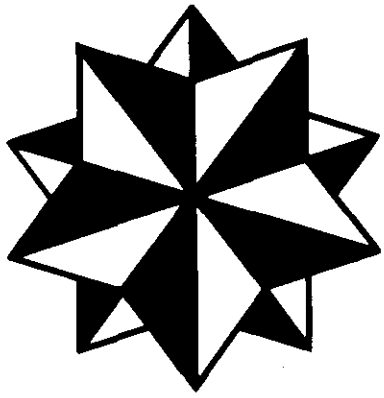

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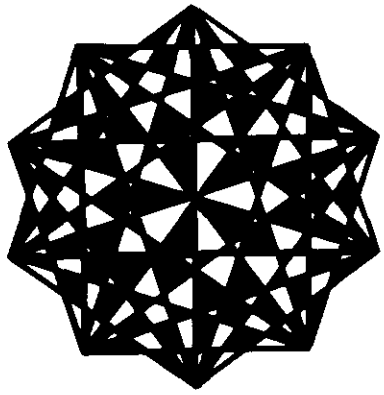

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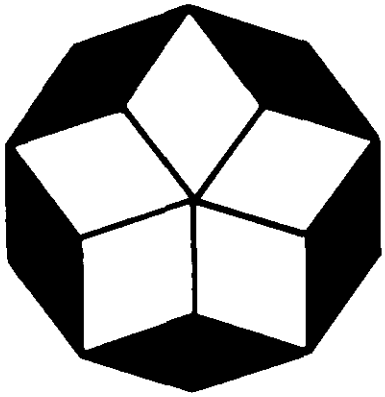

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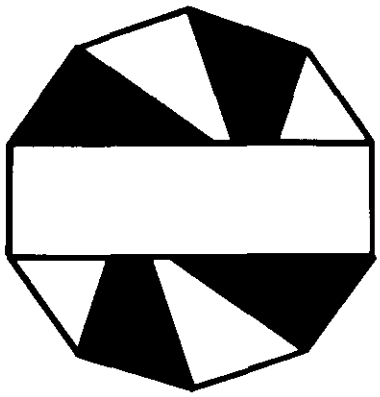

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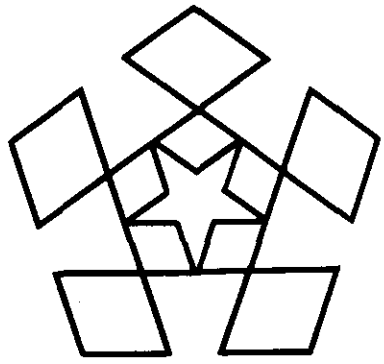

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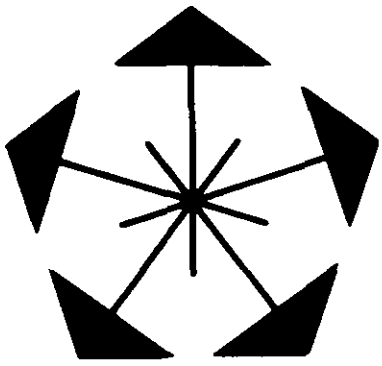

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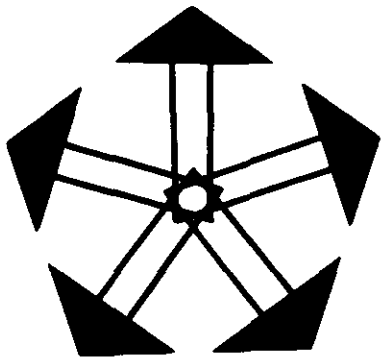

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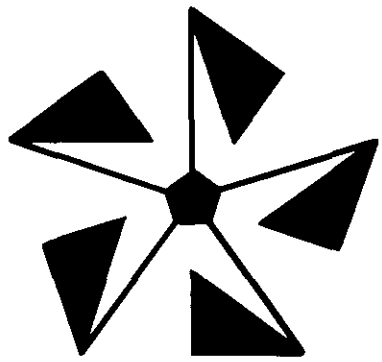

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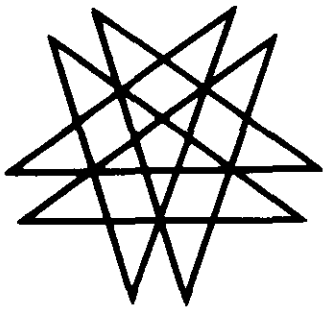

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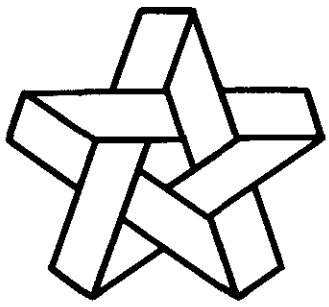

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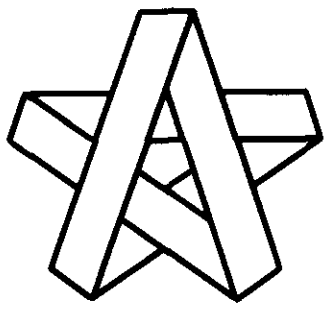

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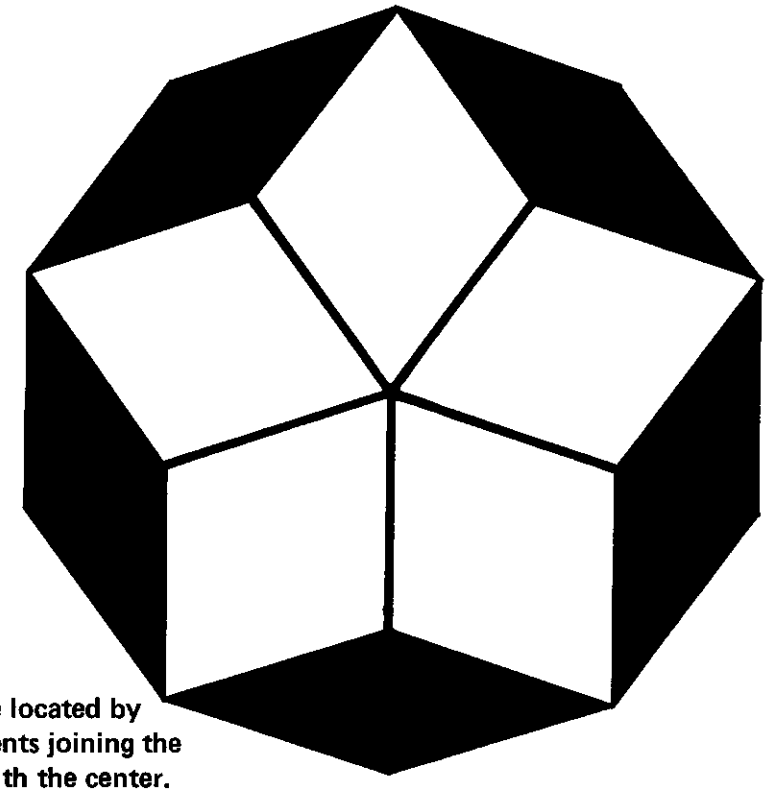

Decagon vertices are located by extending the segments joining the pentagon vertices with the center.

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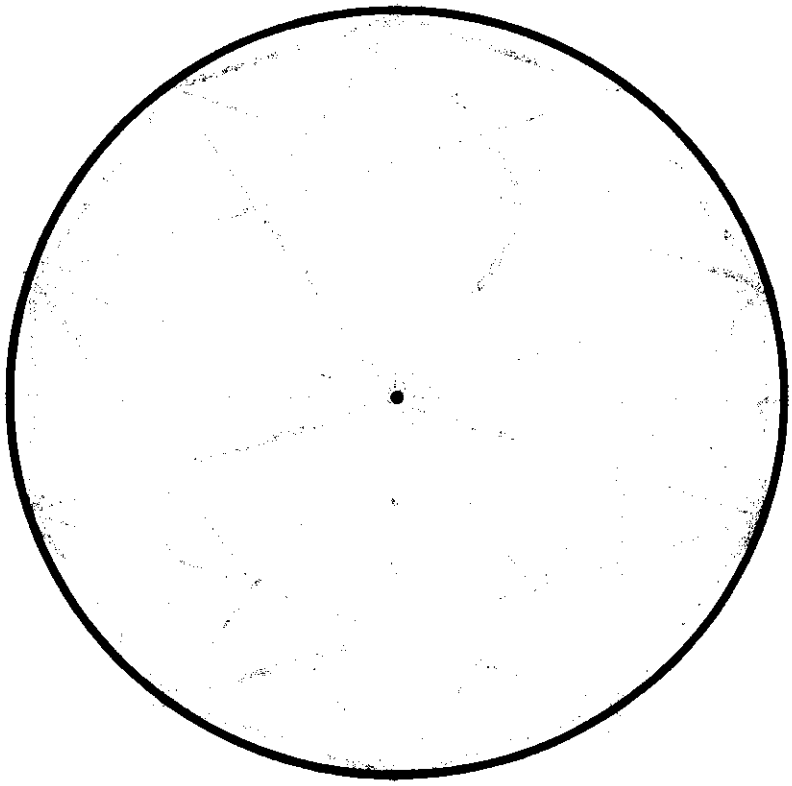

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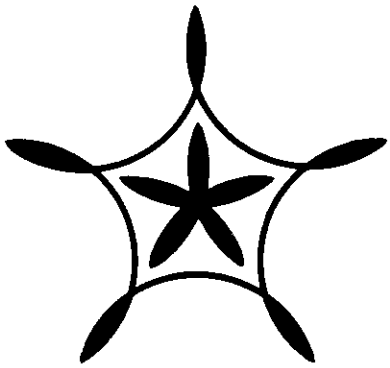

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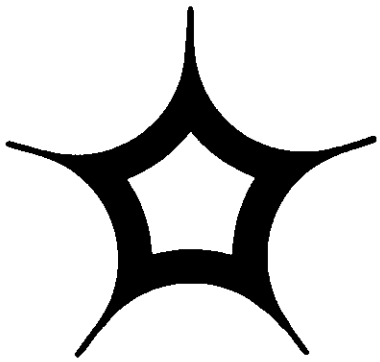

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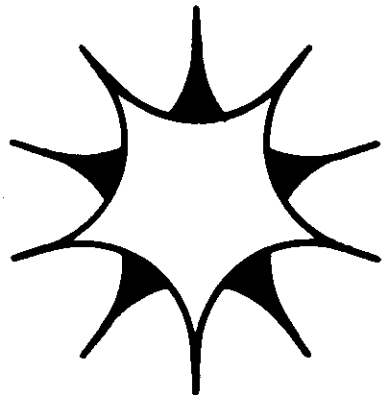

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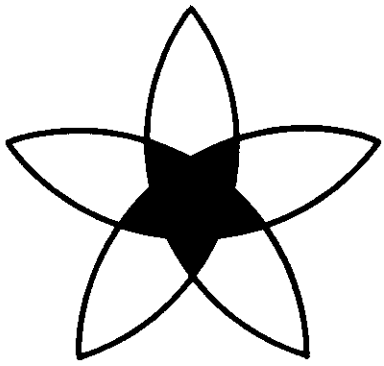

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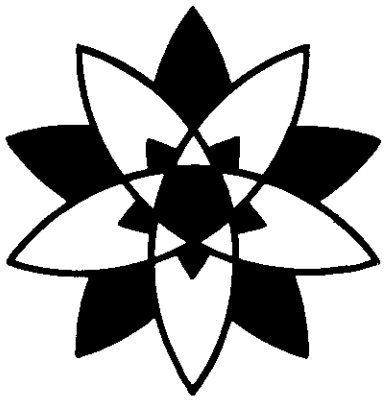

