The Contempra Phone
Telesis (May 1968)

The Contempra* Phone — A New Shape in Communications

S.M.K. Horne
J.F. Tyson
G.W. Parsons

The evolution of a new Canadian telephone set, equally suitable for desk or wall application, in which the handset and base receptacle become an integrated unit.

The telephone set is one of the few products in the portfolio of the telecommunications manufacturer that enter the visual and physical world of the customer. The elaborate switching complexes, transmission facilities and peripheral equipment which accomplish today's telephone feats go virtually unnoticed in the central offices, switching exchanges and vast transmission networks across the country.

For this reason, therefore, the telephone set is to the subscriber the only means of conveying the technological advances which are being made throughout the telephone system. In other words, the terminal device communicates the new technology that is up-dating the system, through the media of modern and contemporary design.

The CONTEMPRA phone (Figure 1), to be introduced into the consumer market in early 1969 marks Northern Electric's entry into the field of station apparatus design, from initial concept to final product. This article describes the requirements that were established for such a telephone set, discusses the industrial design process as well as the problem associated with its refinement and manufacture.

In the past, most of the telephone apparatus and equipment manufactured by the Northern Electric Company was designed by the Bell Telephone Laboratories. In the field of station apparatus, this association has enabled Canadian telephone companies to offer their subscribers the latest U.S. Bell System designs of telephone sets and associated equipment. The reasons for the gradual change in the relationship between Northern Electric and the Bell System were discussed in an article by Dr. A.B. Hunt (TELESIS, Nov. 1967).

A direct result of this change has been the formation of the Northern Electric Laboratories, charged with the responsibility of new designs of modern communications equipment which can be manufactured economically to meet the needs of the Canadian communications industry and the expanding export market. In the field of telephone sets, it is necessary for a design not only to meet the technical and economic objectives but also to satisfy adequately the stringent requirements of human engineering and good aesthetic design. The latter factors are of great importance in today's highly competitive marketplace.

System Requirements

The method of designing a telephone set is evolutionary in process. It begins with the identification of a need, followed by a selection of one or more alternatives which will satisfy that need. After a selection has been made as to which alternative is to be proceeded with, a closely coordinated team possessing a variety of skills is formed.

After the design has been resolved development commences and proceeds to a point where limited quantities of the telephone sets are made available for field trial purposes. Experience has shown that a field trial under actual service conditions inevitably brings about changes and improvements and provides necessary information that could not be obtained in any other way.

A need was identified for a new telephone set of modern design employing the dial-in-handset concept, which had proved popular with users in several countries. Our studies indicated that to produce a telephone set of this type at an acceptable cost it was mandatory to use existing major components such as the transmitter, receiver and ringer. While this requirement imposed severe restrictions on the design of the telephone set because of the relatively large size of these components, it did offer the advantage of availability of components and known reliability. A further advantage was early introduction of the set because only a few new components were required. An additional requirement was that one design of telephone set should serve both wall and desk applications.

The identification of all these requirements set the industrial design and development process in motion and provided the opportunity for the team to evolve a telephone set of distinctive Canadian design to meet Northern Electric's market requirements.

