THE DEVELOPMENT AND DESIGN OF THE "VISUAL STREET INDICATOR"

AN IMPROVED MEANS FOR CONVEYING ROUTE INFORMATION TO PASSENGERS ON PUBLIC TRANSPORTATION

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ABSTRACT

IN RECENT YEARS THE GROWTH OF CITIES AND THE CORRELATED EXPANSION OF TRANSPORTATION FACILITIES HAS POSED MANY TRANSIT PROBLEMS. A STUDY OF THE SITUATION INDICATED THAT ONE OF THE DIFFICULTIES WAS THE NEED FOR AN IMPROVED METHOD FOR CONVEYING ROUTE INFORMATION TO PASSENGERS.

THE FAMILIARITY NECESSARY FOR THE ESTABLISHMENT OF THE BASIC REQUIREMENTS OF THIS PROBLEM WAS OBTAINED THROUGH INTERVIEWS, QUESTIONNAIRES AND OBSERVATION OF BUS OPERATION. THE EXIGENCY WAS ONE OF REDUCING THE OPERATOR'S RESPONSIBILITIES AND WORK LOAD, WHEN AT THE SAME TIME PASSENGERS WERE REQUIRING ADDITIONAL SERVICES. THIS THESIS RELATES TO THE DEVELOPMENT OF A UNIT WHICH WILL ENABLE THE OPERATOR TO PRESENT VISUALLY THE NAME OF THE NEXT STOP HIS VEHICLE WILL MAKE.

THE "VISUAL STREET INDICATOR" WILL BE ATTACHED TO THE CEILING AT THE FRONT OF THE VEHICLE. IT CONTAINS A SEMI-AUTOMATICALLY CONTROLLED MOTOR DRIVEN ROLL ON WHICH IS PRINTED THE NAMES OF THE VEHICLE'S STOPS. THE DESIGN IS A RESULT OF COMPROMISED CONSIDERATION FOR PRACTICAL FEATURES AND ECONOMIC MANUFACTURE AND THE SOLUTION OFFERS A CONVENIENT METHOD FOR ANSWERING MANY OF THE PASSENGER'S QUESTIONS AND IS ACCEPTABLE AS AN AID BY THE VEHICLE OPERATORS.

ACKNOWLEDGEMENTS

THE AUTHOR WISHES TO THANK THE FACULTY OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY AND ESPECIALLY THE MEMBERS OF HIS COMMITTEE, DEAN FRANKLIN THOMAS, CHAIRMAN MR. DAVID F. WELCH AND MR. SALVATORE MERENDINO, AS WELL AS THE FACULTY OF THE INDUSTRIAL DESIGN SECTION WHO HAVE SO FAITHFULLY SUPERVISED THE PREPARATION OF THIS THESIS. A SPECIAL NOTE OF THANKS GOES TO MR. J. PAUL YOUTZ, HEAD OF THE INDUSTRIAL DESIGN SECTION, FOR THE AID RENDERED AT MANY CRITICAL POINTS IN THE VARIOUS PHASES OF THIS PROBLEM.

THE WRITER WISHES ALSO TO EXPRESS APPRECIATION TO MR. R. A. HAUER, JR. OF THE PASADENA CITY LINES WHO GAVE VERY GENEROUSLY OF HIS TIME AND THE TRANSIT FACILITIES AT HIS COMMAND. IT WAS LARGELY THROUGH THIS CHANNEL THAT INFORMATION WAS OBTAINED WHICH PROPERLY COMPLETED THE PICTURE NECESSARY TO AN ADAQUATE DESIGN.

TO DR. HENRIETTA JOHNSON AND DR. L. L. HENRY, OF PASADENA, THE AUTHOR IS INDEBTED FOR MUCH ASSIS-TANCE IN ESTABLISHING THE VISUAL REQUIREMENTS SO ESSENTIAL IN THIS SOLUTION. THEIR AID AND THE

VERY HELPFUL RESPONSE OF THE VARIOUS VISUAL COMPANIES WHICH THEY RECOMMENDED FOR ASSISTANCE WAS INVALUABLE.

ACKNOWLEDGEMENT IS GIVEN TO THE MANY OTHERS WITHOUT WHOSE HELP THIS THESIS COULD NOT HAVE BEEN COMPLETED, ESPECIALLY TO THE NUMEROUS TRANSIT COMPANIES WHO SO KINDLY RESPONDED TO QUESTIONNAIRES WITH ANSWERS FAR MORE ENLIGHTENING THAN NECESSARY TO SIMPLY FULFILL THE AUTHOR'S REQUESTS.

AND MENTION SHOULD BE MADE HERE OF THE UNDERSTANDING FROM A PATIENT AND THOUGHTFUL FAMILY.

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THE "VISUAL STREET INDICATOR" - AS IT WOULD APPEAR IN A GENERAL MOTORS BUS

MODERN BUS - 1930 VINTAGE

1950 MODEL G.M.C. 55 PASSENGER

- FIGURE 1 -

INTRODUCTION AND SCOPE

GENERAL BACKGROUND

THERE HAVE BEEN MANY ADVANCES IN VEHICLE DESIGN TO KEEP ABREAST WITH THE CONTINUAL EXPANSION OF CITIES AND THE ADDED REQUIREMENT FOR PUBLIC TRANSPORTATION IN MANY OF THE SMALLER TOWNS AND COMMUNITIES. HOWEVER, DURING THE SAME PERIOD THERE HAVE BEEN RELATIVELY FEW CHANGES IN BASIC OPERATING PROCEDURES OR IN EXTRA SERVICES RENDERED BY THE TRANSIT COMPANIES.*

THE POINT RAISED FOR CONSIDERATION HERE IS THE PRESENT METHOD FOR PASSING ROUTE INFORMATION TO PASSENGERS. THIS IS STILL A MATTER OF CONVERSATION BETWEEN OPERATORS OR EMPLOYEES OF THE TRANSPORTATION COMPANY AND THE PASSENGER. THE PROCEDURE HAS NOT CHANGED APPRECIABLY FROM THE TIME WHEN ONE TROLLEY OPERATED ON THE MAIN STREET OF A CITY TO THE PRESENT WHEN CITIES COVERING HUNDREDS OF SQUARE MILES ARE BEING SERVICED AND PASSENGERS FIND THEMSELVES MORE AND MORE ON ROUTES STRANGE TO THEM.

ON THE OPPOSITE PAGE, FIGURE 1 IS AN INDICATION

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* R. A. HAUER, JR., MANAGER PASADENA CITY LINES, PASADENA, CALIFORNIA

OF THE PROGRESS MADE IN VEHICLE DESIGN DURING A RELATIVELY SHORT PERIOD OF TIME. IN THE TRANSIT SYSTEMS ACROSS THE COUNTRY IT IS STILL POSSIBLE TO SEE THE PRIDE OF FIFTEEN YEARS AGO EITHER RETIRED OR SADLY IN NEED OF BEING RETIRED. HOWEVER, COUPLED WITH THE LONG STEPS IN IMPROVED MEANS OF TRANSPORTATION, THERE HAVE BEEN NO REALLY NEW WAYS TO MAKE IT EASY FOR THE PASSENGER TO GET INFORMATION IMPORTANT TO HIS RELAXED RIDING COMFORT. THESE QUESTIONS STILL ARISE CONTINUOUSLY -- WHAT STOP IS THIS?-- HOW FAR OR HOW MANY STOPS UNTIL I GET OFF?-- DID THE OPERATOR CALL MY STOP?-- WILL HE REMEMBER?-- WILL I BE ABLE TO HEAR?--

AS THIS DESCRIPTION PROGRESSES IT SHOULD BE POINTED OUT THAT THE OPERATOR IS NOT COMPLETELY AT FAULT NOR CAN HE EASILY REMEDY THESE PROBLEMS. AS THE MEANS FOR TRANSPORTATION HAS IMPROVED AND SCHEDULES BECOME FASTER, THE NUMBER OF PASSENGERS HANDLED BY A SINGLE VEHICLE MOVES STEADILY UPWARD AND THE TASK OF THE OPERATOR BECOMES INCREASINGLY COMPLICATED AND MORE DIFFICULT.(50-6)* THIS POINT

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* THE NUMBERS IN PARENTHESIS THROUGHOUT THIS THESIS REFER TO THE PAGE NUMBER AND ITEM IN THE REFERENCE SECTION.

REGARDING INFORMATION IS A SOURCE OF FRICTION WHICH CERTAINLY DOESN'T JUSTIFY ADDITIONAL PERSONNEL TO THE TRANSIT COMPANIES, YET LEAVES MUCH TO BE DESIRED ON THE PART OF THE PASSENGER.

WITH THESE FACTS IN MIND, THE PURPOSE OF THIS THESIS IS TO PRESENT A SIMPLE MECHANISM WHICH WILL REQUIRE A MINIMUM OF EFFORT ON THE PART OF THE OPERATOR AND WHICH WILL CONVEY TO ALL PASSENGERS THE NAME OF THE NEXT STOP TO BE MADE BY THE VEHICLE. IN CONNECTION WITH THIS UNIT, A SIMPLE STRIP MAP OR A LIST OF STOPS COULD BE INCLUDED ON THE PRESENT TRANSFER OR ON ANOTHER THROW-AWAY SHEET. BY USING THE TWO TOGETHER, THE AVERAGE PASSENGER COULD EASILY ANSWER MANY OF HIS OWN ROUTINE QUESTIONS. AS THE SITUATION EXISTS NOW, THE RESULTS ARE OFTEN SHORT TEMPERS, ARGUMENTS, COMPLAINTS OF POOR SERVICE, SLOWING OF SCHEDULES AND ACCIDENTS DUE TO DRIVERS BEING DISTRACTED.*

CHOICE OF VEHICLE

IN THE SCOPE OF THIS PROBLEM THERE WERE SEVERAL BASIC CONSIDERATIONS FOR STUDY. FIRST IT WAS

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* SEE APP. B, P. 71, COMMENT SUMMARY ITEM 3,4,5. P. 73, GENERAL COMMENT ITEM A AND B.

NECESSARY TO DECIDE WHETHER THE UNIT TO BE DESIGNED SHOULD SATISFY THE REQUIREMENTS FOR INSTALLATION IN ALL TYPES OF PUBLIC CONVEYANCES. AFTER A BRIEF ANALYSIS OF THE PROBLEMS ASSOCIATED WITH THE OPERATION OF BUSES, STREET CARS, TROLLEYS, SUBWAYS AND ELEVATED TRAINS, IT WAS DECIDED THAT ANY ADEQUATE SOLUTION TO ANY ONE OF THESE INSTALLATIONS WOULD OFFER MORE THAN ENOUGH RESTRICTIONS TO THE DESIGN. THE CHOICE WAS MADE TO USE THE WELL KNOWN DIESEL OR GASOLINE BUS FOR THE PURPOSE OF THIS THESIS.

JUSTIFICATION FOR THIS CHOICE WAS BASED ON INFORMATION RECEIVED FROM A NATIONAL TRANSIT ASSOCIATION IN WHICH THE TREND TOWARD REPLACEMENT OF OTHER TYPES OF CONVEYANCES BY BUSES IS CLEARLY INDICATED.(50-7)

THE MEDIUM - HEARING OR VISION

ANOTHER BASIC POINT FOR STUDY WAS THE COMPARATIVE ADVANTAGES OF USING HEARING OR VISION FOR THE PURPOSE OF TRANSMITTING THE INFORMATION TO PASSENGERS. A RECENT IMPROVEMENT WHICH HAS A BEARING ON THIS CHOICE IS THE STEP TAKEN BY SOME COMPANIES WHICH INVOLVES THE INSTALLATION OF AN

AMPLIFICATION SYSTEM FOR THE OPERATORS. THE OPERATOR USES THIS SPEAKER ARRANGEMENT IN HIS NORMAL ROUTINE OF "CALLING" STOPS, AND THE AMPLIFICATION IS SUPPOSED TO MAKE IT POSSIBLE FOR ALL PASSENGERS TO HEAR. THIS, HOWEVER, HAS NOT BEEN WIDELY ACCEPTED FOR SEVERAL REASONS. THE ACOUSTICAL CHARACTERISTICS OF THE USUAL PUBLIC VEHICLE ARE NOT WELL ADAPTED AND THE AVERAGE OPERATOR IS EMPLOYED FOR HIS ABILITY TO DRIVE RATHER THAN TO SPEAK AND ENUNCIATE CLEARLY. IN ADDITION, THE MANY DRIVERS WHO DO NOT CALL STOPS NORMALLY WILL MAKE NO USE OF SUCH AN AID.*

AT THIS POINT THE POSSIBILITY OCCURS FOR RECORDING THE VARIOUS STOPS ON TAPE OR WIRE AND HAVING THE OPERATOR CONTROL THE SYSTEM WHICH WILL REPEAT THE NAMES AS DESIRED. THERE ARE, HOWEVER, SEVERAL FUNDAMENTAL REASONS WHICH RULE OUT THIS POSSIBILITY. THE NOISE LEVEL AND INTERFERENCE CAUSED BY CONVERSATION, MOTOR, TIRE AND OUTSIDE NOISES MAKE IT NECESSARY TO RAISE THE VOLUME LEVEL TO SUCH A POINT THAT IT IS OFTEN A SOURCE OF DISCOMFORT TO THOSE NEAR THE SPEAKER. ALSO ANOTHER FACTOR WHICH MIGHT

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* SEE APP. B, P. 71, COMMENT SUMMARY ITEM 2

BE OFFERED FOR CONSIDERATION IS A COMMENT MADE BY DR. L. L. HENRY DURING A DISCUSSION.* IT WAS HIS OPINION THAT THE AVERAGE PERSON WITH THE BENEFIT OF CORRECTIONS USUALLY WORN HAD BETTER VISION THAN HEARING. IN ADDITION, THERE IS THE FACTOR OF LITTLE RENTENTIVE POWER IN THE SENSE OF HEARING UNLESS A CONCENTRATED EFFORT IS BEING EXERTED WHEN THE SOUND ACTUALLY OCCURS, AND IF SUCH IS THE CASE, THE RETENTION BECOMES A MATTER OF MEMORY.**

IN THE CASE OF THE NAME BEING PRESENTED SO IT IS AVAILABLE FOR READING, IT CAN BE REFERRED TO FROM THE TIME THE VEHICLE LEAVES A STOP UNTIL IT ARRIVES AT THE NEXT. THIS DOES NOT TAX THE MEMORY OR REQUIRE CONSTANT ATTENTION ON THE PART OF THE PASSENGER SO THAT HE WILL BE ABLE TO HEAR AND UNDERSTAND THE STOP AS IT IS CALLED.

DESIGN SUMMARY

THE DETAILED STUDY WHICH FOLLOWS IN THE BODY OF THIS THESIS REPORTS ON THE DESIGN AND DEVELOPMENT

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* L. L. HENRY, M.D., OPHTHALMOLOGIST AND EYE PHYSICIAN, PASADENA, CALIFORNIA.

** ANON, "HEARING", ENCYCLOPEDIA BRITANNICA, VOLUME XI, (CHICAGO 1942), P. 297

OF THE "VISUAL STREET INDICATOR".* THE VSI OFFERS AN IMPROVED METHOD FOR CONVEYING ROUTE INFORMATION TO BUS PASSENGERS THROUGH THE MEDIUM OF VISION. BY THE USE OF THE VSI, THE VEHICLE OPERATOR CAN MAKE KNOWN TO ALL PASSENGERS THE NAME OF THE NEXT STOP WITHOUT TAKING HIS ATTENTION FROM HIS MORE IMPORTANT RESPONSIBILITIES. THIS WILL BE ACCOMPLISHED BY A SIMPLE PUSH-BUTTON CONTROL AND WILL RELIEVE THE OPERATOR OF REMEMBERING WHICH STOPS SHOULD BE CALLED AS REQUESTED OR OF CALLING ALL STOPS WHICH IS ALSO INEFFECTIVE. SINCE THE INFORMATION WILL BE AVAILABLE TO PASSENGERS ANYWHERE IN THE VEHICLE, IT WILL DO AWAY WITH THE NECESSITY OF REMAINING NEAR THE OPERATOR AS IS THE PRESENT REQUIREMENT.

THE VSI IS A SMALL UNIT APPROXIMATELY 30 INCHES LONG, NINE INCHES HIGH AND EIGHT INCHES DEEP. IT IS ENCASED IN METAL AND WILL BE MOUNTED NEAR THE CEILING AT THE FRONT OF THE BUS. THE FRONT OF THE VSI WILL PRESENT A "SHADOW BOX" OPENING TWO INCHES HIGH AND SEVENTEEN INCHES LONG. IN THIS FRAME WILL APPEAR THE NAME OF THE NEXT STOP TO BE MADE BY THE VEHICLE.

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* REFERRED TO HEREINAFTER AS THE "VSI".

IT IS NOT EXPECTED THAT THE VSI WILL COMPLETELY REMOVE THE NECESSITY FOR DRIVERS ANSWERING QUESTIONS. HOWEVER, THE INTENT IS THAT IT WILL RELIEVE HIM OF A LARGE PART OF THE ROUTINE QUESTIONS WHICH CAN BE BETTER HANDLED IN THIS MANNER.

IN OPERATION THE DRIVER HAS A SELECTOR SWITCH FOR CHOICE OF EXPRESS, LOCAL, OR CONTINUAL WINDING, AND A CONTROL BUTTON WHICH HE PUSHES MOMENTARILY FOR EACH DESIRED CHANGE. THIS CONTROL IS SEMI-AUTOMATIC IN THAT THE DRIVER HAS BUT TO ACTUATE IT FOR STARTING AND THE UNIT WILL CONTINUE UNTIL A PREDETERMINED INDEXING ARRANGEMENT TURNS IT OFF.

A THOROUGH STUDY OF THE SURROUNDING CONDITIONS HAS RESULTED IN A DESIGN WHICH WILL MAKE THE VSI A VALUABLE ADDITION TO BE INCORPORATED IN THE SERVICE OF MANY TRANSIT LINES. NOT ONLY DOES THIS UNIT MAKE THE OPERATOR'S VERY COMPLEX TASK EASIER, BUT IT ALSO RENDERS A SERVICE TO ALL PASSENGERS. THE VSI FULFILLS A NECESSARY FUNCTION FOR PASSENGERS TRAVELING ON STRANGE ROUTES AND IS AN ADDED SERVICE TO THOSE WHO TRAVEL THE SAME ROUTES CONSTANTLY.

MARKET PROBLEMS

PRODUCTION PRACTICES

THE MARKET FOR BUSES OF THE TYPE WHICH WILL BE CONSIDERED FOR THIS STUDY IS SUPPLIED BY FIVE MAJOR COMPANIES.(-1) LISTED IN THE ORDER OF THEIR IMPORTANCE IN THE SUPPLY PICTURE, THEY ARE GENERAL MOTORS COMPANY, MACK MANUFACTURING CORPORATION, THE WHITE MOTOR COMPANY, TWIN COACH COMPANY AND ACF-BRILL MOTORS COMPANY. SINCE GENERAL MOTORS IS BY FAR THE LARGEST SUPPLIER AND HAS THE MOST COMPLETE FACILITIES FOR MANUFACTURE, IT WILL SUFFICE FOR THE PURPOSE OF THIS THESIS TO REVIEW THE PRACTICES WHICH IT UTILIZES IN THE MANUFACTURE OF THEIR VEHICLES. THIS IS ESPECIALLY TRUE SINCE ITS PRACTICES ARE NOT CONSISTANT WITH WHAT MIGHT BE EXPECTED.

BECAUSE GENERAL MOTORS IS SUCH A LARGE AND COMPLETE ORGANIZATION, IT COULD BE LOGICALLY ASSUMED THAT IT MANUFACTURES ALL OR NEARLY ALL OF THE COMPONENTS OF ITS VEHICLES. HOWEVER, SUCH IS NOT THE CASE. GENERAL MOTORS ACTUALLY CONSTRUCTS THE BASIC FRAME, BODY AND MOTOR, BUT IT RESORTS TO OTHER SPECIALISTS FOR SUPPLY OF PARTS SUCH AS

CHAIRS, WINDOWS, FLOORS, COIN BOXES, WHEELS, BRAKES, DRUMS, AXLES, PNEUMATIC DOORS, BUZZER SYSTEMS, TRANSMISSIONS, CLUTCHES, DESTINATION SIGNS AND A VAST NUMBER OF OTHER MAJOR AND MINOR ACCESSORIES. IT REQUIRED ONLY A BRIEF STUDY TO SUBSTANTIATE THE FACT THAT THE SMALLER COMPANIES FOLLOW THIS SAME PROCEDURE.

THIS ANALYSIS IS MADE FOR THE PURPOSE OF SHOWING THAT THE PRODUCTION OF THE VSI WOULD NOT BE RESTRICTED TO ONE OF THE MAJOR MANUFACTURING COMPANIES. IT INDICATES THAT THE FINAL DESIGN MUST BE SIMPLIFIED TO A POINT SUCH THAT A SMALL ORGANIZATION CAN UNDERTAKE TO MANUFACTURE THE VSI BY SUB-CONTRACTING THE FEW COMPLICATED PARTS AND THEN DOING THE ASSEMBLY IN THEIR OWN PLANT.

VOLUME ESTIMATE

AS THE PREVIOUS SECTION WAS INSERTED BECAUSE OF A DEFINITE BEARING ON THE PROBLEM, THIS SECTION OFFERS THE POSSIBILITY OF ADDITIONAL RESTRICTIONS. IN THE FIELD OF CONSUMERS' GOODS, A VOLUME POTENTIAL IS ESTIMATED FOR THE MAIN PURPOSE OF DETERMINING WHETHER THE VENTURE CAN BE A SUCCESSFUL ONE. AN ATTEMPT IS MADE TO ESTABLISH THE EXISTENCE OF A

DEMAND, AND THE SIZE OF THAT DEMAND IS A MAJOR CONSIDERATION IN PRODUCTION. A SCHEDULE OF SEVERAL THOUSAND UNITS WOULD JUSTIFY AN EXPENSIVE TOOLING ARRANGEMENT, WHEREAS A COMPARATIVELY SMALL RUN WOULD REQUIRE A "HAND MADE" APPROACH WITH A MINIMUM OF CAPITAL INVESTMENT FOR TOOLS AND DIES.