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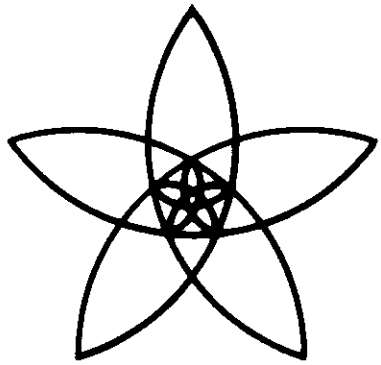

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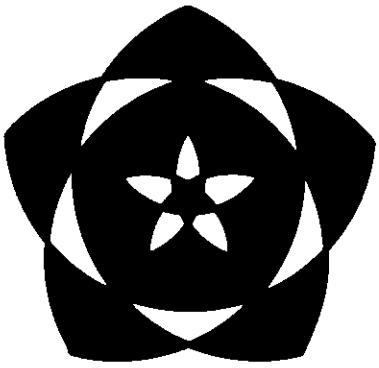

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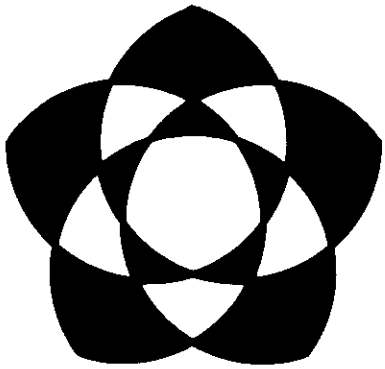

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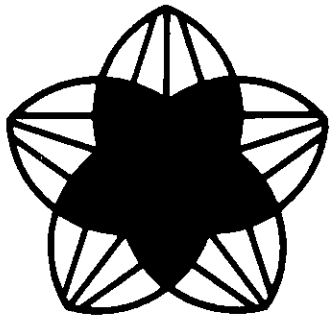

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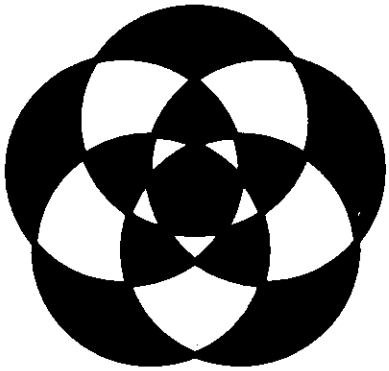

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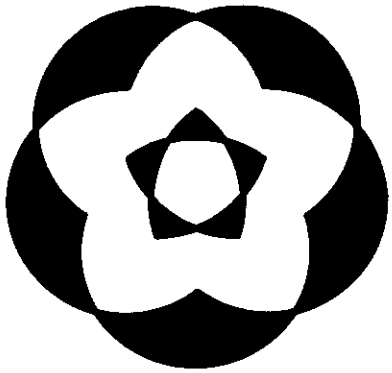

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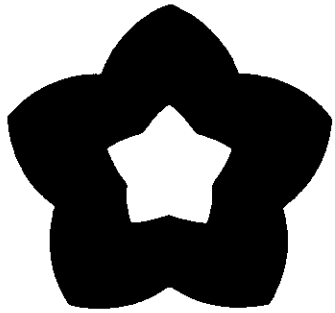

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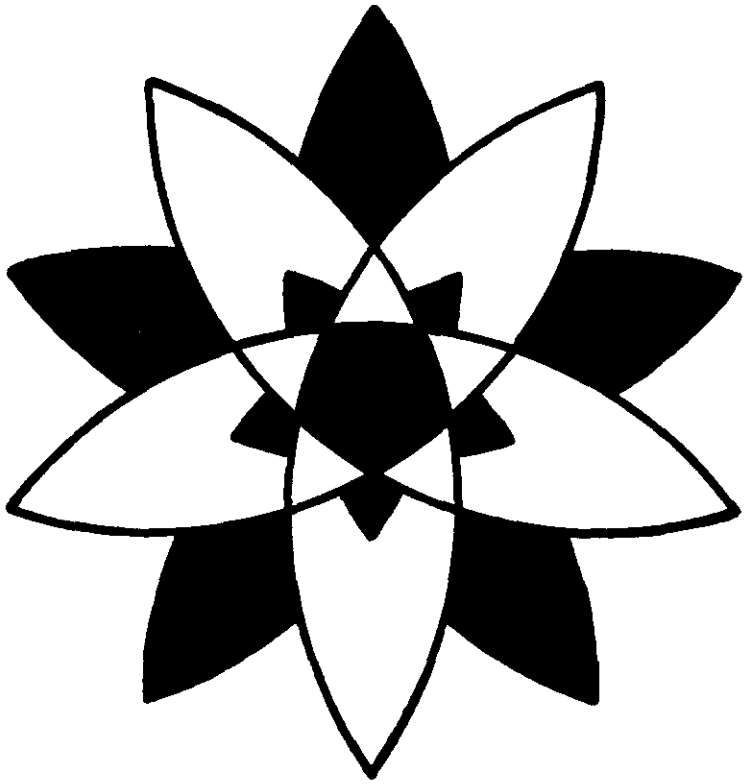

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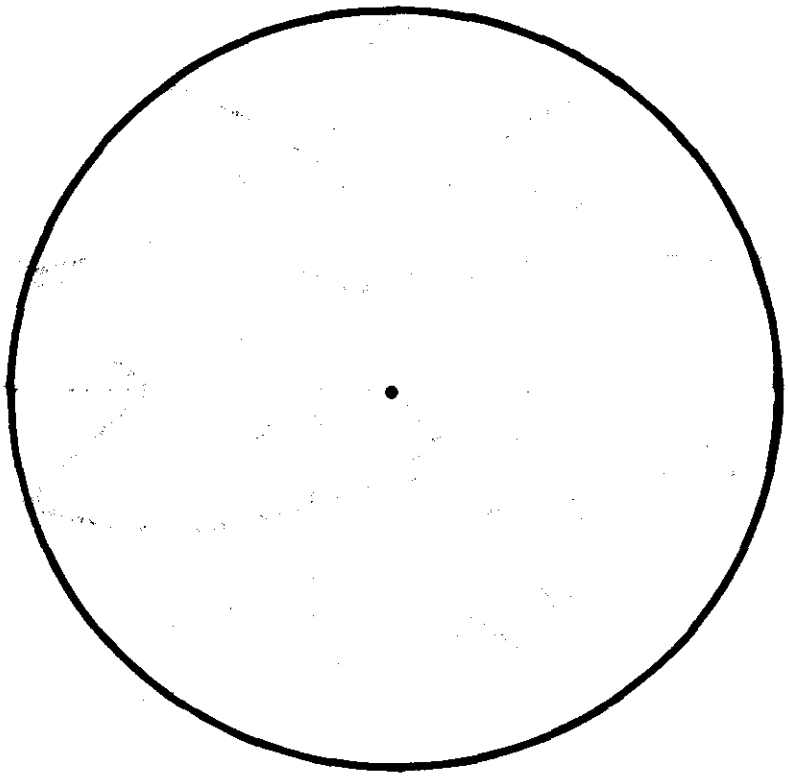

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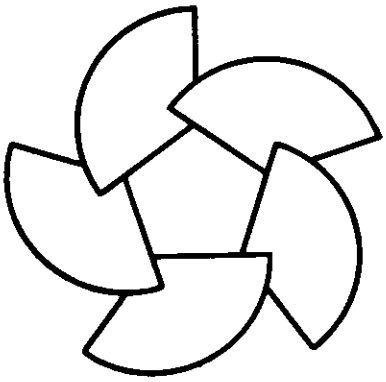

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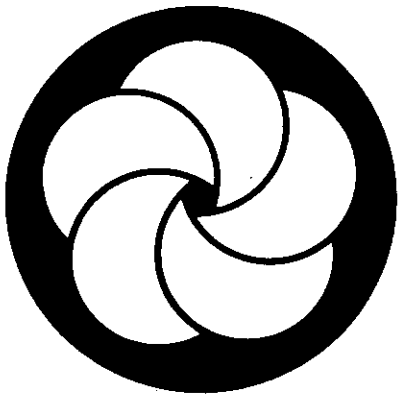

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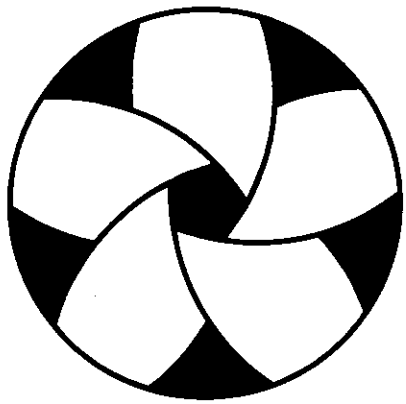

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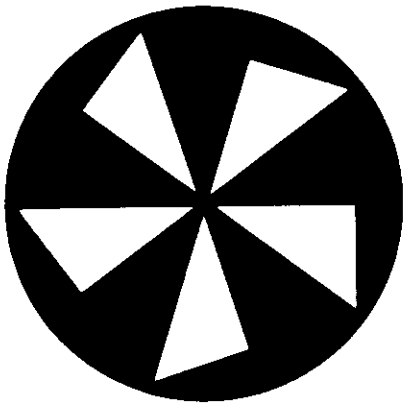

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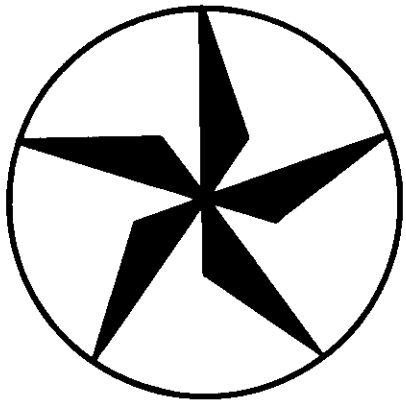

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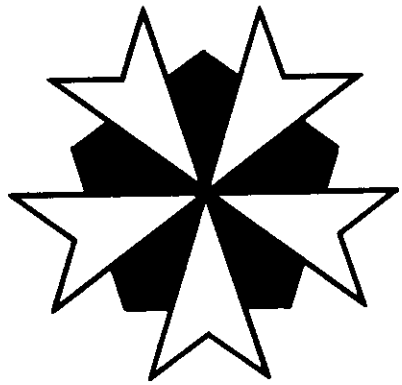

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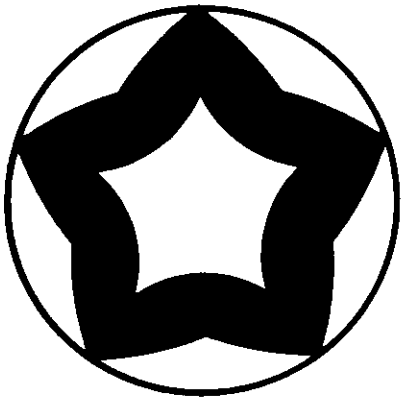

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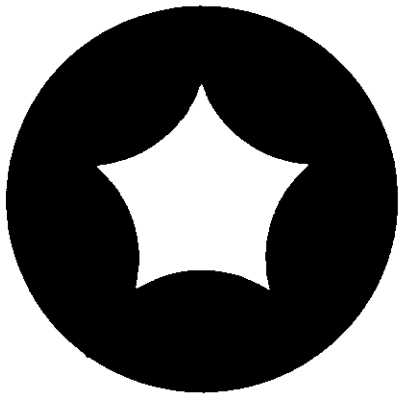

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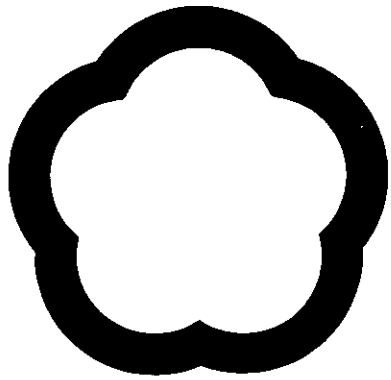

