TIME AND SCHEDULING SYSTEM

TECHNICAL FIELD

The present invention relates generally to the graphical and spatial representation of time. The inventor anticipates that primary application of the present invention will be in display units for representing time and events. Examples of such display units include, without limitation, substitutes for conventional standalone clocks and calendars, substitutes for conventional computerized scheduling and calendaring applications, as well as a broad range of new time and event based devices and computerized applications which have heretofore not been practical due to the inherent limitations of prior art systems.

BACKGROUND ART

Though it has always been important to plan time, we like to think that in an earlier, simpler era, less exact planning was necessary. People could get up when the sun rose and do their work without having to coordinate with many others, especially not having to coordinate with people far away. In modern times -- for the last several centuries -- appointments have been kept by the clock, on the assumption that people had access to a common time reference. Mercifully this time reference has usually been local, since our dealings usually took place in one city or county.

Today, however, we live in a 24-hour global world. Some of us must stay in frequent touch with people or events in other parts of the world. And more and more of us lead round-the-clock lives with highly variable schedules. Many of us work in facilities (such as hospitals) or occupations (such as broadcasting) where work is ceaseless, requiring 24-hour planning awareness, and where facilities must be scheduled for 24-hour utilization. Many people have to work at night, or on schedules that fluctuate between night and day work. These are very hard to plan. Those of us who work at night, and have meetings at night, need to see the relations of night and day, and how a succession of related meetings and events will be spaced.

All of these developments increase the need for tighter and more exact scheduling around the clock, day in and day out, and the coordination of numerous different schedules.

But our present low state of visualizing time is summarized in the system of time we use. While science, and most of the civilized world, uses the 10-based metric system for measuring all other things, the exception is time, which is still everywhere measured by the Babylonian divisions: 24 hours, 60 minutes, 60 seconds. These numbers have the advantage of being divisible by both two and three, but have no other advantages.

This is because time was left out when they built the metric system. When measurement was rationalized in the French Revolution, leading to the present metric system, time was not rationalized because two different factions disagreed: those who thought the revolution of the earth (seen by us as day and night) should be divided into ten units, and those who thought it should be divided into twenty. Both factions built clocks and argued vehemently; the matter was left undecided, leaving the world in temporal Babylon ever since.

CYCLICALITY

We "could" show time simply by a line, and this is often done (hence the word time-line). But dividing a time-line into units -- say, dividing a time-line of a month, or a year, into days -- does not show periodic phenomena, such as weekends.

There are many periodic phenomena in the passage of time. Time-lines don't show the cyclicalities inherent in time as we use and perceive it. Furthermore, cyclicalities overlap. And such overlapping cyclicalities can be hard to visualize and work with.

Think of a year as a time-line. We can measure it off in weeks, we can measure it off in months, we can measure it off in lunar months, we can measure it off in quarters. But these divisions of a straight line are not visually clarifying, as seen in FIG. 33, where different cycles map to the time-line of the year without showing any visually recognizable repetition on that line.

We need to visualize, understand and predict the cyclicalities of time past, present and future. That is one important reason that we refer to calendars and clocks -- to see the cyclicalities. Clocks and calendars show cycles, but in visualizations which are very simple, conventionalized, and limited, showing only certain "particular" cycles. Neither of these systems is optimal, but they are so familiar that people do not question their usefulness.

Calendars and clocks each help us visualize certain cyclicalities, or periodicities; but select particular cycles and show them only.

The clock (FIG. 32, left side) shows twelve hours at a time (although there are also 24-hour models). Only one 12-hour period is shown at a time, so the periodic repetitions and relations must be imagined. We are so used to this peculiar system that it seems reasonable!

The calendar page ordinarily shows one month at a time (FIG. 32, right side), emphasizing the periodicity of the week. Four weeks, usually a few days more, are shown at once on each month's calendar page, so that some periodic repetitions and relations can at least be seen.

Each of these two conventional visualizations shows one particular cyclicality. But there are many cyclicalities that we may want to note and understand. And so a principal issue in understanding time is how we may visualize the many different cyclicalities and inter compare them.

There are many periodic divisions and natural cyclic phenomena, such as day and night, the week, the month, the year, hour, month and second; the tides (and the corresponding lunar month), the four seasons, quarters of the year (of significance especially for financial planning and reporting). And there are many other cyclicalities, more removed from everyday life, that are of concern to scientists and technologists. These include cyclicalities from outer space: the sidereal day and sidereal year (necessary for astronomical research), the years and days of the other planets, the periods of pulsars and spurts from black holes, the periodic orbits of comets, artificial satellites and space stations (orbital periods which vary with altitude or size of orbit). These include cyclicalities in biology and medicine, such phenomena as reproductive cycles of bacteria and fruit flies, the anticipated reactions of the body -- numerous natural processes, medical and experimental procedures -- which must all be timed or compared. These include cyclicalities in computerdom, where there is great concern with time cycles in both software and hardware: such cyclical software phenomena as user time slices, refresh rates and swap times, such cyclical hardware phenomena as microprocessor cycles and disk latency -- which must all be timed or compared.

We may need to note and study not only the length of these cycles and where in the cycle the current instant lies; but variations from the average cycle, leading and lagging indicators and side effects, or the place in a cycle where some particular event occurs.

BRIEF DESCRIPTION OF THE DRAWINGS

The purposes and advantages of the present invention will be apparent from the following detailed description in conjunction with the appended drawings in which:

FIG. 1-4 are intentionally omitted;

FIG. 5 shows the limited number of cycles available in a spiral when the same increment is allocated to each sweep of the spiral;

FIG. 6 shows that with a diminishing function, such as logarithmic diminution, the number of cycles which may be represented in a spiral is in principle infinite, limited only by the resolution of available graphic devices;

FIG. 7-31 are intentionally omitted;

FIG. 32 shows a conventional 12-hour clock (left side) and a conventional 7-wide calendar page (right side);

FIG. 33 show how various wheels can measure off a time-line, where a period of time (in this case a year) is simultaneously measured off in different cycles (month, quarter, week);

FIG. 34 shows a spiral view of time where one sweep represents one year, creating an infinite spiral calendar wherein many years are seen looking inward toward the center, as many years as our eyes, and the presentation medium, can resolve;

FIG. 35A shows a detail view of the infinite spiral calendar of FIG. 34, wherein individual days may be seen;

FIG. 35B shows a schematic overview of a spiral clock, whose granular color-coding as detailed in FIG. 35A has been blurred into curved lines, much in the way that the eye would see them without focussing sharply;

FIG. 36 shows a calendar display similar to FIG. 35B, where a single sweep of the spiral represents one quarter of the year (three months), so that one year is shown by four turns of the spiral. The radial lines marked "1" indicate color-coding of the first of each month;

FIG. 37A shows a one-week view of such a spiral display, functioning both as clock and calendar, where noon is represented as a vertical line from the center;

FIG. 37B indicates schematically the relation between a helical structure in 3 dimensions (left), constructed in some 3D data structure, and its 2-dimensional perspective projection, on a user's screen or display surface, to create the appearance of a visible spiral clock or calendar (right);

FIG. 38-41 are intentionally omitted;

FIG. 42A indicates "ticking" by truncation of the now-edge, moving clockwise;

FIG. 42B shows how the clockwise direction of conventional clocks transposes to the clockwise spiral visualization of time, and the corresponding rotary motion of the now-edge;

FIG. 43 indicates a 24-hour division of a time spiral;

FIG. 44 shows successive January 1 cell elements lined up in a spiral visualization of time with one year as the unit (enlarged detail); showing also the semi-diagonal distribution of the days of the week (the first Sundays of 1998-2005 highlighted as an example);

FIG. 45 shows the use of an ovoid, or squashed, spiral to divide the presentations of day and night;

FIG. 46 shows the annotation of a time spiral with words;

FIG. 47 is intentionally omitted;

FIG. 48 shows the annotation of a time spiral with a marker, in this case a virtual card;

FIG. 49-51 are intentionally omitted;

FIG. 52 shows concentric spirals marked as a double calendar for coordinating meetings and phone calls between two businesspeople;

FIG. 53 shows concentric spirals marked as a double calendar to coordinate the activities of a scheduled facility (in this case a dialysis machine) and its intermittent use by a patient, with improved visualization both of the overall schedule and different aspects of the detailed time relationships;

FIG. 54-55 are intentionally omitted;

FIG. 56A is a side view showing two interpenetrating coaxial helices of different colors, wound mutually and symmetrically through each other and separated in the Z dimension, constructed as a 3D model;

FIG. 56B, derived from FIG. 56A, is a frontal view of concentric spirals presented by perspective projection from the same data structure of coaxial helices being shown, but seen as a two-dimensional view of concentric spiral zones of two different colors;

FIG. 57 is intentionally omitted;

FIG. 58 shows a relative tilting of the helical data structure with respect to the projected view; indicating the user's possible adjustment of the tilt angle "A" of the virtual helix in order to change the time emphasis being visually presented;

FIG. 59 is intentionally omitted;

FIG. 60 indicates a visual emphasis created by tilting of the helical data structure as in FIG. 58, showing also the misalignment in presentation of the hours caused by tilting the virtual helix, except for two points on each sweep of the spiral, which two portions remain aligned;

FIG. 61 shows a side view of such a helix;

FIG. 62 shows a perspective view through the helix of FIG. 61;

FIG. 63-65 are intentionally omitted;

FIG. 66 shows a time spiral visualization installed in eyeglasses as an LCD screen, where "LCD" represents a cross-section of the LCD screen;

FIG. 67 shows a time spiral installed in eyeglasses reflectively, where "M" represents a semi-silvered mirror and CRT represents a cathode-ray tube;

FIG. 68-69 are intentionally omitted;

FIG. 70 shows a paradoxical multi tunnel view where the tunnels are the year and the days (detail);

FIG. 71 shows a paradoxical multi tunnel view where the tunnels are the year and four quarters, with the quarters corresponding to twelve consecutive months shown in the year spiral;

FIG. 72 shows a paradoxical multi tunnel view where the tunnels are the year, quarter, month, week and day, with displayed arrows showing their correspondences;

FIG. 73-95 are intentionally omitted;

FIG. 96 shows the "left-fist" spiral direction;

FIG. 97 shows a three-dimensional structure adequate for the kind of annotation shown in FIG. 52 and FIG. 53; and

FIG. 98 shows a schematic side view of the virtual surfaces of FIG. 97.

FIG. 99 shows an hypothetical spiral-time diagram of the Battle of Gettysburg, where "N" represents the time-line of the forces of the North, "S" represents the time-line of the forces of the South, small scribbles represent writing omitted here, and arrows represent attacks, incursions or other timed and directional events of the battle.

BEST MODE FOR CARRYING OUT THE INVENTION

This invention addresses problems in the visualization and management of time: especially, aiding the human need to plan, maintain and change schedules. This human need demands better ways to see, consider and understand temporal relationships, and annotate them.

Conventional clocks and calendars are two-dimensional means for visualizing time. Unfortunately these show a very limited amount of information -- only a very limited time-span in any one view -- and do not facilitate comparison and coordination. The clock and calendar, as we know them, highlight certain main cycles of time (the twelve-hour cycle on the clock, the seven-day cycle on the calendar) but only these particular cycles, and only for a limited simultaneous view (twelve or twenty-four hours for a clock-face, one month for a calendar page).

This invention is a system for better visualizing and working with time, showing time as a spiral, a virtual tunnel with cyclical properties. This spiral visualization system can be adjusted to show a day (like a clock), a month (like a calendar) or any other time-period large or small; thus the distinction between "clock" and "calendar" is here discarded.

Spiral visualization allows viewing and emphasizing the same time-frame of the present that a clock or a calendar shows. In addition, the same view simultaneously looks forward from the present into the future, even a long way into the future. The user may zoom forward into the future or pull back to view records of the past.

Just as the clock and calendar emphasize specific time-cycle perodicities (12 hours and 7 days respectively), a time-tunnel spiral view will also emphasize some specific time-cycle, but it can highlight other periodic relations simultaneously.