IN THE CASE OF THE VSI, IT IS EXTREMELY DIFFICULT TO MAKE THIS FIRST ESTIMATE OF MARKET POTENTIAL. THE MEDIUM OF QUESTIONNAIRES BROUGHT FORTH THE EXTREMES OF INTEREST. THE BREAK DOWN WAS APPROXIMATELY HALF FOR THOSE FAVORABLE IF THE SOLUTION COULD BE WORKED OUT SUCCESSFULLY AND ECONOMICALLY, AND HALF AGAINST IT REGARDLESS OF THE FINAL SOLUTION. PERSONAL CONTACT WITH TRANSIT COMPANY MANAGERS AND BUS OPERATORS, WHO MUST ALSO BE SOLD ON THE VSI, RESULTED IN A SLIGHTLY BETTER AVERAGE OF FAVORABLE REACTION AND INTEREST.

FROM THE LATEST FIGURES AVAILABLE FOR 1948, THERE WERE MORE THAN 60,000 MOTOR BUSES OPERATING IN THE NATION. AND DURING THAT YEAR MORE THAN 15,000 NEW BUSES WERE SUPPLIED TO THE TRANSIT COMPANIES. (46-1) BASED ON THE PREVIOUS DISCUSSION OF FAVORABLE

INTEREST AND THE FIGURES JUST STATED, EVEN A VERY CONSERVATIVE PART OF THE AVAILABLE MARKET WOULD GIVE THE REQUIRED JUSTIFICATION FOR PRODUCTION OF THE VSI. IT WOULD BE ADVISABLE, HOWEVER, IF THE DESIGN COULD ACCOMMODATE COMPARATIVELY SMALL INITIAL PRODUCTION RUNS WITHOUT MAKING THEM AN UNECONOMICAL UNDERTAKING.

PROMOTION AND DISTRIBUTION

THE PREVIOUS DISCUSSION DEALING WITH PRODUCTION PRACTICES HAS ESTABLISHED THE FACT THAT THERE ARE MANY COMPANIES WHICH MANUFACTURE ACCESSORIES FOR THE BASIC BUS. THEIR MAIN CHANNELS FOR ADVERTISING AND CONTACT ARE DIRECT MAIL AND APPROPRIATE TRADE PUBLICATIONS.(46-2) BY THESE MEANS THE COMPANIES ESTABLISH A DEMAND FOR THEIR PRODUCTS, AND TRANSIT COMPANIES PURCHASING UNITS FROM BUS MANUFACTURERS SPECIFY PARTICULAR ACCESSORIES FOR INSTALLATION. THIS COMPRISES THE LARGEST PART OF THE ACCESSORY MANUFACTURER'S SALES VOLUME. IN ADDITION TO THE ORIGINAL SALE, MOST OF THE COMPANIES EMPLOY A FEW MEN WHO COVER THEIR TERRITORY ABOUT TWO TIMES EACH YEAR AND ACT AS A COMBINATION OF FACTORY REPRESENTATIVE AND SALESMAN.

THEY CHECK ON THE SERVICE OF THEIR PARTICULAR PRODUCT AND OFFER THE LATEST SUGGESTIONS PERTINENT TO CONTINUED GOOD SERVICE. IN THIS WAY A PERSONAL CONTACT IS MAINTAINED WITH THE POTENTIAL MARKET. THIS IS ANOTHER CHANNEL OPEN TO THE COMPANY WHICH CHOOSES TO MANUFACTURE THE VSI.

THERE IS ONE POSSIBILITY WHICH SHOULD BE MENTIONED HERE. SINCE THE VSI IS A SELF-CONTAINED UNIT AND CAN BE INSTALLED IN BUSES WHICH ARE ALREADY IN OPERATION, THE POSSIBILITY EXISTS THAT A LARGE PART OF THE SALES COULD BE DIRECT TO TRANSIT COMPANIES RATHER THAN TO BUS MANUFACTURERS FOR INSTALLATION. VEHICLES IN USE MAKE UP A MAJOR PART OF THE POTENTIAL MARKET AND SUCH A SALES APPROACH WOULD CERTAINLY BE EXPLOITED IN THE PROMOTION OF THE VSI.

DISTRIBUTION FOR THE MAJOR ACCESSORIES IN THE TRANSPORTATION INDUSTRY IS VERY SIMPLE. EVEN THE LARGER COMPANIES SUCH AS THE KARPEN CHAIR CORPORATION MAINTAIN A CENTRAL POINT OF BUSINESS IN THE EAST AND HAVE REFUSED TO ESTABLISH ANY SORT OF JOBBER OR DISTRIBUTION ARRANGEMENT. THIS IS TYPICAL FOR MUCH OF THIS TYPE OF EQUIPMENT

WITH AN EXCEPTION OF A FEW WHO HANDLE THEIR PRODUCTS THROUGH MAJOR JOBBERS IN THE LARGE POPULATION CENTERS. THE MAIN CATEGORY OF SUPPLIERS WHO HAVE BEEN FORCED TO BREAK THEIR DISTRIBUTION INTO SHORTER CHANNELS ARE THOSE SELLING REPLACEMENT PARTS FOR MAINTENANCE, REPAIR AND SERVICING SUCH AS ENGINE ACCESSORIES. AND THIS WOULD NOT NECESSARILY APPLY TO THE MANUFACTURER WHO WOULD BE PRODUCING THE VSI.

IN GENERAL, IT SHOULD BE NOTED THAT THE MANUFACTURE OF THE VSI WOULD NOT NECESSARILY BE RESTRICTED TO ANY EXISTING PRODUCER. ANY COMPANY COULD EITHER MAKE MOST OF THE PARTS OF SUBCONTRACT AND ASSEMBLE THE VSI. THEY COULD EITHER SELL IT TO BUS MANUFACTURERS OR DIRECT TO THE TRANSIT COMPANIES. IF THE LATER WERE DONE, EITHER AN INSTALLATION SERVICE COULD BE OFFERED OR INSTRUCTIONS WHICH COULD BE SIMPLE ENOUGH FOR MOST TRANSIT MAINTENANCE SHOPS TO FOLLOW WOULD BE INCLUDED. THE DESIGN OF THE VSI IS NOT RESTRICTED TO A NARROW FIELD OF MANUFACTURE AND COULD BE UNDERTAKEN BY A SMALL COMPANY WITHOUT FIGURING HEAVILY ON A LARGE CAPITAL OUTLAY.

THE NAME

"VISUAL STREET INDICATOR" WAS FINALLY DECIDED ON AFTER A GREAT DEAL OF CONSIDERATION. THE CHOICE OF A NAME IS IMPORTANT AS IT MUST LEND ITSELF IN MANY WAYS IN CONNECTION WITH THE PRODUCT. IN THE CONSUMER GOODS FIELD THERE IS A DEFINITE ADVANTAGE IN A DESCRIPTIVE, PHONETICALLY PLEASING WORD OR SHORT PHRASE WHICH GIVES THE PRODUCT DISTINCTION AND INDIVIDUALITY. HOWEVER, IN THIS CASE THE NAME WILL PROBABLY NOT APPEAR ON THE PRODUCT AND A SLIGHTLY DIFFERENT APPROACH WAS POSSIBLE.

IN THE NAME FINALLY CHOSEN THERE IS THE NECESSARY COMBINATION OF DESCRIPTION AND EXPLANATION OF FUNCTION WHICH IS DESIRED. IN ADDITION, THE AMERICAN HABIT FOR ALPHABET ABBREVIATIONS MAKES IT ALMOST A CERTAINTY THAT THE VISUAL STREET INDICATOR WILL COME TO BE REFERRED TO AS THE VSI AS IS DONE IN THIS THESIS. THE RESULT IS EASILY RECOGNIZED AND PROMOTES AN INTEREST AND ATTENTION. IT IS A LETTER ARRANGEMENT PLEASING TO THE EAR AND WILL LEND ITSELF TO ADVERTISING WHICH WILL INSURE IDENTIFICATION OF THE PRODUCT AND MANUFACTURER.

PRE-DESIGN RESEARCH

IN THE GENERAL APPROACH TO THIS PROBLEM THERE ARE DEFINITE CATEGORIES WHICH MUST BE CONSIDERED. THIS SECTION WILL INDICATE THESE DIVISIONS AND SHOW THEIR IMPORTANCE IN THE COMPLETE DESIGN PICTURE. ALL THESE CONSIDERATIONS WILL HAVE THEIR PROPORTIONATE EFFECT ON THE FINAL DESIGN. HOWEVER IT MUST BE KEPT IN MIND THAT THE PRIMARY JUSTIFICATION FOR THIS THESIS IS THE COMBINED FUNCTION OF GIVING AID TO PASSENGERS AND MAKING THE TASK OF THE OPERATOR EASIER.

PASSENGERS' PROBLEMS

THE TRANSIT COMPANIES HAVE AS THEIR PRIMARY PURPOSE FOR EXISTENCE THE "MOVING" OF PEOPLE. THESE PASSENGERS ARE THE FOCAL POINT OF THIS SECTION. AS THE ACTUAL MEANS FOR TRANSPORTATION BECOMES IMPROVED WITH NEW AND BETTER EQUIPMENT (FIG. 1), THE NECESSARY TREND FOR PROVIDING ADDITIONAL SERVICE BECOMES EVIDENT. A PHASE IN THIS TREND IS THE MORE CONVENIENT DISSEMINATION OF INFORMATION TO PASSENGERS. PEOPLE RIDING IN BUSES IN THE MANY CITIES ACROSS THE NATION ARE AT ONE TIME OR ANOTHER TRAVELING ON ROUTES WHICH ARE

COMPLETELY UNFAMILIAR TO THEM. THIS FIGURE, ACCORDING TO THE AUTHOR'S SURVEY, IS SET IN THE VICINITY OF 15%.* NOT ONLY IN THIS COMPARATIVELY SMALL PERCENTAGE OF THE TRAFFIC IS THIS TRUE, BUT IN AN ESTIMATED 50% OF THE CASES, PASSENGERS ARE NOT WELL ACQUAINTED WITH THEIR ROUTES. THEREFORE QUESTIONS ARISE REGARDING THEIR VEHICLE'S PROGRESS. THIS IS PARTICULARLY TRUE DURING THE DARK HOURS AND OTHER TIMES WHEN OUTSIDE VISIBILITY IS OBSCURED. A GREAT DEAL OF IRRITATION AND DISCOMFORT IS FOCUSED ON THIS POINT.

FOR THE PASSENGER THERE ARE TWO CATEGORIES IN WHICH THE NEED FOR INFORMATION WILL FALL. THERE ARE PROBLEMS WHICH ARISE BEFORE BOARDING THE VEHICLE AND OTHERS WHICH OCCUR AFTER THIS INITIAL CHOICE HAS BEEN MADE. FOR ASSISTANCE WITH PROBLEMS BEFORE BOARDING, AN EFFECTIVE AID HAS BEEN FOUND BY SEVERAL TRANSIT COMPANIES THROUGH THE MEDIUM OF MAPS.** HOWEVER, IT IS ONLY WITHIN THE SCOPE OF THIS STUDY TO BE CONCERNED WITH THOSE QUESTIONS WHICH ARISE AFTER BOARDING THE BUS.

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* SEE APP. B, P. 69, QUESTION 1.

** SEE APP. B, P. 71, COMMENT SUMMARY ITEM 4.

AT PRESENT THE OPERATOR IS THE ONLY DEPENDABLE SOURCE FOR INFORMATION AND THERE ARE MANY TIMES WHEN IT IS IMPOSSIBLE FOR HIM TO DO JUSTICE TO QUESTIONS.* IN ADDITION TO MANY TIMES WHEN THE OPERATOR IS TOO BUSY TO ANSWER QUESTIONS, THERE IS A BARRIER ERECTED BY LAW TO PREVENT CONVERSATION WHICH IS DISTRACTING TO DRIVERS. THESE ORDINANCES RANGE IN EFFECT FROM PROHIBITING ALL CONVERSATION TO THE MORE LIBERAL INTERPRETATION OF LIMITING ONLY UNNECESSARY QUESTIONS TO THE OPERATORS. (51-8)** OCCASIONALLY ONE MAY CONSULT A FELLOW PASSENGER FOR INFORMATION BUT THIS OFTEN PROVES UNSATISFACTORY. IT IS WELL KNOWN THAT THE RESULTS WILL USUALLY VARY DEPENDING ON THE NUMBER OF PERSONS QUESTIONED.

THIS DEPENDENCY ON THE OPERATOR FOR INFORMATION CONTRIBUTES TO ANOTHER PROBLEM ENCOUNTERED BY ALL WHO PATRONIZE THE TRANSIT SYSTEMS. "PLEASE STEP BACK TO THE REAR" IS A REQUEST OFTEN HEARD. THERE SEEMS TO BE AN INHERENT TENDENCY ON THE PART OF ALL PASSENGERS TO REMAIN NEAR THE FRONT OF THE BUS AND THOSE WHO ARE WAITING TO HEAR

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* SEE APP. B, P. 69, QUESTION 2.

** LOS ANGELES MUNICIPAL CODE, SECTION 56.18-19.

A STOP "CALLED" ARE FORCED TO COMPETE FOR A FORWARD LOCATION IF THEY EXPECT TO GET THE INFORMATION. IT IS A COMMON SIGHT TO SEE ALL FRONT SEATS OCCUPIED WHICH LEAVES AN ONLY ALTERNATIVE OF HANGING OVER THE DRIVER, SOMETIMES FOR BLOCKS, JUST WAITING TO HEAR A STREET NAME. THEN, PROVIDING THE PASSENGER WAS ABLE TO HEAR, HE MUST MANEUVER HIS WAY TO THE REAR FOR THE PREFERRED EXIT ON MOST VEHICLES.

WITH A CLEARER PICTURE OF THE PASSENGERS' PROBLEMS, IT IS LOGICAL THAT A NEW METHOD FOR PRESENTING INFORMATION MAY BETTER REMEDY THIS SITUATION. SINCE THE DRIVER'S VOICE, EVEN WITH AMPLIFICATION, IS NOT A SATISFACTORY MEDIUM, THE POSSIBILITY OF A VISUAL AID BECOMES EVIDENT.

VISUAL CRITERIA

A NEW APPROACH, WHICH USES A CHANGING SIGN TO PRESENT THE STOP NAMES, WILL NECESSITATE THE ESTABLISHMENT OF A VISUAL LEVEL TO SATISFY A VAST MAJORITY OF PASSENGERS. THIS IS ESSENTIAL IF THE VSI IS TO PROPERLY PERFORM THE FUNCTION FOR WHICH IT IS DESIGNED. REGARDLESS OF THE

PERFECTION WITH WHICH THE OTHER DESIGN DETAILS ARE SOLVED, IF THE NAMES ARE NOT LEGIBLE TO PASSENGERS, THE VSI WILL NOT BE A USEFUL UNIT.

A MAJOR CONSIDERATION WITH REGARD TO THIS VISUAL LEVEL IS THE OBSERVATION DISTANCE IN THE LONGEST VEHICLE WHICH MIGHT BE EQUIPED WITH THE VSI. IN THE CASE OF BUSES, WHICH WERE CHOSEN FOR THIS THESIS, THE DISTANCE WAS MEASURED AS 30 FEET FROM THE REAR SEAT TO THE FORWARD LOCATION OF THE VSI. THIS REQUIREMENT IS BASED ON A VEHICLE WHICH ITILIZES THE MAXIMUM LENGTH ALLOWED BY LAW.(48-3)

WITH THE READING DISTANCE ESTABLISHED, THE REQUIRED VISUAL LEVEL COULD BE APPROACHED IN TWO WAYS. EITHER IT COULD BE DETERMINED BY EXPERIMENT OR BY REFERENCE TO SOME ESTABLISHED BASIS. SINCE IT WAS CONSIDERED FAR BEYOND THE SCOPE OF THIS STUDY TO CONDUCT A SUFFICIENT NUMBER OF TEST CASES TO SUBSTANTIATE EXPERIMENTAL RESULTS, IT WAS DECIDED TO USE THE OTHER POSSIBILITY. THE FAMILIAR SYSTEM OF VISUAL CHARTS USED IN THE FIELD OF OPTICS FOR EYE EXAMINATION WAS CHOSEN AS THE BASIS FOR COMPARISON.(53-10)

THESE CHARTS ARE SET UP ON THE BASIS OF READING INDIVIDUAL ALPHABET CHARACTERS IN AN UNRELATED GROUP AT A DISTANCE OF 20 FEET WITH ONE EYE. THE LEVEL THUS ESTABLISHED IS CALLED TWENTY-TWENTY AND IS WRITTEN 20/20. THIS ALPHABET SIZE WHICH WAS SELECTED FOR THE BASIC INDEX IS REFERRED TO AS A "20 FOOT" LETTER. ALLOWANCE IS MADE FOR LESSER VISION BY INCREASING THE LETTER SIZE IN PROPORTIONATE STEPS AS 20/30, 20/40 UP TO 20/200. THESE FRACTIONS INDICATE THE EYE UNDER EXAMINATION IS CAPABLE OF READING AT 20 FEET WHAT THE EYE USED AS A STANDARD COULD DISCERN AT 30, 40 OR WHATEVER NUMBER OF FEET THE DENOMINATOR SHOWS. EACH OF THESE LARGER LETTERS IS REFERRED TO FOR SIZE AS A "30 FOOT" LETTER, ETCETERA.

SINCE THE VSI MUST PRESENT NAMES LEGIBLY, THIS FUNCTION WOULD BE FULFILLED BY THE USE OF A VERY LARGE ALPHABET. HOWEVER, THERE IS RESTRICTION ON THE SIZE OF THE UNIT BECAUSE OF INSTALLATION REQUIREMENTS. THIS IS THE INCENTIVE FOR CAREFULLY ESTABLISHING THE ALPHABET SIZE AT THE SMALLEST ALLOWABLE POINT FOR PROPER LEGIBILITY.

THE ALPHABET HEIGHT DETERMINES THE ROLL SIZES AND CASE DIMENSIONS.

IN A DISCUSSION, DR. HENRIETTA JOHNSON SAID IT WAS HER OPINION THAT THE VISION REQUIRED FOR PRACTICAL MOVEMENT IS SOMEWHERE IN THE VICINITY OF 20/70. A PERSON WHO HAS POORER VISION THAN THIS CAN NOT SAFELY GET AROUND IN TRAFFIC WITHOUT BEING A DETRIMENT TO HIMSELF AND OTHERS.* OFCOURSE MANY WHOSE VISION IS IN THIS CATEGORY HAVE HAD CORRECTION WITH GLASSES TO SOME BETTER DEGREE AND POSSIBLY ALL THE WAY TO THE IDEAL 20/20. HOWEVER, IT IS NOT THOSE WITH CORRECTED VISION WHO ARE TO BE USED TO ESTABLISH THE REQUIRED MINIMUM, RATHER IT IS THOSE WHO USE PUBLIC TRANSPORTATION AND ARE IN THE BORDER CATEGORY WHICH MUST BE CONSIDERED.

SINCE THIS FACTOR IS SO IMPORTANT IN THE DESIGN, EXPERIMENTS WERE CARRIED OUT STARTING WITH A LETTER 1.65 INCHES HIGH. THIS DIMENSION RESULTED FROM A PROPORTIONATE SIZE INCREASE OF THE "70 FOOT" LETTER WHICH COMPENSATED FOR OBSERVATION FROM 30 FEET RATHER THAN THE STANDARD 20 FOOT

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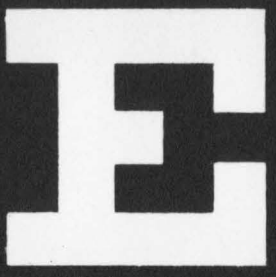
* HENRIETTA JOHNSON, M.D., PRACTICING OPHTHALMOLOGIST 17 YEARS, PASADENA, CALIFORNIA.



STANDARD TEST "E" FROM AMERICAN OPTICAL
CHART # 1937

GOTHIC "E"

FIGURE 2

DISTANCE.*

THERE ARE SEVERAL FACTORS WHICH WOULD INDICATE THAT THE DIMENSION OF 1.65 INCHES INCLUDES A WIDE MARGIN OF SAFETY WHEN CONSIDERED IN THE APPLICATION OF THE VSI, AND THE EXPERIMENTAL RESULTS SUBSTANTIATED THIS. ALTHOUGH IT IS NOT POSSIBLE TO EVALUATE ACCURATELY EACH OF THE FACTORS WHICH WILL BE DISCUSSED IN THIS PARAGRAPH, THEIR TOTAL EFFECT WAS SUFFICIENT TO ESTABLISH THE FINAL STANDARD FOR THE VSI AS A LETTER ONLY 1.25 INCHES HIGH.

FIRST, THE SURROUNDINGS, THE LIGHTING AND THE CHART COLORS USED IN DOCTOR'S OFFICES ARE NOT COMPLETELY STANDARD OR THE OPTIMUM. SECOND, THE BASIC LETTER DIMENSIONS AND FORMS ARE CHOSEN MORE FOR THE ABILITY TO CONFUSE THAN TO AID IN RECOGNITION. THIS CAN READILY BE SEEN BY COMPARING THE EXAMPLES SHOWN ON THE PAGE OPPOSITE, FIGURE 2. THIRD, THE STANDARD IS BASED ON READING WITH EACH EYE SEPARATELY, AND THE RESULT WHEN USING BOTH EYES IS OFTEN BETTER THAN THAT SECURED BY EITHER EYE ALONE. FOURTH, THE LETTER GROUPING

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* FOR A MORE DETAILED AND COMPLETE DISCUSSION OF OF THE VISUAL EXPERIMENTS, SEE APP. A, P. 54.