1

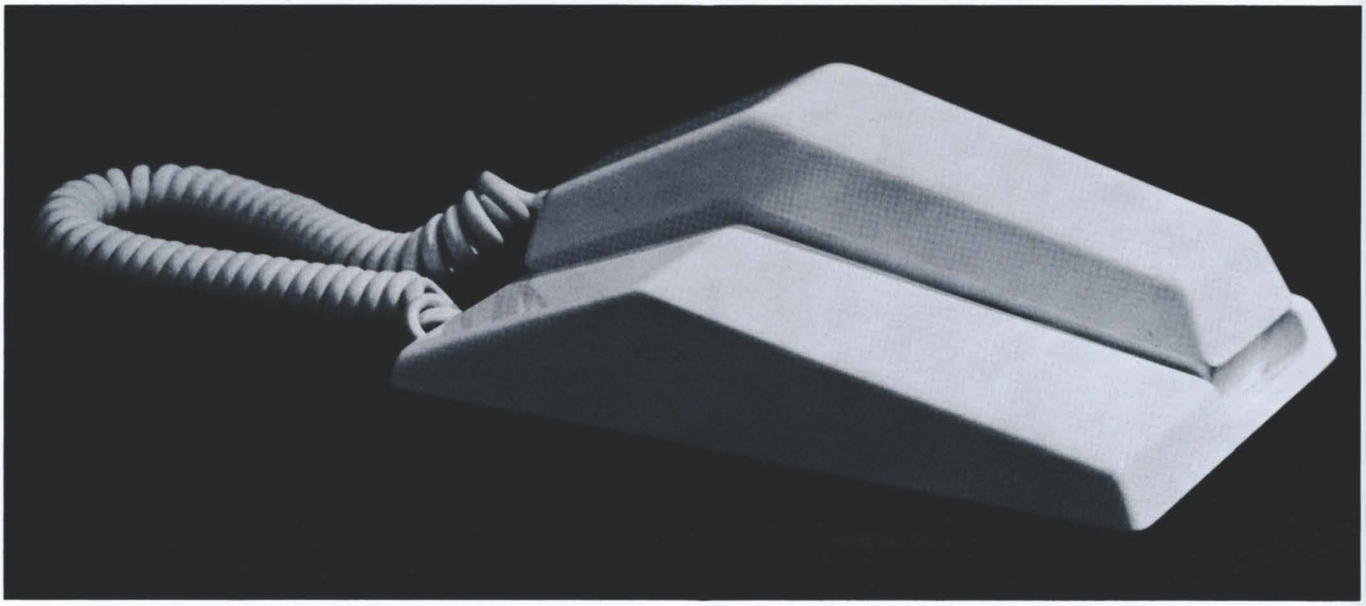


FIGURE 1 The CONTEMPRA phone, Northern Electric's entry into the field of station apparatus design.

Industrial Design

The industrial design resolution of any product is based on a formal design process, involving several sequential steps, as listed in Figure 2. The initial step, namely problem statement, requires the setting out of the requirements established by systems engineering, in this case, the design of a new telephone set employing the concept of a dial-in-handset using existing components, and suitable for desk or wall application. Establishing the design criteria was the second stage; in this case determined by the constraints of the multiple use factor (desk or wall application) in combination with the anthropometric standards for human proportions.

With the physical restrictions established by the problem statement and the set of criteria, the designer must then establish a hypothesis, which becomes the philosophy and basis of the form resolution. The hypothesis requires the answers to many questions:

- What is a telephone, where is it used and under what conditions?
- Why it is used and who uses it?
- Who selects and pays for a telephone?
- Who chooses its colour?
- How long must the design last?
- Is it easy to keep clean?
- Is it stable and not prone to slipping on a surface?
- Is it pleasant to use and look at?

The answers to these questions lead the designer into developing the hypothesis (a series of general statements). For example, a telephone is an entity which expresses and extends human conversation and as such it must be suited to varied environments and applications. It is a piece of communication equipment and should communicate not only its function, but project, through external form, the technological development within. The telephone should not dominate its surroundings, since it is basically a utility service. It should therefore harmonize with its environment or gently complement it. To adapt an old saying, a telephone should be heard but not seen. Intimacy, security and confidence are important factors and it should psychologically communicate these functions both in the user's hand and also when not in use. Handset and base must harmonize, since they are closely related for most of the time. The telephone must be adaptable to multiple environments from the most contemporary to the most traditional, in the bedroom, living room, kitchen, recreation room or office, It must look like a desk set on a desk, and wall set on a wall, with no apparent inconsistencies.