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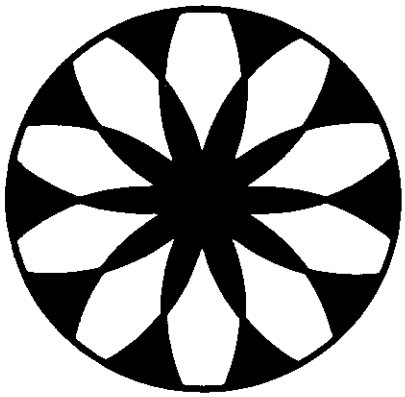

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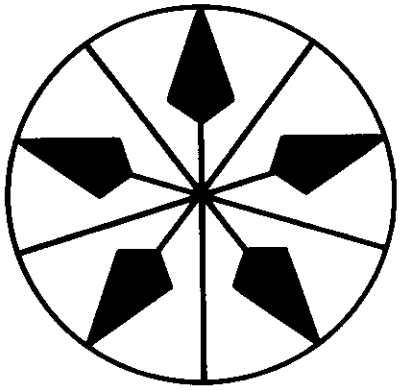

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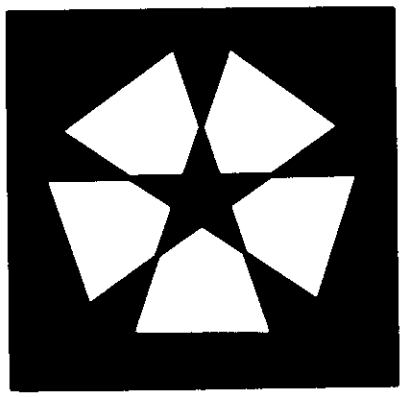

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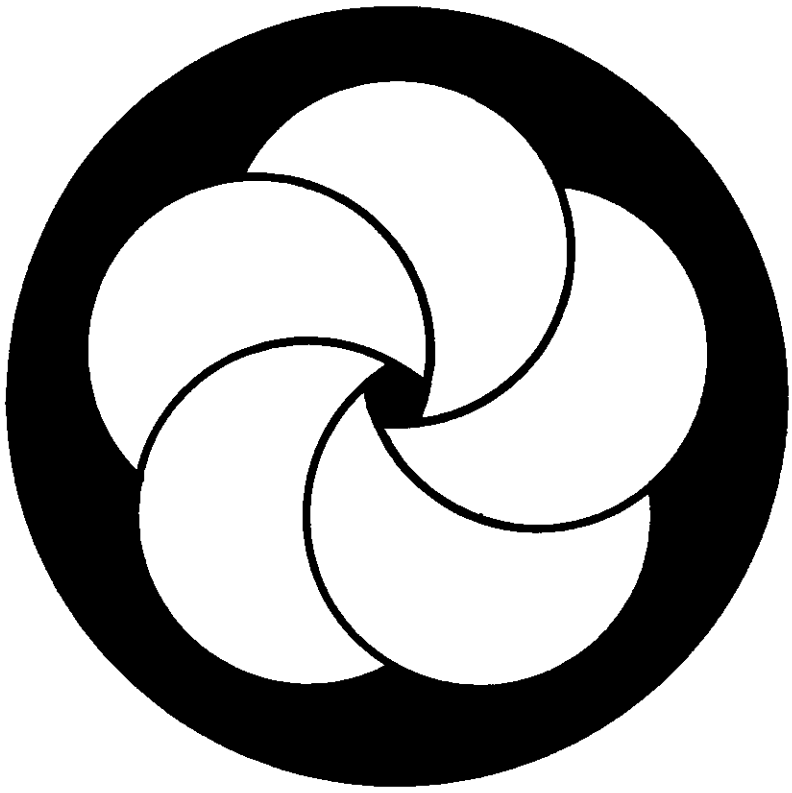

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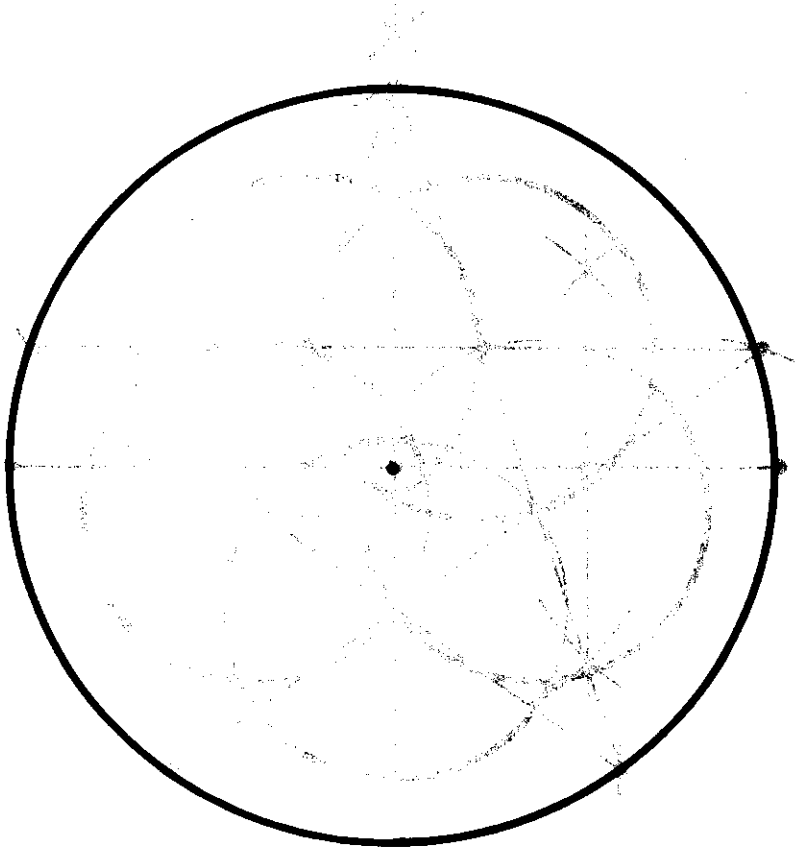

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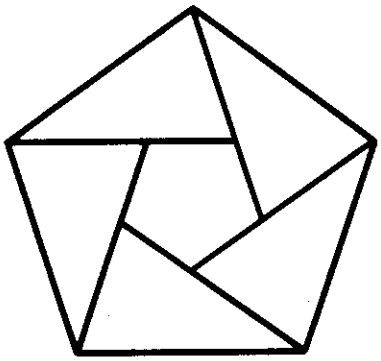

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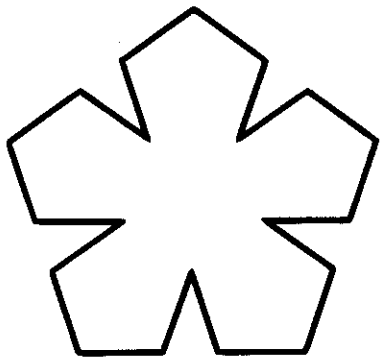

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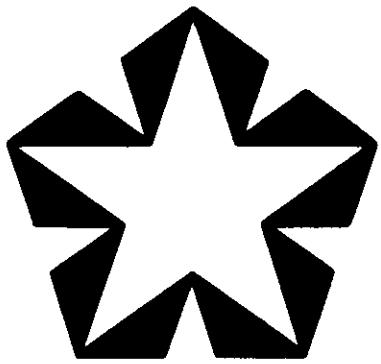

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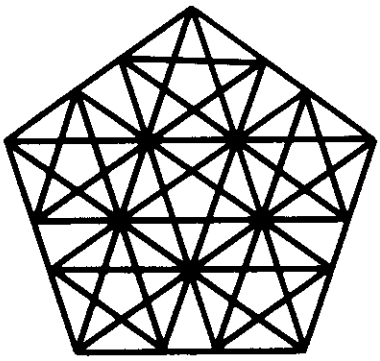

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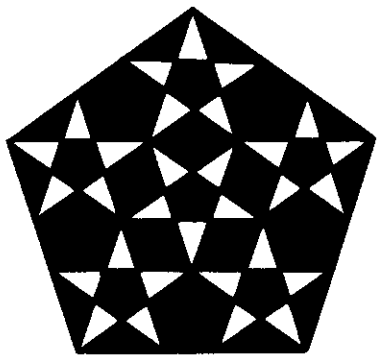

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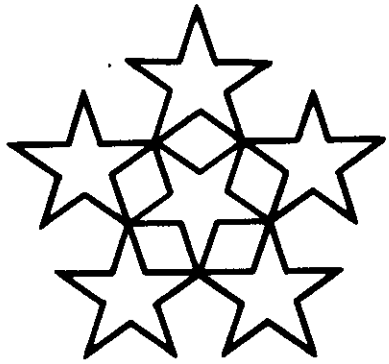

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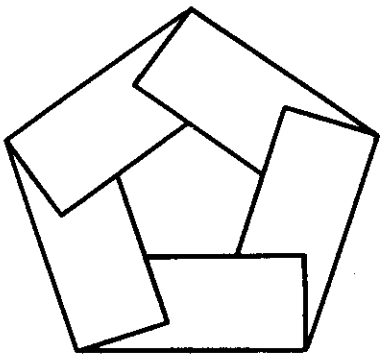

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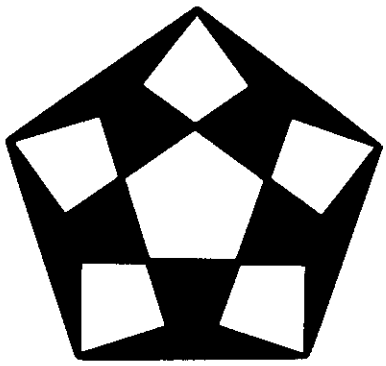

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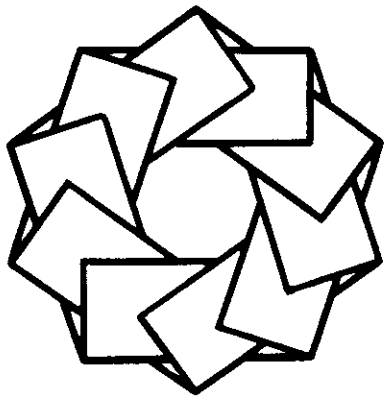

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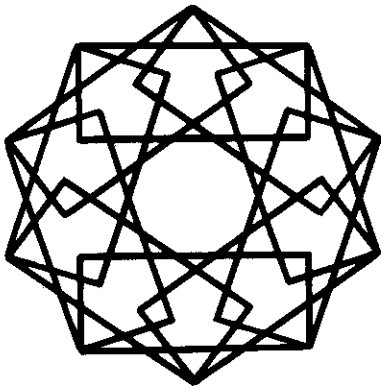

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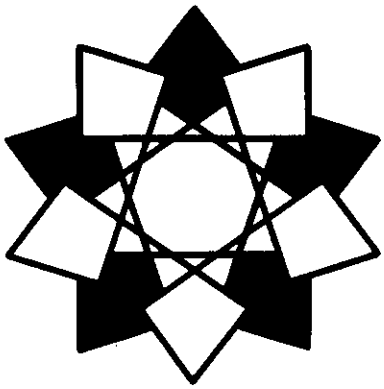

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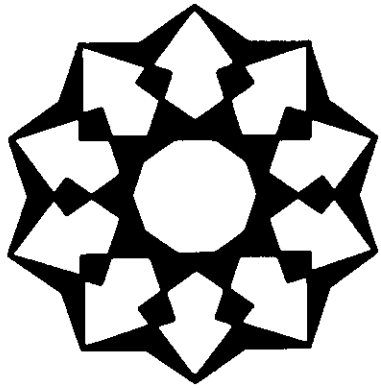