IS SPECIFICALLY UNRELATED SO THAT NO WORD IS FORMED WHICH ALSO ADDS TO THE DIFFICULTY OF "READING". IN THIS CATEGORY, ANOTHER FAVORABLE FACTOR IS THE PSYCHOLOGICAL EFFECT OF KNOWING AHEAD OF TIME THE WORD WHICH IS TO BE IDENTIFIED.* THIS IS A DEFINITE ADVANTAGE AND IS THE SITUATION WHICH WOULD EXIST WHEN USING THE VSI.

OPERATOR'S PROBLEMS

IN BUSES WHERE THE OPERATOR IS AVAILABLE FOR QUESTIONING, HE IS CONSTANTLY BURDENED BY REQUESTS FOR "CALLING" CERTAIN STREETS. THIS IS AN ADDED DUTY TO AN ALREADY LONG LIST OF RESPONSIBILITIES, THE MOST IMPORTANT OF WHICH IS THE CAREFUL AND SAFE HANDLING OF HIS VEHICLE TO CAUSE THE LEAST DISCOMFORT TO PASSENGERS -- AND OTHERS ON THE STREET. IN ADDITION, HE MUST TAKE FARES AND MAKE CHANGE, WATCH THE DORRS AND CHECK FOR SAFE LOADING AND UNLOADING, ANSWER QUESTIONS AND MAINTAIN A VERY CLOSE TIME SCHEDULE.**

WITH THIS IN MIND, IT IS EASY TO SEE THAT THE

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* DR. HENRIETTA JOHNSON, OP. CIT.

** DRIVER'S CHECK SHEET, FORM NCL-110, NATIONAL CITY LINES, INCORPORATED, CHICAGO, ILLINOIS.

ADDITIONAL LOAD OF GIVING INFORMATION SHOULD BE SIMPLIFIED AS MUCH AS POSSIBLE. ROUTINE QUESTIONS AND THE MENTAL EFFORT NECESSARY TO REMEMBER WHICH STREETS TO CALL OR CALLING ALL STREETS IS AN UNDUE STRAIN AND SOURCE OF DISTRACTION TO OPERATORS.* IT IS ESSENTIAL, THEREFORE, THAT THE REQUIREMENTS FOR THE OPERATION OF THE VSI BE AS SIMPLE AS POSSIBLE AND THAT ITS USE EFFECTIVELY RELIEVES THE OPERATOR.

IN THE INITIAL STAGES OF DEVELOPMENT, SEVERAL METHODS FOR COMPLETE AUTOMATIC CONTROL WERE CONSIDERED AS MEANS FOR REMOVING THE NEED OF RESPONSIBILITY ON THE PART OF THE OPERATOR. TO MENTION THESE BRIEFLY, THERE WAS THE POSSIBILITY OF ELECTRONIC ACTUATION FROM POSITIONS ALONG THE ROUTE. THIS COULD BE ACCOMPLISHED BY SMALL UNITS EMITTING SIGNALS WHICH WOULD EFFECT A CHANGE AS THE VEHICLE PASSED THAT PARTICULAR SPOT AND RECIEVED THE IMPULSE. ANOTHER POSSIBILITY WAS A GEARING ARRANGEMENT TO MAINTAIN AN ASSOCIATION WITH THE VEHICLE MILEAGE, OR FOR BUSES WHICH TAKE THEIR POWER

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* SEE APP. B, P. 69, QUESTION 3; P. 71, COMMENT SUMMARY ITEM 3.

FROM OVERHEAD WIRES, THERE WAS THE TROLLEY WHICH MIGHT BE USED AS A MEANS FOR CONTROL. HOWEVER, IT WAS QUITE EVIDENT THAT THE SCOPE OF THIS PROBLEM DID NOT ALLOW FOR THE COMPLICATED AND EXPENSIVE EQUIPMENT NECESSARY TO A SOLUTION OF THIS TYPE.

CONSIDERATION WAS ALSO GIVEN TO INCORPORATING A SEQUENCE REQUIREMENT IN AN AUTOMATIC CONTROL. THIS WOULD ACTUATE THE UNIT FOLLOWING A SET PATTERN OF INCIDENTS WHICH OCCURRED AT EACH STOP. BUT CAREFUL OBSERVATION OF BUS TRAVEL SHOWED TOO MANY VARIABLES IN NORMAL OPERATION AND THE DRIVER WOULD STILL BE REQUIRED TO EXERCISE A CONSTANT CKECK ON THE UNIT TO ASCERTAIN THAT IT WAS "IN STEP" WITH THE BUS.

ANOTHER FACTOR WEIGHING AGAINST AUTOMATIC CONTROL WAS A SERIES OF REPLIES TO THE AUTHOR'S QUESTIONNAIRES WHICH RELATED UNSUCCESSFUL ATTEMPTS TO DESIGN UNITS OF THIS CATEGORY.*

THIS PHASE THEREFORE RESOLVES ITSELF INTO A MATTER OF MAKING A MANUAL CONTROL WHICH COULD

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* SEE APP. B, P. 72, COMMENT SUMMARY ITEM 8.

BE ACTUATED BY THE OPERATOR AND PREFERABLY SO CONNECTED WITH HIS NORMAL SEQUENCE OF OPERATION THAT IT WOULD SOON BE AN AUTOMATIC MOVEMENT REQUIRING ALMOST NO CONCENTRATION OR EFFORT ON HIS PART. IT IS A POSSIBILITY THAT THIS CONTROL BUTTON, WHICH MUST BE PUSHED FOR EVERY CHANGE, BE LOCATED ON SOMETHING THAT IS USED IN EACH SEQUENCE OF OPERATION AS THE BUS LEAVES A STOP.

IN ADDITION TO THE ROUTINE CONTROL NECESSARY FOR THE NORMAL "LOCAL" OPERATION WHICH HAS VERY FREQUENT STOPS, THERE WAS A FACTOR OF "EXPRESS" RUNS WHICH MAY BE OVER THE SAME ROUTE. AT TIMES A TRIP MAY BE ENTIRELY "EXPRESS" OR ONLY PARTS OF THE ROUTE MAY BE HANDLED IN THIS WAY DEPENDING ON MANY CONDITIONS.* TO PREVENT THE OPERATOR FROM HAVING TO WATCH THE VSI TO SEE WHICH NAME IS APPEARING, IT IS IMPORTANT THAT A SELECTOR WHICH CAN MAKE THIS CHOICE BE INCORPORATED IN THE CONTROL SYSTEM AND LOCATED CONVENIENTLY.

ANOTHER FUNCTION OF THE CONTROL SYSTEM MUST BE THAT OF ALLOWING FOR COMPLETE RE-WIND OR REVERSAL

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* SEE APP. B, P. 73, GENERAL COMMENT ITEM C.

FOR A SHORT PERIOD OF TIME IN CASE THE VSI IS NOT COORDINATED WITH THE BUS OPERATION. IN EITHER CASE, THE OPERATOR MUST HAVE THIS FUNCTION PERFORMED WITHOUT HAVING TO REMOVE HIS ATTENTION FROM OTHER DUTIES. AT THE END OF THE ROUTE, IN PARTICULAR, THERE ARE MANY THINGS WHICH MUST BE DONE AND RESETTING THE VSI SHOULD NOT BE AN ADDED DUTY.

THERE IS ONE OTHER REQUIREMENT WHICH MUST BE FULFILLED BY THE OPERATOR. IT IS NECESSARY TO COMPENSATE FOR THE FACT THAT VEHICLES DO NOT TRAVEL THE SAME ROUTES DAILY OR EVEN ONE ENTIRE DAY. THEREFORE, THE ROLLS USED IN THE VSI WOULD EITHER HAVE TO BE LONG ENOUGH TO CONTAIN ALL THE ROUTES IN A CITY OR ELSE EACH ROLL WOULD CARRY ONLY ONE ROUTE. THE FIRST PREMISE IS IMPRACTICAL BECAUSE OF THE BULKY ROLLS WHICH WOULD RESULT AND THE OTHER ALTERNATIVE WILL REQUIRE OCCASIONAL CHANGES OF ROLLS. SINCE THIS OPERATION OF ROLL CHANGE WILL PROBABLY BE PERFORMED BY THE OPERATOR BEFORE HE STARTS HIS DAILY RUN OR SOMEWHERE DURING THE DAY WHEN DISPATCH HAS REQUIRED A CHANGE OF ROUTE, SPECIAL ATTENTION MUST BE GIVEN

TO MAKING THIS A FAST SIMPLE MATTER. THIS IS AN IMPORTANT FACTOR IN A LARGE NUMBER OF RETURNS TO THE AUTHOR'S QUESTIONNAIRES.*

THE APPEARANCE

THE VSI HAS TWO MAJOR CONSIDERATIONS WHICH MUST BE FULFILLED BY THE EXTERIOR CASE DESIGN. THESE RESTRICTIONS WILL BE DICTATED BY THE PURPOSE AND FUNCTION OF THE UNIT AND THE SURROUNDINGS IN WHICH IT MUST BE PLACED.

SINCE THE VSI MUST PRESENT INFORMATION IN THE FORM OF A PRINTED WORD, IT IS REQUIRED THAT THIS PRESENTATION BE THE OUTSTANDING FEATURE OF THE DESIGN. TO INSURE THAT THE "NEXT STOP" APPEARS PROMINENTLY, IT SHOULD BE EFFECTIVELY FRAMED FOR CONTRAST WITH THE DISTRACTING SURROUNDINGS. THIS FRAME MUST NOT ONLY DISTINGUISH THE WORD BY COLOR CONTRAST BUT IT MUST ALSO FILL THE REQUIREMENT OF REDUCING INTERFERENCE FROM SHADOWS, CROSS-LIGHTING AND GLARE FROM THE BUS WINDOWS. TO ACCOMPLISH THESE FACTORS, THE NAME OF THE STOP WILL BE PRESENTED IN A RECESSED "SHADOW BOX"

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* SEE APP. B, P. 72, COMMENT SUMMARY ITEM 7

72 - Comment Sum 7

OPENING, THE MOST PROMINENT FEATURE ON THE FRONT OF THE UNIT.

DIMENSIONAL RESTRICTIONS ON THE CASE DEPEND ON THE CONTOUR OF THE VEHICLE CEILING AND THE HEAD ROOM REQUIREMENTS FOR PEOPLE GETTING ON THE BUS. SINCE THE SCOPE OF THIS PROBLEM IS DIRECTED TOWARD THE GASOLINE OR DIESEL BUS, THE MOST POPULAR MODEL WOULD BE USED TO DETERMINE THESE RESTRICTING FACTORS.(46-1) AN ADDITIONAL RESTRICTION IN SIZE IS OFFERED BY A VENTILATING UNIT MOUNTED OVER THE DRIVER'S POSITION. THIS IS ONLY FOUND IN THE LATEST VEHICLES DELIVERED.

IN ADDITION TO FULFILLING THESE FUNCTIONAL REQUIREMENTS, THE CASE MUST FIT INTO THE SIMPLE, ALMOST SEVERE INTERIOR OF TODAY'S BUS. THE APPLIED ORNAMENTATION WHICH ACCOMPANIED THE EARLY MODELS HAS ALL BEEN REMOVED FOR EASIER MAINTENANCE AND IMPROVED APPEARANCE.

MOTIVE POWER

ON THE VEHICLE CHOSEN FOR THE PURPOSE OF THIS DESIGN, THERE IS THE POSSIBILITY OF TWO POWER SOURCES. EITHER ELECTRICITY OR AIR MIGHT BE USED

TO DRIVE THE VSI. THIS WAS A POINT INCLUDED IN THE QUESTIONNAIRES SENT TO TRANSIT COMPANIES AND A GENEROUS MARGIN WERE IN FAVOR OF ELECTRICITY AS A RELATIVELY TROUBLE FREE MOTIVE SOURCE.*

IN ADDITION, THE NECESSARY WORK COULD BE ACCOMPLISHED BY A SMALL MOTOR WHICH WOULD REQUIRE VERY LITTLE MAINTENANCE. THE WIDE VARIANCE IN CONTROL WHICH WAS DESIRED COULD BE ACCOMODATED BY A FAIRLY SIMPLE ARRANGEMENT OF SWITCHES AND RELAYS. ALSO, THE ELECTRIC MOTOR WOULD OFFER A QUIETER, SMOOTHER OPERATION THAN THE AIR MOTOR WHICH WAS THE ALTERNATIVE SOURCE OF POWER.

SUMMARY

A SUMMARY OF THE FEATURES DISCUSSED IN THIS SECTION AND THOSE POINTS WHICH WERE RAISED IN ANSWERS TO QUESTIONNAIRES INDICATED THAT A SATISFACTORY SOLUTION TO THIS PROBLEM WILL BE FOUND IN A UNIT WHICH WILL EFFECTIVELY MEET THE FOLLOWING REQUIREMENTS:

1. PROVIDE THE NAME OF THE NEXT STOP IN SUCH A WAY THAT IT IS READABLE TO PASSENGERS ANYWHERE IN THE VEHICLE.

2. PROVIDE THIS INFORMATION SOON ENOUGH TO ALLOW FOR A REASONABLE AMOUNT OF TIME FOR EXIT PREPARATIONS.

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* SEE APP. B, P. 70, QUESTION 6.

3. REQUIRE AN ABSOLUTE MINIMUM OF EFFORT ON THE PART OF THE OPERATOR IN THE ROUTINE CONTROL OF THE UNIT.

4. HAVE A CAPACITY SUFFICIENT FOR AT LEAST 170 NAMES PER ROLL AND PREFERABLY MORE, WITH SOME PROVISION FOR SPLICING AND CHANGING ROUTES.*

5. PROVIDE FOR A QUICK, EASY WAY TO CHANGE THE ROLLS.

6. PROVIDE FOR "EXPRESS" OR "LOCAL" OPERATION OR A COMBINATION OF THE TWO OVER THE SAME ROUTE.

7. PRESENT A WELL INTEGRATED AND PLEASING APPEARANCE IN ITS SURROUNDINGS.

8. PROVIDE LONG AND RELIABLE SERVICE WITH A MINIMUM OF SERVICING AND MAINTENANCE.

9. INCORPORATE ALL THESE REQUIREMENTS WITHIN A "REASONABLE" PRICE. APPROXIMATELY $100.00 WOULD WELL SATISFY THOSE WHO ANSWERED THIS POINT ON THE AUTHOR'S QUESTIONNAIRES.**

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* SEE APP. B, P. 70, QUESTION 7.

** SEE APP. B, P. 70, QUESTION 10.

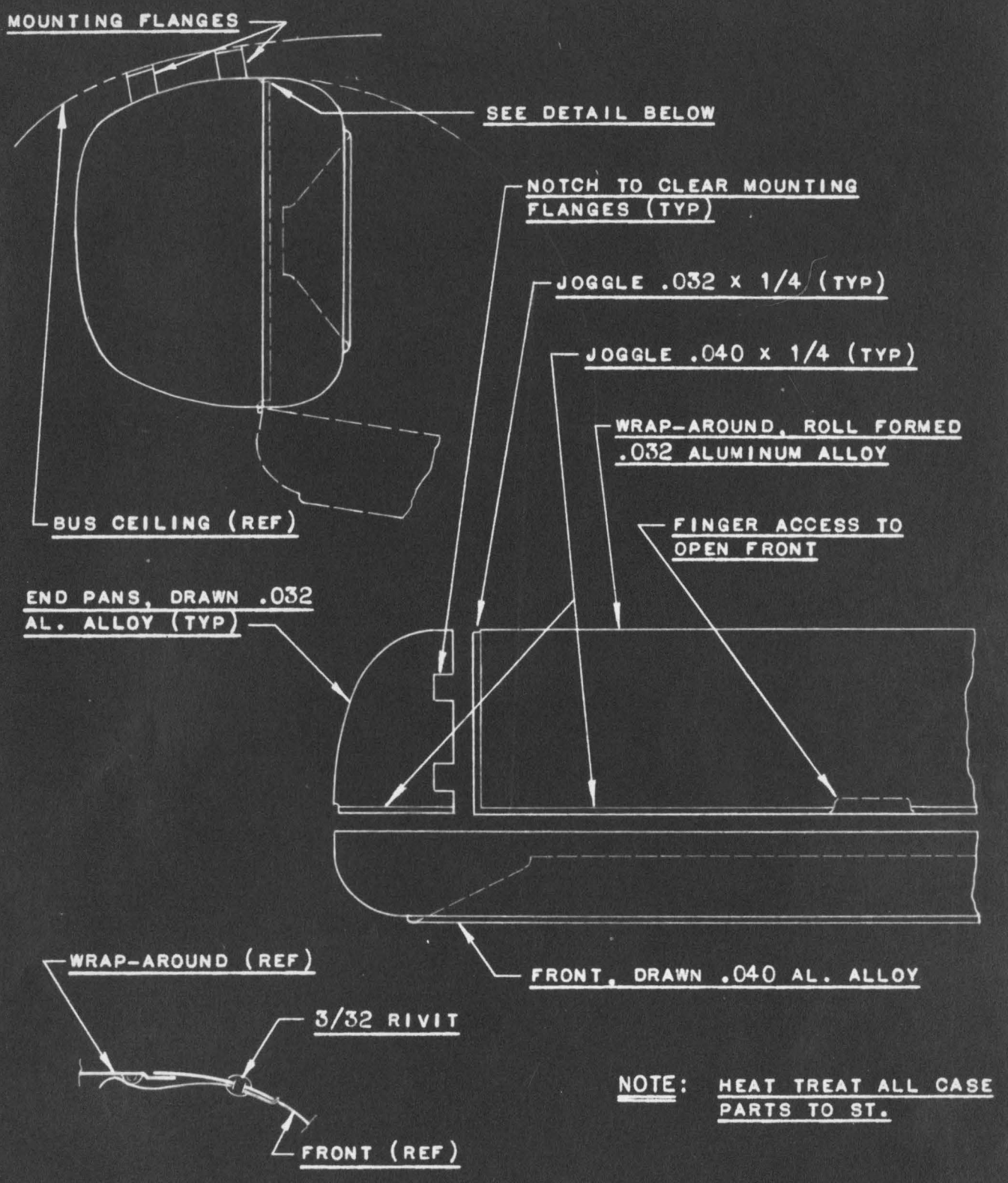
THE VISUAL STREET INDICATOR

THE FINAL DESIGN

THE DESIGN OF THE VSI WAS DETERMINED BY FIRST ESTABLISHING THE REQUIREMENTS FOR AN IDEAL UNIT AND THEN CAREFULLY MODIFYING THIS IDEAL IN THE LIGHT OF PRACTICALITY. ATTENTION WAS GIVEN TO DETAILS WHICH WERE AFFECTED BY FUNCTION, OPERATION, APPEARANCE AND MANUFACTURE. THE FINAL DESIGN PRESENTED IN THE FOLLOWING SECTIONS IS A SIMPLE MECHANISM WHICH REQUIRES LITTLE EXPENSIVE TOOLING, NO SPECIAL PROCESSES, AND FULFILLS MANY OF THE IDEAL REQUIREMENTS. THE NAME "VISUAL STREET INDICATOR" WAS DECIDED ON AS A SATISFACTORY TRADE MARK UNDER WHICH TO MARKET THIS UNIT. IT IS A DESCRIPTIVE TERM AND POSSESSES THE ADVANTAGE OF A GENERIC, YET DISTINCTIVE NAME.

