

# PROTOTIP D'UN SISTEMA *CASHLESS* SOBRE EXPENEDORS AUTOMÀTICS EXISTENTS

*Treball de Final de Grau*  
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*estudis del grau en*

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## Resum

Aquest document presenta el disseny i el desenvolupament d'un prototip per a un sistema de pagament sense contacte en expenedors automàtics ja fabricats. L'expenedor serà controlat usant un ordinador de placa reduïda per controlar els circuits que engeguen motors de l'expenedor i comunicar-se amb el servidor central, i un lector NFC per poder llegir targetes dels usuaris.

El projecte es centra en el desenvolupament del codi de les aplicacions de servidor i de client, i en el desplegament de hardware que s'integrarà dins de l'expenedor automàtic.

## Resumen

Este documento presenta el diseño y el desarrollo de un prototipo para un sistema de pago sin contacto en máquinas expendedoras ya fabricadas. La máquina expendedora será controlada usando un ordenador de placa reducida para controlar los circuitos que encienden los motores de la máquina expendedora y comunicarse con el servidor central, y un lector NFC para poder leer las targetas de los usuarios.

El proyecto se centra en el desarrollo de código de las aplicaciones de servidor y de cliente, y en el despliegue de hardware que se integrará dentro de la máquina expendedora.

## Abstract

This document presents the design and development of a prototype for a cashless system on existing vending machines. The machine will be controlled using a small-sized single-board computer to control the circuits that power the motors of the vender and to communicate with the central server, and an NFC reader to read users' cards.

This projects focuses in the code development of the server and client applications, and also on the hardware deployment that will later integrate in the vending machine.

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*“Agraïments”*  
*Autor Frase*

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# AGRAÏMENTS

Voldria a en Marcel Fernández per creure en mi i acceptar la meva proposta de projecte.

Als companys que anaven a acompanyar-me en l'aventura de desenvolupar aquest projecte abans de decidir presentar-ho com a treball de fi de grau i en especial a l'equip vell de IT de l'associació per tota l'ajuda que m'han prestat.

I sobretot als meus pares, per tot el seu suport infalible les 24 hores del dia, cada dia.

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# CAPÍTOL 1

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## INTRODUCCIÓ

Els expenedors automàtics de begudes fredes tenen una vida útil bastant llarga però les compres amb efectiu s'estan quedant enrere.

Pels expenedors que originalment no inclouen sistemes de pagament sense monedes existeixen accessoris que se'ls pot afegir com acceptadors de bitllets o de targetes de crèdit.

En aquest projecte el que intentarem és crear una solució que sigui integrable en un expenedor existent que no inclou sistemes de pagament que no sigui amb monedes. La idea és util per integrar en expenedors que es troben en l'edifici d'una empresa i es vol, per exemple, donar descomptes als seus empleats en funció del consum o de l'hora del dia.

### Objectius del projecte

L'objectiu d'aquest projecte és dissenyar i desenvolupar un prototip per a un sistema *cashless* que es pugui integrar dins d'expenedors automàtics existents. El projecte es centrarà en un model específic d'expenedor automàtic de begudes fredes (Dixie-Narco DNCB 386) perquè és l'expenedor que hi ha disponible per al desenvolupament.

Els principals objectius es poden resumir en els següents punts:

*Dissenyar i desenvolupar l'aplicació de servidor.* El sistema de la solució serà un sistema centralitzat. Tot es gestionarà des d'un mateix lloc, i aquest serà l'aplicació de servidor.

*Dissenyar i desenvolupar l'aplicació de client.* Per tal de poder controlar l'expenedor automàtic i comunicar-se amb l'aplicació de servidor, és necessària l'aplicació de client.

*Dissenyar i desenvolupar el sistema de hardware.* Per tal de que l'aplicació de client pugui controlar l'expenedor, és necessari el sistema de hardware que farà d'interfície entre l'aplicació i els circuits de l'expenedor.

La feina feta durant aquests mesos s'ha centrat en desenvolupar el codi de les aplicacions i en desenvolupar el desplegament de hardware que s'integrarà a l'expenedor.



# Planificació del temps

La planificació temporal que s’ha seguit durant el projecta es mostra a la Figura 1.1 Diagrama de Gantt.

La feina s’ha repartit en 6 blocs. La descripció detallada de cada bloc es troba a l’Apèndix A.

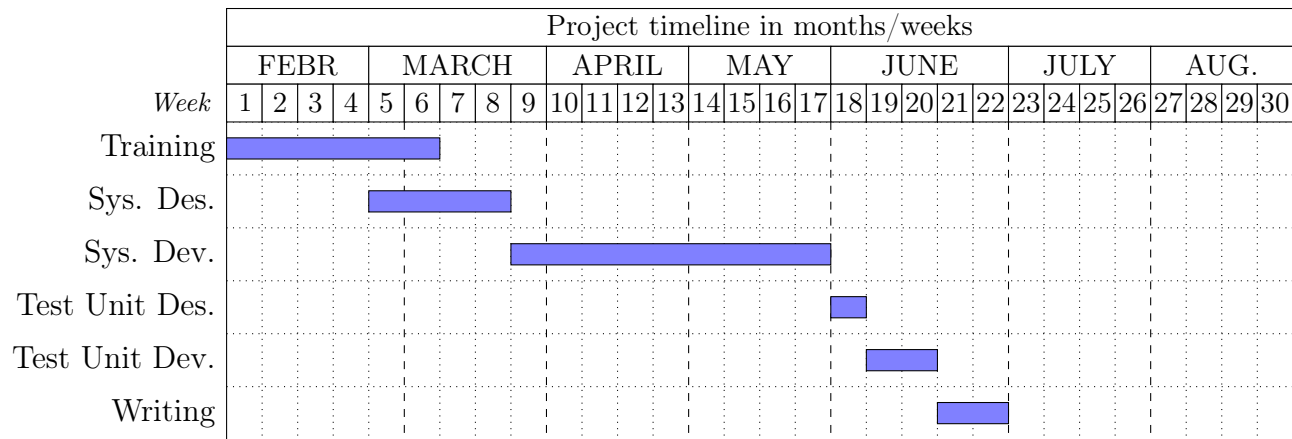


Figura 1.1: Diagrama de Gantt del projecte

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# CAPÍTOL 2

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## REQUERIMENTS

L'objectiu del projecte és dissenyar un sistema que es pugui integrar en expenedors automàtics existents i permeti la compra de begudes sense necessitat de fer ús de diners en efectiu en el moment de la compra.

### Requeriments generals de la solució

**Millors prestacions** La solució no pot empitjorar les prestacions que tenia l'expenedor automàtic en l'estat original. Només n'ha de millorar.

**Reversibilitat** En cas de necessitat, s'ha de poder retrocedir en la configuració de l'expenedor automàtic i deixar-lo en l'estat original.

**Seguretat** El sistema ha de ser prou segur per evitar frau o robatoris de diners.

Per assolir aquests requeriments el projecte es dividirà en tres parts:

**Aplicació de Servidor** És el sistema central de la solució. Serà la part que gestionarà les compres, transaccions monetàries, usuaris.

**Aplicació de Client** És el sistema que controlarà directament l'expenedor. Quan l'usuari s'identifiqui i faci una selecció, l'aplicació es comunicarà amb el sistema central perquè autoritzi la compra i pugui fer que l'expenedor serveixi una beguda.

**Implementació i integració del hardware** És tota la part del projecte que tracta la part física del projecte. En altres paraules, la integració del dispositiu que contindrà l'aplicació de client, el/s dispositiu/s que servira/n per identificar l'usuari i tots els circuits elèctrics per controlar l'expenedor i el seu estat.

Un cop dividit el projecte en tres blocs, perquè la solució sigui prou segura contra frauds, es proposa que el sistema sigui un sistema de prepagament on el saldo de cada usuari l'emmagatzema i gestiona el sistema central. També es proposa que l'usuari s'identifiqui mitjançant una etiqueta NFC.

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## Requeriments específics

### Aplicació de Servidor

Per tal de tenir una solució que compleixi els requeriments generals, es proposen una sèrie de requisits específics per a l'aplicació de servidor:

**Gestió d'expedadors** Ha de tenir control sobre els expedadors. Ha de gestionar quin producte tindrà l'expedidor a cada carril i a quin preu. Ha de poder deshabilitar la venda d'un cert carril. Ha de poder visualitzar l'estat en el que es troba un expedidor (s'ha quedat sense monedes per donar canvi, s'ha avariat, s'ha quedat sense producte ...).

**Gestió d'usuaris** Ha de poder crear nous usuaris, eliminar-ne, modificar-ne les dades. També ha de poder identificar un usuari a partir d'algun identificador amb què aquest s'identifica quan fa ús d'un expedidor.

**Gestió del saldo disponible** Ha de controlar el saldo disponible del que disposa cada usuari. L'ha de poder consultar, modificar-lo quan hi ha un pagament o una recàrrega de saldo.

**Gestió de les compres** Ha d'autoritzar la compra que fa un usuari tenint en compte el seu saldo disponible i la disponibilitat del producte a l'expedidor.

**Seguretat en les transaccions** El sistema ha de ser segur en termes de transaccions de diners i recàrregs de saldo per compra. S'han d'evitar suplantacions d'identitat, intrusions en el sistema, frauds i demés possibles accions que perjudiquin al propietari de l'expedidor o als usuaris.

**Detecció i gestió d'incidències** En sistemes que involucren parts mecàniques, elèctriques, i parts que es comuniquen per xarxa, no és tan estrany que en certs moments les coses no funcionin com haurien de funcionar. Així el sistema hauria de ser capaç de detectar la gran part d'incidències produïdes per errors de comunicació o fallades en l'expedidor i solucionar-les en la mesura que sigui possible.

### Aplicació de client

De la mateixa manera que amb l'aplicació de servidor, es proposen un seguit de requeriments específics per l'aplicació de client:

**Control sobre l'expedidor** Ha de poder controlar els circuits de l'expedidor per exendre llaunes. També ha de poder analitzar els paràmetres dels circuits per a poder preveure la quantitat de producte restant que conté l'expedidor i a més detectar i evitar fallades.

**Comunicació amb el sistema central** S'ha de comunicar amb el sistema central per a recollir la informació necessària per funcionar i per a poder realitzar les vendes. També ha de comunicar al servidor la informació sobre l'estat de l'expedidor.

**Interfície fàcil d'usar** L'ús de l'aplicació de cara a l'usuari es farà a través d'una interfície gràfica d'usuari que ha de ser senzilla d'utilitzar de la mateixa manera que ho és un expedidor automàtic usual.

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**Seguretat en les comunicacions** Les comunicacions han de tenir un mecanisme per evitar intents de frau i demés accions perjudicials per al propietari de l'expenedor i altres usuaris.

## Implementació del Hardware

Tenint en compte els requisits generals de la solució i els requisits proposats per a l'aplicació de client, es proposen un seguit de requeriments específics per a la implementació del hardware dins l'expenedor:

**Reversibilitat de la integració** Un cop integrat el sistema, en cas de necessitat, s'ha de poder extreure el hardware i deixar l'expenedor en l'estat original. Això vol dir que no es pot alterar irreversiblement el cablejat de l'expenedor.

**Volum reduït** No pot ocupar molt espai. Ha de caber dins de la porta de l'expenedor.

**Implementació modular** Ha de ser prou fàcil de posar i treure de l'expenedor. Fàcil de reparar i reposar blocs defectuosos.

**No interferir amb el funcionament mecànic de l'expenedor** La implementació no ha d'interferir en el funcionament mecànic usual que té un expenedor com són l'obertura de l'expenedor per recollir les monedes o reposar producte.

**Evitar creuament amb una compra amb monedes** Es pot donar el cas que es vulgui efectuar una compra sense efectiu i s'hagin introduït monedes a l'expenedor al mateix temps. Ha d'evitar que es produeixin problemes per aquest creuament.

**Aïllament físic amb l'exterior** Ha d'estar físicament de l'exterior per protegir el sistema i evitar possibles intents de manipulació.

**Interfície d'usuari** Ha de tenir una interfície de manera que l'usuari pugui visualitzar la informació que dona l'aplicació de client i també alguna manera d'introduir la seva selecció.

**Lector NFC** Ha d'incloure un lector NFC per a la identificació dels usuaris.

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## CAPÍTOL 3

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# FUNCIONAMENT D'UN EXPENEDOR AUTOMÀTIC DE BEGUDES FREDES

Per a poder dissenyar la solució i poder entendre les millores, primer s'ha d'esbrinar i entendre el funcionament original d'un expenedor automàtic.

### Descripció de les parts

La descripció de les parts es pot trobar al manual d'instruccions de l'expenedor a l'Apèndix ??.

### Cas d'ús

Presentem el cas d'ús usual:

1. Un usuari s'acosta fins l'expenedor i observa quins productes estan disponibles i quin preu tenen. Cada botó de selecció té una etiqueta al costat que indica el producte i el seu preu. La disponibilitat del producte la indica un indicador lluminós sota el botó (si emet llum, no està disponible).
2. Un cop l'usuari ha fet la seva elecció, introdueix monedes amb un valor igual o superior a l'import del producte.
3. L'usuari apreta el botó de selecció del producte que ha escollit.
4. L'expenedor retorna el canvi (si n'hi ha) i serveix la beguda que l'usuari ha seleccionat.

Exposem els casos d'ús quan alguna cosa va com no hauria d'anar:

**L'usuari apreta el botó d'un producte que no està disponible:** No passa res. És com si no hagués apretat cap botó.

**L'usuari apreta el botó d'un producte pel qual no té saldo suficient:** No passa res. És com si no hagués apretat cap botó.

**L'indicador de "import exacte" està encès:** L'expenedor només accepta monedes del tipus que pot retornar i no retorna canvi.

## Circuit elèctric

L'expenedor automàtic està dissenyat per funcionar amb un sistema electromecànic sense necessitat de circuits electrònics.

El mecanisme consistia en un petit interruptor mecànic amb una palanqueta allargada que quedava premuda quan s'introduïa un tipus de moneda concret i activava la resta del circuit que era controlat per un relé de tres commutadors, els botons de selecció i els interruptors que es troben on els carrils per controlar la posició dels motors.

Avui dia, amb expenedors que retornen el canvi, aquest relé és substituït per la màquina de canvi, que és l'aparell que classifica les monedes segons el seu valor, i després retorna canvi si cal. A més, dona la possibilitat de poder definir diversos preus.

Per tal de tenir una visió més clara del funcionament per tal de poder dissenyar el nostre sistema, presentem un circuit simplificat de l'expenedor juntament amb la màquina de canvi que s'ha extret del manual d'instruccions (llegint les explicacions i analitzant l'esquema elèctric complet).

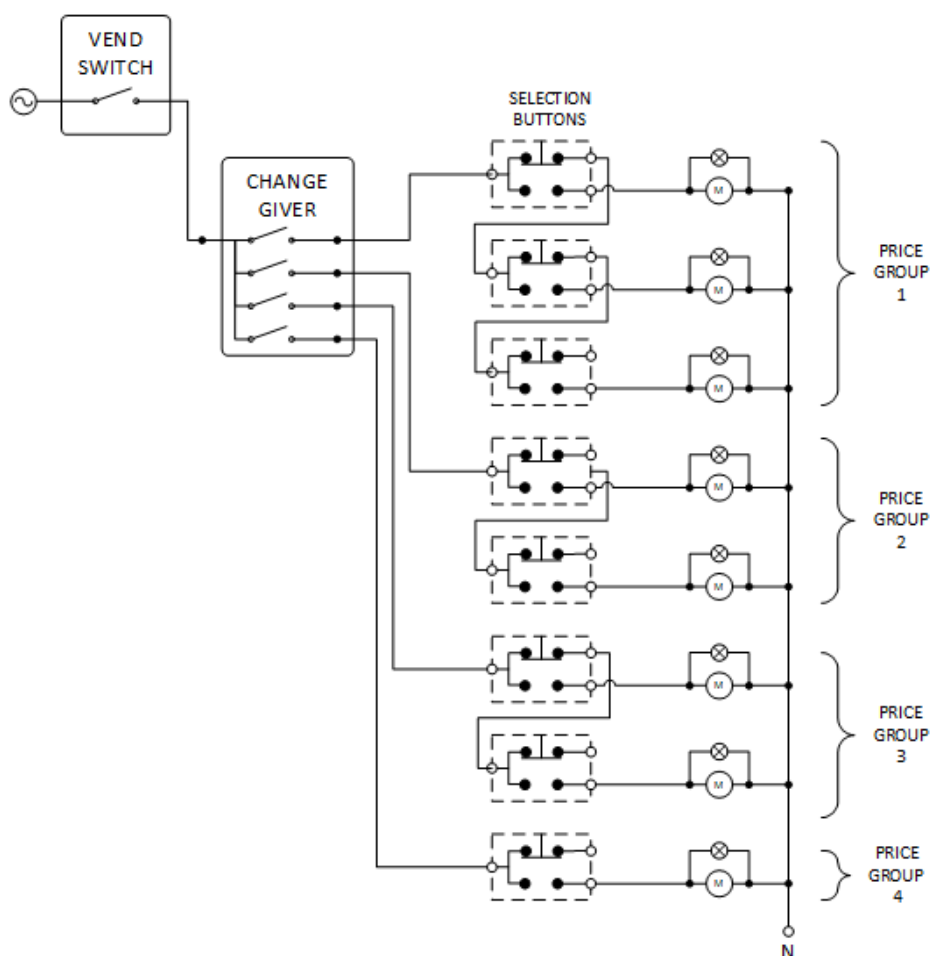


Figura 3.1: Esquema elèctric simplificat de l'expenedor

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Quan s'introdueixen les monedes, la màquina de canvi dona corrent als botons pels quals s'ha introduït un import suficient. Un cop premut el botó de selecció, es tanca el circuit del motor i el motor s'acciona. Hi ha més factors a tenir en compte, però per a dissenyar el nostre sistema ja en tenim suficient.

Els botons de selecció estan connectats en serie d'aquesta manera en concret per evitar que el circuit el tanqui més d'un botó al mateix temps.

Com podem veure a l'esquema, abans de la màquina de canvi hi ha un interruptor. Aquest interruptor obre el circuit quan es deshabilita la venda en casos com quan no queda producte a cap carril de l'expenedor, o s'està servint una beguda o bé quan hi ha algun problema amb el mecanisme de l'expenedor i s'ha encallat.

Quan es deshabilita la venda, la màquina de canvi ja no accepta més monedes però l'import de les monedes que s'hagi introduït abans no es perd. Quan es torna a habilitar la venda es pot seguir comprant amb el saldo anterior. Si s'apreta la palanca de retorn mentre la venda està deshabilitada la màquina de canvi retorna els diners introduïts.

Malauradament, si l'expenedor es queda sense energia durant el procés de compra, es perd l'import introduït.

Les làmpades que hi ha en paral·lel amb els motors tenen dues funcions:

1. Si estan enceses durant el període entre que s'ha apretat el botó de selecció i s'ha servit la beguda, indica que el circuit s'ha tancat correctament i que el motor d'aquell carril està girant.
2. Si estan enceses durant de forma permanent indiquen que ja no queda producte en aquell carril.

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# CAPÍTOL 4

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## DISSENY DE SOFTWARE

En aquesta part es presenta el disseny de l'aplicació amb les decisions de disseny explicades.

Per al projecte sencer s'ha escollit programar en llenguatge *Python* perquè és molt senzill de programar i és molt més llegible.

### Aplicació de servidor

Per a l'aplicació de servidor s'ha fet servir un *framework* per a desenvolupar webs en Python anomenat Django.

S'ha seguit el patró MVC (Model-Vista-Controlador).

### Model de dades

Per a desenvolupar una aplicació web mínimament complexa, primer s'ha de començar dissenyant el model de dades.

Cada *model* en Django representa una taula a la base de dades.

**User** Cada usuari està associat a un **User** i contindrà les dades que l'identificaran com el seu nom, correu electrònic, nom d'usuari i contrassenya, DNI ...

**Credit** Conté el saldo disponible de l'usuari i, per tant, està associat a un **User**, i cada **User** té associat com a molt un **Credit**. Està en una taula separada perquè està pensat perquè l'aplicació pugui ser integrada en una base de dades d'usuaris existent.

**Card** Representa la targeta amb la què s'identificarà l'usuari. Per tant està associada a un usuari. Igual que les targetes de crèdit, un usuari pot tenir més d'una targeta associada.

**Vender** Representa un expenedor. Conté la informació bàsica de l'expenedor (model, número de sèrie, localització geogràfica), i també la informació sobre el seu estat.



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**ApiKeyToken** Per a garantir un mínim de seguretat en les comunicacions, l'aplicació de client usará un codi per a identificar l'expenedor des del qual s'està comunicant. Aquest identificador serà únic per a cada expenedor. **Vender** i **ApiKeyToken** estan en taules separades per raons d'implementació de codi d'autenticació en Django.

**Column** Representa un carril d'un expenedor. Cada carril té un preu de venda i un tipus de producte. També pot estar actiu o inactiu, i també pot estar buit o ple.

**Purchase** Cada cop que l'usuari fa una selecció i tot va bé (la informació proporcionada per realitzar la compra és correcta i l'usuari té suficient saldo disponible) es crea una instància de **Purchase** que representa la compra que ha fet l'usuari amb la informació corresponent (targeta amb què s'ha comprat, producte, carril, preu, data i hora, identificador de la compra, i si ha estat pagada). L'identificador de la compra és un identificador aleatori que assigna l'aplicació de client per raons que comentarem més endavant. Tot i que **Column** ja conté la informació de carril, producte i preu, es guarda per separat ja que al llarg del temps aquests paràmetres podrien canviar.

**Payment** Quan un **Purchase** ha estat creat, s'ha de procedir al pagament de la compra, per tant un pagament està associat directament a una compra. **Payment** representa l'acció de pagar la compra. Inclou el preu de la compra, la quantitat descomptada (si es fa descompte) i el preu final a pagar. També inclou l'usuari a qui se li ha de cobrar, el dia i hora i la informació per determinar si el pagament està pagat i és vàlid, o si l'han hagut de reemborsar.

**RefundPetition** Quan un procés de compra es queda a mitges, o l'expenedor pateix una fallada tècnica, o per qualsevol altre motiu és necessari reemborsar l'import d'una compra a l'usuari, primer s'ha de crear una petició de reemborsament. És així perquè d'aquesta manera les peticions es poden generar de manera automàtica mentre que l'autorització de la petició es realitza amb més cura (un sistema més curós o bé amb supervisió humana). Conté l'identificador del pagament que es vol reemborsar, el sol·licitant (ja sigui un empleat o bé un expenedor de manera automàtica), la raó de la petició, l'hora i la data, i la informació per determinar si ha estat denegada o finalment s'ha realitzat el reemborsament.

**Refund** Representa el reemborsament d'un pagament un cop la petició és acceptada. Així doncs conté l'entitat que ha autoritzat el reemborsament, la petició que ha estat autoritzada i l'hora i la data de l'autorització.

## Controlador

El controlador és on es troba tota la lògica en si del sistema.

En Django, quan es desenvolupa una aplicació de servidor que respon a peticions, la funció de controlador ho desenvolupen les classes que de l'API.

Les següents són les classes que fan de control·lador i cadascuna respon a un tipus diferent de petició:

**GetUserDataFromCard** Retorna la informació de l'usuari (nom i saldo disponible) a partir de l'identificador de la seva targeta.

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**GetVenderColumns** Retorna la informació de cada carril de l'expenedor que l'ha demanat (tots els paràmetres que conté el model **Column**).

**ProductPurchase** Quan l'usuari ha fet la selecció del producte, es comprova que el producte estigui disponible, que el producte del carril seleccionat coincideixi amb el producte que conté, que el preu també coincideixi i que el saldo disponible de l'usuari sigui suficient. Si tot és correcte, es crea una instància de **Purchase** i el seu **Payment** associat i se li descompta l'import de la compra al saldo de l'usuari. Finalment se li retorna una resposta de que tot ha anat bé a l'expenedor perquè serveixi una beguda o bé se li retorna una resposta d'error informant de què és el que ha anat malament.

**RequestCancelPayment** Quan alguna cosa ha anat malament a la banda de l'expenedor (s'ha encallat el mecanisme, ha fallat la xarxa, ...) pot ser que s'hagi cobrat la compra a l'usuari i no s'hagi servit la beguda. És per això que cal un mecanisme per demanar reemborsament sota certes circumstàncies. Quan es rep una sol·licitud de reemborsament aquesta s'emmagatzema si fins el moment no existia cap altra sol·licitud associada al mateix pagament.

## Vista

La vista en si és la informació que es pot visualitzar de la resposta d'una petició. En la nostra aplicació hi ha dos possibilitats d'origen de petició: des de l'aplicació de client, i des de la interfície d'administració.