A particularly good way to present such a spiral visualization is by projective display (using 3D hardware or software) from a 3-dimensional helical data structure, viewing the helix in perspective as the desired spiral. Such a three-dimensional data structure can show one particular schedule and commentary on it, or (by nesting helices) coordinate two or more schedules, or show commentaries on them.

Several of these time-tunnel spiral views may be combined into a useful grand view which simultaneously (though paradoxically) shows time-tunnels of years, months, days, or other periods.

Particular advantages include these: 1. By changing the cycle, setting one turn of the spiral to some particular time unit, we can make that unit the main coordinate-set and focus of attention. 2. Within the spiral visualization measured by one principal cycle it is possible to see other periodic relationships simultaneously, independently of the principal cycle being shown. 3. By zooming into the view of this spiral, or zooming out, we go backward and forward in time. 4. The spiral visualization provides overview among successive cycles, showing continuity and repetition. 5. Comparing spiral visualizations aids in comparison and combination of different schedules.

This design offers a new topology of time management, since it permits visual connectivity between the cycles, and annotations which connect the cycles as well.

This design is intrinsically interactive. It replies upon visualizing methods probably not possible with physical mechanisms such as clocks, requiring graphic projection from an abstract model, as is now possible with computer graphics.

THE SPIRAL TIME-TUNNEL VISUALIZATION

This invention presents time as a spiral.

Visualizing time as a spiral has special advantages, as will become clear.

WHAT UNIT?

Any unit of time can be represented. The spiral view emphasizes whichever unit of time is assigned to one complete cycle, or 360-degree sweep of the spiral. We will call that unit of time the "sweep unit."

The sweep unit can be a month (as on the ordinary calendar), half a day (as on the ordinary clock), a year, a week, or any other period of time. Any cycle you want to emphasize or view can be made the periodicity of the spiral.

These adjustments to the sweep unit we may think of as "degrees of magnification" of our view of time.

CURVATURE OF THE SPIRAL

Depending on the curvature of the spiral, a limited or unlimited amount of time may be displayed. FIG. 5 shows that only a limited number of cycles are available in a spiral when the same increment is allocated to each sweep of the spiral. But a different curvature, proportionately diminishing, can show a limitless amount of time. FIG. 6 shows that with a diminishing function, such as logarithmic diminution, the number of cycles which may be represented in a spiral is in principle infinite, limited only by the resolution of available graphic devices.

In principle the spiral can show all past and future time, although (as with most comprehensive visualizations) resolution lessens as the scope of presentation increases. Time shown nearer the center of the spiral requires finer and finer resolution to show as much information as time shown nearer the edge. (Just as the amount of fidelity in old phonograph records decreased toward the center of their spiral.) We see this in FIG. 6, which shows that the successive sweeps of a proportional spiral allow less and less space for the presenting of information as the spiral curves in toward a center never reached.

FIRST EXAMPLE: A 1-YEAR SWEEP

For example, consider displaying the year. If we assign one year to each complete turn of the spiral, we see ahead (in principle) all the years of the future. FIG. 34 shows such a spiral view of time with one sweep representing one year.

For this first example, we make the current month and day the outside endpoint of the spiral, so that the future is toward the center of the spiral. (This option will be discussed later.) Think of the spiral as tightening toward the center.

One sweep is one year; and so several years may be seen at once. In principle we can see an infinite number of years ahead, creating an infinite spiral calendar where many years are seen as we look inward toward the center -- as many years as our eyes, and the presentation medium, can resolve.

We line up January first of each year into a vertical line leading to the center.

SECOND EXAMPLE: A WEEK'S CLOCK

A day-night diurnal spiral lets us see days and nights for a number of days at once, and the relations of successive days and nights. This is illustrated in FIG. 43, indicating a 24-hour division of a time spiral, functioning both as clock and calendar. (Effectively, the distinction between clock and calendar disappears in this spiral design. However, we may still refer to a view with a short sweep unit (such as a day) as a "clock," and a view with a longer sweep unit (such as a month) as a "calendar.")

FIG. 37A shows a more detailed view of such a one-week spiral display, functioning both as clock and calendar, where noon is represented as a vertical line from the center. (The corresponding lines from the center to 6 PM, midnight and 6 AM are implied but not shown.) Each turn of the spiral represents a day (labeled on this vertical noon-line as M, T, W, Th, F, Sat, Sun).

The lower shading is a convenient darkening for the user's recognition of night. The heavy lines intermittently positioned along the spiral represent "plans," that is, committed or projected appointments, work sessions, sleep or other pastimes, viewed in advance. While for simplicity they are not specifically labeled here, such labeling is likely to be a common practice.

THIRD EXAMPLE: QUARTERS

For an entirely different unit, we can contrive to visualize three-month quarters. In that case we tighten the spiral so that the beginnings and ends of the quarters line up.

FIG. 36 shows a spiral calendar display where the sweep unit represents one quarter of the year (three months), so that one year is shown by four sweeps of the spiral. The radial lines marked "1" indicate color-coding of the first of each month.

VIEWS, OPTIONS AND DETAILS

There are many options of viewing that need to be considered.

PUT THE FUTURE INWARD OR OUTWARD?

Shall we put the future at the center of the spiral, or at the outer rim?

Putting the future at the center seems more reasonable, since we are usually most concerned with details of the present, and it makes sense to have the present time represented by the most detailed portion of the visual presentation. (However, there are circumstances in which you would want to have the present appear in the center, relatively small, and have the future appear larger, at the outside: for instance, planning a complex event where there will be many more details of concern in the future event than among the events leading up to them in the plan.)

HOW TO MARK THE TIME?

The division of the day into 24 hours (still, unfortunately, the standard units) is most conveniently shown by lines or pips of division on the spiral display (Figs 43, 45).

Where to put the particular hours -- such as midnight at the top, or somewhere else -- should probably be user-settable.

HOW TO VISUALIZE THE TICKING OF "NOW"?

On the spiral clock (a spiral having a relatively short sweep unit), the user could see "ticking" as the continuing rhythmic truncation of the spiral's end, a visible edge or now-edge. FIG. 42A indicates such ticking by repeated rhythmic truncation of the now-edge, moving clockwise. Or (for emphasis, and a slightly more traditional view), we could show the passage of time by a moving line from the center outward to the spiral's end, sweeping like a clock-hand (as depicted in FIG. 42B).

CONTINUOUS EXPANSION OF THE VIEW

As the position of "now" is continually truncated, without adjustment the presentation would become smaller and smaller. This is good for some situations, such as countdowns and other processes measuring time as a diminishing resource. However, in ordinary operation the whole spiral display should become unnoticeably larger at each instant of motion of the now-edge, so that the spiral always occupies the same total area.

HOW TO DIVIDE PAST AND FUTURE?

If the past and future are shown at the same time, we can replace the now-edge with a divider, preferably between areas of different color; in which case the clock's ticking is seem as a moving line denoting the boundary between past and future.

DIRECTION OF WINDING / TWIST / CURL

Which is the best way for the spiral to wind, left-fist (clockwise inward) or right-fist (clockwise outward)? FIG. 96 indicates the relation of spiral direction to the human fist. Left fist, or clockwise-inward, is preferable for most time visualization, as it maintains the familiar clockwise direction for the calibration of hours in the day.

This direction of moving the "now" indicator -- corresponding to the minute-hand of the conventional clock -- transposes directly from the clock as everyone is familiar with it, and there is no reason to make people unlearn this direction. This “clockwise” direction of time's motion is deeply embedded in our thinking, and so the most natural visualization will have the center (the future) spiral inward in the clockwise direction.

The result is that the position of the now-edge will move clockwise as the minutes tick.

However, there are circumstances (such as countdowns or reversing a process) in which we may want to reverse this visualization of ticking.

GRANULAR VIEWS

Note that for any sweep unit the spiral may be seen as smooth, but with some units, such as the year, it may also be useful to look at a day (or other sub unit) as a granule, or cell.

In such granular spiral visualizations of time, we may contrive to line up cells showing the first days of each month for successive years.

For visualization of the year, let us say that we line up the first days of each month, and show the individual days of the year as small dots, like kernels of corn.

If we color the first of each month, we see that the beginnings of the months line up as almost-straight lines heading toward the center, as in FIG. 34 (such a line being shown in FIG. 34 for January 1 and July 1). FIG. 35A shows a detail view of the infinite spiral calendar of FIG. 34, wherein individual days may be seen (note that by color-coding of the individual elements (in this case, days of the week), stripes of other cyclicalities become visible). FIG. 44 shows this in more detail, with successive January 1 cell elements lined up in a spiral visualization of time with one year as the unit (enlarged detail); showing also the semi-diagonal distribution of the days of the week (the first Sundays of 1998-2005 highlighted as an example).

MAKING THE YEARS FIT

The spiral system for the sweep unit of one year is thrown off slightly by leap years. Years vary in length, but can be made to line up visibly in this system. There are different options.

Leap years, with one extra day, have to be coiled a little tighter to fit in the 360 degrees of the circle. To line up the year boundaries we have the choice of compressing February, or some larger period, like the first quarter, first two quarters, or the whole year, slightly affecting the way the cells representing the individual days line up and stack together.

SEEING DIFFERENT CYCLES AT ONCE; DIFFERENT PERIODICITIES VISIBLE IN THE SAME VIEW

The spiral viewing system can also show different cycles, with different periodicities, at the same time.

It can show, not one particular cyclicality, but several at once -- a year spiral also making visible the periods of week, month, and lunar month.

Let's color them so that they stand out.

By distinctively coloring one element of each different cycle of interest (such as each Sunday or the Full Moon), the cycle of weeks or of full moon may be plainly seen, even at the same time, on a spiral visualization of successive years.

We may see the beginnings of the months as almost-straight lines. But the beginnings of the weeks line up as slight spirals, since fifty-two times seven is 364, one or two days short of the full year.

Such a presentation allows the simultaneous visualization and mental comprehension of different cyclicalities at once, as seen in FIG. 35B. FIG. 35B shows a schematic overview of a spiral calendar, whose granular color-coding as detailed in FIG. 35A has been blurred into curved lines, much in the way that the eye would see them without focussing sharply.

The schematic division of FIG. 35B shows curved lines of three different cyclicalities (each of which might be carried out around the full disk area of the spiral, highlighting respectively the first of: calendar months (straight lines radiating from the center, of which twelve would exactly divide the year); lunar months (curved lines radiating from the center, of which slightly more than twelve would divide the year); and weeks (curved lines radiating from the center, of which slightly more than fifty-two would divide the year).

MORPHING BETWEEN SWEEP UNITS

If the sweep unit is a calendar year, then lunar months may be clearly seen as curving lines to the center.

But what if we want to emphasize the lunar cycles and the tides? Why, we tighten the spiral, creating a spiral of the lunar year, so that the full moons line up as straight lines radially. It is then the calendar months that become spirals.

Indeed, with appropriate animation it will be possible to tighten and loosen the winding, morphing the sweep unit from month to lunar month and back.

It will be possible interactively to tighten and loosen the spiral to different sweep units with animation, so that the user can see the proportional morphing of the sweep unit, tightening or loosening the spiral by twisting a knob, or performing some similar operation to indicate the degree of change, the user may watch the presentation become more tightly wound or more loosely wound, changing the resolution, or magnification, of the overall view. The smoother the animation, the cleaner conceptually the user's understanding.

Going back and forth between views, especially with such animation, should be especially useful in the study of close periodic relationships, such as calendar month and lunar cycle, or 24-hour day and sidereal day.

PERSPECTIVE: INTERNAL DATA AS A HELIX

So far we have talked a fair amount about how spiral time visualizations should look and behave, but we have said nothing about actual mechanisms for such spiral presentation.

A particularly simple and parsimonious way of implementing the spiral visualization of time is as by means of a spatial helix in three dimensions, allowing direct perspective projection to the desired spiral.

While this could be accomplished by a physical model or cardboard, wood or metal, it is more easily achieved by a 3D data structure projected by computer-graphic means to the desired spiral view.