THE CASE

THE CASE DESIGN WAS KEPT AS SIMPLE AS POSSIBLE AND THE FINAL SHAPES ARE SUCH THAT NOMINAL PRODUCTION USING ALUMINUM COULD BE ACCOMPLISHED WITH "KIRKSITE" OR "CERROBEND" DIES. THIS WOULD BE A SUBSTANTIAL SAVING IF THE PRODUCTION PLAN DID NOT JUSTIFY THE LARGE CAPITAL OUTLAY FOR STEEL DIES. THE CONTOUR OF THE TOP OF THE CASE WAS



DETAIL OF SPRING CLIP

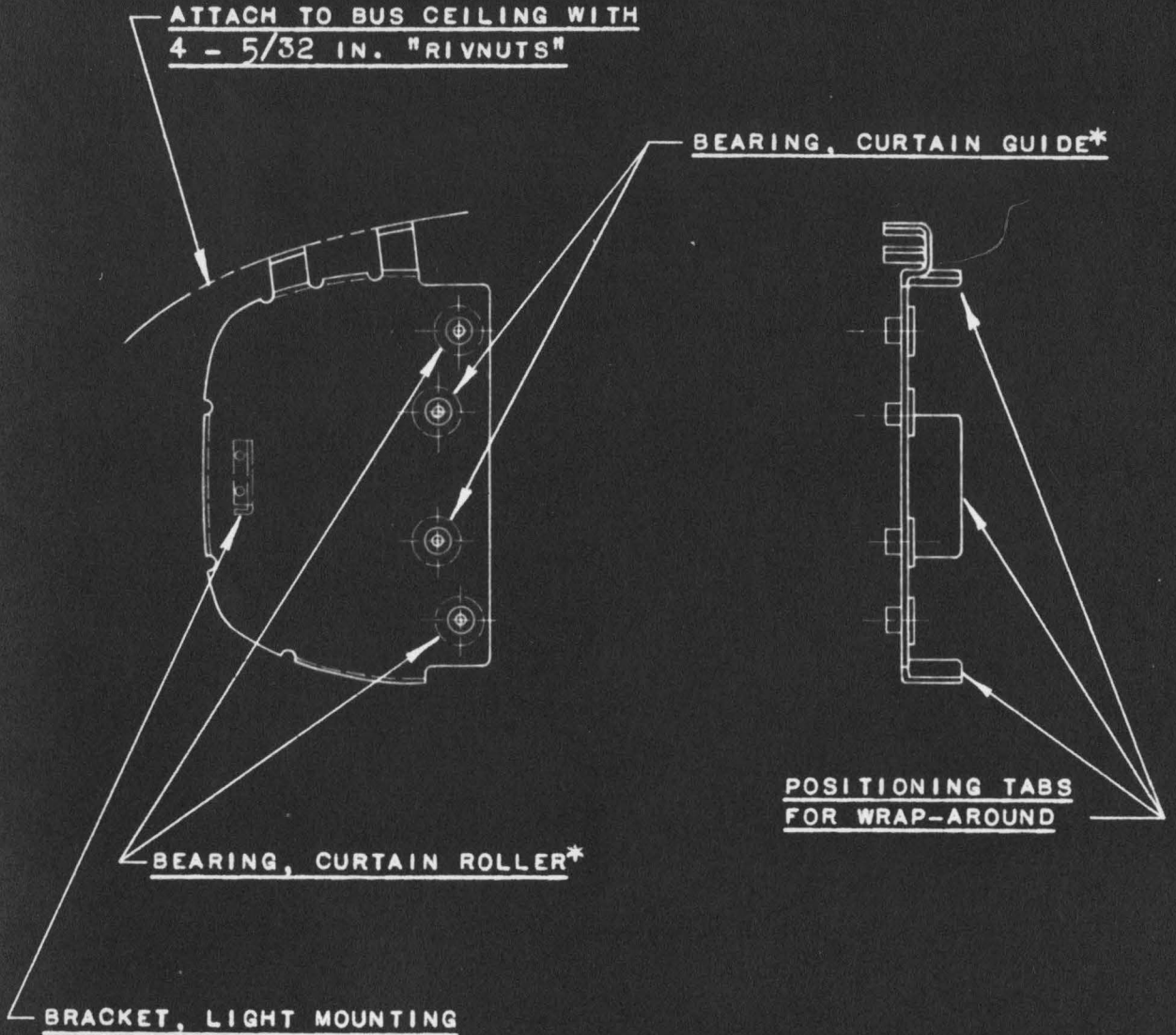
NOTE: HEAT TREAT ALL CASE PARTS TO ST.

SCALE: 1/4

- FIGURE 4 -

DETERMINED BY CUTTING A TEMPLATE TO MATCH THE BUS CEILING AT THE PROPER MOUNTING LOCATION. THE LENGTH OF THE VSI WAS DETERMINED BY THE NECESSITY OF CLEARING THE HEADS OF PASSENGERS BOARDING AND BY INSTALLATION REQUIREMENTS IN THE LATEST MODEL BUSES, WHICH HAVE A VENTILATION UNIT OVER THE DRIVER'S SEAT. IT WAS LEFT AS LONG AS POSSIBLE, HOWEVER, TO ALLOW FOR READING FROM THE SIDE SEATS WHEN STANDEES WERE IN THE AISLE. A MORE COMPLETE DISCUSSION OF THIS FACTOR MAY BE FOUND IN THE NEXT SECTION DEALING WITH THE CURTAIN, SEE PAGE 39.

THE CASE IS MADE FROM FOUR ALUMINUM SECTIONS, THREE OF WHICH ARE DRAWN AND THE OTHER IS ROLL FORMED. FIGURE 4 SHOWS THEIR RELATIONSHIP AND METHOD OF ASSEMBLY. THE CASE IS A SIMPLE WRAP-AROUND, IT DOES NOT CARRY ANY OF THE LOAD AND ITS ONLY FUNCTION IS AS A COVERING. IN ADDITION TO THE LARGE ACCESS THROUGH THE FRONT, WHERE ROLL CHANGES ARE ACCOMPLISHED, THE ENTIRE CASE CAN BE REMOVED FOR SERVICING OR INSPECTION BY TAKING OUT SIX SCREWS. THE FRONT OF THE UNIT HINGES ALONG THE BOTTOM AND HAS TWO SIMPLE SPRING



SUPPORT FORMER SCALE: 1/4

* ALL BEARINGS MACHINED FROM 1020 STEEL AND SPOT WELDED IN POSITION. IF THEY PROVE INADEQUATE POROUS BRONZE INSERTS MAY BE INSTALLED

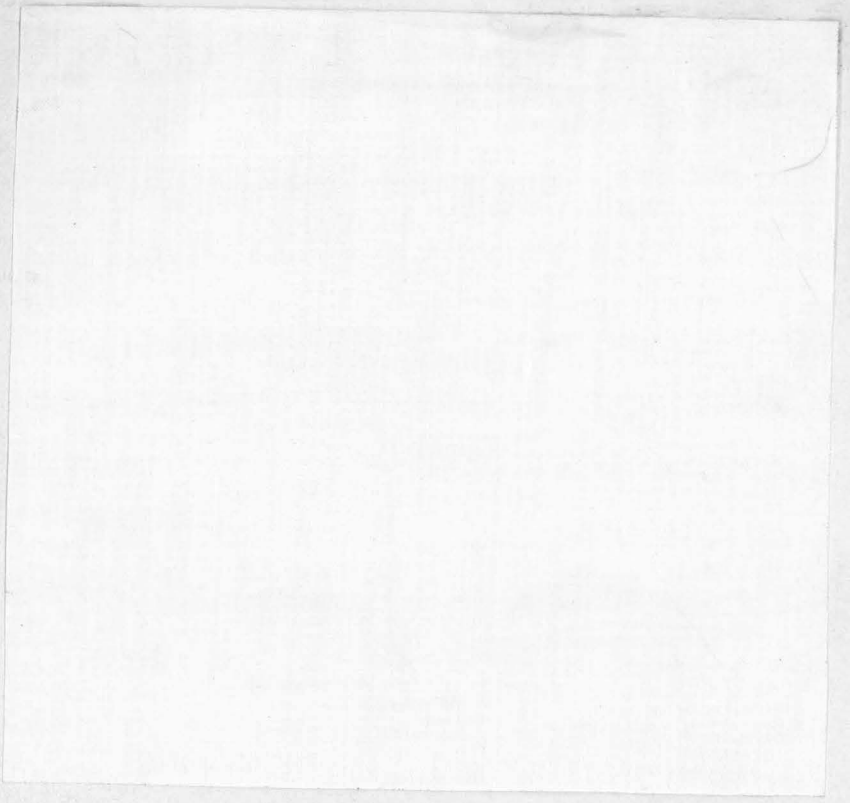
- FIGURE 5 -

CATCHES WHICH INSURE QUICK, EASY CLOSING.

INSIDE THE CASE THERE ARE TWO MAIN SUPPORT FORMERS, WHICH WILL INCORPORATE MOUNTING ARRANGEMENTS FOR ALL OF THE INTERIOR PARTS. IN ADDITION, THEY WILL STIFFEN AND HOLD THE CASE IN SHAPE PLUS BEING THE POINTS FOR INSTALLATION MOUNTING OF THE VSI IN THE VEHICLE. FIGURE 5 SHOWS THESE FORMERS WHICH WILL BE MADE FROM 16 GAGE STEEL. THE BEARING INSERTS, WHICH ARE SPOT WELDED INTO PLACE WILL BE MACHINED FROM 1020 STEEL BAR STOCK. IF THEY PROVE INADEQUATE FOR THE LOADING AND SPEEDS ENCOUNTERED IN THE OPERATION OF THE VSI, POROUS BRONZE INSERTS MAY BE INSTALLED IN THE EXISTING BEARINGS.

THE PRINTED CURTAIN

THE CURTAIN ROLLER WHICH IS USED IN THE VSI IS ONE OF THE LIMITING FACTORS OF THE DESIGN. IF THE VSI IS TO FULFILL THE FUNCTIONAL REQUIREMENT, IT MUST SATISFACTORILY PRESENT THE STOP NAME SO THAT THE MAJORITY OF PASSENGERS WILL BE ABLE TO READ IT. BECAUSE OF THE IMPORTANCE OF CONSIDERATIONS AS TO COLOR CONTRAST, TYPEFACE AND



"CURTAIN" - MATERIAL SAMPLE

TRACING CLOTH, TYPE 118T
EUGENE DIETZGEN COMPANY

- FIGURE 6 -

ILLUMINATION, SEVERAL TESTS WERE CONDUCTED AND AUTHORITIES IN THE FIELD OF OPTICS, ADVERTISING AND ILLUSTRATION WERE INTERVIEWED AND QUESTIONED. FOR A MORE COMPLETE DISCUSSION OF ALL FACTORS IN THIS SECTION, SEE APPENDIX A, VISUAL EXPERIMENTS, ON PAGE 54.

THE MATERIAL CHOSEN FOR THE CURTAIN WAS A FILLED CLOTH OF THE TYPE USED FOR TRACING DRAWINGS. AN EXAMPLE IS SHOWN AS FIGURE 6. ACCORDING TO MR. A. W. ARLIN, THIS TYPE OF CURTAIN WAS MOST SATISFACTORY IN A SIMILAR INSTALLATION AS USED BY THE ELECTRIC SERVICE MANUFACTURING COMPANY IN THE FAMILIAR DESTINATION MARKERS ON THE EXTERIOR OF BUSES.*(52-9) TO FURTHER SUBSTANTIATE THE ACCEPTABILITY OF THE CHOSEN MATERIAL, AN EXPERIMENT WAS CONDUCTED WHICH CLOSELY APPROXIMATED THE ACTUAL CONDITION OF USE IN THE VSI AND THE RESULTS WERE GOOD.**

THE COLORS FOR PRINTING WERE CHOSEN AS BLACK ON YELLOW ON THE BASIS OF REFERENCE SOURCES AND INFORMATION RECEIVED DURING INTERVIEWS. ALTHOUGH IT IS

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* A. W. ARLIN, COMPANY REPRESENTATIVE, HUNTER CAR AND BUS SIGN DIVISION, ELECTRIC MANUFACTURING CO., LOS ANGELES, CALIFORNIA

** SEE APP. C. P. 75.

ASIAN

AN EXAMPLE, FRANKLIN GOTHIC
1.05 INCHES HIGH

Characters in Complete Font

A B C D E F G
H I J K L M N O
P Q R S T U V
W X Y Z & $ 1 2
3 4 5 6 7 8 9 0
a b c d e f g h i
j k l m n o p q
r s t u v w x y z
. , - ' : ; ! ?

THE SELECTED TYPEFACE - FRANKLIN GOTHIC

- FIGURE 7 -

IMPOSSIBLE TO DETERMINE CONCLUSIVELY THAT BLACK ON YELLOW IS A BETTER COMBINATION THAN YELLOW ON BLACK, IT WAS THE CONSENSUS OF THOSE QUESTIONED THAT SUCH A COLOR ARRANGEMENT SHOULD BE USED.

AS WAS THE CASE WITH CHOOSING THE COLOR COMBINATION FOR THE CURTAIN, THERE WAS ALSO THE PROBLEM OF PERSONAL PREFERANCE AS TO THE BEST TYPEFACE. THE ONE CHOSEN FOR THIS DESIGN WAS FRANKLIN GOTHIC, MEDIUM WEIGHT AND 1.25 INCHES HIGH. THE STANDARD OR CONDENSED TYPE WOULD BE USED DEPENDING ON THE LENGTH OF THE WORD. IN GENERAL, THE DECISIONS BEARING ON THE CHOICE WERE THE REQUIREMENTS FOR A SANS SERIF LETTER FORM OF SIMPLE CONTOUR WHICH WAS HEAVY ENOUGH TO GIVE A CLEAR AND DISTINCT IMAGE BUT LIGHT ENOUGH THAT THE "O", "P", "R", ETC. WOULD NOT CLOSE IN AND FORM A "BLOB". FIGURE 7 IS AN EXAMPLE OF THE ALPHABET.

IN ADDITION TO BEING THE MEDIUM FOR CARRYING THE NAMES OF THE STOPS, THE CURTAIN MUST ALSO FUNCTION AS THE CONTROL SOURCE FOR THE MOTOR CIRCUIT. BY TAKING THE CONTROL FOR POWER

INTERRUPTION FROM THE CURTAIN, THE RESULT IS AN ADDED CERTAINTY THAT THE NAME WILL ALWAYS BE PROPERLY ALIGNED WITH THE OPENING. FIGURE 8 ILLUSTRATES THE SPACING LAYOUT FOR THE CURTAIN, AND SHOWS THE METHOD FOR CONTROL OF THE VARIOUS RELAY CIRCUITS FOR LOCAL, EXPRESS, OR CONTINUOUS WIND OPERATION. TO DETERMINE THAT THE PUNCHED HOLES WOULD FUNCTION PROPERLY AS CONTROL MEDIUMS AND THAT THEY WOULD STAND UP UNDER EXTENDED USE, A TEST WAS CONDUCTED AND THE RESULTS WERE SATISFACTORY.*

ON THE BASIS OF TWO INCHES PER NAME AS SHOWN ON THE LAYOUT, AND THE REQUIRED MAXIMUM OF 170 NAMES WHICH WILL BE INCLUDED ON SOME ROLLS, THE LENGTH OF THE CURTAIN WILL BE ABOUT 30 FEET.** WINDING THIS LENGTH ON A TUBE ONE INCH IN DIAMTER RESULTED IN AN INCREASED ROLL SIZE OF APPROXIMATELY 1.75 INCHES. THIS DIMENSION OF 1.75 INCHES IS A LIMITING FACTOR IN DETERMINING THE MIMIMUM CASE SIZE.

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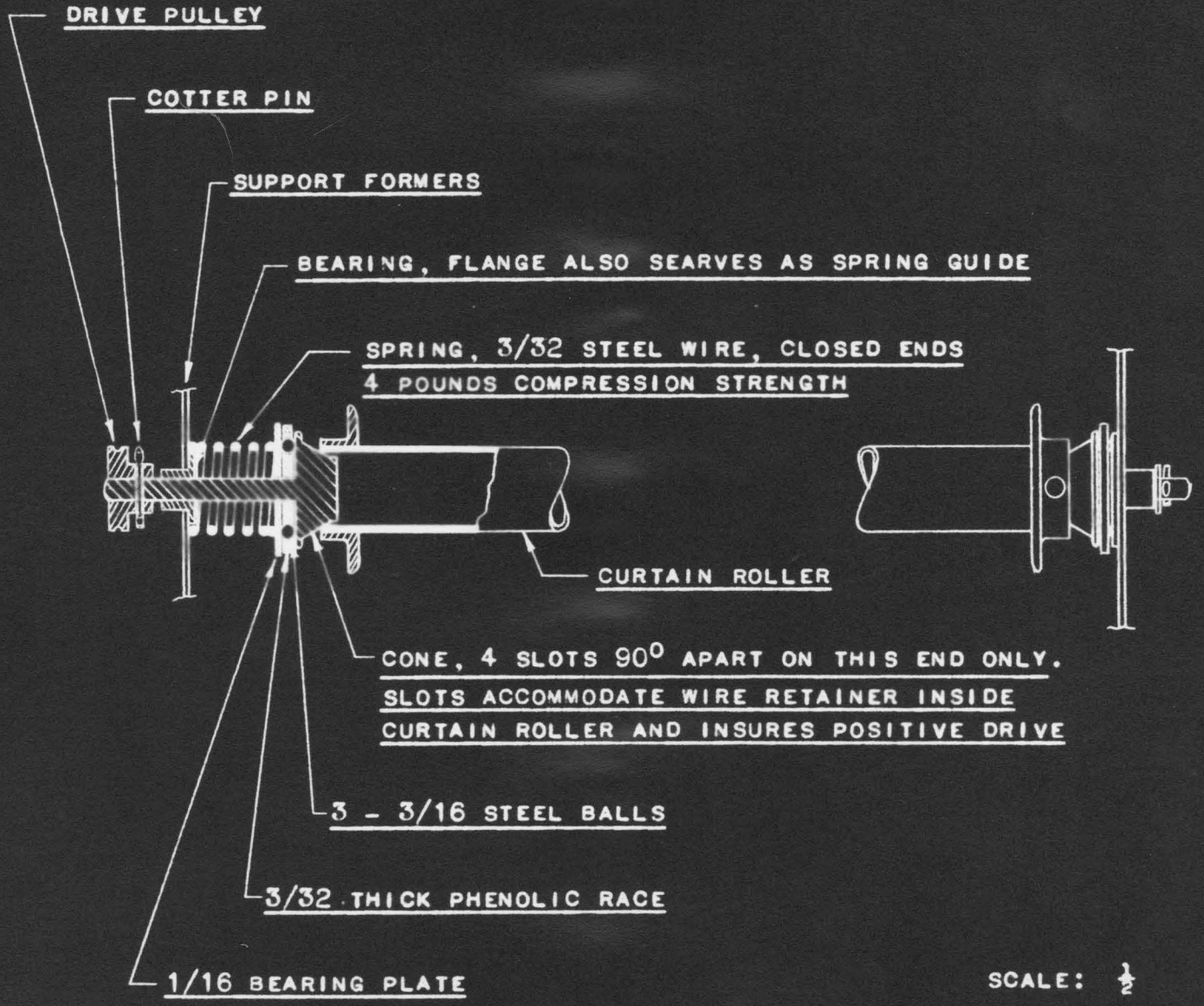
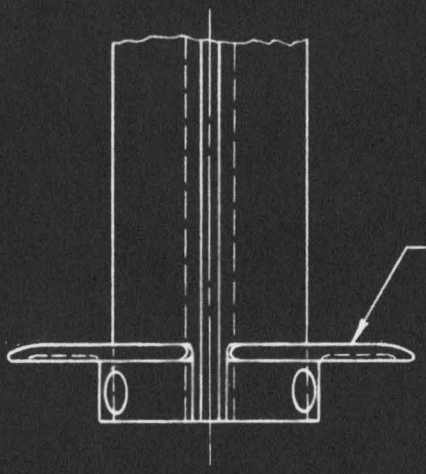
* SEE APP. C, P. 75.

** SEE APP. B, P. 70, QUESTION 7.


DRIVE PULLEY
COTTER PIN
SUPPORT FORMERS
BEARING, FLANGE ALSO SEARVES AS SPRING GUIDE
SPRING, 3/32 STEEL WIRE, CLOSED ENDS
4 POUNDS COMPRESSION STRENGTH
CURTAIN ROLLER
CONE, 4 SLOTS 90° APART ON THIS END ONLY.
SLOTS ACCOMMODATE WIRE RETAINER INSIDE
CURTAIN ROLLER AND INSURES POSITIVE DRIVE
3 - 3/16 STEEL BALLS
3/32 THICK PHENOLIC RACE
1/16 BEARING PLATE
SCALE: ½

- FIGURE 9 -

SINCE THE LENGTH OF THE CASE WAS LIMITED BY MOUNTING RESTRICTIONS AND CLEARANCES FOR PASSENGERS, THE WIDTH OF THE CURTAIN WAS ALSO FIXED. A PROBLEM WAS ENCOUNTERED HERE WITH THE OBSTRUCTION OF SIGHT BETWEEN SEATED PASSENGERS AND THE VSI, WHEN STANDEES WERE IN THE AISLE. THIS CONDITION FORTUNATELY EXISTS MOSTLY DURING THE RUSH HOUR AND COINCIDES WITH THE TIME WHEN THE SMALLEST PERCENTAGE OF PEOPLE, THE COMMUTERS, NEED INFORMATION. HOWEVER, IN AN ATTEMPT TO MAKE THE VSI AS USEFUL AS POSSIBLE, EVEN UNDER THESE CONDITIONS, THE LAYOUT SHOWN IN FIGURE 8 IS SUGGESTED AS A PARTIAL RELIEF. WITHIN REASON, ALL NAMES SHOULD GO FROM THE LEFT TO THE RIGHT MARGIN, USING AN EXTENDED ALPHABET IF NECESSARY. THIS WILL ALLOW THE SEATED PASSENGERS TO CATCH AT LEAST THE FIRST OR LAST LETTERS. ALSO, SHORT NAMES WILL BE REPEATED ON EACH END. BY UTILIZING THE ENTIRE WIDTH OF THE CURTAIN, PASSENGERS LOOKING FOR A NAME SUCH AS CALIFORNIA WOULD AT LEAST SEE THE CAL OR THE NIA WHICH IS SUFFICIENT TO IDENTIFY THE STOP. THE CHANCES FOR DUPLICATION IN THE BEGINNING OR ENDING OF CONSECUTIVE NAMES ARE VERY SMALL. IF THE NAME BE SHORT, LIKE LAKE, IT WILL



CURTAIN GUIDE FLANGE BOTH ENDS

1/16 IN. RIVETS

SLOT ONE END ONLY FOR INSERTING CURTAIN

EXTRUDED TUBE

RETAINING WIRE SEWN IN BOTH ENDS OF CURTAIN

MACHINE OTHER END OF RETAINING SLOT SO IT DOES NOT INTERFERE WITH CONE WHEN INSTALLING TUBE

SCALE: FULL

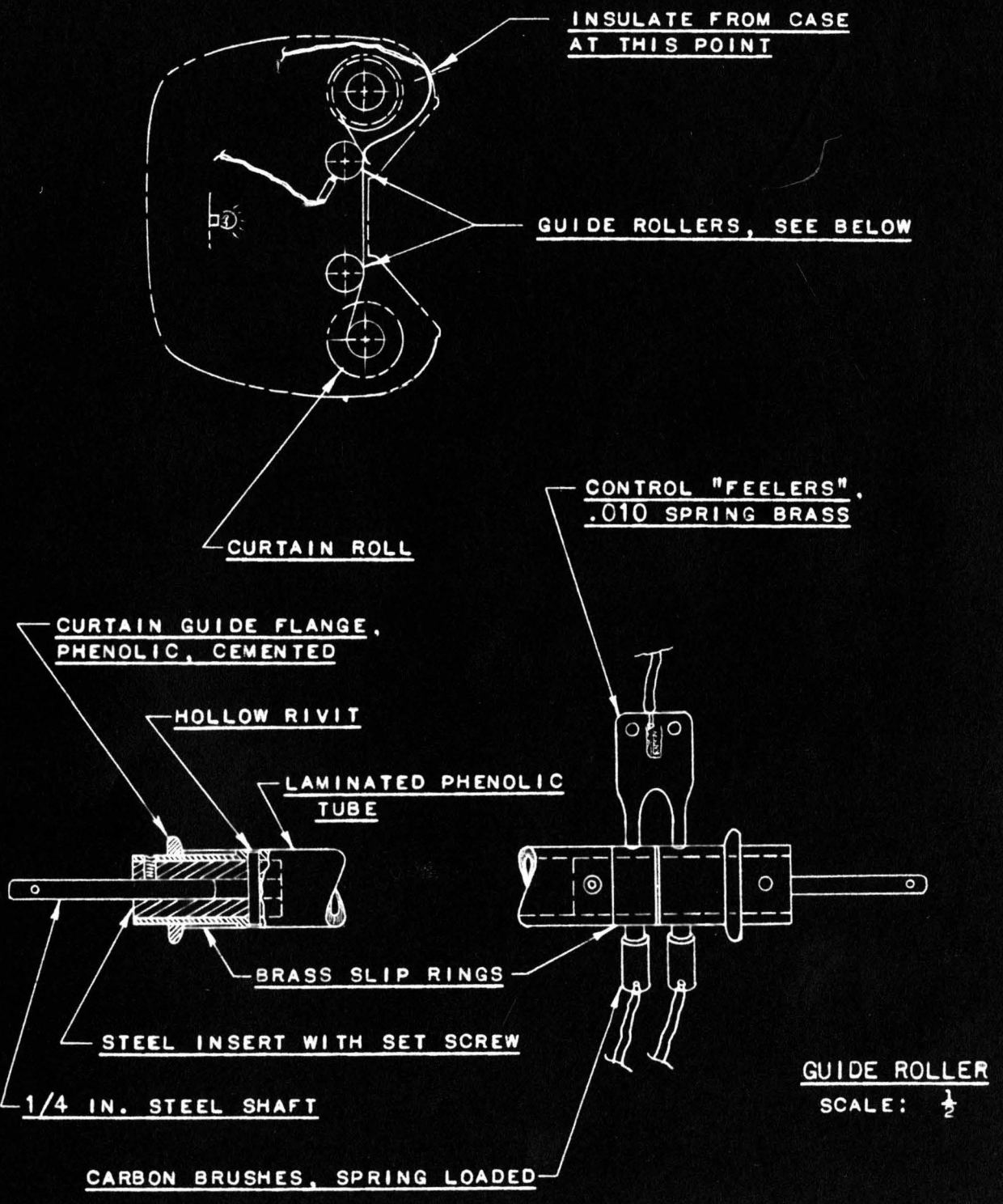
- FIGURE 10 -

BE VISIBLE ON BOTH ENDS RATHER THAN LOST IN THE CENTER.