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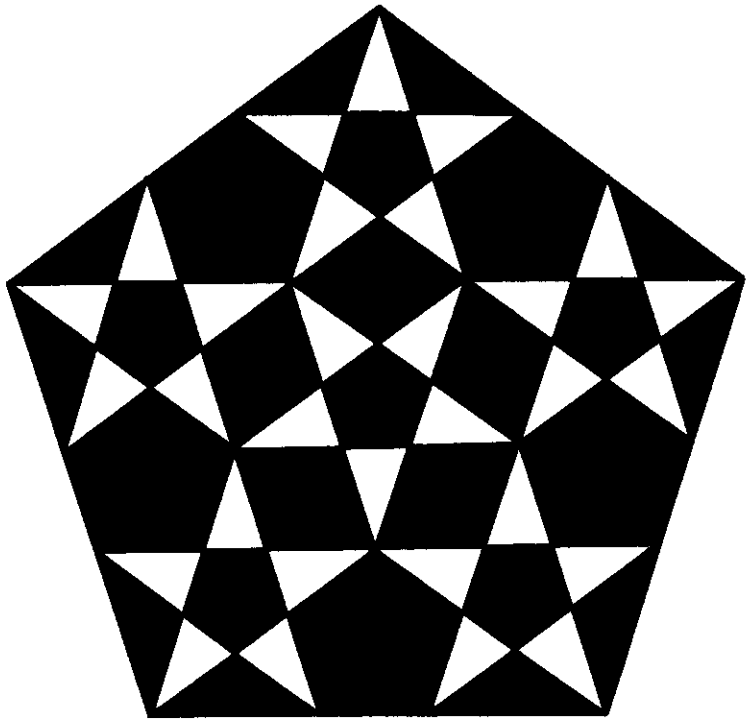
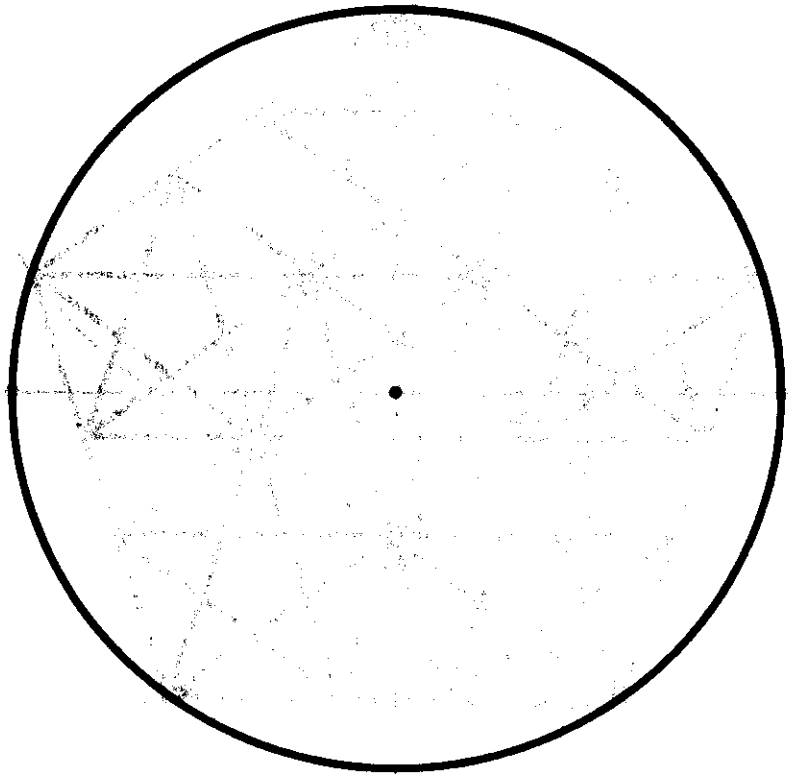


CONSTRUCT THIS DESIGN IN THE CIRCLE BELOW



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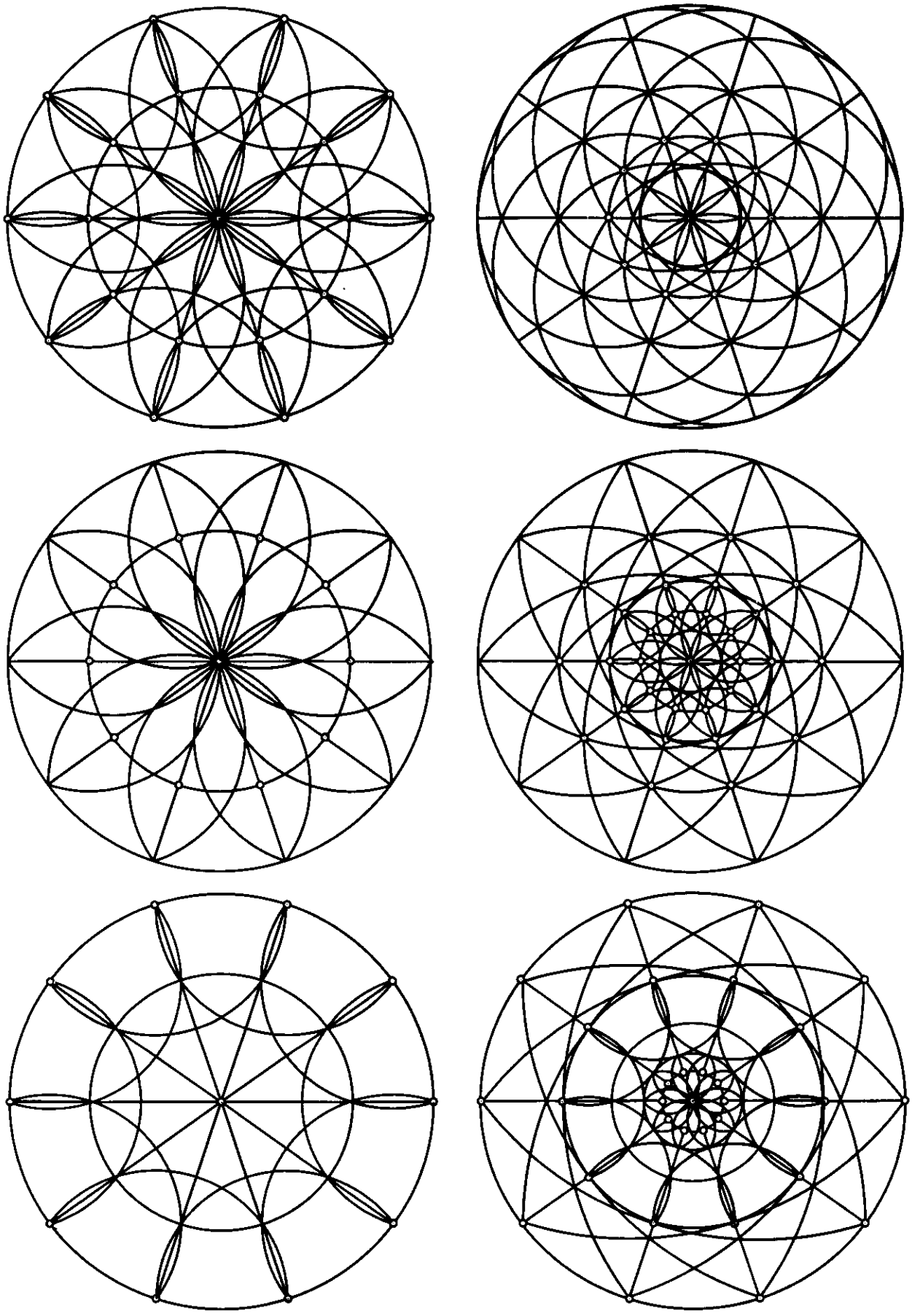

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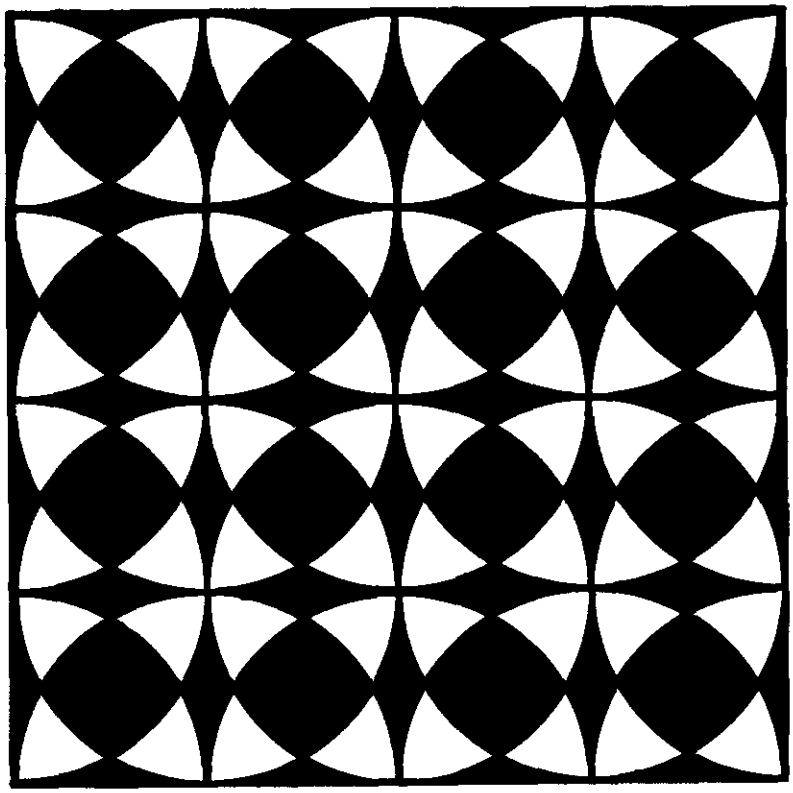
MISCELLANEOUS DESIGNS

The variety of designs on the next five pages are not necessarily based upon regular inscribed polygons. The position of many of the lines and arcs of the designs have been chosen arbitrarily.



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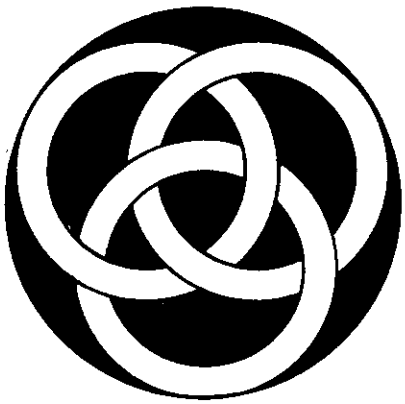

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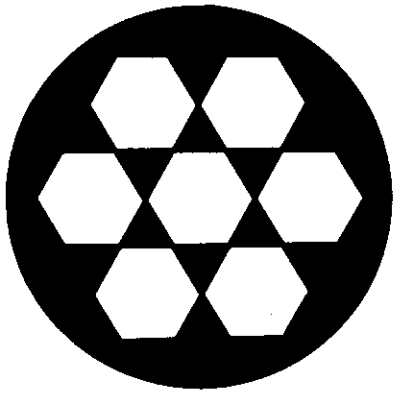

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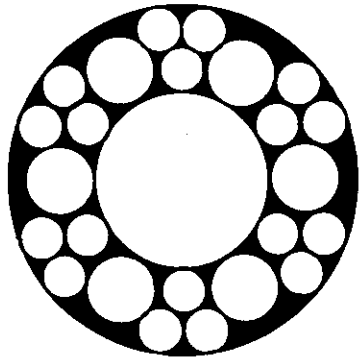

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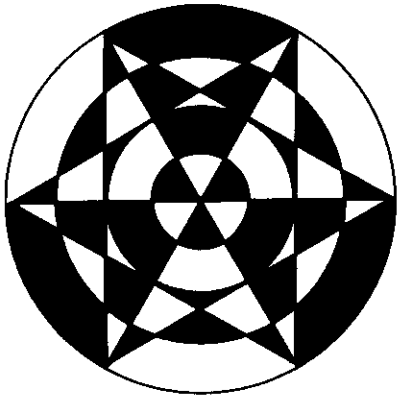