Django té per defecte implementada una interfície d'administració per gestionar manualment les dades de l'aplicació. Amb això ens estalviem haver de desenvolupar aplicacions d'interfície gràfica d'usuari per tal de poder gestionar nous usuaris, incidències, etcètera.

Aleshores, la interfície d'administració és un tipus de vista, i la informació que retorna el controlador a l'aplicació de client és l'altre tipus de vista de l'aplicació.

## Aplicació de client

Per a l'aplicació de client, com ha de tenir una interfície gràfica d'usuari, s'ha decidit utilitzar **PyQt4** que és una llibreria gràfica. Té integrada la part gràfica i també la comunicació entre fils d'execució.

L'aplicació de client es divideix en 6 grans blocs diferenciables:

**comms** S'encarrega d'implementar la comunicació amb el servidor.

**card\_reader** S'encarrega de controlar el lector de targetes. Cada cop que detecta una targeta avisa al fil d'execució principal juntament amb l'identificador de la targeta.

**column\_controller** S'encarrega de controlar els mecanismes dels carrils de l'expenedor i de detectar les possibles fallades mecàniques.

---

**db\_controller** S'encarrega de controlar la base de dades local. En aquesta base de dades s'emmagatzema la informació dels carrils i també la informació de compres fallides per les quals el servidor encara no ha confirmat la creació d'una petició de reemborsament.

**graphic\_ui** : S'encarrega de crear la interfície gràfica d'usuari i de gestionar totes les accions de l'usuari i derivar-les cap el fil d'execució principal.

**cocacolero** : S'encarrega d'instanciar, controlar i coordinar la resta de blocs. Aquest bloc es troba en el fil d'execució principal

## Cas d'ús

A continuació s'exposa l'explicació del cas d'ús usual de l'aplicació per part de l'usuari.

1. L'usuari arriba i apropa la seva targeta al lector.
2. L'usuari és correctament identificat i el seu nom i el seu saldo disponible apareixen per pantalla. Els botons de selecció dels productes disponibles queden habilitats.
3. L'usuari fa la selecció pitjant amb el dit sobre el botó del producte que ha escollit
4. L'usuari disposa de suficient saldo disponible i la compra s'efectua amb èxit. L'expenedor serveix la beguda, es deshabiliten els botons i finalitza el procés.

Exposem el mateix cas d'ús des del punt de vista de l'aplicació.

1. **card\_reader** detecta una targeta i comunica l'identificador a **cocacolero**.
2. **cocacolero** demana la informació de l'usuari associat a la targeta detectada a l'aplicació del servidor. El servidor l'identifica amb èxit i retorna la informació demanada (nom i saldo). **cocacolero** habilita els botons de **graphic\_ui** dels productes disponibles.
3. Quan l'usuari fa la selecció, **graphic\_ui** comunica a **cocacolero** la selecció.
4. **cocacolero** genera un identificador aleatori per a la compra, envia al servidor la petició de la compra. El servidor comprova que la informació és correcta i que l'usuari té suficient saldo. El servidor respon amb èxit. **cocacolero** comunica a **column\_controller** el carril que s'ha d'activar i aquest li respon amb èxit quan la beguda s'hagi servit. **cocacolero** deshabilita els botons de **graphic\_ui** i finalitza el procés.

Ara exposem els casos d'ús quan alguna cosa no funciona com està previst:

**L'usuari no vol realitzar cap compra després d'identificar-se:** L'usuari pitja el botó Log Out i finalitza el procés.

**L'usuari no s'ha identificat amb èxit:** S'ignora

---

**Es detecta una targeta durant un procés de compra:** S'ignora

**L'usuari fa una selecció per la qual no disposa de saldo suficient:** el servidor ho detecta i ho comunica a l'aplicació de client. L'aplicació descarta la compra i finalitza el procés.

**La informació de la compra és incorrecta:** El mateix cas que el de saldo insuficient.

**El servidor no pot processar la compra per qualsevol altre motiu:** El mateix cas que el de saldo insuficient.

**El servidor no respon dins del termini establert:** S'anul·la el procés. S'emmagatzema la informació de la compra i s'envien peticions al servidor periodicament fins que el servidor crea la petició de reemborsament amb èxit o la descarta per qualsevol motiu.

**L'aplicació detecta una fallada tècnica i no s'ha servit el producte:** El mateix cas que quan es perd la resposta del servidor.

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# CAPÍTOL 5

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## DISSENY DE HARDWARE

En aquest capítol comentarem tot el disseny del hardware que s'ha seguit per poder controlar l'expenedor automàtic assolint els requisits definits anteriorment.

### Disseny elèctric

A partir de l'esquema elèctric simplificat de l'expenedor, la idea del nostre disseny elèctric és d'afegir un circuit paral·lel a la màquina de canvi i als botons de selecció per poder accionar el motor del carril desitjat i que pugui deshabilitar la màquina de canvi durant el transcurs d'una venda en el nostre sistema.

Per aconseguir deshabilitar la màquina de canvi, afegim un relé commutador abans d'aquesta i així també dirigir el corrent cap els relés que accionaran els motors.

Els relés es connecten en serie de la mateixa manera que els botons de selecció per evitar que més d'un d'ells pugui tancat el circuit al mateix temes.

Per tal de poder controlar l'estat de l'expenedor per saber si no queda producte en algun carril o si la venda ha quedat deshabilitada per algun motiu, s'ha de poder verificar si hi ha tensió en certs punts del circuit.

Per verificar que el carril no està buit i hi queda producte per vendre, es pot observar si la làmpada esta encesa mesurant la tensió que cau entre els seus borns. Això ho farem amb un circuit que hem trobat en un blog de projectes casolans i hem adaptat al nostre sistema:

Un rectificador d'alta impedància connectat a un opto-acoblador per separar els circuits de l'expenedor dels circuits del nostre hardware.

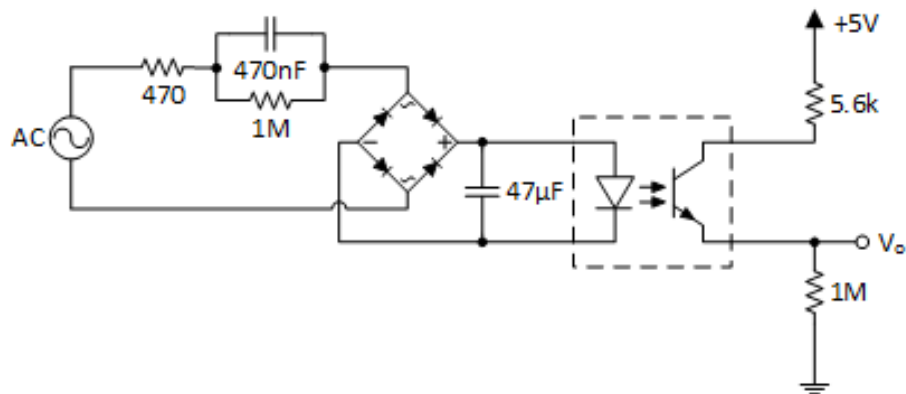


Figura 5.1: Esquema elèctric del circuit de sensing

Per verificar que la venda no ha quedat deshabilitada, mesurarem la tensió al node comú del relé de by-pass amb el mateix circuit anterior.

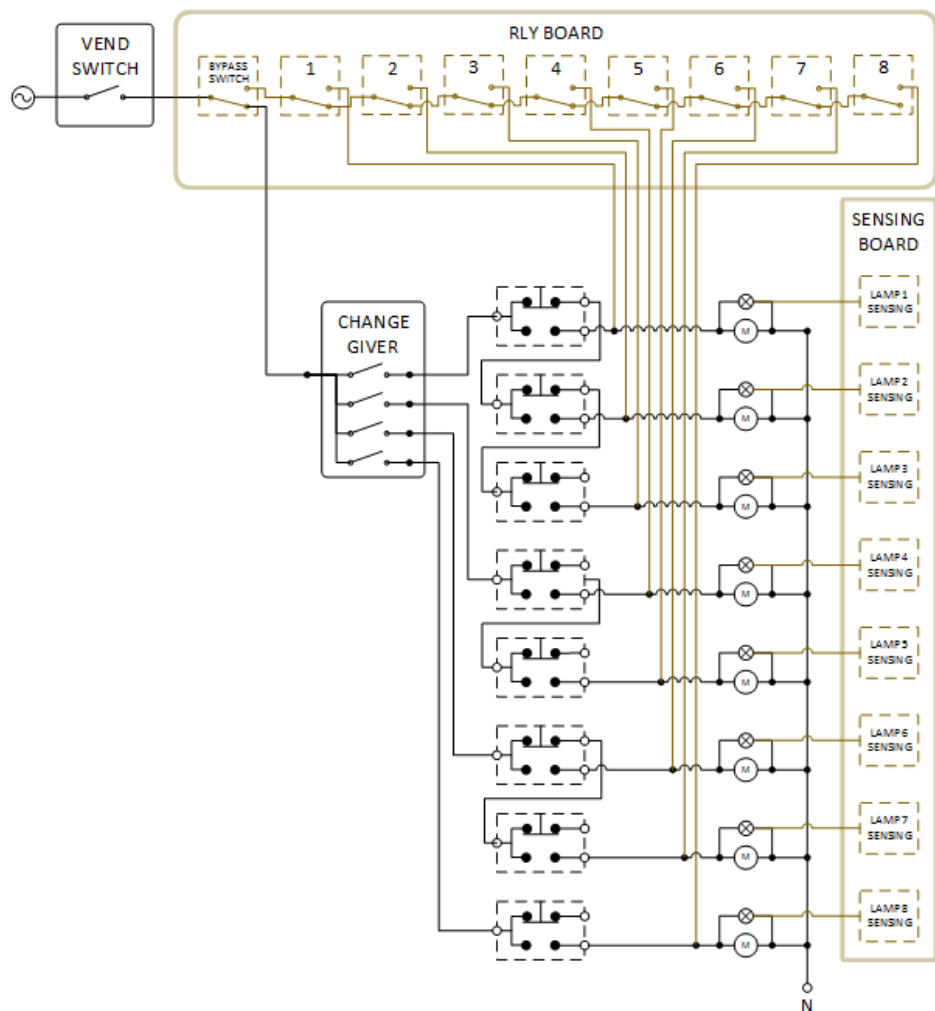


Figura 5.2: Esquema elèctric proposat de l'expenedor

Tot i que pel funcionament del nostre sistema no és gaire rellevant, també mesurarem la tensió a la làmpada de *canvi exacte* per poder notificar al servidor que

l'expenedor gairebé s'ha quedat sense canvi.

## Components

Com a controlador central de l'expenedor es farà servir un ordinador de placa petita *RaspberryPi 2 B* (a partir d'ara, RPi), ja que disposa de bastants pins d'entrada/sortida, se li pot instal·lar un sistema operatiu basat en linux (que fa molt més fàcil el disseny de l'aplicació de client), té connexió a internet, possibilitat de connectar-hi una pantalla per HDMI o bé una pantalla tàctil.

Per a la interfície d'usuari usarem la pantalla tàctil *Raspberry Pi Touch 7"*.

Per a poder accionar els circuits que accionen els motors de l'expenedor des de la RPi farem servir una placa de relés activats per nivell baix.

RPi necessitarà una alimentació de 5V i 1A. La pantallà tàctil necessita una alimentació de 5V i 1A. La placa de relés necessita una alimentació de 12V.

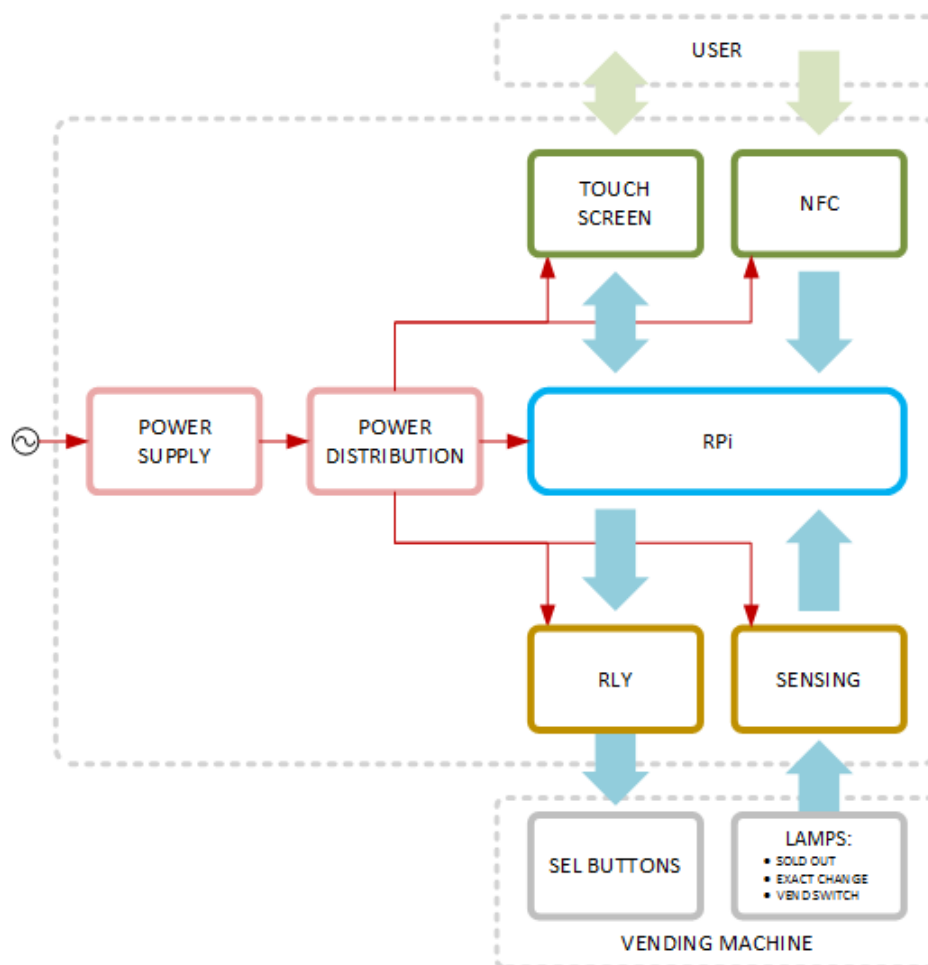


Figura 5.3: Diagrama de bloc de la unitat de test

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## Unitat de prova

Per tal de poder fer proves amb el sistema prèvies a la integració final, s'ha desenvolupat una unitat de test que consisteix en una capsa de metacrilat que conté tots els components fixats a dins i interconnectats de manera que sigui fàcil de transportar.

A més, s'ha desenvolupat una placa de sensing a part per a la unitat de test ja que el sensing sobre alta tensió no té gaire sentit fer-lo si no és sobre l'expenedor.

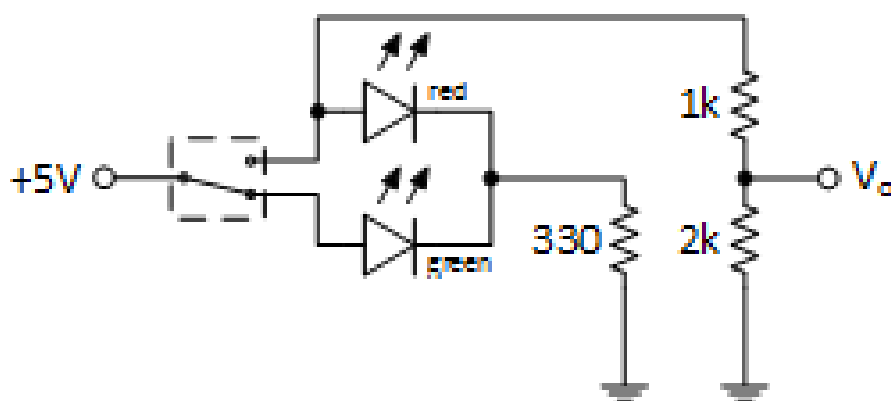


Figura 5.4: Esquema elèctric del circuit de sensing de la unitat de test

Aquesta placa té uns pins d'entrada on hi van connectats les sortides dels relés i quan s'activa un relé s'encén un LED per poder visualitzar des de fora de la capsa quins relés estan activats.

També té uns pulsadors interruptors que són per a simular l'estat de les làmpades dels botons de selecció, que estan connectats als pins de sortida de la placa que aniran connectats als pins d'entrada de la RPi.



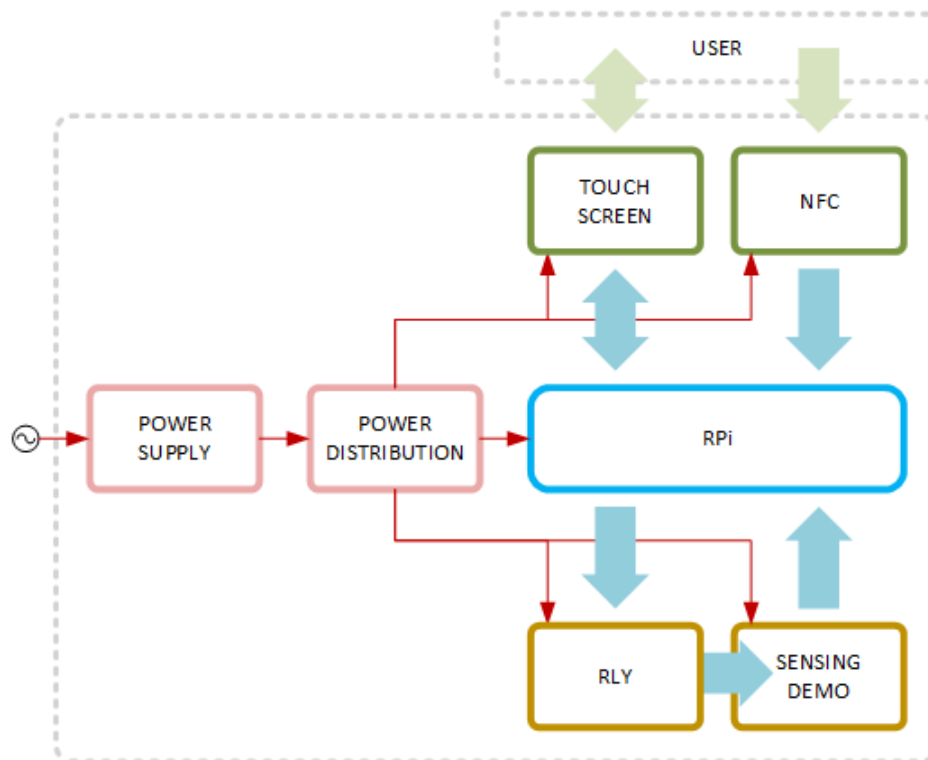


Figura 5.5: Diagrama de bloc de la unitat de test

# CAPÍTOL 6

## RESULTATS

En aquest capítol exposem els resultats del disseny i el desenvolupament del sistema sencer.

### Aplicació de servidor

L'aplicació de servidor és la que més s'ha trigat en dissenyar i desenvolupar perquè el disseny de l'aplicació de client depen directament de la de servidor.

L'aplicació funciona com s'esperava.

A través de la interfície d'administració es poden fer fàcilment les gestions necessàries com són: afegir usuaris nous, afegir expenedors nous, gestionar els carrils dels expenedors ..., tot el que es requeria de poder gestionar en remot.

A la intefície d'administració només hi poden accedir els usuaris que tinguin permís d'administració, i això es pot gestionar des de la mateixa interfície.

The screenshot shows the 'Add user' form in the Django administration interface. The form includes fields for Username, Password, Password confirmation, User profile (User profile: #1, Birth date, National id number), and Credits (Credit: #1, Amount, Active checkbox). The URL bar shows 'https://localhost:8000/admin/auth/user/'.

(a) Interfície d'administració per crear usuaris

The screenshot shows the 'Change vender' form in the Django administration interface. The form includes fields for Name, Vender model, Location, and a checkbox for 'Need change'. Below the form is a table with columns: CONTENT, CAPACITY, PRICE, NEED REFILL, ACTIVE, and DELETE? The table lists various vending machines with their details. The URL bar shows 'https://localhost:8000/admin/vendingServer/v'.

CONTENT	CAPACITY	PRICE	NEED REFILL	ACTIVE	DELETE?
Dispatx - 0. Random	70	0.34	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Dispatx - 1. Coca-cola	70	0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Dispatx - 2. Estrella Damm	80	0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Dispatx - 3. Random	70	0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Dispatx - 4. Guarana	30	0.6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Dispatx - 5. Nestle	30	0.6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dispatx - 6. Fanta Orange	30	0.5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dispatx - 7. Fanta Lemon	30	0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

(b) Interfície d'administració per gestionar els expenedors

Figura 6.1: Captures de la interfície d'administració de l'aplicació de servidor

## Aplicació de client

L'aplicació de client compleix els requeriments que s'han especificat.

No obstant, té un problema amb el lector de targetes: si l'aplicació es tanca de manera inesperada (per exemple, degut a un error d'execució inesperat), es perd la comunicació amb el lector, i no es pot recuperar fins que no se li fa un reset de l'alimentació al lector. Això és un problema de la llibreria que utilitzem per controlar-lo (nfcpy), ja que amb altres llibreries que s'han provat això no passava.

La interfície gràfica d'usuari no ha estat dissenyada per un dissenyador



(a) Interfície d'administració per crear usuaris

(b) Interfície d'administració per gestionar els expenedors

Figura 6.2: Captures de la interfície d'usuari de l'aplicació de client

## Sistema de hardware

El hardware en conjunt està desenvolupat. No obstant, per temes de calendari de l'associació (durant el mes de març l'expenedor està inaccessible, durant l'agost i part de setembre el despatx està tancat), no s'han pogut fer totes les proves que es volia fer.

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Durant el quadrimestre s'han fet petites proves de concepte bàsiques amb èxit:

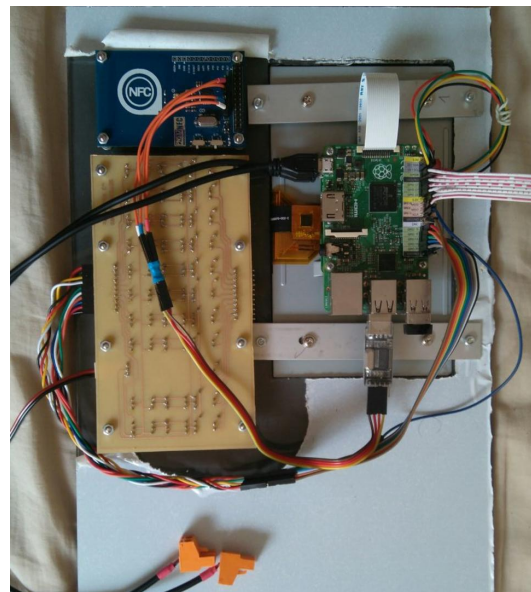
1. Provar d'expendre una llauna amb un relé activant-lo manualment.
2. Provar d'expendre una llauna amb els relés activats per l'aplicació de client.

Més enllà d'això no s'ha pogut integrar el sistema dins de l'expenedor per problemes de calendari i falta de temps.

La unitat de prova ha estat desenvolupada amb èxit i és molt útil per transportar el sistema d'una manera còmode.