FIG. 37B indicates schematically the relation between a helical structure in 3 dimensions (left), constructed in some 3D data structure such as OpenGL or VRML, and its 2-dimensional perspective projection, on a user's screen or display surface, to create the appearance of a visible spiral clock or calendar (right).

FIG. 61 shows a side view of such a helix constructed with VRML and viewed through the Netscape browser with COSMO VRML plug-in program.

FIG. 62 shows a perspective view through the helix of FIG. 61, showing a spiral image generated by perspective viewing of the VRML construction by means of the perspective projection of the VRML plug-in program.

(Another alternative 3D method would proceed from a tubular data structure which is helically texture-mapped with the desired contents.)

ZOOMING IN TIME

Such a spiral view, if generated from a 3D helix or tube, becomes "zoomable" by the standard art of computer graphics; by zooming the view of this helix, or dollying (moving the point of view backward or forward through the helix or tube), the user can move forward or back in the view of time past or future.

UNIFIED DATABASE

Since these are different views of time, to be generated by computer techniques, a benefit of these different variations -- year view, week view, quarter view, and so on -- is that they can all be driven by a common computer database, thus showing the same schedule at different resolutions. Then a change to the data of one time visualization is a change to all of them, since they share a common base of information.

ANNOTATION

The user should be able to annotate both past and future, showing appointments, planned spans of time (dinner, recreation, sleep, etc.) planned or actually spent. Such annotation would normally be done by typing or some other textual input.

One form of annotation would be a word, like "LUNCH" or "SLEEP," as in FIG. 46, showing the annotation of a time spiral with words. Others could be an annotation flag -- marker, icon or visual attachment, as in FIG. 48, showing the annotation of a time spiral with a marker, in this case a virtual card.

Clicking on such a flag, or zooming on such a card, could show more detail, or a hyperlink from the flag could lead directly to further information on the appointment.

Darkening of an arc on the edge of the spiral is one good way to show the planned usage of a span of time, as in FIG. 37A, where the darkened edges show planned spans of time.

PLANS BECOME RECORDS OF THE PAST

The user's present plans, if executed and not changed, would then become a diary (much as a paper "desk diary" becomes a record of events).

But similar notations may also be added to past records retroactively to improve the detailed recording of past time.

TRANSPARENCY

Another way to compare schedules, and successive days, could be by transparency, making a transparent layer over two adjacent spirals; or by using variable alpha-channel, equivalent to a slightly dirty window, successive layers could be seen less and less clearly.

COMPARISON AND COORDINATION USING TWO OR MORE SPIRALS: CONCENTRIC TIME-LINES WOUND IN A SPIRAL

The spiral visualization can be extended to comparison and coordination -- of schedules, of event histories, of different kinds of phenomena.

We may annotate and compare two (or more) time-lines wound together as concentric, nested spirals, spiraling in together toward a common center (which is never reached).

This method may be thought of as the comparison of time-lines, but instead of seeing them side by side as straight lines, with no cycles showing, being able to see the cycles as well.

Such a comparison method should be useful for: comparison of alternative plans being considered; comparison of two individuals' plans; comparison of an institutional schedule with an individual schedule (such as comparing a surgeon's current plan against a schedule of operations and procedures not yet assigned); allocation of facilities to individuals (such as rental of rehearsal rooms or medical machines); scheduling of an individual's classes; comparison of several peoples' schedules; comparative time-zones; and comparison of correspondences between two cycles (such as sidereal versus 24-hour day, calendar month versus lunar month)

Examples:

FIG. 52 shows concentric spirals marked as a double calendar for coordinating meetings and phone calls between two businesspeople.

FIG. 53 shows concentric spirals marked as a double calendar to coordinate the activities of a scheduled facility (in this case a dialysis machine) and its intermittent use by a patient, with improved visualization both of the overall schedule and different aspects of the detailed time relationships.

In both FIG. 52 and 53, a simple marking has been shown which lies across the two concentric spirals. More elaborate markings may of course be contrived.

COMPARISON BY 3D PROJECTION

I spoke above of comparing concentric 2D spirals as a way of comparing schedules and plans. There are at least two simple and parsimonious ways to do this technically, based on the 3D helix already mentioned. One is with separated helices, as in FIG. 56A. (The coincidence of this double helix with the structure of DNA is amusing.)

FIG. 56A is a side view showing two interpenetrating coaxial helices of different colors, wound mutually and symmetrically through each other and separated in the Z dimension. To make this illustration the helices were constructed as a 3D model using VRML and presented through Netscape with the COSMO VRML plug-in program.

FIG. 56B, derived from FIG. 56A, is a frontal view of concentric spirals presented by perspective projection from the same data structure of coaxial helices being shown through the VRML program, and seen as a two-dimensional view of concentric spiral zones of two different colors.

FIG. 97 shows a data structure capable of generating the markings of FIG. 52 and FIG. 53. A virtual plaque or lozenge is placed in the 3D space, overlapping the two curves of the spiral corresponding to the two schedules being coordinated. This is schematically illustrated in FIG. 98. A simple VRML view of this arrangement could generate markings like those shown in FIG. 52 and FIG. 53.

SECOND METHOD

In a second, or "cheating" method, the two spirals could be markings which are texture-mapped onto the same helical surface, effectively dividing the helical surface into a painting of two concentric helices. The resulting appearance would be quite similar to the use of a double-helix data structure.

MORE ELABORATE ANNOTATIONS

It is also possible to make more elaborate annotations, such as connective annotations between two other spirals on a third spiral area. In this case the third spiral area serves as a bridge between the other two, on which new material can be written. This could be a third helix data structure separated spatially from the other two, or a texture-mapped area that looks like it.

ANNOTATION FOR UNDERSTANDING

Inter comparison of time-lines can be significant even when there is no practical, or forward-looking, value. For instance, in FIG. 99 we see a hypothetical spiral diagram of the Battle of Gettysburg, where "N" and "S" represent respectively the time-lines of Northern and Southern forces. Such a spiral visualization shows the timing relations over a four-day period. Arrows are also shown, meant to indicate military attacks or initiatives, and indicating also that such visualizations can show movements, transfers, initiatives, and other symbolic representations of changing relationships between parties, objects or events represented on time-lines.

VIRTUAL LIGHT

This visualization system may be differentially lit or colored for emphasis, or to show night and day distinctively.

This is particularly easy in 3D computer graphics, whereby a virtual light source applied to one side of the 3D helix can simulate day. Brightness of lettering can be adjusted for readability on the night side.)

OVAL WINDOW

Another good arrangement for the day would show it not as a circular spiral but as a more ovoid spiral, with one side for day and one side for night. FIG. 45 shows the use of such an ovoid, or squashed, spiral to divide the presentations of day and night. One side shows day and one side shows night. (Such an oval presentation may be implemented in the 3D data structure by "squashing" the helix sideways, so that viewed lengthwise it has an oval rather than a circular cross-section envelope.)

This has the advantage of packing more annotation-space into the daytime, where the most annotation is likely to be wanted. It has the disadvantage that 6 AM and 6 PM have less annotation-space in the presentation.

TILTING THE SCENE: SKEWED SPIRALS FOR EMPHASIS

The two-dimensional spiral view does not have to be evenly shown. Unbalanced views of the spiral may be beneficial.

Skewing the view can enlarge, and thus emphasize, one portion of the sweep, and by narrowing de-emphasize the rest.

Using the 3D mechanism, this is easily done by angling the point of view slightly off center in the helix, away from the side to be emphasized.

By tilting the projective view of the helical data structure, one part or the other of the cycle becomes emphasized.

This could be done dynamically, tilting the helical data structure in real time to show more or less of a particular portion of the sweep. A user control could affect the straightness of the view down the helix, effectively thickening one side of the spiral sweep and thinning the other, at the user's choice. This is seen FIG. 58, showing a relative tilting of the helical data structure with respect to the projected view; and indicating the user's possible adjustment of the tilt angle A of the virtual helix in order to change the time emphasis being visually presented.

Note, however, that one disadvantage of this method is that it knocks askew the alignment between corresponding pips or time-markings on successive layers of the spiral. This is seen in FIG. 60, which indicates a visual emphasis created by tilting the helical data structure as in FIG. 58, showing also the misalignment in presentation of the hours (or other markings) caused by tilting the virtual helix, except for two points on each sweep of the spiral, which two portions remain aligned.

ALARM CLOCK AND OTHER TRIGGERING

Electrical mechanisms may be associated with such clocks or calendars, in order to trigger preset events, such as alarm-clock ringing, the turning on of lights, etc. Phone calls can be made automatically, or at least lined up and held ready to initiate by the user, by connecting the spiral time visualization to an auto-dial system.

MULTI TUNNEL VIEWS

A somewhat startling view, with a nightmarish Mandelbrotian quality, may be had by combining views simultaneously. The time-tunnel of a year may be surrounded by 365 little time-tunnels, one for each day (day-tunnel), but each one being a view into infinite time. We observe this in FIG. 70, which shows a paradoxical multi tunnel view where both the year and the individual days are infinite time tunnels (detail).

Or the view of a year (a year-tunnel) could be shown with four time-tunnels each representing a quarter of a year around it (quarter-tunnels). We observe this in FIG. 71, which shows a paradoxical multi tunnel view where the tunnels are the year and four quarters, the quarters corresponding to twelve consecutive months shown in the year spiral.

There are various possibilities for multi tunnel views, such as: Year-quarter-month; Year-quarter-day; Year-month-day; Year-quarter-week; Quarter-day; Month-day; Week-day; Month-day-week; and for the grand finale, Year-quarter-month-week-day. We observe this in FIG. 72, which shows a paradoxical multi tunnel view where the tunnels are the year, quarter, month, week and day, with displayed arrows showing their correspondences.

While there is a consistency about showing a year, or a day, as a time tunnel, there is a kind of inconsistency, or at least redundancy, about showing several time-tunnels at once, considering that each one can be showing all future time. But that is not a real problem to the mind; to study these separate time tunnels is like looking through separate sides of a binocular. They all show the same thing, albeit in different ways.

PACKAGED EMBODIMENTS

I envisage a number of embodiments for this invention. One kind of package will be on the computer screen; another will be stand-alone.

COMPUTER SCREEN EMBODIMENTS

One embodiment of this invention is a Web page in VRML (Virtual Reality Modeling Language), run over the Internet by a CGI script on a centralized server. A user could open a Web browser window (such as Netscape Navigator or Microsoft Explorer) and leave this continually on the screen. Centralized service of this kind on a server within an organization will be particularly useful for organizations in which different people's schedules need to be coordinated.

Another embodiment will be a stand-alone program in Java, likewise producing a dynamic Web page, but with no connection a server, maintaining the scheduling data on the user's computer.

SCREEN SAVER

Another computer-screen embodiment of this invention will present it as a screen saver, appearing after a certain time of user inactivity.

SCREEN DECORATION

Such a spiral visualization of time will also be a useful screen decoration, continuously present on the screen.

WRISTWATCH EMBODIMENT

A particularly charming embodiment will be to install this visualization system in a wristwatch. This will use a circular wristwatch area to the fullest.

The user could turn a dial at the watch's edge to cause tightening and loosening animations, effectively to move forward and backward in visualized time by moving the viewpoint. Another mode for such a dial -- invoked, for example, with the click of a button, changing the function of the edge dial -- dynamically tightens and loosens the sweep unit, from year to month to day.

In one method of input, for such a portable visualization system, the user should be able to trace letters with a finger on the surface of the watch to make a textual note, noting an appointment, plan or other textual note by means of a touch-sensitive screen and handwriting recognition. Another input option is to provide an audio recording facility, allowing the user to make spoken comments. These may then be associated by software with some point or area of the time visualization.

EYEGLASSES

This visualization system can be installed in eyeglasses, either as an LCD display between the user and the world, as in FIG. 66, which shows a time spiral visualization installed in eyeglasses as an LCD screen, where "LCD" represents a cross-section of the LCD screen.

Such a visualization system may also be installed in eyeglasses reflectively. FIG. 67 shows a time spiral installed in eyeglasses reflectively, where "M" represents a semi-silvered mirror and "CRT" represents a cathode-ray tube. This has the advantage that the brightness of the image can be increased or decreased by illumination of the CRT, which can be electronically adjustable.