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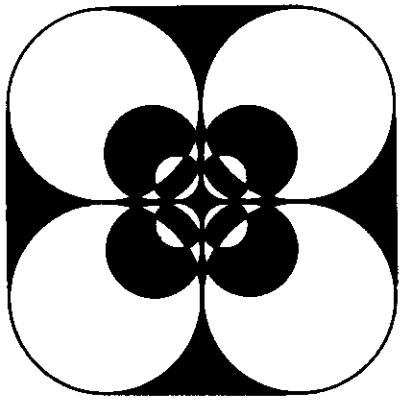

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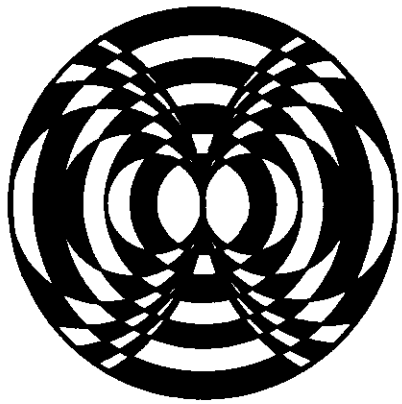

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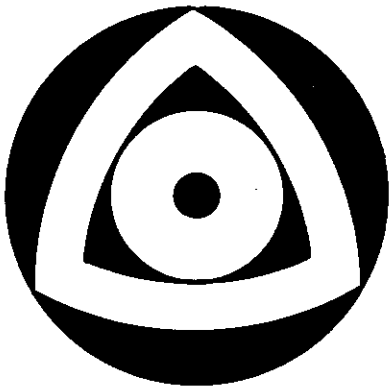

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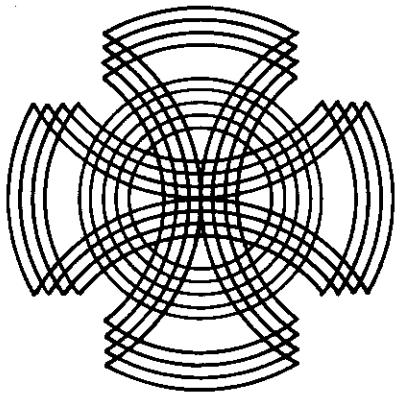

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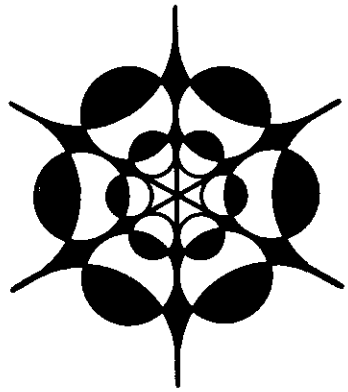

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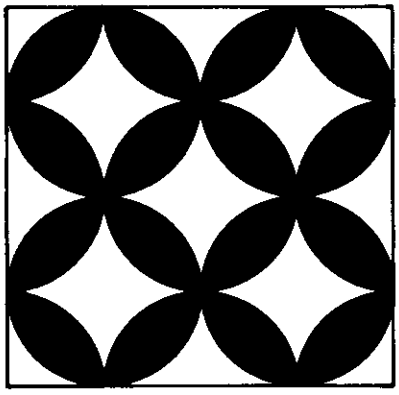

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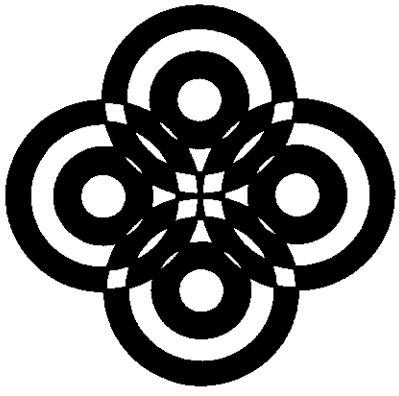

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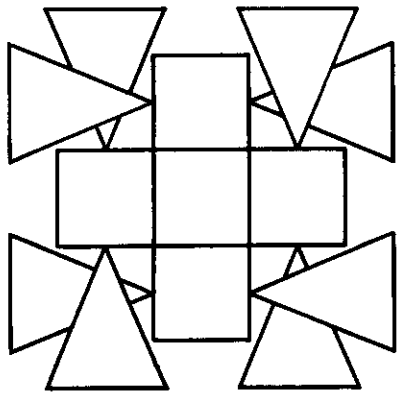

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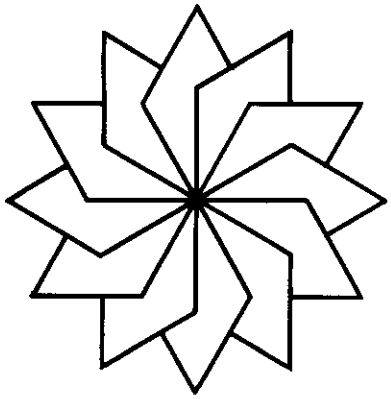

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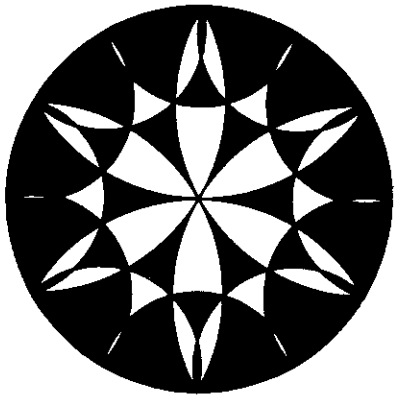

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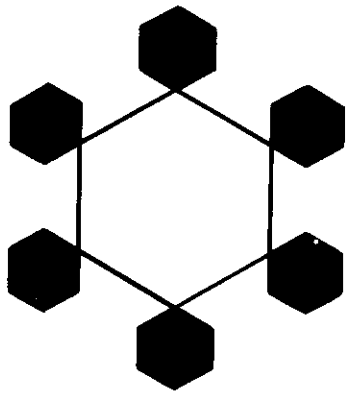

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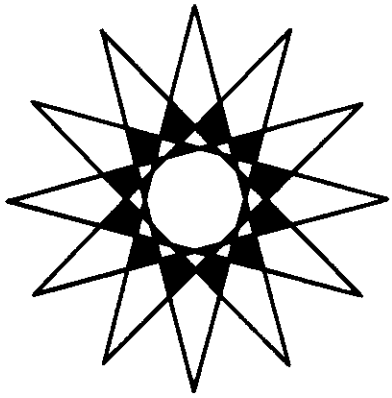

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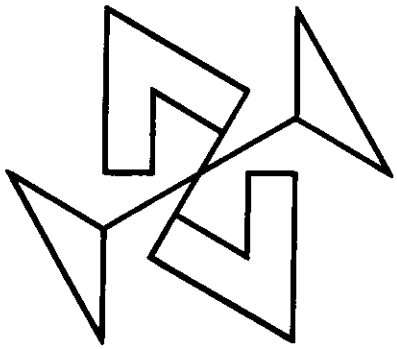

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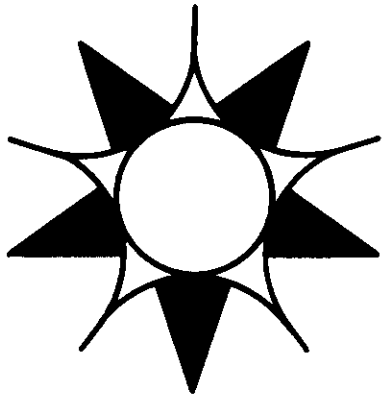

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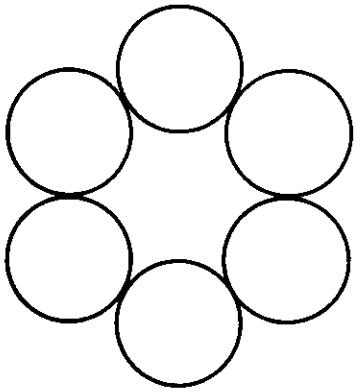

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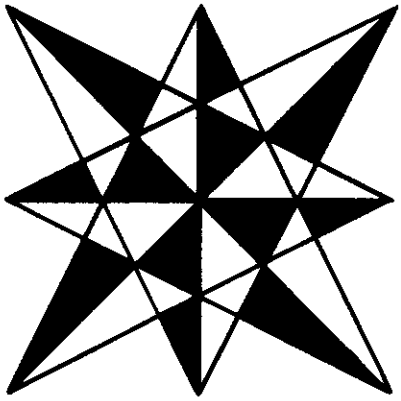

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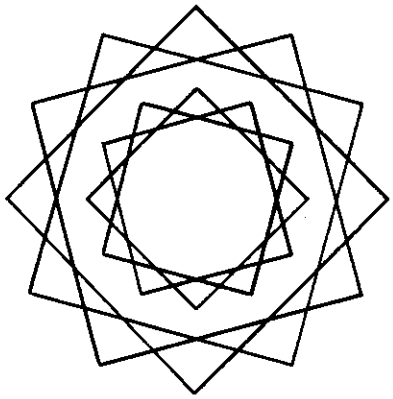

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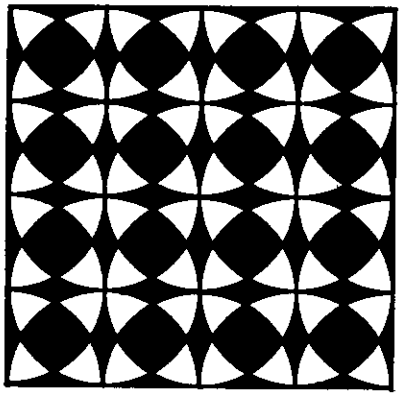

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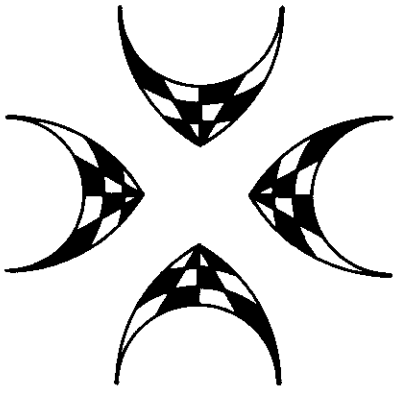

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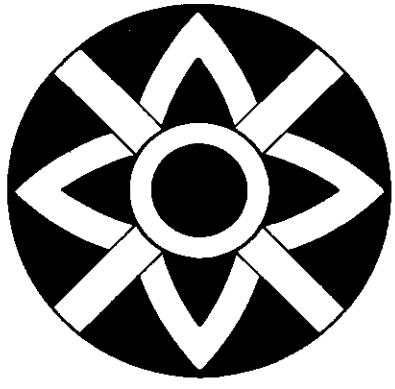

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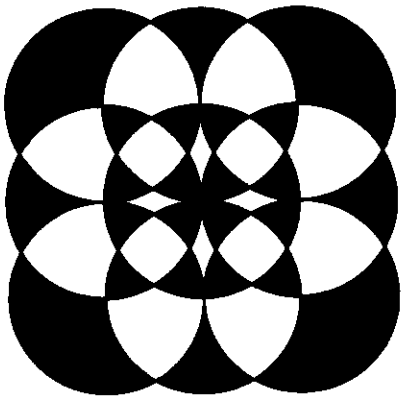

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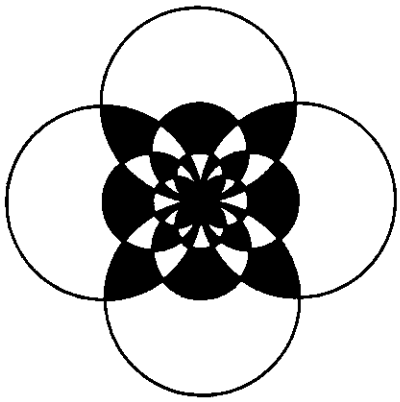

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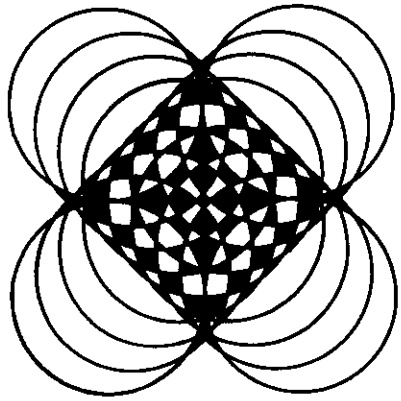