CURTAIN INSTALLATION

FIGURE 9 SHOWS THE MECHANICAL ARRANGEMENT FOR MOUNTING THE CURTAIN ROLLS IN THE UNIT. IT IS ESSENTIAL THAT REMOVING AND REPLACING THE ROLLS BE A QUICK, EASY OPERATION. TO INSURE THIS, REMOVAL REQUIRES OVERCOMING THE SPRING PRESSURE AND TAKING OUT THE TUBE ON WHICH THE PRINTED "CURTAIN" IS WOUND. THERE ARE NO TOOLS OR ADJUSTMENTS NECESSARY. THE METHOD FOR ATTACHING THE CURTAIN TO THE TUBE IS FAST AND SIMPLE; YET IT ASSURES POSITIVE ALIGNMENT. AFTER INSERTING THE FULL ROLL IN THE VSI, THE EMPTY TUBE IS REMOVED FROM THE LOWER MOUNTING POSITION, AND THE END OF THE CURTAIN IN WHICH A PIECE OF WIRE IS SEWN IS SLID INTO A FORMED GROOVE RUNNING THE LENGTH OF THE TUBE. THIS IS ILLUSTRATED IN FIGURE 10, WHICH ALSO SHOWS THE COMBINATION RETAINERS AND GUIDES ON EACH END OF THE CURTAIN ROLL.

IN ADDITION TO THE TWO MAIN ROLLS ON WHICH THE CURTAIN IS CARRIED, THERE ARE TWO GUIDE ROLLERS.


INSULATE FROM CASE AT THIS POINT
GUIDE ROLLERS, SEE BELOW
CONTROL "FEELERS", .010 SPRING BRASS
CURTAIN ROLL
CURTAIN GUIDE FLANGE, PHENOLIC, CEMENTED
HOLLOW RIVIT
LAMINATED PHENOLIC TUBE
BRASS SLIP RINGS
STEEL INSERT WITH SET SCREW
1/4 IN. STEEL SHAFT
CARBON BRUSHES, SPRING LOADED
GUIDE ROLLER
SCALE: 1/2

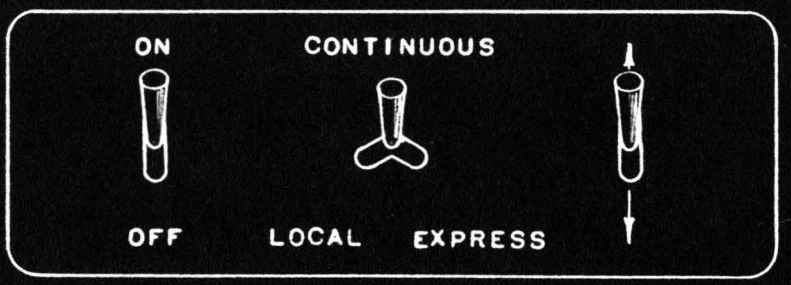
- FIGURE 11 -

THESE ROLLERS ALLOW FOR THE CHANGING DIAMETERS AS THE CURTAIN WINDS FROM ONE END TO THE OTHER. THE CONTROL SYSTEM FOR THE MOTOR RELAY IS ALSO OPERATED FROM A SET OF CONTACT STRIPS WHICH ARE INCORPORATED ON THE END OF ONE OF THE ROLLERS. FIGURE 11 SHOWS AN END VIEW OF THE CURTAIN THREADING AND THE SCHEMATIC FOR ACTUATING THE MOTOR CONTROL RELAY THROUGH PERFORATIONS IN THE CURTAIN.

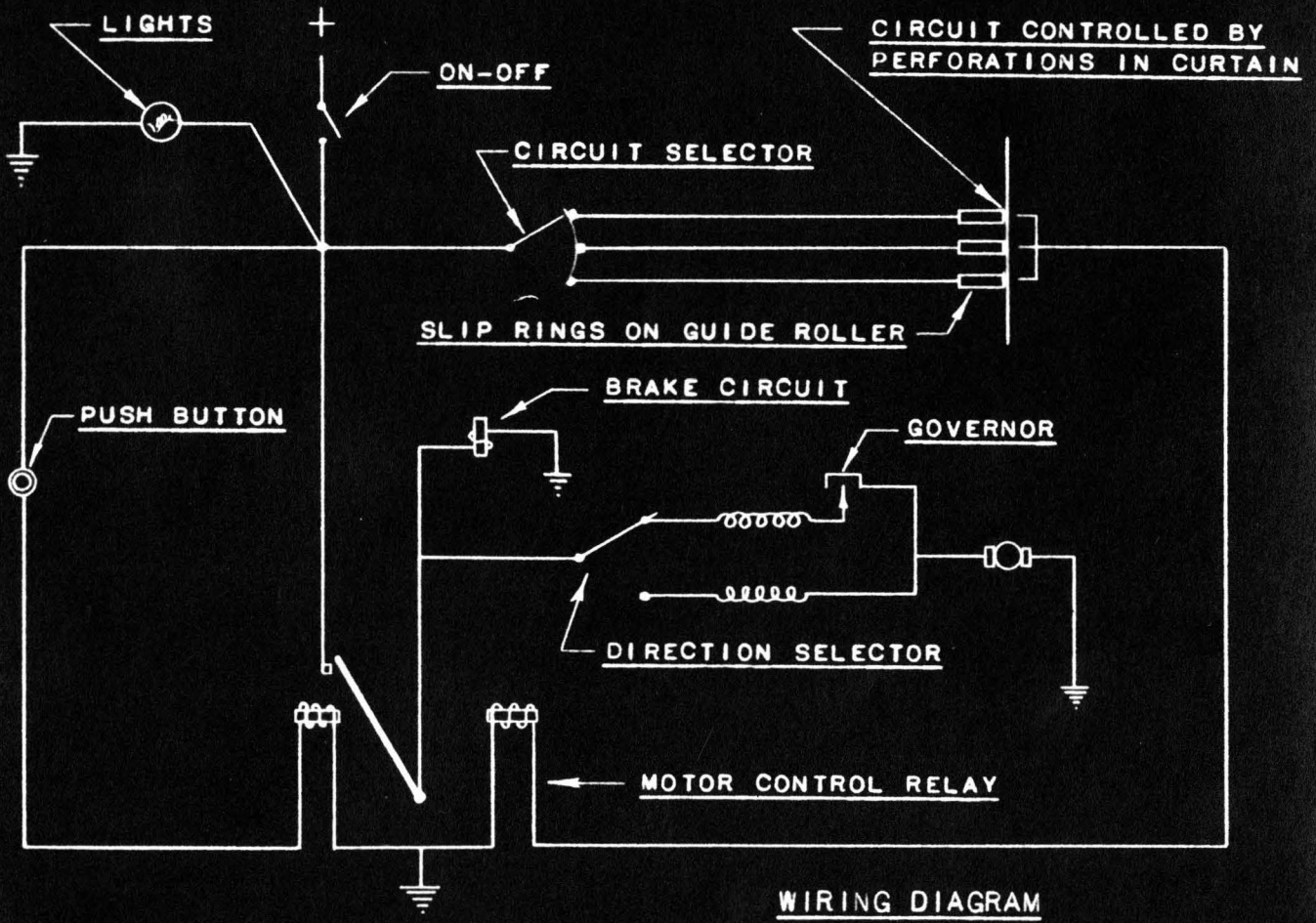
CONTROL AND WIRING

TO PRODUCE THE DESIRED CONTROL WHICH WAS DISCUSSED IN THE SECTION ON PRE-DESIGN RESEARCH, PAGES 27 AND 28, IT WAS FOUND CONVENIENT TO ARRANGE THE SWITCHES IN TWO LOCATIONS. ONE GROUP, COMPRISED OF THE CONTROLS WHICH ARE USED OCCASIONALLY, COULD BE MOUNTED ON THEIR OWN SWITCH PANEL OR INCORPORATED ON THE EXISTING CONTROL PANEL FOUND ON MOST BUSES. THE OTHER CONTROL, A PUSH BUTTON USED FOR EACH CHANGE OF THE VSI COULD BE MOUNTED ON THE HANDLE FOR OPERATING THE BUS DOORS OR IN ANY OTHER PLACE WHICH WAS CONVENIENT OR DESIRED BY THE INDIVIDUAL TRANSIT COMPANIES.

CONTROL PANEL



- FIGURE 12 -



WIRING DIAGRAM

- FIGURE 13 -

ON THE SWITCH PANEL WILL BE THREE SWITCHES AS ILLUSTRATED IN FIGURE 12. THE ON-OFF SWITCH WILL CONTROL POWER TO THE MOTOR AND LIGHTS AND ALSO TO THE PUSH BUTTON AND SELECTOR CIRCUITS. THE THREE WAY SELECTOR PERMITS A CHOICE OF LOCAL, EXPRESS OR CONTINUOUS WINDING OF THE CURTAIN. THE THIRD SWITCH IS FOR REVERSAL OF DIRECTION. THE WIRING DIAGRAM FOR THE SYSTEM CAN BE SEEN IN FIGURE 13.

THE RELAY, WHICH IS SCHEMATICALLY REPRESENTED IN THE WIRING DIAGRAM, IS NOT AVAILABLE AS A STANDARD PART. HOWEVER, MINOR MODIFICATIONS COULD BE MADE ON EXISTING MODELS WHICH WOULD FULFILL THE REQUIREMENTS NECESSARY FOR THIS APPLICATION.(48-4)*

MOTOR AND DRIVE

THE MOTOR CHOSEN FOR THE VSI IS A 12 VOLT, DIRECT CURRENT, SERIES WOUND UNIT WITH A SPLIT FIELD WHICH CAN BE DESIGNED TO FIT THE REQUIREMENTS OF THE VSI.(49-5)** INCORPORATED ON THE MOTOR WILL BE A TWO-STAGE GEAR REDUCTION UNIT AND A LOW SPEED GOVERNOR FOR MAINTAINING A REASONABLE RATE DURING

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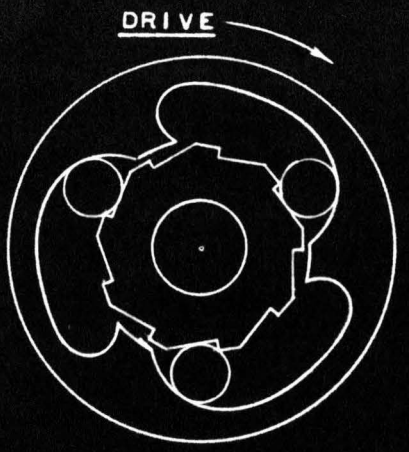
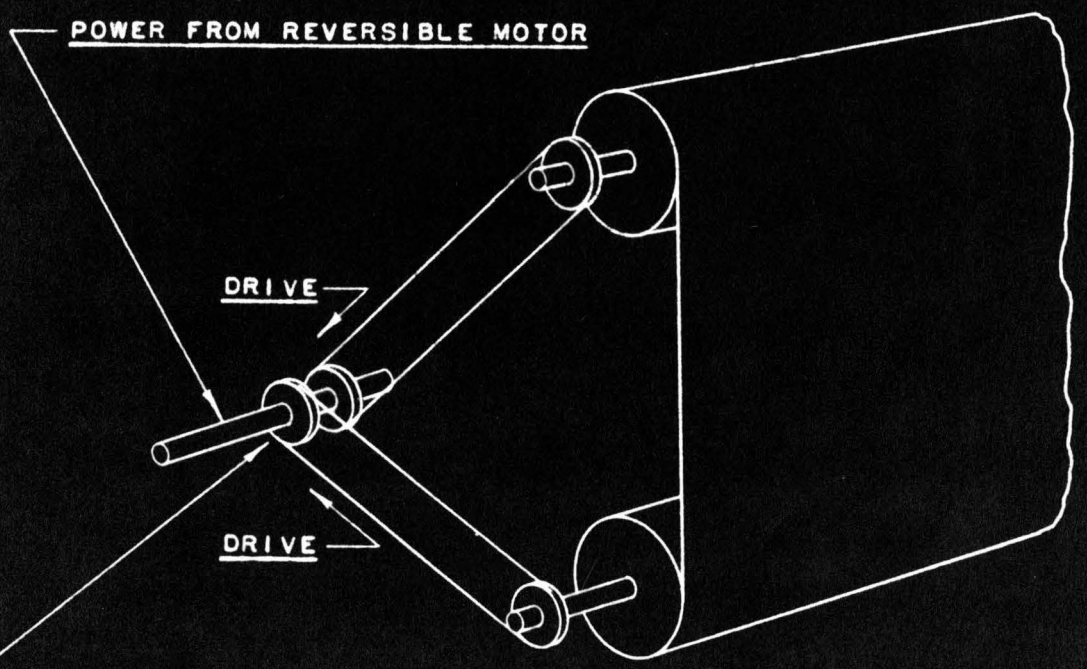
* D. LEROY, ADVANCE RELAY COMPANY, LOS ANGELES CALIFORNIA.

** R. MUESSDORFFER, COMPANY REPRESENTATIVE, LOS ANGELES, CAL., ELECTRIC MOTOR CORP., RACINE, WIS.



DOUBLE SCALE

FREE WHEELING DRIVE PULLEY*



* TWO FREE WHEELING PULLEYS MOUNTED TO DRIVE OPPOSITE

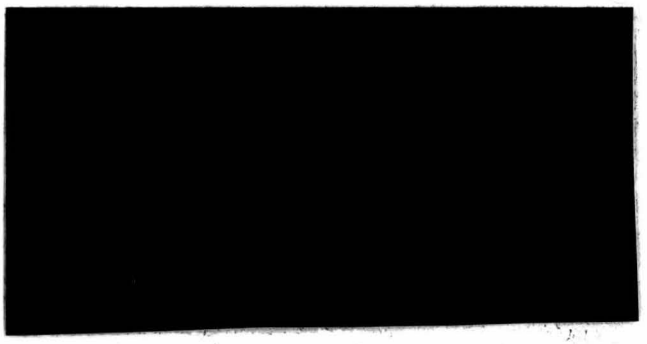
SCHEMATIC OF DRIVE

- FIGURE 14 -

THE SLOW "LOCAL" AND "EXPRESS" OPERATION. ALSO ON THE SHAFT WILL BE A RELAY CONTROLLED, FRICTION BRAKE WHICH WILL HOLD THE MOTOR IN A FIXED POSITION WHILE THE POWER IS NOT BEING APPLIED, AND WHICH WILL INSURE APPROXIMATELY THE SAME AMOUNT OF "COAST" EACH TIME THE CURRENT IS INTERRUPTED.

THE DRIVE ARRANGEMENT OF THE VSI IS DESIGNED FOR SIMPLICITY. ON THE "OUT" END OF THE GEAR REDUCTION UNIT WILL BE TWO FREE-WHEELING CLUTCHES. THESE PULLEYS WILL BE MOUNTED ON THE SHAFT SO THAT POWER WILL BE TRANSMITTED IN EACH DIRECTION OF ROTATION. NEOPRENE BELTS OF A CIRCULAR CROSS-SECTION, SIMILAR TO THE TYPE USED TO TRANSMIT POWER TO THE BLOWER IN VACUUM CLEANERS, WILL DELIVER THE DRIVE FROM EACH OF THE FREE-WHEELING PULLEYS TO A PULLEY ON THE END OF EACH CURTAIN ROLLER. FIGURE 14 ILLUSTRATES THE TYPE OF CLUTCH TO BE USED IN THE UNIT FOR THE DIRECTIONAL DRIVE AND ALSO SHOWS A SCHEMATIC ARRANGEMENT OF THE POWER TRANSMISSION.

THIS SYSTEM ALLOWS FOR A CONNECTION WHICH MAKES THE POWER DELIVERY SMOOTH. IT ALSO COMPENSATES



EXTERIOR COLOR SAMPLES

- FIGURE 15 -

COULD BE DELIVERED WITH A PRIMER COAT APPLIED AND PURCHASERS COULD EASILY SPRAY ON A COLOR TO MATCH THEIR BUS INTERIORS. HOWEVER, THERE IS SOME DISADVANTAGE IN SUCH A TREATMENT BECAUSE OF THE IMPRESSION THAT THE ITEM IS NOT A FINISHED ARTICLE.

THERE ARE TWO REQUIREMENTS WHICH THE FINISH SHOULD HELP TO FULFILL. THE CASE CONTOURS ARE SIMPLE IN ORDER TO REDUCE DISTURBING, BOTHERSOME HI-LIGHTS AND REFLECTIONS AND THE SURFACE COATING SHOULD ASSIST TOWARD THIS DESIRED EFFECT. ALSO, THE "SHADOW BOX" FRONT SHOULD BE A DARK COLOR TO FRAME EFFECTIVELY THE LIGHTED YELLOW BACKGROUND OF THE CURTAIN. TO GET THESE RESULTS, IT IS SUGGESTED THAT A WARM GREY LACQUER IN A SEMI-MAT FINISH WOULD SUFFICE AND ALSO HARMONIZE WITH MOST BUS INTERIORS. FIGURE 15 IS A COLOR SAMPLE AS DONE ON THE VSI MODEL.

TO PREVENT THE FEELING OF A DARK, HEAVY OBJECT IN THE PROMINENT POSITION WHICH THE VSI WILL OCCUPY, ONLY THE FRAME IN THE FRONT WILL BE THE DARK COLOR. THE REMAINDER, WHICH IS NOT SO VISIBLE AND COMPRISES THE GREATER PART OF THE EXTERIOR SURFACE WILL BE WHITE TO BLEND THE VSI IN WITH THE COLOR OF THE MAJORITY OF BUS CEILINGS.

REFERENCE SECTION

(1) BUS MARKET AND SUPPLY

MR. F. W. MCDONALD, LOCAL REFRESENTATIVE FOR GENERAL MOTORS, IN CHARGE OF THEIR BUS AND COACH DIVISION. WITH GENERAL MOTORS SALES SINCE 1914, IN BUS DIVISION SINCE ITS ORGANIZATION IN 1925.

DURING THE OPERATING YEAR OF 1948 THERE WERE APPROXIMATELY 15,000 CITY BUSES SOLD. OF THAT NUMBER, GENERAL MOTORS SUPPLIED ABOUT 40% OR 6,000. THE OTHER MAJOR SUPPLIERS IN THEIR PROBABLE ORDER OF IMPORTANCE IN THE SUPPLY PICTURE ARE MACK MFG. CO., WHITE MOTOR CO., TWIN COACH CO., AND ACF-BRILL MOTORS. DURING THE WAR WHEN MANY OF THESE COMPANIES WERE CONVERTED TO WAR PRODUCTION, FORD MOTOR COMPANY SUPPLIED A MAJOR PART OF THE TRANSIT COMPANIES REQUIREMENTS. HOWEVER, AT THE PRESENT TIME FORD DOES NOT RANK AMONG THE TOP LISTING.