(a) Front de la tapa



(b) Revers de la tapa

Figura 6.3: Tapa de la unitat de test

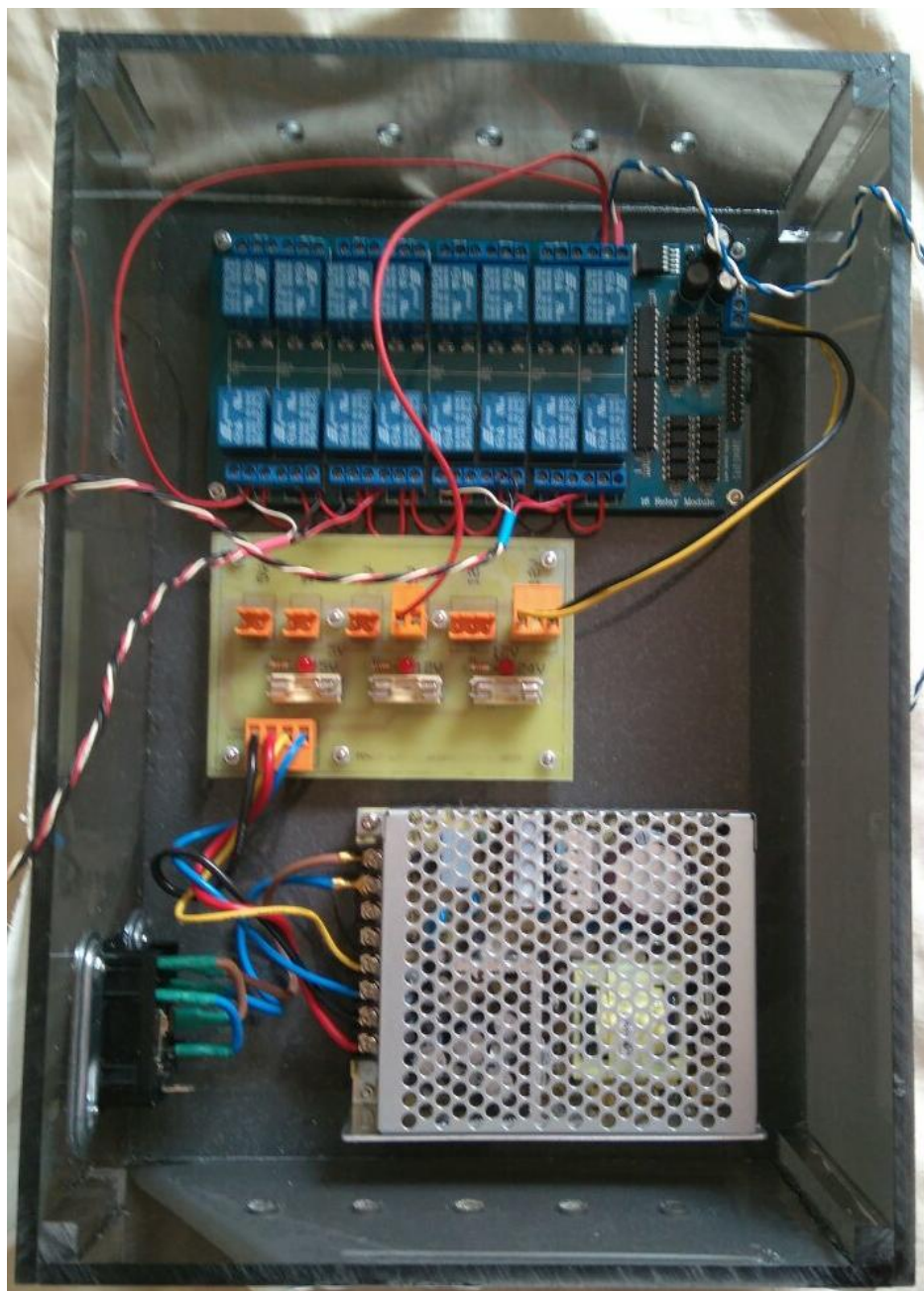


Figura 6.4: Interior de la unitat de test

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# CAPÍTOL 7

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## PRESSUPOST

This TFG project has been developed jointly with the GPI team. The budget presented is divided in Activities. Each Activity corresponds to an specific task, and the division has been done according to the equipment and staff needed to develop each tasks. In this budget are considered not only the activities developed in this project scope, but also the activities that are required to perform this project development.

The Activities that had been taken into account are:

*Activity 1: Recording I.* Captures done using cones as a pattern.

*Activity 2: Recording II.* Captures done using a chessboard as a pattern.

*Activity 3: Undistortion.* Test the different undistortion algorithms.

*Activity 4: Registration, warping and blending.* This Activity includes all the algorithms and methods tested in this TFG project scope and are directly related to the Arcol project.

*Activity 5: Documentation.* Additional activity that includes all the tasks done outside the Arcol project scope -TFG writing, additional tests, etc.-.

Each Activity summarized cost is the following:

Activity	Equipment	Workers	Subtotal
1 Cone recording	197.06 €	290.00 €	487.06 €
2 Chessboard recording	205.83 €	290.00 €	495.83 €
3 Undistortion	46.70 €	1,030.00 €	1,076.70 €
4 Registration. warping and blending	442.00 €	21,000.00 €	21,442.00 €
5 Documentation	66.00 €	3,800.00 €	3,866.00 €
<b>TOTAL</b>			<b>27.367,59€</b>

Each activity detailed costs can be found in Appendix ???. This Appendix also contains each equipment detailed amortization and each worker salary.

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## CAPÍTOL 8

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### CONCLUSIONS I TASQUES FUTURES

En general, en aquest projecte, un cop plantejat el problema a soluciona, el que més temps s'ha hagut d'invertir ha estat l'aprenentatge de com funciona l'expenedor i l'aprenentatge de les eines de programació.

De cara als objectius podem dir que s'ha elaborat un prototip funcional però que encara falta per mecanitzar-lo dins de l'expenedor.

De tasques futures que s'hauran de realitzar sobre el projecte una és la mecanització definitiva del sistema i una altra és el *deploy* de l'aplicació en un servidor.

Una altra cosa que també s'hauria de fer és desenvolupar unes interfícies personalitzades a l'aplicació de servidor per tal de facilitar l'entrada de nous usuaris o bé la

This project has described the procedure followed to obtain an specific image stitching algorithm. This algorithm had to merge the image from four cameras located around a bus in a single 360°view image. The work described in this project has been done in a multidisciplinary UPC team working in a project commissioned by the Arcol company.

First of all, all the requirements and specifications inherited from the Arcol project have been stated. In basis on these requirements, a research in the current stitching methods has been done, including both commercial systems and high-level algorithms.

The next part included in this project have shown the used methods in the steps inside this TFG scope. From the four different stitching steps –undistortion, registration, warping and blending–, only warping have been fully developed in this project. Table 8.1 shows each step internal tasks and its final status.

<i>Stitching step</i>	<i>Internal task</i>	<i>Status</i>
Undistortion	Search and test undistortion algorithms	Done by another team member
	Apply the final algorithm	Done by the project author
Registering	Automatic registering	Not done
	Manual registering	Done by the project author
Warping	Search and test warping algorithms	Done by the project author
	Apply the final algorithm	Done by the project author
Blending	Apply provisional algorithm	Done by the project author
	Search and test blending algorithm	Not done
	Apply the final algorithm	Not done
Unghosting	Segment above ground objects	Not done
	Define an algorithm	Not done
	Apply the algorithm to the stitching	Not done

Taula 8.1: Internal tasks status

Finally, the last part of this project shows the results obtained in the warping process. It can be extracted from the results that the developed algorithm beats the state-of-the-art algorithms for this specific application. As it can be seen in Chapter ??, the *Homography merging* algorithm developed in this project obtains better results than simple homography in this specific application.

Regarding to the initial goals of this project, the results obtained in each point can be summed up as follows:

*Representative points automatic detection.* The automatic key points detection has been left outside this project scope, and has been left to a future development.

*Estimate the warping parameters.* The warping parameters and warping algorithm had been estimated successfully.

*Blending the results on the final stitching.* Blending algorithms have been tested and the feathering selected offers an acceptable performance for the project.

*Follow the requirements stated by the Arcol project.* Regarding the Arcol specifications, this project is fully adapted to be used with the specific hardware and software. Moreover, the land lines discontinuity has been fully fulfilled. Exposure compensation and avoiding host images has been left to the Arcol project future development.

The overall project assessment is that, although not completely fulfilling all the goals stated at this project beginning, the results obtained in the developed parts are fully satisfactory. At the project start, the warping process has stated to be a trivial part, by simply applying the homography method. However, the development has arose many issues a priori not taken into account. These difficulties had recommended a change in the project direction, focusing on obtaining a more precise warping algorithm. This development sprung good results –and many discarded algorithms– and establish a base-line for the future development.

This project had left the development in a solid stage, with several work strands to be followed. First of all, an automatic registration algorithm can be implemented on



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the final product. This algorithm should automatically detect the chessboard corners and automatically do the key points registration. Another opened work strand is the definitive blending algorithm, directly bounded up with the above ground object treatment. In this part, an algorithm has to be defined to manage this objects and obtain the minimum image distortion.



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# APÈNDIX A

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## DESCRIPCIÓ DE LES TASQUES

Document: critical_review.pdf	Project Critical Review <b>Prototype of a Cashless System</b>	 
Date: 09/05/2016		
Rev: 01		
Page 6 of 8		



## 2. UPDATED WORK PLAN

### 2.1. Updated Work Packages, Tasks and Milestones

Project: Prototype of a cashless system	WP ref: WP1	
Major constituent: Programming Learning	Sheet 1 of 6	
Short description: Learn python language and other software concepts that will be needed in the software development in order to design the software system.	Planned start date: 01/02/2016 Planned end date: 12/03/2016	
	Start event: T1 End event: T2	
Internal task T1: Learn python. Internal task T2: Learn to use other needed tools.	Deliverables: None	Dates: None

Project: Prototype of a cashless system	WP ref: WP2	
Major constituent: System design	Sheet 2 of 6	
Short description: Design of the whole system (software and hardware) fulfilling the project requirements and specifications  Also will have to do all proofs of concept to ensure that the design is feasible.	Planned start date: 28/02/2016 Planned end date: 26/02/2016	
	Start event: T1 End event: T4	
Internal task T1: Design server application Internal task T2: Design client application Internal task T3: Design hardware system Internal task T4: Proofs of concept	Deliverables: None	Dates: None

Project: Prototype of a cashless system	WP ref: WP3	
Major constituent: System development	Sheet 3 of 6	
Short description: Develop the system following the system design.	Planned start date: 27/03/2016 Planned end date: 28/05/2016	
	Start event: T1 End event: T3	
Internal task T1: Develop the server application Internal task T2: Develop the client application Internal task T3: Develop the hardware system	Deliverables: None	Dates: None

Document: critical_review.pdf	Project Critical Review <b>Prototype of a Cashless System</b>	 
Date: 09/05/2016		
Rev: 01		
Page 7 of 8		

Project: Prototype of a cashless system	WP ref: WP4	
Major constituent: Design the test unit	Sheet 4 of 6	
Short description: Design the test and demonstration unit that will be portable to show the results of the project	Planned start date: 29/05/2016	
	Planned end date: 02/06/2016	
	Start event: T1	
	End event: T1	
Internal task T1: Design the test unit	Deliverables: None	Dates: None

Project: Prototype of a cashless system	WP ref: WP5	
Major constituent: Develop the test unit	Sheet 5 of 6	
Short description: Develop the test unit that will be used in the presentation following the design.	Planned start date: 03/06/2016	
	Planned end date: 09/06/2016	
	Start event: T1	
	End event: T2	
Internal task T1: Develop the test unit	Deliverables: None	Dates: None
Internal task T2: Test the system on the test unit		

Project: Prototype of a cashless system	WP ref: WP6	
Major constituent: Writing	Sheet 6 of 6	
Short description: Write down the final degree project	Planned start date: 10/06/2016	
	Planned end date: 27/06/2016	
	Start event: T1	
	End event: T1	
Internal task T1: Write the final document	Deliverables: Final degree project	Dates: 27/06/2016

## Milestones

WP#	Task#	Short title	Milestone / deliverable	Date (week)
2	4	Proofs of concept	Validated Design	26/02/2016
3	3	System development	System developed	07/05/2016
5	2	Test Unit Development	System tested on test unit	09/06/2016
6	1	Final Degree Project	Document	27/06/2016

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## APÈNDIX B

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### MANUAL D'ÚS DE L'EXPENEDOR



# **SERVICE MANUAL**

**Series 90 Single Price Venders**

**January 1, 1992**

**Beginning serial #0001-6000**



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<b>Product Shimming.....</b>	<b>16</b>
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	<b>WILLISTON, SC</b>
Phone:	(800) 688-9090
Phone:	(803) 266-5000
FAX:	(800) 266-5150

<b>EASTLAKE, OH</b>
(800) 321-0765
(216) 946-3000
(216) 942-1835

## **GENERAL INFORMATION**



## **VENDER SAFETY PRECAUTIONS**

**This service information is intended to be used by a qualified service technician, who is familiar with proper and safe procedures to be followed when repairing, replacing or adjusting any Dixie-Narco vender components. All repairs should be performed by a qualified service technician who is equipped with the proper tools and replacement components, using genuine Dixie-Narco factory parts.**

**Repairs and/or servicing attempted by uninformed persons can result in hazards developing due to improper assembly or adjustments while performing such repairs. Persons not having the proper background may subject themselves to the risk of injury or electrical shock which can be serious or even fatal.**

## MODELS & DETAILS

### DNCB 168

Height:	56-11/16
Width:	28-5/16
Depth:	29
Shipping Wt.:	462 lbs.
Capacity:	
Can, 12 oz.	174
10 oz. PLB	168

### DNCB 180

Height:	56-11/16
Width:	28-5/16
Depth:	30-1/2
Shipping Wt.:	462 lbs.
Capacity:	
Can, 12 oz.	190
10 oz. PLB	180

### DNCB 276

Height:	72
Width:	28-5/16
Depth:	30-1/2
Shipping Wt.:	573 lbs.
Capacity:	
Can, 12 oz.	282
10 oz. PLB	264

### DNCB 300

Height:	72
Width:	29 1/2
Depth:	30 1/2
Shipping Wt.:	536 lbs.
Capacity:	
Can, 12 oz.	300
10oz.PLB	300

### DNCB 348

Height:	72
Width:	37-1/16
Depth:	30-1/2
Shipping Wt.:	690 lbs.
Capacity:	
Can, 12 oz.	350
10 oz. PLB	328

### DNCB 360

Height:	72
Width:	37-1/16
Depth:	30-1/2
Shipping Wt.:	670 lbs.
Capacity:	
Can, 12 oz.	372
10 oz. PLB	348

### DNCB 368

Height:	72
Width:	37-1/16
Depth:	30-1/2
Shipping Wt.:	690 lbs.
Capacity:	
Can, 12 oz.	376
10 oz. PLB	352

### DNCB 414

Height:	79-1/2
Width:	37-1/16
Depth:	30-1/2
Shipping Wt.:	748 lbs.
Capacity:	
Can, 12 oz.	416
10 oz. PLB	396

### DNCB 432

Height:	79-1/2
Width:	37-1/16
Depth:	30-1/2
Shipping Wt.:	716 lbs.
Capacity:	
Can, 12 oz.	444
10 oz. PLB	432

### DNCB 440

Height:	79-1/2
Width:	37-1/16
Depth:	30-1/2
Shipping Wt.:	748 lbs.
Capacity:	
Can, 12 oz.	448
10oz.PLB	432

### DNCB 501T

Height:	72
Width:	37-1/16
Depth:	32
Shipping Wt.:	695 lbs.
Capacity:	
Can, 12 oz.	501
Bottle, 16oz.PLB	280

### DNCB 522T

Height:	72
Width:	37-1/16
Depth:	32
Shipping Wt.:	672 lbs.
Capacity:	
Can, 12 oz.	522
Bottle, 16oz.PLB	336

### DNCB 600T

Height:	79-1/2
Width:	37-1/16
Depth:	32
Shipping Wt.:	800 lbs.
Capacity:	
Can, 12 oz.	600
Bottle, 16oz.PLB	340

## **PRODUCT WARRANTY**

Dixie-Narco warrants to the purchaser of a Dixie-Narco unit all parts thereof (except light bulbs, fuses or finish) to be free from defects in material and workmanship, under normal use and service for a period of 12 months from the date of shipment from either our plant or warehouse.

All conditions as set forth in this Warranty apply also to the Dixie-Narco Dollar Bill Validator, which is warranted for 15 months based on the coded date on the serial plate of the Validator or 12 months from the date of shipment, whichever is greater.

Dixie-Narco's obligation under this warranty is limited to repairing or replacing without charge any part, including the Dixie-Narco Validator which, upon our examination and to our satisfaction, was defective in material or in workmanship and which failed under normal operating conditions and service.

The hermetically sealed refrigeration system (included in the machine), consisting of the motor compressor, condenser, evaporator and the refrigerant tubing, is warranted for a total period of 60 months from date of shipment of the vender.

The vend motor is warranted for a total period of 60 months from date of shipment of the vender.

The 60-month warranty does not apply to any electrical controls, fan motors, overload switches, starting relays, temperature controls, wiring harnesses, cabinet or finish. Dixie-Narco's obligation under this warranty on the sealed refrigeration system referred to above is limited to repairing and returning or replacing at Dixie-Narco's option any unit with a similar unit when, upon examination and to our satisfaction, it was determined to have been defective. If our examination reveals that the unit is inoperative because of a defective accessory, both cost of repairs and freight charges will be paid by the customer.

Dixie-Narco will pay transportation charges under this warranty on all parts replaced or repaired when transportation has been made in the most economical way. If special handling or special transportation is used or requested, the charges will be paid by the customer.

This warranty only applies to units located within the United States and Canada and when operated in normal conditions and with electrical power supplies of 110/120 volts, 60 cycle. Further, the warranty is voided when the serial number is missing or when a unit or any part has been subject to defacing, vandalism, misuse, neglect, alteration without proper authorization, accident or damage caused by transportation, flood, civil disorder, fire, or the Acts of God.

"Return Material Tags," indicating model number of unit, serial number and explanation of defect, must accompany all returned parts or units. "Return Material Tags" will be furnished upon request.

Effective Date: December 1, 1987, 0730

Reprint: January 1, 1992

# **INSTALLATION & SET-UP**

# **SERIES 90 CAN AND BOTTLE VENDER INSTALLATION & SET-UP**

## **RECEIVING INSPECTION:**

When the venders are received inspect them for any damage. If there is any damage, have the delivery driver note the damages on the bill of lading. According to I.C.C. regulations, shipping damage claims must originate with the consignee. Please advise Dixie-Narco as soon as possible if any shipping damage has occurred. Dixie-Narco will be happy to assist you if you must file a shipping damage claim.

## **UNPACKING THE VENDERS**

Remove the stretch wrap and top covers from the venders. If flavor labels were shipped with the venders they will be in an envelope taped to the back of a vender in the shipment.

**NOTE: DO NOT STORE THE VENDERS OUTSIDE WITH THE STRETCH WRAP ON.  
THIS COULD CAUSE THE STRETCH WRAP TO BOND TO THE VENDER'S  
SURFACE WHICH COULD DAMAGE THE FINISH.**

To open the vender, remove the shipping boards from the bottom of the vender. The shipping boards are fastened to the base with the leveling legs. Remove the shipping boards by removing the leveling legs to avoid damage to the leveling legs or the base. A 1½ inch socket type wrench can be used on the bottom of the leveling legs. The door lock keys will be found taped in the coin return cup. Remove the keys and open the vender door. Remove all internal packaging. Check the coin box on the door for any extra parts, pricing labels, or other information on any factory equipped accessories. Check the "T" handle for proper alignment and locking function. Check all lamps for proper function.

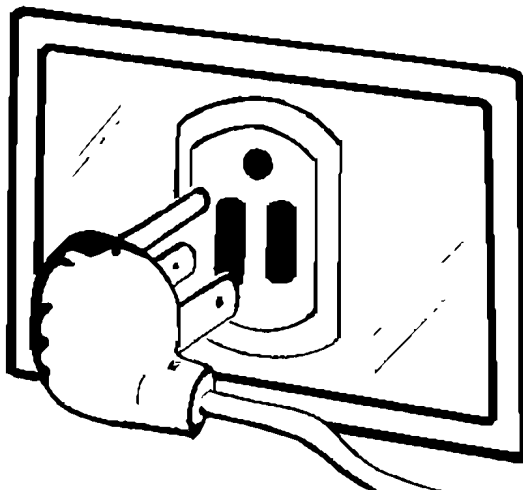
## **ELECTRIC POWER NEEDED**

The vender uses 115 volts single phase, 60 cycle, alternating current. The voltage must be between 103 and 127 volts. Look at the cabinet serial number plate to determine how much current the vender requires. Be sure the vender is plugged into a circuit which will provide correct amperage, with its own circuit protection (fuse, circuitbreaker). Do not use an extension cord.

## **GROUND THE VENDER**

The vender is equipped with a three wire grounded power supply cord. The vender must be plugged into a properly wired grounded outlet. **DO NOT REMOVE THE GROUND PIN OR USE ANY TYPE OF 3 PRONG TO 2 PRONG ADAPTOR.**

**WARNING:** Failure to comply with these instructions may subject the user to the risk of injury or electrical shock which can be serious or fatal.



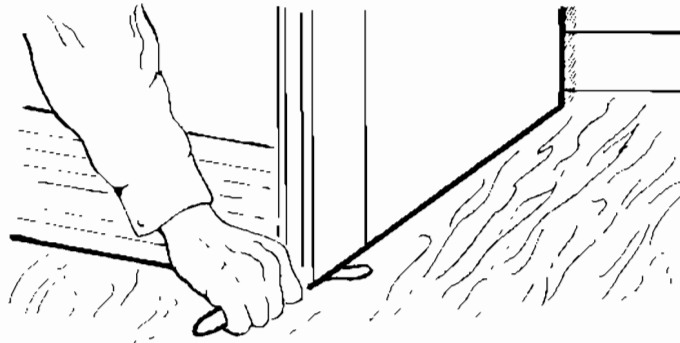
## PLACING THE VENDER ON LOCATION

**CAUTION: DO NOT TRANSPORT THE VENDER TO OR FROM THE LOCATION LOADED WITH PRODUCT OR DAMAGE TO THE VENDER MAY RESULT.**

The vender should be located on a solid, as flat as possible, surface. **CAUTION: Local loading under the leg levelers must be capable of 225 P.S.I.** The vender must be positioned close enough to an electrical outlet that an extension cord is not required. If securing the vender to the floor or wall is required, call the Dixie-Narco Service Department for securing suggestions.

## LEVEL THE VENDER

Level the vender. When the vender is level the door can be opened to any position and it will not move by itself. Try it half closed, straight open and wide open before deciding that the vender is level. Make sure that all of the leveling legs are touching the floor.



**DANGER:** The vender must be properly located and leveled to minimize the risk of injury or death from tip over in the event of user misuse or vandalism.

## SPACE THE VENDER

Do not block the rear of the vender. Maintain a minimum of 4 inches from the wall to provide adequate ventilation for the condenser and compressor. Also, in front of the vender, make sure that nothing obstructs the air intake at the bottom of the main door.

## LOADING THE VENDER

All Series 90 Venders are shipped ready to vend 12 oz. cans unless another package was specified at the time the vender was ordered from the factory. If a package other than a 12 oz. can is to be vended contact a Dixie-Narco Factory Service Representative, or refer to the proper Service Bulletin, for spacer settings and shims.

## INITIAL LOADING

Oscillators must be in the extreme left or right position to insure proper loading. When loading wide columns, the first row of cans should be loaded on the bottom bar of the oscillator. The second row of cans must be loaded on the top bar of the oscillator. Always load complete rows, do not load only to the back or only to the front of the column. Rotors must be in the "cup" position to receive the first cans. When loading narrow columns lay the rows in the column until the column is full.

Do not fill the columns to the top of the cabinet. Allow about 3 inches at the top of the column because the can stack will move up and down in the column during the vend cycle. Correct loading will prevent service calls and insure proper vending.

After loading a vender for the first time test vend each selection with money until the first can is delivered. This will ensure that the vender is loaded and working properly.

**NOTE: TO INSURE PROPER AIR FLOW THROUGH THE EVAPORATOR, DO NOT PLACE CANS (OR OTHER FOREIGN OBJECTS) IN THE BOTTOM OF THE TANK.**

COIN CHANGERS AND OTHER ACCESSORIES

The Series 90 Vender must have a single price coin changer installed. Most styles can have a bill acceptor installed. If the coin changer and other accessories are not factory installed, refer to the instructions received from the manufacturer of the coin changer and other accessories for proper set-up and installation.

INSTALLING A SINGLE PRICE COIN CHANGER

Set the vend price according to the instructions for the coin changer. Also, set the escrow mode in the coin changer to "Escrow To Price" and if required, set the coin changer for the proper bill acceptor interface. Hang the coin changer on its mounting panel and secure it by tightening the 3 securing screws. Plug the coin changer into the 8 pin Jones socket in the vender. Manually load all coin changer coin tubes with at least 10 coins each, and, "Prime" the coin changer by making one correct change transaction.

**NOTE: If a bill acceptor is being used the bill acceptor must be interfaced to the coin changer. Refer to the instructions provided by the manufacturer of the coin changer and the bill acceptor.**

The following single price coin changers will work properly with the Series 90 Vender.

MARS Electronics Int.		Coin Acceptors, Inc.		Crane International Currency	CONLUX-USA
TRC 6200	MC 5802	3340-S	S75-9400B-977	525E	US-111A-1
TRC 6200C	MC 5800	9340-S	S75-9800B-907	525C	US-111A-1D
TRC 6800	MC 5800 DH	9360-S		525EC	USA-121 A-OC
TRC 6800 H		9370-S		500	
TRC 6800 C		S300E9240		510	
TRC 6800 HC					

**\*NOTE: The Crane International models listed are not approved by CSA as of manual publication dates.**

INSTALLING FLAVOR CARDS

The flavor cards are inserted into the selection buttons. To insert the flavor cards into the selection buttons swing the coin changer mounting plate away from the outer door exposing the back of the selection buttons. The flavor cards can be inserted into the back of the selection buttons from, either side. Ensure that the flavor cards are placed in the selection buttons that correspond to the columns the product is in.