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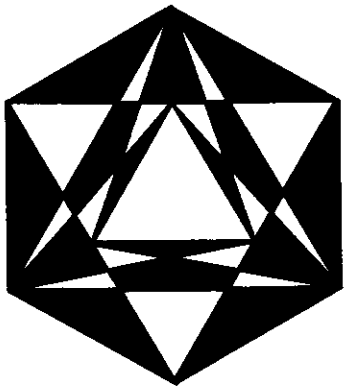

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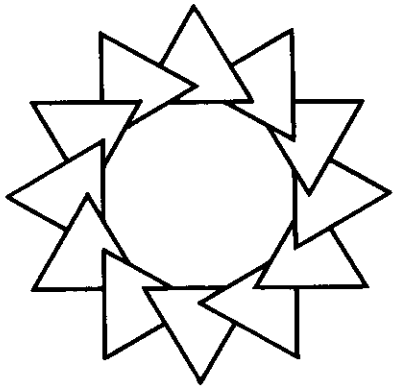

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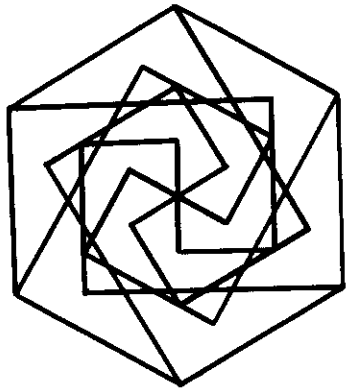

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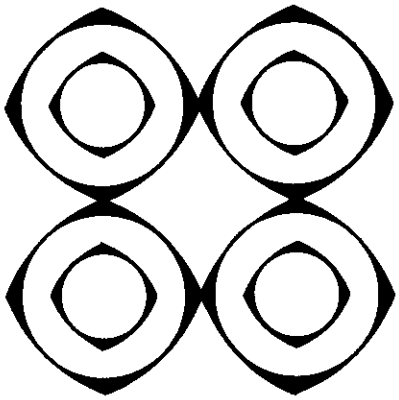

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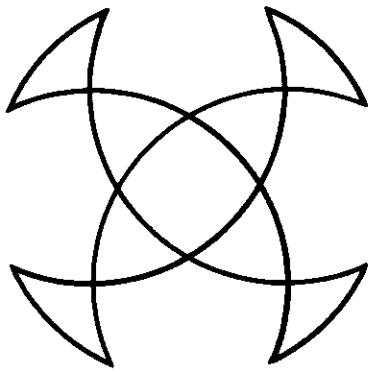

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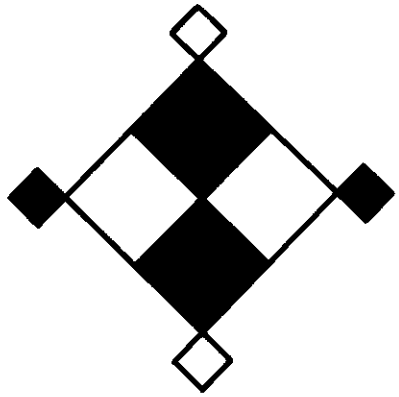

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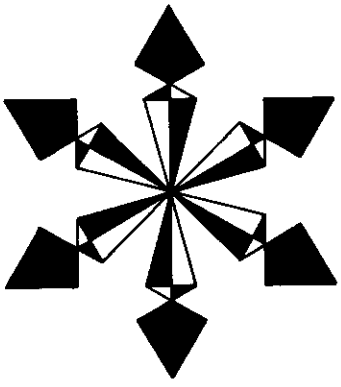

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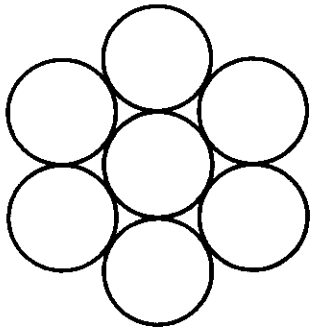

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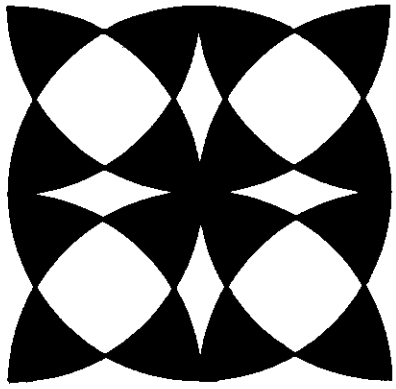

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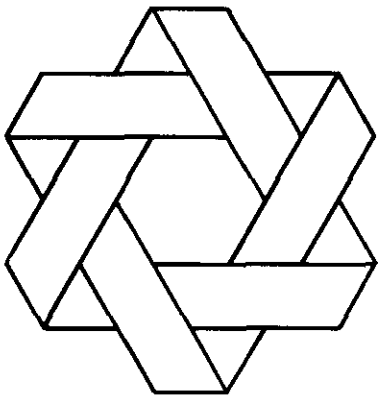

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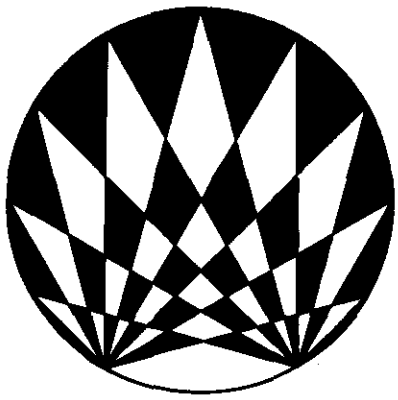

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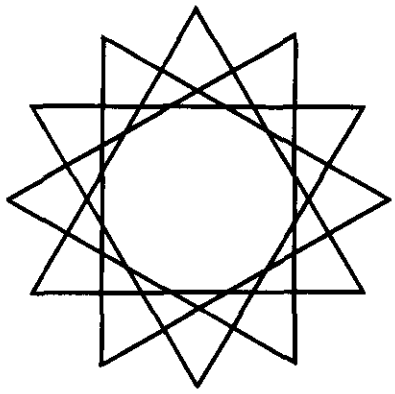

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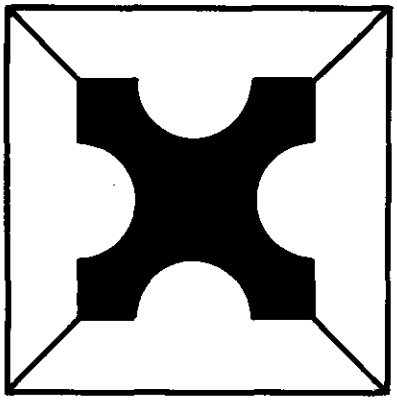

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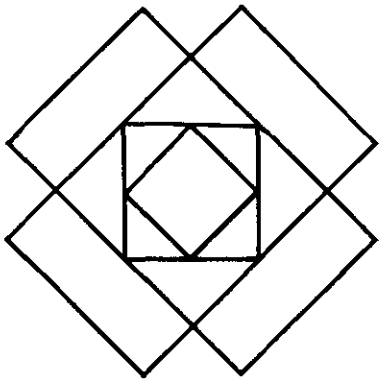

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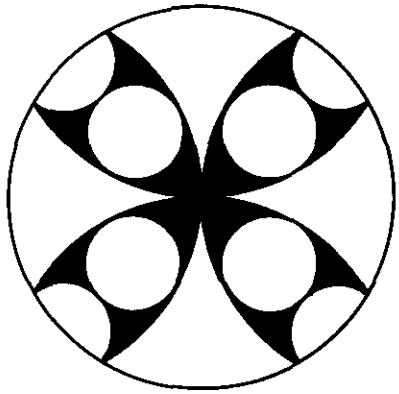

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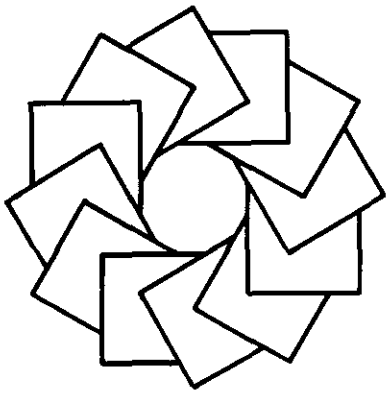

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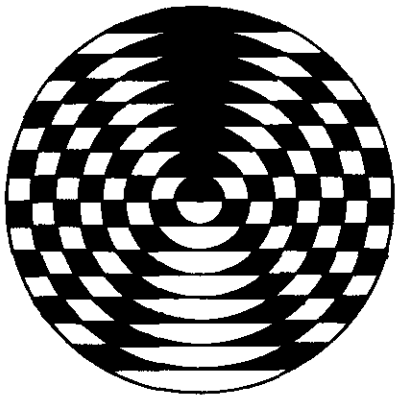

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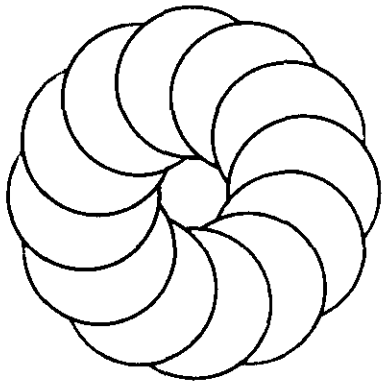

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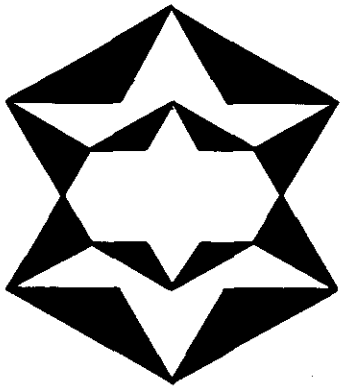

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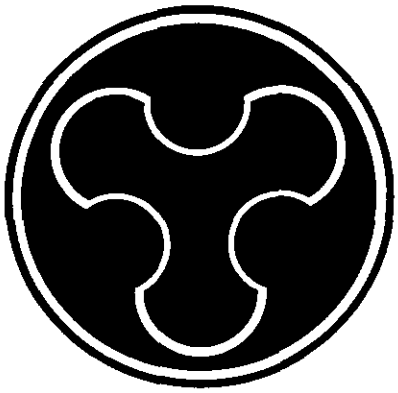

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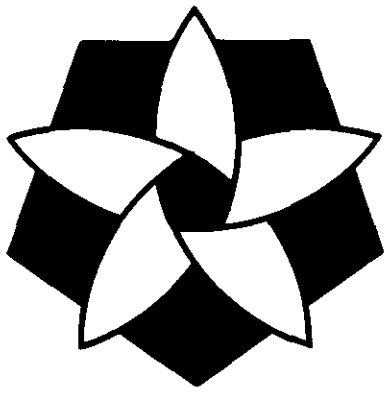

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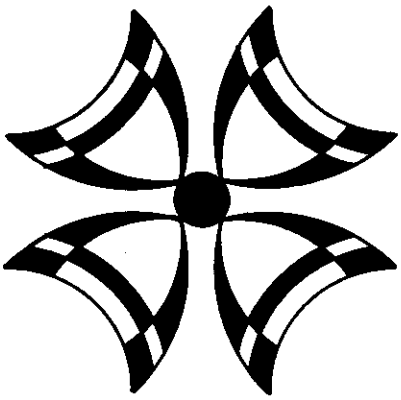

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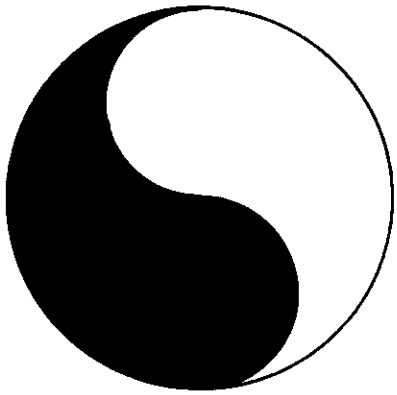