LAST YEAR MARKED A PEAK IN SALES BUT THE FUTURE TREND IS UNCERTAIN AND SOME REDUCTION IS ESTIMATED IN 1949. PRODUCTION AND SALES IN THE CURRENT YEAR WILL PROBABLY BE IN THE RANGE FROM 12,000 TO 14,000 UNITS. IT MUST BE NOTED THAT THE TREND TOWARD TRANSPORTATION ON RUBBER WILL, IN ADDITION TO NEW SALES, CONTINE TO AFFORD A LARGE REPLACEMENT MARKET. LAST YEAR BUSES COVERED 1,855,700,000 MILES IN THE NATION. A BUS IS GOOD FOR BETWEEN 500,000 AND 1,500,000 MILES, DEPENDING ON THE CONDITIONS OF SERVICE. AN INTERESTING NOTE IS THE COST OF THESE UNITS. THE VERY POPULAR 45 PASSENGER BUS LISTS FOR ABOUT $20,000. THIS WOULD INDICATE A MARGIN FOR SMALL ADDITIONAL EXPENDITURES IN ACCESSORIES WHICH WILL IMPROVE THEIR FUNCTION AND SERVICE.

(2) PRODUCTION PRACTICES AND MERCHANDISING

MR. F. W. MCDONALD, OP. CIT.

AT PRESENT, GENERAL MOTORS PURCHASES ABOUT TEN PERCENT OF THE VALUE OF A DELIVERED BUS

FROM OUTSIDE SOURCES OF SUPPLY. THE SMALLER COMPANIES RUN THIS FIGURE NEAR THE TWENTY PERCENT MARK. SEVERAL YEARS AGO THERE WAS A TREND TOWARD BUYING "STRIPPED" BUSES. THIS MEANT THE VEHICLE WAS DELIVERED IN VARIOUS STAGES OF COMPLETION AND THE MINOR ACCESSORIES WERE THEN INSTALLED BY THE TRANSIT COMPANY. THE PRACTICE HAS DISAPPEARED FOR TWO REASONS. FIRST IT WAS DECIDED THAT THE MANUFACTURERS COULD MAKE THE INSTALLATIONS MORE ECONOMICALLY, AND SECOND, MANY OF THE ADDED ACCESSORIES WERE POORLY CHOSEN AND DID NOT BRING IN A PROPORTIONATE INCREASE IN REVENUE. THE ACCESSORIES MANUFACTURERS NOW FIND THEIR MAJOR MARKETS WITH THE VEHICLE BUILDERS AND HAVE ADDITIONAL OUTLETS TO TRANSIT COMPANIES WHICH USE THEIR PRODUCTS FOR REPAIR, REPLACEMENT AND SERVICING.

THE MAJOR SUPPLIERS OF BUS PARTS EITHER HAVE A NATIONAL COVERAGE BY ABOUT 25 OR 30 REPRESENTATIVES AS DOES GENERAL MOTORS, OR THEY DO BUSINESS FROM A CENTRAL OFFICE. THE PICTURE IS MUCH THE SAME WITH THE SUPPLIERS OF ACCESSORIES. SOME OF THE LARGER COMPANIES DO NOT FEEL IT NECESSARY TO ASSIGN JOBBERS OR REPRESENTATIVES WHILE OTHERS DO. ADVERTISING IS HANDLED THROUGH THE RELATIVELY FEW TRANSIT PUBLICATIONS SUCH AS "BUS TRANSPORTATION" AND THE SECTION OF THE "MASS TRANSPORTATION DIRECTORY" WHICH IS USED AS A BUYERS GUIDE. IT IS THROUGH SUCH TRADE PUBLICATIONS AND BY PERSONAL CONTACT THROUGH JOBBER'S SALESMEN OR FACTORY REPRESENTATIVES THAT THEIR BUSINESS IS DONE. BECAUSE THE NATION IS SO THINLY COVERED, IT IS POSSIBLE AND USUAL THAT A PERSONAL CALL MAY NOT OCCUR MORE THAN TWO TIMES EACH YEAR. THESE MEN OFTEN ACT AS ADJUSTERS IN THE CASE OF COMPLAINTS AND ALSO PASS VALUABLE INFORMATION TO THE FACTORY BASED ON EXPERIENCE GAINED IN THE FIELD.

(3) BUS SPECIFICATIONS

MR. F. W. MCDONALD, OP. CIT.

GENERAL MOTORS AND THE OTHER MANUFACTURERS ARE MAKING BODIES AS LONG AS THE LAW WILL PRESENTLY ALLOW. THE 45 PASSENGER BUS MOST COMMONLY USED IS 34½ FEET IN OVERALL LENGTH. THE SHORTER VERSION, CARRYING 36 PASSENGERS IS 30 FEET FOUR INCHES. THERE IS A NEW 55 PASSENGER BUS WHICH MAY BE RELEASED SOON BUT IT CAN ONLY BE OPERATED OUT OF CITIES BECAUSE OF ITS EXCESSIVE LENGTH. NO SPECIFICATIONS ARE AVAILABLE FOR THIS MODEL NOW.

(4) ELECTRIC RELAY, MOTOR CONTROL

MR. D. LEROY, SALES ENGINEER, ADVANCE RELAY COMPANY, 1260 W. 2ND STREET, LOS ANGELES, CALIFORNIA

RELAY REQUIREMENTS:

12 VOLT CONTROL AND POWER CIRCUITS
40 WATTS IN POWER CIRCUIT
DOUBLE POLE, SINGLE THROW
VIBRATION PROOF
IMPULSE ACTION IN SOLONOID CONTROLS

THE REQUIRED UNIT COULD BE MADE BY MODIFYING A 605-B RELAY. THE ACTION WOULD BE DOUBLE POLE, SINGLE THROW AND LATCHING, WHICH WILL PREVENT CHATTER DUE TO VIBRATION OF THE UNIT.

THE CONTROL SOLONOIDS WOULD BE MADE TO GUARD AGAINST PASSAGE OF POWER THROUGH THEM AFTER THE INITIAL IMPULSE HAD ACCOMPLISHED THE DESIRED CHANGE.

SHOULD INTERRUPTING THE CURRENT FLOW THROUGH THE CONTROL CIRCUITS CAUSE UNDUE ARCING AT THE POINTS, A SERIES OF CONDENSORS ARE AVAILABLE WHICH WILL REDUCE THIS TO A MINIMUM. EXPERIMENT WILL SHOW WHICH IS BEST FOR THE PARTICULAR APPLICATION IN THE VSI.

(5) ELECTRIC MOTOR AND EQUIPMENT

MR. R. MUESSDORFFER, MANUFACTURER'S REPRESENTATIVE, ELECTRIC MOTOR CORPORATION, RACINE, WISCONSIN. OFFICE, LOS ANGELES, CALIFORNIA.

MOTOR REQUIREMENTS:

POWER OUTPUT APPROXIMATELY 15 RPM.
LOAD, FROM MODEL - 5"# STARTING TORQUE
REVERSIBLE
HIGH SPEED RATIO OF 5:1

THE MOTOR REQUIREMENTS ARE QUITE EASILY ATTAINED WITH THE "EMC" MODEL 11-A WHICH WOULD MORE THAN FILL THE NEED. BECAUSE THE MOTOR DESIGN IS FLEXIBLE AND A GOVERNOR WHICH IS TO BE INCORPORATED IS ADJUSTABLE, THE DESIGN CRITERIA NEED ONLY BE APPROXIMATE.

THE MODEL 11-A IS A 12 VOLT, SERIES WOUND MOTOR WITH A SPLIT FIELD. THE LOW SPEED DESIRED WOULD BE ACHIEVED BY GEAR REDUCTION AND A GOVERNOR. THERE IS A POSSIBILITY THAT ENOUGH RESISTANCE COULD BE INSERTED IN SERIES WITH THE FIELD TO GET THE LOWER REQUIRED SPEED; HOWEVER, THIS MAY RESULT IN AN UNSTABLE RUNNING CONDITION. EXPERIMENT WOULD PROVE THIS POINT.

THE MOTOR DESIGN WOULD BE SUCH THAT THE SPEED-TORQUE CURVE WOULD INTERSECT THE LOAD CURVE AT THE PROPER POINT FOR THE REQUIRED HIGH SPEED TO RE-WIND. THIS WOULD BE SOMEWHERE AROUND 10,000 RPM OF THE MOTOR. A CONTROLLED TEST USING AN OVERSIZED MOTOR ON THE FIRST MODEL WOULD GIVE ALL THE NECESSARY INFORMATION. THE RESULTS COULD THEN BE INCORPORATED INTO A CUSTOM WINDING ON THE MODEL 11-A FRAME. A GOVERNOR IS AVAILABLE WHICH WOULD EFFICIENTLY REDUCE THE MOTOR SPEED TO A LOW LEVEL OF 2,000 RPM AND STILL MAINTAIN A STABLE RUNNING SPEED AND MOTOR CONDITION.

THE STARTING TORQUE MEASURE ON THE ROUGH MODEL WAS APPROXIMATELY 5"#, WHICH SHOULD BE VERY NEAR THAT OF THE FINISHED VSI. AT 100 RPM, THIS LOAD REPRESENTS .008 HP

WHICH, INCLUDING THE GEAR REDUCTION UNIT, WOULD LEAVE A WIDE SAFETY MARGIN IN THE 1/60TH HP OF THE 11-A.

THE MOTOR WOULD DRAW BETWEEN 34 AND 36 WATTS. THE TWO STAGE GEAR REDUCTION IS AVAILABLE WITH A CHOICE IN RANGE BETWEEN 2700:1 AND 40:1. WITH THIS WIDE FIELD OF SPEEDS PLUS THE GOVERNOR CONTROL ON THE MOTOR, IT WOULD BE FAIRLY SIMPLE TO PRODUCE THE DESIRED SHAFT SPEED.

TO INSURE CONSISTENT STOPPING TIME AND NO MOVEMENT DURING NON-OPERATING PERIODS, THERE IS AVAILABLE A SIMPLE SPRING LOADED BRAKE WHICH IS RELAY CONTROLLED AND CAN BE APPLIED ON THE SHAFT OF THE 11-A.

(6) MR. R. A. HAUER, JR., MANAGER, PASADENA CITY LINES, PASADENA, CALIFORNIA.

"BASED ON FACTS FROM A TRANSPORTATION JOURNAL, IT WAS RECENTLY CALCULATED THAT THE NUMBER OF PASSENGERS HANDLED PER VEHICLE EACH DAY IS NOW ALMOST 50% MORE THAN IT WAS 20 YEARS AGO."

(7) MASS TRANSPORTATION DIRECTORY, KENFIELD-DAVIS PUBLISHING COMPANY, CHICAGO 1949, P. 52-3.

"TRANSIT EQUIPMENT SINCE 1926...

THE PROGRESS OF CONVERSION FROM STREET RAILWAY TO MOTOR BUS IS AGAIN THE MOST STRIKING FEATURE OF THE RECORD. OVER THE 22 YEAR PERIOD WHILE THE NUMBER OF SURFACE STREET CARS WAS DECREASING FROM 62,857 TO 21,607, THE NUMBER OF MOTOR BUSES WAS INCREASING FROM 14,400 TO 56,917, A SHRINKAGE OF 66% IN THE CASE OF ONE AND AN EXPANSION OF 295% IN THE CASE OF THE OTHER. TROLLEY COACHES DO NOT GET INTO THE PICTURE UNTIL 1928, BUT BETWEEN THAT YEAR AND 1947 THEY INCREASED FROM 41 TO 4,632. THE NUMBER OF SUBWAY AND ELEVATED CARS INCREASED FROM 8,909 IN 1926 TO

11,205 IN 1938, BUT THE RAZING OF THE ELEVATED LINES IN NEW YORK REDUCED THEIR NUMBER TO 9,174 IN 1947 ONLY 265 MORE THAN IN 1926.

WITH ELECTRIC RAILWAYS RAPIDLY DISAPPEARING FROM THE LOCAL TRANSIT PICTURE IN SMALL CITIES, THE REMAINING TRACK STILL IN OPERATION IS LARGELY CONCENTRATED IN CITIES OVER 250,000 POPULATION."

(8) PUBLIC HAZARDS

LOS ANGELES MUNICIPAL CODE - ORD. NO. 77,000 AS AMMENDED TO AND INCLUDING ORD. NO. 93,150, CHAPTER 5, ARTICLE 6.

SECTION 56.18 - STREET CARS - MOTERMEN - CONVERSATION

"NO PERSON SHALL TALK UNNECESSARILY TO, OR ENGAGE IN UNNECESSARY CONVERSATION WITH ANY MOTORMAN, OR OTHER PERSON OPERATING ANY STREET RAILROAD CAR, OR INTERURBAN RAILWAY CAR, AND NO SUCH MOTORMAN SHALL TALK UNNECESSARILY TO OR ENGAGE IN UNNECESSARY CONVERSATION WITH ANY OTHER PERSON. PROVIDED, HOWEVER, THAT NOTHING CONTAINED IN THIS SECTION SHALL BE CONSTRUED TO APPLY TO THE NECESSARY CONVERSATION OF THE MOTORMAN OR OTHER PERSON OPERATING SUCH CAR WITH OTHER PERSONS EMPLOYED IN THE OPERATION THEREOF, OR IN THE OPERATION OF THE STREET RAILROAD OR INTERURBAN RAILROAD TO WHICH SUCH CAR BELONGS."

SECTION 56.19 - STREET CARS - NOTICE PROHIBITING CONVERSATION

"NO PERSON SHALL RUN OR OPERATE ANY STREET RAILROAD CAR OR INTERURBAN RAILROAD CAR ALONG ANY STREET UNLESS THERE SHALL BE DISPLAYED OR PLACED OVER THE STATION IN SUCH CAR, OCCUPIED BY THE MOTORMAN THEREOF, A SIGN TO THE EFFECT THAT CONVERSATION WITH THE MOTORMAN IS PROHIBITED BY LAW."

(9) MR. E. J. FOX, MAINTENANCE SUPERINTENDENT, PASADENA CITY LINES, PASADENA, CALIFORNIA.

"SINCE THE CLOTH "CURTAIN ROLLS" HAVE BEEN USED IN THE DESTINATION SIGNS, I CAN NOT REMEMBER HAVING TO REPLACE ONE DUE TO ROUTINE WEAR."

(10)


Based on visual angle
of one minute.
200 ft. or 61 m.
E
100 ft. or 30.5 m.
C B
70 ft. or 21.75 m.
D L F
50 ft. or 15.24 m.
P T E O
40 ft. or 12.19 m.
F Z B D E
30 ft. or 9.14 m.
O F L C T B
20 ft. or 6.10 m.
T P E O L F D Z
15 ft. or 4.75 m.
L P C T Z B D F E O
10 ft. or 3.05 m.
Z O C E F L D P B T
American Optical
No. 1937

-FIGURE 16-

APPENDIX A

VISUAL EXPERIMENTS

THE ESTABLISHMENT OF PROPER VISUAL CHARACTERISTICS FOR THE VSI WAS OF GREAT IMPORTANCE IN FULFILLING THE FUNCTION OF THE UNIT. THEREFORE, A CONCERTED EFFORT WAS MADE TO PROPERLY EVALUATE THE FACTORS EFFECTING LEGIBILITY. REFERENCE WAS MADE TO PUBLICATIONS WHICH DEAL WITH READING, VISION AND LEGIBILITY AND PEOPLE WHO SPECIALIZE IN THIS AND ASSOCIATED FIELDS WERE CONSULTED TO DETERMINE THE PROPER APPROACH FOR EXPERIMENT.*

AS A RESULT OF THIS INITIAL RESEARCH, THE FOLLOWING POINTS WERE ESTABLISHED AS PERTINENT FOR CONSIDERATION: (1), LETTER HEIGHT (2), TYPEFACE (3), COLOR (4), ILLUMINATION. THESE WERE DETERMINED AS THE ESSENTIAL FACTORS EFFECTING LEGIBILITY.

TO PREFACE THIS SECTION ON VISUAL EXPERIMENT, THE FOLLOWING EXCERPTS ARE INSERTED AS AN EFFECTIVE SUMMARY INDICATING THE DIRECTION OF ENDEAVOR.

> "LEGIBILITY MAY BE SAID, GENERALLY TO DEPEND ON THREE ABSTRACT QUALITIES: SIMPLICITY, HAVING ONLY ESSENTIAL PARTS; DISTINCTION, HAVING MARKED CHARACTERISTICS;

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* A LIST OF PERSONS INTERVIEWED APPEARS AT THE END OF THIS APPENDIX, P. 63.

PROPORTION, EACH PART HAVING ITS PROPER VALUE. THE DESIGN OF PRINTED LETTERS, THEREFORE SHOULD BE OF A FORM THAT IS FAMILIAR, SHAPED ACCORDING TO THE PROPORTIONS WHICH ARE NOW ACCEPTED AS TRADITIONAL."*

"WITH REGARD TO THE COLOR OF INK ON PAPER, THE FOLLOWING HAS BEEN GIVEN AS AN ORDER OF LEGIBILITY: BLACK ON YELLOW, GREEN ON WHITE, RED ON WHITE, BLUE ON WHITE, WHITE ON BLUE, BLACK ON WHITE, YELLOW ON BLACK, WHITE ON RED, WHITE ON GREEN, WHITE ON BLACK AND RED ON YELLOW."**

IT IS REALIZED THAT EXPERIMENTAL RESULTS BASED ON PERSONAL ABILITIES AND OPINION REQUIRE AN EXTREMELY LARGE NUMBER OF TEST CASES FOR SUBSTANTIATION. BECAUSE THE SCOPE HERE IS LIMITED, THE CONCLUSIONS REACHED IN THIS ANALYSIS MAY NOT BE THE ULTIMATE. HOWEVER, THERE WAS AGREEMENT ON THE PART OF THOSE CONSULTED AND TESTED THAT THE RESULTS WERE USEFUL AND ADEQUATE.

AS AN INITIAL POINT FOR EXPERIMENT, THE LETTER SIZE WAS DETERMINED FROM THE "SNELLEN" EYE CHART WHICH IS CONSIDERED AS A STANDARD IN THE OPTICAL FIELD. AS SUGGESTED BY DR. JOHNSON AND SUBSTANTIATED BY OTHER SPECIALISTS, VISION OF 20/70 WAS CONSIDERED

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* J. C. TARR, HOW TO PLAN PRINT, (LONDON 1946), PP. 3 - 4.

** BEN SHERBOW, EFFECTIVE TYPE - USE FOR ADVERTISING, (NEW YORK 1922), PP. 16 - 17.

A FAIR POINT AT WHICH TO ESTABLISH THE SIGHT LEVEL NECESSARY FOR SAFE AMBULATION. THE LETTER HEIGHT WHICH CORRESPONDS TO THIS VISUAL LEVEL WAS TAKEN FROM THE CHART AS APPROXIMATELY 1.1 INCH. HOWEVER, THE READING DISTANCE INVOLVED IN THIS TEST IS 20 FEET AND THE REQUIREMENT FOR THE VSI IS 30 FEET. SINCE THE SIZE IS DIRECTLY PROPORTIONAL TO THE VIEWING DISTANCE, THE CORRECTION FOR AN EXTRA 10 FEET MAKES THE LETTER HEIGHT FOR INITIAL TESTS 1.65 INCHES. (1.1 x 30/20)

THIS LETTER HEIGHT COULD BE USED IN THE FINAL SOLUTION; HOWEVER, THERE IS REASON TO ATTEMPT SOME REDUCTION IN SIZE. THE OVERALL DIMENSIONS OF THE VSI ARE DEPENDENT ON THE ROLL SIZE AND THE WINDOW OPENING, BOTH OF WHICH ARE DETERMINED BY THE LETTER HEIGHT. ANY REDUCTION WHICH COULD BE ACCOMPLISHED WITHOUT DETRIMENT TO THE FUNCTION WOULD BE A DEFINITE ADVANTAGE.

THERE WAS SOME INDICATION THAT THE VISUAL LEVEL OF 20/70 ESTABLISHED BY THE CHARTS COULD BE DUPLICATED WITH SMALLER LETTERS WHEN APPLIED TO NORMAL READING. THIS LEVEL INCLUDED A MARGIN OF SAFETY

WHICH COULD BE UTILIZED TO SECURE SOME DESIRED REDUCTION IN THE LETTER SIZE FOR THE APPLICATION IN THE VSI. THE FOLLOWING PARAGRAPHS DISCUSS THE VARIOUS FACTORS WHICH HAVE A BEARING ON THIS POINT.

THE OPTICAL TESTING CHARTS ARE MADE TO ACCURATELY MEASURE A PERSON'S VISION. THEY DO NOT ACTUALLY INDICATE ABILITY TO READ STANDARD TYPES OF THE SAME SIZE AT THE SAME DISTANCE. TO INSURE THAT THE TEST BE MORE ACCURATE, THE LETTER SHAPES ARE VARIED FROM COMMON TYPES AND THEIR ORDER IS SUCH THAT NO WORD IS FORMED. THIS IS DONE TO ASCERTAIN THAT THE PERSON BEING TESTED IS ACTUALLY SEEING EACH LETTER, RATHER THAN GRASPING A USUAL ARRANGEMENT OR MEANING AS IS DONE IN NORMAL READING.

AN ADDITIONAL AID TO LEGIBILITY WHICH IS NOT INCORPORATED IN THE TEST CHARTS IS THE MORE IDEAL COLOR SUGGESTED BY EVERY PERSON INTERVIEWED AND INDICATED IN REFERENCE MATERIAL. THE SPECIAL EFFECT OF YELLOW ON THE EYE IS NOT A NEW DISCOVERY, AS EVIDENCED BY THE FOLLOWING, PUBLISHED IN 1925.