CONTACT LENS

In a far-fetched but possible embodiment, the system could even be installed inside a contact lens, functioning as a miniaturized version of the LCD glasses shown in FIG. 66.

In addition to the above mentioned examples, various other modifications and alterations of the invention may be made without departing from the true spirit of the invention.

***

FIG. 5

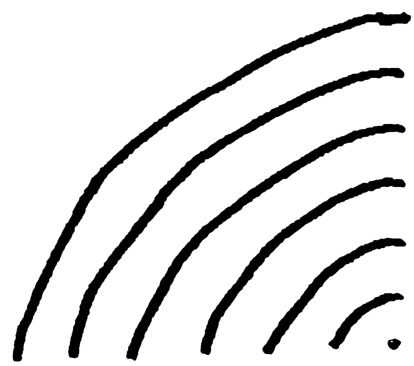


Fig. 6

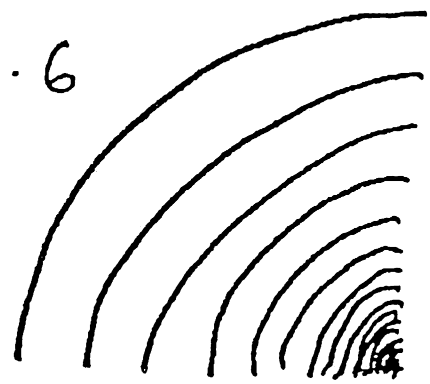
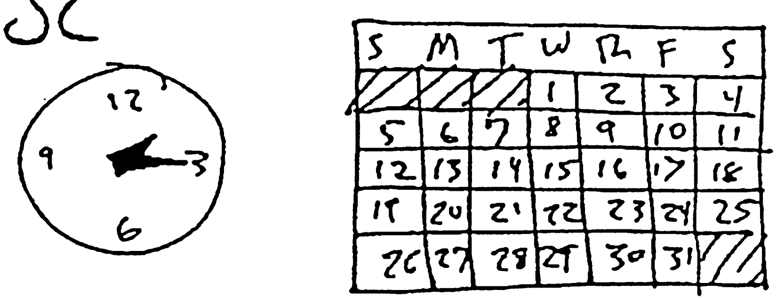


Fig 32



EVERYDAY CLOCK & CALENDAR

the way some people put them on a computer screen

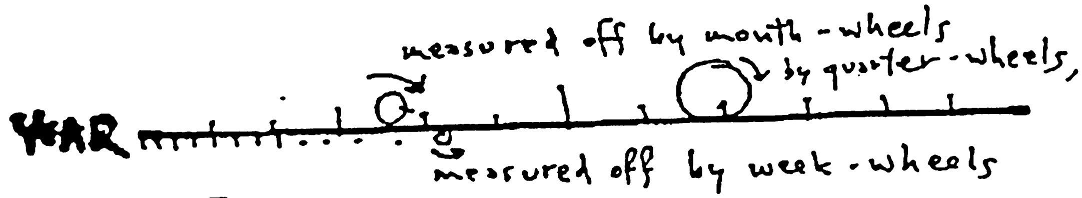
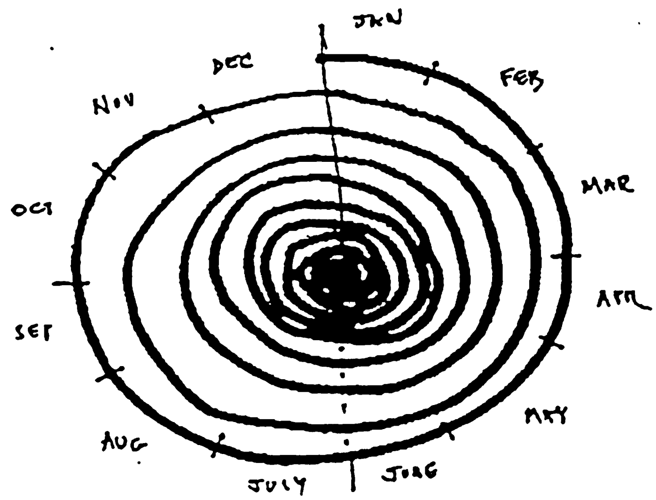

measured off by month-wheels
by quarter-wheels,
YEAR
measured off by week-wheels

FIG. 33

Fig 3d



INFINITE SPIRAL CALENDAR (zoomable)

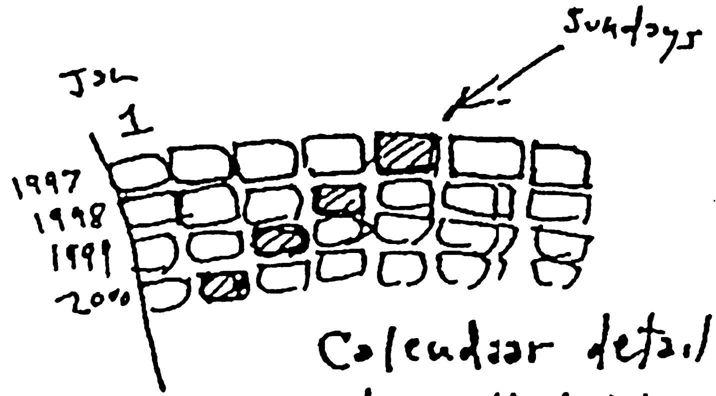


FIG 35A

Calendar detail:
days look like kernels of corn

By colour-coding,
DIFFERENT CYCLES may be seen simultaneously,

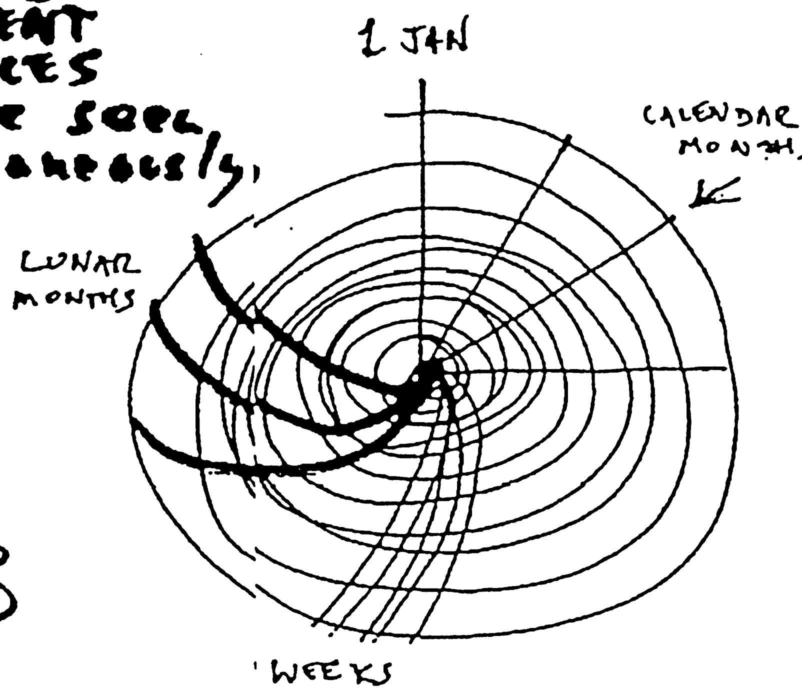
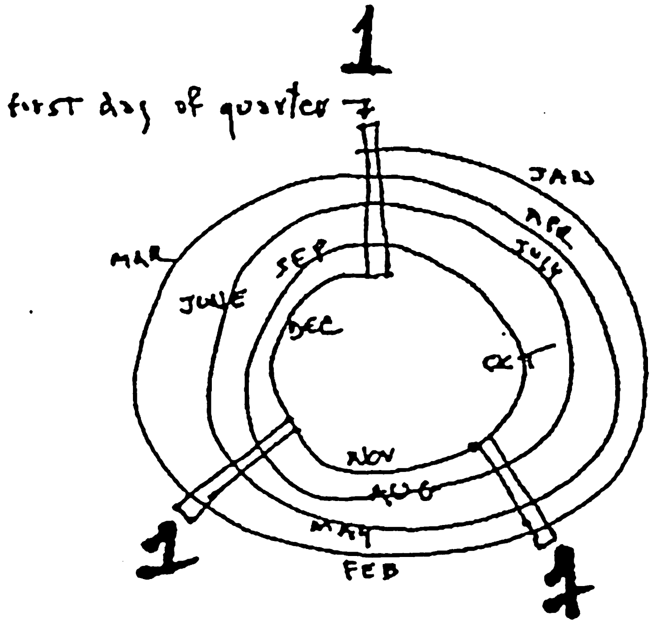


FIG 35B

FIG 56



QUARTERS for one year

A WEEK OF DAYS AND NIGHTS AND PLANS

Fig 37A

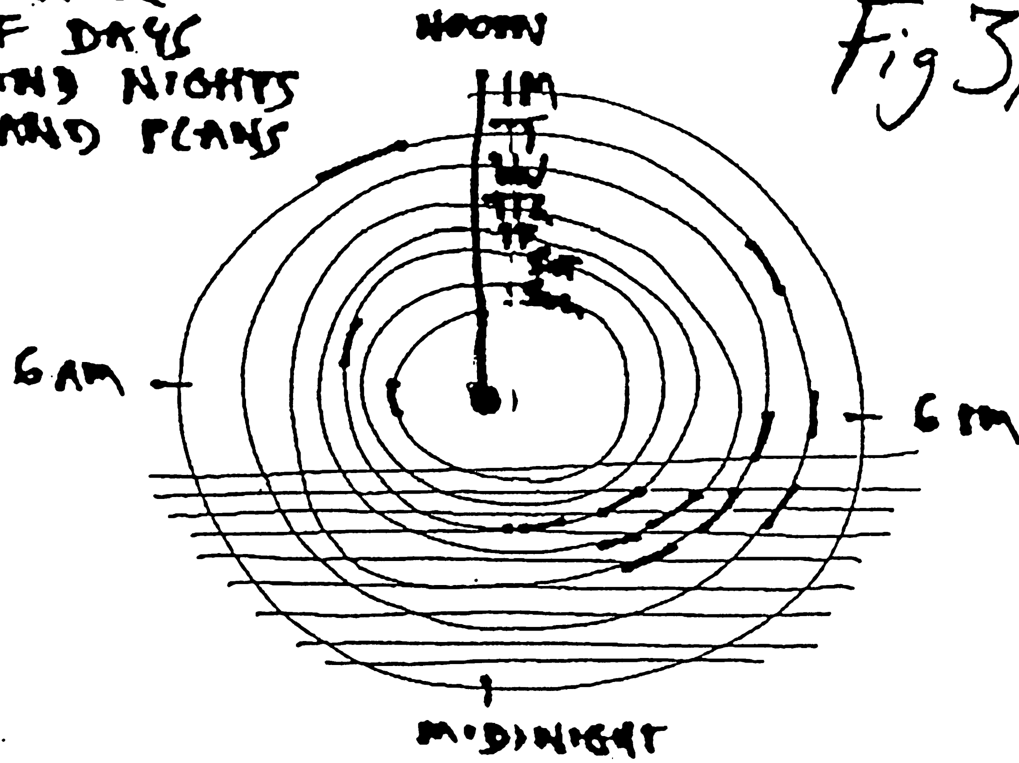
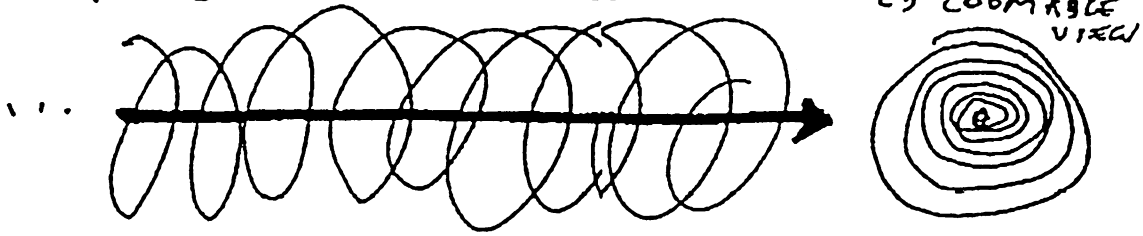