## — CHECK IT OUT —

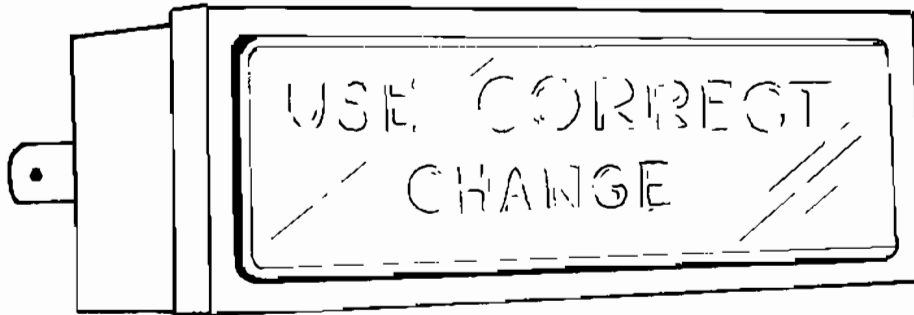
WHAT TO DO	WHAT SHOULD HAPPEN
Plug the power cord in.	The compressor runs, condenser fan runs, evaporator fan runs, "Correct Change Only" window lights and "Sold Out" lamps light.
Load a few cans into each column (above sold out).	Sold Out lights go off.
Close the vender door.	And
Put in correct change.	And
Push a select button.	Product is dispensed and delivered
If a dollar bill validator is used: Load the changer with at least 10-Quarters, 10-Dimes and 10-Nickels. Prime the coin changer, insert \$1 bill into validator.	Correct change is paid back.
Push a select button.	Product is dispensed and delivered.
Once the vender is placed on location, load the changer money tubes and fully load the vender with warm product.	Return to the vender the next day and check that a cold product is dispensed from each column; the first product vended has a temperature of 32° to 34° F.



# **ELECTRICAL PARTS & THEIR FUNCTIONS**

# ELECTRICAL PARTS AND FUNCTIONS

## CORRECT CHANGE LAMP

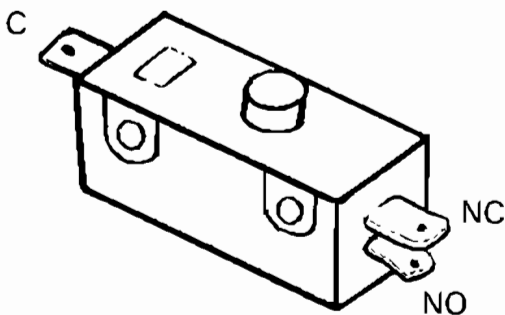


Correct Change Lamp

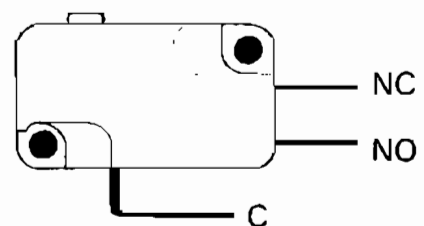
The correct change lamp is mounted in the coin insert casting and is retained by projections on the top and bottom.

The correct change lamp is controlled by the coin changer and is "OFF" when coins are in the tubes.

## SELECT SWITCH



OR



Select Switch

The select switch is located in the selector panel behind the push button and is secured with two (2) screws.

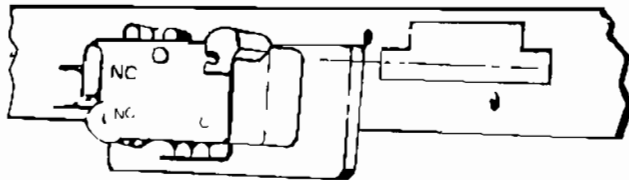
The N.O. contact of the Select Switch is in the sold out lamp and vend motor coil circuits. This N.O. contact closes and completes the sold out lamp circuit and the vend motor coil circuit.

The N.C. contact of the Select Switch is in the Select Panel Circuit.

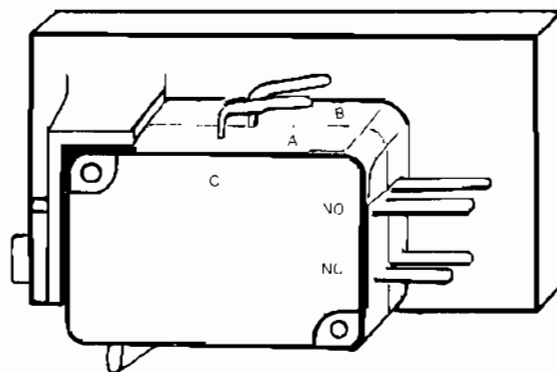
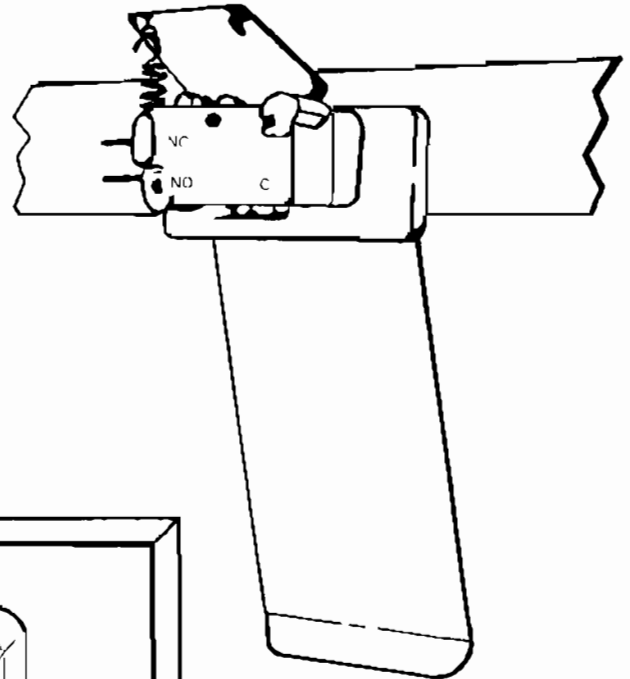
## **SOLD OUT SWITCHES** (2 in a cluster)

The Sold Out Switches are located on the front mechanism plate under the Vend Motor Cover.

The Sold Out Switches are the "snap in" type. To install, place the switch in position over the opening, push in and at the same time, slide to the right.



**SOLD OUT SWITCH PACK**



**Sold Out Switch Pack**

The sold out switch pack (one for each vending circuit) is located near the bottom of the column at the front and snaps into place.

### **(A) Front Sold Out Switch** (one for each column)

The N.C. contact of the front sold out switch is in the Vend Relay Coil Circuit and the Coin Changer Inhibit Circuit. This N.C. contact (kept closed by can or bottle) is in parallel with all the other N.C. contacts of the Front Sold Out Switches and when all are open, the coin changer will not accept coins.

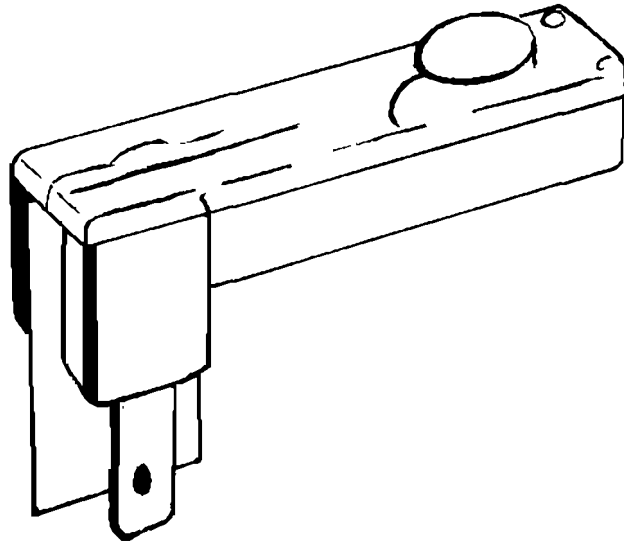
The N.O. contact of the front sold out switch has no function.

### **(B) Vend Sold Out Switch** (one for each vending circuit)

The N.C. Contact of the Vend Sold Out switch is in the Vend Motor Circuit. This N.C. contact (held closed by can or bottle) stays closed in the vend motor circuit so the Vend Motor Circuit can be completed.

The N.O. contact of the Vend Sold Out Switch is in the Sold Out Lamp circuit (kept open by a can or bottle). When not kept open by a can or bottle, the N.O. contact closes and completes the Sold Out Lamp circuit.

## SOLD OUT LAMPS



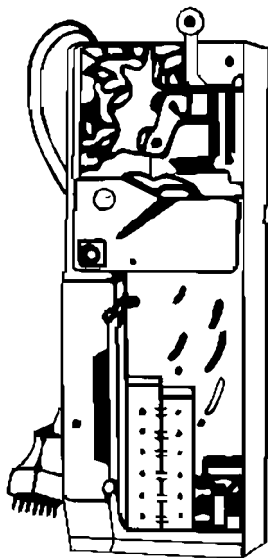
Sold Out Lamp

The Sold Out Lamp (one for each vending circuit) is secured to the back of the select button in the Selector Panel.

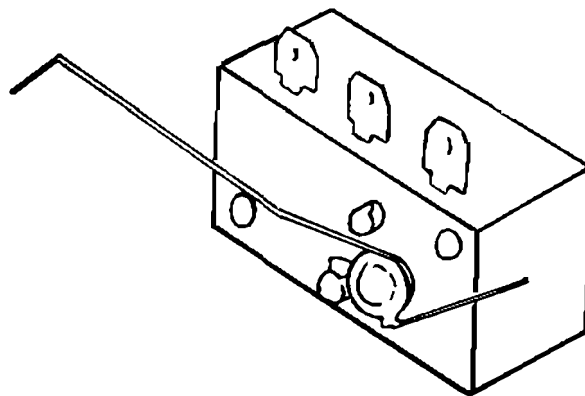
The Sold Out Lamp is turned on by the closing of the N.O. contacts of the Vend Sold Out Switch.

## COIN VEND SWITCH

(Coin Changer)



Coin Changer



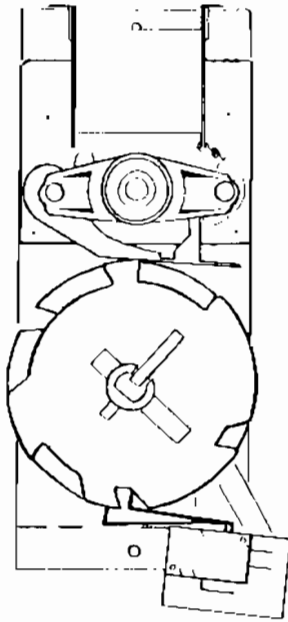
Coin Vend Switch  
(Used in mechanical coin mechs)

The Coin Vend Switch is located below the slug rejector and is fastened to the coin changer housing with two (2) screws and nuts.

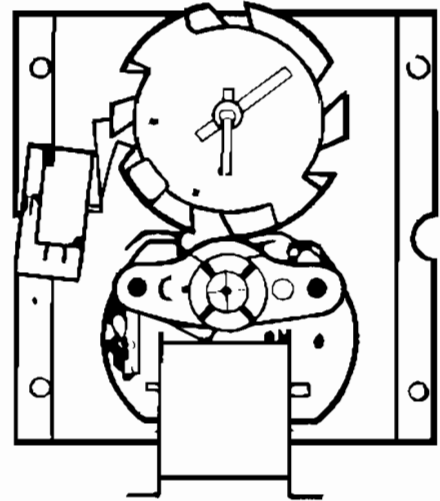
The N.O. contact of the Coin Vend Switch is in the vend relay coil and the coin changer magnet circuits. This N.O. contact closes and completes the vend relay coil circuits.

The N.C. contact of the Coin Vend Switch is in the Vend motor coil circuits. This N.C. contact closes in the vend motor coil circuits to set up these circuits so that a selection can be made.

## VEND MOTOR



For Narrow Column

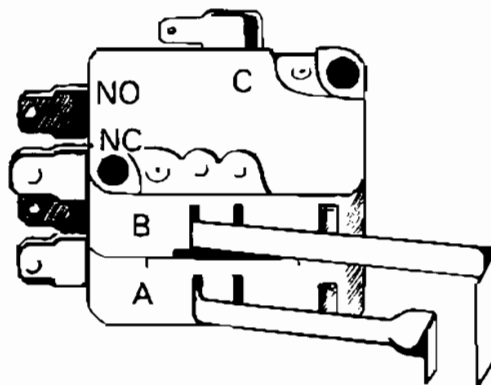


For Wide Column

The Vend Motor (one for each vending stack) is mounted on a bracket at the front of the vender.

The Vend Motor is in the Vend Motor Coil Circuit. The Vend Motor runs when a N.O. select switch (pushed) closes and completes the Vend Motor Coil Circuit. The Vend Motor continues to run through the N.O. contact (closed by the Vend Motor Cam) of the Vend Motor Switch. The Vend Motor stops when the Vend Motor Switch arm drops off the high side of the Vend Motor Cam.

## VEND MOTOR SWITCH



A. Vend Motor Switch

The Vend Motor and the By-Pass Switches are together and do not come apart. The **Vend Motor Switch**, one (1) for each circuit, is located on the Vend Motor Assembly and secured by two (2) screws.

The N.O. contact of the Vend Motor Switch is in the Vend Motor Coil Circuit. This N.O. contact closes in the Vend Motor Coil Circuit to keep the Vend Motor running and at the same time lights the sold out light, until the arm of the Vend Motor Switch drops into the cam notch and the Vend Motor stops.

The N.C. contact of the Vend Motor Switch has no function.

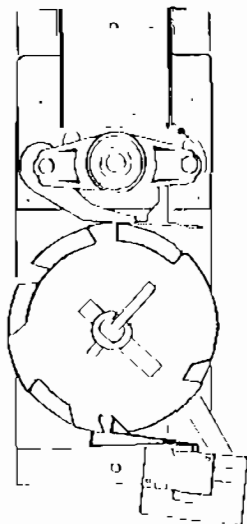
## B. BY-PASS SWITCH

The Vend Motor and the By-Pass Switches are together and do not come apart. The **By-Pass Switch**, one (1) for each circuit, is located on the Vend Motor Assembly secured by two (2) screws. This switch is a by-pass around the Vend Motor Switch to keep the Coin Changer Inhibit Circuit closed if the Vend Motor stops or is stopped when the arm of the Vend Motor Switch is top side of the vending cam, i.e., all other vending circuits are operative.

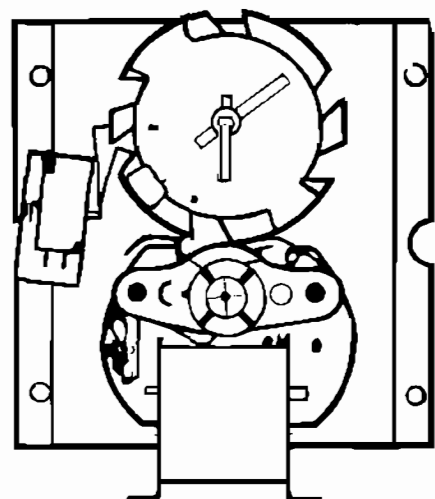
The N.O. contact of the By-Pass Switch, (held closed by the vending cam), is in the Coin Changer Inhibit Circuit. Shortly after the beginning of the vending cycle, the arm of the switch (worked by the vending cam) drops into the cam notch and this N.O. contact opens in the Coin Changer Circuit. When the arm of the switch reaches the top side of the cam, this N.O. contact closes in the Coin Changer Circuit and remains closed at the end of the vending cycle.

The N.C. contact of the By-Pass Switch is in the Coin Changer Circuit. This N.C. contact opens in the Coin Changer Circuit. The N.C. of the By-Pass Switch is also in the Vend Motor Coil Circuit. The N.C. contact closes in the vend motor coil circuit to keep vend motor running until the N.O. contact of vend motor switch closes to keep the vend motor running.

## HOW THE VEND/BY-PASS SWITCHES WORK



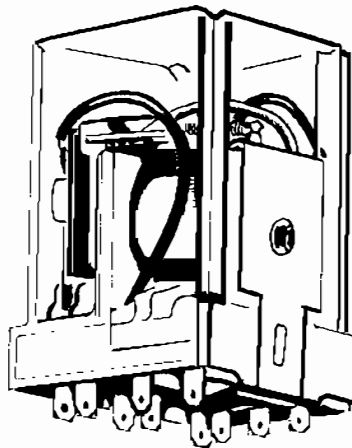
**For Narrow Column  
Fig. 1**



**For Wide Column  
Fig. 2**

1. See the Vend Motor and Vend Motor switches in the stand-by position Figure 1 and Figure 2. The Arm of the Vend Motor Switch A is in the cam notch - Figure 2. The Arm of the By-Pass Switch B is on top of the cam - Figure 2.
2.
  - a. Set up a credit.
  - b. Make a selection.  
(Pushing a select switch causes the vend motor to run and the arm of the by-pass switch drops into the cam notch and breaks the circuit to the vend relay coil [cancels credit].)
  - c. The Vend Motor continues to run through the notch.
  - d. The arm of the Vend Motor switch reaches the top side of the cam causing the vend motor to continue to run.
  - e. A fraction of a second later the by-pass switch arm reaches the top side of the cam and forms a by-pass around the vend motor switch. If a jam occurs, all other selections will work.
  - f. The Vend Motor continues to run to the stand-by position.

## VEND RELAY



### **VEND RELAY SWITCH NO. 1 N.C.** (the N.O. contact is not used)

The N.C. contact of Vend Relay Switch No. 1 is the Coin Changer Inhibit Circuit. When this N.C. contact opens the Coin Changer is inhibited.

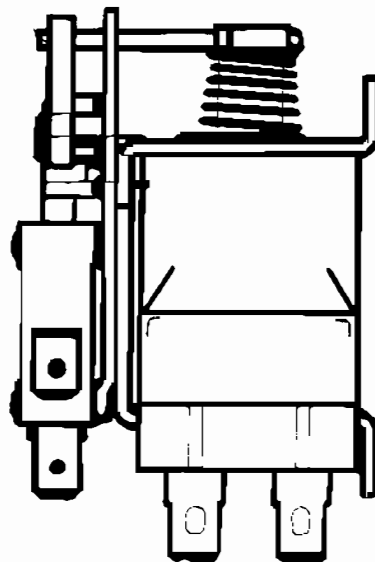
### **VEND RELAY SWITCH NO. 2 N.O.** (The N.C. contact is not used)

The N.O. contact of Vend Relay Switch No. 2 is in each of the Vend Motor Coil Circuits. This N.O. contact closes in the Vend Motor Coil Circuits to set up these circuits so that a selection can be made.

### **VEND RELAY SWITCH NO. 3 N.O.** (The N.C. contact is not used)

The N.O. contact of Vend Relay Switch No. 3 is in the Vend Relay Coil Circuit. This N.O. contact closes and keeps the Vend Relay Coil Circuit completed.

## **SEQUENCE RELAY** (Not on all Venders)



The sequence relay is located on a bracket, adjacent to the vend relay (credit relay) on the main door and secured with two (2) screws.

When a credit is set up by the Coin Changer and the vend relay is energized, the N.O. vend relay switch #2 closes and completes the sequence relay coil circuit.

The sequence relay coil circuit is broken when any N.C. select switch opens in the sequence relay coil circuit.

## VEND MOTOR WIDE COLUMN

Mounted on the vender with the Vend/By-Pass switches on the left side (See Fig. 3). Linkage and drive arm assembly is used to connect the vend motor to the oscillator. (See Fig. 4)

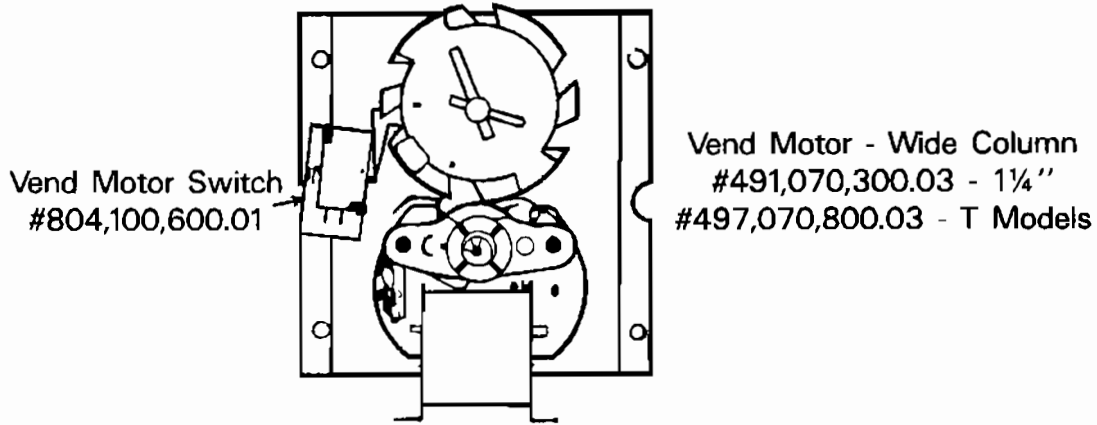


Fig. 3

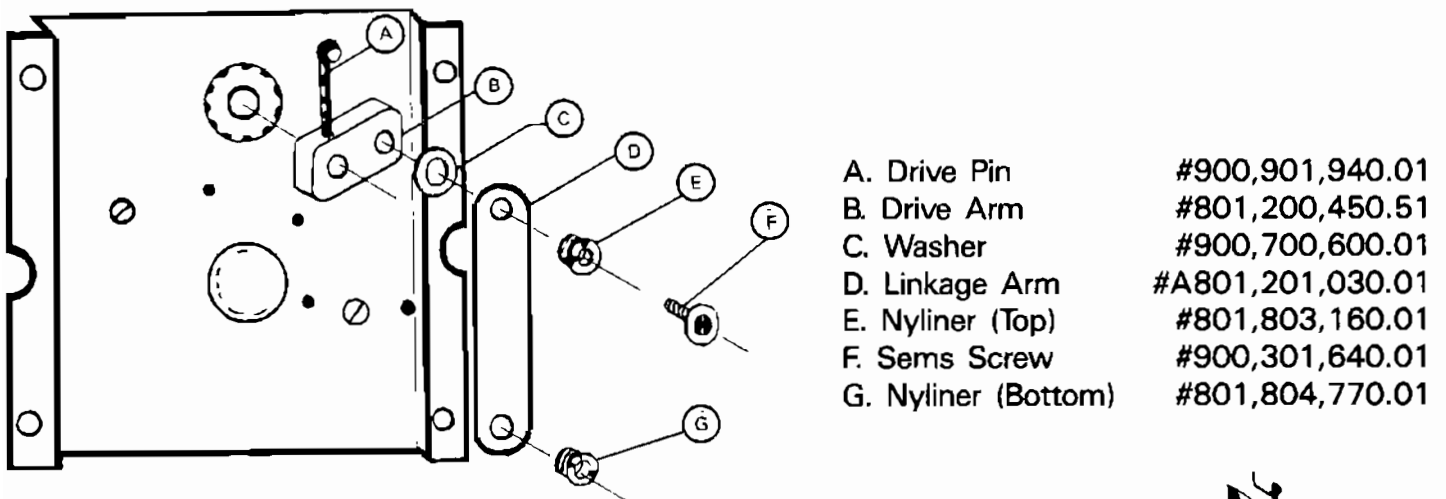
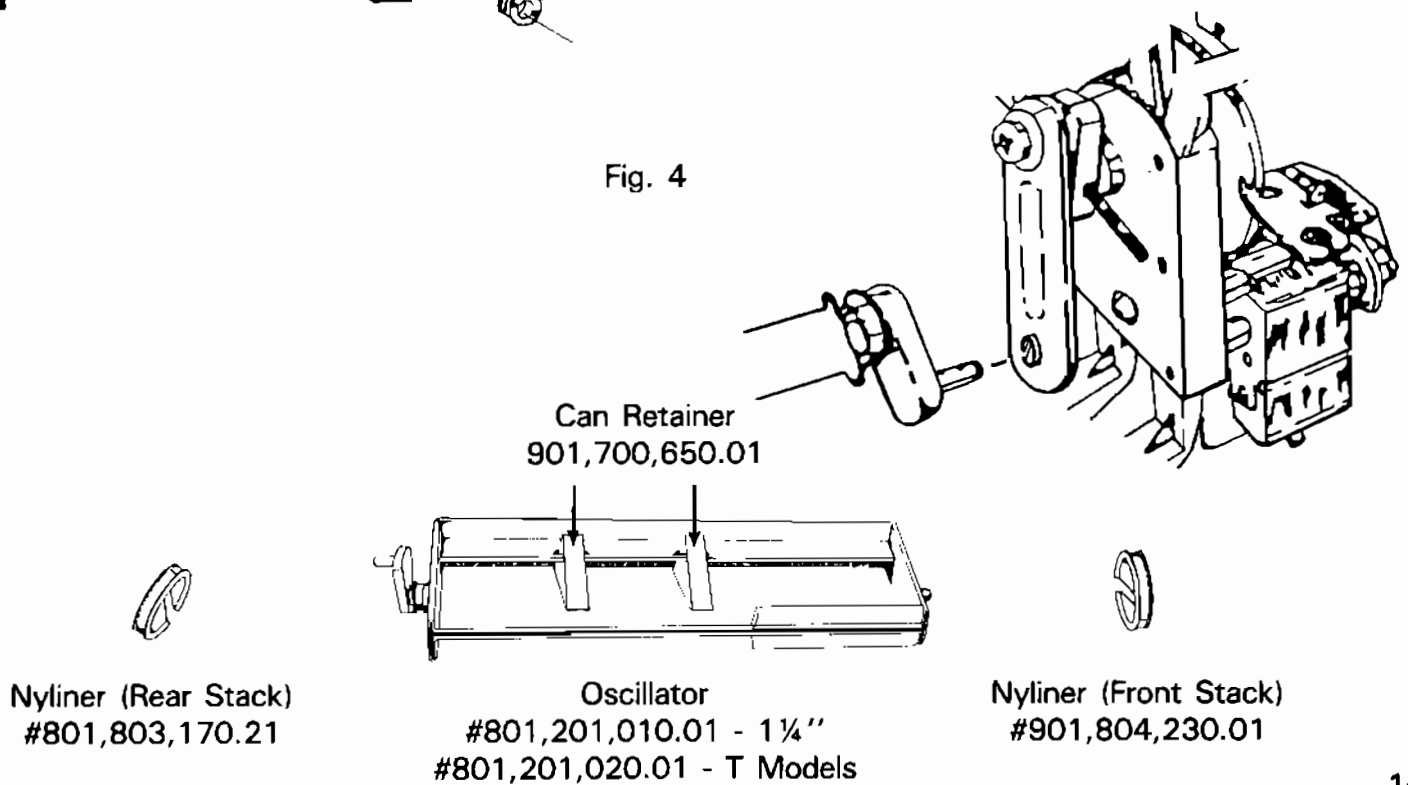