A telephone is a convenience and must have a highly functional design. However, the status of the telephone has changed — after 90 years it is no longer a prestige item, but has become a necessity in contemporary life. Any newly-introduced product will have momentary status and prestige simply because it is new and in short supply. Therefore, the telephone product must have some endearing and enduring quality to satisfy the consumer long after the initial impact has died. The set must be stable, easy to lift for cleaning, and easy to keep attractive. On the wall, the protrusion must be kept to a minimum. It must be comfortable to use and since it is used by everyone, male, female, adult and child, it must have no gender.

Problem Restatement

This empirical analysis projects the designer into a problem restatement since new criteria have been established by the hypothesis. He must take upon himself the physical resolution of the product through visual sketches, renderings and three dimensional models. The creative process involved in this resolution is of course extremely difficult to describe in words. However, the following is an outline of some of the trends of thought contributing to the final CONTEMPRA phone design, which evolved in three distinct directions — the handset, housing and functional features.

The handset has primarily two asymmetrical planes, a long plane extending from the ear to the chin and a second plane from the chin around in front of the mouth. The handset is placed to one side of the housing to enable the resulting asymmetrical arrangement to modulate at the demand of the components to be housed within while maintaining a low and stable form. The final dimensions of the complete telephone are 9″ x 5″ x 2¾″ high.

This possibility of further modulation and variation can result in a family of station apparatus. The handset is equally attractive with a push-button system as it is with a rotary dial. On the other hand, if push-buttons are mounted on the base, they can form part of an intercom telephone unit or, when accompanied by a miniature video screen, as a data retrieval system or videophone as shown in Figure 3.

Some earlier telephones had made provision for supporting the handset "off-hook", for example while calling a third party to the phone, and this was considered a desirable feature. In the CONTEMPRA phone, designed for both desk and wall application, it had to be provided in two different ways. It was important that the unused handset-holding structure should be discreetly hidden, particulary in the "on hook" position. To achieve this the angles in the base receptacle and those at the back of the handset are made complementary so that the handset can be inverted for "third party calling" position on the desk version. The wall "third party calling" hook uses the receiver lip and a designed shelf in the receiver receptacle. Thus both features are built into the receptacle and as a result are hidden when the handset is in place. Figures 4 and 5 illustrate the "third party calling" features in desk and wall applications respectively.

One useful feature of the new set is the shape of the recess between the plastic housing and base plate which in the wall mounted application provides a location for a pencil, especially convenient if there is no table handy. Similarly, the flat surface on the plastic housing beside the receiver end of the handset allows for a clip-on pad.

To take advantage of the dial-in-hand concept, a longer extension cord is provided to allow up to 5½ feet of freedom. This feature is enhanced by a call cancel button duplicated in the handset so that several calls can be made from the same location without the need of hanging up the handset in order to obtain a dial tone.

The new telephone set embodies many other design features, all of which have been the subject of customer preference tests. In addition, and simultaneously with the mechanical design, the closely related problem of colour selection was resolved. A complete range of nine non-impact, harmonizing and complementary colours were selected on the basis of the same hypothesis that was applied to the basic form. A great deal of research went into this phase of the project backed up by several internationally-known colour consultants. Figure 6 lists the nine selected colours.