FIG 37B



SPIRAL CLOCK/CALENDAR
AS 2D VIEW OF 3D HELIX

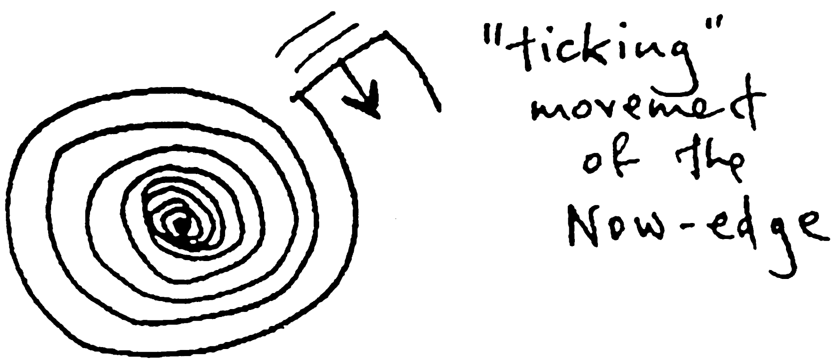
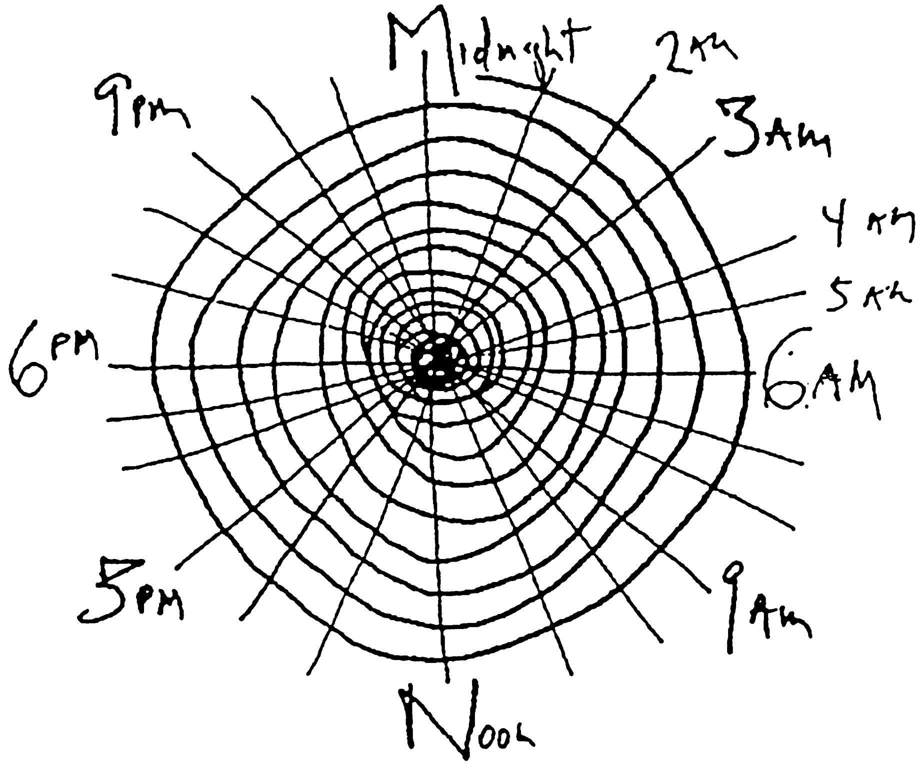


FIG 42A

FIG 42B

FIG 43



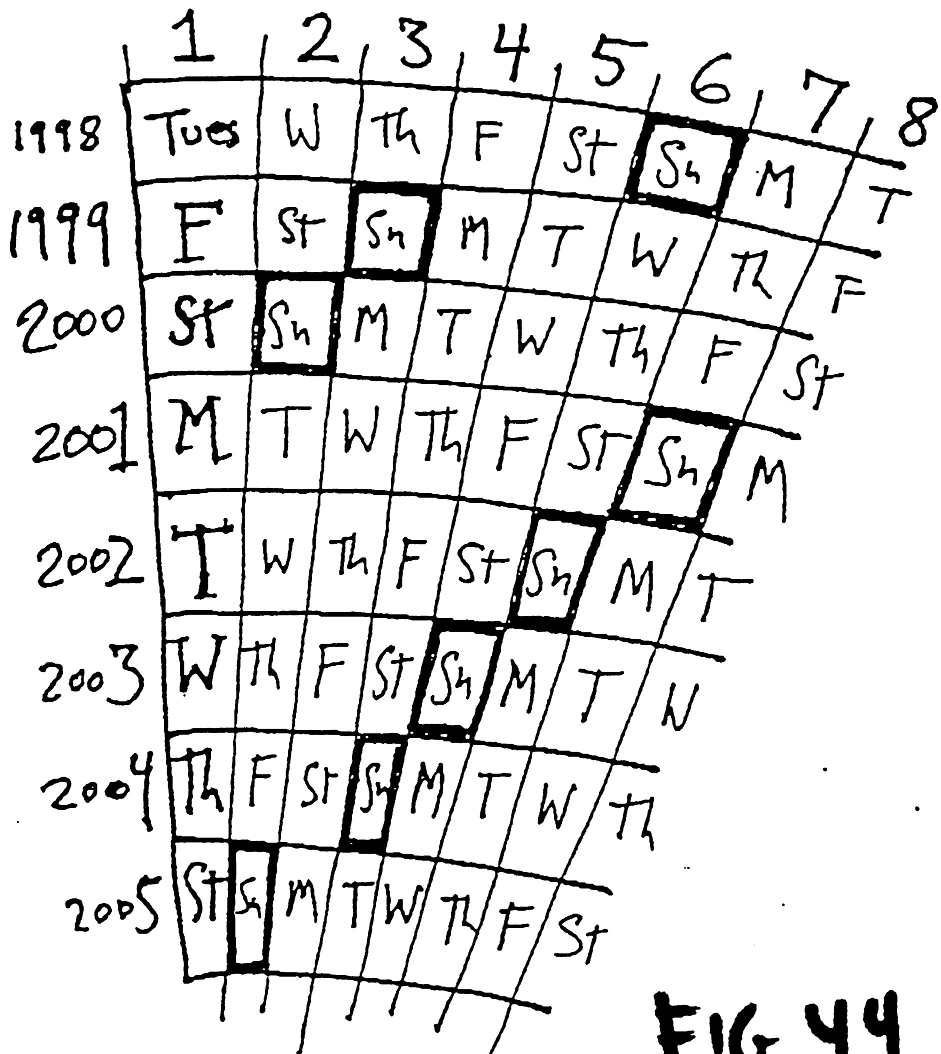

1 2 3 4 5 6 7 8
1998 Tues W Th F St Sn M T
1999 F St Sn M T W Th F
2000 St Sn M T W Th F St
2001 M T W Th F St Sn M
2002 T W Th F St Sn M T
2003 W Th F St Sn M T W
2004 Th F St Sn M T W Th
2005 St Sn M T W Th F St