> "THE EYE IS NOT EQUALLY SENSITIVE TO ALL COLORS. A YELLOW-GREEN LIGHT OF THE SAME

INTENSITY PROVIDES MORE LIGHTING EFFECT UPON THE EYE THAN DOES A RED OR VIOLET LIGHT."**

ALTHOUGH WHITE REFLECTS APPROXIMATELY 90% OF THE LIGHT INCIDENT UPON IT AND THE YELLOW SPECTRUM BAND REFLECTS ONLY 75%, THE YELLOW AND BLACK COMBINATION SEEMED TO HAVE A GREAT ADVANTAGE.** MR. FREEMAN, AN ART DIRECTOR, SAID THE FINDINGS IN THE FIELD OF ADVERTISING WERE DEFINITE ON THIS POINT. "WHEN CONTRASTED WITH BLACK, THE YELLOW GIVES THE MAXIMUM DISTINCTION WITH THE MINIMUM DISTURBANCE." ✓

IN AN ATTEMPT TO FURTHER IMPROVE LEGIBILITY OVER THAT OF THE TEST CHARTS, A VERY SIMPLE AND PLAIN TYPEFACE WAS SUGGESTED BY THOSE QUESTIONED. THE DISTORTED TYPES USED ON THE CHART ARE QUITE CONFUSING. THIS IS LARGELY BECAUSE OF PROMINENT SERIFS AND UNBALANCED FORMS. (NOTE THE "E" AND "8", "F" AND "P", "O" AND "C", PAGE 53)

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* C. A. ATHERTON, ELECTRICAL ADVERTISING. (GENERAL ELECTRIC 1925), P. 128.

** REFLECTION PERCENTAGES, FUNCTION OF COLOR ON WALLS, SHERWIN WILLIAMS PAINT COMPANY.

✓ ROBERT FREEMAN, FOOTE, CONE AND BELDING, LOS ANGELES, CALIFORNIA

THE TYPES SUGGESTED FOR MAXIMUM LEGIBILITY WERE THOSE WITHOUT SERIF AND CLOSE TO THE "GOTHIC" FAMILY. THE TYPEFACES CHECKED FOR POSSIBLE USE IN THE VSI WERE NEWS GOTHIC, FUTURA, COPPERPLATE GOTHIC, HEADLINE GOTHIC, SANS SERIF (KABEL), ALTERNATE GOTHIC AND THE FINAL CHOICE, FRANKLIN GOTHIC. ALTHOUGH THERE IS LITTLE DIFFERENCE IN ALL THE VERY PLAIN, SIMPLE FORMS LISTED, THERE PROVED TO BE A SLIGHT ADVANTAGE FOR FRANKLIN GOTHIC IN THIS APPLICATION BECAUSE OF WEIGHT AND SOME MINOR REFINEMENTS IN FORM. THE CHARACTERS WERE HEAVY ENOUGH TO MAKE A VERY DISTINCT VISUAL IMPRESSION, YET THE CENTERS OF CIRCULAR LETTERS DID NOT CLOSE UP. FRANKLIN GOTHIC WAS ESPECIALLY GOOD WHEN "BACK LIGHTED", A SUBJECT DISCUSSED ON PAGE 59 OF THIS SECTION.

TO PROVE THAT THE FACTORS JUST COVERED: USE OF A STANDARD TYPEFACE, LETTER ARRANGEMENT WHICH FORMED A WORD, AND BETTER COLOR CONTRASTS, DO HAVE A FAVORABLE EFFECT ON THE OPTICAL TEST, THE FOLLOWING EXPERIMENT WAS CONDUCTED. FIFTEEN PEOPLE WERE CHECKED ON A STANDARD EYE CHART.* EACH PERSON

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* AMERICAN OPTICAL COMPANY, TEST CHART # 1937.

ESTABLISHED THEIR VISUAL LEVEL AS DETERMINED BY THE SMALLEST ROW OF LETTERS ON THE CHART WHICH COULD BE RECOGNIZED WITH ONE EYE. AFTER THIS LEVEL WAS ESTABLISHED, A TEST WAS MADE USING A WELL KNOWN WORD PRINTED IN GOTHIC OF A SMALLER SIZE THAN THAT WHICH CORRESPONDED TO THEIR RATING. IN EVERY CASE, THE PERSON WAS ABLE TO READ THE WORD WITH LESS EFFORT THAN THE INDIVIDUAL TEST LETTERS. WHEN USING BOTH EYES AND A COLOR COMBINATION OF BLACK ON YELLOW, A WORD OF STILL SMALLER TYPE WAS RECOGNIZED. THIS PROPORTIONATE DECREASE IN SIZE RESULTING FROM THE ADVANTAGES DISCUSSED WAS AVERAGED AT APPROXIMATELY 25%. THE EFFECT INDICATED THAT LETTERS OF A SMALLER SIZE THAN 1.65 COULD BE USED IN THE VSI WITHOUT REDUCING THE LEGIBILITY. THE FINAL CHOICE WAS MADE ON THE BASIS OF THIS EXPERIMENT AND THE LETTER HEIGHT WAS SET AT 1.25 INCHES. (1.65 x 75%)

HAVING ESTABLISHED THE OTHER FACTORS, THERE WAS THE LAST ITEM REGARDING ILLUMINATION WHICH HAD TO BE SOLVED. THERE WAS SOME QUESTION OF THE COMPARATIVE ADVANTAGES BETWEEN LIGHTING AN OPAQUE PRINTED SURFACE FROM THE FRONT AND "BACK LIGHTING" A TRANSLUCENT SCREEN. THE SOURCES QUESTIONED ON THIS

POINT WERE NOT COMPLETELY IN ACCORD ALTHOUGH THERE WAS A SMALL MAJORITY IN FAVOR OF TRANSMITTED LIGHT OVER REFLECTED LIGHT. THE EXPERIMENT MADE TO DETERMINE THIS FACTOR DID NOT PROVE CONCLUSIVE BECAUSE ADEQUATE ILLUMINATION COULD BE SECURED BY EITHER METHOD. STRIPS WERE LETTERED ON CARDBOARD AND TRACING CLOTH, USING THE SAME WORD, ALPHABET SIZE AND COLOR COMBINATION. THE ONLY RESULT DRAWN FROM THESE EXPERIMENTS WAS THAT BLACK ON YELLOW SEEMED A BETTER COLOR ARRANGEMENT THAN YELLOW ON BLACK. HOWEVER, SINCE IT WAS A DESIGN ADVANTAGE TO MAKE THE UNIT COMPLETELY SELF-CONTAINED BY LIGHTING FROM THE INSIDE, IT WAS DECIDED TO USE "BACK LIGHTING".

TO DETERMINE THE PROPER LEVEL OF ILLUMINATION FOR THE CURTAIN, A "ROUGH" VSI WAS MADE FROM A BIX. A SAMPLE LETTERED STRIP WAS PLACED IN AN OPENING IN ONE FACE AND VARIOUS LIGHTING ARRANGEMENTS FOR 12 VOLT OPERATION WERE TRIED INSIDE. A SINGLE SOURCE OF 25 CANDLE POWER WAS USED FIRST. THIS WAS FOUND UNSATISFACTORY BECAUSE OF INTENSE HEAT AND LIGHT CONCENTRATION. THE NEXT ATTEMPTS WERE VARIOUS COMBINATIONS OF SMALLER BULBS. FOR THESE TESTS, THREE AND SEVEN CANDLE POWER LIGHTS WERE

USED. A SATISFACTORY SOLUTION WAS THREE OF THE 6 - 12 VOLT, THREE CANDLE POWER #68 MAZDA LAMPS SPACED ACROSS THE CURTAIN ABOUT 5 INCHES BEHIND IT. THESE SMALL LIGHTS GAVE ADEQUATE DISPERSION AND OFFERED ABSOLUTELY NO PROBLEM OF HEAT DISSIPATION. AFTER CONTINUED USE THEY WERE NOT TOO HOT TO TOUCH NOR DID THEY SEEM TO HAVE ANY DETRIMENTAL EFFECT ON THE "CURTAIN" MATERIAL.

SUMMARY

IN CONCLUSION, THE FOLLOWING RESULTS WERE DETERMINED REGARDING THE FACTORS CONSIDERED PERTINENT TO LEGIBILITY:

LETTER HEIGHT - 1.25 INCHES

ALPHABET - - - FRANKLIN GOTHIC, STANDARD WEIGHT AND SPACING WHEREVER POSSIBLE

COLOR - - - - BLACK LETTERS ON YELLOW BACKGROUND

ILLUMINATION - "BACK LIGHTED" TRANSLUCENT CURTAIN

APPENDIX A

REFERENCE LIST

HENRIETTA JOHNSON, M.D., PRACTICING OPHTHALMOLOGIST SEVENTEEN YEARS, PASADENA, CALIFORNIA

L. L. HENRY, M.D., OPHTHALMOLOGIST AND EYE PHYSICIAN, PASADENA, CALIFORNIA

DAVID W. QUINT, M.D., OPTOMETRIST, LOS ANGELES, CALIFORNIA

ROBERT FREEMAN, ART DIRECTOR, FOOTE, CONE AND BELDING ADVERTISING AGENCY, LOS ANGELES, CALIFORNIA

WARD RICHEY, MANAGER, PRODUCTION DEPARTMENT, FOOTE, CONE AND BELDING ADVERTISING AGENCY, LOS ANGELES, CALIFORNIA

JOHN BRENNAN, ADVERTISING CONSULTANT, AUTHOR, "HOW TO DESIGN POSTERS", ADVERTISING AND SELLING, (FEBRUARY 1947), RESEDA, CALIFORNIA

BOB KILKELLY, SALES MANAGER, FOSTER AND KLIESER OUTDOOR ADVERTISING COMPANY, LOS ANGELES, CALIFORNIA

DALT BISHOP, SALES MANAGER, PACIFIC OUTDOOR ADVERTISING COMPANY, LOS ANGELES, CALIFORNIA

MAYNARD BOYCE, BOYCE CAR CARD ADVERTISING COMPANY, LOS ANGELES, CALIFORNIA

JENS P. H. JENSON, DIRECTOR OF VISUAL RESEARCH, KEYSTONE VIEW COMPANY, MEADVILLE, PENNSYLVANIA, AIR MAIL LETTER: APRIL 11, 1949

F. BRASLOW, BETTER VISION INSTITUTE, INCORPORATED, NEW YORK, NEW YORK
LETTER AND CHARTS: APRIL 15, 1949

D. ROBERTSON, SALES MANAGER OPHTHALMIC EQUIPMENT, AMERICAN OPTICAL COMPANY, LOS ANGELES, CALIFORNIA

APPENDIX B

MARKET SURVEY AND QUESTIONNAIRE

AN INTRODUCTORY LETTER AND SURVEY QUESTIONNAIRE WERE SENT OUT BY THE AUTHOR IN AN ATTEMPT TO ESTABLISH SOME LEVEL OF INTERST IN THIS PROJECT AND TO GET A MORE CLEAR PICTURE OF THE PROBLEMS INVOLVED. ADDRESS WERE TAKEN FROM THE "MASS TRANSPORTATION DIRECTORY, A COMPILATION OF TRANSIT COMPANIES THROUGHOUT THE NATION. AN ATTEMPT WAS MADE TO SPREAD THE SURVEY OVER A FAIRLY REPRESENTATIVE AREA. TO INSURE A FAIR CROSS-SECTION, TRANSIT LINES WERE CONTACTED OPERATING AS LOW AS 50 VEHICLES, AND NEW YORK WAS CHOSEN AS THE ULTIMATE ON THE HIGH SIDE.

THE WRITER SUPPLEMENTED THIS SURVEY WITH MANY VISITS TO TRANSIT LINES OPERATING IN THIS AREA. THERE WERE PERSONAL DISCUSSIONS WITH MANAGERS, TRAFFIC MEN AND MAINTENANCE FOREMEN IN SEVERAL OFFICES. "FIELD WORK" WAS ALSO DONE ON BUSES IN OPERATION ON REGULAR SCHEDULES. A GREAT DEAL OF INFORMATION WAS OBTAINED WHILE TALKING WITH THE OPERATORS AS THEY DROVE. THE INCIDENTS WHICH THE VSI SHOULD HELP TO ELIMINATE WERE CONSTANTLY ARISING. THIS INFORMATION WAS HELPFUL IN COMPLETING

THE DESIGN REQUIREMENTS AND IN INTERPRETING THE RESULTS OF THE QUESTIONNAIRES.

SINCE THERE WAS NO APPARENT CORRELATION BETWEEN THE SIZE OR LOCATION OF THE COMPANY AND THEIR REPLIES, NO ATTEMPT WAS MADE TO DISTINGUISH INDIVIDUAL RESULTS. ALTHOUGH ALL REQUESTS WERE ADDRESSED TO PRESIDENTS OF THE VARIOUS COMPANIES, RETURNS WERE RECEIVED FROM SECRETARIES, GENERAL MANAGERS, TRAFFIC MANAGERS, MAINTENANCE, SUPERINTENDENTS AND PURCHASING AGENTS. THE 67 FORMS WHICH WERE RETURNED WERE AVERAGED AND TABULATED IN THE SAMPLE FORM WHICH FOLLOWS. IN ADDITION, THERE IS A SUMMARY OF PERTINENT COMMENTS WHICH ACCOMPANIED VARIOUS ANSWERS TO THE QUESTIONNAIRE AND IN THESE THERE HAS BEEN MADE MENTION OF THEIR SOURCE. THESE REPLIES REPRESENT A 74% USEFUL RETURN WHICH IS AN EXCEPTIONALLY HIGH FIGURE.

APPENDIX B

CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA
4

7 FEBRUARY 1949

NAME OF PRESIDENT
TRANSIT LINE
ADDRESS

DEAR MR . . . :

MY PURPOSE IN WRITING IS TO REQUEST INFORMATION OF ASSISTANCE IN THE DESIGN OF A UNIT SIMILAR TO THE SKETCH ENCLOSED. I AM AT PRESENT COMPLETING THE REQUIREMENTS FOR A DEGREE IN THE GRADUATE SCHOOL OF INDUSTRIAL DESIGN AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY AND THE PROJECT I HAVE CHOSEN FOR MY THESIS WORK IS ASSOCIATED WITH VARIOUS MEANS OF PUBLIC TRANSPORTATION, SOME OF WHICH ARE UTILIZED IN YOUR CITY.

THUS FAR, IN THE LIGHT OF MY INVESTIGATION WITH THE TRANSPORTATION COMPANIES IN THE LOS ANGELES AREA, I HAVE BEEN ABLE TO FORMULATE THE BASIS FOR DESIGN OF A UNIT WHICH WILL VISUALLY NOTIFY PASSENGERS OF THE NEXT STOP TO BE MADE. IN MY OPINION, SUCH AN INSTALLATION WOULD BE AN AID TO TRAVELERS WHERE NO OPERATOR IS AVAILABLE TO ANSWER QUESTIONS AND IT WOULD RELIEVE DRIVERS, WHERE THEY ARE ACCESSIBLE, OF MUCH OF THEIR EFFORT AND DISTRACTION. THE PRESENT APPROACH WOULD INCLUDE MAPS IN A "PICK UP" DISPENSER WHICH WOULD GRAPHICALLY ILLUSTRATE THE ROUTE AND STOPS MADE BY THAT PARTICULAR VEHICLE. CONSIDERATION IS BEING GIVEN TO THE PLAN OF HAVING GENERAL "NETWORK" MAPS ON ONE SIDE OF THE SHEETS AND INDIVIDUAL "ROUTE" MAPS ON THE REVERSE SIDE. WITH THE UNIT AND THE MAPS, PASSENGERS COULD ANSWER MOST OF THEIR TRAVEL QUESTIONS FOR THEMSELVES.

THE GENERAL DESCRIPTION AND OPERATION OF THE UNIT IS SHOWN BELOW THE SKETCH ILLUSTRATION ENCLOSED.

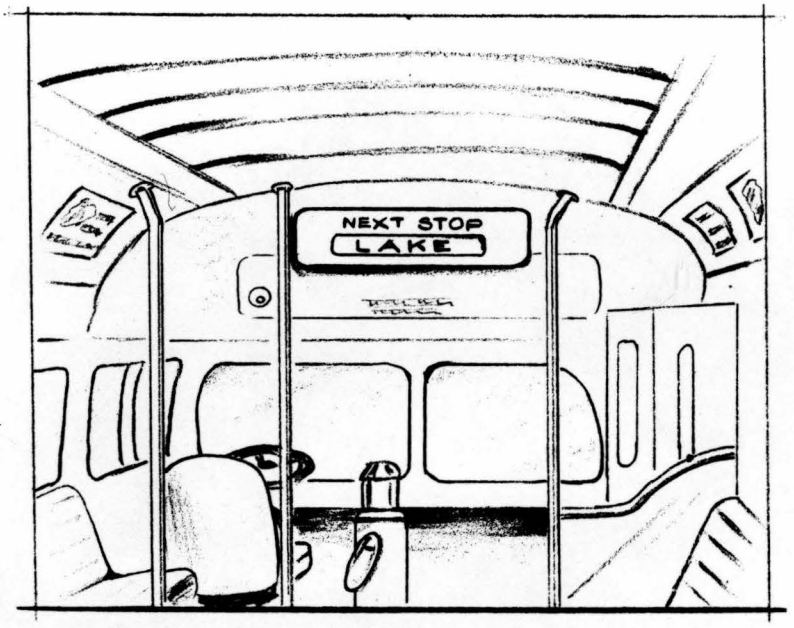
THERE ARE SEVERAL BASIC CONSIDERATIONS IN THE DESIGN AS I NOW CONTEMPLATE IT. I HAVE LISTED SEVERAL POINTS WHICH WILL EFFECT THE FINAL SOLUTION. BEARING IN MIND THAT THESE UNITS MAY BE INSTALLED IN BUSES, STREET CARS, SUBWAYS AND ELEVATED TRAINS, I WOULD GREATLY APPRECIATE YOUR OPINIONS, COMMENT, BOTH CRITICAL AND OTHERWISE, WHICH WILL BE OF VALUE IN MY THESIS RESEARCH.

I AM SURE THAT IT IS CLEAR THAT NO OBLIGATION IS INVOLVED. THE ASSIGNMENT IS PURELY ACADEMIC AND INFORMATION FROM THOSE OF YOU IN CLOSE CONTACT WITH THE PROBLEM WILL HELP TO MAKE MY SOLUTION AS PRACTICAL AS IT MIGHT POSSIBLY BE.

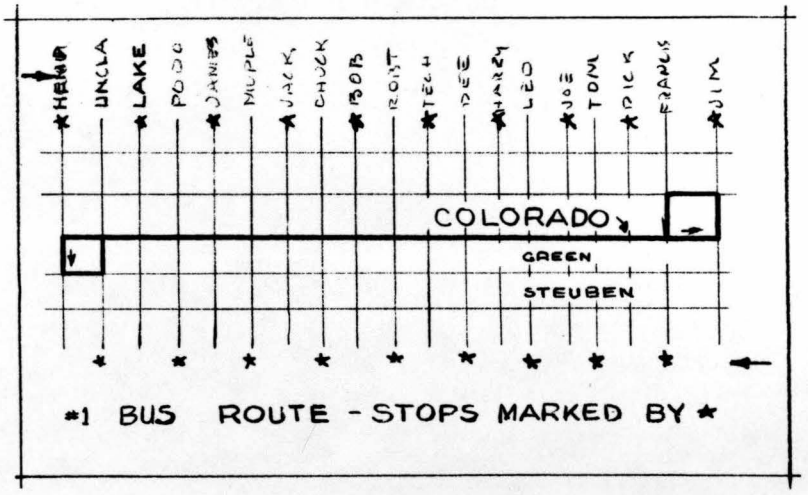
THANK YOU FOR YOUR COOPERATION AND ASSISTANCE.

SINCERELY,

LEO WOLF,
INDUSTRIAL DESIGN SECTION



QUESTIONNAIRE ILLUSTRATIONS



- FIGURE 17 -

GENERAL DESCRIPTION - A UNIT WHICH VISUALLY INDICATES THE NEXT STOP TO BE MADE.

VISUAL AID - NAME OF THE STOP IS READ DIRECTLY FROM ROLLERS OF PAPER OR CLOTH. THE ROLL CAN BE EASILY REMOVED AND CHANGED ALLOWING FOR VEHICLES WHICH DO NOT TRAVEL IDENTICAL ROUTES EVERY DAY.

CONTROL - MANUAL OPERATION BY A BUTTON ON OR NEAR THE DOOR CONTROL HANDLE. POSSIBLY AUTOMATIC CONTROL FROM TRACK OR TROLLEY ON FIXED TRAVEL VEHICLES SUCH AS STREET CARS, SUBWAYS OR ELEVATED TRAINS.

POWER - PROBABLY ELECTRIC, POSSIBLY AIR.

DESCRIPTION - PROBABLY DRAWN METAL CASE ABOUT 10 INCHES HIGH, 36 INCHES LONG AND 8 INCHES DEEP. MOUNTING CAN BE ADAPTED FOR DIFFERENT INSTALLATIONS.

QUESTIONS (NOTE: SUMMARY OF COMMENTS WHICH FOLLOW THIS SECTION IS KEYED TO THESE QUESTIONS)

1. WHAT IS YOUR ESTIMATE OF THE PERCENT OF PASSENGERS TRAVELING UNFAMILIAR ROUTES?	AVG	16%
2. DO OPERATORS AND EMPLOYEES HAVE TIME TO ANSWER TRAVEL QUESTIONS SATISFACTORILY UNDER NORMAL TRAFFIC CONDITIONS?	YES	46*
	NO	12
UNDER RUSH HOUR CONDITIONS?	NO	53
	YES	9
3. IS PASSENGER QUESTIONING CONSIDERED AN APPRECIABLE SOURCE OF DISTURBANCE AND DISTRACTION TO OPERATORS?	YES	39
	NO	23
4. HAVE YOU TRIED PLACING "NETWORK" OR "ROUTE" MAPS ON VEHICLES?	YES	18
	NO	29
DID YOU FIND IT HELPFUL?	YES	15
	NO	3

* WHERE TOTALS DO NOT ADD TO 67, SOME QUESTIONNAIRES HAD NO COMMENT ON THAT PARTICULAR POINT.