Design Finalization

One of the basic functions of the Regional Laboratory in the research

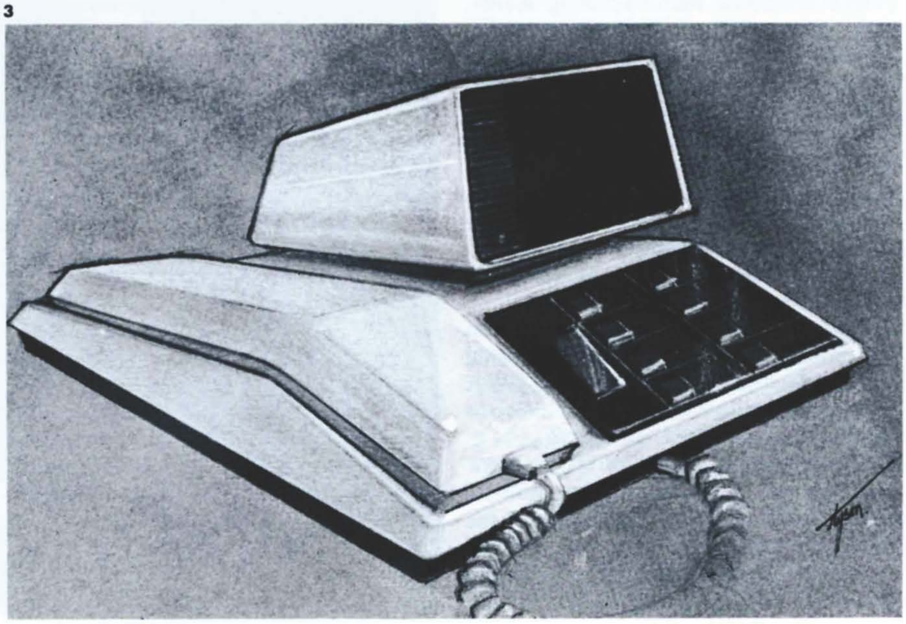
FIGURE 2 Table of sequential steps of industrial design resolution.

FIGURE 3 Designers' rendering of a CONTEMPRA phone utilizing push button controls and video screen for data retrieval.

2

TABLE OF SEQUENTIAL STEPS LEADING TO DESIGN RESOLUTION
1) the problem statement
2) criteria
3) hypothesis (an empirical investigation)
4) problem restatement (based on results of the hypothesis)
5) physical resolutions
6) selection and optimization
7) presentation
8) manufacturing refinements.