FIG 44

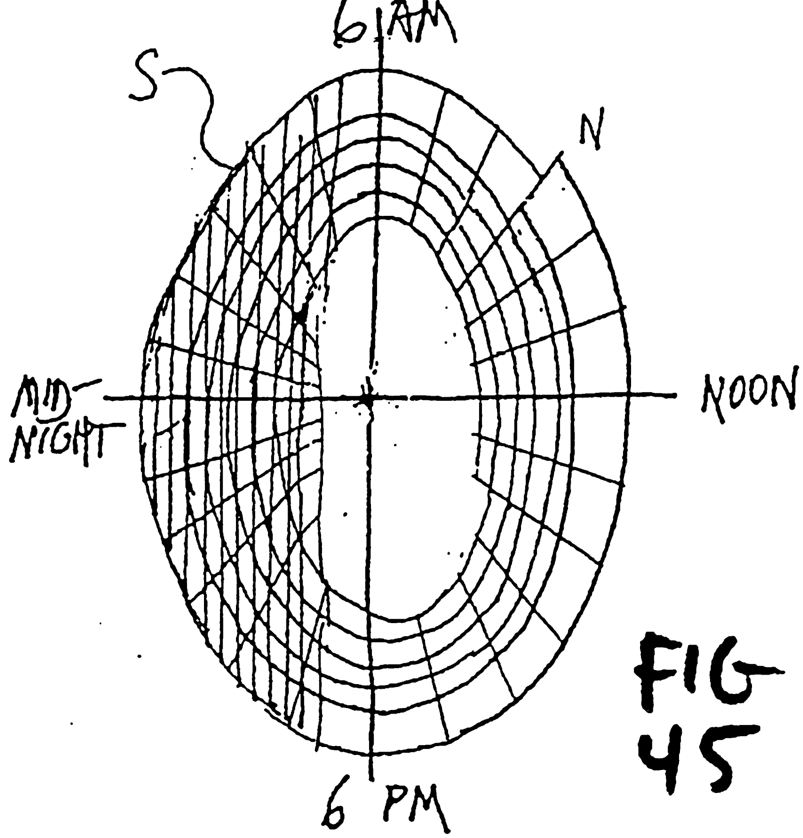


FIG
45

p. 15

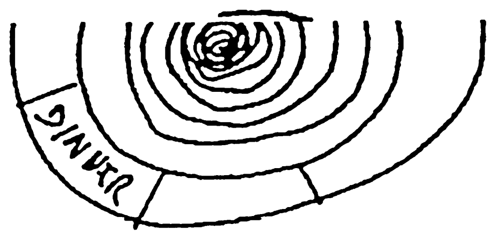


FIG 46

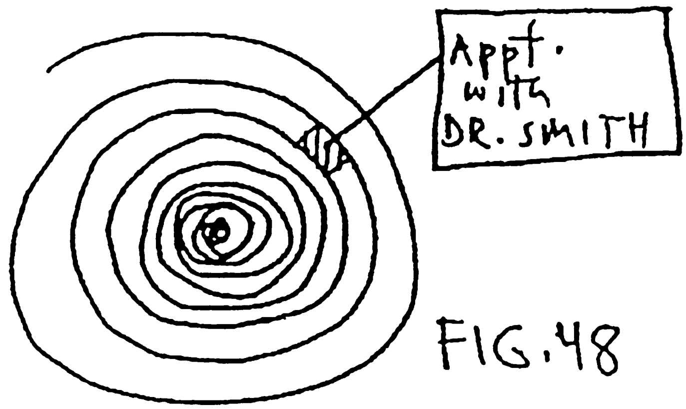


FIG. 48

Fig 52

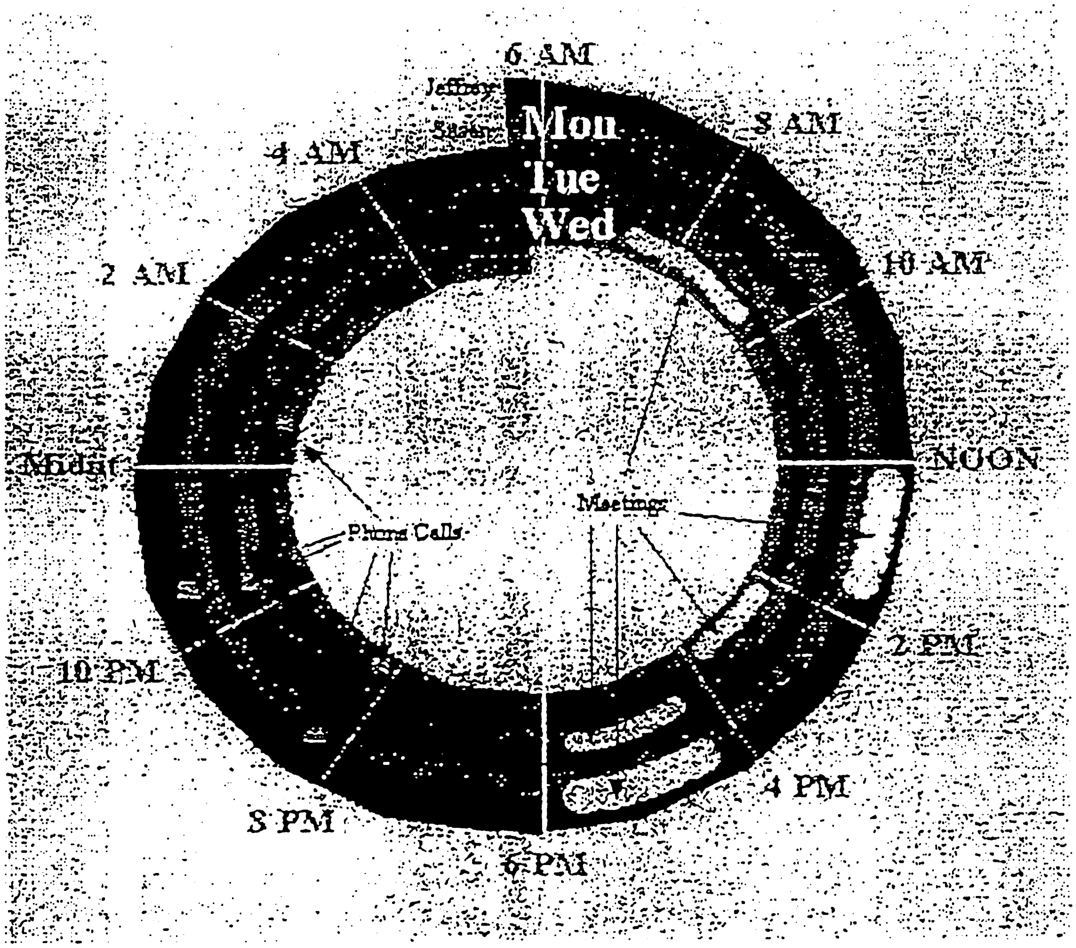
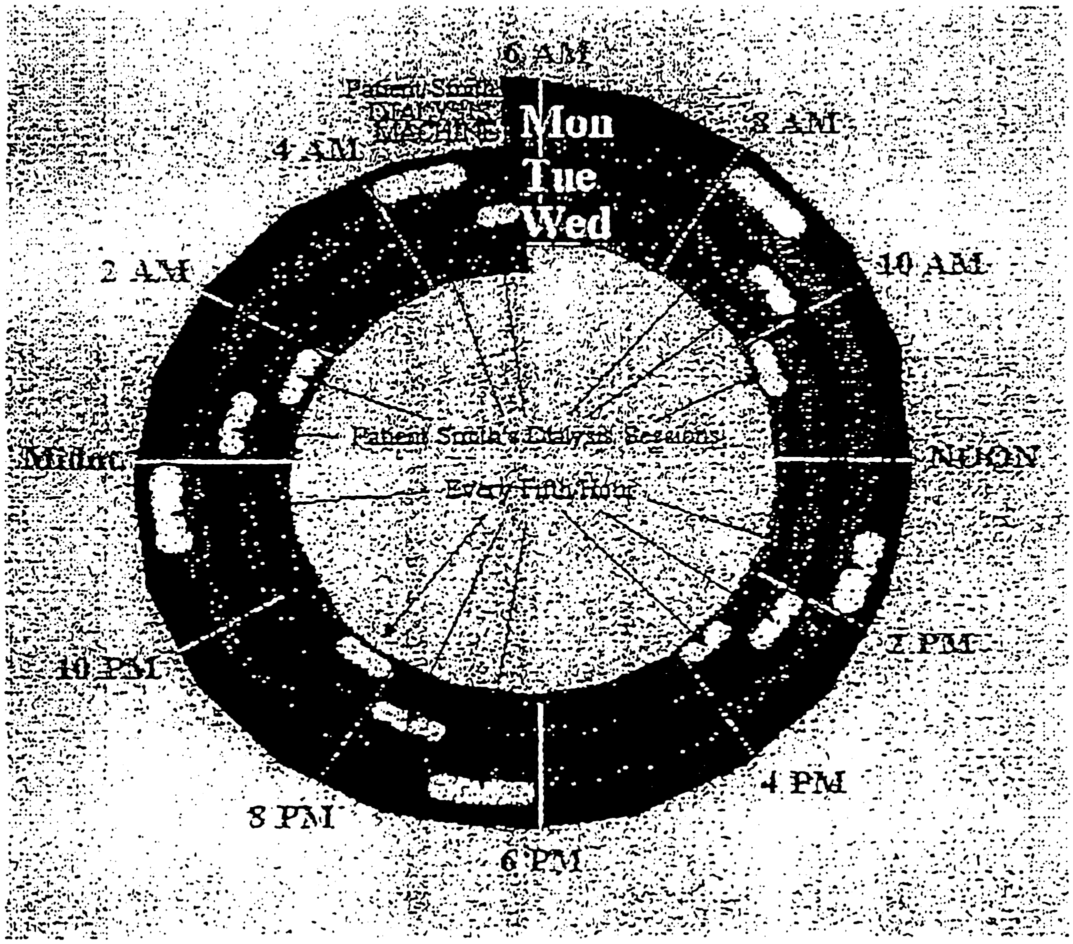