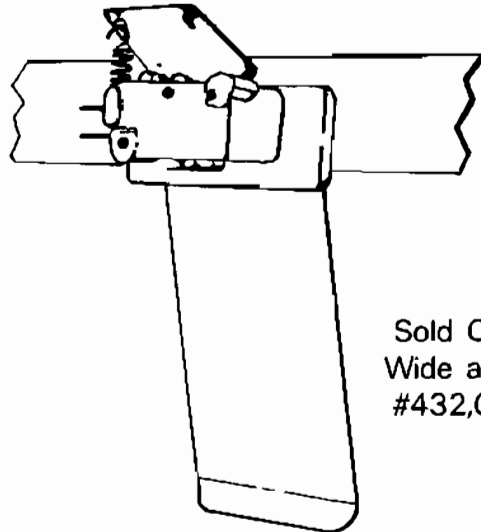
Fig. 4





Sold Out Spring  
#901,700,740.01

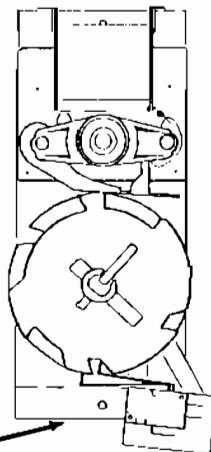
Sold Out Switch Assy. Snap In  
#804,100,610.01  
(Insulator and Switch are  
one (1) piece)



Sold Out Paddle  
Wide and Narrow  
#432,070,190.13

## VEND MOTOR NARROW COLUMN

Mounted on the vender with the Vend/By-Pass switches on the underside (See Fig. 1). Shaft of the vend motor slides into a slot in the vend rotor (See Fig. 2).



Vend Motor - Narrow Column  
#491,070,400.03 - 1 1/4"  
#497,070,900.03 - T Models

Vend Motor Switch  
#804,100,600.01

Fig. 1

(No Nyliner Required)

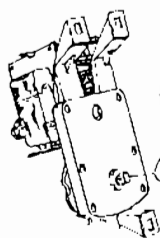


Fig. 2

Vend Rotor  
#801,201,211.61 - 1 1/4"  
#801,201,230.01 - 489/588  
#801,201,220.01 - T Model



Nyliner (Rear Stack)  
#801,803,170.21

# **PRODUCT SHIMMING**

## **PRODUCT SHIMMING**

Refer to the appropriate service bulletin for proper set-up and vending procedures.

**SERVICE BULLETIN 377 -** For 5, 6, 8, and 10 column Adaptable and Dual Adaptable 1¼" Deeper Shimless Stack venders. Serial #'s 0001-3098AN and up. Also, identified with a large decal on motor cover or sold out bar cover reading; **SHIMLESS STACK**

**SERVICE BULLETIN 247 -** For 5, 6, 8, and 10 column Adaptable and Dual Adaptable 1¼" Deeper pre-series 90 venders. Serial #'s 001-2569CG to 0001-3098AN.

**SERVICE BULLETIN 282 -** For 8 column "T" models (501's and 600's). This includes both pre-series 90 and Series 90 T Models. Serial #'s 0001-2775 DI and up.

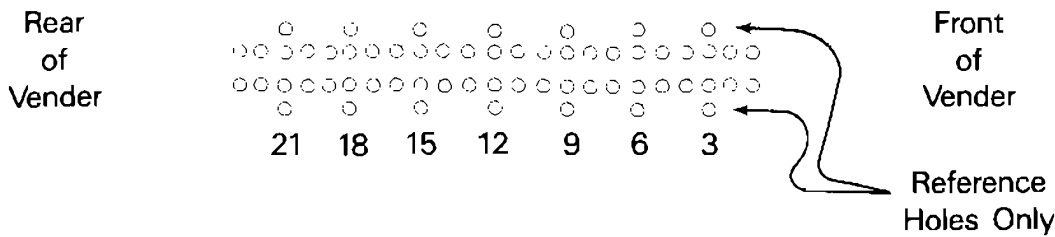
**For shimming of venders or products not listed in the above Service Bulletins, call the Dixie-Narco Service Department or contact your Dixie-Narco Representative.**

# PRODUCT SHIMMING

Refer to proper Service Bulletin for proper set up and vending.

**This page is for reference only.**

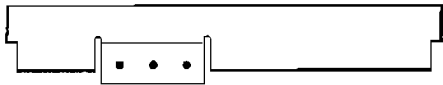
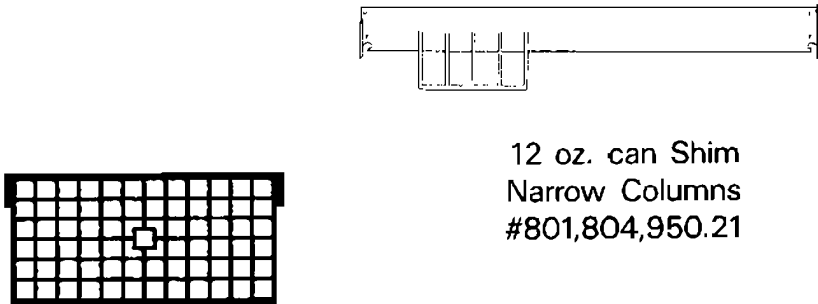
Rear spacer adjustment holes located in the sidewalls of the stacks



The shims and rods shown here are for reference only, i.e., to identify these parts. Refer to corresponding shimming bulletin for shims and rods required per column, for vend cam adjustment on vend motors for both wide and narrow columns for different product vending.

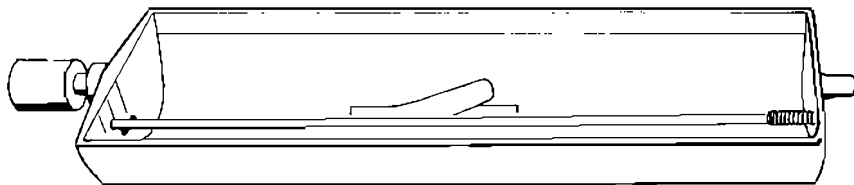
## SHIM & ROD EXAMPLES:

From **SERVICE BULLETIN 247** (1¼" Deeper Pre-series 90 Pre-shimless stack)



12 oz. can Flat Black Shim  
Wide Columns  
#801,804,960.01

10 oz. PLB Shim  
#267,010,230.01



Rotor  
#801, 201, 060.01  
Rod & Spring Assembly  
#267,012,300.03

From: **SERVICE BULLETIN 377** (1¼" Deeper Shimless Stack)

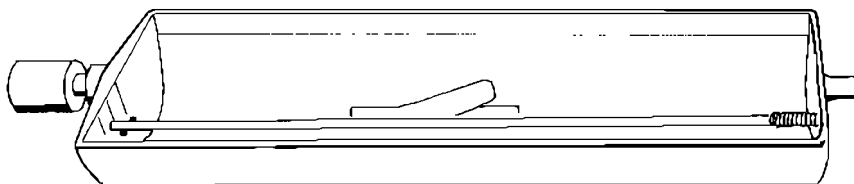
NOTE: No shims are needed to vend 12 oz. cans or 10 oz. PLB bottles.



10 oz. can shim (rimless)  
6 & 8 column venders  
#463,010,010.03



10 oz. can shim (rimless)  
10 column venders  
#350,010,010.03



Rotor  
#801, 201, 210.01  
Rod & Spring Assembly  
#267,012,300.03

From **SERVICE BULLETIN 282** (501T and 600T - triple depth can venders)



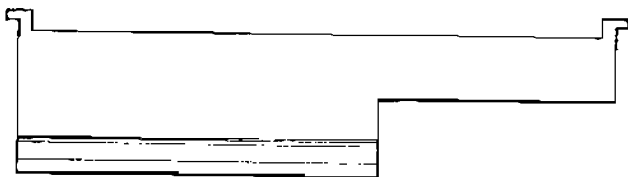
Left hand ribbed shim for 12 oz. cans (shown above)

#801,804,900.01

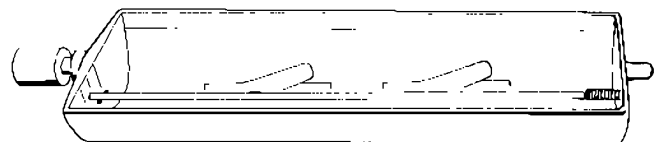
Right hand ribbed shim #801,804,890.01 (Not shown)



Can stop shim  
497,070,130.33



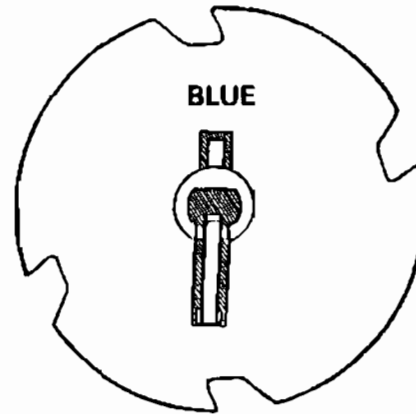
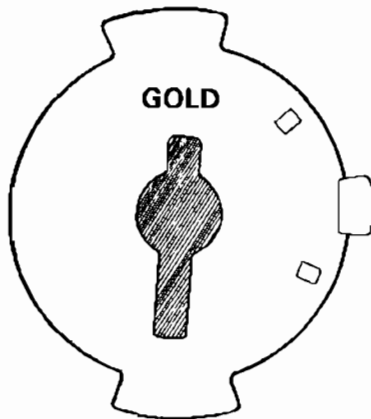
Bubble shim for 16 oz. PLB  
#361,010,080.43



Rotor  
#801, 201, 220.01  
Rod and spring assembly  
#361,010,100.03

## **AJUSTMENTS: CAMS/REAR SPACERS**

## CAMS FOR VEND MOTORS

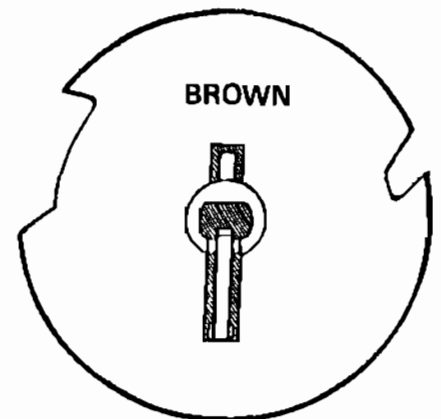
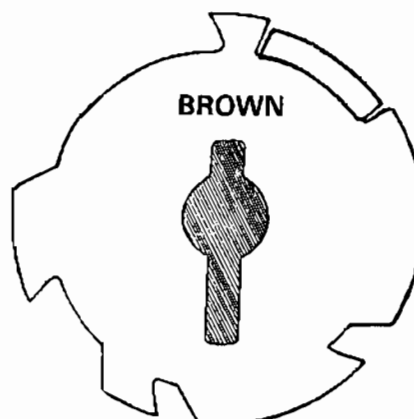
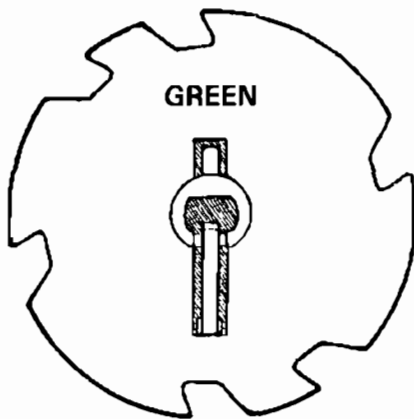


### 1. Adjustable Cam For:

- a. DNCB 1¼" deeper wide column.
- b. DNCB T Models and DNCB 489 and 588 single, double or triple depth wide column.
- c. Color of Cam is Gold.
- d. Part #801,806,400.11

### 2. Vending Cam For:

- a. DNCB 1¼" deeper single and double depth wide column.
- b. DNCB T-Models and DNCB 489 and 588 single depth wide column.
- c. Color of Cam is Blue.
- d. Part #801,806,390.11.



### 3. Vending Cam For:

- a. DNCB T Models and DNCB 489 and 588 double or triple depth wide column.
- b. Color of Cam is Green.
- c. Part #801,806,410.01.

### 4. Adjustable Cam For:

- a. DNCB 1¼" deeper narrow column.
- b. DNCB T Models and DNCB 489 and 588 single, double or triple depth narrow column.
- c. Color of Cam is Brown.
- d. Part #801,806,610.21.

### 5. Vending Cam For:

- a. DNCB 1¼" deeper narrow column.
- b. DNCB T Models and DNCB 489 and 588 single, double or triple depth narrow column.
- c. Color of Cam is Brown.
- d. Part #801,806,180.21.



# CAM INSTALLATION AND REMOVAL

## TO INSTALL A VENDING CAM:

1. Select the vending cam required. (See page 20).
  2. Locate the hub at the center of the cam (See Fig. 6).
  3. With the hub facing you, slowly slide the cam onto the front shaft of the vend motor while depressing the lock tab. (See fig.6).
- NOTE: Reference below for timing of the motors.
4. A distinct click will be heard, when the tab has locked into the locator hole of motor shaft.

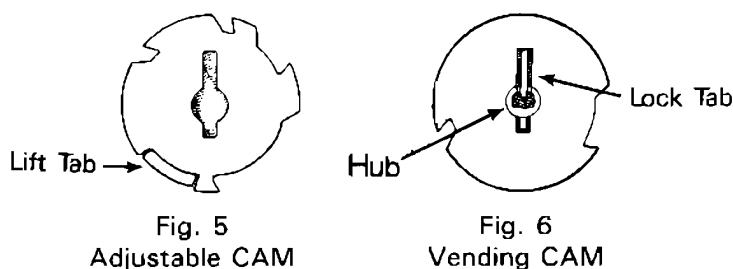
**CAUTION:** Depress the switch arms when installing the cam to prevent possible damage to the switch arms.

## TO INSTALL AN ADJUSTABLE CAM:

1. Select the adjustable cam required. (See page 20).
2. Locate the lift tab on the outer edge of the cam. (See Fig 5).
3. With the lift tab facing you, align the slot of the adjustable cam with the locking tab of the vending cam.
4. Place the adjustable cam onto the vending cam.

**CAUTION:** Depress the switch arms when installing the cam to prevent possible damage to the switch arms.

5. Lift the lock tab of the vending cam, at the same time lift the lift tab of the adjustable cam and rotate the adjustable cam clockwise to the desired setting.



## TO REMOVE AN ADJUSTABLE CAM:

1. Lift the lift tab and rotate the adjustable cam clockwise until the vending cam lock tab is aligned with the slot of the adjustable cam.
2. Remove the adjustable cam from the shaft of the motor.

## TO REMOVE THE VENDING CAM:

1. Depress (push in) the lock tab firmly to disengage it from the motor shaft.
2. At the same time pull the vending cam towards you until it is removed from the motor shaft.

# TIMING

## TO SET THE TIMING OF A NARROW COLUMN VEND MOTOR:

1. Make sure the hole through the rear shaft is in a horizontal plane. (If a pin were inserted in the hole, the pin would be horizontal.) See Fig 8, pg. 22.
2. The vend rotor must be in the loading position when the motor shaft is inserted into the end of the rotor. See Fig. 8, pg. 22.
3. Insert the motor shaft into the rotor and secure the motor.
4. Install the vending cam onto the front shaft of the motor making sure the lock tab is at the 9 o'clock position. See Fig 7, pg. 22.
5. Install the adjustable cam per the instructions above.

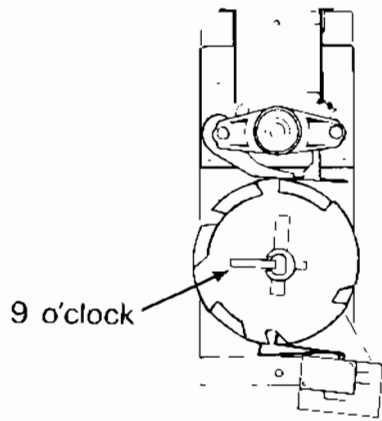


Fig. 7.

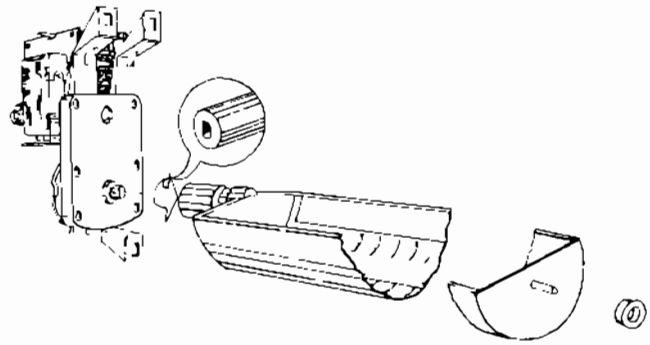


Fig. 8

#### TO SET THE TIMING OF A WIDE COLUMN VEND MOTOR.

1. Make sure the hole through the rear shaft is in a horizontal plane. (If a pin were inserted in the hole, the pin would be horizontal). See Fig. 10.
2. Slide the Drive Arm (with linkage attached) onto the rear shaft as shown. See Fig. 10.
3. Secure by installing the groove pin.
4. With the oscillator in position, align the hole in the linkage arm with the pin of the oscillator.
5. Slide the linkage onto the pin.
6. Install the vending cam onto the front shaft of the motor making sure that the lock tab is at 6 o'clock as shown. See Fig. 11.

**NOTE: When the screw holding the linkage arm to the drive arm is at a 12 o'clock position (See Fig. 10), the lock tab will be at the 6 o'clock position (See Fig. 11).**

7. Install the adjustable cam per the instructions on page 21.

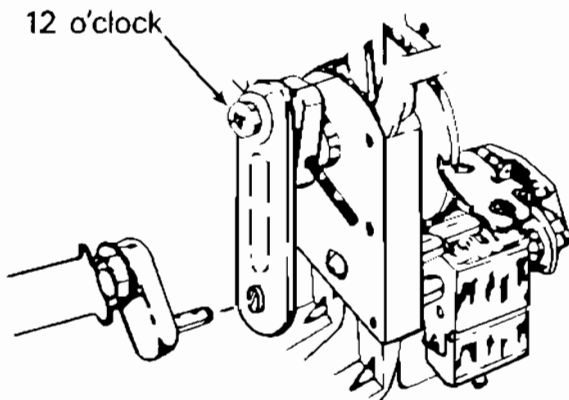


Fig. 10

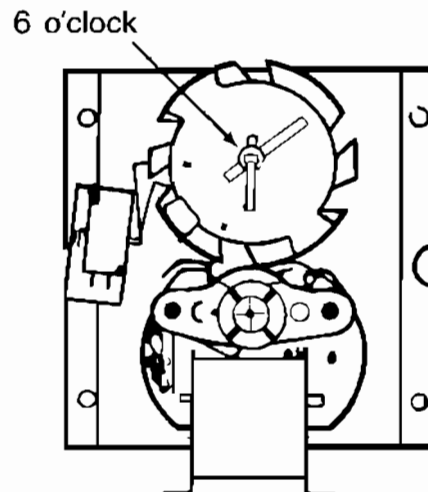


Fig. 11

## REAR SPACER

The rear spacer, one for each column, is located vertically at the rear of the column. The latch fingers, adjustable by hand, slide into the holes in the column wall for cans and other package settings.

See Fig. 13, the latch fingers are in the open position with the lock tabs disengaged.

See Fig. 14, the latch fingers are in the closed position with the lock tabs engaged. Make sure the tabs are in a locked position as shown, before loading the vender.

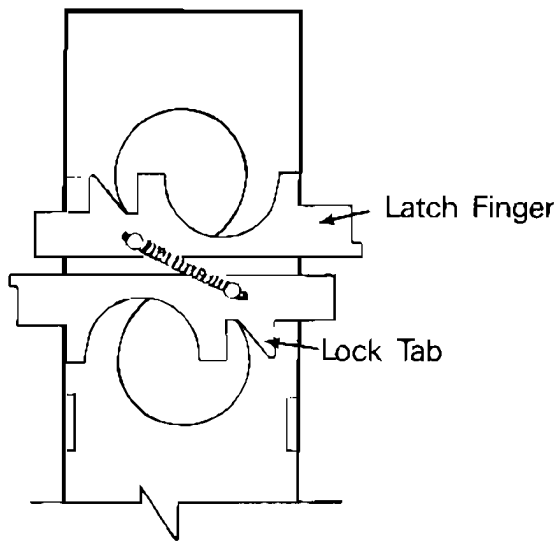


Fig. 13  
Rear Spacer

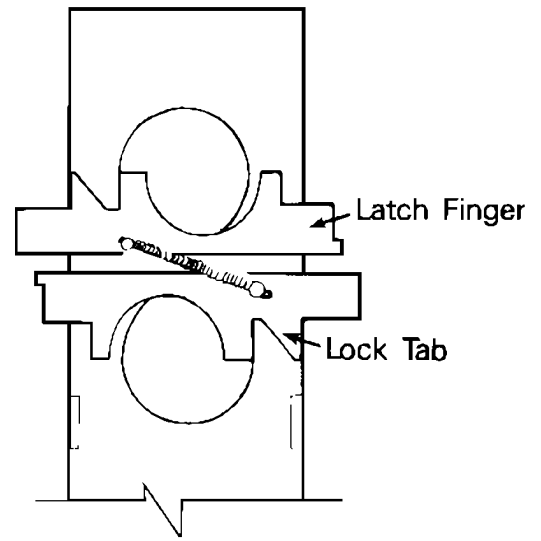


Fig. 14  
Rear Spacer

## **VEND CYCLE POWER FLOW**

# VEND CYCLE

## HOW THE VENDING MECHANISM WORKS

Refer to across the line wiring diagrams beginning on page 27, 28, 29

WHAT DOES IT	WHAT HAPPENS
* 1. Insert a coin	1. Coin travels into the coin mechanism.
* 2. The coin	2. Pushes the coin vend switch arm down and;
* 3. The N.O. contact of the coin vend switch	3. Closes and completes the vend relay coil circuit.
4. The Vend Relay Coil is energized	4. Closes the N.O. contact of the Vend Relay Switch #3 in the vend relay coil circuit, holding the vend relay closed.  Opens the N.C. contact of the vend relay switch #1 in the Coin Changer Inhibit circuit.  Closes the N.O. contact of the vend relay switch #2 in the vend motor coil circuit.
* 5. A spring (in the coin vend switch)	5. Pulls the coin vend switch arm back up and;
* 6. The N.C. contact of the coin vend switch	6. Energizes the select panel (and completes the sequence relay coil circuit, if there is a sequence relay circuit).
7. The customer pushes a select button	7. While the select button is depressed
8. The N.O. contact in the select switch	8. Closes and completes the circuit to the sold out lamp and the vend motor coil.
9. The vend motor	9. Starts to run and at the same time,
10. The N.C. contact in the select switch	10. Opens in the select panel circuit, and a short time later
11. The arm of the by-pass switch	11. Drops into the notch of the cam
12. The N.O. contact of the by-pass switch	12. Opens in the select panel circuit

\*Steps 1, 2, 3, 5, 6 represent the use of a mechanical coin changer.