3



4

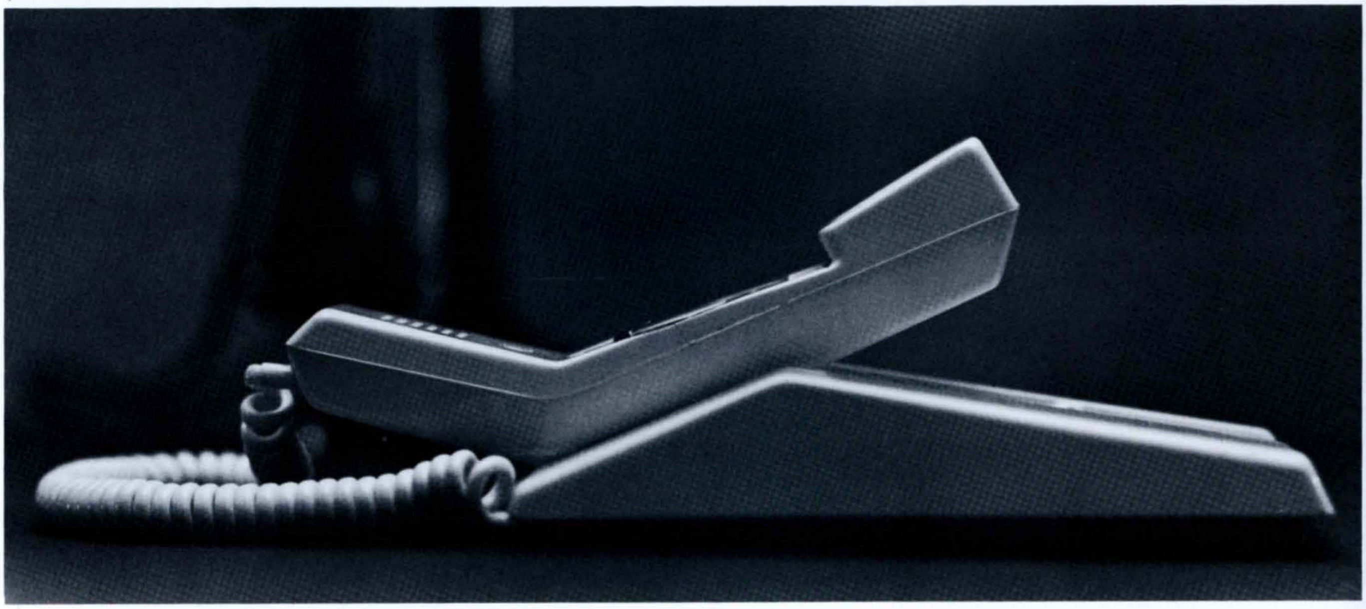


FIGURE 4 Third party call off-hook position of the CONTEMPRA phone in desk version.

and development complex of Northern Electric is to take a concept or idea of proven feasibility and translate it into a detailed design from which the manufacturing personnel can produce the final product. This function actually starts in the very early stages of the project with the choice of internal components, some basic decisions as to manufacturing methods and the planning of the work load. Early planning is done with the various groups involved in the introduction of a new product — Manufacturing Engineers, Tool and Machine Designers, Test Set Designers and the New Product Coordinator.

Prior to the completion of the industrial design work which established the exterior shape of the telephone set, the involvement of the London Regional Laboratory located at the Company's telephone manufacturing works, had been limited to an advisory capacity. Such items as the size of existing internal components and manufacturing techniques which might influence the exterior shape of the set were made known to the Industrial Designer. However, once the concept and general appearance of a new telephone set was accepted as the final design, the work of the London Laboratory began in earnest.

Initially, a PERT chart was drawn to indicate the time intervals involved in various phases of CONTEMPRA phone project, as well as indication of those events which were critical in maintaining the schedule. The PERT chart served as a reference for periodic reviews of progress throughout the project, while a computer was utilized to provide up-to-the-minute information showing critical activity items and which departments were responsible for the activities.