6 AM
Mon
Tue
Wed
8 AM
10 AM
NOON
2 PM
4 PM
6 PM
8 PM
10 PM
Midnt
2 AM
4 AM
Meetings
Phone Calls

FIG 53



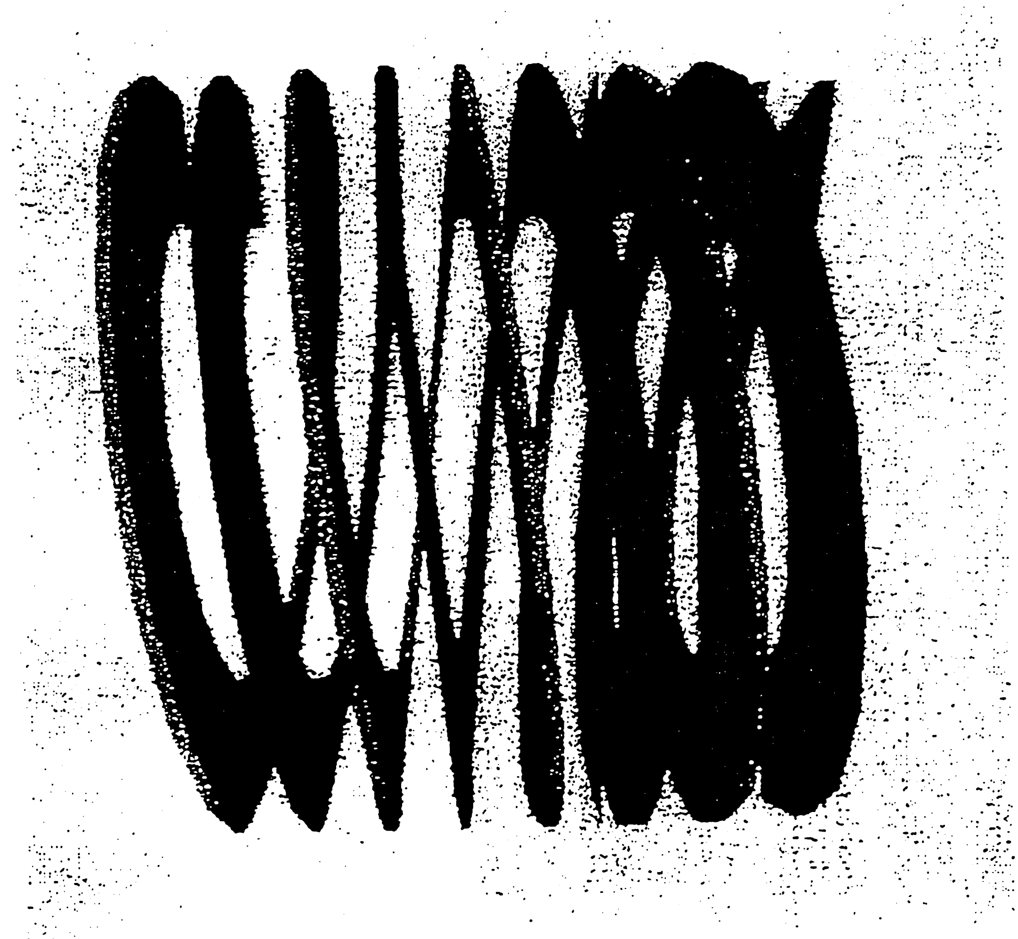


FIG 56A

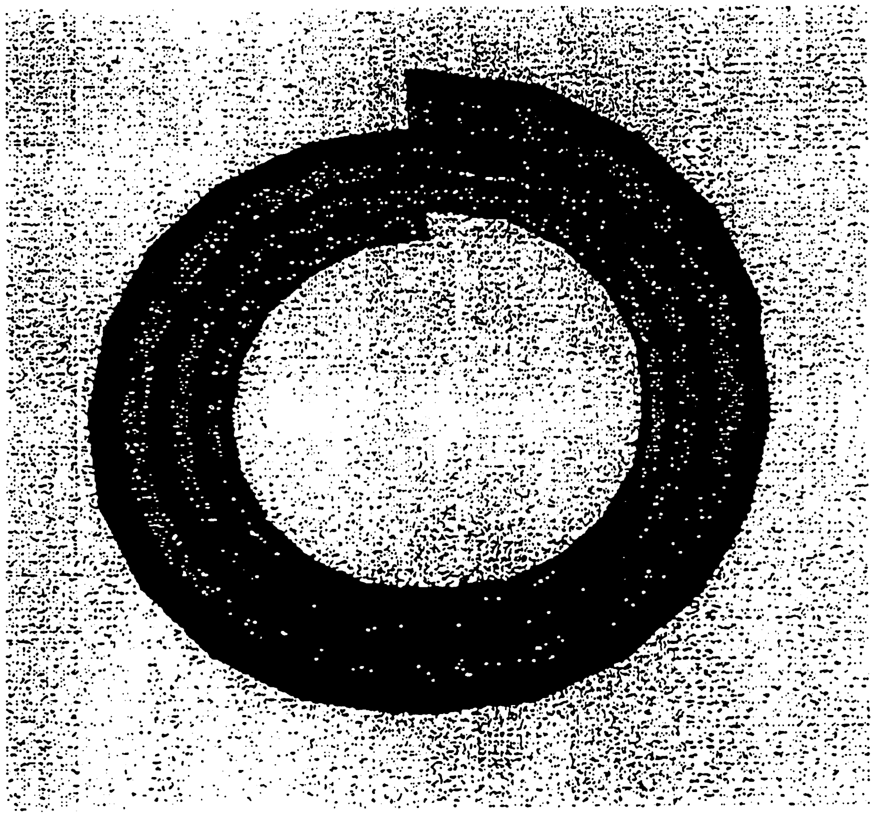


FIG 56B

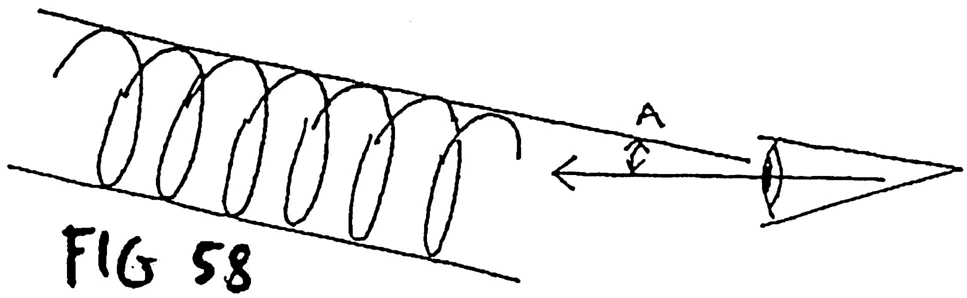


FIG 58

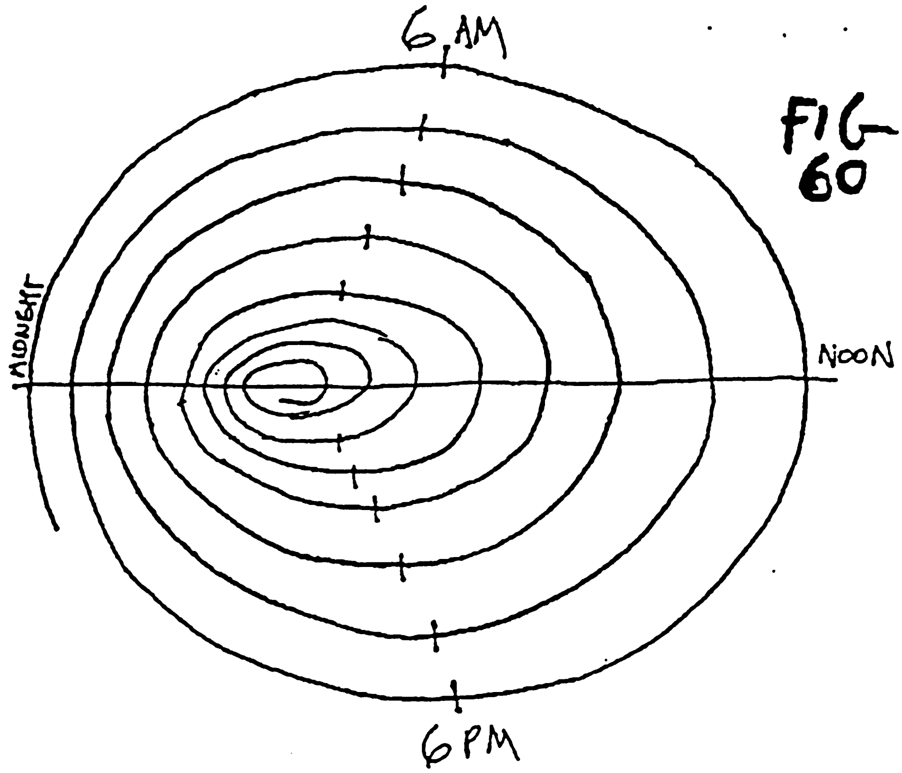
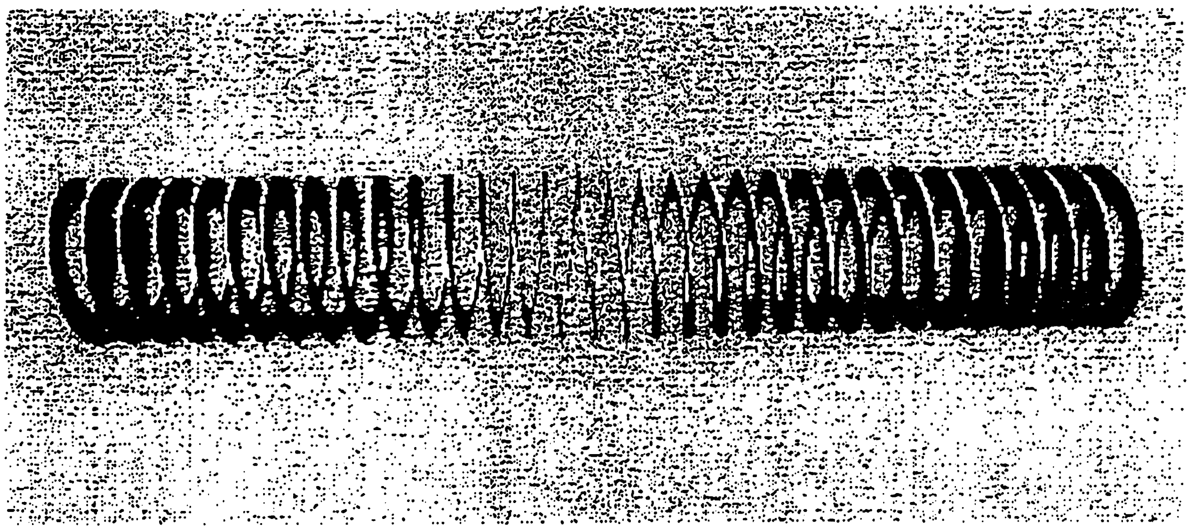