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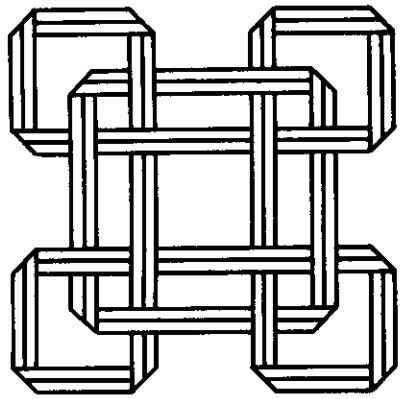

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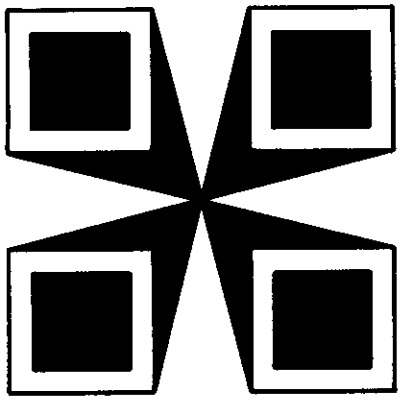

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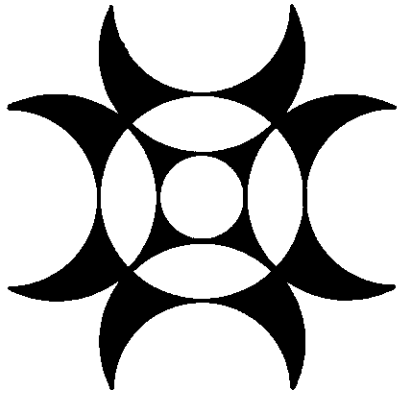

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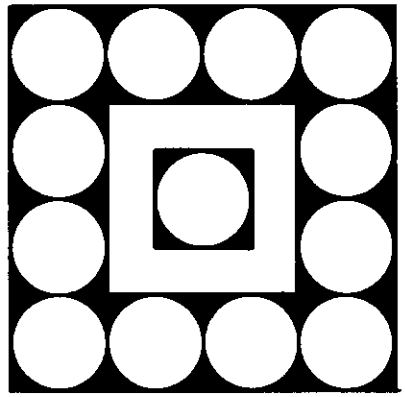

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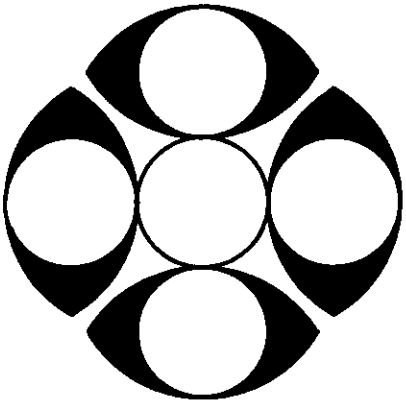

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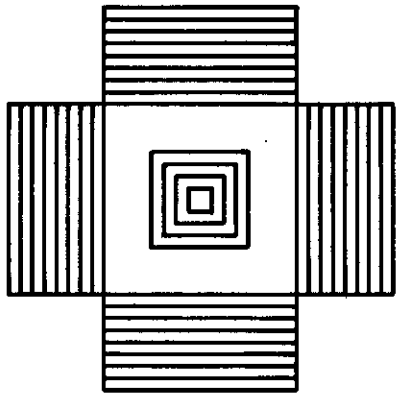

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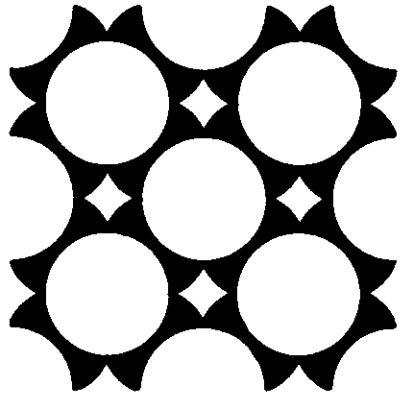

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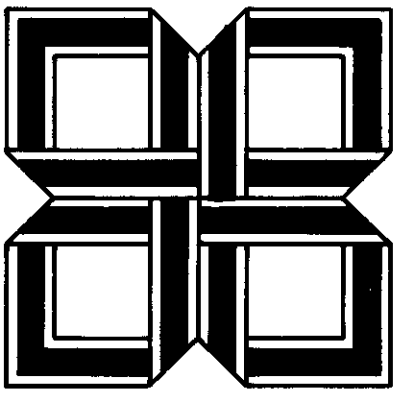

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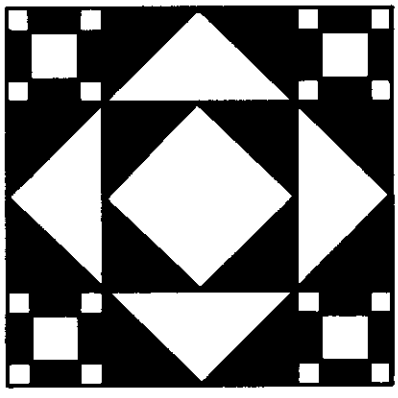

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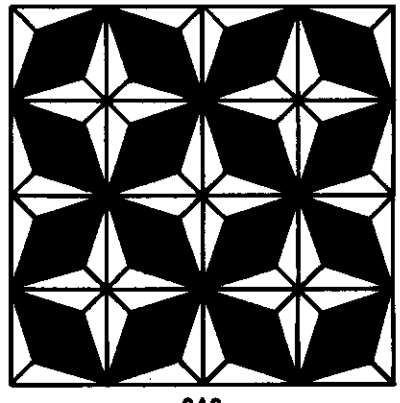

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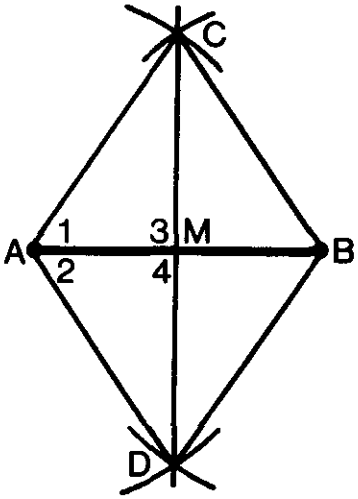
PROOFS OF THE BASIC CONSTRUCTIONS

COPIED LINE SEGMENT

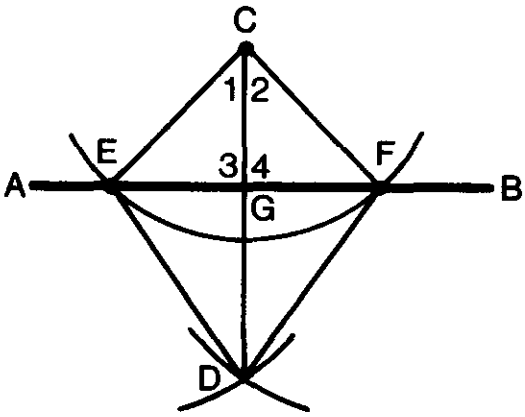
1. $\overline{AB} \cong \overline{CD}$	1. BY CONSTRUCTION

BISECTION OF A LINE SEGMENT



1. $\overline{AC} \cong \overline{AD} \cong \overline{CB} \cong \overline{DB}$	1. BY CONSTRUCTION
2. $\overline{AB} \cong \overline{AB}$	2. IDENTITY
3. $\triangle ACB \cong \triangle ADB$	3. SIDE-SIDE-SIDE
4. $\angle 1 \cong \angle 2$	4. CORRESPONDING ANGLE
5. $\overline{AM} \cong \overline{AM}$	5. IDENTITY
6. $\triangle AMC \cong \triangle AMD$	6. SIDE-ANGLE-SIDE
7. $\angle 3 \cong \angle 4$	7. CORRESPONDING ANGLES
8. $\overline{AB} \perp \overline{CD}$	8. DEFINITION OF $\perp$

CONSTRUCTION OF A PERPENDICULAR TO A LINE FROM A POINT OFF THE LINE



1. $\overline{EC} \cong \overline{CF}$	1. BY CONSTRUCTION
2. $\overline{ED} \cong \overline{FD}$	2. BY CONSTRUCTION
3. $\overline{CD} \cong \overline{CD}$	3. IDENTITY
4. $\triangle CED \cong \triangle CFD$	4. SIDE-SIDE-SIDE
5. $\angle 1 \cong \angle 2$	5. CORRESPONDING PARTS
6. $\overline{CG} \cong \overline{CG}$	6. IDENTITY
7. $\triangle CEG \cong \triangle CFG$	7. SIDE-ANGLE-SIDE
8. $\angle 3 \cong \angle 4$	8. CORRESPONDING PARTS
9. $\overleftrightarrow{CD} \perp \overleftrightarrow{AB}$	9. DEFINITION OF $\perp$

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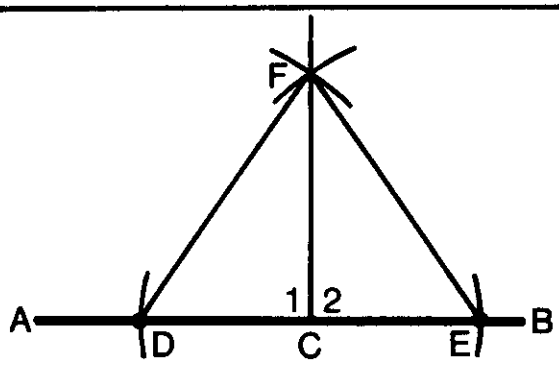
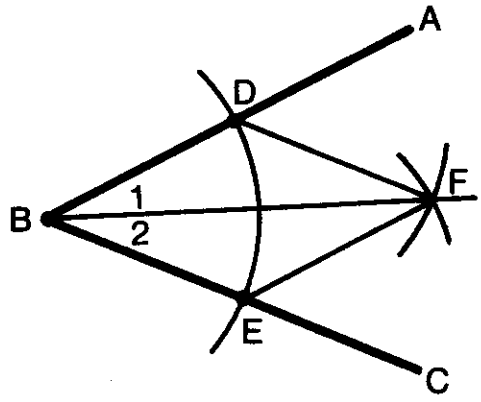
CONSTRUCTION OF A PERPENDICULAR TO A LINE FROM A POINT ON THE LINE



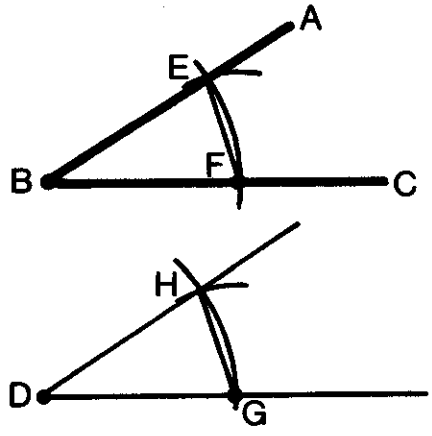
1. $\overline{DC} \cong \overline{EC}$	1. BY CONSTRUCTION
2. $\overline{DF} \cong \overline{EF}$	2. BY CONSTRUCTION
3. $\overline{CF} \cong \overline{CF}$	3. IDENTITY
4. $\triangle DCF \cong \triangle ECF$	4. SIDE-SIDE-SIDE
5. $\angle 1 \cong \angle 2$	5. CORRESPONDING ANGLES
6. $\overline{FC} \perp \overleftrightarrow{AB}$	6. DEFINITION OF $\perp$