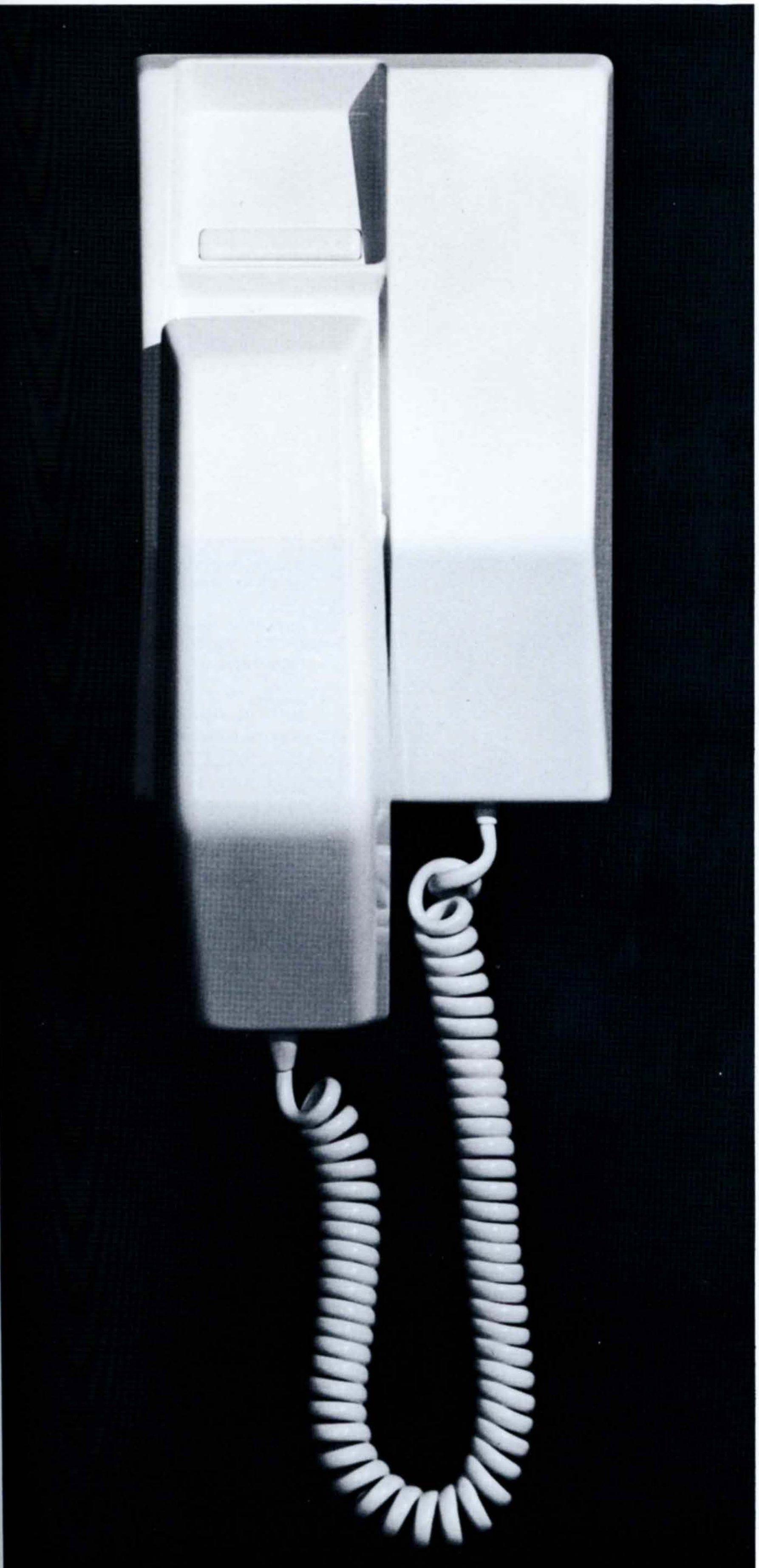
The work of the Design Engineers at the London Laboratory began with the production of a copy of a model depicting the exterior form of the telephone set, machined from a laminated plastic block. Using this model as the master, a series of further models were prepared which were accurate, not only in outward appearance, but also in inner shapes, contours and clearances. These "shells" were then utilized in order that decisions could be made on the locations and methods of mounting of components, means of joining various sections and such details as the locations of parting lines for plastic moulding purposes.

Each model that was produced was closer to the final design than its predecessor, and more accurate with respect to design details. After several months of such activity, the design was sufficiently advanced to allow the building of a working model.

A number of processes and techniques were utilized in the model-building process. Basic machining techniques were used to produce some of the more simple parts, while more advanced approaches were required for complex parts such as handset, housing and base plate. The major plastic components were produced by means of a female mould of the exterior shape into which the plastic material was inserted by a process of building up the wall thickness in glass-filled plastic. Vacuum forming was used for other plastic parts, and some small parts were produced by means of injection moulding using model shop dies of epoxy or soft metal.

One of the major design problems was the shape of the handset and mating support surfaces of the housing. Since the CONTEMPRA telephone set is designed to operate as either a desk or a wall set without modification, the handset must nest in the housing and be supported in either the vertical or horizontal plane, and must operate the line switch in both cases. This dictated a new approach to the switch design since it had to operate electrically at the beginning of its travel to allow for any failure of the handset to bottom in the supporting nest. The solution was found to be a plastic operating arm (polycarbonate was chosen because of its properties of high impact strength, clarity and low coefficient of friction) on which are affixed electrical contact surfaces. As the weight of the plunger causes the arm to depress, these contacts move away from fixed springs, thereby providing the normally open contacts. The other springs are pretensioned and move sufficiently to make contact with mating springs to provide the normally closed contacts.