WHAT DOES IT	WHAT HAPPENS
13. The N.O. contact of the vend relay switch #3	13. Opens in the vend relay coil circuit
14. The N.O. contact of the vend relay switch #2	14. Opens in the vend motor coil circuit and opens and breaks the select panel circuit
15. The N.C. contact of the vend relay switch #1	15. Closes in the coin changer circuit and
16. The N.C. contact of the by-pass switch	16. Closes and completes the circuit to the vend motor coil.
17. The vend motor	17. Continues to run
18. The vending cam	18. Works the arm of the vend motor switch and the switch arm rises to the high side of the cam
19. The N.C. contact of the vend motor switch opens	19. And
20. The N.O. contact of the vend motor switch closes	20. The sold out lamp turns on and  The vend motor circuit receives power to keep the motor running.
21. A short time later the arm of the by pass switch rides to the high side of the cam	21. and
22. The N.O. contact of the by-pass switch closes	22. Enabeling the coin changer
23. The vending cam	23. Continues to work the arm of the vend motor switch and the switch arm drops into the notch of the cam
24. The N.O. contact of the vend motor switch opens	24. Breaking the sold out lamp and vend motor coil circuits, the motor stops and the oscillator or rotor stops
25. The N.C. contact of the vend motor switch closes	25. We are back to standy-by in the vender.

## HOW THE VENDING MECHANISM WORKS

\*Refer to across the line wiring diagrams beginning on page 27.

Study the written vending cycle on pages 24 and 25 in connection with the across the line wiring diagram. The Across the Line Wiring Diagram can serve as an excellent "trouble shooting chart."

### EXAMPLE:

The Vender accepts coin.

The Vend relay is energized but immediately "pops" out.

### DO THIS:

Look at the Across the Line Wiring Diagrams on pages 27, 28 and 29 and locate:

1. the coin vend switch
2. the vend relay
3. the vend relay switch #1

### OBSERVATIONS:

1. The Vend relay coil is the affected circuit.
2. The N.O. coin vend switch is in the vend relay coil circuit.
3. The N.O. vend relay switch #3 is also in the vend relay coil circuit.
4. The N.O. vend relay switch #3 is the "holding switch" for this circuit.

### CONCLUSIONS:

1. N.O. vend relay switch #3 did not "hold" or keep the circuit closed.
2. N.C. vend relay switch #1 is open.

### CHECK:

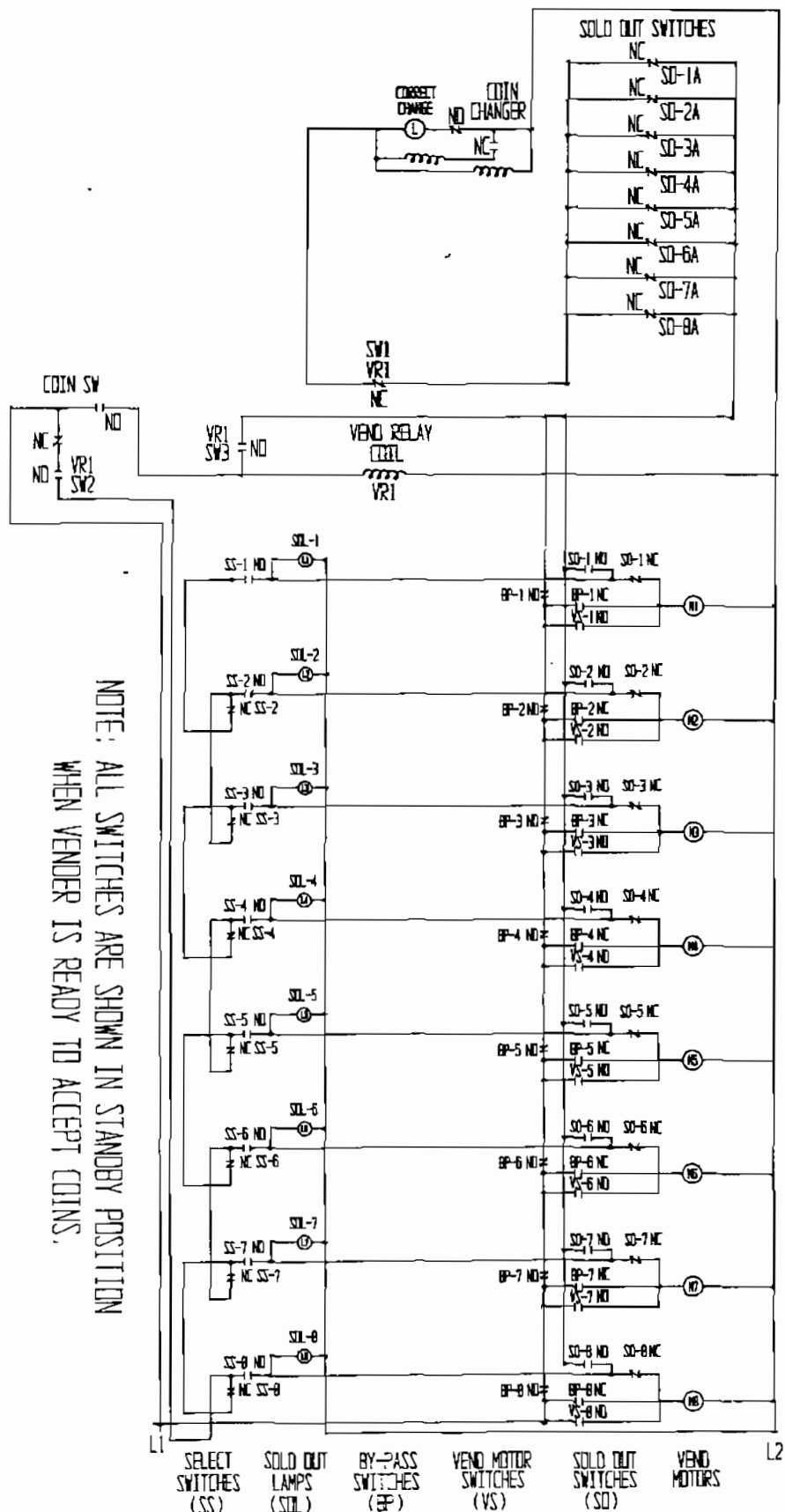
1. The gap between the contacts (too far apart). Replace the relay.
2. Dirt between the contacts. Replace the relay.
3. A broken wire.
4. The power flow is broken which feeds the common of the vend relay switch #3.

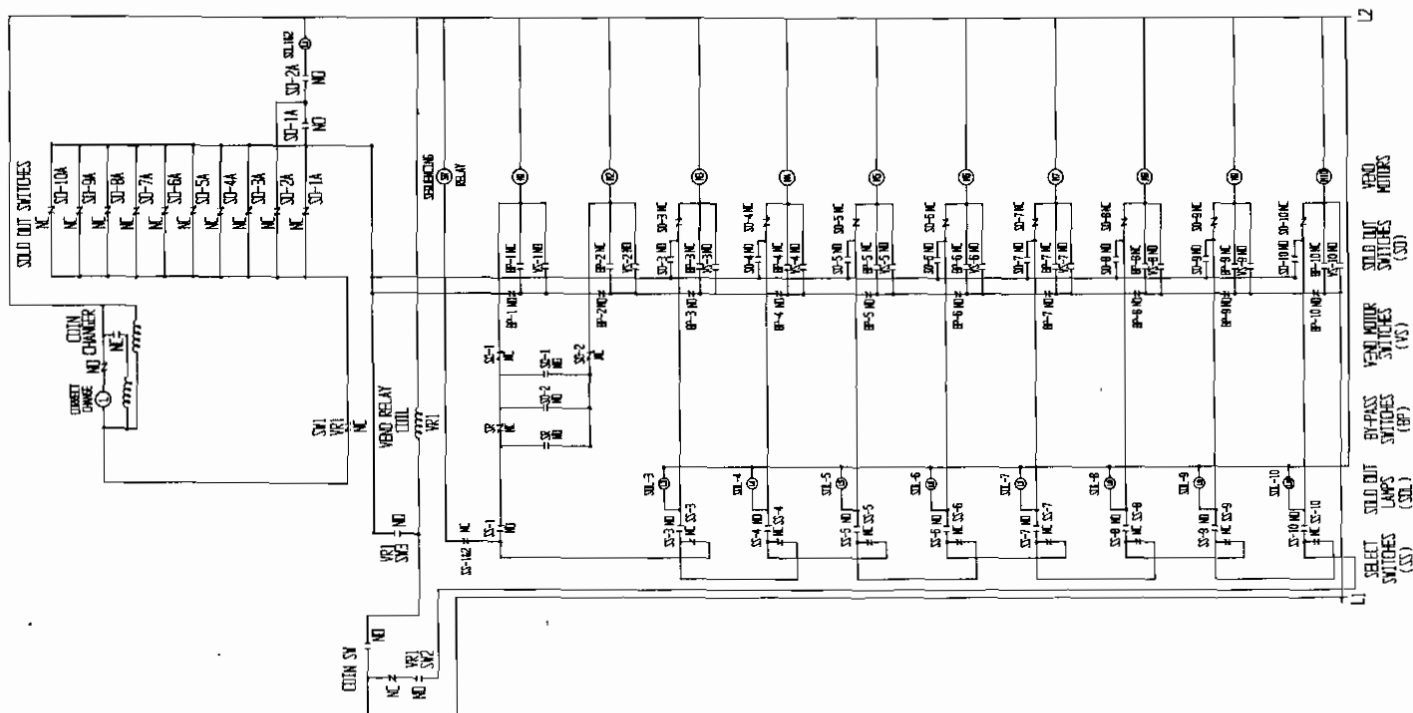
# **ELECTRICAL SCHEMATICS**



ACROSS THE LINE  
8 SELECT SERIES 90  
ELECTRICAL SCHEMATIC

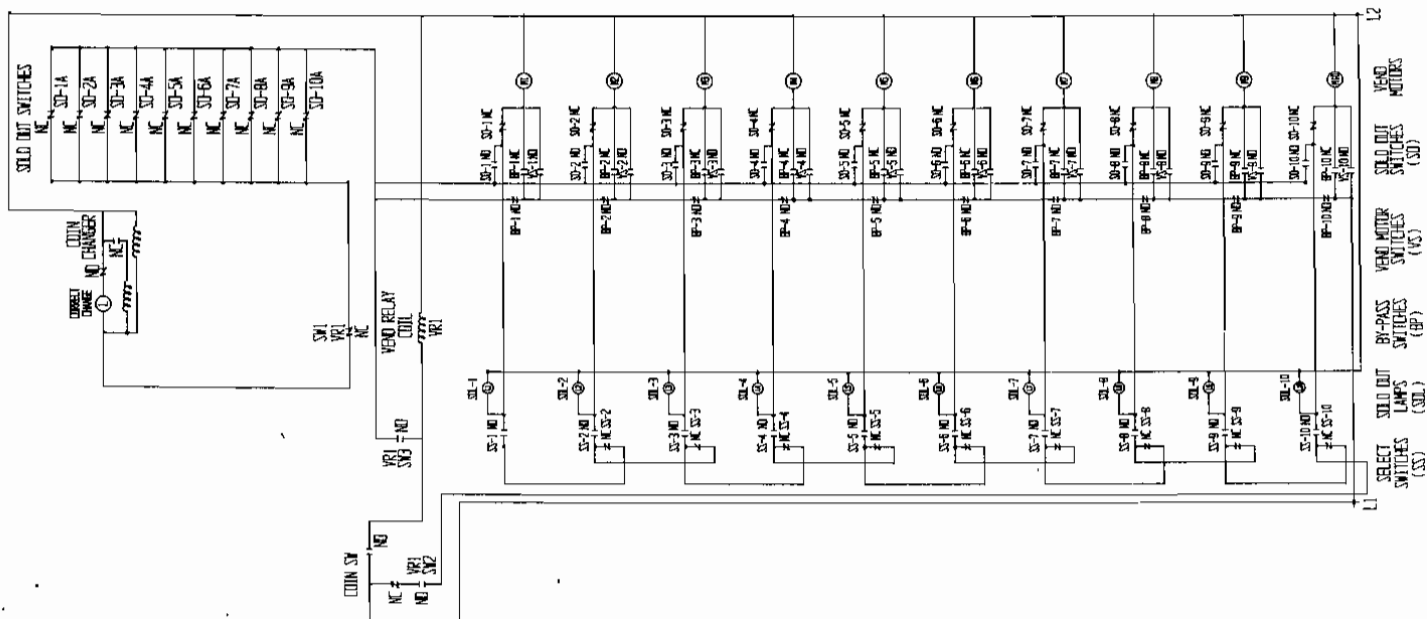
NOTE: ALL SWITCHES ARE SHOWN IN STANDBY POSITION  
WHEN VENDER IS READY TO ACCEPT COINS.





NOTE: ALL SWITCHES ARE SHOWN IN STANDBY POSITION  
WHEN VENDER IS READY TO ACCEPT COINS.

ACROSS THE LINE  
9 SELECT SERIES 90  
ELECTRICAL SCHEMATIC



NOTE: ALL SWITCHES ARE SHOWN IN STANDBY POSITION  
WHEN VENDER IS READY TO ACCEPT COINS.

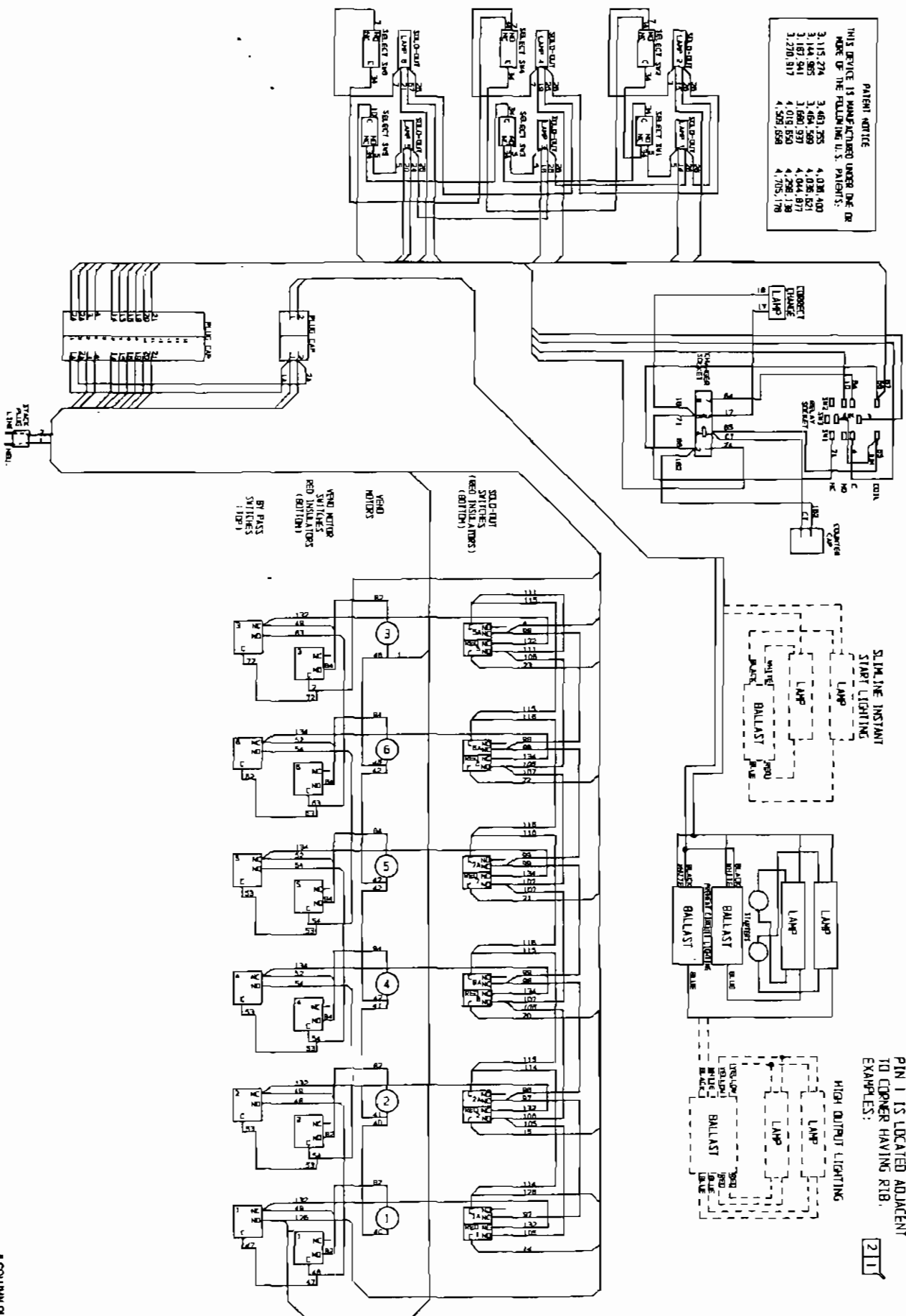
ACROSS THE LINE  
10 SELECT SERIES 90  
ELECTRICAL SCHEMATIC

3.115.274	3.463.366	4.026.400
3.114.965	3.464.589	4.036.621
3.167.941	3.580.937	4.064.877
3.270.917	3.702.154	4.264.000
3.367.536	4.019.650	4.298.139



PATENT NOTICE  
THIS DEVICE IS MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENTS:

3,115,274	3,461,255	4,036,400
3,144,985	3,464,569	4,036,621
3,167,941	3,680,937	4,044,877
3,270,817	4,018,850	4,298,138
	4,509,658	4,705,176



3	2	1
6	5	4
9	8	7
12	11	10
15	14	13

THIS DEVICE IS UNMANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENTS.

3,115,274	3,463,355	4,006,400
3,144,965	3,464,559	4,036,621
3,187,941	3,660,837	4,044,877
3,270,917	3,702,164	4,264,000
3,367,536	4,019,650	4,296,138
	4,509,634	4,705,176

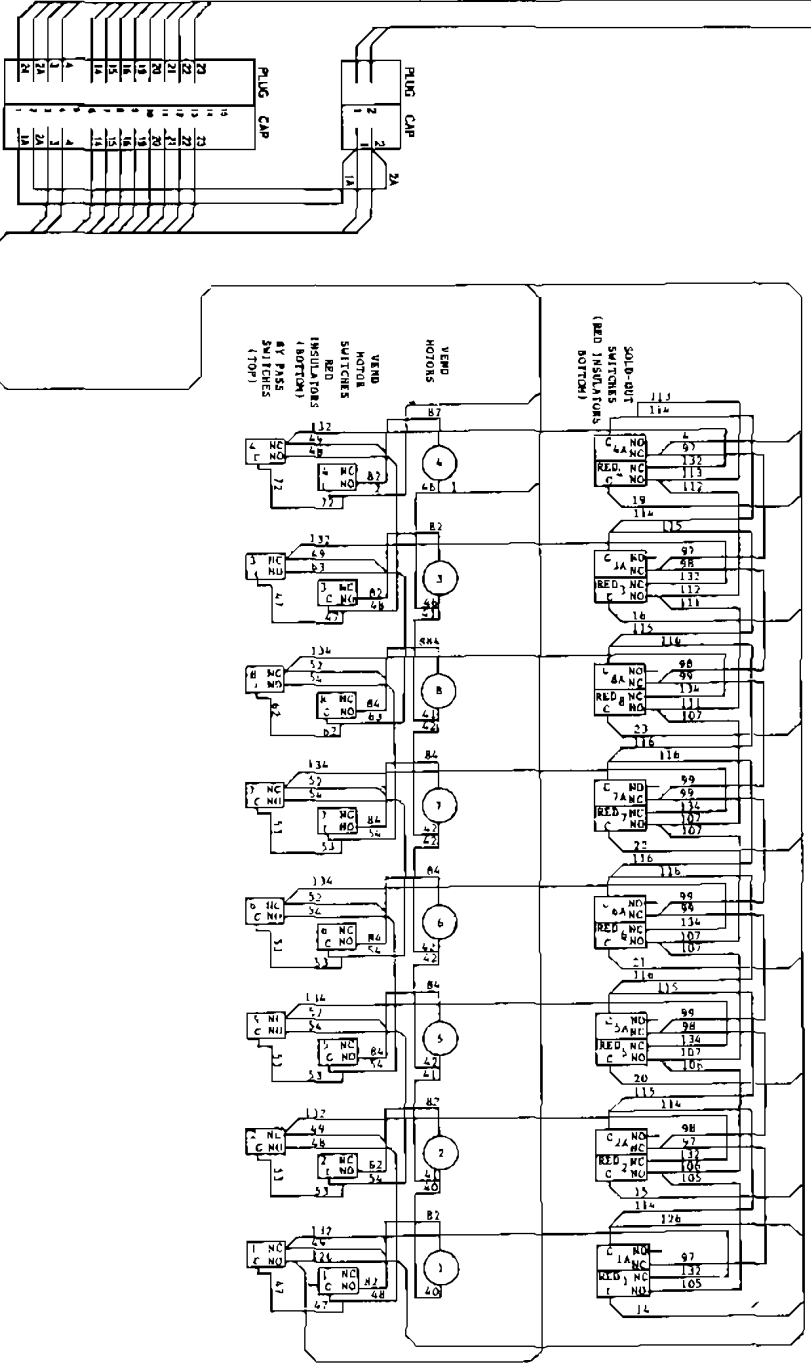
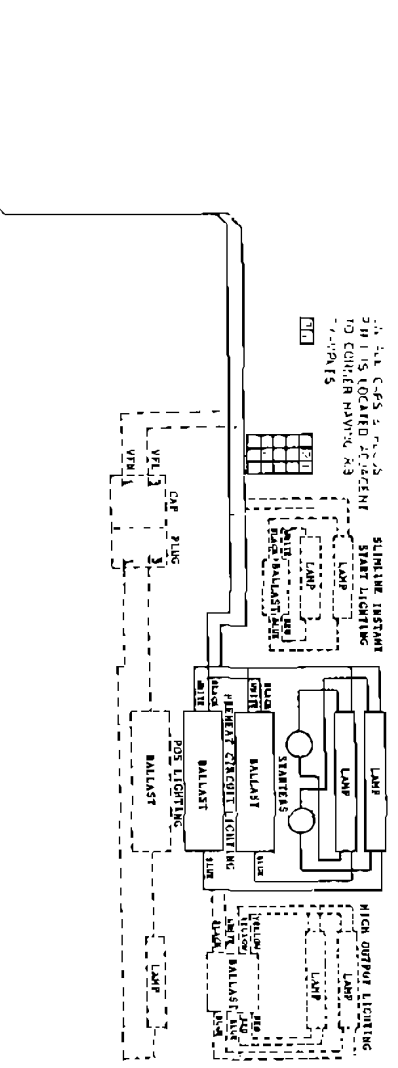
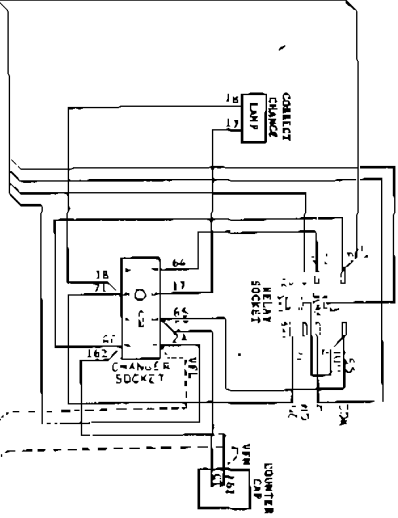
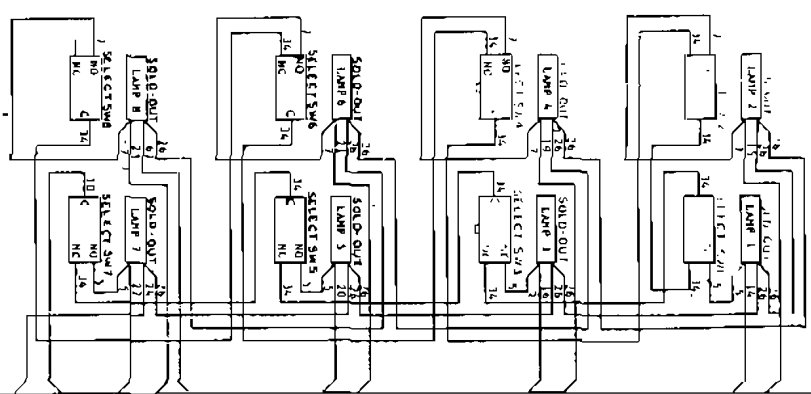