BISECTION OF AN ANGLE



1. $\overline{BD} \cong \overline{BE}$	1. BY CONSTRUCTION
2. $\overline{DF} \cong \overline{EF}$	2. BY CONSTRUCTION
3. $\overline{BF} \cong \overline{BF}$	3. IDENTITY
4. $\triangle BDF \cong \triangle BEF$	4. SIDE-SIDE-SIDE
5. $\angle 1 \cong \angle 2$	5. CORRESPONDING ANGLES

COPIED ANGLE



1. $\overline{BE} \cong \overline{BF} \cong \overline{DH} \cong \overline{DG}$	1. BY CONSTRUCTION
2. $\overline{EF} \cong \overline{HG}$	2. BY CONSTRUCTION
3. $\triangle BEF \cong \triangle DHG$	3. SIDE-SIDE-SIDE
4. $\angle B \cong \angle D$	4. CORRESPONDING ANGLES

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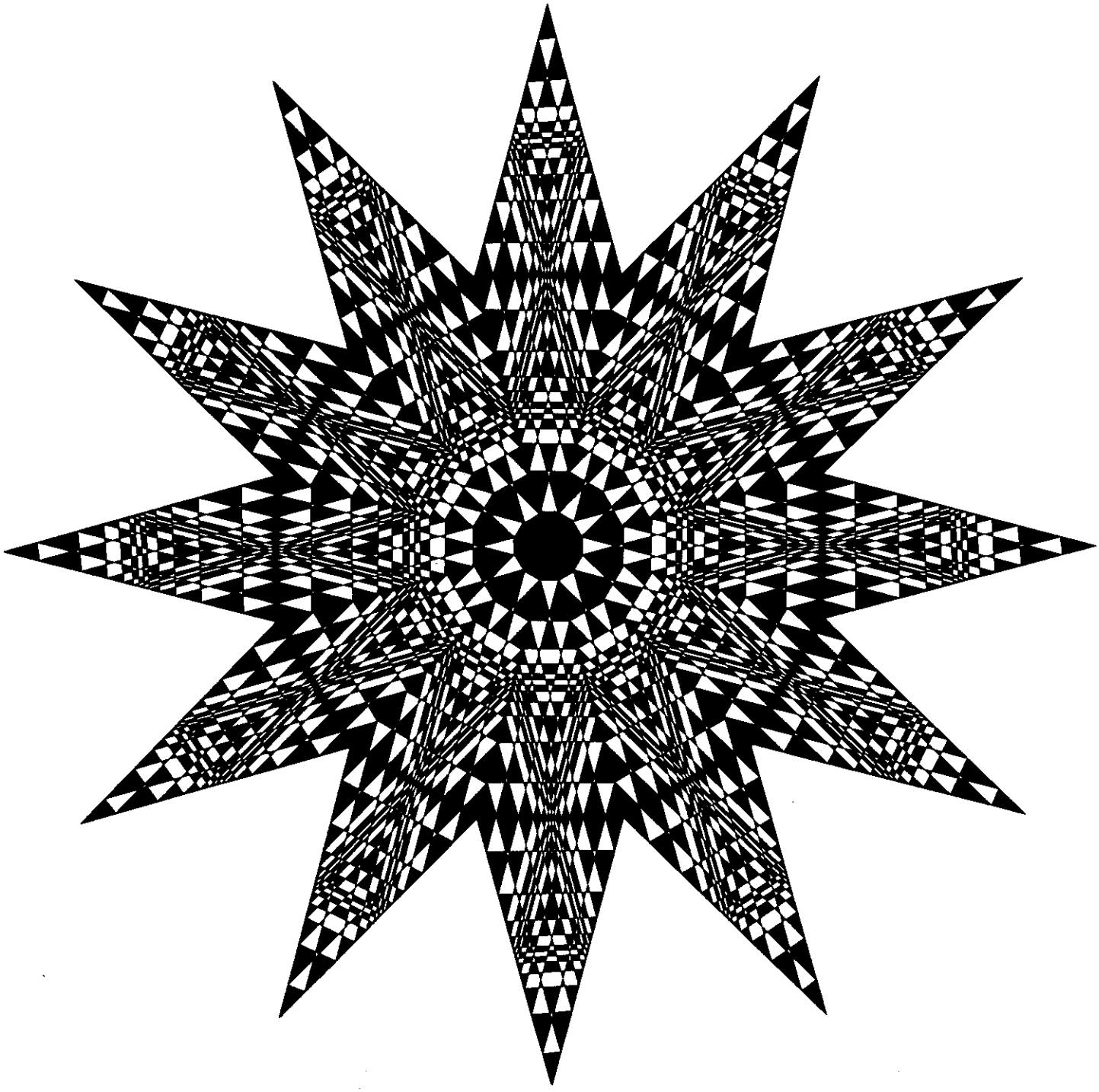

Illustration from *Pattern Blocks Coloring Book* by Silvey and Pasternack, © 1974 Creative Publications

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GLOSSARY OF TERMS AND SYMBOLS

ANGLE ($\angle$)	Two rays with a common endpoint
ARC ($\frown$)	Part of a circle
BISECT	Divide into two congruent parts
CHORD	Segment joining two points of a circle
CIRCLE ($\bigcirc$)	Set of all points equidistant from a fixed point called the center
CONGRUENT ($\cong$)	Same size and shape
DECAGON	Polygon with ten sides
DIAMETER	Chord passing through the center of a circle
HEXAGON	Polygon with six sides
INSCRIBED POLYGON	A polygon with all vertices on a circle
LINE ($\leftrightarrow$)	An undefined term; usually the term line means straight line
LINE SEGMENT OR SEGMENT ($-$)	Part of a line which lies between two points on the line
MIDPOINT	Point equidistant from the endpoints of a segment
OCTAGON	Polygon with eight sides
PENTAGON	Polygon with five sides
POLYGON	Closed, plane figure with segments as sides
PERPENDICULAR ($\perp$)	Lines which form 90° angles
POINT	An undefined term; described as having position but no size
RADIUS (RADII, PL.)	Segment joining center of a circle with a point on the circle
RAY ($\rightarrow$)	Part of a line which lies on one side of a point on the line
REGULAR POLYGON	All sides and angles congruent
SQUARE	Regular polygon with four sides
TRIANGLE ($\triangle$)	Polygon with three sides

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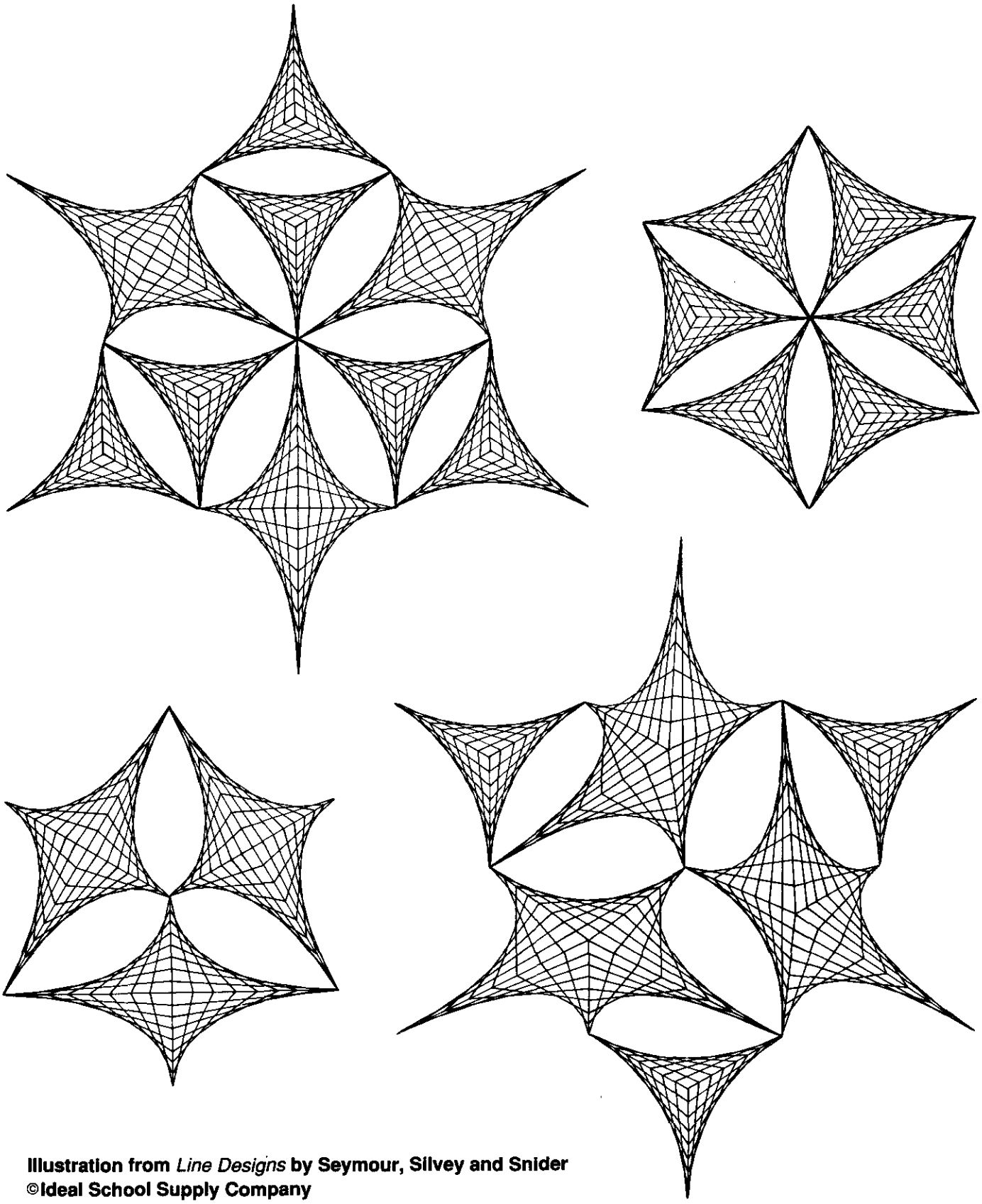

Illustration from *Line Designs* by Seymour, Silvey and Snider
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Also available from Ideal School Supply Company:

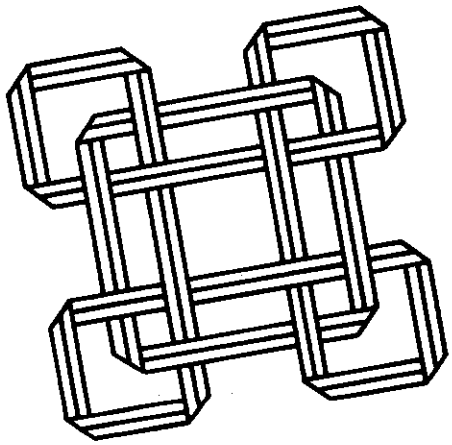
LINE DESIGNS, ID10031

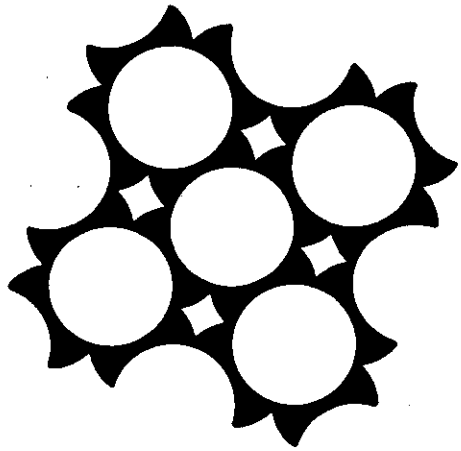
by Seymour, Silvey and Snider

Line Designs is an 80 page construction and design book that the authors recommend be used to complement activities from *Creative Constructions*. The book contains more than 100 designs all made with straight lines using the technique commonly known as "curve stitching." Most of the more beautiful, complex line designs require the construction techniques explained in *Creative Constructions*.

Geometric Design Posters, ID60140

A set of two posters. One poster contains 28 designs from *Line Designs*. The second poster contains 78 figures from *Creative Constructions*.





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