While this provided a functional line switch, the design of the handset supporting nest itself was still critical. The weight of the handset had to be of a value that would cause it to bottom in the supporting nest as well as to overcome the spring tension of the line switch actuating arm in two positions 90 degrees opposed. This was further complicated by the problem that the handset could be dislodged from the housing due to impact, such as might occur if a wall set was mounted on a light partition and a door was slammed. A unique design involving the radii of the receiver end of the handset and the mating surfaces of the housing was



developed to overcome this problem. When the handset is hung up in the wall position, a small clearance exists between the vertical surfaces of the receiver end of the handset and the housing. Under impact conditions, as described above, the handset is driven inwards towards the base and begins to ride up a gradual curved continuation of the receiver hang-up shelf. The radius of this continuation is greater than that of the receiver lip, with the effect that only a small part of the shock energy is transferred as kinetic energy in the horizontal direction. After the handset has absorbed this energy in moving up the curvature, it returns to the shelf to its original position.

Major Components

The choice of materials to be used in a product is one of the major responsibilities of the Design Engineer. The main plastic components (two halves of the handset and the base housing) are made from A.B.S. plastic (acrylonitrile butadiene styrene) which has been found from past experience to provide the best combination of desirable characteristics: impact strength, abrasion resistance, resistance to staining, colour stability, ease of moulding, resistance to heat, and low cost.

The base plate design is a zinc alloy die casting structure allowing for the provision of mounting brackets and cord retainers as part of the base. The original concept of a plastic base plate was abandoned because it could not provide sufficient weight to ensure the stability of the set.

A wide range of other plastic mate-

FIGURE 5 Third party call off-hook configuration of the CONTEMPRA phone in wall application.

rials are being used for the CONTEMPRA telephone, each chosen because of its unique properties which make it suitable for a particular application. For example, neoprene is used for the four small feet on the set because of its frictional and non-staining properties. P.V.C. (polyvinyl-chloride) is used for the insulation on the cords and for grommets within the set. Acetal resin will be used for molding dial gears and bearings because of its excellent wear characteristics and polycarbonate for the fingerwheel because of its impact strength. CONTEMPRA phone has a plastic to metal parts number ratio of 37 to 70. Figure 7 summarizes these major plastic materials.

The handset design presented two problems, one mechanical and one acoustic. The mechanical problem was solved by carefully locating the receiver, transmitter and dial components in the limited confines of the handset. This assembly is covered by the back section of the housing and held together by two screws. The acoustic problem was slightly more difficult. An early working model revealed the need for complete acoustic isolation between the receiver and transmitter units in order to prevent coupling. This coupling occurred in two forms: acoustically through the handset cavity and mechanically due to resonances in the back half of the handset. A controlled acoustic cavity was specified and designed to prevent this coupling.

In order to conserve space in the tight confines of the low-profile base

6

CONTEMPRA TELEPHONE COLOURS
ivory
beige
deep green
warm white
pale yellow
deep blue
deep turquoise
mauve
bright red

7

MAJOR PLASTIC MATERIALS USED IN CONTEMPRA PHONE

Acrylonitrile butadiene styrene (ABS) Plastic
two halves of handset and base housing