5. WOULD THE COMBINATION OF MAPS AND A UNIT SIMILAR TO THE SKETCH ABOVE ANSWER MANY OF THE PASSENGERS' TRAVEL QUESTIONS?	YES 32 MAYBE 19 NO 8
6. IN YOUR OPINION, BASED ON EXPERIENCE WITH OTHER ACCESSORIES, WOULD ELECTRICITY BE A BETTER POWER SOURCE THAN AIR FOR A UNIT SUCH AS THIS?	YES 53
7. WHAT IS THE MAXIMUM NUMBER OF STOPS WHICH WOULD HAVE TO BE LISTED ON A ROLL IN SUCH A UNIT?	AVG 136 MAX 170
IS SPLICING ROLLS FOR INSERTING NEW STOPS OR MAKING ROUTE CHANGES AN IMPORTANT CONSIDERATION?	YES 49 NO 8
8. WOULD DRIVERS OBJECT TO PUSHING A BUTTON ON OR NEAR THE DOOR CONTROL HANDLE WHICH WOULD CHANGE THE "NEXT STOP" OF THE VSI? (NOTE #8 IN SUMMARY BELOW)	YES 43 NO 7
9. IS INCORPORATING A TONE CHIME TO FOCUS ATTENTION ON EACH NAME CHANGE AN ESSENTIAL CONSIDERATION?	YES 21 NO 14
10. WOULD $100.00, AS A CONSERVATIVE ESTIMATE OF COST PER VEHICLE UNIT BE AN ACCEPTABLE PRICE?	YES 23 NO 8
IF NOT, WHAT WOULD YOUR ESTIMATE OF WORTH BE?	AVG $220*
11. WOULD AN ADVERTISING TIE-IN WITH LOCAL BUSINESS WHICH WOULD HELP DEFRAY THE EXPENSE OF THIS ADDITIONAL SERVICE BE A WORTH WHILE CONSIDERATION?	YES 4 NO 15

* SOME WHO ANSWERED "NO" TO THE FIRST PART OF QUESTION 10 WROTE IN FIGURES MUCH HIGHER THAN $100.00.

SUMMARY OF PERTINENT COMMENTS*

(1) AMERICAN TRANSIT ASSOCIATION, NEW YORK, NEW YORK

"THE PERCENTAGE OF PASSENGERS ON UNFAMILIAR ROUTES IS NOT CONSTANT THROUGHOUT THE DAY. DURING RUSH HOURS THE FIGURE IS SMALL DUE TO THE LARGE NUMBER OF COMMUTORS. HOWEVER, DURING THE MORNING, AFTERNOON AND EVENINGS, THE FIGURE IS FAR ABOVE THE DAILY AVERAGE."

(2) DEPARTMENT OF STREET RAILWAYS, CITY OF DETROIT, MICH.

"A PROBLEM WHICH ARISES HERE IS THE FACT THAT SOME OPERATORS HAVE TO DRIVE ON ROUTES WHICH THEY DO NOT KNOW WELL ENOUGH TO CALL OR GIVE INFORMATION ON ALL STOPS."

(3) PASADENA CITY LINES, PASADENA, CALIFORNIA

"ALTHOUGH IT IS ALMOST IMPOSSIBLE TO ASCERTAIN THAT DISTRACTION DUE TO MANY VARIED DUTIES HAS A DETRIMENTAL EFFECT ON DRIVERS, IT IS MY OPINION THAT THESE DISTRACTIONS ARE MANY TIMES PARTIALLY RESPONSIBLE FOR ACCIDENTS. THIS, HOWEVER, IS ALMOST IMPOSSIBLE TO PROVE BECAUSE ACCIDENTS OF THIS TYPE GO AGAINST THE DRIVER'S RECORD AND THEY WILL TRY TO AVOID SUCH AN ENTRY IF AT ALL POSSIBLE."

(4) INDIANAPOLIS RAILWAYS INC., INDIANAPOLIS, INDIANA

"MAPS HAVE BEEN AN EXTREMELY EFFECTIVE METHOD FOR GIVING INFORMATION TO PASSENGERS. THE PUBLIC HAS BEEN VERY APPRECIATIVE OF THIS EXTRA HELP AND SERVICE."

OMAHA AND COUNCIL BLUFFS STREET RAILWAY, OMAHA, NEB.

"MAPS ARE VERY HELPFUL. THEY PLAY A GREATER PART IN DISSEMINATING INFORMATION THAN ANY OTHER MEANS THAT WE HAVE TRIED."

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* THESE COMMENTS, WHICH REFER DIRECTLY TO THE PREVIOUS QUESTIONS, IS KEYED WITH THEIR SAME NUMBER.

(5) GEORGIA POWER COMPANY, ATLANTA, GEORGIA

"YOUR UNIT AS DESCRIBED WOULD ANSWER MANY OF THE PASSENGERS' TRAVEL QUESTIONS, HOWEVER, THERE WOULD STILL BE QUESTIONING OF DRIVERS IN SOME CASES."

(7) MILWAUKEE ELECTRIC RAILWAY AND TRANSPORT COMPANY, MILWAUKEE, WISCONSIN

"ROLLS WOULD HAVE TO BE LARGE AND CUMBERSOME IN BIG CITIES. THIS SYSTEM IS DEFINITELY MOST PRACTICAL IN SMALL AND MEDIUM SIZE OPERATIONS."

UNITED ELECTRIC RAILWAY COMPANY, PROVIDENCE, R.I.

"IF ROLLS ARE AS LARGE AS THOSE USED NOW IN THE DESTINATION SIGNS, THE UNIT WOULD HAVE TO BE QUITE LARGE AND CHANGING THEM WOULD BE A VERY DEFINITE RESISTANCE POINT. THIS METHOD OF CHANGING MUST THEN NECESSARILY BE SIMPLIFIED TO ALLOW FOR SEVERAL CHANGES WHILE THE BUS IS IN OPERATION."

(8) PORTLAND TRACTION COMPANY, PORTLAND, OREGON

"COMPLETELY AUTOMATIC TIMING OR CONTROL HAS PROVEN COSTLY AND INEFFECTIVE IN ATTEMPTS AT UNITS OF THIS TYPE."

BOARD OF TRANSPORTATION OF CITY OF NEW YORK, NEW YORK

"AUTOMATIC CONTROL FOR STOPS FROM THE TROLLEY WAS CONSIDERED HERE AND RULED OUT AS IMPRACTICAL."

DEPARTMENT OF STREET RAILWAYS, CITY OF DETROIT, MICH.

"DRIVERS WILL DEFINITELY OBJECT UNLESS IT IS PROVEN TO THEM WITHOUT A DOUBT THAT THIS ADDITIONAL DUTY WILL SIMPLIFY THEIR JOBS."

(11) OMAHA AND COUNCIL BLUFFS STREET RAILWAYS COMPANY, OMAHA, NEBRASKA

"ADVERTISING WOULD RESULT IN SOME DEFRAYMENT OF EXPENSES BUT WOULD ENTAIL AN ADDED TROUBLE WITH ADVERTISING CUSTOMERS. IT WOULD ALSO DETRACT FROM THE ORIGINAL PURPOSE OF THE UNIT."

PUBLIC SERVICE COMPANY, ST. LOUIS, MO.

"IT IS THE FEELING THAT ADVERTISING ON BUSES HAS JUST ABOUT REACHED THE SATURATION POINT. THE ULTIMATE OF EXPLOITATION IS THE LATEST ADDITION OF RADIO AND SPECIAL BROADCASTS TO THE VEHICLES."

GENERAL COMMENTS

(A) CAPITOL TRANSIT COMPANY, WASHINGTON, D.C.

"WE FEEL THAT AN EFFECTIVE WAY OF ANNOUNCING STOPS IS IMPORTANT. IT WOULD NOT ONLY AID THE PASSENGERS AND REDUCE COMPLAINTS, BUT IT ALSO AIDS THE OPERATOR IN AVOIDING DELAYS IN MOVING HIS VEHICLE. THIS WOULD SERVE TO MAKE IT MUCH EASIER TO MAINTAIN THE IMPORTANT SCHEDULES."

(B) DEPARTMENT OF STREET RAILWAYS, CITY OF DETROIT, MICH.

"A UNIT LIKE THIS WOULD HAVE CONSIDERABLE RIDER APPEAL AND MAY HAVE SOME BENEFITS IN INCREASING PATRONAGE."

(C) OMAHA AND COUNCIL BLUFFS STREET RAILWAY COMPANY, OMAHA, NEBRASKA

"THE METHOD OF CONTROL SHOULD ALLOW FOR INTERMITTENT "EXPRESS" OR "LOCAL" OPERATION."

(D) PHILADELPHIA TRANSIT COMPANY, PHILADELPHIA, PENN.

"MOUNTING IN DIFFERENT TYPES OF VEHICLES SHOULD DEFINITELY BE TAKEN INTO CONSIDERATION."

(E) TWIN CITY RAPID TRANSIT COMPANY, MINNEAPOLIS, MINN.

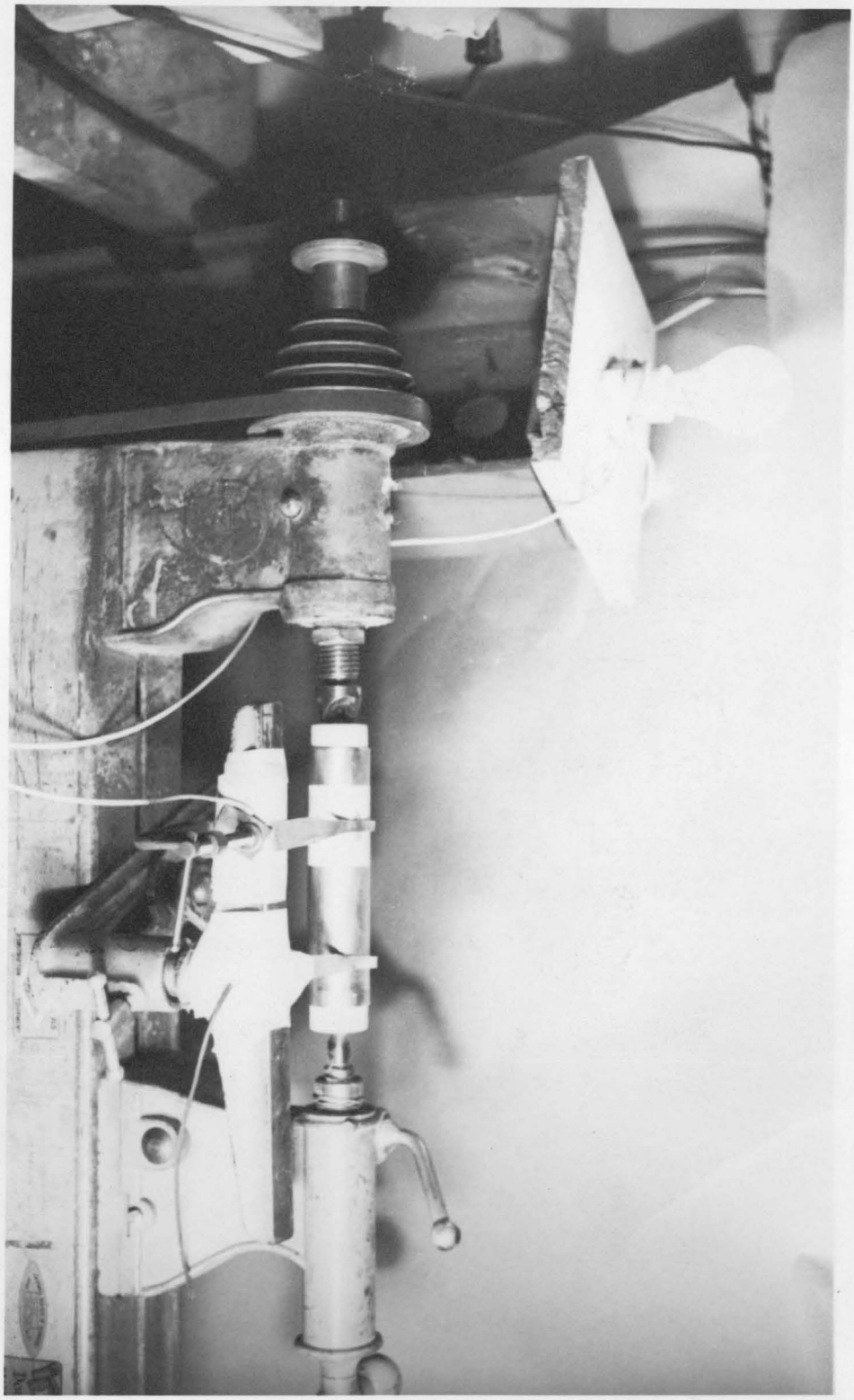
"THE ROLL MATERIAL USED IN YOUR UNIT MUST STAND UP UNDER ABUSIVE WEAR."

(F) NEW ORLEANS, PUBLIC SERVICE COMPANY, NEW ORLEANS, LA.

"A SUCCESSFUL SOLUTION, ALTHOUGH WORTHWHILE, WOULD BE MUCH TOO COSTLY."

(G) BIRMINGHAM ELECTRIC COMPANY, BIRMINGHAM, ALABAMA

"THIS IS AN IMPOSSIBLE PROBLEM."



TEST APPARATUS - CONTROL CIRCUIT AND CURTAIN LIFE

- FIGURE 18 -

APPENDIX C

CONTROL CIRCUIT AND CURTAIN LIFE TEST

FIGURE 15 IS A PICTURE OF THE TEST APPARATUS USED TO DETERMINE WHETHER THE CONTROL CIRCUIT AS DESIGNED FOR THE VSI WOULD FUNCTION PROPERLY.

THE TEST SET-UP CONSISTS OF AN ALUMINUM TUBE MOUNTED ON WOOD WITH A STRIP OF THE "CURTAIN" MATERIAL CEMENTED AROUND IT. A PERFORATION LIKE THE ONES WHICH WILL BE IN THE ACTUAL ROLL WAS MADE IN THIS STRIP. USING A SERIES CIRCUIT OF 110 VOLTS, A BRUSH WAS PLACED AGAINST THE TUBE WHERE IT WAS NOT COVERED AND A SECOND BRUSH WAS PLACED SO THAT IT WOULD RUN ON THE MATERIAL AND HIT THE PERFORATION AS THE TUBE REVOLVED. FROM THIS BRUSH, A CONNECTION WAS MADE THROUGH A 60 WATT BULB AND BACK TO THE CIRCUIT GROUND WHICH COMPLETED THE SYSTEM.

WHEN THE TUBE WAS TURNED SLOWLY, THE CIRCUIT WAS COMPLETED AS THE BRUSH CAME TO THE PERFORATION. THE RESULTING FLOW OF CURRENT MADE THE LIGHT GO ON. THE ONLY PROBLEM WAS THE ARCING WHICH OCCURRED AS THE CIRCUIT WAS BROKEN BY THE OTHER SIDE OF THE PERFORATION. ALTHOUGH THIS DIFFICULTY DID EXIST IN THE TEST APPARATUS, IT WOULD NOT OCCUR IN THE VSI.

THE BUS ELECTRICAL SYSTEM IS ONLY 12 VOLTS. ALSO, THE RELAY, WHICH IS CONTROLLED BY THIS CIRCUIT, HAS AN IMPULSE OPERATION WHICH BREAKES THE FLOW OF CURRENT AS SOON AS THE ACTUATION OCCURS.* BECAUSE OF THIS FEATURE IN THE RELAY, ANY ARCING WHICH MIGHT OCCUR WOULD TAKE PLACE AT THE RELAY POINTS AND NOT AT THE CURTAIN.

IN ADDITION TO TESTING THE ACTUAL OPERATION OF THE CONTROL CIRCUIT, THERE WAS SOME QUESTION CONCERNING THE WEAR OF "FEELERS" RUNNING ON THE CURTAIN MATERIAL. IF THERE WAS SUCH A PROBLEM, IT WOULD BE NECESSARY TO INCORPORATE SOME TYPE OF ROLLER TO MAKE THIS CONTACT. A BRUSH, HOWEVER, WOULD MAKE A MUCH SIMPLER SOLUTION.

THE LATHE, EVEN ON ITS SLOWEST SPEED, MADE THE ROLL TRAVEL MUCH FASTER THAN IT WOULD EVER DO IN THE VSI. ACTUALLY TEN OR TWELVE TRIPS PER 24 HOUR PERIOD WOULD BE ENOUGH TO DUPLICATE BUS OPERATION ON A COMPARATIVELY SHORT ROUTE. THIS MEANS THAT EVERY TIME THE TEST STRIP MADE 24 REVOLUTIONS (THROUGH THE VSI AND RE-WIND), IT EQUALLED ONE DAY OF OPERATION. ON THE SLOWEST LATHE SPEED, IT WAS MORE THAN 40 MINUTES BEFORE THE MATERIAL BEGAN TO

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* NOTE REFERENCE SECTION, P. 48, ITEM 4.

WEAR APPRECIABLY WHERE THE "FEELER" WAS TOUCHING IT. ANOTHER 14 MINUTES ELAPSED BEFORE THE STRIP WOULD NO LONGER INTERRUPT THE CURRENT.

THESE TIMES, WHEN CONVERTED TO NORMAL OPERATION WOULD BE ALMOST FOUR YEARS OF CONTINUAL OPERATION. SINCE THERE IS SOME DOUBT WHETHER THE ENTIRE CURTAIN WOULD BE SERVICEABLE FOR A LONGER PERIOD, THE TEST INDICATES AN AMPLE LIFE. IF THE CURTAIN WEARS OUT ONLY ALONG THE CONTROL EDGE, THIS PART COULD BE CUT OFF AND REPLACED BY SEWING A NEW STRIP OF PERFORATIONS IN ITS PLACE. THIS PROCESS OF SEWING IS USED IN ANY EVENT WHERE SOME CHANGE MUST BE MADE IN A ROLL.

APPENDIX D

COST ESTIMATE

A COST ANAYLSIS AND ESTIMATE DONE WITHOUT KNOWLEDGE OF THE MANUFACTURING PLAN OR OF PLANT FACILITIES CAN ONLY BE A VERY ROUGH APPROXIMATION. IT IS WITH THIS REALIZATION THAT THE FOLLOWING COST BREAK-DOWN IS INSERTED. THE PURPOSE IS TO INDICATE THAT THE FINAL DESIGN HAS BEEN ACCOMPLISHED WITHIN A PRICE BRACKET WHICH WILL SATISFY THE POTENTIAL MARKET. (SEE APP. B, QUESTION 10, P. 70)

THIS ESTIMATE IS DONE THE BASIS OF AN INITIAL PRODUCTION RUN OF 500 UNITS.

PURCHASED PARTS

MOTOR, EMC, MODEL 11-A, WITH MAGNETIC BRAKE, GOVERNOR AND A-5 GEAR REDUCTION. PURCHASED AS A UNIT	$11.50
RELAY, ADVANCE RELAY, MODEL 605-B . .	2.80
PULLEY, FREE-WHEELING CLUTCH (2 RQD) .	1.76
PULLEY, DRIVE (2 RQD)	.32
LIGHTS, #68 MAZDA/SOCKET (3 RQD) . . .	.42
BELTS, NEOPRENE "O" RING (2 RQD) . . .	.08
SPRING, 3/32 STEEL, CLOSED ENDS, 4# COMPRESSION, 3 TURNS (2 RQD) . . .	.26
HINGE, ALUMINUM, 1½ x 2½ LONG (2 RQD).	.20

BEARINGS, 3/16 STEEL BALL (12 RQD).	.12	
BRUSHES, 3/16 CARBON, SPRING LOADED (3 RQD)	.18	
SWITCH, TOGGLE (3 RQD)	.60	
CURTAIN, 24" X 30 FT, PRINTED (30¢/YARD)	8.00	
MISC, SCREWS, COTTER PINS, RIVETS, WASHERS, ETC.	.50	
TOTAL PURCHASED PARTS	$ 26.74	
HANDLING AND STORAGE - 12%	3.20	
		$ 29.94

MANUFACTURED PART - MATERIAL

CASE, FRAME MEMBERS, BRACKETS, .032 AND .040 ALUMINUM ALLOY SHEET 16 SQ. FT. (INCLUDES 20% WASTE) . .	$ 1.25
SUPPORT FORMERS, 16 GAGE STEEL, 2 SQ. FT. (2 RQD)	.20
CURTAIN ROLL, TUBE, ALUMINUM ALLOY, EXTRUSION, 15¢/FT. (2 RQD)	.70
GUIDE ROLL, TUBE, LAMINATED PHENOLIC, 1" O.D., 12¢/FT. (2 RQD)	.55
FLANGE, CURTAIN GUIDE, .050 ALUMINUM ALLOW, 2 SQ. FT. (4 RQD)	.24
CONE, CURTAIN ROLL MOUNT, ZN DIE CAST OR MACHINE 1020 STEEL (4 RQD)	.40
SLIP RINGS, BRASS TUBE, 1" O.D. (3 RQD)	.09
INSERT, GUIDE ROLLER, 13/16 STEEL BAR STOCK, 18¢/FT. (4 RQD)	.24
SHAFT, GUIDE ROLLER, 1/4" STEEL ROD, 8¢/FT. (4 RQD)	.06