FIG 60

FIG 61



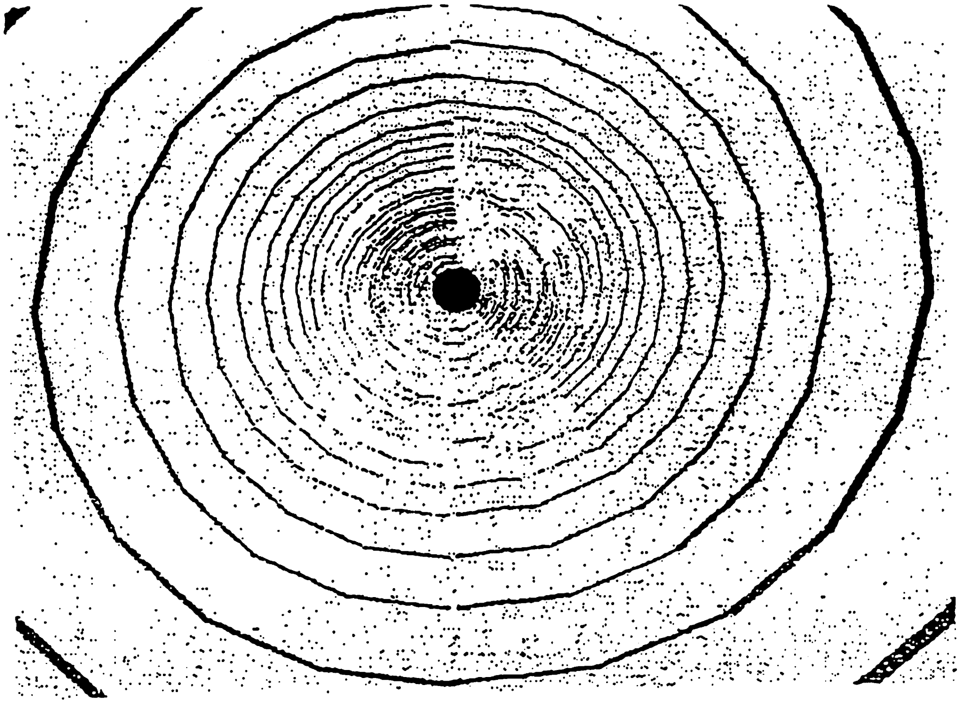


FIG 62

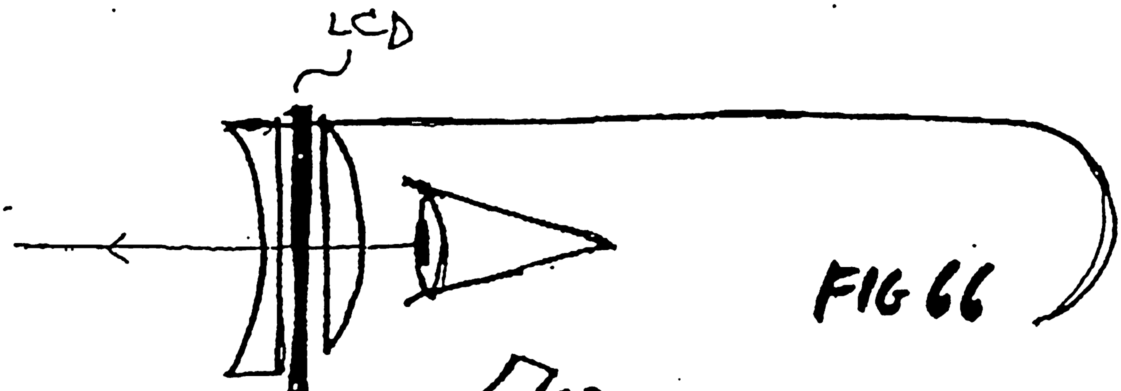


FIG 66

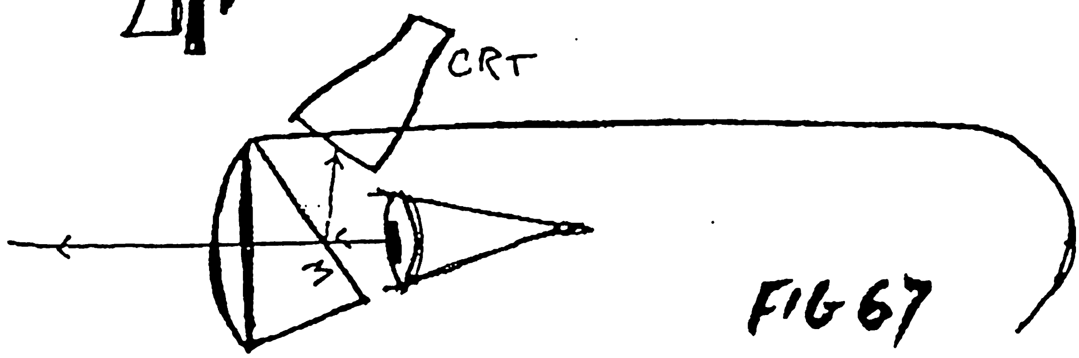


FIG 67

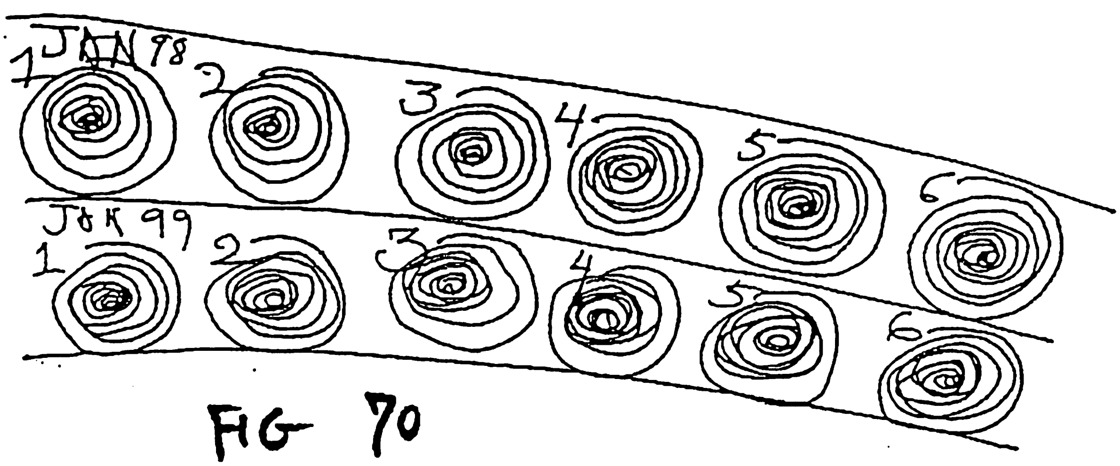


FIG 70

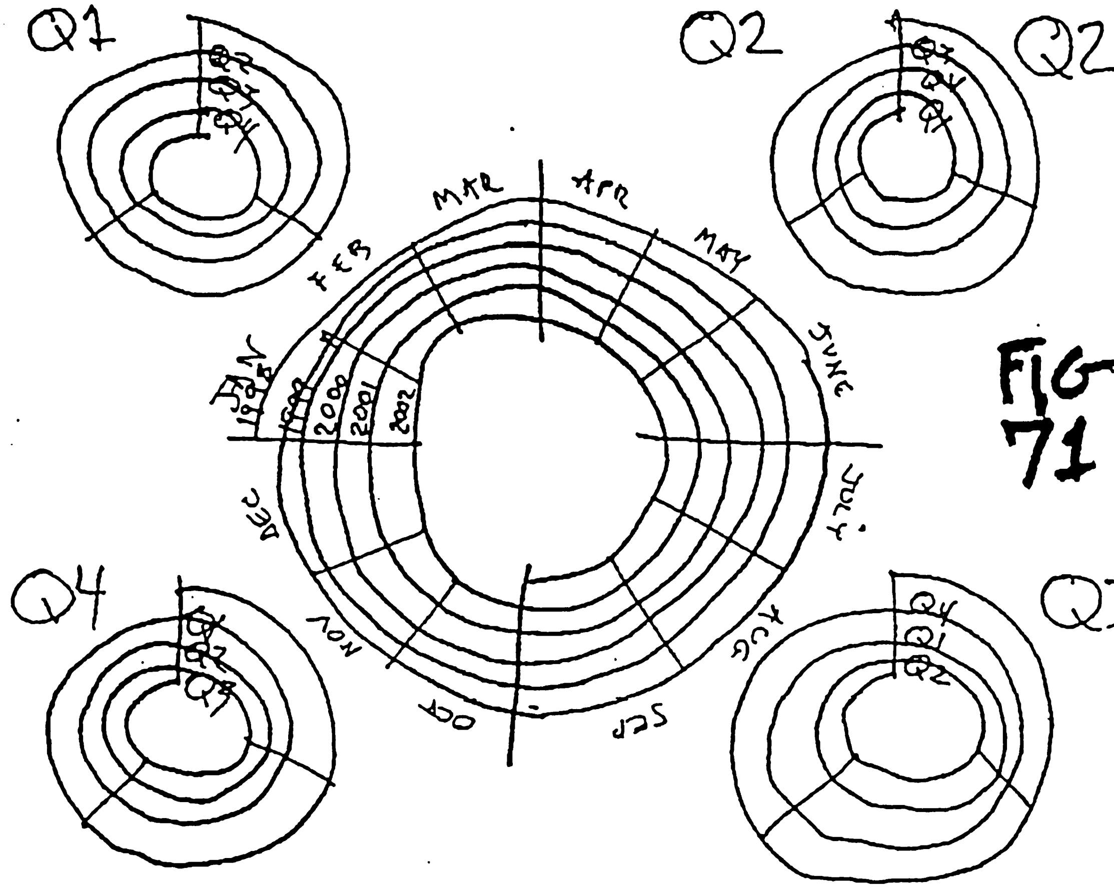

Q1
Q2
Q2
Q4
Q3
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
DEC
2000
2001
2002

FIG 71

p. 29

FIG 72

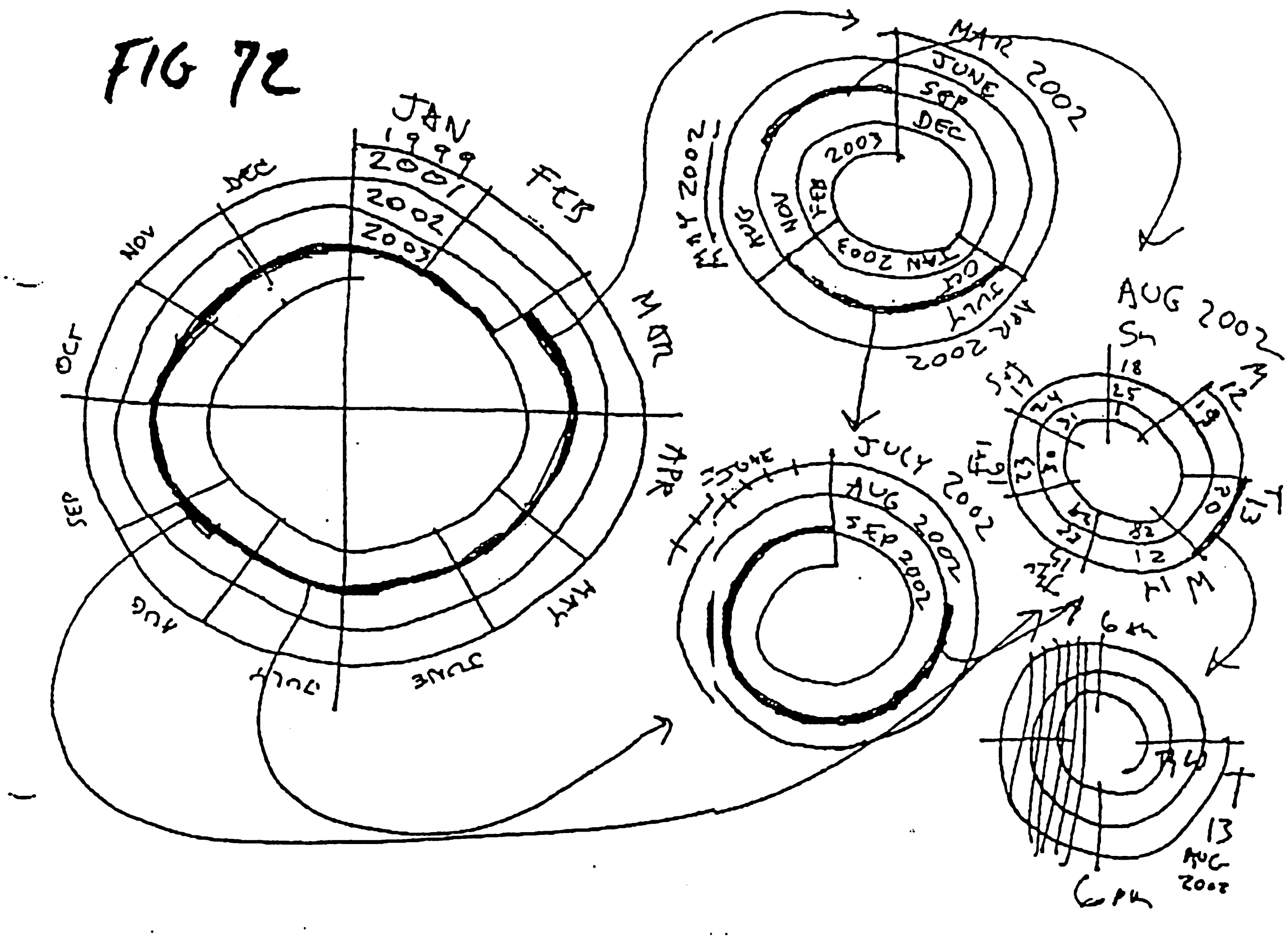
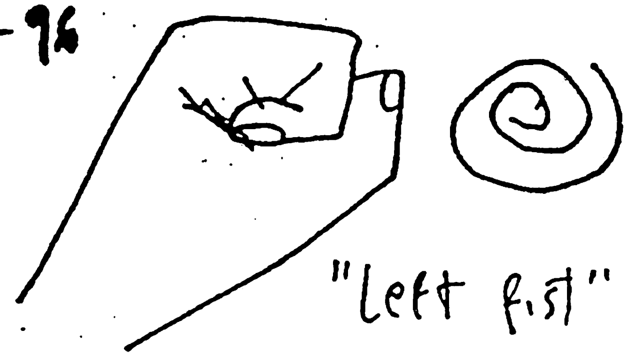

JAN
1999
2001
2002
2003
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
DEC
MAR
JUNE 2002
SEP
DEC
2003
JAN 2003
MAY 2002
AUG
NOV
FEB
OCT
JULY
APR 2002
JULY 2002
AUG 2002
SEP 2002
JUNE
AUG 2002
Sn
18
25
M
12
19
T
13
20
W
14
21
Sat
17
24
31
6 am
6 pm
THU
13
AUG
2002

FIG 96



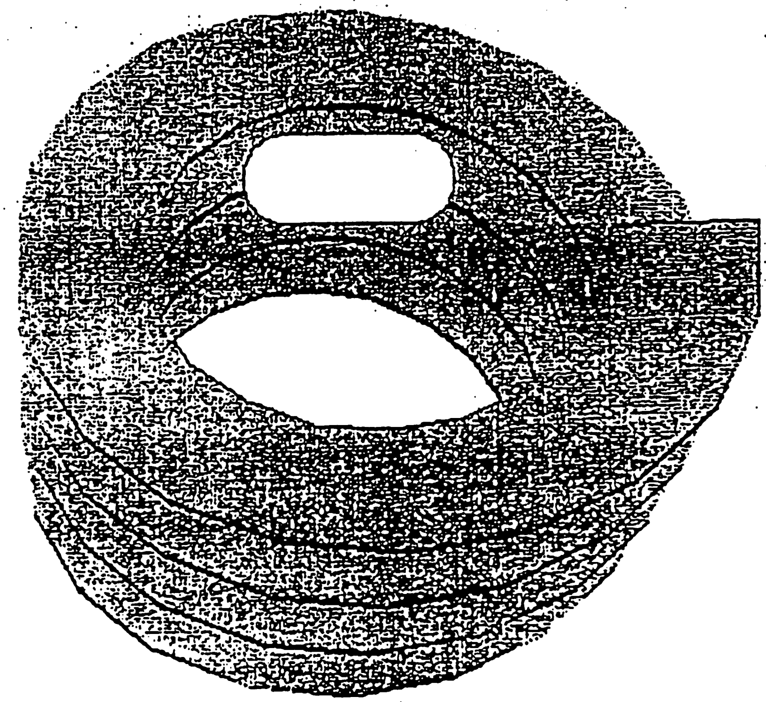


FIG 97

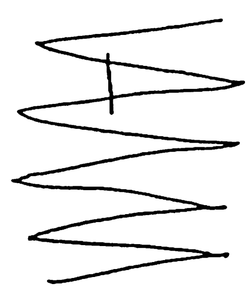
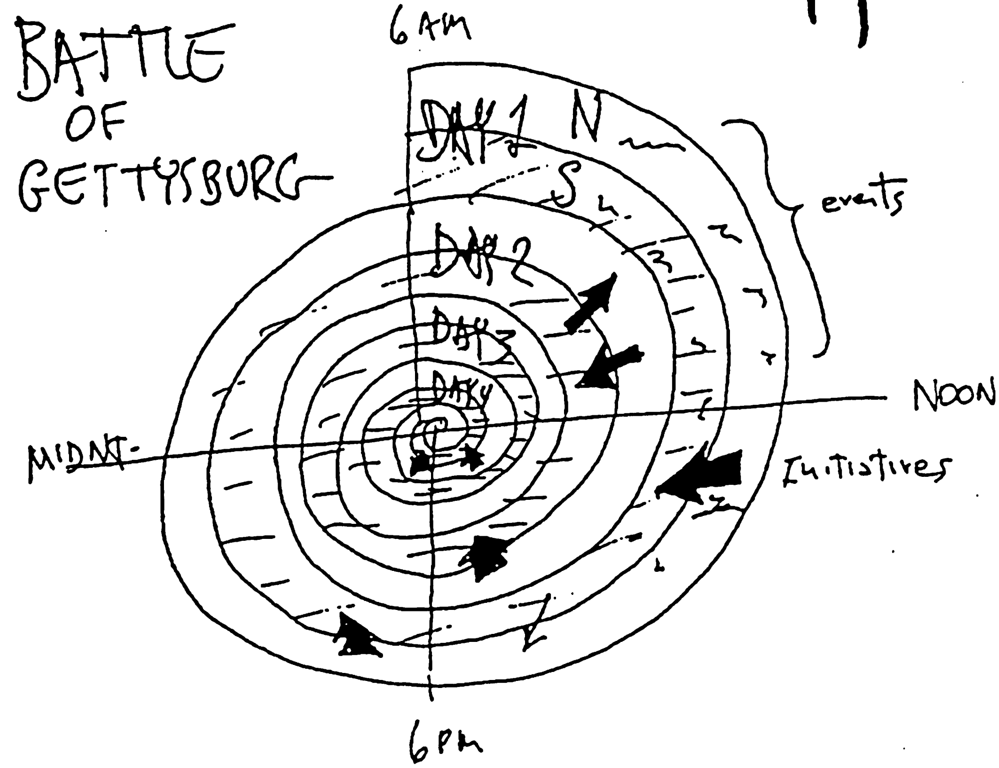


FIG 98

FIG 99


BATTLE OF GETTYSBURG
6AM
DAY 1
N
S
events
DAY 2
DAY 3
DAY 4
NOON
MIDNT
Initiatives
6PM