the ridiculous answer "`42 APRIL`". [See *CACM* **5** (1962), 556.] Write a complete `MMIX` program that finds the *earliest* year for which this error would actually cause the wrong date to be calculated for Easter.

▸ **34.** [*33*] Assume that an `MMIX` computer has been wired up to the traffic signals at the corner of Del Mar Boulevard and Berkeley Avenue, via special "files" named `/dev/lights` and `/dev/sensor`. The computer activates the lights by outputting one byte to `/dev/lights`, specifying the sum of four two-bit codes as follows:

Del Mar traffic light: #`00` off, #`40` green, #`80` amber, #`c0` red;
Berkeley traffic light: #`00` off, #`10` green, #`20` amber, #`30` red;
Del Mar pedestrian light: #`00` off, #`04 WALK`, #`0c DON'T WALK`;
Berkeley pedestrian light: #`00` off, #`01 WALK`, #`03 DON'T WALK`.

Cars or pedestrians wishing to travel on Berkeley across the boulevard must activate a sensor; if this condition never occurs, the light for Del Mar should remain green. When `MMIX` reads a byte from `/dev/sensor`, the input is nonzero if and only if the sensor has been activated since the previous input.

Cycle times are as follows:

Del Mar traffic light is green $\geq$ 30 sec, amber 8 sec;
Berkeley traffic light is green 20 sec, amber 5 sec.

When a traffic light is green or amber for one direction, the other direction has a red light. When the traffic light is green, the corresponding `WALK` light is on, except that `DON'T WALK` flashes for 12 sec just before a green light turns to amber, as follows:

`DON'T WALK` $\frac{1}{2}$ sec
off $\frac{1}{2}$ sec
} repeat 8 times;
`DON'T WALK` 4 sec (and remains on through amber and red cycles).

If the sensor is activated while the Berkeley light is green, the car or pedestrian will pass on that cycle. But if it is activated during the amber or red portions, another cycle will be necessary after the Del Mar traffic has passed.

Write a complete `MMIX` program that controls these lights, following the stated protocol. Assume that the special clock register rC increases by 1 exactly ρ times per second, where the integer ρ is a given constant.

35. [*37*] This exercise is designed to give some experience in the many applications of computers for which the output is to be displayed graphically rather than in the usual tabular form. The object is to "draw" a crossword puzzle diagram.

You are given as input a matrix of zeros and ones. An entry of zero indicates a white square; a one indicates a black square. The output should generate a diagram of the puzzle, with the appropriate squares numbered for words across and down.

For example, given the matrix

$$\begin{pmatrix} 1&0&0&0&0&1\\ 0&0&1&0&0&0\\ 0&0&0&0&1&0\\ 0&1&0&0&0&0\\ 0&0&0&1&0&0\\ 1&0&0&0&0&1 \end{pmatrix},$$

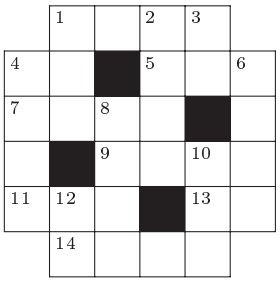

Fig. 18. Diagram corresponding to the matrix in exercise 35.