PATENT NOTICE	
THIS DEVICE IS MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENTS:	
3,119,374	3,463,355
3,164,865	3,444,539
3,161,941	3,480,437
3,278,817	3,702,144
3,301,526	4,075,466
	4,598,864
	4,628,489
	4,628,631
	4,664,877
	4,684,000
	4,704,138
	4,705,176



PATENT NOTICE  
THIS DEVICE IS MANUFACTURED UNDER ONE OR MORE OF THE  
FOLLOWING U.S. PATENTS

2,113,114	2,402,254	4,088,482
2,117,841	2,402,255	4,088,483
2,210,811	2,402,256	4,088,484
2,207,238	4,088,485	4,270,176

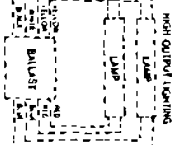
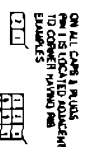




THE SERVICE IS MAINTAINED UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENTS

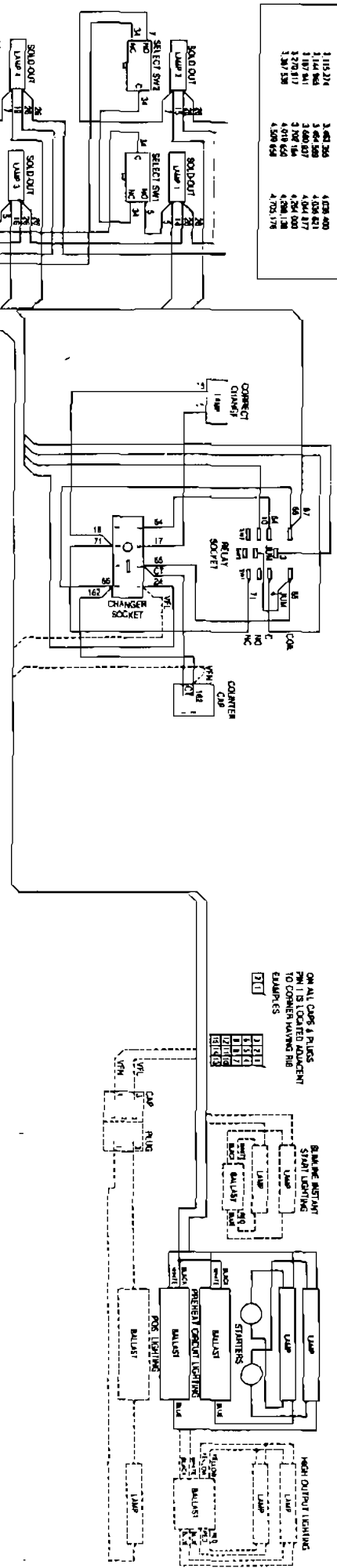
3,319,374	3,443,361	4,028,400
3,344,665	3,464,569	4,028,671
3,347,841	3,480,373	4,044,471
3,370,332	3,702,164	4,264,000
3,381,538	4,018,660	4,298,126
	4,508,608	4,708,178



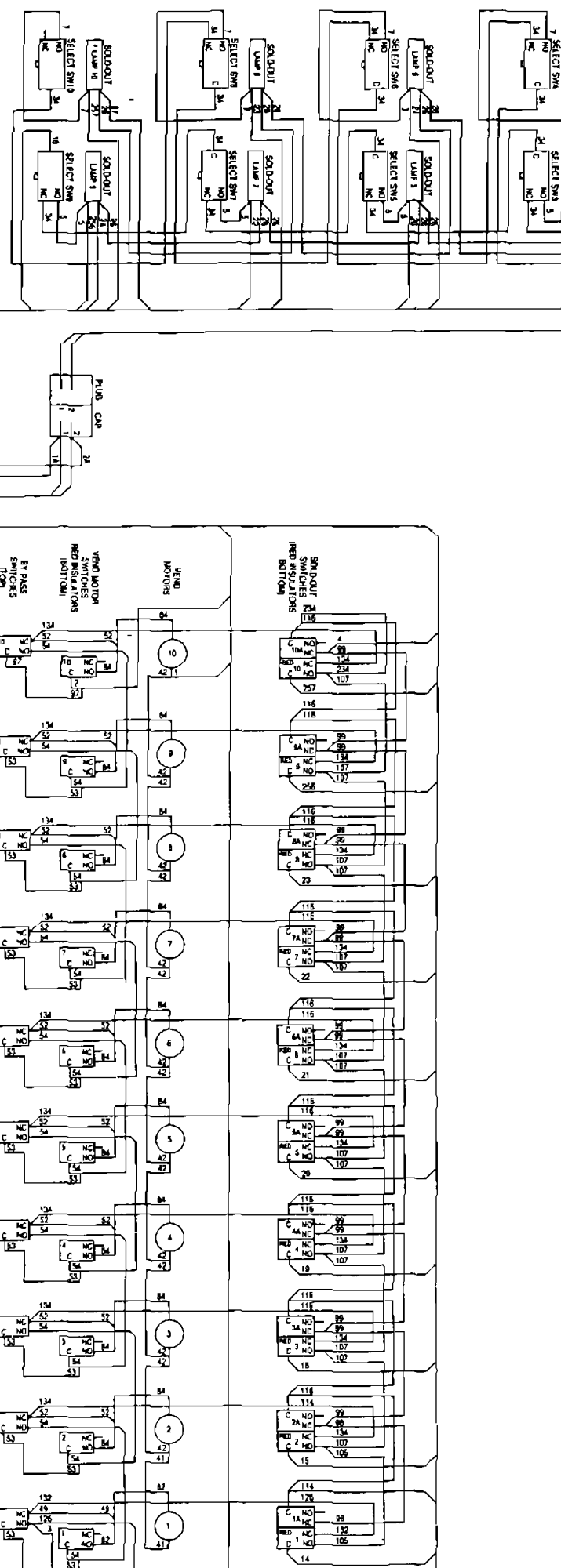


PATENT NOTICE  
THIS DEVICE IS MADE/FACTURED UNDER ONE OR MORE OF THE  
FOLLOWING U.S. PATENTS

1,115,214	3,483,394	4,038,400
1,144,864	3,484,869	4,038,481
1,187,841	3,489,837	4,044,877
1,270,817	3,707,164	4,284,000
1,287,158	4,018,654	4,284,126
	4,300,094	4,703,176



ON ALL COPS & PLUGS  
TO CORRESPONDING  
TO CORRESPONDING  
EXAMPLES



PATENT NOTICE

\* THIS CABLE IS MANUFACTURED UNDER ONE OR  
MORE OF THE FOLLOWING U.S. PATENTS:

345324	345330	4036400
345326	4036401	4036402
345328	4036403	4036404
345332	4036405	4036406
345334	4036407	4036408
345336	4036409	4036410
4036411	4036412	4036413
4036414	4036415	4036416
4036417	4036418	4036419
4036420	4036421	4036422
4036423	4036424	4036425
4036426	4036427	4036428
4036429	4036430	4036431
4036432	4036433	4036434
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4036507	4036508	4036509
4036510	4036511	4036512
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4036516	4036517	4036518
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4036522	4036523	4036524
4036525	4036526	4036527
4036528	4036529	4036530
4036531	4036532	4036533
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# **GENERAL MAINTENANCE**

# WHAT TO CLEAN

## CABINET

- Wash the vender exterior with either soap and warm water or a good detergent and warm water.
- Wash all plastic parts with a mild soap and warm water.  
(NOTE: This includes the sign face.)
- The vender should be waxed often with a good grade of automobile wax.
- Any corrosion inside the vender should be removed with fine steel wool and the area should be painted with aluminum paint.
- Keep the condenser clean.

## COIN ACCEPTOR

- Follow the Coin Acceptor Manufacturers instructions.

## REFREGIRATION CONDENSOR

- Check the condensor periodically for dirt or lint build up.
- Clean the build up with a brush, vacuum, or blow the dirt out of the condensor.

# WHEN AND WHAT TO LUBRICATE

<b>Every Six Months</b> (or as needed)	Main Door	Example of lubricants
	1. Lock bolt and nut retainer	Mechanics Friend
	2. Hinge pivot points	Mechanics Friend
	Inner Door	
	1. Latch Assembly	Mechanics Friend
	2. Hinge pivot points	Mechanics Friend
<b>Every Year</b> (or as needed)	Inner Door	
	1. Door gasket	Petroleum Jelly

# THINGS TO ADJUST

## TEMPERATURE CONTROL — All Series 90 Models

This is a "Constant Cut In" type of control which has two (2) adjustments:

They are:

1. The temperature control knob on the outside of the temperature control box.
2. The inside range screws.

**NOTE: The differential screw located between the terminals of the control is sealed and MUST NOT BE CHANGED.**

### AS TO #1 ADJUSTMENT:

(Outside Range). See Fig. 1.

The temperature control knob is set in an approximate neutral position. It can be used to make **cut out** temperature colder by turning the knob **clockwise** - or - to make the **cut out** temperature warmer by turning the knob **counter clockwise**. When the knob is used the **cut in** temperature (which governs the defrost) remains **constant**.

### AS TO #2 ADJUSTMENT:

(Inside Range). See Fig. 2.

On the Cutler Hammer temperature control there are two (2) screws provided, one (1) for **the cut in temperature** and one (1) for **the cut out temperature**, both must be adjusted for altitude corrections. For temperature adjustment, turn screws **clockwise** for colder and **counter clockwise** for warmer. When adjusting for temperature **DO NOT TURN** more than 1/8 of a turn at a time. Let the machine run over night before making further adjustment.

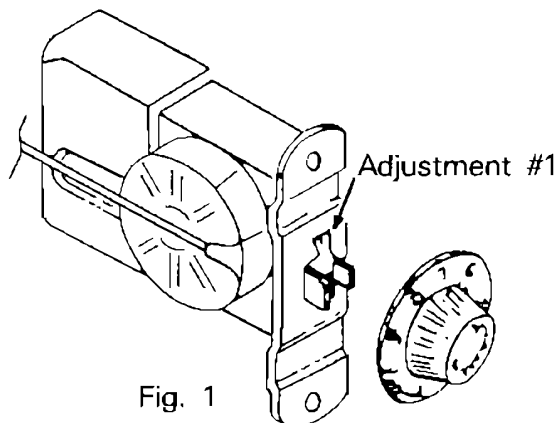


Fig. 1

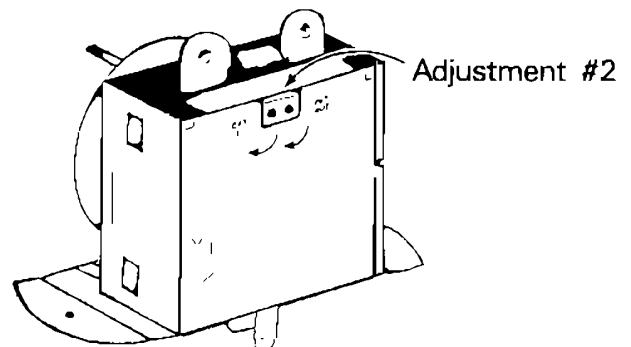


Fig. 2

## TEMPERATURE CONTROL ALTITUDE ADJUSTMENT

The Control is factory set at an altitude of 500 ft. For higher altitudes, the control should be adjusted to prevent freeze-up of product. Adjust the inside range screws as follows:

### Altitude Feet:

2000  
4000  
6000  
8000

### Cutler-Hammer 9531N272 Both Screws Counter-Clockwise

1/8 Turn  
1/4 Turn  
1/2 Turn  
5/8 Turn

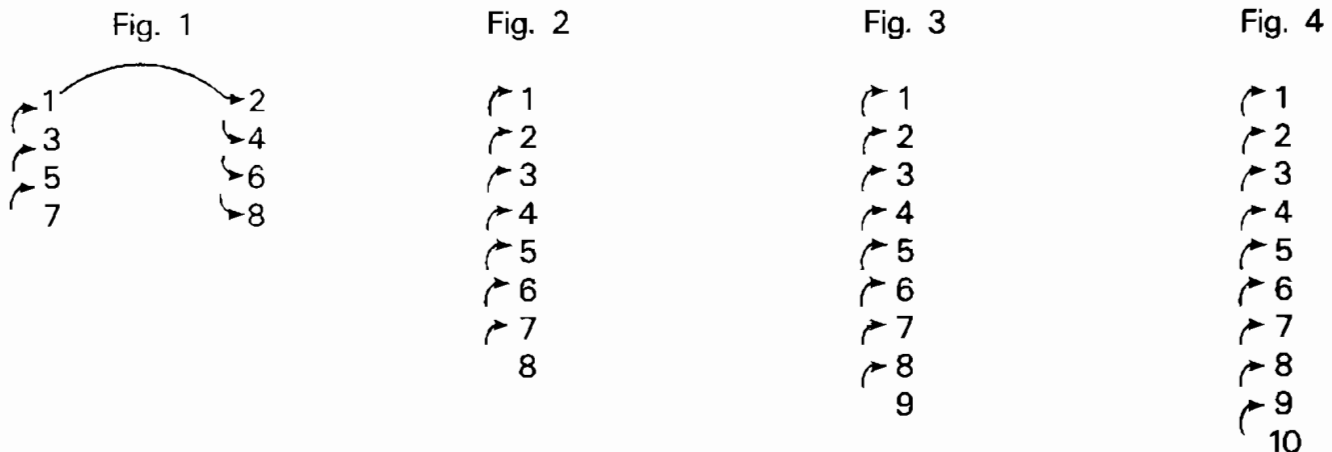
# **VENDER TROUBLE SHOOTING**



# HOW TO CORRECT COMMON VENDING TROUBLES

It should be remembered that when one (1) or more circuits become inoperative on a Dixie-Narco Vender that has been operating satisfactorily, it is usually one (1) component that has failed, and it is with this in mind that the accompanying trouble shooting schematic is presented.

Control Panel  
Electrical Feed  
Thru N.C.'s of Each Select Switch



(CONTROL PANEL: Select button and Select Switch Location)

The control panels shown above represent some of the panels used on Dixie-Narco venders.

It is **IMPORTANT** to keep in mind the feed of electrical current through the select switches.

(Fig. 1)	7, 5, 3, 1, 2, 4, 6, 8 or
(Fig. 2)	8, 7, 6, 5, 4, 3, 2, 1 or
(Fig. 3)	9, 8, 7, 6, 5, 4, 3, 2, 1 or
(Fig. 4)	10, 9, 8, 7, 6, 5, 4, 3, 2, 1

On the inside of the Control Panel, the select buttons and switches are numbered to assist in identifying them. If not numbered, then Push Button arrangement is as shown in (1) one of the foregoing diagrams, i.e., Fig. 1, 2, 3 or 4.

Figures 2, 3 and 4 represent a control panel on which the select buttons are arranged in a vertical pattern and the power feed begins with the highest numbered switch and proceeds to the lowest numbered switch.

Figure 1 represents a control panel on which the select buttons are arranged in a vertical pattern of two rows and the power feed begins with the highest odd numbered switch to the lowest odd numbered switch, then to the lowest even numbered switch to the highest even numbered switch.

## ACCEPTS COINS WILL NOT VEND FROM ONE OR MORE COLUMNS

Although all circuit problems are not necessarily found to be one or more inoperative select switches, the examples listed below are typical of select switch problems found in the control panel. Refer to Fig. 1, page 41.

**PROBLEM 1:** Selection 7 and 5 work.  
Selections 3, 1, 2, 4, 6 and 8 do not work.  
Recall the feed of the electrical current at 7, 5, 3, 1, 2, 4, 6 and 8.

**ANSWER:** Check the N.C. and C. of Select Switch 5.  
Check the N.O. and C. of Select Switch 3.

**PROBLEM 2:** Selection 7 works.  
Selections 5, 3, 1, 2, 4, 6 and 8 do not work.  
Recall the feed of the electrical current.

**ANSWER:** Check the N.C. and C. of Select Switch 7.  
Check the N.O. and C. of Select Switch 5.

**PROBLEM 3:** Selections 7, 5, 3, 1, 2, 4 and 6 work.  
Selection 8 does not work.  
Recall the feed of the electrical current.

**ANSWER:** Check the N.C. and C. of Select Switch 6.  
Check the N.O. and C. of Select Switch 8.

Refer to Figure 2, page 41.

**PROBLEM 4:** Selections 8 and 7 work.  
Selections 6, 5, 4, 3, 2 and 1 do not work.  
Recall the feed of the electrical current.

**ANSWER:** Check the N.C. and C. of Select Switch 7.  
Check the N.O. and C. of Select Switch 6.

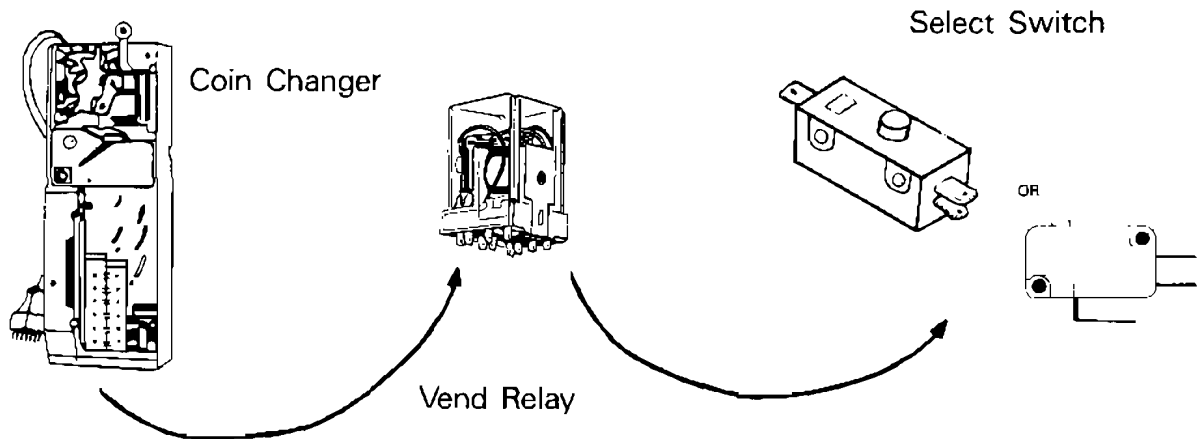
**PROBLEM 5:** Selections 8, 7, 6, 5 and 4 work.  
Selections 3, 2 and 1 do not work.  
Recall the feed of the electrical current.

**ANSWER:** Check the N.C. and C. of Select Switch 4.  
Check the N.O. and C. of Select Switch 3.

## ACCEPTS COINS WILL NOT VEND

**PROBLEM:** All selections do not work.  
Recall the feed of the electrical current.

**ANSWER:** Check the coin changer.  
Check the vend relay.  
Check the select switch that gets power first.



## ACCEPTS COINS WILL NOT VEND FROM ONE COLUMN

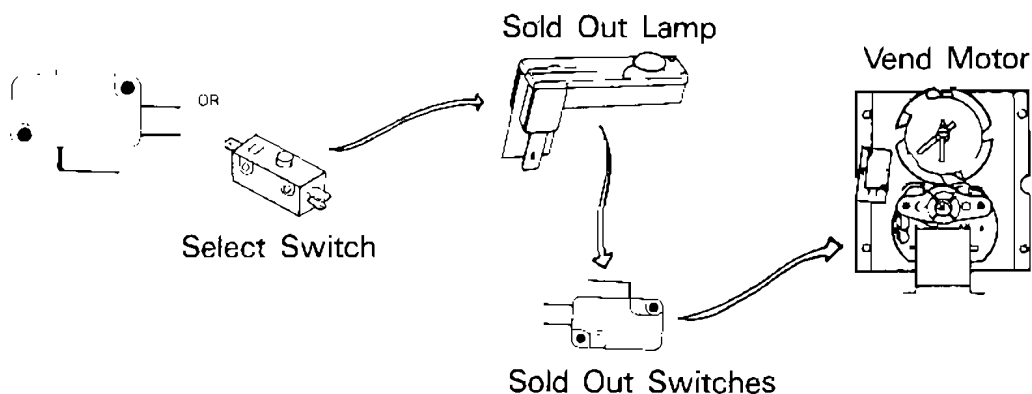
**PROBLEM 1:** Accepts coins but will not vend from one column.

**EXAMPLE:** Selection # 3 will not vend.

**CHECK:** The N.O. of Select Switch #3.  
(NOTE: If the Sold Out Lamp comes on when the button is pushed, the select switch is OK.)

**CHECK:** The Sold Out Switch in the vending circuit.

**CHECK:** The Vend Motor.  
(NOTE: If the vend motor runs by depressing the vend switch, the vend motor is OK.)



## REJECTS ALL GOOD COINS

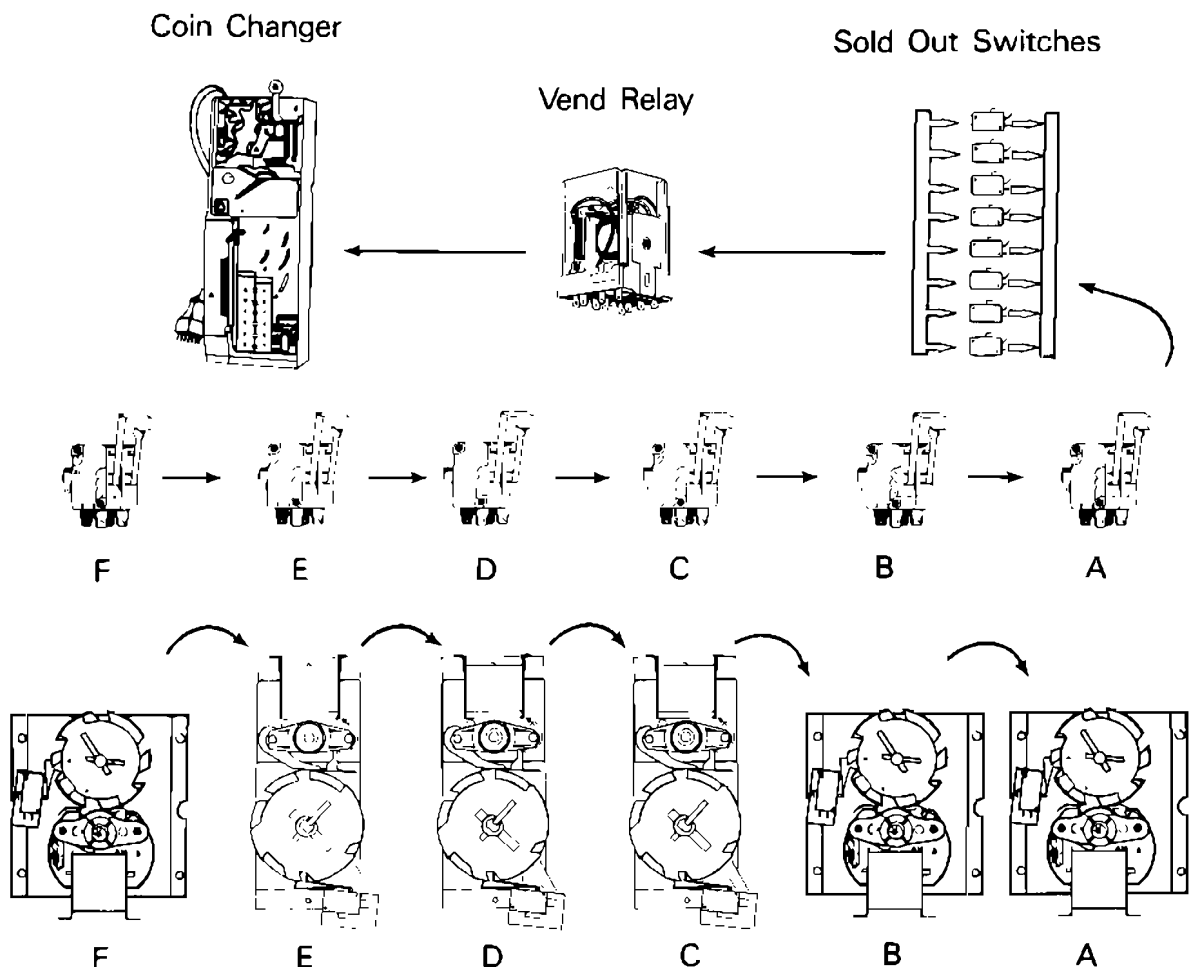
**PROBLEM 2:** The Coin changer will not accept coins.