Polycarbonate
line switch operating arm and finger wheel

Neoprene
feet on base plate

Polyvinyl-chloride (PVC)
insulation on extension cord and grommets within set

Acetal resin
dial gears and bearings

Epoxy compound
encapsulation of network circuit

Nylatron
dial

Celcon
gears in dial

Styrene-acrylonitrile (SAN)
number card window

Polypropylene
encapsulation of network capacitors

8

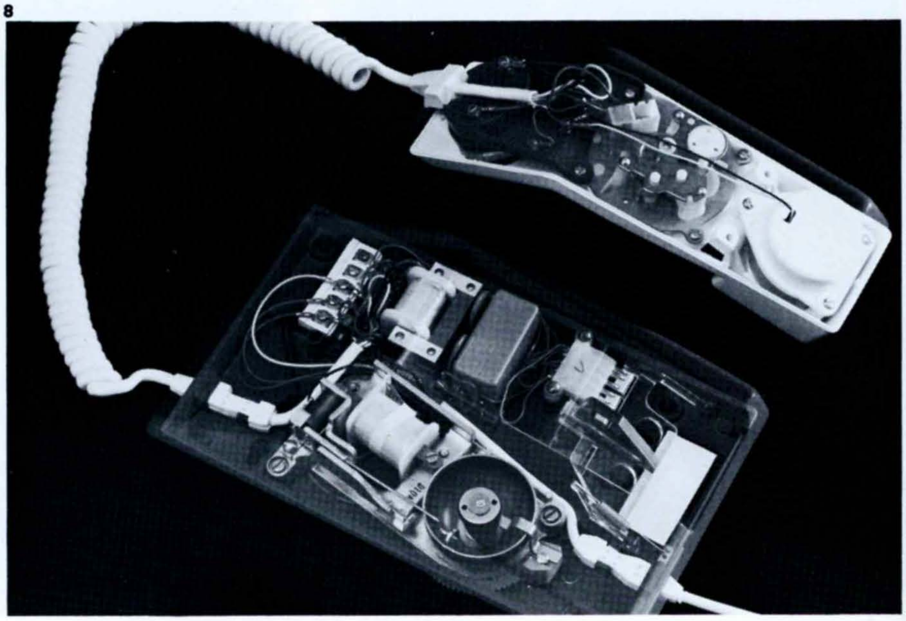


FIGURE 6 CONTEMPRA phone colours.

FIGURE 7 Major plastic materials used in CONTEMPRA phone.

FIGURE 8 The electrical and mechanical layout of the CONTEMPRA phone with plastic housings removed.

assembly, a new approach was used in the mechanical design of the transmission network (which electrically remains identical to the standard "500" set). The four network capacitors were wound using metal on plastic film and then encapsulated in a plastic shell with an epoxy compound. This provided a minimum physical size and maximum electrical stability. The capacitor module, together with the other circuit elements, were mounted on a printed circuit board. Figure 8 illustrates the electrical and mechanical layout of the new CONTEMPRA phone.

In order to provide 1000 early-production sets for field trial purposes, temporary tooling was designed and built while the high production tooling was still in the development stage.

When the CONTEMPRA set is introduced in early 1969, it will be the result of many hours of effort on the part of various design and manufacturing groups. The relatively short interval from conception to introduction will have been accomplished by teamwork and an awareness of the over-all needs of the project of all those involved.

With the introduction of the CONTEMPRA phone, Northern Electric enters a new era in station apparatus design — the production of a telephone set that is truly "Designed and Manufactured in Canada".

Trademark of the Northern Electric Company, Limited.

SYD HORNE (left) obtained Higher National Certificates in both electrical and mechanical engineering at the Woolwich Polytechnic in London, England. He came to Canada in 1955, and joined Northern Electric in 1959. He spent several years developing a variety of types of telephone apparatus, and is now Manager of the Systems Engineering group concerned with Station Apparatus. He is a member of APEO, IEE and I. Mech. E.

JOHN TYSON (centre) was born in Ottawa, and graduated from the Ontario College of Art in Industrial Design in 1966. After a period of freelance consulting, he joined the Northern Electric Laboratories as Industrial Designer. He is a member of the Association of Professional Industrial Designers of Ontario, and of the Association of Canadian Industrial Designers. He is now Manager of Industrial Design at the Northern Electric Laboratories.

GRAHAM PARSONS (right) a native of Montreal, graduated from McGill University in 1957 with a B.Eng. degree. He joined Northern Electric in the same year as Methods Engineer in the Station Apparatus Shop, which was transferred to a new plant in London (Ontario) in 1960. He is now Manager, Telephone Set Development in the London Regional Laboratory, and a member of APEO and IEEE.