Put product in each column.

Follow the arrow WHICH IS THE DIRECTION OF FLOW OF THE ELECTRICAL CURRENT. (See The Figure below)

**DO THIS:**

1. Make sure there is product in each column. The Sold Out Lamps are off.
2. Follow the arrows from Left to Right.
3.
  - a. Push Vend Motor Switch - Motor F - Vend Motor cycles.
  - b. Push Vend Motor Switch - Motor E - Vend Motor cycles.
  - c. Push Vend Motor Switch - Motor D - Vend Motor cycles.
  - d. Push Vend Motor Switch - Motor C - Vend Motor does not cycle.  
The Problem is the Vend Motor Switch and By-Pass Switch on Motor C and/or Motor D.
  - e. If the problem is not found, continue this procedure through Motors B and A.
  - f. If the problem is not found, replace the Vend Relay.
  - g. If the problem is not found, the last component to check would be the coin changer.



## DRIFTING MOTOR AND JACK POTTING PROBLEM

SYMPTOM	THINGS TO CHECK	IF FAULTY, WHAT TO DO!
1. The Vend Motor drifts: Both switch arms drop into the Cam Notch and the Vend Motor keeps running.	<p>A. Vend Motor Switch</p> <p>B. Vend Motor Switch Arm relationship to the Cam</p> <p>C. Check the Pawl for looseness. It should be loose.</p> <p>D. Pawl Spring</p> <p>E. Actuator Should be loose.</p> <p>F. Brake clutch - 2 projections on the clutch.</p>	<p>A. Replace the Switch</p> <p>B. If too close to cam, bend the arm away from the cam slightly or replace the switch.</p> <p>C. If tight, replace</p> <p>D. If off, correct If elongated, replace</p> <p>E. If Actuator sticks to stator due to syrup, clean stator. If tight, clean at the pivot. If still tight, replace the motor.</p> <p>F. If broken replace the Vend Motor Assembly</p>
2. Two cans delivered in a given cycle and the next cycle is a dry vend	<p>A. Shimming</p> <p>B. Cam Setting</p>	<p>A. Correct</p> <p>B. Correct</p>
3. Two cans delivered in a given cycle	<p>A. Shimming</p> <p>B. Cam Setting</p> <p>C. Follow checking procedure for a drifting motor.</p>	<p>A. Correct</p> <p>B. Correct</p> <p>C. Correct</p>
4. Pre-Select, i.e., set up credit, push no button and product is vended time after time.	<p>A. Select Switch; Sticking, incorrectly wired, or bad.</p>	<p>A. Replace or Correct</p>

**ACCEPTS COINS AND WILL VEND, THEN  
REJECTS COINS BUT WILL CONTINUE TO FREE VEND**

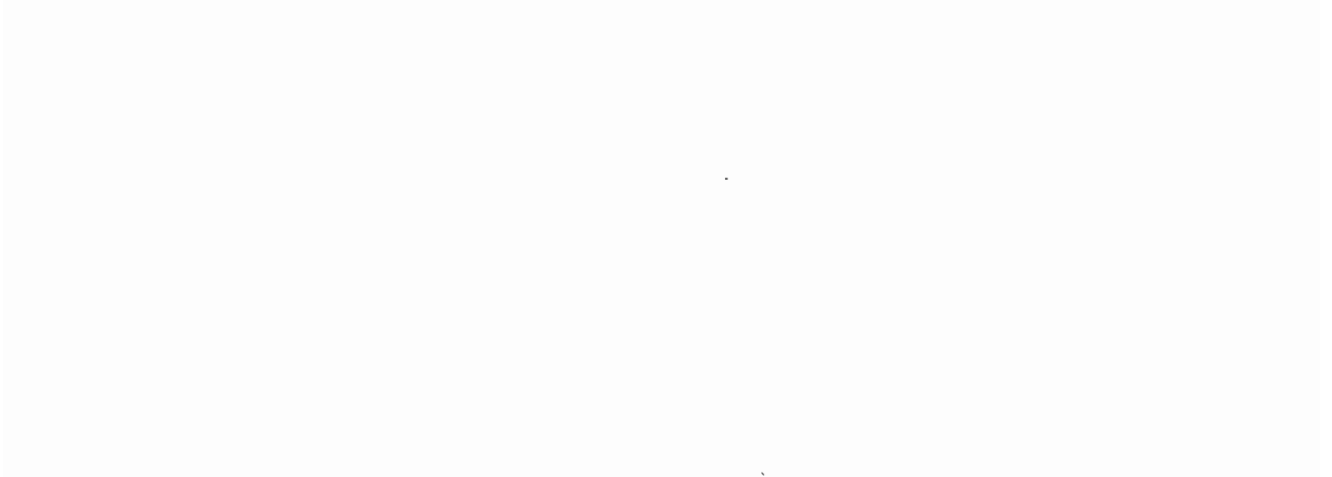
<b>PROBLEM:</b>	Set up Credit	Push a Selection	It will vend
		Push same Selection	It will vend
	Rejects Coins	Push same Selection	It will continue to vend
<b>REASON:</b>	The Credit is not being canceled by the by-pass switch.		
<b>CHECK:</b>	The By-pass switch electrically	If faulty	Replace
	The By-pass switch for a sticking plunger	If faulty	Replace
	The By-pass switch for incorrect wiring.	If incorrect	Correct
	Set up Credit	Push a Selection Push same Selection	It will vend It does not vend

**IF VENDER TROUBLE SHOOTING PROCEDURES FAIL,  
CONSULT THE DIXIE-NARCO FACTORY SERVICE**

**1-800-688-9090**

**NOTE: Have the vender model # and serial # available.**

# **REFRIGERATION PARTS & FUNCTIONS**



# **REFRIGERATION PARTS AND FUNCTIONS**

## **— MECHANICAL PARTS —**

### **COMPRESSOR MOTOR**

The compressor motor (sealed in the compressor housing) drives the compressor with a shaft that is shared by both parts. It is started by the temperature control switch, the starting relay and the thermal overload switch. It is stopped by the temperature control switch, and, if it gets overloaded, by the thermal overload switch.

### **COMPRESSOR**

The compressor (sealed in the compressor housing) draws cold, low pressure freon gas from the evaporator and pumps hot, high pressure freon gas out to the condenser.

### **CONDENSER**

The condenser, located in the base of the vender, at the front, takes heat out of the hot, high pressure gas that comes from the compressor. The gas loses heat as it goes through the condenser coils, and changes into a liquid because it is still under pressure.

### **CONDENSER FAN**

The condenser fan (between the condenser and the compressor motor), first draws air from the outside of the vender through the condenser. This air takes heat from the condenser first and then is blown over the compressor housing from which it also takes heat before going back outside of the vender. The condenser fan runs when the compressor motor runs.

### **FILTER/DRYER**

The filter/dryer is in the liquid line between the condenser and the capillary tube. This dryer filters out any foreign particulate matter and also contains a desiccant to absorb any moisture that may be present in the system.

### **CAPILLARY TUBE**

The capillary tube (between the condenser and the evaporator in the refrigerant line) has a very small inside diameter, and serves to control the refrigerant flow from the condenser into the evaporator.

### **EVAPORATOR**

The evaporator (in the vender cabinet) takes heat from the air in the vender cabinet and gives this heat to the liquid refrigerant. The liquid refrigerant is evaporated (boiled off) as a gas, and the gas is drawn out by the compressor.

### **EVAPORATOR FAN**

The evaporator fan draws warm air from around the cans or bottles in the cooling compartment and blows it across the evaporator. As the air goes across the evaporator, it gives up heat to the evaporator, then goes back to the cans or bottles, and takes heat from them. This fan runs continuously when the vender is plugged in.

### **CONDENSATE PAN**

The condensate pan (located in the compressor compartment) collects the water which runs from the evaporator. The water is evaporated into the surrounding air by means of soakers. The soakers extend down into the pan to absorb the water. Exposure to the surrounding air vaporizes the water in the soakers.



## — ELECTRICAL PARTS —

### **TEMPERATURE CONTROL**

The temperature control is the part that is made up of a control bulb connected by a small metal tube to a bellows. The control bulb is in a slot in the evaporator fan housing. The bellows and a switch known as the temperature control switch, are in the temperature control box which is fastened to the right side inside the vender.

The control bulb and the bellows have a vapor in them. When the temperature of the vapor in the bulb rises, it builds up pressure in the bellows tube. This pushes the bellows out. When the control bulb is cool, the vapor shrinks back, and the bellows pulls in. These movements of the bellows work the switch - called the temperature control switch - closing it when the bulb is heated and opening it when the bulb is cooled.

The contacts of the temperature control switch are in the compressor motor's running and starting circuits. They are also in the condenser fan motor circuit.

When the cabinet temperature gets up to the cut-on setting, the temperature control switch closes in the compressor motor's starting and running circuits and in the condenser fan circuit. When the cabinet temperature gets down to the cut-off setting, the temperature control switch opens in these circuits.

**CAUTION:** To adjust temperature control see "Things to Adjust," page 40.

### **THERMAL OVERLOAD ASSEMBLY**

The thermal overload is a temperature activated switch that interrupts power to the compressor when excessive temperatures occur. This switch protects the compressor from the damage that will occur if the compressor continues to operate under adverse conditions. The overload also opens under abnormally high amp draws, protecting the motor windings from damage. Frequent overload trips may lead to warm product and be the first indication of a dirty condenser or other refrigeration related problems that require attention.

### **STARTING RELAY**

The starting relay is a device that connects the start winding of the compressor during start up. The additional winding (start) helps the compressor motor come up to speed. Once it reaches speed the starting relay disconnects the start winding from the circuit.

## — ELECTRICAL OPERATION —

WHAT DOES IT	WHAT HAPPENS
<b>WHEN THE VENDER TEMPERATURE GETS UP TO THE CUT-ON SETTING</b>	
The temperature control switch	Closes the run winding circuit of the compressor motor. Closes the start relay coil circuit. Closes in the condenser fan motor circuit.
<b>THE HEAVY CURRENT, DRAWN BY THE RUN WINDING, ALSO FLOWS IN THE START RELAY COIL, AND:</b>	
The start relay coil	Closes the start relay contacts and completes the start winding circuit of the compressor motor.
<b>WHEN THE COMPRESSOR MOTOR GETS UP TO SPEED</b>	
The spring in the relay	Pushes the start relay contacts apart because
The start relay coil	No longer gets enough current to hold the contacts closed,
The start relay contacts	Open in the start winding circuit of the compressor motor.
<b>IF THE COMPRESSOR MOTOR DRAWS TOO MUCH CURRENT AND CAUSES THE THERMAL OVERLOAD ASSEMBLY TO GET TOO WARM</b>	
The thermal overload switch	Opens the run winding circuit and disconnects the compressor motor.
<b>WHEN THE THERMAL OVERLOAD ASSEMBLY COOLS DOWN AGAIN</b>	
The thermal overload switch	Closes the run winding circuit and the start relay coil circuit of the compressor motor.
<b>WHEN THE VENDER TEMPERATURE GETS DOWN TO THE CUT-OFF SETTING</b>	
The temperature control switch	Opens in the run winding circuit of the compressor motor. Opens in the starting relay coil circuit.

## — ELECTRIC CIRCUITS AND CIRCUIT DIAGRAMS —

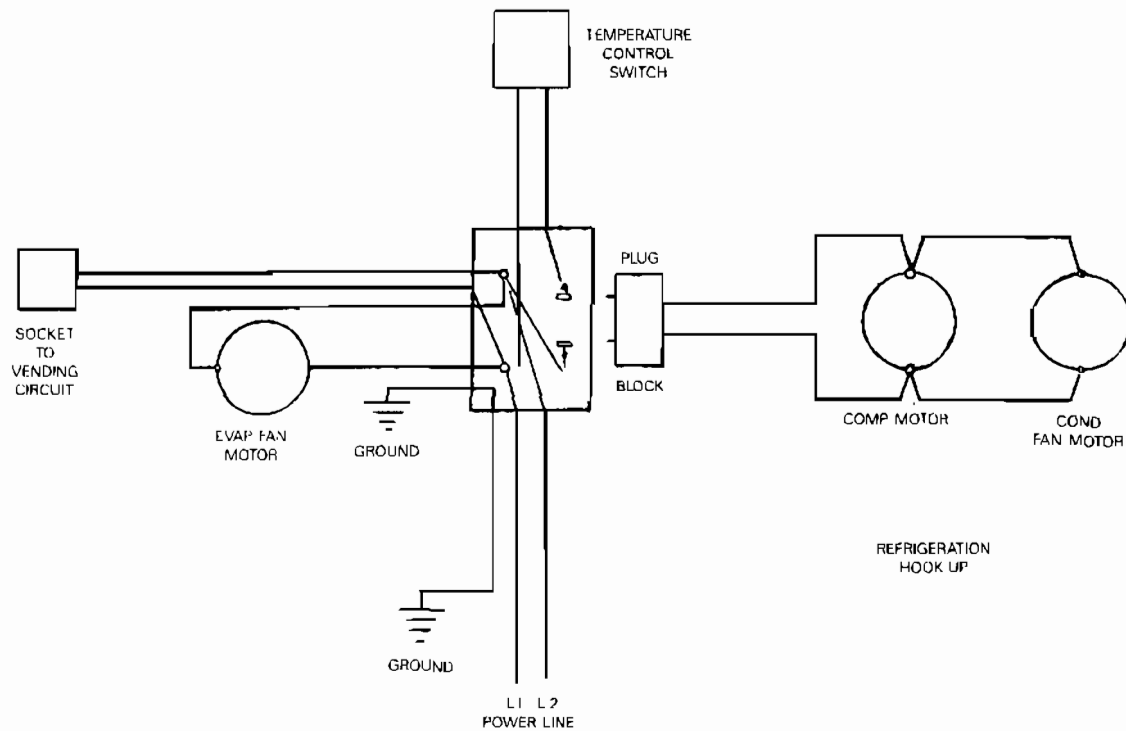
### CONDENSER FAN CIRCUIT

SWITCHES IN THE WIRING	WHAT THE SWITCHES DO	WHAT MAKES THE SWITCHES WORK
Temperature control switch	Turn the condenser fan motor on and off	The temperature in the vender has come up to the cut-on point (or gotten down to the cut-off point) set on the temperature control.

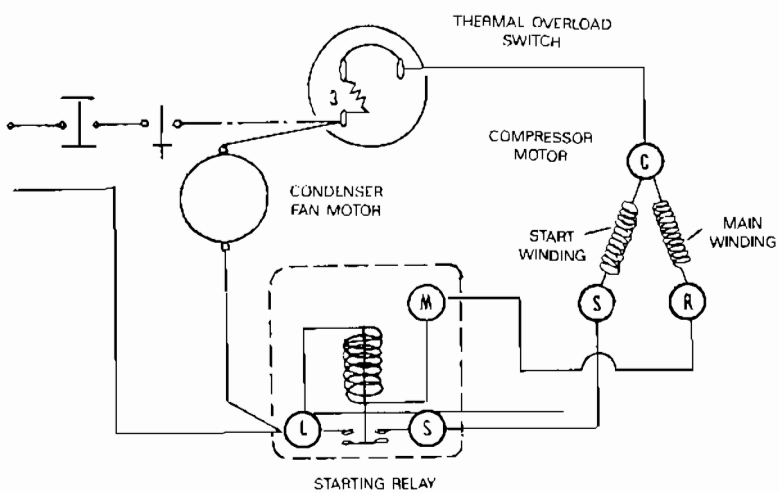
### COMPRESSOR MOTOR RUN WINDING CIRCUIT

SWITCHES IN THE WIRING	WHAT THE SWITCHES DO	WHAT MAKES THE SWITCHES WORK
1. Temperature control switch	1. Turns the compressor motor on and off.	1. The temperature in the vender has come up to the cut on point (or got down to the cut off point) set on the temperature control switch.
2. Start relay	2. Turns the start windings on and off.	2. The presence or absence of heavy current switches the relay which energizes or de-energizes the start windings.
3. Thermal over-load switch	3. Turns the run windings of the compressor motor on.	3. Current drawn by the motor or heat from the compressor can raise the temperatue of the thermal overload assembly and make the thermal overload switch cut off. Which removes power from the compressor.

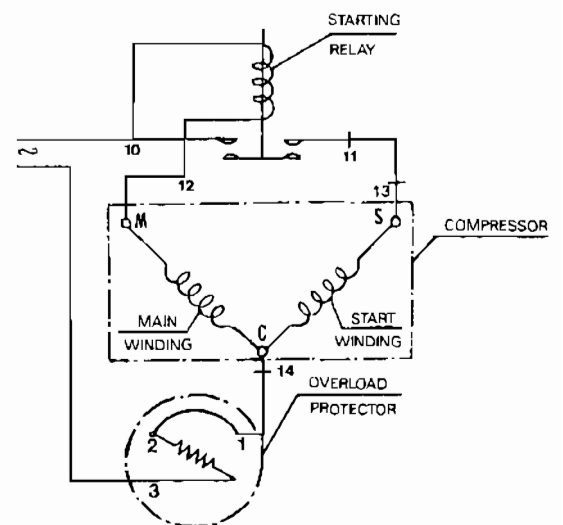
# REFRIGERATION CIRCUIT DIAGRAMS



**Techumseh**



**Embraco**



# **REFRIGERATION CYCLE**

# REFRIGERATION CYCLE

WHAT DOES IT	WHAT HAPPENS
The rising temperature in the vender	Warms the temperature control bulb and the charge in it
The charge in the control bulb	Expands in the control tube and stretches the temperature control bellows.
The bellows	Activates the temperature control switch
The temperature control switch	Turns the compressor motor on. Turns the condenser fan motor on.
The compressor motor	Drives the compressor.
The condenser fan motor	Drives the condenser fan. Draws air through the condensor, cooling it and pushes air over the compressor, cooling it.
The compressor	Draws low pressure refrigerant gas from the evaporator, compresses the gas, and pumps it to the condenser.
The condenser	Takes the heat out of the high pressure refrigerant gas.
The cooled gas	Condenses into liquid refrigerant
More hot gas coming from the compressor	Pushes the liquid refrigerant into the capillary tube.
The capillary tube	Controls the flow of liquid refrigerant into the evaporator.
The evaporator	(Where the pressure is kept low by the suction of the compressor) transfers heat from the air to the liquid refrigerant.
The liquid refrigerant	Changes into gas at low pressure and is drawn into the compressor.
The falling temperature in the vender	Cools the temperature control bulb and the charge in it to a pre-determined temperature.
The charge in the control bulb	Shrinks, and lets the temperature control bellows pull back.
The bellows	Move, and open the temperature control switch.
The temperature control switch	Turns the compressor motor off. Turns the condenser fan motor off.
The compressor	Stops.
The condenser fan motor	Stops.

(With the vender "Plugged In" the evaporator fan motor runs constantly.)

# **HOW TO TAKE CARE OF THE REFRIGERATION SYSTEM**

## **WHAT TO CLEAN**

Carefully clean dirt and lint from the condenser with a brush, vacuum cleaner or compressed air.

## **WHEN AND WHAT TO LUBRICATE**

The refrigeration system is hermetically sealed and does not have to be oiled or greased. Enough oil is put into the condenser and evaporator fan motors when they are manufactured to last the life time of the component.

## **CORRECTING TROUBLES**

When the refrigeration system is not working properly, refer to the section called "Correcting Common Refrigeration Troubles" on the following pages. Find your trouble and see what the possible causes are. When you have found the cause of the trouble, either make the adjustment, repair the part or put a new part in, whatever is needed. This table does not list all the possible causes of refrigeration troubles - but it does have all the common causes. If your vender has a trouble that is not shown on the chart, or the trouble is not the result of one of the causes shown on the chart, study the section on "How the Refrigeration Mechanism Works" and you may be able to find out what is wrong and fix it.

# **REFRIGERATION TROUBLE SHOOTING**

# HOW TO CORRECT COMMON REFRIGERATION TROUBLES

## PRODUCT HOT:

Compressor will not run.

page 54

Compressor starts but will not keep running.

page 55

## PRODUCT COLD BUT NOT COLD ENOUGH:

Compressor runs but won't cool product.

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## PRODUCT TOO COLD OR FROZEN:

Compressor runs too long or continuously.

page 57

## NOISY REFRIGERATION UNIT:

Possible causes.

page 57



Symptom: **PRODUCT HOT**

Possible Cause: **Compressor will not run.**

WHAT TO CHECK	
1. Is the vender plugged in? <b>YES</b>	<b>NO</b> , plug it in.
2. Is the compressor power cord plugged in? <b>YES</b>	<b>NO</b> , plug it in.
3. Is the temperature control on? <b>YES</b>	<b>NO</b> , turn it on.
4. Is the circuit breaker or fuse correct? <b>YES</b>	<b>NO</b> , replace or reset.
5. Is there power at the wall outlet?  <b>YES</b>	<b>NO</b> , consult an electrician.
6. Is the vender power cord good? <b>YES</b>	<b>NO</b> , replace.
7. Is the compressor power cord good? <b>YES</b>	<b>NO</b> , replace.
8. Is the temperature control bulb located properly? <b>YES</b>	<b>NO</b> , correct.
9. Is the temperature control good? <b>YES</b>	<b>NO</b> , replace.
10. Is the thermal overload good? <b>YES</b>	<b>NO</b> , replace.
11. Is the start relay good? <b>YES</b>	<b>NO</b> , replace.
12. Is the compressor good? <b>YES</b>	<b>NO</b> , replace.
13. Consult the Dixie-Narco Factory Service 1-800-688-9090. NOTE: Have the vender Model & Serial number available.	

Symptom: **PRODUCT HOT**

Possible Cause: **Compressor starts, but will not keep running.**

WHAT TO CHECK	
1. Is the temperature control knob set on its highest setting? <b>YES</b>	<b>NO</b> , adjust the knob to a higher setting.
2. Is the voltage supply between 103V and 127V? <b>YES</b>	<b>NO</b> , consult the power company.
3. Is the condensor clear of obstructions? <b>YES</b>	<b>NO</b> , clear or clean.
4. Is the condensor fan blade turning? <b>YES</b>	<b>NO</b> , free the obstruction or replace the blade if needed.
5. Is the condensor fan motor good? <b>YES</b>	<b>NO</b> , replace.
6. Is the temperature control good? <b>YES</b>	<b>NO</b> , replace.
7. Is the tube from the compressor to condensor free of kinks? <b>YES</b>	<b>NO</b> , repair or replace.
8. Is the capillary tube free of kinks? <b>YES</b>	<b>NO</b> , replace.
9. Is the thermal overload good? <b>YES</b>	<b>NO</b> , replace.
10. Is the start relay good? <b>YES</b>	<b>NO</b> , replace.
11. Consult the Dixie-Narco Factory Service 1-800-688-9090. NOTE: Have the vender Model & Serial number available.	

Symptom: **PRODUCT TOO COLD OR FROZEN**

Possible Cause: **Compressor runs too long or continuously.**

<b>WHAT TO CHECK</b>	
1. Is the temperature control knob set properly? <b>YES</b>	<b>NO</b> , set properly.
2. Is the temperature control bulb located properly? <b>YES</b>	<b>NO</b> , correct.
3. Is the temperature control good? <b>YES</b>	<b>NO</b> , replace.
4. Does the evaporator frost over completely while the system is running?	<b>NO</b> , check for leaks or a low charge.
5. Consult the Dixie-Narco Factory Service 1-800-688-9090. NOTE: Have the vender Model & Serial number available.	

Symptom: **NOISY REFRIGERATION UNIT**

<b>POSSIBLE CAUSES</b>	
1. Are refrigerant lines free of contact with surfaces? <b>YES</b>	<b>NO</b> , correct.
2. Is the condensor fan blade hitting? <b>YES</b>	<b>NO</b> , free any obstructions or replace the blade if needed.
3. Is the evaporator fan blade hitting? <b>YES</b>	<b>NO</b> , free any obstructions or replace the blade if needed.
4. Is compressor noisy? <b>YES</b>	<b>NO</b> , replace.
5. Consult the Dixie-Narco Factory Service 1-800-688-9090. NOTE: Have the vender Model & Serial number available.	

**IF REFRIGERATION TROUBLE SHOOTING PROCEDURES FAIL,  
CONSULT THE DIXIE-NARCO FACTORY SERVICE**

**1-800-688-9090**

**NOTE: Have the vender model # and serial # available.**